Effective Health Care Program

Comparative Effectiveness Review
Number 164

Home-Based Primary Care Interventions

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None of the investigators have any affiliations or financial involvement that conflicts with the material presented in this report.

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Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of systematic reviews to assist public- and private-sector organizations in their efforts to improve the quality of health care in the United States. These reviews provide comprehensive, science-based information on common, costly medical conditions, and new health care technologies and strategies.

Systematic reviews are the building blocks underlying evidence-based practice; they focus attention on the strength and limits of evidence from research studies about the effectiveness and safety of a clinical intervention. In the context of developing recommendations for practice, systematic reviews can help clarify whether assertions about the value of the intervention are based on strong evidence from clinical studies. For more information about AHRQ EPC systematic reviews, see www.effectivehealthcare.ahrq.gov/reference/purpose.cfm

AHRQ expects that these systematic reviews will be helpful to health plans, providers, purchasers, government programs, and the health care system as a whole. Transparency and stakeholder input are essential to the Effective Health Care Program. Please visit the Web site (www.effectivehealthcare.ahrq.gov) to see draft research questions and reports or to join an email list to learn about new program products and opportunities for input.

If you have comments on this systematic review they may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 5600 Fishers Lane, Rockville, MD 20857, or by email to epc@ahrq.hhs.gov.

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Key Informants

In designing the study questions, the EPC consulted several Key Informants who represent the end-users of research. The EPC sought the Key Informant input on the priority areas for research and synthesis. Key Informants are not involved in the analysis of the evidence or the writing of the report. Therefore, in the end, study questions, design, methodological approaches, and/or conclusions do not necessarily represent the views of individual Key Informants.

Key Informants must disclose any financial conflicts of interest greater than $10,000 and any other relevant business or professional conflicts of interest. Because of their role as end-users, individuals with potential conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any conflicts of interest.

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Technical Expert Panel

In designing the study questions and methodology at the outset of this report, the EPC consulted several technical and content experts. Broad expertise and perspectives were sought. Divergent and conflicted opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design, methodologic approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

Technical Experts must disclose any financial conflicts of interest greater than $10,000 and any other relevant business or professional conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any potential conflicts of interest identified.

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Peer Reviewers

Prior to publication of the final evidence report, EPCs sought input from independent Peer Reviewers without financial conflicts of interest. However, the conclusions and synthesis of the scientific literature presented in this report do not necessarily represent the views of individual reviewers.

Peer Reviewers must disclose any financial conflicts of interest greater than $10,000 and any other relevant business or professional conflicts of interest. Because of their unique clinical or content expertise, individuals with potential nonfinancial conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

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Home-Based Primary Care Interventions

Structured Abstract

Objective. To assess the available evidence about home-based primary care (HBPC) interventions for adults with serious or disabling chronic conditions.

Data sources. Articles from January 1998 through May 2015 were identified using Ovid MEDLINE®, CINAHL®, ClinicalTrials.gov, Cochrane Database of Systematic Reviews, reference lists, and gray literature databases.

Review methods. We included randomized controlled trials (RCTs) and observational studies of HBPC, including home visits by a primary care provider, longitudinal management, and comprehensive care. Study quality was assessed, data extracted, and results summarized qualitatively.

Results. We identified 4,406 citations and reviewed 221 full-text articles; 19 studies were included. Two were RCTs, while 17 were observational studies.

The strongest evidence (moderate) was that HBPC reduces hospitalizations and hospital days. Reductions in emergency and specialty visits and in costs were supported by less strong evidence, while no or unclear effects were identified on hospital readmissions and nursing home days. Evidence about clinical outcomes was limited to studies that reported no significant differences in function or mortality. HBPC had a positive impact on patient and caregiver experience, including satisfaction, quality of life, and caregiver needs, but the strength of evidence for these outcomes was low.

In studies that reported on the impact of patient characteristics, moderate evidence indicated that frail or sicker patients are more likely than others to benefit from HBPC. No identified studies assessed the impact of organizational characteristics. No adverse events were reported. Only one study examined the potential for a negative impact; none was found.

The services included in the HBPC interventions varied widely, and no identifiable combination was related to more positive outcomes. We identified four studies that evaluated the addition of specific services. Combining palliative care and primary care home visits increased the likelihood of death at home (2 studies; low strength of evidence), while studies on adding caregiver support (1 study) or transitional care (1 study) to HBPC were rated as having insufficient evidence.

Conclusions. Current research evidence is generally positive, providing moderate-strength evidence that HBPC reduces use of inpatient care and providing low-strength evidence about its impact on use of other health services, costs, and patient and caregiver experience. Future research should focus on the content and organizational context of HBPC interventions so that experiences can be replicated or improved on by others. Additional research is also needed about which patients benefit most from HBPC and how HBPC can best be used in the continuum of care.

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Introduction

Background and Objectives

The aging of the population,[1,2] the increasing number of people with chronic illnesses,[3] and multimorbidity[4] are important forces that are changing health care. One motivation for many health care reform efforts is that chronically ill, frail, and disabled patients may not be best served by the current common model of care,[5,6] which is centered in office and hospital settings and frequently involves a disjointed array of providers. Another important motivation for reform is the focus on patient-centered care[7] and on increasing patient and family engagement in health care decisions and management.[8]

High-quality primary care is comprehensive, serves as the patient entry point into the health care system, provides person-focused (rather than disease-oriented) care over time, addresses all but very uncommon or unusual conditions, and coordinates or integrates care across different types of providers and settings. Primary care is at the center of many health services delivery reform efforts, such as patient-centered medical home models (PCMH), precisely because it provides a usual source of care, encourages relationships with a provider, is more likely to include preventive services, can decrease the use of emergency departments for conditions that are not urgent, and may increase patient satisfaction.[9-11]

Home-based primary care (HBPC) interventions move the delivery of primary care from an office to the patient’s home. HBPC programs have roots in the house call and community health outreach practices of earlier eras. In the past, house calls were a standard part of medical care and community health. Forty percent of physicians made house calls in the 1930s but this fell to less than 1 percent by the 1980s.[12] While house calls have been making a comeback, particularly in geriatrics, today’s house calls and home-based care are delivered in a very different health care system. Unlike the family doctor who made house calls, today most primary care providers do not see patients in multiple settings (e.g., in the office, the home, and the hospital) and HBPC primary care providers may or may not directly provide care outside the patient’s home. For example, inpatient care may be primarily the responsibility of hospitalists while the HBPC team assures coordination and smooth transitions across sites of care. Many HBPC teams specialize in home-based care in the sense that they manage a panel of patients who are in these programs and have limited numbers of patients, if any, that they routinely see in an office.

HBPC as it currently exists is a model of health care delivery that combines home-based care for medical needs with intensive management and care coordination, and may also, but does not universally, include arranging or delivering long-term services and supports. HBPC interventions have been proposed as an alternative way of organizing and delivering care that may better address the needs, values, and preferences of chronically ill, frail, and physically or cognitively disabled patients who have difficulty accessing traditional office-based primary care or other models of care that require office visits. HBPC involves more than a rare house call; it is a comprehensive care delivery model that does not necessarily exclude a situation where a single primary care provider delivers most of the care; however, the more common approach is team-based care.

HBPC serves populations in whom complex chronic conditions and functional limitations intersect. Developing and evaluating HBPC interventions is important because the number of people who may benefit from this model of care is large and growing. The American Community Survey conducted by the U.S. Census Bureau estimated that in 2013, 15.4 percent of people in the United States over 65 years (more than 6.6 million people) had independent living difficulties, defined as difficulty with activities such as visiting a doctor's office or shopping without help because of a physical, mental, or emotional problem; 9.2 percent (over 3.9 million) had a cognitive difficulty; and 8.5 percent (over 3.6 million) had difficulty with self-care such as dressing, bathing, and eating.[13] While the percentages are smaller, a similar number of adults 18 to 64 years old have functional difficulties (3.6%, equaling 7.1 million, have independent living difficulties; 1.9%, equaling 3.6 million, have a self-care difficulty).[13] According to the Centers for Medicare & Medicaid Services (CMS), 3,459,600 people were served by Medicare home health in 2012, and the numbers have been increasing every year.[14] Home health under the Medicare skilled home health care Part A benefit differs from HBPC in that it is usually for a shorter, defined period. An analysis of claims data for 2012 identified approximately 620,000 people in fee-for-service Medicare who received primary care in their home.[15] Not everyone with a chronic illness or functional difficulty needs or wants help. Nevertheless, these numbers suggest that many people could benefit from an expansion of HBPC.

The specific reasons a patient may benefit from HBPC and the potential advantages vary. Functional impairments, costs, or other limitations may make transportation to doctors' offices or clinics challenging, or caregivers may not be available to accompany patients during normal office or clinic hours. In some situations, going to an office may be contraindicated. For example, patients with cognitive deficits may become confused or agitated in unfamiliar surroundings. Providers also obtain better insight into the patient's needs with a home visit, often finding environmental factors that are related to patient problems. Patients with complex needs may require frequent monitoring, intense management, or rapid followup that cannot be easily accommodated by an office-based provider. Patients at high risk may avoid complications from hospital care (e.g., certain infections, delirium) if hospitalizations can be prevented, averted, or shortened.

Potential benefits of HBPC include: (1) increased access to care for people who have difficulty traveling to outpatient medical offices or for whom going to a medical office is contraindicated—this could include access afterhours, weekends, or holidays, more frequent visits, and the ability to be seen sooner; (2) access that includes a range of services, including therapies, pharmacy, and medication management that have the potential to prevent or slow functional and cognitive decline; (3) better understanding of patient environments, needs, and constraints that can improve care and ultimately outcomes; (4) increased patient engagement, as a home visit can shift the focus of care more toward patient preferences; (5) decreased hospitalizations and urgent care use when acute incidents are prevented or addressed in the home; (6) better identification of and support for family caregivers; (7) increased patient and caregiver satisfaction; and (8) lower costs for Medicare and other payers. If all these benefits could be realized, HBPC would offer, as one analyst stated, "a win-win for U.S. health care",[16] referring to the potential opportunity to both reduce costs as well as improve quality of care and increase patient well-being.

HBPC was developed based on a house calls program at Mt. Sinai Medical Center in New York City and was implemented as a pilot model in the U.S. Department of Veterans Affairs (VA) more than 3 decades ago. It was designed to serve chronically ill veterans by providing effective primary care services as well as long-term care services in the home. The unique aspects of the model were related to its intention to provide "interdisciplinary care that is longitudinal and comprehensive rather than episodic and focused."[17] While the details can vary across the many different VA medical centers, today the VA HBPC program includes an interdisciplinary team that provides care in the home to veterans with complex needs for whom clinic-based care is difficult due to function or disease. Additionally, in many VA medical centers the model has expanded to include more mental health services and to formally facilitate collaboration with other services such as hospice. In non-VA settings, HBPC has developed based on elements of programs designed for people who are eligible for Medicaid and Medicare (frequently referred to as “dual-eligibles”), on the expansion of home and community-based long-term services and support programs, and on the expansion of physician house call programs.

Interest in HBPC is growing among the general public, health professionals in multiple disciplines, health care delivery organizations, and venture capital investors. This is reflected in current policy, practice, and research. HBPC is currently the subject of a major CMS demonstration project[9] and even before this demonstration, an increasing number of public and private health systems and plans were beginning to offer HBPC.[10] HBPC interventions have been the subject of articles in general publications[11] as well as the topic of policy analyses.[18] Research studies on HBPC have been summarized in seven systematic reviews.[19-26] The increasing interest in HBPC models is also related to efforts to develop and implement new financing mechanisms and interdisciplinary team care as HBPC blurs boundaries between services, episodes, and roles. This level of interest suggests that HBPC programs are likely to continue to expand and to evolve, incorporating advances in communications, health information technology, and care management applications.

Important questions about the impact of HBPC limit its development, promotion, and expansion. Despite the extensive experience that some systems have had with HBPC, the benefits or harms of HBPC have remained poorly defined and documented. Studies of HBPC have been limited in several ways (e.g., single site, small-to-moderate sample sizes, variations in the HBPC intervention within and across studies, and studies spread over more than 2 decades during which the care and policy environments have changed).

The evidence base examining HBPC programs has expanded in recent years, yet challenges in synthesizing this literature reflect the challenges in primary research on HBPC. HBPC interventions are not standardized and often differ in terms of what care and services are offered, how frequently these services are available and used, the resources required to deliver these services, and the goals of the programs and providers. Research articles often do not provide sufficient descriptions of the interventions to allow nuanced analyses of how these differences might impact outcomes. There is marked variation in the prioritization and reporting of outcomes and a lack of clarity about which study designs and comparisons will provide the strongest, most useful evidence for future decisions about HBPC. Previous reviews have frequently highlighted this lack of detailed information about the intervention and outcomes as a weakness in the evidence base. Additionally, most studies provide little information about the comparison group, which is often simply described as “usual care”. Studies of HBPC span more than 20 years and have been conducted in several countries, thus it is likely that “usual care” has had different meanings. Moreover, HBPC interventions have been used to provide services to populations with different health risks, including severely disabled patients of all ages, elderly who would be nursing home eligible, and patients with complex care issues who may be less impaired. Some of these differences may be because patients can enter HBPC programs in different ways such as volunteer enrollment, as a recruitment based on a profile generated by a health plan, or referrals from different types of providers. Given the variation in populations, it is understandable that HBPC interventions have wide-ranging goals that span from preventing falls to providing palliative care.

Questions remain about which outcomes best match the different goals of different applications of HBPC and which outcomes are most important to different patients.[27] The objectives of this review are to summarize the effects of HBPC interventions on a variety of outcomes and to examine how these effects vary by patient, organizational, and intervention characteristics. We examined the literature and included a broad range of outcomes, but with a narrower focus in terms of the population and the goals of the HBPC intervention (we excluded home visit programs that provide only prevention and well elderly outreach) than was used in some prior reviews, with the goal of analyzing this literature in the context of current policy issues.

Scope and Key Questions

To clarify the scope and purpose of our review, we defined HBPC interventions as requiring the four characteristics described in Table 1. These defining characteristics underscore how HBPC interventions differ significantly from other innovative care models such as Hospital at Home (short term for acute need), Program of All-inclusive Care for the Elderly (PACE) (integrated primary and long-term care services, not usually home-based), and Patient-Centered Medical Homes (essentially outpatient, office-based), each of which contain some, but not all of these characteristics.

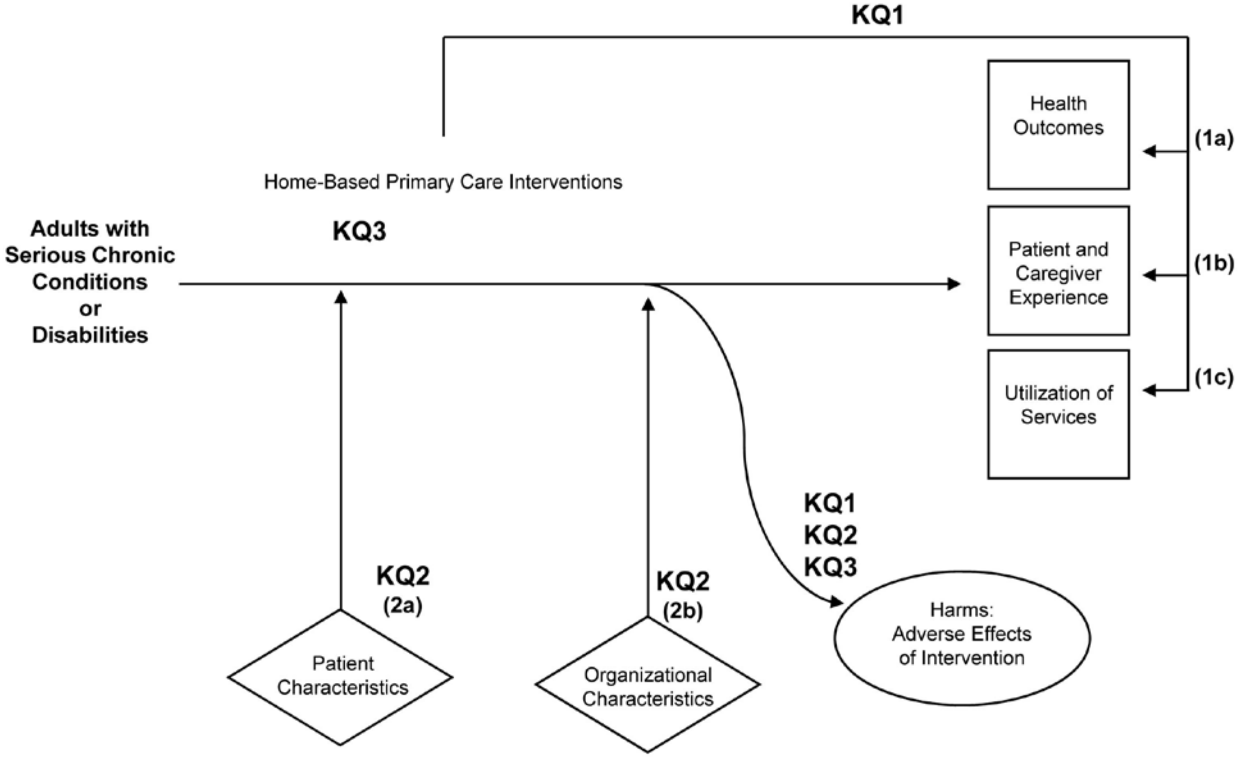
Table 1. Defining characteristics of home-based primary care models for this review

Required for This Review	Optional	Excluded
1. Visits by a primary care provider Visits by a physician, nurse practitioner, or physician assistant.	**Additional visits** Nurses, physical therapists, social workers, counselors, etc.	**Other models** that do not include primary care home visits. Telephone call care only or nurse (or other provider) care only.
2. Visits to a patient's home Home is defined as any noninstitutional setting where the patient resides. It can include private houses or apartments, adult homes, senior housing or assisted living.	**Following patient across care settings** In hospital management and short-term post-acute rehabilitation.	**Patients in institutions** Patients who live in nursing homes, prisons, or long-term care hospitals.
3. Longitudinal management The intention is to provide care for an indefinite period until admission to an institution, change in status, or death.	Not applicable.	**Short term** One-time home visits or assessments, hospital at home models in which care is provided for an acute need and the patient returns to previous primary care, or transitional care, for a short defined period (e.g., 30 to 90 days post-hospitalization, or 14 day after surgery).
4. Comprehensive primary care Includes medical care for, and the management of, chronic conditions and disabilities, preventive care, providing or arranging needed acute care and environmental assessments.	**Inclusion of additional services such as mental health services, palliative care, long term services and supports or social services** Assessment and management of serious mental illnesses including depression. Integration of palliative care or hospice with home-based primary care.	**Single condition care or single topic risk assessments** Fall risk assessments, programs that target a single condition such as congestive heart failure.

The analytic framework used to guide this report is shown below (Figure 1). The analytic framework illustrates the scope of the review, including the target population, interventions, comparators, and outcomes, and represents the interrelationships that are included in our Key Questions and that were examined in this review.

Analytic Framework

Figure 1. Analytic framework for home-based primary care interventions



KQ = Key Question

A document containing the draft Key Questions was developed during Topic Refinement and was available for public comment via the Agency for Healthcare Research and Quality (AHRQ) Effective Health Care Web site from August 15, 2014, to September 05, 2014. The comments received helped us identify areas that required more explanation and reorganization in order to clarify our intentions for the systematic review.

The following are the Key Questions for this review.

Key Question 1. Among adults with chronic conditions that are serious or disabling, what are the effects (positive and negative) of HBPC interventions on:

a. Health outcomes
b. Patient and caregiver experience
c. Utilization of services

Key Question 2. How do the effects of HBPC interventions differ across:

a. Patient characteristics (including, but not limited to: reason for HBPC, type and number of diagnoses, level of physical and cognitive function, caregiver availability, and demographics)

b. Organizational characteristics (including, but not limited to: ownership organizational structure, payment structure, leadership, and staffing patterns of the practice or health system providing HBPC)

Key Question 3. Which characteristics of home-based primary care interventions are associated with effectiveness (including, but not limited to, use of teams, composition of teams, use of technology, frequency of visits, and types of visits/services)?

Methods

We performed the systematic review in accordance with the Evidence-based Practice Center (EPC) "Methods Guide for Effectiveness and Comparative Effectiveness Reviews."[28] Input from experts was invited during protocol development; the final protocol is posted for the public on the Agency for Healthcare Research and Quality (AHRQ) Effective Health Care Web site: www.effectivehealthcare.ahrq.gov/. The protocol is also registered in the PROSPERO database under registration number: CRD42015016714. For detailed descriptions of the review methods, see Appendix A and the protocol on the AHRQ Effective Health Care Web site.

Inclusion/Exclusion Criteria

The criteria for inclusion and exclusion of studies were designed to identify studies that answer the Key Questions. The criteria are based on the population, intervention, comparator, outcome, timing, and setting (PICOTS), which were developed as part of the topic refinement and included in the protocol for this review. The PICOTS are summarized in Table 2 and they were translated into our inclusion and exclusion criteria for the review. The included and excluded studies are listed in Appendix B and Appendix C, and the criteria are detailed in Appendix D.

Table 2. Inclusion and exclusion criteria

	Include	Exclude
Population	Adults with chronic illnesses or disabilities.	Children with special needs. Adults assessed for a single risk factor or condition. Healthy elderly.
Intervention(s)	Home-based primary care, as defined in Table 1.	Care models that do not include the four required characteristics. Examples of excluded care: preventive home visits, single visit home assessments, single purpose visits (fall risk assessments), care for a single condition, short-term home-based care, such as hospital at home programs.
Comparator(s)	Any other model of primary care.	Services that are not primary care.
Outcomes	Health care outcomes including mortality, morbidity and function. Patient and caregiver experience. Utilization of services and costs.	None
Timing	Longitudinal care, expected to continue until change in status. A specific time period for followup was not required for a study to be included.	Short-term, time-limited home-based care such as hospital at home programs.

	Include	Exclude
Setting(s)	Patients' homes, broadly defined. (including private homes, group homes, adult foster care, and assisted living) United States or other developed countries.	Institutions such as nursing homes or prisons. Countries with economies and/or health care systems extremely different from those in the United States.
Study Design	Randomized controlled trials. High-quality observational studies, including comparative cohort studies and time series. Pre/post studies with or without a comparison group. Program reports and evaluations.	Descriptive studies. Case series or reports. Nonsystematic reviews. Journalistic reports.
Publication Type	Peer reviewed journals. Gray literature (if the study meets all other criteria).	Editorials or commentaries.

We included studies that evaluated the effects of home-based primary care (HBPC) interventions, including randomized controlled trials (RCTs), observational studies (comparative cohort studies and time series), pre/post studies with or without a comparison group, program reports, and evaluations. We included this broad range of study designs in order to obtain a comprehensive understanding of the current state of evidence about HBPC. Purely descriptive studies such as case series and case reports and journalist articles were excluded. Studies were not excluded based on a specific comparator or outcome; however, the comparators and approach to measuring the outcomes were considered as part of the assessment of the quality and risk of bias assessment of an individual study and influenced the assessment of the strength of evidence.

Systematic reviews were not included, but their included studies lists were used to identify individual studies to assess for inclusion in our review. English-language abstracts of non-English-language articles were reviewed and evaluated in terms of whether they would significantly add to the body of literature.

Literature Identification and Data Analysis

A research librarian searched multiple electronic databases, including Ovid MEDLINE, CINAHL, ClinicalTrials.gov, and the Cochrane Database of Systematic Reviews for articles published between January 1995 and December 2014; searches were updated to include citations through May 2015. Additional studies were identified by reviewing reference lists of the included studies and systematic reviews and by requesting Scientific Information Packets and expert suggestions. Gray literature was identified by searching the New York Academy of Medicine gray literature database and the Web sites of organizations that may fund or produce research evaluating HBPC.

Two investigators reviewed each abstract and full-text article to determine inclusion eligibility. Any disagreements were resolved by consensus. A record of studies included is in Appendix B, and those excluded at the full-text level with reasons for exclusion are included in

Appendix C. After studies were selected for inclusion, data were abstracted by one team member and verified for accuracy by a second team member. The evidence tables with the abstracted data are included in Appendix E.

Predefined criteria were used to assess the quality of individual RCTs and observational studies. A detailed description of the assessment is included in Appendix F. Individual studies were rated as "good," "fair," or "poor" by two investigators independently, with disagreements resolved by consensus. Studies rated "good" are considered to have low risk of bias and valid results. Studies rated "fair" are susceptible to some bias, though not enough to invalidate the results. Studies rated "poor" have significant flaws that imply biases of various types that may invalidate the results. We did not exclude studies rated as being poor in quality *a priori*, but poor-quality studies were considered to be less reliable than higher-quality studies when synthesizing the evidence.

Qualitative syntheses were conducted because the studies were too heterogeneous to create a meaningful combined estimate with meta-analyses.

The strength of evidence for each Key Question and outcome (Appendix G) was assessed using the criteria described in the AHRQ "Methods Guide for Effectiveness and Comparative Effectiveness Reviews."[28] Initial assessments were made by one researcher, then the entire team reviewed these and differences were resolved by consensus. This approach was possible given that this was a small review. The strength of evidence was assigned an overall grade of "high" (confident that the estimate of effect lies close to the true effect for this outcome), "moderate" (moderately confident that the estimate of effect lies close to the true effect for this outcome), "low" (limited confidence that the estimate of effect lies close to the true effect for this outcome), or "insufficient" (no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome).

Applicability considers the extent to which results from a study or a body of evidence can be used to answer the questions of interest. Variability in the studies or studies with unique attributes may limit the ability to generalize the results to other populations and settings. For this review we considered whether applicability is affected by the characteristics of the patient populations (e.g., demographic characteristics, reason for receiving home-based care, primary condition or disability, or presence of comorbidities) and the setting of the study (e.g., geographic location and practice context).

Peer Review and Public Commentary

We invited specialists, including home-based primary care providers, health policy researchers, health care payers and providers, and patient caregiver/advocates, to provide peer review comments on the draft report. The AHRQ Task Order Officer and an Evidence-based Practice Center Associate Editor also suggested comments and provided editorial review. The draft report was posted on the AHRQ Web site for 4 weeks to acquire public comment. The disposition report with responses from the authors to the peer review comments and public comments will be posted after publication of the final report on the AHRQ Effective Health Care Web site.

Results

Literature Searches

The search and selection of articles are summarized in the study flow diagram (Figure 2). There were 4,406 citations identified at the title and abstract level. Of these, 221 articles appeared to meet inclusion criteria and were selected for full-text review. Following review at the full-text level, a total of 19 studies met the inclusion criteria (Appendix B). Primary reasons for exclusion of the articles reviewed at the full-text level were wrong intervention types, such as telephone care only, temporary postsurgery care, or visits by a social worker or home care nurse only (Appendix C).

Included Studies

The study flow diagram represented in Figure 2 documents how many studies were identified in the search and how many were reviewed at each stage. The triage and review process resulted in the inclusion of 19 studies reported in 20 articles.[29-48]

As many of the most applicable search terms were broad, at the triage stage most of the abstracts excluded were of studies that were clearly not about home-based primary care (HBPC). These included studies about other models of care, such as medical homes, as the indexing in literature databases for these studies includes similar terms. At the full-text review level, most of the excluded studies were about interventions that did not meet our inclusion criteria. Another group of excluded publications were articles that contained descriptions of programs but did not include an evaluation component with any data on outcomes.

Table 3, the text below, and the Evidence Table in Appendix E contain information about the 19 included studies. Table 3 shows that the most common study design is retrospective pre-post studies with no comparison group. Two of the 19 studies were randomized controlled trials (RCTs). Most of the studies were conducted in the United States (16 studies) with eight of these conducted by the U.S. Department of Veterans Affairs (VA). In addition, most studies were conducted in a single medical center or care delivery organization (e.g., one VA medical center or one health plan, not several or nationwide). All studies reported multiple outcomes; however, the most commonly studied outcome was the impact of HBPC on hospitalizations.

Some other characteristics were not reported in detail in the article, but do not appear to vary across the studies so they are not included in Table 3. Examples are specifics about the patient's home and the age of eligible patients. All the HBPC interventions by definition had to include care provided in the patients' homes. We allowed "home" to be defined broadly to include settings such as assisted living or adult foster homes. None of the included studies provided detailed information about the homes of their patients. So while it seems that homes other than private houses and apartments were not excluded, it is not clear how many if any of the patients were residing in settings other than traditional housing.

Similarly, while we restricted our review to HBPC for adults (18 years old or older), most of the studies reported on elderly patients and included no or very few younger adults. The reasons for this varied. In some cases either the program or the study set an age for inclusion (e.g., 65 or older,[35] 67 or older,[38] 75 or older [47]). In other cases because Medicare data were used and most people eligible for Medicare are over 65, the studies included only small numbers of younger adults (e.g., in the study by de Jonge 2.4% of the included patients were under 65[36]). Even when the program and the study were available to adults of all ages, the majority were older (e.g., the study with the most adult but not elderly patients was about cancer patients and 75% of patients were over 60 while 25% were 18 to 59[29]).

Additional information such as the inclusions and exclusion criteria for each study and the number of patients screened, recruited, followed, and included in the analyses are presented in Appendix E.

Figure 2. Study flow diagram

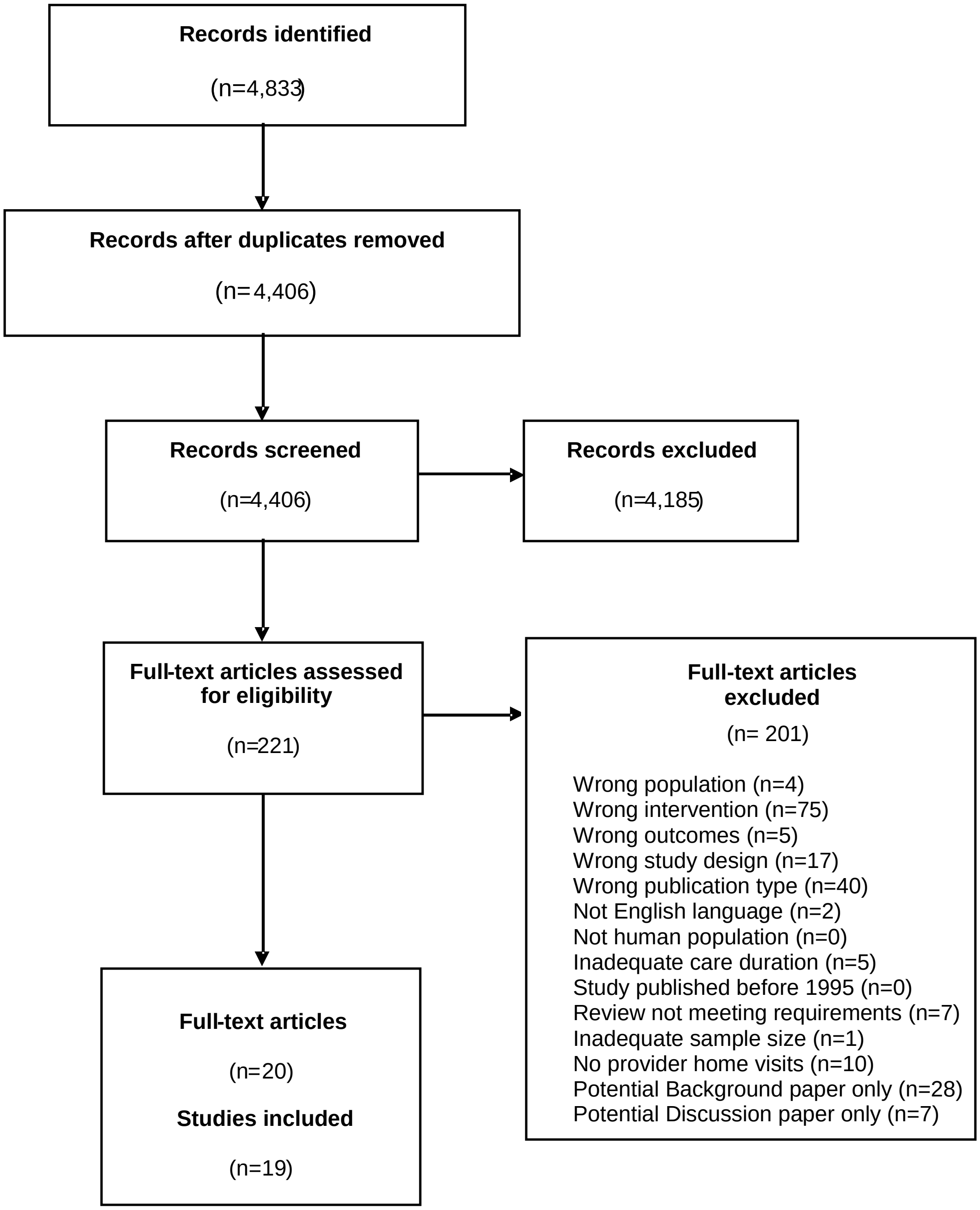


Table 3. Key characteristics of included studies

Key Characteristics	Study Information	Number of Studies (Total N=19)	References[a]
Study Designs	RCTs	2	35,39
	Retrospective cohort	5	29,36-38,40,41
	Prospective pre/post	5	42-46
	Retrospective pre/post	7	30-34,47,48
Length of Followup	1 week up to 3 months	2	29,48
	3 months to up to 6 months	2	34,42
	6 months to up to 1 year	5	30,31,33,39-41
	1 year or more	10	32,35-38,43-47
Setting/Location	VA/United States	8	31,33,34,37-39,42,43
	Non-VA/United States	8	30,32,35,36,44-46,48
	Denmark	2	29,40,41
	Canada	1	47
Sites	Multiple sites	7	29,31,34,37-39,42
	Single site	12	30,32,33,35,36,40,41,43-48
Outcomes (studies can have multiple outcomes)	Hospitalizations	11	32-39,43,47,48
	Hospital bed days	6	31,33,34,37,45,47
	Hospital readmission	3	31,39,45
	Emergency visits	6	32,33,35,36,43,47
	Nursing home admissions	1	48
	Nursing home days	2	31,36
	Specialty visits	2	32,36
	Number of home visits	3	31,32,40,41
	Cost of care	6	31,32,36,37,39,45
	Mortality	2	35,36
	Function	3	30,35,39
	Disease management quality Indicators	1	34
	Caregiver outcomes	4	39,42-44
	Satisfaction	4	30,34,37,39
	Symptoms	3	35,45,46
	SF-36	2	35,39
	Place of death	3	29,40,41,47
	Terminal declaration (certification of terminal status)	1	29

RCT = randomized controlled trial, VA = U.S. Department of Veterans Affairs

[a] One study was the subject of two publications.

Effects of HBPC Interventions

Key Question 1. Among adults with chronic conditions that are serious or disabling, what are the effects (positive and negative) of home-based primary care interventions on (a) health outcomes, (b) patient and caregiver experience, and (c) utilization of services and costs?

Overview of Findings

- Health Outcomes: No significant differences in function or mortality (strength of evidence: low) and insufficient evidence about HBPC impact on symptoms.
- Patient and Caregiver Experience: Satisfaction with care, quality of life, and caregiver outcomes were better with HBPC (strength of evidence: low).
- Utilization of Services:
    - HBPC reduced hospitalization and hospital days (strength of evidence: moderate).
    - Some evidence suggested that numbers of emergency visits and specialty visits are lower with HBPC (strength of evidence: low).
    - Evidence did not indicate HBPC reduces hospital readmissions, and the impact on costs were mixed, with higher quality studies reporting cost savings (strength of evidence: low).
    - There was insufficient evidence on which to base a conclusion about the impact of HBPC on nursing home admissions and nursing home days (insufficient evidence).
    - HBPC results in cost saving for highest risk, most frail patients. (strength of evidence: low).
- The only identified study to directly examine negative unintended consequences reported that none of the patients and caregivers interviewed (n=31) stated they experienced restriction of services (insufficient evidence).

Key results from the included studies that addressed Key Question 1 are presented in Table 4. This table organizes the study results by outcome (rows) and by the quality (columns) based on an assessment of risk of bias or quality of the study. We used this format so that it would be easier to identify if trends in the results vary by the quality of the studies. This is important because syntheses can be potentially flawed when studies of different quality are given equal weight. Specifically, it is possible to conclude that the results are inconsistent or conflicting when looking across all studies, whereas the high quality studies may support a stronger conclusion. Additional information on the results is included in the evidence table in Appendix E. We present all results, including those from studies we rated as poor quality, in order to comprehensively represent the state of the literature. However, we focus on the high- and moderate-quality studies in our summary and conclusions, and we describe differences across studies and the potential implications of these differences in the Discussion. The strength of evidence assessment cited in the overview above is an assessment of the body of evidence, which considers individual study quality as well as other factors, such as the consistency and precision of the findings. (See Appendix A for more detail on the methods and Appendix G for the strength of evidence rating for each Key Question and outcome.)

Key Question 1a. Impact on Health Outcomes

Few studies reported health outcomes or mortality (Key Question 1a), perhaps because the HBPC programs that were the subject of the included studies served patients who were predominately older, frail people with multiple chronic conditions and disabilities. Both studies that included mortality reported no significant difference between the HBPC group and a comparison group.[35,36] Given the population it is not clear that reductions in mortality are possible, raising the possibility that no difference, that is no increase in mortality when care is provided at home, could be considered a positive outcome.

Physical function and symptoms were reported in two different studies. The multi-site RCT of HBPC in several VA medical centers found no significant difference in function between HBPC patients and usual care patients.[39] This is one of the earlier studies of HBPC; one consideration is that the mean and median time in HBPC were 5.6 and 4.5 months, which may not be considered sufficient time to achieve improvements in functional outcomes. Another study in a non-VA HBPC program focused on decreased symptom burden; it reported that pain, anxiety, depression, and tiredness were reduced 3 weeks after HBPC enrollment and maintained at the lower levels at 12 weeks after enrollment.[46] In this study 58 percent of patients with moderate to severe depressive symptoms and 45 percent with moderate to severe tiredness reported no symptoms at 3 weeks.

Key Question 1b. Impact on Patient and Caregiver Experience

Three studies included measures of satisfaction or quality of life. In the two RCTs of HBPC, most caregiver outcomes were better for the HBPC group, and the patients experienced a statistically significant improvement in health-related quality of life.[35,39] In a study that focused on caregiver burden and needs, caregivers of patients in a HBPC program reported a decrease in unmet needs 9 months after enrollment and a decrease in caregiver burden.[46] Two poor-quality studies reported satisfaction at one point in time for HBPC patients.[30,34]

The only study we identified that explicitly raised the issue of potential harms examined whether HBPC had a negative impact on patient or caregiver experience. In patient and caregiver interviews from one VA center that supplemented quantitative analysis of HBPC costs with interviews (n=31), Edes et al. reported that none of the patient or caregivers had experienced any restriction on services since enrolling in HBPC.[37]

Key Question 1c. Impact on Utilization of Services

HBPC impact on health care utilization and costs of services was the most frequently reported outcome in the research identified. Several studies reported the impact on hospitalizations (admissions, readmissions, and hospital days), emergency visits, nursing home admissions, or nursing home days. Studies also included costs of utilization. Fewer studies reported on the expected increase in primary care home visits. These results are in the evidence table (Appendix E).

Reducing hospitalization is an important and frequently stated priority for HBPC interventions based on the idea that high-quality primary care and the ability to address urgent needs should provide the means to avoid or at least reduce hospitalizations. Five high-quality studies[33,35-38] reported on hospital admissions or hospital days. Four studies reported that hospitalization decreased with HBPC, while one study reported an increase (from 700 to 740 per 1000 patients) that was not statistically significant.[35] One fair-quality study reported a 7.8 percent increase in hospitalizations but did not report a statistical test.[32] The remaining fair- and poor-quality studies all reported reduction in hospitalization though some differences were not significant or did not include a statistical test. Based on a similar rationale, emergency visits are expected to be fewer for patients in HBPC programs. All six studies that examined emergency visits reported reductions ranging from 10 to 48 percent; however, one[33] of the three good-quality studies[33,35,36] reported that the reduction was not statistically significant (18.5% decrease, p=0.26), and the lower quality studies did not report actual numbers or a statistical test of difference.

Another intended benefit stated by HBPC programs is that it may reduce the need for skilled nursing facility (SNF) care. Three studies reported positive effects. One high-quality study reported 27 percent fewer SNF days (p=0.001).[36] A fair-quality study found statistically significant fewer admissions,[48] while a poor-quality article that was more of a program report than a research study reported an 89 percent reduction in nursing home days and no statistical test.[31] Only one study analyzed nursing home admissions and reported fewer before HBPC enrollment than after,[48] but this one small, moderate-quality study was not sufficient support for a conclusion in which we could have any confidence.

Costs were often measured as they relate to the utilization of care. In many studies of HBPC, the goal is to document whether the expected reduction in costs occurs, or at least that costs shift from hospital and emergency care to primary and home-based long-term care. Two high-quality studies examined costs, and both calculated that HBPC lowered costs significantly.[36,37] Total Medicare costs were lower for HBPC participants than for matched controls in a Washington, D.C., HBPC program that is part of the Medstar Health Care System ($44,455 vs. $50,977, p=0.001).[36] However, there was a significant reduction in overall cost only for the patients in the highest frailty category, and not in medium- or low-frailty groups. In another study, risk adjusted calculations and modeling for all VA HBPC patients nationwide compared projected costs without HBPC to actual costs and reported an average reduction of 28.1 percent in costs for 6 months of HBPC enrollment.[37] This was a high-quality study, but one concern is that the comparison group used in calibrating the projected costs was a group of Veterans using long-term services and not a group matched to the HBPC participants. A poor-quality study reported a decrease in mean total cost but presented only the raw number with no information on potential confounding or statistical tests[31] and one fair-quality study reported no significant impact to the organization’s financial margin.[45] Contrary to these findings, two studies with moderate risk of bias[32,39] found substantial increases (22.7% and 12.1%) in charges and costs respectively.

Counsell et al.[35] assessed recognition of geriatric conditions and used the Assessing Care of Vulnerable Elders (ACOVE) metrics to assess quality of care. With the exception of visual impairment, geriatric conditions were more commonly identified in the intervention patients (p-values all 0.01 or less). In general health care metrics, primary care visits occurred within 6 weeks of a hospital discharge for 83 percent of intervention patients versus 54 percent of controls (p<0.001), medication lists were provided, and advance care planning documents were more commonly addressed in the intervention patients (p<0.001).

Table 4. Effectiveness of home-based primary care interventions (Key Question 1): primary results by outcome and level of study quality (assessment of risk of bias) for individual studies[a]

Key Question	Outcome	Study Quality: Good	Study Quality: Fair	Study Quality: Poor
Key Question 1a: Health Outcomes	Function	ADLs: No significant difference (Counsell, 2007)[35]	No significant difference (Hughes, 2000)[39]	21% improvement in ADLs No statistical test reported (Anetzberger, 2006)[30]
	Symptoms	—	Reduction in moderate to severe symptom burden % symptom free Pain 3 weeks: 25%, 12 weeks: 27.08% Depression 3: weeks 57.8%, 12 weeks: 50% Loss of Appetite: 3 weeks 20.69%, 12 weeks: 24.49% Anxiety 3 weeks: 58.62%, 12 weeks: 59.26% Tiredness 3 weeks: 45.10%, 12 weeks: 47.5% All p-values: p<0.01 (Ornstein, 2013)[46]	—
	Mortality	7% 24 months HBPC vs. 7.8% controls p=0.64 No significant difference (Counsell, 2007)[35] Mortality during followup period HBPC (40%) Controls (36%) HR 1.06, p=0.44 (De Jonge, 2014)[36]	—	—

Key Question	Outcome	Study Quality: Good	Study Quality: Fair	Study Quality: Poor
Key Question 1b: Patient and Caregiver Experience	Satisfaction	No patient or caregiver reports of restrictions on services (Edes, 2014)[37]	Patient satisfaction Terminally ill patients: no significant difference Nonterminally ill patients: HBPC group significantly better with 5 to 10 point increases in 5 of 6 dimensions (Hughes, 2000)[39]	94% would recommend program to others No statistical test reported (Anetzberger, 2006)[30] 98% rate care as “excellent” or “good” No statistical test reported (Cooper, 2007)[34]
	SF-36 Quality of Life	SF-36 scores at 24 months Improvements for intervention patients compared with usual care in 4 of 8 scale General health (0.2 vs. −2.3), p=0.045 Vitality (2.6 vs. −2.6), p=0 .001 Social functioning (3.0 vs. −2.3), p=0.008 Mental health (3.6 vs. −0.3), p=0.001 Also in the Mental Component Summary (2.1 vs. −0.3), p=0.001 (Counsell, 2007)[35]	Quality of Life Terminally ill patients in HBPC group had significantly better scores in 6 of 8 SF-36 subscales Nonterminal: no significant difference (Hughes, 2000)[39]	—
	Caregiver Outcomes	—	Caregiver Most caregiver outcomes favor the treatment group HBPC group improved in HR-QOL p<0.05 (Hughes, 2000)[39]	Change in % needing assistance baseline to 9 months, p-value Transportation: 19.7, p=0.001 Daily chores: 26.8, p <0.001 Change in Caregiver Burden baseline to 9 months Physical burden: 1.90, p=0.006 Total burden: 3.84, p=0.017 (Ornstein, 2009)[44]

Key Question	Outcome	Study Quality: Good	Study Quality: Fair	Study Quality: Poor
Key Question 1c: Utilization of Services	Hospitalizations	43.7% decrease in hospitalizations (Chang, 2009)[33] Hospital admission rates per 1000 patients (700 [n=474] vs. 740 [n=477]), p=0.66 (Counsell, 2007)[35] HBPC 9% fewer hospitalizations, p=0.001 Hospitalization cost $17,805 vs. $22,096 p=0.001 (De Jonge, 2014)[36] VA+Medicare hospital admissions per 100 patient-months 25.5% decrease (95% CI, -26.5 to -24.5) p<0.001 (Edes, 2014)[37] 5.8% absolute reduction in hospitalizations in year (95% CI, -9.3 to -2.3), decrease from 28.2% to 22.4%. Hazard ratio: 0.71 (0.57 to 0.89) (Edwards, 2014)[38]	7.8% increase in hospitalizations No statistical test reported (Beck 2009) [32] Change pre to post HBPC 59.5% reduction in Hospital admissions, p<0.001 (Rosenberg, 2012)[47] Patients with ≥1 hospitalization Before enrollment 110 (61%) After enrollment 178 (38%), p<0.001 (Wajnberg, 2010)[48] 7.9%, p=0.07 (relative reduction in the proportion of HBPC patients admitted in the first 6 months, not sustained at 12 months) (Hughes, 2000)[39]	27% reduction in hospital admissions No p-values reported for any of the above results (Cooper, 2007)[34] 84% decrease in hospitalizations Pre: 822; post: 135 No statistical test reported (North, 2008)[43]
	Hospital Bed Days/Length of Stay	49.9% decrease in total number of days in hospital, p=0.001 (Chang, 2009)[33] VA Medicare hospital days 36.5% decreased In a high risk for hospitalization group, (95% CI, -37.6 to -35.4) p<0.001 (Edes, 2014)[37]	<u>Length of stay</u> 6.5 days pre; 6.45 days during intervention p=0.09 (Ornstein, 2011)[45] 61.7% reduction in hospital days p=0.004 (Rosenberg, 2012)[47]	59% reduction in hospital bed days no statistical test reported (Beales, 2009)[31] 69% reduction in hospital days No p-values reported for any of the above results (Cooper, 2007)[34]

Key Question	Outcome	Study Quality: Good	Study Quality: Fair	Study Quality: Poor
Key Question 1c: Utilization of Services (continued)	Hospital Readmissions	—	11%, p=0.06 (relative reduction in mean number of readmissions at 6 months not sustained at 12 months) 22%, p=0.03 (relative reduction in mean number of readmissions at 6 months in the subgroup with severe disability) 22% relative decrease in readmissions per patient for HBPC at 6 months, p=0.03, not significant at 12 months (Hughes, 2000)[39] Admissions that generated at least one 30-day readmissions 16.6% pre; 15.7% during intervention p=0.71 (Ornstein, 2011)[45]	21% reduction in 30-day hospital readmission No statistical test reported (Beales, 2009)[31]
	Emergency Department Visits	18.5% decrease, p=0.26 (Chang, 2009)[33] 2-year ED visit rate per 1000 Intervention group 1445 [n=474] vs. 1748 [n=477], p=0.03 (Counsell, 2007)[35] 10% fewer ED visits p=0.001 (De Jonge 2014)[36]	14.7% decrease in ED visits no statistical test reported (Beck 2009) [32] 9.8% reduction ED visits, p=0.66 (Rosenberg, 2012)[47]	48% decrease ED Visits Pre: 166; post: 86 No statistical test reported (North, 2008)[43]
	Nursing Home Admissions	—	Patients with ≥1 SNF admissions Before enrollment 63 (35%) After enrollment 33 (18%), p=0.001 (Wajnberg, 2010)[48]	—
	Nursing Home Days	27% fewer SNF days, p=0.001 (De Jonge, 2014)[36] No difference in SNF days p=0.68 (Edes 2014)[37]	—	89% reduction in nursing home bed days No statistical test reported (Beales, 2009)[31]
	Specialty Visits	23% fewer specialty visits, p=0.001 (De Jonge, 2014)[36]	Specialty Care Before: 1,100; after: 696 No statistical test reported (Beck, 2009) [32]	—

Key Question	Outcome	Study Quality: Good	Study Quality: Fair	Study Quality: Poor
Key Question 1c: Utilization of Services (continued)	Cost	Total Medicare costs during 2-year followup $44,455 vs. $50,977, p=0.001 Cases have lower cost for hospital, physician and SNF and higher costs for skilled home health care and hospice than controls. Overall cost differences significant only in cases vs. controls in the highest frailty category. (De Jonge 2014)[36] Total average cost per patient 6 months before: $19,234 6 months during HBPC: $13,822 Total VA + Medicare costs per patient 28.1% reduction (95% CI, -29.2 to -27.1) p<0.001 13.4% absolute reduction in cost when compared to non-HBPC. Most significant cost saving in highest hierarchical condition category (Edes, 2014)[37]	22.7% increase in mean total charges No statistical test reported (Beck 2009) [32] Total costs: 12.1% higher for HBPC, p=0.005 (Hughes, 2000)[39] Net revenue, $, median (IQR) 9,753 (7,945–14,684) 10,807 (8,174–15,832) p<0.001 Direct care costs, $, median (IQR) 3,245 (1,977–5,834) 3,699 (2,389–6,703) p<0.001 Indirect cost, $, median (IQR) 666.5 (399–1,199) 740 (466–1,355) p<0.001 Contribution to margin, $, median (IQR) 5,658 (3,308–8,408) 5,940 (3,543–9,034) p=0.34 Revenue and Costs increased resulting in a nonsignificant impact (Ornstein, 2011)[45]	24% decrease in mean total cost of care (from $38,000 to $29,000) No statistical test reported (Beales, 2009)[31]

ADL = activities of daily living, CI = confidence interval, ED = emergency department, HBPC = home-based primary care, HR-QOL = health-related quality of life, IQR = interquartile range, p = P-value, SNF = skilled nursing facility, VA = U.S. Department of Veterans Affairs, vs. = versus

[a] Rows of study results are organized by Key Question outcomes, the results are provided by study quality in columns from left to right for “Good”, “Fair”, and “Poor” quality rated results, and outcomes not provided are indicated by “——”.

Key Question 2. How do the effects of home-based primary care interventions differ across patient characteristics and organizational characteristics?

Overview of Findings

- Patient characteristics: Four studies reported outcomes by patient subgroups. While the subgroups were defined differently in each study, the patients who were more frail, sicker, or at higher risk of negative outcomes benefited from HBPC more than those who were less frail or ill.
- Organizational characteristics: No studies were identified.

Key Question 2a. Patient Characteristics

Four studies divided the patient population by severity of illness or frailty and examined results across subgroups:

- De Jonge 2014[36] conducted a case-control study in which HBPC patients were matched to patients in usual care and found that total Medicare costs during the average 2-year followup period were significantly less for the HBPC patients ($44,455 vs. $50,977, p=0.01). When the participants were divided in to three groups based on a frailty index, the difference was significant only at the highest level of frailty (HBPC $58,689 vs. usual care $76,827; p<0.001).
- Edes 2014[37] reviewed projected VA and Medicare costs for Veterans newly enrolled in HBPC and compared these projected costs to actual costs for Veterans enrolled and not enrolled in HBPC. Examining this result for patients divided by risk scores revealed that the magnitude and proportion of the reduction in costs were largest for the patients with the highest risk scores.
- Counsell 2007[35] predefined a group of patients with a high probability of readmission over 4 years ($p \geq 0.4$) and found that both ED use and hospital admissions were significantly lower in this subgroup in the HBPC group than this subgroup in the usual care group during the second year of the intervention.
    - ED visits in the second year (848 [n=106] vs. 1314 [n=105], p=0.03)
    - Hospital admission rates (396 [n=106] vs. 705 [n=105], p=0.03)

  This differs from the overall study results in which the difference in hospital admissions was not significant.
- Hughes 2000[39] divided patients based on whether they were terminally ill or not and found that results differed for these two groups. HBPC improved health-related quality of life in the terminally ill group and patient satisfaction in the group not terminally ill.

A consistent finding is that patients who are more frail, more ill, terminally ill, or in higher risk categories benefit more from HBPC interventions than patients with lower levels of illness severity or disability. However, this result must be tempered by the fact that the patient subgroups were defined differently in each of these studies. One used the JEN Frailty Index[36], another relied on a risk adjustment model designed to project costs,[37] the third estimated probability of hospital readmission,[35] while the fourth study simply divided patients according to whether they had a terminal diagnosis or not.[39]

Key Question 2b. Organizational Characteristics

We did not identify any studies that examined organizational characteristics. Nevertheless, these results suggested that HBPC interventions are most potent in reducing costs and acute care for the more frail populations of patients.

The evidence base was limited for Key Question 2. HBPC programs used different criteria for patient enrollment and thus cared for patients with mortality rates ranging from 7 percent[35] to 40 percent.[36]

Key Question 3. Which characteristics of home-based primary care interventions are associated with effectiveness?

Overview of Findings

- Combinations of components of HBPC interventions: There is wide variation in the services provided as part of HBPC interventions. In the evidence presently available there is not an apparent pattern or cluster of services associated with differences in outcomes. Most included assessment and coordination.
- Adding services to HBPC: Four studies examined the incremental impact of additional services to HBPC. Two studies found that combining palliative care and primary care visits increased the likelihood that patients would die at home (low strength of evidence). Two other studies added different additional services (insufficient evidence).

HBPC is delivered with a spectrum of services. At minimum, it requires a primary care provider willing to tackle the logistics and time investment of home-based care. Additionally, if the HBPC is team-based, it requires an organization with the capacity to assemble and support the team. HBPC can consist of a mosaic of services, many of which could be provided separately or in various combinations. Furthermore, the value added by a combination of services may be more than the sum of the valued added by each individual service. The result is that answering Key Question 3 about what characteristics of HBPC interventions are associated with effectiveness is challenging.

Given this, we attempted to address Key Question 3 in two ways: first by examining the components of the HBPC programs in the included studies and then by searching for and including any research that isolated a potential component of HBPC.

Table 5 lists each of the included studies and indicates which of several components are reported as part of the HBPC intervention. We grouped these components into categories. This approach was not based on any definitions or requirements for HBPC, and it is limited to the information that is available in the published study reports. If a service is or is not listed here for a specific study it does not mean that the service definitely was or was not provided, only that it was listed or not listed in the article.

In describing the components of HBPC across studies, Table 5 illustrates the variation across HBPC interventions. Our definition of HBPC does not include transitional care, preventive single visits, short-term care, or programs that provide care for a single condition. While we did require that a physician (MD or DO), nurse practitioner (NP), or physician assistant (PA) actually make home visits, we did not require specific components of HBPC to be provided or that a program call itself HBPC. As a result we included heterogeneous programs. We did include models where an additional physician may be involved or responsible for care but does not make home visits. For example, in the GRACE model[35] a NP and a social worker make regular home visits to conduct assessments and provide care, but another primary care provider and a consulting geriatrician may be involved in care planning without making home visits. As the NP making the visits could provide care, we included this intervention and view it as a variation on the model that could be considered when assessing different approaches to HBPC.

Table 5. Components of home-based primary care reported in each study

Study	Personnel: Primary care provider	Personnel: Social workers	Personnel: Other providers	Planning: Assessment	Planning: Coordination	Planning: Team meetings	Planning: Referrals	Planning: Caregiver support	Planning: Afterhours and weekend coverage by HBPC (not ED, hospital providers)	Provided Care: Medication Management	Provided Care: Inpatient coordination	Provided Care: Education/ coaching/ Counseling	Provided Care: Medical tests (X-ray, blood, EKG)	Provided Care: Terminally ill care/ palliative care
Aabom, 2006[26]	Physician													✓
Anetzberger, 2006[30]	Physician, NP			✓	✓		✓	✓		✓		✓		
Beales, 2009[31]	Physician, NP or PA	✓	✓	✓	✓		✓							
Beck, 2009[32,49]	Geriatrician	✓	✓	✓	✓	✓			✓				✓	
Chang, 2009[33]	NP		✓	✓	✓		✓	✓	✓	✓		✓	✓	
Cooper, 2007[34]	NP or PA	✓		✓		✓								
Counsell, 2007[35]	Physicians do not do visits; NP does	✓		✓	✓	✓								
De Jonge, 2014[36]	Physician, NP	✓	✓		✓	✓			✓		✓			
Edes, 2014[37]	Physician, NP, or PA	✓	✓	✓	✓	✓		✓		✓				
Edwards, 2014[38]	Physician	✓	✓	✓	✓	✓								
Hughes, 2000[39]	Physician	✓	✓		✓	✓	✓		✓		✓			
Neergaard, 2009[37]	Physician		✓						✓					✓
Nichols, 2011[38]	Physician, NP or PA		✓					✓				✓		
North, 2008[43]	NP	✓	✓		✓	✓	✓							
Ornstein, 2009[44]	Physician, NP	✓		✓	✓			✓	✓					
Ornstein, 2011[45]	Physician, NP		NP specifically for transition	✓			✓	✓		✓		✓		

Study	Personnel: Primary care provider	Personnel: Social workers	Personnel: Other providers	Planning: Assessment	Planning: Coordination	Planning: Team meetings	Planning: Referrals	Planning: Caregiver support	Planning: Afterhours and weekend coverage by HBPC (not ED, hospital providers)	Provided Care: Medication Management	Provided Care: Inpatient coordination	Provided Care: Education/ coaching/ Counseling	Provided Care: Medical tests (X-ray, blood, EKG)	Provided Care: Terminally ill care/ palliative care
Ornstein, 2013[46]	Physician, NP	✓	✓	✓	✓		✓		✓		✓			✓
Rosenberg, 2012[47]	Physician		✓	✓	✓	✓			✓		✓		✓	
Wajnberg, 2010[48]	Physician		✓	✓									✓	

ED = emergency department, EKG = electrocardiogram, HBPC = home-based primary care, NP = nurse practitioner, physician = MD or DO; PA = physician assistant
✓= additional components of home-based primary care reported as included in the specific study.

Programs included a core of assessment and/or coordination and most programs included other health care providers in a team model in addition to the primary care provider. The content of HBPC interventions reported was variable. However, there were not obvious groupings of components of HBPC programs, making it difficult to compare outcomes across groups and make assertions about what combination of intervention components are associated with positive outcomes.

The second approach we used to answer this Key Question was to include studies that examined the incremental benefit of specific potential components of HBPC. We identified four studies that examined three different services that could be added to HBPC; caregiver support, transitional care, and palliative/end-of-life care.

- In a translational study, staff at 24 HBPC programs at VA medical centers in 15 states added an evidence-based caregiver support program, “Resources for Enhancing Alzheimer’s Caregiver Health (REACH)”, to existing HBPC programs. Caregivers were evaluated at baseline and after 6 months. This study found statistically significant reductions in participant ratings of burden, depression, impact of depression on daily life, caregiver frustrations, and troubling dementia behaviors; there was no significant change in general health, health behaviors, safety, social support, and care giving difficulties.[42]
- Another study embedded a nurse practitioner-led transitional care program into a long-standing HBPC program. While qualitative data indicated that the staff was satisfied with the program, hospital length of stay and readmissions did not decline. Other factors resulted in patients with a higher (sicker) case mix, and overall the program did not significantly contribute to or subtract from the financial margin.[45]
- Two studies conducted in Denmark examined the relationship between palliative care and primary care home visits. The first study followed all cancer deaths in a region from 1997-1998 and found that primary care home visits were inversely associated with death in the hospital. As the number of home visits made by the primary care provider increased, the likelihood the patient would die in the hospital decreased.[29] The second study was reported in two articles.[40,41] This study relied on death records and administrative data to identify cancer patients who died in a 9-month study period and obtained data on primary care home visits and place of death. The authors surveyed the primary care physicians to obtain information about the physician’s relationship with the patient and family and additional services provided. This study found that there was a strong association between primary care home visits and home death (prevalence ratio 4.3, 95% CI, 1.2 to 14.9) and that when physicians made three or more home visits the likelihood of home death increased significantly. Other variables related to the physician, such as extent of prior patient knowledge or whether they gave the patient their private phone number, were not significant. The involvement of a community health nurse in care was the only other significant factor in the increased likelihood of home death.

These studies are interesting and are an addition to the literature. However, they do not offer a head-to-head comparison of potential components or sufficient information to know if a component will be beneficial in the context of a different HBPC program.

Discussion

HBPC increases access by providing a different route to health care for people who face barriers to obtaining outpatient primary care. To the extent that HBPC can improve access and not cause harm, it is successful. A common expectation is that HBPC can reduce avoidable use of hospital and emergency services by either preventing the need for higher levels of care or by providing care in in the patient's home. Aligning with these expectations, utilization was the most frequently studied outcome and it is the outcome for which we were able to draw the strongest conclusion. The evidence for each outcome is summarized in Table 6.

In this review we found moderate-strength evidence supporting a reduction in utilization of hospital services with HBPC (Key Question 1c). This is an important finding as hospitalizations are expensive and often drive the overall cost of care. Additionally, some patients may prefer to avoid hospitalizations so this also could be an improvement in quality of life. When hospitalization cannot be avoided, HBPC may reduce the number of hospital days by assuring that adequate post-hospital care will be available (which may include medical interventions, nursing, and other therapies as needed). Low-strength evidence suggested possible reductions in emergency visits while the evidence about nursing home admissions and days was insufficient.

The findings related to costs were inconsistent. The more recent, high-quality studies[36,37] are the ones that reported savings, suggesting that future studies may allow a stronger conclusion than our low-strength of evidence that HBPC reduces costs. This possibility is also supported by the fact that the early studies suggesting that HBPC increased rather than decreased costs had shorter intervention periods. It may be that patients did not receive HBPC for long enough to change their utilizations patterns or health status (e.g., in one randomized controlled trial [RCT] the average time in HBPC was under 5 months[39]). This difference may also be due to the fact that the more recent studies have measured costs using different methodologies that incorporate risk adjustment and include costs across payers. Additionally, while it may be important that HBPC substitutes for rather than supplements other services to offset the cost of the program, the expected or ideal pattern of change in utilization is not straightforward and may vary by the type of patient (e.g., it may be different for a patient nearing the end of life than a patient with a serious but stable condition).

The evidence about how patient characteristics are associated with HBPC effectiveness was limited in that studies investigating HBPC outcomes used different criteria to define the populations who received HBPC services. Despite this we found moderate strength of evidence that complex patients—those at highest risk of hospitalization (sicker) or most frail—have the most potential to benefit from HBPC. While some authors suggested or concluded that HBPC should be targeting the "right" patients, particularly to realize cost savings, other important outcomes were not analyzed by patient group. Without this information decisionmakers are not able to clearly understand how HBPC affects a range of outcomes for particular subpopulations and weigh the importance of different benefits for different patients.

Table 6. Summary of evidence

Key Question	Outcome Number of Studies: Quality Rating	Summary of Findings[a]	Strength of Evidence	Comments on Strength of Evidence
KQ1a. Health outcomes	*Function* *2 RCTs: 1 Good, 1 Fair* *1 Obs: Poor*	No significant difference In 2 RCTs no significant functional differences. 1 poor-quality observational study reported improvement	Low	Findings were inconsistent and the estimates were imprecise
	Symptoms *1 Obs: Fair*	—	Insufficient	1 study (n=140) with relatively short-term followup (3 weeks)
	Mortality *1 RCT: Good* *1 Obs: Good*	No significant difference	Low	Study designs and measurement differ such that confidence in stability of findings is low
KQ1b. Patient and caregiver experience	*Satisfaction* *1 RCT: Fair* *2 Obs: 2 Poor*	Satisfaction results are positive	Low	Positive finding, but limited confidence in its stability given no comparison group in 2 lower-quality studies; higher satisfaction in one subgroup in the moderate-quality RCT
	SF-36 Quality of Life *2 RCTs: 1 good, 1 Fair*	Significant improvement in some scales (4 of 8 in one study; 6 of 8 in another)	Low	Findings are inconsistent within and across studies with improvements in some scales and subgroups and not others
	Caregiver Burden/Needs *1 RCT: Fair* *1 Obs: Poor*	Significant improvements in caregiver outcomes including quality of life and reduced need for assistance	Low	Studies do not control for bias and other influences on results
	Negative unintended consequences/ harms *1 Obs: Good*	—	Insufficient	Good-quality observational study reports lack of negative experience in small number (n=31) of subjects

Key Question	Outcome Number of Studies: Quality Rating	Summary of Findings[a]	Strength of Evidence	Comments on Strength of Evidence
KQ1c. Utilization of services	*Hospitalization* *2 RCTs: 1 Good, 1 Fair* *9 Obs: 4 Good, 3 Fair, 2 Poor*	Hospitalizations were reduced. 9 of 11 studies reported significant reductions in hospitalizations	Moderate	Findings are generally consistent across studies with different designs and 5 good-quality studies reporting reduced hospitalizations
	Hospital bed days *6 Obs: 2 Good, 2 Fair, 2 Poor*	Numbers of days in hospital were reduced. 3 studies reported statistically significant reductions, 1 found no difference and 2 report reductions but do not provide a statistical test result	Moderate	Findings are comparatively precise and consistent
	Hospital Readmissions *1 RCT: Fair* *2 Obs: 1 Fair, 1 Poor*	Reductions were either not significant or not maintained over time	Low	Small differences and changes over time. Findings are inconsistent and imprecise
	Emergency Visits *1 RCT: Good* *5 Obs: 2 Good, 2 Fair, 1 Poor*	Emergency visits may be reduced 2 studies report reductions that are not significant, 4 found significant reductions	Low	Results are inconsistent and studies have important deficiencies in design
	Nursing Home Admissions *1 Obs: Fair*	—	Insufficient	Single study at 1 site with moderate sample (n=179)
	Nursing Home days *3 Obs: 2 Good, 1 Poor*	Good-quality studies report inconsistent findings (1 significant reduction, 1 reduction (not tested), 1 no difference)	Insufficient	It is unclear if HBPC reduces nursing home days
	Specialty Visits *2 Obs: 1 Good, 1 Fair*	Specialty visits may be reduced	Low	While results are consistent, they are limited to 2 studies with design limitations
	Costs *1 RCT: Fair* *5 Obs: 2 Good, 2 Fair, 1 Poor*	Recent high-quality studies document cost savings	Low	Overall findings are inconsistent. Findings of cost savings in high-quality studies and for sub groups of patients suggest cost saving are possible and ongoing studies may confirm this in the near future
KQ 2a. Patient characteristics	*Severity of illness or frailty* *2 RCTs: 1 Good, 1 Fair* *2 Obs; 2 Good*	Sicker or frailer patients are more likely to have positive outcomes.	Moderate	Studies used different approaches to defining subgroups of patients. Other studies may have been able to but did not report results by patient subgroups

Key Question	Outcome Number of Studies: Quality Rating	Summary of Findings[a]	Strength of Evidence	Comments on Strength of Evidence
KQ 2b. Organizational characteristics			Insufficient	No evidence identified
KQ 3. Characteristics of HBPC associated with effectiveness	*Caregiver Support*	——	Insufficient	Single study in one site
	Transitional Care	——	Insufficient	Single study in one site
	Primary care home visits and palliative care	Death seems more likely to occur at home when palliative care includes primary care home visits	Low	Two studies use place of death as outcome and have consistent though imprecise results

KQ = Key Question, Obs = observational study, NA = not applicable, RCT = randomized controlled trial

[a] Summary of findings not provided as evidence is insufficient to support a conclusion and are indicated by "——".

Health outcomes were not frequently or comprehensively evaluated. Function and mortality did not differ significantly in HBPC versus usual care. While this means studies were not able to demonstrate improvement, either because there was no improvement or they were not able to detect it, it also means there was no documented decline in function or increase in death associated with HBPC. This could be viewed as a positive outcome in the sense that it does not appear that patient safety was compromised or that patients were harmed by being cared for with HBPC.

We found the strength of evidence supporting impact on satisfaction, quality of life, and caregiver outcomes to be low. It is notable that the studies that included these outcomes all report some positive effect, though often this was limited to a subgroup of patients or certain subscales of the measures. Only one study explicitly explored what could be considered an unintended consequence or harm and reported that patients and families did not experience any restriction of access to services.

We were unable to identify which specific combinations of program components were associated with success. While HBPC programs involved patient coordination and many used a team approach, the specifics of the intervention were not well defined in most reports. No study evaluated a spectrum of services, and the lack of clear definitions of interventions means it is not possible to precisely identify which components of the HBPC programs are beneficial. Future studies are needed to clarify which populations of patients benefit from HBPC and how to identify these patients. These may need to be pragmatic or adaptive studies that prospectively evaluate HBPC. Ideally, a clear means of characterizing frailty, functional and cognitive limitations, and diseases will be integrated into future HBPC programs. Our knowledge base will also benefit from clarity about the nature of the HBPC services provided in programs.

Findings in Relationship to What Is Already Known

This review differs from several earlier reviews in that these reviews often included interventions that were one-time, that added home care to office-based primary care, or provided care for a limited period. Examples that we excluded but have been included in earlier reviews include preventive home visits, transitional care, hospital-at-home, or diversion programs that allowed acute care to be delivered in a patient's home.[50-52] In fact, the mixing of these types of interventions and HBPC has been one of the problematic aspects of prior reviews. To avoid this we applied a strict definition of HBPC, requiring that primary care be delivered in the patient's home by a physician, NP, or PA and that the care be longitudinal and comprehensive. In our estimation this helped ensure we were comparing equivalent programs. However, we conducted a broad search and included studies that met these aspects of our criteria even if they did not self-identify specifically as HBPC.

One recently-published systematic review used a similar definition of HBPC but also limited the population to the homebound elderly and required that outcomes include hospital, emergency department (ED), or nursing home use.[24] This review identified and summarized nine studies and concluded, as we did, that HBPC reduced hospitalization. While this review also reported a reduction in nursing-home admissions, we found the evidence to be insufficient. The difference is due to the fact that we included an additional, large high quality, recently published study that found no difference, resulting in inconsistent conclusions.

Our review builds and expands on these prior reviews in that it considered HBPC for adults of any age and included studies with any outcome. While the frail elderly are a logical target population for HBPC, the numbers of younger people with serious illness or temporary or permanent disabilities are growing, and it does not appear that the HBPC model needs to be restricted to frail elderly. Similarly, costs and utilization of services are important outcomes, but requiring these outcomes may lead to exclusion of evidence that could help decisionmakers consider costs and benefits in different ways.

Applicability

Our summary and conclusions are applicable to patients with conditions or disabilities that make outpatient primary care difficult or less effective. While the most common type of patients provided HBPC have been homebound elderly, age is not the predominate factor and this model of care could serve patients of various ages, as has been demonstrated in the VA programs.

One consideration is that 8 of the 19 studies were conducted in VA medical centers, which has advantages and disadvantages for applicability. The Veterans served were predominately male, while the patients in other HBPC interventions were predominately female. In the nonveteran population, older male patients are more likely to have a living spouse and may have more access to informal care, although these demographics may be different for veterans. On the other hand the VA provides health services to veterans of all ages, including younger veterans with polytrauma or serious conditions like amyotrophic lateral sclerosis (ALS), making it possible that VA programs can be a model for how HBPC could serve a broader population than Medicare-eligible older adults.

In discussions of the goals of HBPC the target populations are often described as vulnerable, and this vulnerability typically refers to functional status and comorbidities. But vulnerability could be characterized in terms that add social and economic factors to medical and functional status. It seems likely HBPC might be particularly effective for patients who are vulnerable due to lack of social support. That said, HBPC may depend on the availability of a family caregiver. The available evidence does not allow us to say whether HBPC would be effective for these types of vulnerable patients or how their needs might differ.

Another major consideration about applicability relates to the organizations that provide HBPC interventions. Based on current evidence, we do not know what infrastructure is required to support HBPC. The included studies were conducted in the VA, in health plans, or in academic/health organization collaborations. This may reflect the need for both integrated services and the organizational capacity to support a program of care that can be resource intensive and differs in many ways from how office-based primary care is organized. As the authors of one of the included studies points out, “This setting provides ready referrals along with administrative and clerical supports…"[30] While it is possible to make some very preliminary inferences about the types of organizations that could implement HBPC, the research does not address this issue directly; we identified no evidence about the impact of organizational characteristics. Community-based practices and even single primary care practices may be capable of providing HBPC, but they are less likely to be studied than programs in large systems. This may change as the results of the Centers for Medicare & Medicaid Services (CMS) Independence at Home (IAH) demonstration become available, as the participating organizations vary in structure and include free-standing, privately-held practices. Other health care reforms that also encourage collaboration and interdisciplinary approaches, such as patient-centered medical homes (PCMHs) and accountable care organizations, may lead to the development of organizational capacity to provide HBPC in a greater variety of practice settings. Evaluation studies of such more widespread HBPC implementation may produce research that provides a better understanding of the impact of organizational characteristics on HBPC effectiveness.

As discussed in the limitations section, the content of HBPC interventions is not standardized and is rarely reported in detail. This makes it difficult to estimate the extent to which the same results seen in any study or group of studies can be expected in a different situation in which the HBPC may provide or at least have access to different configurations of services.

Implications

The results of this review indicate that HBPC, with its emphasis on coordinated, comprehensive primary care provided in patients' homes, has the potential to produce better outcomes for several types of patients, including patients with serious disabilities or multiple chronic conditions. Given the overall findings of this review that suggest that HBPC is a promising model of care, the expansion of HBPC and additional studies is reasonable and expected to continue.

This expansion is also likely to include standardizing core services and targeting HBPC programs to patients most likely to benefit. However, as one care model is not going to be appropriate for all patients and the exact combination of services or components probably should vary according to patient need, variability in HBPC should not necessarily be discouraged. Perhaps different of levels of intensity of HBPC or versions that address specific issues could be equally if not more effective.

Limitations of the Review

Our review has several limitations. Bibliographic database indexing varies and HBPC is not a major indexing term in the databases we used. To address this limitation, we used combinations of other indexing terms and key word adjacencies. This may not have been sufficient if the intervention studied included the characteristics we required but did not use our included terms in reporting study results.

Additionally, while we did not exclude studies in languages other than English (though we required an English-language abstract), it is possible that in countries other than the United States, where health and social care are organized differently, other terms may have been used to describe research about similar models of health services delivery.

A review of published literature that focuses on comparative and quantitative studies cannot answer all questions about HBPC. Questions about the details of service delivery, the implementation of the programs, or the potential impact of patient, family, and provider attitudes and expectations might be best answered using qualitative research methods. However, reviewing or conducting qualitative research was outside the scope of this report.

Limitations of the Evidence Base

The literature lacks detailed information on both the implementation process and context of HBPC interventions. Implementation is key to the success of an intervention and for this reason there is increasing attention paid to implementation science and process evaluation.[53] The current literature does not directly address the possibility that an effective intervention can be rendered ineffective by how and where it is implemented.

The fact that HBPC interventions are not standardized, means that our comparisons and summaries across programs may be flawed. Perhaps the ability of HBPC to customize services to the patient is one of its strengths, but without agreement on core and optional services, it is possible that apples are being compared to oranges in some cases. This is a common challenge when evaluating complex interventions, and a challenge that ongoing efforts to establish reporting guidelines for complex interventions are working to address.[54,55] While we attempted to document what services were part of the HBPC interventions in the included studies, our accuracy is limited by what was reported and our interpretation of these reports. Even in Veterans Affairs (VA) settings, there is likely more variation than might be expected. While HBPC programs in the VA are governed by national policy, there is considerable variation in staffing arrangements across the VA system. Some HBPC programs have nurse practitioners (NPs) or physician’s assistants (PAs) who do nearly all of the diagnostic evaluation and management as well as most of the medication management; physicians provide oversight and make occasional home visits. Some programs have multiple physicians who routinely make home visits to every patient. But a limited number of sites do not have providers who make home visits, though the VA is working to establish the presence of providers in these locations.[56]

Given that we were not able to accurately assess the intensity, consistency, and quality of care provided, we cannot be sure whether in some cases the lack of HBPC benefits was related to the poor quality of the services. Quality metrics for home-based primary care are not widely used and are only in the developmental stages. One organization has developed a quality measurement framework, identified domains, and is currently field testing quality indicators, but that effort has its own challenges. For example, 14 of the 36 proposed quality standards could not be mapped to any existing quality standards in ambulatory and long-term care.[51] The work in progress bodes well for the future, but the gaps between what is important in HBPC and quality measures currently in use in other settings underscore why it can be difficult to assess HBPC outcomes or determine which aspects of HBPC improve quality of care.

Finally, there is ambiguity in the literature surrounding the appropriateness and relative importance of potential outcomes for HBPC. Based on expert input about HBPC, we chose to report all the outcomes studied rather than limit the review to a specific subset of outcomes (e.g., only health services utilization or only clinical outcomes). However, one of the challenges related to outcomes for HBPC is that expecting improvement in many common clinical measures such as mortality or physical function may not be appropriate for the populations served by these programs. Particularly if HBPC is targeted to frail patients or those with high mortality rates, improvement may not be possible and a good outcome would be rates that are not higher than those in a similar population (i.e., that HBPC does not appear to be doing harm) as long as there were other benefits.

Future Research

HBPC is a service delivery model that promises more efficient and effective care for patients with extensive needs in a format that may facilitate better quality of care and quality of life. Research on HBPC has increased over time in both volume and complexity; nevertheless, the level of the available knowledge does not match the growing interest in HBPC. In conducting this review and summarizing the available literature we identified areas in which future research could advance our understanding of HBPC and improve care of seriously ill or disabled patients.

However, in discussing topics for future research, it is important to acknowledge that a significant amount of new information will be available from the evaluation of the CMS IAH demonstration. Initial results released on June 18, 2015, report savings of more than 25 million in the first performance year with an estimated average savings of $3,070 per patient[57] while all 17 participating practices improved on at least three of six measures of quality. This is the first release of data from a mixed methods evaluation that will document how HBPC practices approached improving outcomes; assess the impact on outcomes including health status, utilization of services, costs and savings, and patients and their caregiver's experiences with the program; and identify HBPC features that are the most important predictors of positive results.[58] In our discussion of future research needs we consider which outstanding questions the IAH evaluation may address, but must acknowledge that this is speculation based on the information publicly available at the time this review was completed.

Based on our review, we offer the following considerations for planning future research in the advancing field of HBPC.

Patient Selection

An important area for future research is refining the definition of which patient subpopulations will benefit most, that is, identifying for whom HBPC works, either by reducing costs or providing benefits or both. Ideally, research should include clear, replicable definitions of the target population for the HBPC intervention. Important knowledge could come from subgroup analyses of studies with less strict inclusion criteria or comparisons across HBPC implementations with different targeting criteria, although these approaches may require larger studies and more complex analyses. While the target populations are most frequently thought of in terms of severity or type of functional deficit or illness, the benefits of HBPC could also be studied across other patient characteristics, such as the type of housing (e.g., private single family home, apartment, assisted living, and adult foster care) and location (e.g., urban, suburban, rural, and proximity to other health services). It is also possible that HBPC could benefit different types of patients and targeting to restrict the program would not be desirable.

The IAH demonstration required that program patients have deficits in two or more activities of daily living (ADLs) and a hospitalization in the last year. These patients are quite ill and essentially nursing home eligible. The advantage of this approach is that these patients are also those likely to have high health costs, making it feasible that cost savings could be realized in a relatively short period of time even if providing HBPC requires significant resources (e.g., team care, travel time, 24/7 coverage).

What IAH will not reveal is whether or not there are other groups of patients who could benefit from variations on the HBPC model. Perhaps a less intensive version of HBPC provided to patients at risk of developing ADL deficits could also be effective in slowing decline. A version of HBPC might be appropriate for patients who do not have ADL deficits but who have serious mobility restrictions. HBPC should, as it often already does, serve both patients at the end of life and those with multiple conditions who are not terminally ill.

Composition of HBPC Services

More research is needed that addresses which components of HBPC are linked to cost savings and benefits. As with other complex interventions, a typology could facilitate a better description and understanding of HBPC interventions. Being able to describe components and programs in a standardized way could encourage both systematic experimentation and better reporting about HBPC interventions and the care received by people in the comparison groups. The components could be specific services (e.g., types of visits) or they could be elements of the mission or organization structure. Categorizing these would allow us to ask and answer questions such as: Do social work visits improve outcomes? or, Do HBPC programs that explicitly have as a goal to keep patients out of the hospital have a greater impact on utilization? Another possibility that was not addressed in any of our included studies but that has been raised in policy discussions, the general press, and could be the subject of future study, is how technology could permit virtual visits to play a role in HBPC in the future.

Both the IAH evaluation and the efforts to develop quality measures for HBPC may improve our understanding of which components of HBPC contribute to improved outcomes. But this may be more complicated than simply identifying necessary program components. The results may suggest that different combinations of components can produce positive results. It is also possible that adding a particular component may benefit some people and not others (e.g., palliative care or mental health services) or that the timing and intensity of services may be as important as the combination of services. Given the number of important questions on this topic, it is likely that there will need to be significant research in this area in addition to the IAH evaluation.

Study Designs

The study designs and quality of the studies we identified varied from program descriptions that included minimal data to randomized controlled trials (RCTs) and large, higher-quality observational studies. It is encouraging to note that the more recent studies were of higher quality and that researchers are applying more sophisticated approaches to the study of HBPC.

HBPC can be difficult to study for several reasons, making study design especially challenging. Randomization may be difficult given the patient population and the complexity of the intervention. Patients may need this type of care at a time when they are clinically unstable or after a medical crisis, making it difficult to determine whether improvement or decline would be expected and how long it might take for the intervention to improve outcomes. Given these challenges, observational studies that use sophisticated risk adjustment and modeling approaches to create valid comparisons are particularly important for future, high-quality research on HBPC. Also, longer studies are needed both to be sure that HBPC has had time to affect outcomes and to answer questions about whether the benefits persist and for how long.

More sophisticated study designs, such as randomization of sites within systems rolling out HBPC, staggered start designs that add HBPC to different sites at different times or observational studies that apply sophisticated analysis approaches to match patients or allow patients to serve as their own controls, could all add to our understanding of HBPC. In transitional care, which like HBPC is a complex intervention, more advanced study designs have followed the initial pilot and efficacy studies[52] and this seems a logical next step for research on HBPC.

Studies must also be designed to evaluate implementation as well as effectiveness. These could be separate studies or objectives combined in a single study. In evaluations of service delivery, it can be difficult to disentangle the assessment of implementation from the study of effectiveness, but understanding what is important for successful implementation is critical. Without knowledge of factors contributing to successful implementation, the utility of proof of effectiveness is reduced. Implementation science and related methods continue to evolve and could be applied to this topic.

The IAH evaluation is an example of a nonrandomized study that uses advanced methods to address the selection bias and create appropriate comparisons. A key element of future research for IAH and other nonrandomized studies of HBPC will be sensitivity analyses and secondary analyses. Researchers should both test the sensitivity of the results to the selected methods used to create comparisons and explore what additional questions might be answered by further analyses.- Methods development related to complex interventions and implementation research could both be useful in increasing our understanding of HBPC.

Outcomes

Utilization of services and costs may be key to feasibility, but the ultimate goal of any care model should be to improve the health and well-being of patients. None of the studies we identified asserted that they measured what was most important to HBPC patients. An effort to identify and use patient-centered outcomes specific to HBPC could lead to improvements in the relevance of future research.

The IAH demonstration evaluation plan includes patient and caregiver experiences with the program as outcomes to be studied. This is a step in the right direction. An important complementary effort would be to understand how patients and family caregivers prioritize clinical and functional outcomes. However, if HBPC serves different types of patients (e.g., patients on hospice at home and patients who are not terminally ill) it is also necessary to consider whether the outcomes and priorities differ for these different groups.

As HBPC expands, the number of evaluations is likely to increase. Developing a core set of outcomes (like a core set of quality measures currently under development[51] discussed in Limitations in the Literature Base above) and encouraging their measurement in future research would facilitate comparisons across individual studies as well as potential future meta-analyses. These may need to be expanded to include outcomes specific to subgroups of patients, such as those at the end of life. Other important questions related to outcomes are: how quickly HBPC should be expected to have an impact on outcomes such as hospitalizations and ED use? and can changes in utilization be expected to continue to decrease, or should they stabilize as the program matures?

Context

Ultimately the research on individual HBPC interventions should also advance our understanding of how to position HBPC in the larger health care system and the continuum of services. It is possible the HBPC could complement other care models, replace office-based care at certain times in a patient’s trajectory, or be integrated into a package of comprehensive service. While we did consider the characteristics of the organizations providing HBPC, issues associated with how HBPC could fit with other models of primary care, long term services and support, or integrated models was outside the scope of this review and they were not directly addressed.

Our more narrow questions leads, nevertheless, to research (and policy) questions about when HBPC should be considered for different types of patients at different times in their illness or disability trajectory. It also raises questions about the comparative effectiveness of primary care in different settings (e.g., office, home, adult day health, assisted living, and nursing facility), how research might attempt to isolate the value of HBPC, and if HBPC should always be strictly defined as a separate service, incorporated into hybrid services, or if some patients should be discharged from HBPC if their condition improves. For example, if the patient is cared for by several home care physicians and does not establish a relationship with one, is HBPC more effective than office-based care where this relationship exists? Or could a model be created that adjusts the site of care as needed (e.g., home visits for assessment, urgent need, when transportation is not possible, and some office visits for planned, routine care).

Organization of service delivery and payment for services are intertwined. Several different financing mechanisms currently exist for services like HBPC, and new payment structures are an important part of health reform. How these may or may not impact the incentives for HBPC is another question related to the larger context.

Conclusions

Home-based primary care (HBPC) is a promising model of care delivery for patients who may not be best served by the combination of outpatient and hospital care that predominates in our current system. Current research evidence is generally positive, providing moderate evidence that HBPC reduces utilization of inpatient care, and providing low strength evidence that it reduces utilization of other health services or improves clinical outcomes and patient and caregiver experiences. A small number studies reported results by patient subgroups; however, it appears that higher risk patients are likely to benefit from HBPC. We were not able to identify any research that directly examined organizational characteristics of health systems, health plans, or practices and how those characteristics might influence the impact of HBPC. While we documented the components of HBPC programs that have been the subject of study and we searched for studies that examined specific services (e.g., caregiver support), there is still insufficient evidence on which to base conclusions about the impact of different individual or combinations of services in HBPC.

The more recent studies of HBPC included larger sample sizes and comparison groups, and they incorporated more complex designs and analyses; however, the body of evidence is still comparatively small. When its results are released, the Centers for Medicare & Medicaid Services (CMS) Independence at Home (IAH) demonstration is likely to provide substantial new evidence about the benefits of HBPC for patients with significant functional deficits who would be nursing home eligible. Additional future research is needed that focuses on the content and organizational context of HBPC interventions so that differences can be identified and the experiences replicated or improved on by others. Research is also needed about what subgroups of patients benefit most from HBPC and how HBPC can be best used in the continuum of care for different types of patients.

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Abbreviations and Acronyms

ACOVE	Assessing Care of Vulnerable Elders
ADL	Activities of daily living
AHRQ	Agency for Healthcare Research and Quality
CI	Confidence Interval
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CMS	Centers for Medicare & Medicaid Services
DO	Osteopathic physician
ED	Emergency department
EPC	Evidence-based Practice Center
GRACE	Geriatric Resources for Assessment and Care of Elders
HBPC	Home-based primary care
IAH	Independence at Home
MD	Allopathic physician
MEDLINE	Medical Literature Analysis and Retrieval System Online, or MEDLARS Online
NP	Nurse practitioner
OR	Odds ratio
PA	Physician assistant
PACE	Program of All-inclusive Care for the Elderly
PCMH	Patient-centered medical home
PCP	Primary care provider
PICOTS	Populations, Interventions, Comparators, Outcomes, Timing, and Setting
RCT	Randomized controlled trial
REACH	Resources for Enhancing Alzheimer’s Caregiver Health
SNF	Skilled nursing facility
VA	U.S. Department of Veterans Affairs

Appendix A. Methods

We performed the systematic review in accordance with the Evidence-based Practice Center methods guides.[1]

This Appendix provides detail on the methods used to conduct this review. This supplements the briefer overview provided in the report and repeats what is also available in the protocol, which is posted for the public on the Agency for Healthcare Research and Quality (AHRQ) Web site: http://effectivehealthcare.ahrq.gov/ and registered in the PROSPERO database under registration number: CRD42015016714 at http://www.crd.york.ac.uk/PROSPERO/.

Criteria for Inclusion/Exclusion of Studies in the Review

The criteria for inclusion and exclusion of studies were designed to identify studies that answer the Key Questions and are based on population, interventions, comparators, outcomes, timing, and setting (PICOTS).

Table A-1. Inclusion and exclusion criteria

	Include	**Exclude**
Population	Adults with chronic illnesses or disabilities	Children with special needs Adults being assessed for a single risk factor or condition Well elderly
Intervention(s)	HBPC as defined in Table 1 in the report	Care models that do not include the four required characteristics Examples of excluded care; preventive home visits, single visit home assessments, single purpose visits (fall risk assessments), care for a single condition, short-term home-based care such as Hospital at Home programs
Comparator(s)	Any other model of primary care	Services that are not primary care
Outcomes	Health Care Outcomes Patient and Caregiver Experience Utilization of Services	None
Timing	Longitudinal care, expected to continue until change in status	Short-term, time-limited home-based care such as Hospital at Home programs
Setting(s)	Patients' homes, broadly defined United States or other developed countries	Institutions such as nursing homes or prisons Countries with extremely different economies and/or health care systems
Study Design	• Randomized Controlled Trials • High quality observational studies including: comparative cohort studies and time series • Pre/post studies with or without a comparison group	• Descriptive studies • Case series or reports • Nonsystematic reviews
Publication Type	Peer reviewed journals Gray literature (if the study meets all other criteria)	Editorials or commentaries

We included studies that evaluated the effect of home-based primary care (HBPC) interventions, including randomized controlled trials and high-quality observational studies such as comparative cohort studies and time series. We included pre/post studies with or without a comparison group, though we highlighted the relative higher risk of bias in studies without a comparison group and we may have given more weight and attention to more rigorous study designs. We excluded case series and case reports as they are descriptive rather than assessments of effectiveness. We did not exclude studies based on any specific comparator or outcome; however, the comparators and approach to measuring the outcomes were considered as part of the assessment of the quality of an individual study and of the quality of the body of evidence.

Systematic reviews were used only to identify individual studies we may not have identified through our searches. This approach was based on our knowledge of the field and the results of Topic Refinement and preliminary searches, which suggested that there is not a large volume of literature, and that the scope and purpose of reviews conducted to date differ in key ways from those for this review.

We restricted inclusion to English-language articles and reviewed English-language abstracts of non-English-language articles in order to identify studies that would otherwise meet inclusion criteria and to assess the likelihood of language of publication bias.

Literature Search and Triage

The primary searches included articles published between 1995 and May 2015. We confirmed through our literature scan and discussion with our Technical Expert Panel that the majority of programs began after 1997. We also checked reference lists of the included studies and systematic reviews to confirm that earlier studies were not missed. Library searches were designed and conducted by a medical librarian familiar with systematic reviews in consultation with the review team. Suggestions about search terms were requested and received from Technical Expert Panel members and these were evaluated and included when appropriate. Ovid MEDLINE, CINAHL, Clinical Trials.gov, and Cochrane Database of Systematic Reviews were searched to capture published literature. Gray literature will be identified by searching the NYAM gray literature database and the websites of organizations that may fund or produce research evaluating HBPC.

Requests for unpublished evaluation data on HBPC interventions were sent to professional organizations, organizations that fund or conduct research, and government agencies. Submissions were reviewed by the review team and assessed for relevance and quality. Reference lists of included articles were also reviewed for includable literature. If information regarding methods or results appeared to be omitted from the published results of a study, or if we were aware of unpublished data, we emailed the authors and request this information.

We established the criteria used to determine eligibility for inclusion and exclusion of abstracts in accordance with the Key Questions and the *Methods Guide for Effectiveness and Comparative Effectiveness Reviews.*[1] To ensure accuracy, all excluded abstracts were dual reviewed. The full text was retrieved for all citations deemed appropriate for inclusion by at least one of the reviewers. Each full-text article, including any articles suggested by peer reviewers or that may arise from the public posting process, was independently reviewed for eligibility by two team members. Any disagreements will be resolved by consensus.

The searches were updated while the draft report is posted for public comment and peer review to capture any new publications. Literature identified from the updated search was assessed by following the same process of dual review as all other studies considered for inclusion in the report. Any pertinent new literature was incorporated before the final submission of the report.

Data Abstraction and Data Management

After studies were selected for inclusion, data was abstracted into categories including but not limited to: study design, year, setting, geographic location, sample size, eligibility criteria, patient characteristics, HBPC intervention characteristics, organizational characteristics, and results relevant to each Key Question as outlined in the PICOTS section. Information that was abstracted and relevant for assessing applicability includes the characteristics of the population, intervention, and care settings.

Abstracted study data was verified for accuracy and completeness by a second team member. A record of studies excluded at the full-text level with reasons for exclusion is included in Appendix C.

Assessment of Risk of Bias

Predefined criteria were used to assess the quality of individual controlled trials, systematic reviews, and observational studies by using clearly defined templates and criteria as appropriate. Randomized trials and observational studies were evaluated according to criteria recommended in the AHRQ Methods Guide chapter, Assessing the Risk of Bias of Individual Studies When Comparing Medical Interventions.[1] Individual studies were rated as “good,” “fair,” or “poor,” or as specified by the particular criteria. Studies rated “good” are considered to have low risk of bias and their results considered valid. Good-quality studies include clear descriptions of the population, setting, interventions, and comparison groups; a valid method for allocation of patients to treatment or identifying the treatment and control groups in observational studies; low dropout rates and clear reporting of dropouts; appropriate means of controlling for confounding; and appropriate measurement of outcomes.

Studies rated “fair” are susceptible to some bias, though not enough to invalidate the results. These studies may not meet all the criteria for a rating of good quality, but no flaw is likely to cause major bias. The study may be missing information, making it difficult to assess limitations and potential problems. The fair-quality category is broad, and studies with this rating will vary in their strengths and weaknesses. The results of some fair-quality studies are likely to be valid, while for others the validity may be uncertain.

Studies rated “poor” have significant flaws that imply biases of various types that may invalidate the results. They have a serious or “fatal” flaw in design, analysis, or reporting; large amounts of missing information; discrepancies in reporting; or serious problems in the delivery of the intervention. The results of these studies areas likely to reflect flaws in the study design as the true difference between the compared interventions. We did not exclude studies rated as being poor in quality *a priori*, but poor-quality studies were considered to be less reliable than higher-quality studies when synthesizing the evidence, particularly if discrepancies between studies of differing quality were present.

Each study evaluated was dual-reviewed for quality by two team members. Any disagreements were resolved by consensus.

Data Synthesis

We constructed evidence tables identifying the study characteristics, outcomes, and quality ratings for all included studies.

We reviewed and highlighted studies using a hierarchy-of-evidence approach. The best evidence available was the focus of our synthesis for each Key Question. If high-quality evidence was not available we described any lower-quality evidence we were able to identify, but underscored the issues that make it lower quality. We assessed and stated whether the inclusion of lower-quality studies would change any of our conclusions.

Meta-analyses are often considered to summarize data but before any statistical tests are done the interventions and outcomes are reviewed to determine if they are similar enough from a clinical perspective to combine. In this case the differences in how outcomes were defined and measured were extensive.. The Key Questions were designed to assess the comparative effectiveness and harms by patient demographics, comorbidities, and treatment features. Meta-regression was conducted to explore statistical heterogeneity using additional variables on methodological or other characteristics (e.g., quality, randomization or blinding, outcome definition and ascertainment) given a large enough number of studies.

Grading the Strength of Evidence

The strength of evidence for each Key Question was initially assessed by one researcher for each outcome (see the PICOTS above), using the approach described in the AHRQ Methods Guide.[1] To ensure consistency and validity of the evaluation, the grades were reviewed by the entire team of investigators for:

- Study limitations (low, medium, or high level of study limitations based on study design and the quality of the included studies)
- Consistency (consistent or inconsistent findings, or unknown)
- Directness (direct or indirect evidence)
- Precision (precise or imprecise estimates of effect)
- Reporting bias (suspected or undetected).

The strength of evidence was assigned an overall grade of high, moderate, low, or insufficient according to a four-level scale by evaluating and weighing the combined results of the above domains:

- High—We are very confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has few or no deficiencies. We believe that the findings are stable, i.e., another study would not change the conclusions.
- Moderate —We are moderately confident that the estimate of effect lies close to the true effect for this outcome. The body of evidence has some deficiencies. We believe that the findings are likely to be stable, but some doubt remains.
- Low—We have limited confidence that the estimate of effect lies close to the true effect for this outcome. The body of evidence has major or numerous deficiencies (or both). We believe that additional evidence is needed before concluding either that the findings are stable or that the estimate of effect is close to the true effect.
- Insufficient—We have no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome. No evidence is available or the body of evidence has unacceptable deficiencies, precluding reaching a conclusion.

Assessing Applicability

Applicability considers the extent to which results from a study or a body of evidence can be used to answer the questions of interest. Variability in the studies or studies with unique attributes may limit the ability to generalize the results to other populations, and settings. What may affect applicability can vary depending on the question of interest and currently the assessment of applicability is not standardized.

For this review we considered if applicability is affected by the characteristics of the patient populations (e.g., demographic characteristics, reason for receiving home-based care, primary condition or disability, presence of comorbidities) and the setting of the study (including geographic location and practice context).

Peer Review and Public Commentary

We invited specialists including home-based primary care providers, health policy researchers, health care payers and providers, and patient caregiver/advocates to provide peer review the draft report. The AHRQ Task Order Officer and an Evidence-based Practice Center Associate Editor also suggested comments and provided editorial review. The draft report was posted on the AHRQ Web site for 3 weeks to acquire public comment. The disposition of comments report with responses from the authors to the peer review comments will be posted after publication of the final report on the AHRQ public Web site.

Reference

1. Methods Guide for Effectiveness and Comparative Effectiveness Reviews. AHRQ Publication No. 10(14)-EHC063-EF. Rockville, MD: Agency for Healthcare Research and Quality; January 2014 Chapters available at: www.effectivehealthcare.ahrq.gov.

Appendix B. Included Studies

Please refer to this appendix as the reference list for Appendixes E and F.

1. Aabom B, Kragstrup J, Vondeling H, Bakketeig LS, Stovring H. Does persistent involvement by the GP improve palliative care at home for end-stage cancer patients? Acad Nurs Palliat Med. 2006;20(5):507-512, PMID: 16903404.

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Appendix C. Excluded Studies

Key to Excluded Study Reasons:

2 = Background
3 = Discussion paper only (clinical subgroups)
4 = Discussion paper only (demographic subgroups)
5 = Wrong population
6 = Wrong intervention
7 = Wrong outcome
8 = Wrong study design
9 = Wrong publication type
10 = Not English language but otherwise relevant
11 = Not human population
12 = Inadequate care duration
13 = Study published before 1995
14 = Systematic review not meeting requirements
15 = Inadequate sample size (n<20)
16 = Primary care intervention, but no provider home visits

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Appendix D. Included and Excluded Studies Criteria

Full-Text Paper Inclusion/Exclusion Codes: Reasons for paper inclusion or exclusion

Inclusion:

1 = Paper included as evidence (see Appendix A for inclusion criteria)

Exclusion:

2 = Background paper only, no data for evidence

3 = Discussion paper only (clinical subgroups, see above), no data for evidence

4 = Discussion paper only (demographic subgroups, see above), no data for evidence

5 = Wrong population (children and adolescents, patients with single conditions, healthy people receiving only preventive or assessment home visits)

6 = Wrong intervention (does not meet criteria specified in Table 1), examples: Hospital at Home, PACE, Patient-Centered Medical Home (PCMH), postsurgery care, visits by (RN, LPN social workers only)

7 = Wrong outcomes (not listed above)

8 = Wrong study design (case reports, descriptive study, or design not sufficiently described)

9 = Wrong publication type (opinions, letters to the editor, conference proceedings, abstract only)

10 = Not English language but otherwise relevant*

11 = Not human population

12 = Inadequate care duration - short-term, time-limited home-based care, one-time visits

13 = Study published before 1995

14 = Systematic review not meeting requirements (wrong study designs included, no quality rating, nonsystematic reviews)

15 = Inadequate sample size (n<20)

16 = Primary care intervention, but no provider home visits

*NOTE: If foreign language but possibly relevant, code as 10. If foreign language and not included for another reason, use exclusion code for the other reason)

Appendix E. Evidence Table

See Appendix B for the reference list for Appendix E.

Table E-1. Evidence table for home-based primary care interventions

Author, Year	Study Design	Data Sources	Study Purpose/ Research Question	Location	Setting	Organizational Characteristics (of the organization providing HBPC)	Study Duration	Types of Service Provided	Services Provided on Evenings and Weekends	Provider Types and Roles	Duration of HBPC, Number of Visits, Frequency of visits	How HBPC is Funded
Aabom, 2006	Retrospective Cohort	Danish registries: civil, cancer, hospital discharge, and health services	Analyze the effect of GP home visits for end-stage cancer patients receiving palliative care	Denmark Island of Funen	Patient's home	National Healthcare System for Denmark	1997-1998	Terminal care provided by primary care. Details not provided	NR	NR	Number of GP home visits is a variable in analysis	National HealthCare System

Author, Year	Inclusion Criteria	Exclusion Criteria	Intervention Group or Groups	Comparators/ Comparison Group or Time Period	Outcomes Measured	Study Participants: Baseline Demographics	Screened Eligible Enrolled Analyzed Loss to Followup	Adverse Events Including Withdrawals	Results	Quality Rating
Aabom, 2006	Resident at home at time of death Cancer patient who died in 1997 or 1998	Resident in nursing home at beginning of study period or in 3 months prior to death	Patients who received GP home visits	Patients who did not received GP home visits	Place of death Terminal Declaration (acknowledge of terminal diagnosis with death expected within 6 months, must be signed by patient)	Median Age at death: 74 75% over 60 25% 18 to 59 Sex: 49% Female Race: NR	Screened: NR Eligible: 2025 Enrolled: 2025 Analyzed: varied by analysis	NR	56% died in hospital 38% received a TD GP home visit before TD 1 week before adjusted OR 16.8 (95% CI 8.2- 34.4) 4 weeks before adjusted OR 9.7 (95% CI 46.4-14.6) GP home visits association with death in hospital with TD OR 0.18 (95% CI 0.11-0.29 and group without TD OR: 0.08 (95% CI 8.2-34.4)	Fair

Author, Year	Study Design	Data Sources	Study Purpose/ Research Question	Location	Setting	Organizational Characteristics (of the organization providing HBPC)	Study Duration	Types of Service Provided	Services Provided on Evenings and Weekends	Provider Types and Roles	Duration of HBPC, Number of Visits, Frequency of visits	How HBPC is Funded	Inclusion Criteria
Anetzberger, 2006	Post Only Pilot Evaluation with some repeated measures during enrollment	Referral logs; intake forms; referral source satisfaction survey	Evaluation of Primary Care in the home for high-risk older adults	United States Cleveland Ohio	Patient's home	Visiting Nurse Association	March 2003 - October 2003	Diagnosis Care coordination Medication management Caregiver support Health education Referrals	NR	Physicians NP	Average 4 times Range 1-9, SD 2.33 and received one telephone contact (range 0-7, SD 1.43) during the 4 month period Monitored no less frequently than every 3 months	Medicare	50 and older, focus on 65 or older Physical impairment and find it difficult to travel Bed bound History of falls Received initial assessment and at least one followup visit
Beales, 2009	Pre/post No comparison group 2 cohorts	NR, implied VA administrative data	Estimate the impact of HBPC on utilization of services	United States	Patient's home	Veterans Health Administration	1 year (6 months prior to HBPC enrollment and 6 months post)	PCP Interdisciplinary Team including MD, nurses, social worker, rehabilitation therapist, pharmacist, dietitian and psychologist Access to and coordination of other VA programs Case management by RN	NR	MD/NP/PA can be PCP, RN case manager others members of team	Enrollment average 315 days 3 visits per month	VA	Veteran who meets program requirements and receives care from Veterans Health Administration

Author, Year	Exclusion Criteria	Intervention Group or Groups	Comparators/ Comparison Group or Time Period	Outcomes Measured	Study Participants: Baseline Demographics	Screened Eligible Enrolled Analyzed Loss to Followup	Adverse Events Including Withdrawals	Results	Quality Rating
Anetzberger, 2006	Patients where data was insufficient medical consultation patients	Visiting Nurse Association House Calls	Before Intervention	Functional Status Feeling of Well being Hospitalization or use of ED Satisfaction with quality of care	Mean Age: 76 Sex: 67% Female White 66% Black 34% More than 1/2 a dozen diagnosis Specific : NR	Screened: NR Eligible: 343 Enrolled: NR Analyzed: varies by outcome: all for hospitalizations, 17 for ADLs; 16 for health maintenance	NR	No statistical tests reported 13% of patients had hospitalizations or ED visits post enrollment ADLs/IADLs 21% improved 75% remained the same 4% Declined Health Maintenance Ratings 31% improved 38% Remained the same 31% Declined	Poor
Beales, 2009	Non-Veterans	6 months prior to enrollment in HBPC 6 months post enrollment in HBPC	Pre enrolment to post enrollment	Hospital bed days Nursing home bed days Total inpatient days (hospital and nursing home) Inpatient admissions Cost of Care	Mean Age: 76.5 years Sex: 96% Male Race: NR 47% Dependent in 2 or more ADLs	Screened: NR Eligible: NR Enrolled: NR Analyzed for 2002: 11,334	NR	2002 62% reduction in hospital bed days 88% reduction in nursing home bed days 24% decrease in mean total cost of care (from $38k to $29k) 264% increase in all home care visits 2007 59% reduction in hospital bed days 89% reduction in nursing home bed days 21% reduction in 30-day hospital readmission	Poor

Author, Year	Study Design	Data Sources	Study Purpose/ Research Question	Location	Setting	Organizational Characteristics (of the organization providing HBPC)	Study Duration	Types of Service Provided	Services Provided on Evenings and Weekends	Provider Types and Roles	Duration of HBPC, Number of Visits, Frequency of visits	How HBPC is Funded	Inclusion Criteria
Beck, 2009	Pre/Post No comparison group	Program EMR Regional HIE that allowed utilization from 5 health care systems Program budges	Describe how House Calls for Seniors affected health care utilization	United States Indianapolis Indiana	Patient's home	Private health plan and academic geriatrics program	1999 to 2007	Initial assessment by geriatrician and social work followup visits Urgent visits Portable X-ray and electrocardiogram weekly team meetings	After hours telephone	Geriatric NP Social worker Nurse Patient service Assistant Practice Manager	Patients see a provider 9 times on average the first year	Healthcare system (62%) Provider billing (36%) Philanthropy (2%)	65 and older Live within Marion County Accept House Calls providers as their primary providers Accept Wishard Hospital as their primary hospital Be homebound according to the definition created by the team
Chang, 2009	Retrospective Review 6 months Before 6 months After HBPC	EMR data extraction	Describe how an interdisciplinary HBPC program affected hospital and ED use in an urban VA medical center	United States Washington DC	Patient's home	VA	January 1, 2001 - December 31, 2002	Pre-pour meds Draw blood Educate caregiver or home health on wound care Foley changes, home safety assessments and other evaluations Case management of VA - Medicare services such as subspecialty consults, pharmacy, prosthetics, home oxygen, respite, adult day care and home health aide services	Problems that occurred on evenings and weekends were triaged by phone by ED Nurses and physicians 911 called when indicated	NP served as primary care provider, while Registered Nurse performed routine nursing duties	At least monthly by a team member (physician, NP or registered nurse) Occasionally frequency of visits increased to weekly if indicated	VA	HBPC patients who were admitted to HBPC for at least 6 months Dependency in 2 or more ADLs Residence within 35 mile radius

Author, Year	Exclusion Criteria	Intervention Group or Groups	Comparators/ Comparison Group or Time Period	Outcomes Measured	Study Participants: Baseline Demographics	Screened Eligible Enrolled Analyzed Loss to Followup	Adverse Events Including Withdrawals	Results	Quality Rating
Beck, 2009	NR	Year After Enrollment	Year Before Enrollment	Healthcare Utilization	Mean Age: 80.2 Sex: (78.2% Female) Black: 63.5% White: 35.9% 71% impaired in at least one ADL 53% had a mini mental state score of 23 or less	Screened: NR Eligible: NR Enrolled: 468 Analyzed: 468	Of 48 withdrawals 19% transferred to SNF 73% died	No statistical tests reported ED visits Before 805 After 686 (14.7% decrease) Hospitalizations Before 330 After 356 (7.8% increase) Primary Care Before 1,111 After 193 House Calls for Seniors Before 187 After 4,073 Mental Health home visits Before 188 After 1,978 Specialty Care Before 1,100 After 696 Mean total charges $10,244 before $12,573 after (22.7% increase)	Fair
Chang, 2009	Patients with less than 6 months to live Patients who required visits more than weekly Patients under active investigations by Adult Protective Services Patients requiring in home nursing or home hospital services	HBPC	Same patients before HBPC	Hospital Admissions Hospitalized Days Emergency Department visits	Mean age; 73.6 Range: 36-95 Female: 8 (4.4%) African American: 130 (71.0%) Caucasian 53 (29.0%) <u>Common diagnosis</u> Hypertension: 140 (76.5%) Dementia: 118 (64.5%) Anemia: 104 (56.8%) Depression: 99 (54.1%) Urinary incontinence: 98 (53.6%) Degenerative joint disease/amputations: 84 (45.9%) Cerebral vascular accident: 75 (41.0%) Diabetes: 69 (37.7%) Coronary artery disease: 63 (34.4%) Other neurologic conditions (ALS, MS, TBI, epilepsy): 70 (38.3%)Pressure ulcers: 70 (38.3%) Chronic renal insufficiency: 44 (24.0%) Chronic obstructive pulmonary disease: 43 (23.5%) Percutaneous endoscopic gastrostomy tubes: 17 (9.3%) Methicillin-resistant Staphylococcus aureus: 15 (8.2%) Blind: 11 (6.0%) Home O2/Bilevel positive airway pressure/ventilator: 10 (5.5%) Indwelling Foley/Suprapubic catheter: 10 (5.5%)	Screened: NR Eligible: NR Enrolled: 183 Analyzed: 183	NR	Total number of ED visits Pre-HBPC: 130 HBPC: 106 Percent change: 18.5% Total number of hospitalizations Pre-HBPC: 126 HBPC: 71 Percent change: 43.7% Total number of days in hospital Pre-HBPC: 1033 HBPC: 518 Percent change: 49.9%	Good

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Cooper, 2007	Pre/Post No comparison group	National VA data	Describe the impact of the HBPC program in VA	United States	Patient's home	VA	First 3 quarters of fiscal year 2006	Assessment for health and social work care plan Revisions and reassessments weekly meetings	NR	NP or PA as PCP	Within 30 days and at least every 3 months	VA	Frail, chronically ill veterans who require the skills of an interdisciplinary healthcare team to cover their complex medical, social, rehabilitative, and behavioral care needs
Counsell, 2007	RCT	Project web tracking system EMR Patient Interviews Regional HIE	Test the effectiveness of a geriatric care management model on improving the quality of care for low-income seniors	United States Indianapolis Indiana	Patient's Home	Health Plan	January 2002 to August 2004	Initial Geriatric assessment Individualized care plan Medication management Physical Therapy Mental health social worker Community based services	NR	NP	Minimum of one in-home followup,one telephone or face-to-face contact per month Face-to-face home visit after any ED visit or hospitalization. Increased visits as deemed appropriate	Nina Mason Pulliam Charitable Trust and Wishard Health Services	Age 65 and older 1 visit to a primary care clinician at the same site within the past 12 months Income less than 200% of the federal poverty level

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Cooper, 2007	NR	HBPC enrollees	6 months prior to enrollment	Hospital admissions In patient days Patient satisfaction Disease management indicators	Mean age:76.7 years old Sex; 95.6% Male Race: NR Average of 19.36 diagnoses and 15 active medications 60% with cognitive impairment 42% being treated for depression	Screened: NR Eligible: NR Enrolled: NR Analyzed: 20,783	NR	27% reduction in hospital admissions 69% reduction in hospital days 98% rate care as excellent or good Hemoglobin A1C <8 78% Blood pressure <140/90 (with diagnosis of hypertension) 84% Low-density lipoproteins <100 (with diagnosis of acute myocardial infarction>8 weeks) 80% no p-value reported for any of the above	Poor
Counsell, 2007	Residence in a nursing home Living with a study participant already enrolled in another research study Receiving dialysis Severe hearing loss English-language barrier No access to a telephone Severe cognitive impairment Without an available caregiver to consent	Geriatric Resources for Assessment and Care of Elders (GRACE)	Access to all primary and specialty care services available as part of usual care	Medical Outcomes SF - 36 Activities of Daily Living ED Visits Hospitalizations at 6, 12, 18 and 24 months	Mean age Intervention Group: 71.8 (5.6)Control Group: 71.6 (5.8) Sex: Intervention Group: 75.5% Female Control Group: 76.5% Female Black Intervention Group: 57.6% Control Group: 62.4%	Screened: 2486 Eligible: 2237 Enrolled: 951 Analyzed: 951 in Primary Analysis Loss to Followup: 10.6% at 6 months	NR	SF-36 Scores at 24 months Improvements for intervention patients compared with usual care in 4 of 8 scale General health (0.2 vs. −2.3, p=0.045) Vitality (2.6 vs. −2.6, p=0.001) Social functioning (3.0 vs.−2.3, p=0.008) Mental health (3.6 vs. −0.3, p=0.001) A Mental Component Summary (2.1 vs. −0.3, p=0.001) No differences for ADLs No difference for death 2-year ED visit rate per 1000 Intervention group 1445 [n=474] vs. 1748 [n=477], p=0.03) Hospital admission rates (700 [n=474] vs. 740 [n=477], p=0.66). Subgroup at high risk of hospitalization ED visit in the second year (848 [n=106] vs. 1314 [n=105]; p=0.03 Hospital admission rates [n=106] vs. 705 [n=105]; p=0.03	Good

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De Jonge, 2014	Cohort study	Medicare claims data	To determine the effect of home-based primary care on Medicare costs and mortality in frail elders	United States District of Columbia Washington	Patient's home	Medicare fee for service arena	2004 to 2008	Case Management Follow patients in hospital and home Social work	On call telephone coverage 24-7	Physician NP Social Workers Licensed Practical Nurses	Physician performs initial visit and visits every 3 to 4 months NPs make frequent visits ranging from every 8 weeks to several times a week depending on medical necessity	Medicare	Age 65 and older and without HMO coverage during the month of enrollment and for 3 months before. Medicare SNF Stay, but not long term care
Edes, 2014	Cost projections using a hierarchical condition category model	Medicare claims data VA 2005-2007 Decision Support System National Data Extract	Assess the impact of HBPC on all federal costs (VA and Medicare) for enrollees	United States	Patient's home	VA	October 1 2005 to September 30, 2006	Unified Care Plan Medication Reconciliation Caregiver Training Attending to people at home	NR	Interdisciplinary team, including a physician, nurse, social worker, rehabilitation therapist (dietitian, psychologist, andpharmacist. In addition to these required disciplines, many programs include a midlevel provider (nurse practitioner, physician assistant) and other providers such as chaplains and recreational therapists	2.9 visits per month on average	VA	Individuals with complex, chronic disabling disease for whom routine clinic-based care is often not effective

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De Jonge, 2014	Lack of Medicare FFS Eligibility Residence in Nursing Home Died during the index month	HBPC	Matched Controls	Medicare costs Mortality Hospital admissions SNF Care ED Visits	Mean Age: 83.7 2.4% under 65 HBPC 82.0 Controls Sex: 76.7% Female – HBPC 76.7% Female Controls African American 90.2% HBPC 90.3% Controls Caucasian 7.1% HBPC 7.1% Controls Other 2.8% HBPC2.6% Controls Selected major chronic conditions Alzheimer's disease or chronic mental illness	Screened: NR Eligible: 722 Enrolled: 722 Analyzed: 2983 HBPC: 722 Controls: 2161	NR	HBPC Controls Total Medicare Costs during mean followup $44,455 vs. $50,977 p=0.001 Difference in costs due to cases with high frailty index HBPC 9% fewer hospitalizations p=0.00110% fewer ED visits p=0.00127% Fewer SNF days p=0.00123% Fewer specialist visits p=0.001105% more generalist visits p<0.001 Mortality during followup period HBPC (40%) Controls (36%) hazard ratio=1.06, p=0.44	Good
Edes, 2014	Not episodic care	VA HBPC enrollees actual expenses	VA enrollees projected expenses	Projected Costs for VA and Medicare Hospital days Hospital admissions Skilled Nursing Days	Mean Age: 77.7 Sex: 96% Male Race: NR 69% Dependent in two or more ADLs Interviews were with 17 veterans, 14 caregivers and 64% of caregivers had medical problems	Screened: NA Enrolled: 9,425 Analyzed: 9,425 (HBPC only) and 6,951 (HBPC and Medicare) Loss to followup: NR 31 veterans and caregivers	No veterans or caregivers reported any perception of restriction of services from HBPC.	Change from 6 months before to 6 months during HBPC Medicare hospital days -7.8 (95% CI -8.4 to -7.1; Before 4,511 After 4,161) p<.0001 Medicare SNF days 0.6 (95% CI 0.4 to 0.7; Before 5,559 After 5,594) p=0.68 Total Medicare costs per patient -10.8 (95% CI -11.5 to -10.1; Before 4,025 After 3,590) p<0.001 VA hospital days -51.1 (95% CI -52.3 to -49.9; Before 8,877 After 4,339) p<0.001 Total VA costs per patient -28.1 (95% CI -29.2 to -27.1; Before 19,234 After 13,822) p<0.001 VA+Medicare hospital admissions per 100 patient-months-25.5 (95% CI -26.5 to -24.5; Before 15.7 After 11.7) p<0.001 VA+Medicare hospital days -36.5 (95% CI -37.6 to -35.4; Before 13,388 After 8,500) p<0.001	Good

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Edwards, 2014 Study of HBPC and Hospitalizations in Diabetes Patients	Retrospective Cohort Study	VA data Medicare claims	To characterize the association between enrollment in HBPC and hospitalizations owing to an ambulatory care-sensitive condition among older veterans with diabetes mellitus.	VA Data from across the US	Patient's home	Veterans Affairs	2006 - 2010	NR	Physicians Nurses Social Workers Psychologists Rehabilitation Therapists Dieticians Pharmacists	Varied, 2 HBPC encounters required for inclusion	Medicare

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Edwards, 2014 Study of HBPC and Hospitalizations in Diabetes Patients	Age 67 or older Fee for service Medicare beneficiaries At least 1 hospitalization in baseline year Diabetes At least one other chronic disease Primarily use a VA Medical Center Received a Diabetes prescription through VA	Lived farther than 500 miles from the nearest VA facility that provides HBPC	A minimum of 2 HBPC encounters during followup period, with first HBPC encounter occurring within 6 months of the baseline year	No HBPC, used Veterans Affairs facilities	Hospitalizations for ambulatory care-sensitive conditions (ACSC)	HBPC vs Not HBPC Mean Age 79.1 vs 77.1 %Female 2.6% vs 1.5% %White 76.1 vs. 86.2 % Black 20.8 vs 10.9 % Other 3.1 vs 3.0 Diabetes Complications Severity Index Mean 4.8 vs. 4.2	Screened: n=462,039 Eligible: HBPC n=1978 No HBPC n = 54630 Enrolled: HBPC n=1978 No HBPC n = 54630 Analyzed: HBPC n=1978 No HBPC n = 54630 Loss to Followup: n=NA	NR	HBPC Compared to Non HBPC Hazard ratio for Hospitalizations 0.71; 95% CI, 0.57-0.89) 5.8% absolute reduction in hospitalization for HBPC Patients (from 28.2% to 22.4%)	Good

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Hughes, 2000	RCT	VA national data files Medicare data Patient self-report	To assess impact of Team Managed HBPC on functional status, health related quality of life, satisfaction with care and cost of care	United States 16 VA medical centers with HBPC	Patient's Home	VA	October 1994 to September 1998	Target care to high risk patients Designate primary care manager within team 24 hour contact Prior approval of hospital readmissions Transfer stable readmitted pts to step down beds HBPC Participation in discharge planning	NR	Primary Care Manager Physician	Sites used clinical judgment to provide visits based on patient condition and need Mean 5.6 months; median4.5 months in HBPC in intervention group	VA	2 or more ADLs impairments or prognosis of a terminal illness or were homebound with a primary diagnosis of congestive heart failure or COPD Lived within 35 mile catchment area

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Hughes, 2000	Patients with primary diagnosis of psychiatric illness, alcoholism, substance abuse, or spinal cord injury	Team Based HBPC for as long as needed until maximum patient benefit was achieved or until a different level of care was required	Customary VA and private sector care	Patient Functional Status Patient and caregiver satisfaction Caregiver burden Hospital readmissions Costs over 12 months	Mean Age HBPC 70.4 (10.3) Control 70.4 (10.3) Female HBPC 83.3 Control 83.6 White - HBPC 62.8 Control 64.2 Black - HBPC 29.7 Control 28.3 Other HBPC 7.5 Control 7.5 Terminally ill - HBPC 20.7 Control 20.1 Severely disabled - HBPC 75.1 Control 74.4 Congestive Heart Failure - HBPC 1.4 Control 1.6 Chronic obstructive pulmonary disease - HBPC 2.8 Control 3.9	Screened NR Eligible 2202 Enrolled 1966 Analyzed: 1704 at 1 monthn 1309 at 6 months 667 at 1 year Loss to follow up:13.3% at 1 month 33.1% at 6 months 66.1% at 1 year	Died 340 of 981 in HBPC group 336 of 985 in control group	Results reported by treatment group and by terminal (n=188) vs. nonterminal patients (n=906) Functional Status: no significant difference QOL: terminal patients in HBPC group had better scores Nonterminal: no significant difference Patient satisfaction: terminal patients no significant difference Nonterminal patients: HBPC group significantly better 5- to 10-point increases in 5 of 6 dimensions Caregiver Most caregiver outcomes favor the treatment group HBPC group improved in HRQOL $p<0.05$ VA Hospital Readmissions Relative reduction in the proportion readmitted patients admitted in the first 6 months, not sustained at 12 months 7.9% (HBPC 49.2% Control 53.4%) $p=0.07$ Relative reduction in the number of readmissions of HBPC patients admitted in the first 6 months, not sustained at 12 months 11% (HBPC 0.8 Control 0.9) $p=0.06$ Relative reduction in mean number of HBPC the nonterminal, severely disabled subgroup readmissions at 6 months not sustained at 12 months 22% (HBPC 0.7 Control 0.9) $p=0.03$ Relative reduction in mean number of HBPC readmissions at 6 months in the terminal, CHF or COPD subgroups No differences in 6 or 12 months Overall Costs Total costs: 12.1% higher for HBPC (HBPC 31,401 Control 28,008) $p=0.005$	Fair

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Neergaard, 2009 and Neergaard, 2010	Retrospective Cohort	Register data and physician questionnaires	Examine association between home death and palliative care including GP home visits	Denmark	Patient's home	The National Healthcare System for Denmark	9 months in 2006 (March 1 to November 30)	GP Home visits Palliative Care	Community Nurses available 24 hours for visits or phone	GP Community Health Nurses Specialist Palliative visiting teams	NR	National HealthCare system, GP received special fee for involvement in palliative care	Adults in Aarus county who died from cancer during the study period
Nichols, 2011	Prospective Pre-Post No comparison group	Assessment and questionnaires	Effectiveness of dementia caregiver support	United States 24 VA facilities	Patient's home and telephone	VA	6 months	Education Support Skill training to address 5 caregiving risk factors: safety, social support, problem behaviors, depression and caregiver health	NR	Intervention was performed by non PCP member of HBPC team	Nine 1 hour individual home sessions three .5 hour individual home sessions Five 1 hour monthly support group sessions	VA	Caregivers providing 4 or more hours of assistance per day for at least 6 months and enduring at least 2 caregiving stress behaviors Patient inclusion - Alzheimer disease or related dementia and at least 1 ADL limitation or 2 or more instrumental activities of day living limitation

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Neergaard, 2009 and Neergaard, 2010	Noncancer deaths	Patients who received GP home visits	Patients who did not receive GP home visits	Home death	Mean age: 69.4 Sex: 45.6 Female Race: NR	Screened: NR Eligible: 599 Enrolled: 599 Analyzed: 333 (63.2%) for other GP characteristics	NR	Median number of GP home visits: 3 Prevalence Ratios (PRs) Home death, with 0 home visits as reference group any visits PR 4.3 (95% CI 1.2-14.9)3 or more PR 6.9 (95% CI 2.0-23.4)4 or more PR 6.1 (95% CI 1.8- 20.0) Involvement of community nurse	Fair
Nichols, 2011	Patients to ill (bed bound with severe dementia) 3 hospitalizations in past year Planned institutionalization	After Intervention	Before Intervention	Caregiver Improved Skills Increased Knowledge	Caregivers/ Intervention Recipients Age: 83.4 (6.2) Female .9 White 78.0	Screened: NR Eligible: NR Enrolled: 127 Analyzed: 105 at 6 months for burden 98 for survey Loss to followup: 29 (22.8%)	In lost to followup Veterans placed in nursing home n=4	Caregiver measure Improvement 95% CI (p-value) Significant Burden: 2.88 (0.86) 1.17 to 4.59 (0.001) Effect size 0.33 Depression: 1.49 (0.55) 0.39 to 2.59 (0.009) Effect size 0.26 Depression impact: 0.29 (0.11) 0.07 to 0.51 (0.01) Effect size 0.26 Behaviors: 1.02 (0.49) 0.04 to 2.00 .04 Effect size 0.20 Caregiving frustrations: 0.26 (0.09) 0.09 to 0.44 (0.003) Effect size 0.30 Time on duty, h: 1.75 (0.92) −0.09 to 3.58 (0.06) Effect size 0.15 Not Significant General health: 0.13 (0.12) −0.11 to 0.37 (0.27) Effect size 0.11 Health behaviors: 0.20 (0.20) −0.19 to 0.59 (0.30) Effect size 0.10 Safety: 0.06 (0.13) −0.20 to 0.32 (0.65) Effect size 0.04 Social support: 0.11 (0.18) −0.25 to 0.46 (0.56) Effect size 0.06 Bother with behaviors: −0.18 (0.63) −1.43 to 1.08 (0.78) Effect size 0.03 Caregiving difficulties: 0.12 (0.18) −0.24 to 0.48 (0.51) Effect size 0.07 Time providing care, h: 0.96 (0.63) −0.29 to 2.20 (0.13) Effect size 0.15	Fair

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North, L., 2008	Pre/Post No comparison group	Management databases of performance indicators Patient phone interviews VA cost data	HBPC impact on Hospitalizations and ED visits	United States Denver Colorado	Patient's Home	VA	December 30, 2002 through December 31, 2003	Provide access to primary medical care Maximize independence and function Provide adequate ED and hospital stays Enhance safety and quality of life	NR	NP Dietitians Occupational Therapists Medical social services Pharmacists Home health services Home delivered meals Transportation Services	Home visit frequency is determined by the veteran's health and functional status at any given time, but patients are seen at least monthly	VA	HBPC at least 12 months Received care at Denver VA at least 12 months prior to HBPC enrollment
Ornstein, 2009	Prospective Pre/Post No comparison group	Caregiver interviews by phone or in person	Impact of HBPC on caregiver burden and their unmet needs	United States Manhattan New York	Patient's Home	Mount Sinai Visiting Doctors Program	April 2001 to April 2002	Initial visit by PCP Followup PCP visits every 2 to 8 weeks depending on severity of illness Coordination of all aspect of care Initial Social Work assessment/ home visit, social work followup according to plan for patient	On call PCP or resident is available	PCP could be MD or NP	Every 2 to 8 weeks based on severity	Medicaid and some private insurance	Patient had to be new admission to HBPC program during period and alive at time of interview Caregiver has to be the primary caregiver Able to complete interview in English or Spanish

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North, L., 2008	NR	During HBPC	Before HBPC	HospitalizationED visits Clinic no shows	Average age 80 Sex: (7% Female) White 59% Cardiovascular Disease Diabetes COPD Dementia Musculoskeletal	Screened: NR Eligible: NR Enrolled: 104 Analyzed: 104	NR	Hospitalizations - Pre 822 Post 135 - 84% decrease ED Visits - Pre 166 Post 86 - 48% decrease No Show - Pre 206 Post 112 - 26% decrease	Poor
Ornstein, 2009	If patient died before interview caregiver was not included Caregiver exclusions Severe hearing limitations Participant in pilot or study for another patient or being investigated for abuse or neglect	Mount Sinai Visiting Doctors Program	Baseline to 9 month followup	Unmet Needs Scale Caregiver Burden Inventory Level of Care Index	Caregiver Mean age: 55 Sex: 78.6% Female White 32% Patient Mean Age 78 Range 36 to 101	Screened: 212 Eligible: 127 Enrolled: 114 baseline Eligible at 9 months: 72 Analyzed: 56 Loss to followup: 16 (51%)	NR	Change in Percent Needing Assistance baseline to 9 months, (p-value) Financial: –12.5 Before 37.5 After 25 (0.071) Housing: –3.6 Before 39.29 After 35.71 (0.527) Employment: –3.6 Before 16.1 After 12.5 (0.414) Health insurance: –3.6 Before 17.9 After 14.3 (0.500) Transportation: –19.7 Before 26.8 After 7.14 (0.001) Home care: –12.5 Before 53.6 After 41.1 (0.162) Daily chores: –26.8 Before 41.1 After 14.3 (<0.001) Medical information: –10.7 Before 25 After 14.3 (0.083) Medical staff availability: –7.2 Before 16.1 After 8.9 (0.248) Emotional problems: –10.7 Before 35.7 After 25 (0.058) Family problems: –1.8 Before 16.1 After 14.3 (0.701) Spiritual or religious needs: –7.1 Before 10.7 After 3.6(0.056) Change in Caregiver Burden baseline to 9 months: Time burden: –0.89 Before 11.27 After 10.38 (0.053) Developmental burden: –0.43 Before 9.3 After 8.89 (0.285) Physical burden: –1.90 Before 7.86 After 5.96 (0.006) Social burden: –0.625 After 4.41 After 3.79 (0.127) Total burden: –3.84 Before 32.84 After 29 (0.017)	Poor

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Ornstein, 2011	Prospective Pre/post No comparison group	Billing department data Provider focus groups	Transition of Care Program	United States New York	Patient's Home	Mount Sinai Visiting Doctors Program	Before Period January 1, 2004 - May 30, 2006 After Period September 1 2006 - December 31, 2008	Focused physical examination Medication reconciliation Appropriateness of home care services Adequacy of patient caregiver education	Transition care not available on weekends; normal HBPC included 24 hour coverage	NP for transition PCP and other HBPC team stayed the same	Contact with hospital staff during admission Visit with patient during admission Initial visit within 3 weeks of discharge Once every 6- 8 weeks	NR	Patient in Mount Sinai Visiting Doctors ProgramHospital Admission
Ornstein, 2013	Prospective Pre/post No comparison group	Collected by physician during visit and research assistant over the phone	Transitional Care within HBPC	United States Manhattan New York	Patient's Home	Mount Sinai Visiting Doctors Program	September 2008 to February 2010	Ongoing chronic disease management Palliative care End of life care Treatments are at the discretion of each provider	Contact the on call physician	PCP Social Worker Nurses Specialists if needed	Initial visit and then every 2 to 12 weeks depending on the severity of the illness	NR	Living in Manhattan above 59th Street age> 18 Medicare Homebound Definition Report at least one symptom

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Ornstein, 2011	No Hospital Admission	During Enrollment in the program	Before enrollment in program	Hospital Admissions Length of Stay 30 Day Readmissions Case Mix Index Direct Costs	Mean Age: 81.1 (s.d. 13.8) Sex: 72.7% Female White 178 (33.5) Black 157 (29.6) Latino 172 (32.4) Other 23 (4.3)	Screened: 1,464 Eligible: 532 Enrolled: 532 Analyzed: 530 (Note: this is patients, for some outcomes the unit is hospitalizations and a patient may have more than one)	NR	Length of Stay Before 6.5 days During 6.45 days p=0.0930-day Rehospitalization Before 6.23 During 6.83 p=0.05 Net revenue, $, median (IQR) 9,753 (7,945–14,684) 10,807 (8,174–15,832) p<0.001 Direct care costs, $, median (IQR) 3,245 (1,977–5,834) 3,699 (2,389–6,703) p<0.001 Indirect cost, $, median (IQR) 666.5 (399–1,199) 740 (466–1,355) p<0.001 Contribution to margin, $, median (IQR) 5,658 (3,308–8,408) 5,940 (3,543–9,034) p=0.34 Revenue and Costs increased resulting in a nonsignificant impact	Fair
Ornstein, 2013	Death Being ambulatory Not requiring home based care Placement in nursing home	3 and 12 weeks after enrollment	Before enrollment in program	Pain Depression Loss of appetite Anxiety Tiredness	Majority of patients more than 80 (73%) Sex: 75% Female White: 54 (39%) Latino: 41 (29%) Black: 35 (25%) Asian: 3 (2%) Other: 2 (1%) Missing: 5 (4%) Dementia: 64 (46%) CHF: 18 (13%) COPD: 7 (5%) Depression: 43 (31%) Cancer: 19 (14%)	Screened: Eligible: 267 Enrolled: 140 Analyzed: 140 (Note: n vary by symptom) Loss to followup: 48%	NR	Reduction in Moderate to Severe Symptom Burden % symptom free Pain: 3 weeks 25% 12 weeks 27.08% Depression: 3 weeks 57.8% 12 weeks 50% Loss of Appetite: 3 weeks 20.69% 12 weeks 24.49% Anxiety: 3 weeks 58.62% 12 weeks 59.26% Tiredness: 3 weeks 45.10% 12 weeks 47.5%	Fair

Author, Year	Study Design	Data Sources	Study Purpose/ Research Question	Location	Setting	Organizational Characteristics (of the organization providing HBPC)	Study Duration	Types of Service Provided	Services Provided on Evenings and Weekends	Provider Types and Roles	Duration of HBPC, Number of Visits, Frequency of visits	How HBPC is Funded	Inclusion Criteria
Rosenberg, 2012	Retrospective Pre/Post No comparison group	Abstraction from Electronic chart, Practice Profile	To evaluate the effect of medical Primary Integrated Interdisciplinary Elder Care at Home (PIECH) on acute hospital use and mortality in a frail elderly population	Victoria British Columbia Canada	Patient's home	Provincial Healthcare System	May 1, 2010 - April 30, 2010 (and year prior to enrollment)	Comprehensive geriatric assessment Clinical case management Primary medical care Joint injection Cryotherapy Skin biopsies Long term planning Acute hospital and discharge planning	Family doctors from local clinics provided after-hours telephone coverage. Individuals were free to go to walk-in clinics. HBPC program did not provide coverage.	Physician Nurse Physiotherapist	Physician saw patients every 2 to 3 months. Nurses saw them monthly. Care in the home fluctuated depending on needs.	Provincial Government and Private Practice Fee	Age 75 or older Difficulty getting to physician's office Complex medical or functional problems Living in geographic catchment area Transfer primary medical care
Wajnberg, 2010	Retrospective Chart Review Pre/post No comparison group	Medical (paper) and billing records Clinical assessment	To evaluate the effect of an urban house calls program on healthcare utilization	United States New York	Patient's home	Health Plan	October 2004 to August 2006	Initial Assessment within 2 weeks of referral Blood draws as needed. Wound care by nursing services Some x-rays in the home Podiatry visits Patients travel to any specialty needs	NR	Primary Care Physician NP Social Worker Nursing services	After the initial assessment NP sees patient monthly and Primary Care Physician every 3 months Median days enrolled: 198 Range: 32 - 368 At least 30 days of followup in the program	Montefiore Medical Center Care Management Company a capitated insurance program	Medicare definition of homebound Able to leave home only with great difficulty and short duration

Author, Year	Exclusion Criteria	Intervention Group or Groups	Comparators/ Comparison Group or Time Period	Outcomes Measured	Study Participants: Baseline Demographics	Screened Eligible Enrolled Analyzed Loss to Followup	Adverse Events Including Withdrawals	Results	Quality Rating
Rosenberg, 2012	Enrolled less than 1 year	Most recent 12 month period	Year prior to entering program	Acute hospital Admissions ED contacts Reason for leaving practice Site of death	Mean Age: 86.7 Sex: 71.7% Female Race: NR Frailty Scale Mean 5.4 (high is 7)	Screened: 306 Eligible: 248 Enrolled: 248 Analyzed: 198 Lost to followup: 20.2%	NR	Change pre to post Hospital admissions: -59.5 (Pre 84 Post 34) p<0.001 Hospital days: -61.7 (Pre 1,197 Post 459) p=0.004 ED visits: -9.8 (Pre 90 Post 82) p=0.66	Fair
Wajnberg, 2010	Unavailable charts or no record of HBPC	HBPC	Before enrollment in program	Hospital Admissions Skilled Nursing Facility Admissions	Mean Age: 79.0 (s.d.10.6) Female: 70% Male Black: 87 (49) White: 46 (26) Hispanic: 21 (12) Other: 25 (14) <u>Diagnoses, n (%)</u> Congestive heart failure: 46 (26) Diabetes mellitus: 78 (44) Dementia: 60 (34) Depression: 40 (22) Arthritis: 99 (55) Coronary artery disease 36 (20) Anticoagulation (warfarin) 24 (13) COPD or asthma 44 (25) History of stroke 40 (22) History of falls 25 (14)	Screened: NR Eligible: 210 Enrolled: 179 Analyzed: 179	NR	Patients with ≥1 hospitalizations Before Enrollment: 110 (61) After enrollment: 178 (38) p= <0.001 Patient with ≥ 1 Skilled Nursing Facility Admissions Before Enrollment: 63 (35) After Enrollment: 33 (18) p=0.001	Fair

Please see Appendix B. Included Studies for full study references.

ADL = Activities of daily living, CHF = congestive heart failure, CI = confidence interval, COPD = chronic obstructive pulmonary disease, ED = emergency department, FFS = fee for service, GP = general practitioner, HBPC = home-based primary care, IADL = Instrumental Activities of Daily Living, NP = Nurse Practitioner, NR = not reported, OR = odds ratio, PA = physician assistant, PCP = primary care provider, QOL = quality of life, RN = registered nurse, RCT = randomized controlled trial, SD = standard deviation, SNF = skilled nursing facility, TD = terminal declaration, VA = Veterans Affairs

Appendix F. Quality Rating

Table F-1. Randomized controlled trials quality rating

Author, Year	Was the randomization method adequate?	Was the allocation concealment adequate?	Were groups similar at baseline or did the analysis control for any important baseline differences?	Were outcome assessors blinded to the patient group? Or are primary outcome measures unlikely to be biased?	Did the study rule out or control for impact from unintended exposures or concurrent interventions that might bias results?	Are there no concerns about bias due to attrition? Where comparable groups maintained?
Hughes, 2000	NR	Yes	Yes	Yes	No	No
Counsell, 2007	Yes	Yes	Yes	Yes	Yes	No

Author, Year	Was fidelity to the intervention adequate?	Were valid and reliable measures of outcomes and confounders used and implemented consistently across all study participants/groups?	Was intention to treat analysis used? Was the method for handling missing data appropriate?	Were the potential outcomes prespecified and were all the prespecified outcomes reported?	Funding Source	External Validity	Quality Rating
Hughes, 2000	No	Yes	Yes	Yes	Department of Veterans Affairs	VA, predominately male population	Fair
Counsell, 2007	Yes	Yes	Yes	Yes	Grant: R01 AG20175 from the National Institute on Aging, National Institutes of Health		Good

Please see Appendix B. Included Studies for full study references.

Table F-2. Observational studies quality rating

Author, Year	Was the selection of comparison groups or time periods adequate? Were inclusion and exclusion criteria applied uniformly across groups or time periods?	Were groups similar at baseline or did the analysis control for any important baseline differences?	Were outcome assessors blinded to the patient group? Or are primary outcome measures unlikely to be biased?	Did the study rule out or control for impact from unintended exposures or concurrent interventions that might bias results?	Are there no concerns about bias due to attrition? Where comparable groups maintained?	Was fidelity to the intervention adequate?
Aabom, 2006	Yes	Yes	Yes	No	NA (retrospective)	Yes
Anetzberger, 2006	Unclear	NA	No	No	No	Unclear
Beales, 2009	Yes	Yes	Yes	No	No	Unclear
Beck, 2009	Yes	No	Yes	No	No	Yes
Chang, 2009	Yes	Yes	Yes	No	Yes	Yes
Cooper, 2007	Yes	Yes	Yes	No	Yes	Unclear
De Jonge, 2014	Yes	Yes	Yes	Unclear	Yes	Yes
Edes, 2014	Yes	Yes	Yes	No	Yes	Unclear
Edwards, 2014	Yes	No	Yes	No	Yes	Unclear
Neergaard, 2009 Neergaard, 2010	Yes	Yes	Yes	No	No 63.2% response rate	Unclear
Nichols, 2011	Yes	NA	No	No	No	Yes
North, 2008	Yes	Yes	Yes	No	No	Unclear
Ornstein, 2009	Yes	NA	No	No	No	Yes
Ornstein, 2011	Yes	Yes	Yes	Unclear	Yes	Yes
Ornstein, 2013	Yes	NA	No	No	No	Yes
Rosenberg, 2012	Yes	NA	Yes	No	No	Yes
Wanjberg, 2010	Yes	NA	Yes	No	No	Yes

Author, Year	**Were valid and reliable measures of outcomes and confounders used and implemented consistently across all study participants/groups?**	**Was intention to treat analysis used? Was the method for handling missing data appropriate?**	**Were the potential outcomes prespecified and were all the prespecified outcomes reported?**	**Funding Source**	**External Validity/Applicability Considerations**	**Quality Rating**
Aabom, 2006	Yes	Unclear	Yes	Health Insurance Foundation, Danish Research Foundation for General Practice, Danish College of General Practitioners' Research Scholarship	Cancer patients from one region of Demark in a registry	Fair
Anetzberger, 2006	Yes	No	Yes	Grants from the Abington, Bruening, Cleveland, Saint Luke's, and Sisters of Charities Foundations.	Pilot project by one agency in Cleveland, OH	Poor
Beales, 2009	Unclear	Unclear	Unclear	Department of Veterans Affairs	VA, predominately male population	Poor
Beck, 2009	Yes	No	Yes	National Institute on Aging awards K24-AG026770-01 and P30AG024967	One program in a comprehensive academic health center senior care program	Fair
Chang, 2009	Yes	Yes	Yes	Department of Veterans Affairs	VA, predominately male population, single VA Medical Center	Good
Cooper, 2007	Unclear	Unclear	Yes	VHA	VA, predominately male population	Poor
De Jonge, 2014	Yes	Yes	Yes	Deerbrook Charitable Trust	VA, predominately male population	Good
Edes, 2014	Yes	Yes	Yes	Geriatrics & Extended Care, Office of Clinical Operations & Management, Veterans Health Administration; Intel Corporation; and the Memphis VA Medical Center	VA, predominately male population	Good
Edwards, 2014	Yes	NA	Yes	Department of Veterans Affairs	VA, predominately male population	Good
Neergaard, 2009 Neergaard, 2010	Yes	NA	Yes	Aarhus County Research fund for Clinical Development and Research in General Practice and Danish National Research Foundation for Primary care	Cancer patients in a single county in Denmark	Fair
Nichols, 2011	Yes	No	Yes	VA Patient Care Services	VA, predominately male population; multiple VA sites	Fair
North, 2008	Yes	Unclear	No	Department of Veterans Affairs	VA, predominately male population, single VA Medical Center	Poor

Author, Year	**Were valid and reliable measures of outcomes and confounders used and implemented consistently across all study participants/groups?**	**Was intention to treat analysis used? Was the method for handling missing data appropriate?**	**Were the potential outcomes prespecified and were all the prespecified outcomes reported?**	**Funding Source**	**External Validity/Applicability Considerations**	**Quality Rating**
Ornstein, 2009	Yes	NA	Yes	NR	Single, large HPBC program in an urban area	Poor
Ornstein, 2011	Yes	Unclear	Yes	Fan Fox and Leslie R. Samuels Foundation	Single, large HPBC program in an urban area	Fair
Ornstein, 2013	Yes	No	Yes	Y.C. Ho/Helen and Michael Chiang Foundation	Single, large HPBC program in an urban area	Fair
Rosenberg, 2012	Yes	Unclear	Yes	Publically funded by the provincial government, BC and Victoria, Canada	Single program in Victoria, BC	Fair
Wanjberg, 2010	Yes	Unclear	Yes	No sponsor	Single, large HPBC program in an urban area	Fair

Please see Appendix B. Included Studies for full study references.

Appendix G. Strength of Evidence

Table G-1. Strength of evidence by outcome

Key Question Outcome	Number of Studies	Study Limitations (High, Medium, Low)	Directness (Direct, Indirect)	Consistency (Consistent, Inconsistent, Unknown)	Precision (Precise, Imprecise)	Reporting Bias (Suspected or undetected)	Strength of Evidence/ Grade (High, Moderate, Low,
***Key Question 1:** Among adults with chronic conditions that are serious or disabling, what are the effects (positive and negative) of home-based primary care interventions on:*							
Health outcomes							
Function	3	High	Direct	Inconsistent	Imprecise	Undetected	Low
Symptoms	1	Medium	Direct	Unknown	Imprecise	Undetected	Insufficient
Mortality	2	Low	Direct	Inconsistent	Imprecise	Undetected	Low
Patient and caregiver experience							
Satisfaction	3	High	Direct	Consistent	Imprecise	Undetected	Low
SF-36/Quality of Life	2	Medium	Direct	Inconsistent	Imprecise	Undetected	Low
Caregiver Burden/Needs	2	High	Direct	Consistent	Imprecise	Undetected	Low
Utilization of services							
Hospitalization	11	Medium	Direct	Consistent	Precise	Undetected	Moderate
Hospital Bed Days	6	Medium	Direct	Consistent	Precise	Undetected	Moderate
Hospital Readmissions	3	High	Direct	Inconsistent	Imprecise	Undetected	Low
Emergency Department	6	Medium	Direct	Inconsistent	Precise	Undetected	Low
Nursing Home Admissions	1	Medium	Direct	Unknown	Precise	Undetected	Insufficient
Nursing Home Days	3	Medium	Direct	Inconsistent	Precise	Undetected	Insufficient
Specialty Visits	2	Medium	Direct	Consistent	Imprecise	Undetected	Low
Costs	6	Medium	Indirect	Consistent	Imprecise	Undetected	Low
Negative unintended consequences/harms	1	High	Indirect	Unknown	Imprecise	Undetected	Insufficient
***Key Question 2:** How do the effects of home-based primary care interventions differ across:*							
Patient characteristics: severity of illness or frailty	4	Low	Direct	Consistent	Precise	Suspected	Moderate
Organizational characteristics	0	–	–	–	–	–	Insufficient
***Key Question 3:** Which characteristics of home-based primary care interventions are associated with effectiveness?*							
Caregiver support	1	Medium	Direct	Unknown	Precise	Undetected	Insufficient

Transitional care	1	Medium	Direct	Unknown	Precise	Undetected	Insufficient
Primary care home visits and palliative care at end of life	2	Medium	Indirect	Consistent	Imprecise	Undetected	Low
Others program components	0	–	–	–	–	–	Insufficient