Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Geriatric Nursing 41 (2020) 962–969

Contents lists available at ScienceDirect

Geriatric Nursing

journal homepage: www.gnjournal.com

Feature Article

The outcomes of nurse practitioner (NP)-Provided home visits: A systematic review

Zainab Toteh Osakwe, PhD, MSN, NP[a,*], Sainfer Aliyu, RN, PhD[b], Olukayode Ayodeji Sosina, MSc[c], Lusine Poghosyan, RN, PhD, MPH, FAAN[d]

[a] Adelphi University College of Nursing and Public Health, 1 South Avenue, Garden City, New York 11530, United States
[b] Washington Hospital Center. 110 Irving Street, NW. Washington, DC 20010, United States
[c] Johns Hopkins Bloomberg School of Public Health, 615 North Wolfe Street, Baltimore, MD 21205, United States
[d] Columbia University, School of Nursing, 560W 168th St, New York, New York 10032, United States

ARTICLE INFO

Article history:
Received 27 March 2020
Received in revised form 1 July 2020
Accepted 6 July 2020
Available online 24 July 2020

Keywords:
Homebound Older Adult
Nurse Practitioners
Home Visits
Medicare Homebound
House Calls

ABSTRACT

Background: With the shortage of primary care providers to provide home-based care to the growing number of homebound older adults in the U.S. Nurse Practitioners (NPs) are increasingly utilized to meet the growing demand for home-based care and are now the largest type of primary care providers delivering home-visits.
Purpose: The purpose of this study was to systematically examine the current state of the evidence on health and healthcare utilization outcomes associated with NP-home visits.
Method: Five Databases (PubMed, EMBASE, Cumulative Index to Nursing and Allied Health Literature and the Cochrane Library) were systematically searched to identify studies examining NP-home visits. The search focused on English language studies that were published before April 2019 and sought to describe the outcomes associated with NP-home visits. We included experimental and observational studies. Quality appraisal was performed with the Kmet, Lee & Cook tool, and results summarized qualitatively. The impact of NP-home visits on clinical (functional status, quality of life [QOL]), and healthcare utilization (hospitalization, Emergency department(ED) visits) outcomes was evaluated.
Results/Discussion: A total of 566 citations were identified; 7 met eligibility criteria and were included in the review. The most commonly reported outcomes were emergency department (ED) visits and readmissions. Given the limited number of articles generated by our search and wide variation in intervention and outcomes measures. NP-home visits were associated with reductions in ED visits in 2 out of 3 studies and with reduction in readmissions in 2 out of 4 studies.
Conclusion: Published studies evaluating the outcomes associated with NP-home visits are limited and of mixed quality. Limitations include small sample size, and variation in duration and frequency of NP-home visits. Future studies should investigate the independent effect of NP-home visits on the health outcomes of older adults using large and nationally representative data with more rigorous study design.

Introduction

Over two million older adults in the United States are homebound and have great difficulty living in their home independently.[1] Homebound older adults have medical and psychiatric illness, higher functional limitations, symptom burden and mortality compared to non-homebound older adults.[1-4] These individuals also have poor clinical outcomes, including high hospitalization and emergency room visits.[5,6] Despite being a fragile population, many homebound patients have inconsistent access to office-based care, often only receiving care for medical emergencies.[5,7] Because of their multiple chronic co-morbidities and functional impairments, homebound patients are among the most costly group of patients in the U.S healthcare system accounting for more that 30 percent of Medicare expenditure.[8-11]

A few modes of "home-based" healthcare services have been developed to meet the needs of homebound patients, from home health care which provides episodic skilled nursing, therapy and home health aide services,[12] to the provision of primary care at home.[13] Home-based medical care (HBMC) is one of such services. HBMC provides primary, urgent or palliative care to homebound patients by bringing the provider into the home.[14] Nurse practitioners (NPs) and physicians are the most common providers of HBMC services in the U.S.[15] Common models of HBMC are home-based primary care (HBPC), home based palliative care and

*Corresponding author.
E-mail addresses: zosakwe@adelphi.edu (Z.T. Osakwe), sainfer.e.aliyu@medstar.net (S. Aliyu), ksosina1@jhu.edu (O.A. Sosina), lp2475@columbia.edu (L. Poghosyan).

https://doi.org/10.1016/j.gerinurse.2020.07.001
0197-4572/$ – see front matter © 2020 Elsevier Inc. All rights reserved.

transitional care programs. In HBPC, healthcare providers (e.g., physicians, NPs, and physician assistants) and interdisciplinary care team provide comprehensive longitudinal in-home medical care to homebound.[16,17] In home-based palliative care, the focus is on symptom control and entails the provision of consultative palliative care in collaboration with the patient's primary care provider.[18] In transitional care programs, patients transitioning from the hospital to the home setting receive transitional care home visits by a master's prepared advanced practice nurses such as clinical nurse specialist, more recent forms of the transitional care programs utilize NPs.[19,20] A growing body of evidence has demonstrated that HBMC programs lead to reduction in hospitalizations, 30−day readmissions, and potentially preventable hospitalizations.[20-24]

While the outcomes of HBMC have been shown to be positive, there is currently a national shortage of providers in the U.S,[25] in part due to the escalating primary care physician shortage.[26,27] As a result, there has been an increasing reliance on other health care providers such as physician assistants and NPs to reduce barriers in access to HBMC. Current evidence points to high utilization of NP-home visits. In 2013, NPs made 1.1 million home visits making them the largest provider of home visits and the most common provider of home visits to rural residents in the U.S.[28,29] This number nearly doubled to 2 million NP-home visits in 2016.[30,31] Many homebound patients who receive home visits from an NP, physician or physician assistant also receive Medicare Home Healthcare services, which provides skilled nursing, therapy or home health aide services. For decades, long standing federal regulations in the U.S that govern the services that NPs can provide, have restricted the autonomy of NPs in meeting patient care needs of homebound patients who receive Medicare Home Healthcare services. Although NPs were recognized by Medicare and Medicaid as primary care providers, NPs were not been able to order, certify or re-certify Medicare Home Healthcare —a service utilized by about 3 million Medicare beneficiaries each year.[12,32]

More recently, amidst the COVID-19 pandemic, the Home Health Care Planning Improvement Act (S. 296/H.R. 2150), was included in the Coronavirus Aid, Relief, and Economic Security Act or the "CARES Act" (H.R. 748).[33] This bill now permanently authorizes NPs to order Medicare Home Healthcare services for Medicare patients consistent with state scope-of-practice law governing NP practice. Allowing NPs to order, certify and re-certify Medicare Home Healthcare services increases practice autonomy for NPs and expands access to home healthcare for vulnerable homebound patients.[31,32]

Despite the growing utilization in the delivery of varied modes of HBMC, very little is known about outcomes associated with NP-provided care. While studies of HBPC report positive outcomes, patient outcomes are not delineated by provider type (physician or NP), making it hard to precisely estimate the impact of the NP role.[21,34,35] Studies of transitional care have focused on the post-acute care population transitioning from one setting to another, with NPs providing transitional care supplemental to the care delivered by the primary care providers.[20,36] Although substantial evidence has shown that NPs provide quality of care similar to that of physicians,[37,38] even with medically complex patients[39] most of these studies have focused on acute care[40] or ambulatory care,[41,42] and these findings are not generalizable to care provided in a patient's home environment which presents unique challenges.[34]

Because NPs are more likely to serve in low income, minority, and rural areas and to accept Medicaid insurance when compared to physicians,[43] increased practice independence for NPs in HBMC has the potential to address physician shortage and extend care to underserved populations in the U.S. Nevertheless, lack of evidence about the outcomes associated with NP-home visits restricts the optimal utilization of the growing NP workforce to meet the increasing demand for HBMC.[44,45]

The use of NP-home visits has particularly gained national and policy interest. A current Medicare demonstration program, Independence at Home (IAH), tests the effectiveness of delivering primary care in the home by an interdisciplinary team led by physicians or NPs. The IAH demonstration showed that patients who receive HBPC had fewer 30-day readmissions, hospitalizations, and emergency department visits.[46,47] In light of IAHs success, there is a clear need to assess and quantify the specific contributions of NPs reflected in patient outcomes. With the growing aging population, the utilization of NPs in the delivery of HBMC is expected to increase. An understanding of the health and healthcare utilization outcomes associated with NP-home visits will inform efforts to expand access to HBMC for vulnerable homebound older adults in the U.S.

Therefore, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement,[48] we performed a review of the literature to examine the relationship between NP-home visits and health and healthcare utilization outcomes of homebound older adults.

Methods

Search strategy

With the assistance of a medical librarian, searches were conducted in the following electronic databases: PubMed, EMBASE, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and Cochrane Central Register of Clinical Trials to identify studies investigating the outcomes of NP- home visits. The search procedure developed for PubMed was carefully replicated to retrieve studies from EMBASE, CINAHL and Cochrane. Initially, broad categories of search terms were chosen, including the following: "nurse practitioner", "advanced practice nursing", "advanced practice nurse", "nurse clinician," in combination with "house," "home care services," "home health nursing," "transitional care," "house call," "home visit," "home based," "home care," "home health," "home healthcare," "transitional care," "transitional health care," "aged," "middle aged," "elderly seniors" and "senior citizen." Medical subject heading (MESH), key words and truncated search terms were used when available to capture all relevant articles in a database. The search was conducted without date restriction. Reference list of included articles were screened for additional relevant articles. The complete lists of search strategies for each database are listed in Appendix A.

Eligibility criteria

To be included in the review, studies must have met the following criteria: target patient population was (a) older adults ≥ 65; (b) the study investigated patient outcomes associated with NP- home visits, (c) qualitative or quantitative study design, and (d) from peer-reviewed journals published in English through April 30, 2019. Excluded from this review were review articles, editorials, case reports or case studies, reports published as abstracts or commentaries. Because we sought to obtain a comprehensive understanding of the current state of evidence about the outcomes of NP-home visits, studies were not excluded based on study design. Studies were also not excluded based on location/country. Relevant articles were imported to Endnote, reference management software (Endnote X9; Thomas Reuters) and duplicates were deleted.

Study selection

Fig. 1 provides the details of the search process. Two reviewers (SA and ZO) independently screened titles and abstracts of articles to determine whether inclusion criteria were met. Full text articles were reviewed independently by the same reviewers (SA and ZO), and references of those articles were searched for potentially relevant publications. All disagreements were resolved by consensus.

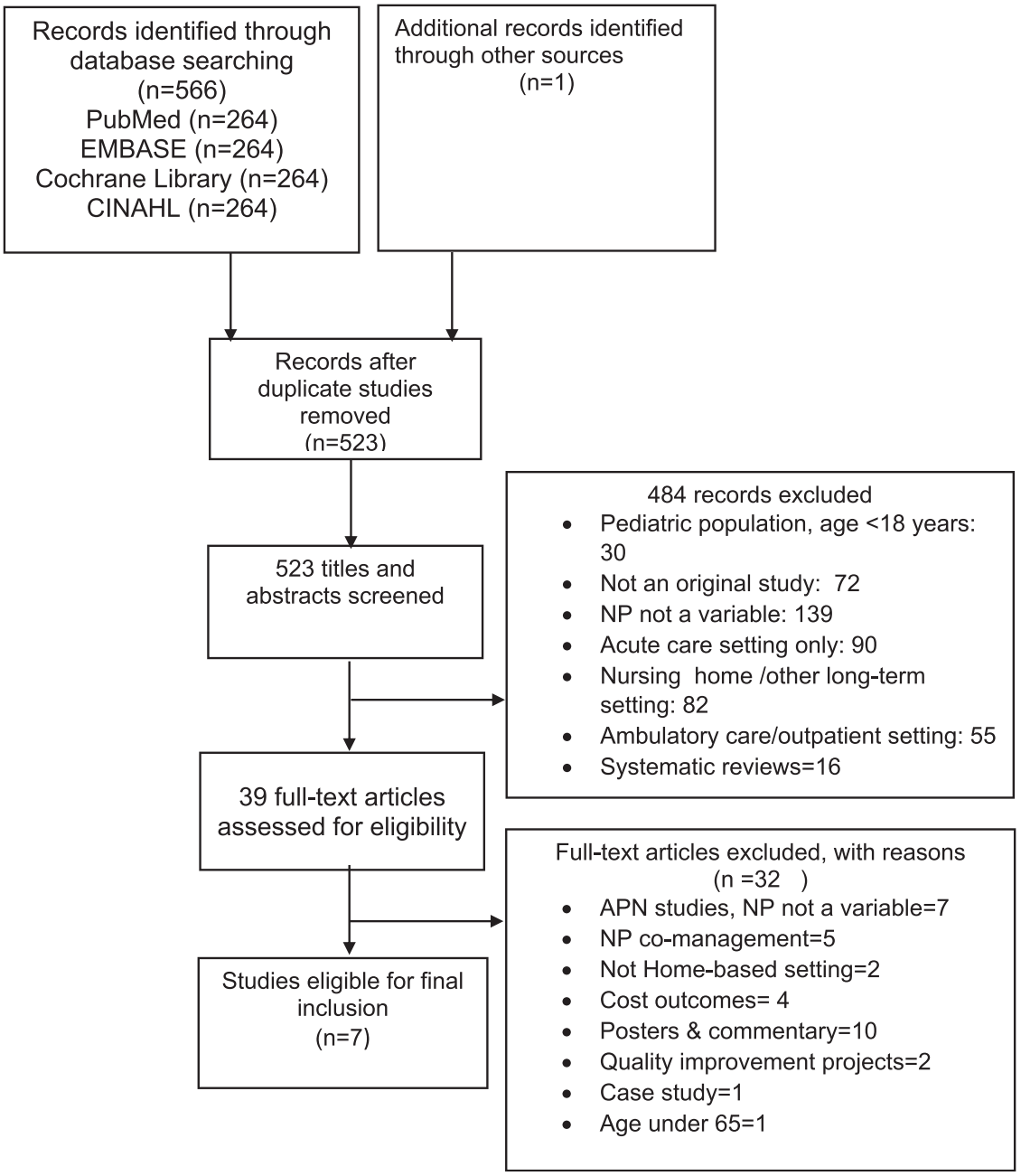

Fig. 1. Flow diagram of the process of study selection.

Data extraction

The following information was collected from each study: first author's name, publication year, study design, study objective, number of NP-home visits, characteristics of the study sample, including sample size, mean age and sex of participants, race/ethnicity of sample and study setting (country and/or area in which the study was conducted) and outcome variables. All data were entered in an Excel (Microsoft Corp., Redmond, VA) document.

Quality appraisal

The quality appraisal instrument developed by Kmet, Lee & Cook[49] was used to assess the quality of the selected studies. This is a validated tool containing individual checklists to assess the quality of qualitative and quantitative studies and consists of 14 criteria scored on a 3-point scale (2 = yes, 1 = partially, 0 = no). Following the guidelines of the tool, "non-applicable" was applied when criteria were not applicable to a study design. Items that met the "non-applicable" criteria were marked and excluded from the calculation of the summary score. The scores were then summed and divided by the total number of items to obtain a summary score for each paper. The summary score was then converted into a percentage of the maximum possible score. Studies were determined to be of high quality if they scored > 75%, unclear quality if they scored 55%–75%, and of low quality of they scored < 55%. Two reviewers (SA and ZO) independently appraised each study. Discrepancies were resolved by discussion between the 2 reviewers, and in consultation with a third reviewer (KS).

Results

In total, 566 article titles and abstracts were screened for study relevance. After applying the eligibility criteria and removing duplicates, 484 articles were excluded by reviewing titles and abstracts. The remaining 39 articles were obtained for full text review out of which, 7 peer-reviewed studies of various designs met inclusion criteria and were selected for the review: 2 randomized control trial (RCT),[50,51] 3 quasi-experimental,[52-54] 1 observational study[55] and 1 mixed methods study.[56] A flowchart with details on the literature search and search results is shown in Fig. 1.

Characteristics of included studies

Table 1 provides a description of each included study. The study samples represent data from 1748 participants who received NP-home visits. Five studies were conducted in the U.S. and the remaining 2 were conducted in Canada,[52] and in the UK.[54] Mean age of study participants ranged from 66.1 to 81.4 years. The model of NP-home visits varied across the included studies; 3 studies were based on HBPC,[52,53,56] while 2 studies were based on the TCM,[50,55] and 1 study was based on an in-home comprehensive geriatric assessment (CGA) program.[51] The in-home CGA is conducted to assess the medical, psychological and functional abilities of older adults.[57] In all studies, the NP role during home visits included medication management, patient education, and coordination of care. The impact of NP-home visits on healthcare utilization (ED visits, hospitalizations, and readmission) was the most frequently reported outcome[50,52-56] Study period across the included studies ranged from 2 months[52] to 36 months.[51]

Participant recruitment varied across studies. Two studies recruited hospitalized patients,[50,55]another 3 recruited community dwelling participants.[51-53] In 2 studies, participants had specific diagnosis such as chronic obstructive pulmonary disease (COPD),[54] and post Coronary artery bypass grafting (CABG) surgery.[55] One study specifically utilized NPs with specialty training in geriatrics.[51]

Unsurprisingly, we found that most studies conducted in the U.S. reported a physician oversight,[55] consultation[51] or collaboration with the physician for medication management,[50] although only the NP made home visits. Of the 2 RCTs, 1 compared NP-home visits to case management and physician office visits,[50] the second study compared NP-home visits to medical and social services.[51] One of the quasi-experimental studies compared the NP-home visit intervention to participants receiving care in a hospital setting,[54] another recruited patients receiving home care services.[52]

Quality assessment of included studies

Based on the quality assessment tool, 4 studies were of high quality, 2 studies were of unclear quality, and 1 study was of low quality. Quality scores ranged from 54%–100% (mean score 77%). Overall, all the articles had clearly stated aims, main outcomes, and findings. Of the 7 studies, three of the studies did not control for potential confounders (42.8%, $n = 7$) and one study (14.2%, $n = 7$) did not provide a rationale for including the covariates in multivariate analyses.

Impact of NP home-visits on emergency department (ED) visits

One RCT[50] and 2 quasi-experimental studies[52,53] examined the effect of NP-home visits on ED visits. Two studies reported a reduction in ED visits.[52,53] Coppa et al. tested the impact of NP-home visits on ED visits and reported significant reductions in the ED visits by 35.56% and 23.7% after implementation of the HBPC program after with 6 months ($p = 0.001$) and 12 months ($p = 0.001$) before the program was implemented.[53] Although the patients received NP-home visits, the visits were only supplemental to visits provided by the patient's primary care providers, therefore, patients in the study still received care from primary care physicians. A Canadian study by Tung et al. compared the number of ED visits among home care patients who received NP home-visits with home care patients who received usual medical care from family physician offices or community outreach medical teams. Participants in the intervention group received at least one home visit from the NP for assessment, treatment or a procedure. The authors found that patients who received NP-home visits had less ED visits at 2 weeks ($p = 0.0005$) and 4 weeks ($p = 0.0055$) compared to those receiving usual care. However, there was no significant difference in the number of ED visits between the 2 groups at the 8 week period ($p = 0.800$).[52] Enguidanos et al. conducted a brief transition intervention for older adults using a RCT designed to examine the impact of the NP intervention on 6 month-service utilization among patients enrolled from one managed care medical center. The NP also contacted the patient's PCP when medication problems were identified. Usual care was described as standard medical care combined with case management services. Patients assigned to the intervention group had half as many ED visits compared with the usual care group (mean=0.50, SD=1.2 versus mean =0.99, SD=2.5; $P = 0.096$); however the decrease was not statistically significant.[50]

Impact of NP home-visits on hospitalizations

Two RCTs reported the effect of NP-home visits on hospitalizations.[50,51] Stuck et al. conducted a 3-year RCT to test the effect of annual in-home CGA on the rate of hospitalization among community dwelling older adults, they found no statistically significant difference between participants who received annual in-home CGA from a geriatric specialty-NP and the usual care group. The usual care group received medical and social services. The mean length of stay per hospitalization was 6.3 days in the intervention group and 5.1 days in the control group ($p = 0.7$) .[51] Enguidanos et al. found no difference in days spent in the hospital in patients who received NP-home visits compared to patients who received usual care ($p = 0.514$), patients enrolled in the usual care received all medical services, including disease senior case management.[50]

Impact of NP home-visits on readmission

Four studies including 1 RCT,[50] 1 quasi experimental study, ,[53] 1 observational study[55] and 1 mixed methods study[56] evaluated the impact of NP-home visits on hospital readmissions. Hall et al. found that patients who received NP-home visits post CABG surgery had a significant decrease in all-cause hospital readmissions compared to patients who did not receive NP-home visits. Patients in the intervention group received 2 NP-home visits in the first week to 10 days after discharge from the hospital. Each home visit involved physical examination, medication reconciliation and medication changes under the supervision of the operating surgeon. Six of the 156 patients who received the NP-home visits (3.85%) and 18 of the 156 controls (11.54) were readmitted ($p = 0.023$).[55] Coppa et al., also found a 59.42% decrease in readmissions at 6 months ($p = 0.001$) after enrollment in the HBPC intervention led by a NP, however the result was not sustained at the 12 month-interval ($p = 0.087$).[53]

Enguidanos and colleagues[50] evaluated the impact of NP intervention on care transitions among older adults and found no change in readmission rates at 6 months following enrollment in the study ($p = 0.526$). Ornstein and colleagues examined the impact of NP-home visits in a transitional care program embedded within a HBPC program; while the 30-day readmission decreased from 16.6% to 15.8%, it did not reach statistical significance.[56]

Table 1
Characteristics of included studies.

Author Year County	Study Design	Sample Setting	Study Period	NP Model HBPC†* TCM†**	Study Outcomes	Results
Ansari 2009, UK	Quasi-experimental, study	*N* = 90 Age(years): 72± 9.0 NP-Home group, 77.3 ± 6.7 hospital group Race/ethnicity: NR	2–3months	# of NP-home visits not defined	Health-related quality of life	**In the intervention group, at recovery, the decrease of the total SGRQ score did not reach significance (*P* = 0.06)**, while the improvement in the activity domain was highly significant($p<0.05$)
Coppa 2018, USA	Quasi-experimental, study	*N* = 82 Age(years): 60.6 ± 16.5 Race/ethnicity: 86% White	1 year	HBPC 1–5 home visit during study period	*Re*-hospitalizations and ED visit rates	HBPC delivered by NP resulted in a 23.7% **decrease in emergency department visits and a 34.9% reduction in re-hospitalization**
Enguidanos 2012, USA	RCT	NP home visit group *N* = 100; Physician office visit *N* = 99 Age(years): 73.58±10.53 Race/ethnicity: White 38.7%	6 months	TCM 1–3 home visits	Number of ED visits, hospital admissions, physician office visits Hospital readmission rate Satisfaction with medical care Self-efficacy in managing medical conditions	no change in hospital readmissions Decrease in ED visits not statistically significant
Hall 2014, USA	Observational cohort study	NP home visit group *N* = 169; Cardiac surgery clinic and visiting nurse group=232 Age(years): NP Home Visit 66.1 ± 10.0; Usual Care: 66.2 ± 9.8; Race/ethnicity: White (Intervention 87%) White (Usual Care 79.3%)	15 months	TCM 2 home visits First week 10 days post discharge	Readmission/death within 30 days of discharge	**Lower 30-day readmission/death rate of 3.85% compared with 11.54% for the usual care matched group (*p* = 0.023)**. Patients in the usual care group were 2.99-times more likely to be readmitted than patients in the FYH group ($p = 0.015$).
Stuck 1995, USA	RCT	NP home visit group =215; intervention= 199. Age (years): NP Home Visit 81.0 ± 3.9; Usual Care: 81.4 ± 4.2 Race=NR	3 years	CGA 1 home visit/year x 3 years	Prevention of disability (decline in ADL/IADL) Prevention of nursing home admissions	20 in the intervention and 32 in the control group required assistance in performing the basic ADLs ($p = 0.02$). 9 in the intervention and 20 in the control group were permanently admitted to nursing homes ($p = 0.02$). **Acute care hospitalization and short-term nursing home admissions did not differ significantly between the two groups.**
Tung 2012, Canada	Quasi experimental	*N* = 39 30: intervention 9: control Age (years): 73.6 ± 13.1 Race/ethnicity=NR	2months	HBPC At least 1 Home visit	The number of ED visits	**The number of ED visits was reduced at two and four weeks in the intervention group, *p* = 0.0005 and *p* = 0.0055, respectively).** The death rate between the intervention and control groups was not statistically significant
Ornstein 2011, USA	Mixed-methods program evaluation	*N* = 532 Age (years): 81.1 ± 13.8 Race/ethnicity=White(33.5%), Black(29.6%).	2 years	HBPC 1 post discharge home visit	Length of stay Case-mix index (CMI) Readmission rates hospital financial outcomes	**There was no decrease hospital length of stay**. CMI increased from 1.25 to 1.35 during the intervention period ($p = 0.005$). Readmission rate decreased but was not statistically significant.

NP* = Nurse Practitioner.
HBPC†* = Home based primary care.
TCM†** = Transitional care mode.

Table 2
Summary of Physician Involvement in NP-Home Visits.

Study	Description Physician Involvement	Country	NP-Provided Care
Ansari, 2009	NPs alone managed patients in the community	U.K	Independent NP Care
Coppa, 2018	NPs provided supplemental care to PCP	U.S	Supplemental care
Enguidanos, 2012	NP contacted the PCP with medication problems.	U.S	Supplemental care
Hall, 2014	NP-care under supervision of cardiac surgeon	U.S	Supplemental care
Hanrahan, 2014	Psychiatrist provided medication management	U.S	Supplemental care
Ornstein,2011	NP coordinated with PCP	U.S	Supplemental care
Stuck, 1995	NP discussed each case with study geriatricians	U.S	Supplemental care
Tung, 2012	Only control group received physician care.	Canada	Independent NP care

Impact of NP home-visits on quality of life

One quasi-experimental study[54] assessed quality of life. Health related quality of life (HRQoL) was assessed differently in both studies. A UK study by Ansari et al., compared patients with exacerbation of COPD managed at home by an NP to a hospital cohort of patients with COPD exacerbation managed in an acute care hospital. In this study, COPD -specific quality of life was assessed with St George's Respiratory Questionnaire (SGRQ); a disease-specific questionnaire, which measures health status and perceived wellbeing in persons living with COPD. At recovery, the total SGRQ score decreased for patients who received NP-home visits, it did not reach significance ($p = 0.06$), however, improvement in the activity domain was significant ($p < 0.05$).

Impact of NP home-visits on functional status and nursing home admission

The analysis was based on 1 RCT conducted in 1995.[51] In this study, geriatric specialty NPs provided annual in-home CGA with follow up visits to community dwelling older adults 75 years or older . The odds of dependency in basic activity of daily living was significantly lower in the intervention group compared to the control group (adjusted odds ratio, 0.4; 95% CI, 0.2−0.8; $p = 0.02$). Additionally, 9 people in the intervention group (4%) and 20 people in the control group (10%) were permanently admitted to nursing homes ($P = 0.02$).

Discussion

We conducted a systematic review to assess existing evidence about NP- home visits and how they affect the outcomes of older adults. In this review spanning almost 3 decades, we found only 7 published studies. Studies varied considerably in terms of study design, delivery of intervention, and study outcomes. Given the small number of studies and their methodological limitations, overall evidence of the relationship between NP-home visits and patient outcomes is limited. While we attempted to identify the outcomes associated with autonomous NP-home visits, this was particularly challenging, as we excluded studies where the NP and physicians provided home visits to the same patients.

Similar to a systematic review by Stall and Colleagues,[21] which evaluated the outcomes of HBPC, in this review the most common outcomes were related to healthcare utilization (ED utilization, hospitalizations and readmissions). Many of the studies we identified were based on the TCM and largely enrolled a post-acute care population. Although prevention of acute care utilization is an important goal of HBMC. The use of NP-home visits among homebound older adults extends beyond transitional care purposes; to prevent healthcare utilization post discharge,[58] but fill a critical access gap, by meeting the ongoing healthcare needs in the home environment.

In studies examining the effect of NP-home visits on readmissions, 1 high quality observational study[55] found that a home transition program, which involved NP-home visits for patients post CABG-surgery significantly, reduced 30-day readmission. One additional study found a decrease in readmissions at 6 months, yet the results were not sustained at 1 year,[53] the 2 remaining articles found no effect.[50,56] Therefore, the results do not conclusively demonstrate that NP-home visits will lead to reductions in readmissions.

Emergency department utilization was another common outcome examined in the reviewed studies. Although results for ED utilization were promising, more evidence is needed to fully understand the impact of NP-home visits on the rate of ED utilization among older adults. Two of the 3 studies in our review showed that use of NP-home visits could lead to reduction in ED visits. One study found decrease in ED visits at 2 and 4 weeks; however this association was not consistently significant at 8 weeks; this study did not control for comorbidities.[52] A second study found reductions in ED utilization at 6 months and 1 year, although it had a small sample size, and there was no comparison group.[53]

Overall, research on the effect of NP-home visits on health and healthcare utilization outcomes is limited and inconclusive. Study design and methodological rigor varied across studies; hence, it was challenging to compare outcomes across studies. Most of the studies did not find associations that reached statistical significance,[50,52,54,56] though this may be due to the fact that they were insufficiently powered. Intervention characteristics included in the studies also varied including intensity of home visit, use of specialty NPs across studies, this made synthesis of study measures and outcomes difficult. The comparison groups were inconsistent and none of the studies directly compared NP-home visits to home visits by other healthcare providers such as physicians or physician assistant. Although, the RCTs compared an intervention with "usual care," specific details of usual care were not clearly provided.

While beyond the scope of this review, analysis of the included studies points to known barriers to autonomous NP-provided care in the home setting prior to the implementation of the CARES Act. Of the 7 studies, studies conducted in the U.S captured the presence of physician oversight, supervision or collaboration although the NPs provided the home visits (Supplemental Table 1). In efforts to examine the unique outcomes of NP-home visits, we attempted to exclude studies that describe NP-home visits that involved physician co-management; this presented a challenge predominantly for studies conducted in the U.S. where state scope-of- practice restrictions on NPs vary across the country and many states require collaboration with a physician.[59] Notably, in this review, studies conducted outside the U. S did not mention any form of physician consultation or oversight.

Strengths and limitations

Findings from this review are supported by rigorous methods including the use of a medical librarian in developing the search strategy, independent selection of studies by 2 reviewers, and quality appraisal conducted by 2 reviewers, and validated by a 3rd reviewer.

This systematic review has certain limitations. First, the paucity of published studies related to NP- home visits limits the ability to draw conclusions. Second, studies that met our inclusion criteria had

varied study designs and patient samples, and duration and frequency of NP home-visit varied across studies. Third, our restriction to studies published in English may have also excluded some relevant papers. We may have also missed articles in the literature search due to other variations in terminology describing NPs particularly for studies conducted outside the U.S., where other terms may capture the role of an NP. Finally, there is a possibility of publication bias, as we did not include unpublished findings such as conference proceedings or dissertation results. Notwithstanding these limitations, our findings present the state of the literature assessing NP-home visits and point to important future directions for continued investigation.

Implications for practice and future research

The use of NP-home visits is widely recognized and has gained national interest,[28,60] yet few studies have assessed the outcomes of NP-home visits. This is the first study to our knowledge to systematically review the evidence of the impact of NP-home visits on the outcomes of homebound older adults. Our findings indicate that the effect of NP-home visits on health and healthcare utilization outcomes is mixed at best, with only half of the studies reviewed reported positive findings on reducing ED utilization. We identified gaps in the evidence that future research could address.

Future studies should directly compare NP-home visits to home visits provided by other health care providers or teams. While RCTs investigating the effect of NP-home visits may be difficult given the patient population and the complexity of the intervention, researchers should consider observational studies that use robust risk adjustment and modeling approaches to create more defined comparison groups. Future research should also identify larger samples of patients receiving NP-home visits or use large datasets such as nationwide Medicare data to ensure sufficient statistical power to identify associations.

Clinical outcomes were underrepresented in the results generated by our systematic review; the most commonly reported outcomes were related to health care utilization. Although health care utilization (hospitalizations, readmission and ED visits) is an important indicator of high-quality HBMC,[21] other outcomes such as functional status or medication adherence are also important patient outcomes to be evaluated. Future studies should also identify patient-level factors, for example, level of comorbidity that may be associated with likelihood to receive NP- home visits, such studies will inform policy and clinical practice decisions about what subgroups of patients benefit most from NP-home visits. In the U.S, racial and ethnic minorities and rural populations tend to have poorer access, satisfaction, and health outcome;s[61,62] researchers should consider subgroup analysis of these understudied groups in future work. Doing so will inform the development of future targeted interventions.

Conclusion

While expanding the independence of NPs in the delivery of HBMC is a topic of ongoing debate[32]; based on our review, little research informs such discussion. This gap in evidence is critical given the expected increase in the homebound older adults as the current population ages and growing reliance on NP-home visits. Future studies should investigate the independent effect of NP- home visits on the health outcomes of older adults using large and nationally representative data with more rigorous study design.

Acknowledgments

We would like to acknowledge Ms. Karen Sorenson, Research and Education Librarian, Albert Einstein College of Medicine, New York for her appreciated assistance with the literature search for this systematic review. We thank Dr. Yamnia I. Cortes for a careful read and helpful comments.

References

1. Ornstein KA, Leff B, Covinsky KE, et al. Epidemiology of the Homebound Population in the United States. *JAMA Intern Med*. 2015;175(7):1180–1186. https://doi.org/10.1001/jamainternmed.2015.1849.
2. Qiu WQ, Dean M, Liu T, et al. Physical and mental health of homebound older adults: an overlooked population. *Journal of the American Geriatrics Society*. 2010;58(12):2423–2428. https://doi.org/10.1111/j.1532-5415.2010.03161.x.
3. Wajnberg A, Ornstein K, Zhang M, Smith KL, Soriano T. Symptom burden in chronically ill homebound individual. *Journal of the American Geriatrics Society*. 2013;61(1):126–131.
4. Soones T, Federman A, Leff B, Siu AL, Ornstein K. Two-Year Mortality in Homebound Older Adults An Analysis of the National Health and Aging Trends Study. *Journal of the American Geriatrics Society*. 2017;65(1):123–129. https://doi.org/10.1111/jgs.14467.
5. Aldridge ASK, Kelly MD. Epidemiology of serious illness and high utilization of health care Institute of Medicine. *Dying in America: Improving Quality and Honoring Individual Preferences Near the End of Life*. WashingtonDC: National Academies Press; 2014.
6. Musich S, Wang SS, Hawkins K, Yeh CS. Homebound older adults: Prevalence, characteristics, health care utilization and quality of care. *Geriatric nursing (New York, NY)*. 2015;36(6):445–450. https://doi.org/10.1016/j.gerinurse.2015.06.013.
7. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med*. 2009;360(14):1418–1428. https://doi.org/10.1056/NEJMsa0803563.
8. De Jonge KE, Jamshed N, Gilden D, Kubisiak J, Bruce SR, Taler G. Effects of home-based primary care on Medicare costs in high-risk elders. *Journal of the American Geriatrics Society*. 2014;62(10):1825–1831. https://doi.org/10.1111/jgs.12974.
9. To Strengthen The Primary Care First Model For The Most Frail. Look To The Independence At Home Demonstration. *Health Affairs Blog*. 2020. https://doi.org/10.1377/hblog20200218.661865. *February 18*.
10. Rotenberg J, Kinosian B, Boling P, Taler G. Home-Based Primary Care: Beyond Extension of the Independence at Home Demonstration. *Journal of the American Geriatrics Society*. 2018;66(4):812–817. https://doi.org/10.1111/jgs.15314.
11. Mattke S, Han D, Wilks A, Sloss E. Medicare home visit program associated with fewer hospital and nursing home admissions, increased office visits. *Health Affairs*. 2015;34(12):2138–2146.
12. Medicare Payment Advisory Commission. Report to the Congress: Medicare payment policy. *Published*. March 2019. http://www.medpac.gov/docs/default-source/reports/mar19_medpac_ch9_sec.pdf?sfvrsn=0. Accessed March 8, 2020.
13. Landers S, Madigan E, Leff B, et al. The future of home health care: a strategic framework for optimizing value. *Home health care management & practice*. 2016;28(4):262–278.
14. Harrison KL, Leff B, Altan A, Dunning S, Patterson C, Ritchie CS. What's happening at home: A claims-based approach to better understand home clinical care received by older adults. *Medical care*. 2020;58(4):360.
15. Yao NA, Ritchie C, Cornwell T, Leff B. Use of Home-Based Medical Care and Disparities. *Journal of the American Geriatrics Society*. 2018;66(9):1716–1720. https://doi.org/10.1111/jgs.15444.
16. Norman GJ, Wade AJ, Morris AM, Slaboda JC. Home and community-based services coordination for homebound older adults in home-based primary care. *BMC Geriatr*. 2018;18(1):241. https://doi.org/10.1186/s12877-018-0931-z.
17. Schuchman M, Fain M, Cornwell T. The Resurgence of Home-Based Primary Care Models in the United States. *Geriatrics (Basel, Switzerland)*. 2018;3(3):41. https://doi.org/10.3390/geriatrics3030041.
18. Ritchie CS, Leff B. Population health and tailored medical care in the home: the roles of home-based primary care and home-based palliative care. *Journal of pain and symptom management*. 2018;55(3):1041–1046.
19. Naylor MD, Aiken LH, Kurtzman ET, Olds DM, Hirschman KB. The importance of transitional care in achieving health reform. *Health affairs*. 2011;30(4):746–754.
20. Mora K, Dorrejo XM, Carreon KM, Butt S. Nurse practitioner-led transitional care interventions: An integrative review. *Journal of the American Association of Nurse Practitioners*. 2017;29(12):773–790. https://doi.org/10.1002/2327-6924.12509.
21. Stall N, Nowaczynski M, Sinha SK. Systematic review of outcomes from home-based primary care programs for homebound older adults. *J Am Geriatr Soc*. 2014;62(12):2243–2251. https://doi.org/10.1111/jgs.13088.
22. Jones MG, DeCherrie LV, Meah YS, et al. Using Nurse Practitioner Co-Management to Reduce Hospitalizations and Readmissions Within a Home-Based Primary Care Program. *J Healthc Qual*. 2017;39(5):249–258. https://doi.org/10.1097/jhq.0000000000000059.
23. Feltner C, Jones CD, Cené CW, et al. Transitional care interventions to prevent readmissions for persons with heart failure: a systematic review and meta-analysis. *Annals of internal medicine*. 2014;160(11):774–784.
24. Naylor MD, Brooten DA, Campbell RL, Maislin G, McCauley KM, Schwartz JS. Transitional care of older adults hospitalized with heart failure: a randomized, controlled trial. *Journal of the American Geriatrics Society*. 2004;52(5):675–684. https://doi.org/10.1111/j.1532-5415.2004.52202.x.
25. Cornwall iC. T.. House Calls Are Reaching the Tipping Point—Now We Need the Workforce. *Journal of patient-centered research and reviews*. 2019.

26. U.S. Department of Health and Human Services, Health Resources and Services Administration, National Center for Health Workforce Analysis. *Projecting the Supply and Demand for Primary Care Practitioners Through 2020 Rockville, Maryland: US Department of Health and Human Services*. 2013.
27. The Number of Practicing Primary Care Physicians in the United States. *Content last reviewed July 2018*. Rockville, MD: Agency for Healthcare Research and Quality; 2018.
28. Yao NA, Rose K, LeBaron V, Camacho F, Boling P. Increasing Role of Nurse Practitioners in House Call Programs. *Journal of the American Geriatrics Society*. 2017;65(4):847–852. https://doi.org/10.1111/jgs.14698.
29. Yao N, Ritchie C, Camacho F, Leff B. Geographic Concentration Of Home-Based Medical Care Providers. *Health Aff (Millwood)*. 2016;35(8):1404–1409. https://doi.org/10.1377/hlthaff.2015.1437.
30. The Moran Company. (2019). Medicare payment systems. http://www.themorancompany.com/expertise/medicare-payment-system.
31. Wolff-Baker D, Ordona RB. The Expanding Role of Nurse Practitioners in Home-Based Primary Care: Opportunities and Challenges. *Journal of gerontological nursing*. 2019;45(6):9–14.
32. Jaffe S. Home Health Care Providers Struggle With State Laws And Medicare Rules As Demand Rises. *Health Affairs*. 2019;38(6):981–986.
33. Centers for Medicare for Medicaid Services. Home Health Agencies: CMS Flexibilities to Fight COVID-19. Available at: https://www.cms.gov/files/document/covid-home-health-agencies.pdf. PublishedMarch 2020. Accessed April 15, 2020.
34. Muramatsu N, Mensah E, Cornwell T. A physician house call program for the homebound. *Jt Comm J Qual Saf*. 2004;30(5):266–276. Published 2004/05/25.
35. Jones MG, Ornstein KA, Skovran DM, Soriano TA, DeCherrie LV. Characterizing the high-risk homebound patients in need of nurse practitioner co-management. *Geriatric nursing (New York, NY)*. 2017;38(3):213–218. https://doi.org/10.1016/j.gerinurse.2016.10.013.
36. Naylor MD, Hirschman KB, Toles MP, Jarrín OF, Shaid E, Pauly MV. Adaptations of the evidence-based Transitional Care Model in the US. *Social Science & Medicine*. 2018;213:28–36.
37. Stanik-Hutt J, Newhouse RP, White KM, et al. The Quality and Effectiveness of Care Provided by Nurse Practitioners. *Journal for Nurse Practitioners*. 2013;9(8):492–500. https://doi.org/10.1016/j.nurpra.2013.07.004.
38. Swan M, Ferguson S, Chang A, Larson E, Smaldone A. Quality of primary care by advanced practice nurses: a systematic review. *Int J Qual Health Care*. 2015;27(5):396–404. https://doi.org/10.1093/intqhc/mzv054.
39. Morgan PA, Smith VA, Berkowitz TSZ, et al. Impact Of Physicians, Nurse Practitioners, And Physician Assistants On Utilization And Costs For Complex Patients. *Health Aff (Millwood)*. 2019;38(6):1028–1036. https://doi.org/10.1377/hlthaff.2019.00014.
40. Mundinger MO, Kane RL, Lenz ER, et al. Primary care outcomes in patients treated by nurse practitioners or physicians: a randomized trial...Copyright © 2000 American Medical Association. All rights reserved. JAMA, January 5, 2000-Vol 283, No. 1 pages 59-68. *Academic Nurse*. 2000;17(1):8–17. http://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=107136145&site=ehost-live.
41. Buerhaus P, Perloff J, Clarke S, O'Reilly-Jacob M, Zolotusky G, DesRoches CM. Quality of Primary Care Provided to Medicare Beneficiaries by Nurse Practitioners and Physicians. *Med Care*. 2018;56(6):484–490. https://doi.org/10.1097/mlr.0000000000000908.
42. Kurtzman ET, Barnow BS. A Comparison of Nurse Practitioners, Physician Assistants, and Primary Care Physicians' Patterns of Practice and Quality of Care in Health Centers. *Med Care*. 2017;55(6):615–622. https://doi.org/10.1097/mlr.0000000000000689.
43. Buerhaus PI, DesRoches CM, Dittus R, Donelan K. Practice characteristics of primary care nurse practitioners and physicians. *Nursing Outlook*. 2015;63(2):144–153.
44. Yao N, Ritchie C, Cornwell T, Leff B. Use of home-based medical care and disparities. *Journal of the American Geriatrics Society*. 2018;66(9):1716–1720.
45. Cornwell T. House Calls Are Reaching the Tipping Point—Now We Need the Workforce. *Journal of patient-centered research and reviews*. 2019;6(3):188.
46. Reckrey JM, Soriano TA, Hernandez CR, et al. The team approach to home-based primary care: restructuring care to meet individual, program, and system needs. *Journal of the American Geriatrics Society*. 2015;63(2):358–364. https://doi.org/10.1111/jgs.13196.
47. Kimmey L, Anderson M, Cheh V, Li E, McLaughlin C, Barterian L, Heitkamp S. Evaluation of the Independence at Home Demonstration: An Examination of the First Four Years, Appendices (No. 47ebac688f0c47dc98e946af794500fb). *Mathematica Policy Research*. 2019.
48. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine*. 2009;6:(7)e1000097. https://doi.org/10.1371/journal.pmed.1000097.
49. Kmet LM, Cook, L. S., & Lee, R. C. (2004). Standard quality assessment criteria for evaluating primary research papers from a variety of fields. 2004.
50. Enguidanos S, Gibbs N, Jamison P. From hospital to home: a brief nurse practitioner intervention for vulnerable older adults. *J Gerontol Nurs*. 2012;38(3):40–50. https://doi.org/10.3928/00989134-20120116-01.
51. Stuck AE, Aronow HU, Steiner A, et al. A trial of annual in-home comprehensive geriatric assessments for elderly people living in the community. *N Engl J Med*. 1995;333(18):1184–1189. https://doi.org/10.1056/nejm199511023331805.
52. Tung TK, Kaufmann JA, Tanner E. The effect of nurse practitioner practice in home care on emergency department visits for homebound older adult patients: an exploratory pilot study. *Home Healthc Nurse*. 2012;30(6):366–372. https://doi.org/10.1097/NHH.0b013e318246dd5.
53. Coppa D, Winchester SB, Roberts MB. Home-based nurse practitioners demonstrate reductions in rehospitalizations and emergency department visits in a clinically complex patient population through an academic-clinical partnership. *J Am Assoc Nurse Pract*. 2018;30(6):335–343. https://doi.org/10.1097/jxx.0000000000000060.
54. Ansari K, Shamssain M, Farrow M, Keaney NP. Hospital-at-home care for exacerbations of chronic obstructive pulmonary disease: an observational cohort study of patients managed in hospital or by nurse practitioners in the community. *Chron Respir Dis*. 2009;6(2):69–74. https://doi.org/10.1177/1479972309102728.
55. Hall MH, Esposito RA, Pekmezaris R, et al. Cardiac surgery nurse practitioner home visits prevent coronary artery bypass graft readmissions. *Ann Thorac Surg*. 2014;97(5):1488–1493. https://doi.org/10.1016/j.athoracsur.2013.12.049. discussion 1493-1485.
56. Ornstein K, Smith KL, Foer DH, Lopez-Cantor MT, Soriano T. To the hospital and back home again: a nurse practitioner-based transitional care program for hospitalized homebound people. *Journal of the American Geriatrics Society*. 2011;59(3):544–551. https://doi.org/10.1111/j.1532-5415.2010.03308.x.
57. Ward KT, Reuben DB. *Comprehensive geriatric assessment*. Waltham, MA: UpToDate; 2016.
58. Naylor MD, Kurtzman ET. The role of nurse practitioners in reinventing primary care. *Health Aff (Millwood)*. 2010;29(5):893–899. https://doi.org/10.1377/hlthaff.2010.0440.
59. American Association of Nurse Practitioners. State Practice Environment: States Categorized By Type. *AANP*. 2020.. available at; https://www.aanp.org/advocacy/state/state-practice-environment. Accessed May 15th.
60. Li E, Kimmey L, Cheh V. Evaluation of the Independence at Home Demonstration. 2020.
61. Joynt Maddox KE, Chen LM, Zuckerman R, Epstein AM. Association Between Race, Neighborhood, and Medicaid Enrollment and Outcomes in Medicare Home Health Care. *J Am Geriatr Soc*. 2018;66(2):239–246. https://doi.org/10.1111/jgs.15082.
62. Weech-Maldonado R, Morales LS, Elliott M, Spritzer K, Marshall G, Hays RD. Race/ethnicity, language, and patients' assessments of care in Medicaid managed care. *Health Serv Res*. 2003;38(3):789–808.