

(0). Physician assistants and nurse practitioners in primary care plus: a systematic review

R.M.A. van Erp, PhD, HAN University of Applied Sciences, Verlengde Groenestraat 75, 6525 EJ, Nijmegen, the Netherlands, Reni.vanErp@han.nl

A.L. van Doorn, PhD, HAN University of Applied Sciences, Verlengde Groenestraat 75, 6525 EJ, Nijmegen, the Netherlands, Arna.vanDoornKlomborg@han.nl

G.T. van den Brink, MSc., HAN University of Applied Sciences, Verlengde Groenestraat 75, 6525 EJ, Nijmegen, the Netherlands, Geert.vandenBrink@han.nl

J.W.B. Peters, PhD, Master Advanced Nursing Practice, HAN University of Applied Sciences, Groenewoudseweg 1, 6524 TM, Nijmegen, the Netherlands, Jeroen.Peters@han.nl

M.G.H. Laurant, PhD, HAN University of Applied Sciences, Faculty of Health and Social Studies, Kapittelweg 33, 6525 EN, Nijmegen, the Netherlands, Miranda.Laurant@han.nl

A.J. van Vught, PhD, HAN University of Applied Sciences, Faculty of Health and Social Studies, Kapittelweg 33, 6525 EN, Nijmegen, the Netherlands, A.vanVught@han.nl

A.J. van Vught, PhD
HAN University of Applied Sciences
Kapittelweg 33, 6525 EN, Nijmegen
+316 52416018
A.vanVught@han.nl

Summary

Introduction: Shifting specialist care from the hospital to primary care/community care (also called primary care plus) is proposed as one option to reduce the increasing healthcare costs, improve quality of care and accessibility. The aim of this systematic review was to get insight in primary care plus provided by physician assistants or nurse practitioners.

Methods: Scientific databases and reference list were searched. Hits were screened on title/abstract and full text. Studies published between 1990–2018 with any study design were included. Risk of bias assessment was performed using QualSyst tool.

Results: Search resulted in 5.848 hits, 15 studies were included. Studies investigated nurse practitioners only. Primary care plus was at least equally effective as hospital care (patient-related outcomes). The number of admission/referral rates was significantly reduced in favor of primary care plus. Barriers to implement primary care plus included obtaining equipment, structural funding, direct access to patient-data. Facilitators included multidisciplinary collaboration, medical specialist support, protocols.

Conclusions and discussion: Quality of care within primary care plus delivered by nurse practitioners appears to be guaranteed, at patient-level and professional-level, with better access to healthcare and fewer referrals to hospital. Most studies were of restricted methodological quality. Findings should be interpreted with caution.

Keywords

Physician assistants, nurse practitioners, primary health care, systematic review, substitution of care, integrated care

(1). Introduction

While life expectancy of people living in Europe increases rapidly [1], the number of people with multiple chronic diseases (multimorbidity) increases along. One-third of the people aged 55 years and older experiences multimorbidity according to a Dutch general practitioner database [2]. The proportion of people of ≤ 65 years is expected to increase from 14% (2010) to 25% (2050) in the European region [1]. Therefore, the number of people with multimorbidity is expected to increase in the near future as well.

Patients with multimorbidity require specialist health care, which is usually provided in a hospital or a specialized clinic. Specialist care in the hospital setting can however be very expensive. In combination with the expected increase in patients with multimorbidity, Western countries face the need to change the health care system to control the increasing health care costs [3]. One option is integrating specialist care from the hospital setting to the primary care setting or community care setting; in other words, care provided at patients' home or close to patients' home.

In the past years many studies have been performed about integrated models of care provision, for example extensive care, transmurial care and collaborative care. The umbrella term for these models of care is integrated care. The aim of integrated care is achieving more care beyond the hospital walls, change in the size and shape of acute hospitals, and increased attention to prevention and population health [4]. Also primary care plus is a model of integrated care. In primary care plus, specialist care which was previously performed by a medical specialist in a hospital or (outpatient) clinic is now provided in primary care or community care, close to the patients' home [5]. This model is roughly equivalent to a patient-centred medical home programme as are common in the US, which provides comprehensive, coordinated and continuous primary care close to patient's home [6].

Primary care plus was developed with the aim of creating substitution and stimulating integrated care by allowing medical specialists to perform consultations within primary care. For example, a cardiologist providing a consultation in a general practitioner practice [7] which was previously provided in the hospital setting. In contrast to integrated care, primary care plus only focuses on substitution of specialist medical care usually performed by medical specialists from hospital to primary health care. Primary care plus has two goals; either preventing patients to be referred to a hospital (specialized screening and treatment), or earlier hospital discharge (specialized treatment). A potential advantage of primary care plus for patients is the prevention from hospitalization (and possibly over diagnosing), early discharge, and health care delivery close to or at patient's homes [8,9].

A recent systematic review of van Hoof et al. (2019) investigated the difference in effectiveness between specialist hospital care and primary care plus. Included initiatives were located in the UK (n=10), the Netherlands (n=3) and Spain (n=1,) [10]. They reported at least equal effectiveness, shorter waiting lists/times and higher patient satisfaction in favour of primary care plus. In these initiatives, specialist care was mainly provided by a medical specialist, whether or not in collaboration with a general practitioner. The question is whether other health care professionals such as a physician assistant or nurse practitioner could play a role in primary care plus.

Physician assistants and nurse practitioners both work at a Master degree level and are trained to take over medical tasks independently from doctors [11, 12]. Physician assistants work in the medical domain, which means that they provide patient consultations and visits (direct-patient care), but also develop or improve protocols and provide training to clinical colleagues (indirect patient care). Nurse practitioners, on the other hand, work in both the medical and the nursing domain. They primarily focus on specific diseases and become experts in that field. In the Netherlands, physician assistants and nurse practitioners work independently and are authorized to perform specified reserved medical procedures [13, 14].

Previous systematic reviews have shown that both professionals can effectively and safely provide tasks and responsibilities, which were usually performed by medical specialists [15, 16, 17]. To what extent substitution of specialist care by a physician assistant or nurse practitioner is possible or effective within primary care plus is less investigated. No systematic review has yet been performed which investigated the delivery of care by both professionals in primary care plus.

(1.2) Research aim

The aim of this systematic review was to provide an overview of studies evaluating primary care plus services provided by a physician assistant and/or nurse practitioner in a team of health care professionals. In particular, we were interested in the roles of both professionals within primary care plus, the effectiveness (at patient and professional level), costs and influencing factors (barriers and facilitators).

(2). Methods

(2.1) Design

A systematic review was performed according to the Cochrane Collaboration guidelines. Furthermore, it was registered in the International Register of Systematic Reviews (PROSPERO; available from <https://www.crd.york.ac.uk/PROSPERO/>; registration number: XXXX; XXXX).

(2.2) Eligibility criteria

Original national and international studies with any study design (either qualitative or quantitative), written in English or Dutch and published between January 1990 and 2018 as peer-reviewed article were eligible for the systematic review. Letters, personal stories, editorials, conference abstracts, reviews and meta-analyses were not included in the systematic review.

Studies had to investigate primary care plus which we defined as ‘specialist care which is usually provided by a medical specialist, physician assistant or nurse practitioner in a hospital, but which is now provided (or integrated) in primary care setting or community care’, face-to-face, by a physician assistant or nurse practitioner with specific expertise in this patient population.

Exclusion criteria for primary care plus included: solely “additional care” which is provided in addition to usual care, which has not been provided previously and which aims to increase the quality of care (e.g. heart failure screening or follow-up care after hospital discharge which was not provided before primary care plus was introduced); primary care provided by a physician assistant / nurse practitioner; substituted care from mental health services, nursing homes, hospice or rehabilitation centres to primary care; a nurse-led clinic in a hospital; telephone consultations by a hospital-based physician assistant / nurse practitioner; educational programs provided by a physician assistant / nurse practitioner to improve self-management of patients (e.g. patients learn to perform injections themselves); health care which would normally be provided by a practice nurse in the Dutch health care system (e.g. monitoring of patients with stable chronic diseases, including given advice and education according to evidence based protocols) [12].

Primary care plus had to be provided by a physician assistant and/or nurse practitioner qualified with a master’s degree (EQF 7). Since different synonyms are used for physician assistant and nurse practitioner, studies evaluating a Physician Assistant, Physician Associate, Nurse Specialist, Nurse Practitioner, Clinical Nurse Specialist, Advanced Practice Nurse or Advanced Nurse Practitioner were included. No restrictions were imposed on age, gender, ethnic or other demographic characteristics, or the number of years spent working. In addition, no restrictions were set for the patient population except that primary care plus service had to be provided by a physician assistant and/or nurse practitioner.

Primary outcomes of interest for the systematic review included “patient outcomes” (morbidity, mortality, health status, quality of life, patient satisfaction, patient compliance, referral to hospital, admission, and patient safety), “care outcomes” (health care activities/roles such as examination, advice, treatments; the quality of the health care; and facilitators and barriers), “provider outcomes” (job workload, job satisfaction, and the experiences of physician assistants / nurse practitioners / medical specialists), and “costs and cost-effectiveness” (including utilization of resources).

(2.3) Literature search

A search strategy was developed by multiple authors (XXXX) and optimized by an information specialist (XX) working at the XXXX (XXXX). The search strategy included a combination of indexed keywords such as Medical Subject Headings (MeSH) and text terms, which were searched on title/abstract (Appendix 1). Since there is no specific term for “primary care plus service” the search strategy included a broad range of related terms to increase the chance of identifying relevant studies (higher sensitivity, lower specificity). The search strategy included e.g. (Integrated) health care delivery, health care reform, consultation, liaison, hospital based home

care, and etcetera.

The information specialist conducted the search in February 2018 and used the following databases: CINAHL (EBSCO), Cochrane Database of Systematic Reviews (CDSR; Cochrane Library: Wiley), Embase (Ovid), PubMed (NLM; Internet, <http://www.ncbi.nlm.nih.gov/pubmed>) and Web of Science. At a later stage (February 2019), reference lists of included articles and (systematic) reviews were screened for additional eligible studies. Search records were downloaded, collected and de-duplicated using EndNote bibliographic software (Clarivate Analytics, Philadelphia, PA, U.S.A.). Afterwards, search records were exported to Rayyan QCRI [18] for the selection procedure.

(2.4) Study selection / selection methods

Three review authors (XXXX) performed the study selection procedure. Records were first sorted on relevance. Title and abstracts of the first 30 records were independently screened by all three review authors. Review authors discussed interpretation of eligibility criteria. Next, all records were sorted alphabetically and the first 1,500 records were independently screened by two reviewers on title/abstract. Screening results were discussed between the two review authors and if necessary, screened by a third review author to resolve disagreement. The remaining records (4,348 records) were divided over the three review authors and screened on title and abstract. Only in case of selection for inclusion and when in doubt for selection for inclusion, a second review author was involved for final inclusion. Next, all papers identified to be included based on title and abstract were full text screened. Again, records were divided over three review authors and screened. In case of selection for inclusion and when in doubt for selection for inclusion a second review author was involved for final decision (i.e. final inclusion of the study in the systematic review). Reference lists of included articles were subsequently screened on relevant articles. In addition, reference lists of relevant review articles derived from the search were screened as well.

(2.5) Risk of bias assessment

Two review authors (XXXX) performed the risk of bias assessment using the Quality Assessment Tool for Quantitative Studies (QualSyst tool) [19]. The QualSyst tool is developed by the Effective Public Health Practice Project (EPHPP, Canada) for Public Health purposes and can be used for the assessment of studies with varying study designs. It is therefore a suitable instrument to be used in this systematic review. The risk of bias assessment was performed by one review author and checked by another. Kmet et al (2004) defines studies with a sum score of ≥ 0.5 of adequate quality. We choose however not to exclude studies based on the sum score. The topic of this systematic review is in its infancy and therefore frequently studied in non-randomised studies and/or reported descriptively. Excluding studies with a low sum score would give a narrowed insight in the roles and tasks from physician assistants and nurse practitioners in primary care plus.

(2.6) Data extraction

One review author (XXXX) extracted data from the included studies using a predefined data extraction form for quantitative and qualitative data. Another review author (XXXX) checked the extracted data. Relevant extracted data included i.e. author, publication date, study design, participants, intervention(s), outcomes and results. In addition, and if deemed necessary, the corresponding author of the study was contacted to clarify extracted data. It was not possible (and not planned) to perform a meta-analysis as this systematic review allowed studies with varying research designs, populations, health care settings, interventions and outcomes.

(3). Results

The search resulted in 9,382 hits (Fig. 1). After de-duplicating, 5,848 hits remained and were screened on title and abstract. Of these, 152 hits were screened on full text. One additional hit was identified by checking reference lists of relevant systematic reviews. Eventually 15 studies, reported in 16 articles, met the inclusion criteria and were therefore included in the systematic review.

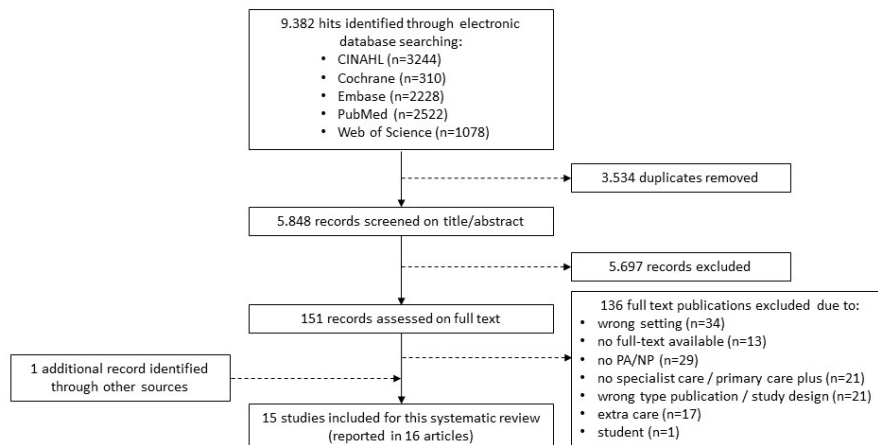


Fig. 1 Study flow diagram

PA = physician assistant, NP = nurse practitioner

(3.1) Characteristics of included studies

Included studies were performed in USA (n=5), Canada (n=1), New Zealand (n=2) and the United Kingdom (n=7). Study designs ranged from randomized controlled trials (RCT; n=3), pre-post single patient group designs (n=3), cohort studies (n=2), to observational descriptive studies (n=7). Publication date ranged between 2000 and 2016.

(3.2) Participants

All included studies investigated the implementation of a nurse practitioner in primary care plus (Table 1). No studies investigated the implementation of a physician assistant. Some studies used other synonyms for nurse practitioner (e.g. (clinical) nurse specialist, advanced practice nurse or advanced nurse practitioner). Since these professions all require a Master degree [11, 12], they are collectively mentioned as nurse practitioner in this systematic review. The number of nurse practitioners involved in the studies varied from one nurse practitioner to a team of nurse practitioners. Most studies lacked information about the characteristics of the nurse practitioners such as education level, years of working experience and the degree of autonomy. If they did report this, years of experience varied from 5 [8] to 25 years [20]. More than half of the studies reported supervision by medical specialists (e.g. family medicine physician, cardiologist, radiologist, clinical doctor) [8, 21-28]. Supervision occurred at weekly meetings or in case of complications. In addition to face-to-face consultations, two studies reported support by virtual technology (including webinars and telehealth), software (drawing tool and administration system), and/or decision-making tools (pocket-cards and summarized guideline templates) [29, 30]. Others did not report supervision nor supportive tools [9,20,31,32].

(3.3) Interventions

As described in the Introduction, primary care plus can be classified into two groups based on the goal of the intervention: (1) preventing referral to a hospital, or (2) stimulating early discharge from the hospital to the home situation. Most of the included studies, concentrated on the first goal (n=12). Care was usually regular hospital care integrated in primary care whether or not in combination with extra follow-up assessments. If primary care plus was compared with a control intervention, the control intervention consisted of usual specialist hospital care (Table 1). Primary care plus was mostly developed for patients with chronic and/or well-defined health issues, e.g. Chronic Obstructive Pulmonary Disease, hepatitis C virus, diabetes, kidney disease, lower gastrointestinal tract symptoms, heart disease, cancer, dystonia, and patients requiring IV antibiotics. Only few primary care plus interventions was developed for general illnesses / health care, e.g. palliative care for elderly with advanced illnesses, preterm infants, first aid, and family medicine.

Table 1. Characteristics of the included studies

NP = nurse practitioner; COPD = Chronic Obstructive Pulmonary Disease; N.A. = not applicable; NS = nurse specialist; RCT = Randomized Controlled Trial; CNS = clinical nurse specialist; ANP = advanced nurse practitioner; APN = advance practice nurse; RN = registered nurse, PN = practice nurse

(3.4) Risk of bias assessment

The risk of bias assessment resulted in a sum score ranging from 0.19 [27, 30] to 0.89 [28] (Table 2). Despite low sum scores, no studies were excluded from the analysis as mentioned in the methods section. As became clear, random allocation and blinding of investigators and subjects was not applicable in 12/15 included studies. Furthermore, the sample size was appropriate in two studies only [28, 31], and 4/15 studies controlled for confounding [9, 23, 25, 28]. Studies having a very low sum score [27, 30] both used a descriptive design in which the selection and characteristics of participants were insufficiently described, and results were not reported in sufficient detail.

Table 2. Risk of bias assessment

*Total sum = (number of “yes” * 2) + (number of “partials” * 1); total possible sum = 28 – (number of “n/a” * 2); summary score = total sum / total possible sum

(3.5) Outcomes

(3.5.1) Quality of care (patient-level)

Ten studies reported patient-related outcomes such as health status, mortality and satisfaction (Table 3). Of the studies that compared primary care plus with usual specialist hospital care, most reported no significant differences in patient-related outcomes between the interventions [9, 28, 31]. One exception was the study of McCorkle et al. (2000) who reported that the risk of death was doubled in patients receiving usual specialist hospital care as compared to primary care plus (adjusted hazard ratio 2.04; confidence interval 1.33-3.12). Furthermore, a significant higher 2-year survival rate for a specific subgroup of patients (late stage cancer) was found in favour of the primary care plus intervention (67% versus 40%, $p < 0.05$). Quality of life did not significantly differ between the interventions [25].

Of the studies in which the implementation of the primary care plus intervention was evaluated, without a comparison with usual specialist hospital care, reported that the health status of patients either significantly improved from baseline ($z = -2/390$, $p = 0.003$) [21] or remained stable [29]. However, the use of some medications increased significantly, e.g. aspirin ($p = 0.001$) [26], angiotensin-converting enzyme inhibitors / -receptor blockers and cholesterol-lowering medication (20% and 27% increase, respectively) [29].

Patient satisfaction was reported in five studies. Most patients were highly satisfied with the primary care plus intervention in general (not compared with usual specialist hospital care) [8, 24]. Patients reported good facilities and easy access of primary care plus [24]. They were satisfied with the early discharge [9], being treated at home [27] and the prevention from being admitted to the hospital [28]. When compared to usual specialist hospital care, patients from one study preferred primary care plus over usual specialist hospital care [28]. Almost two-third of the patients from another study also preferred primary care plus over usual specialist hospital care. Patients who did not prefer primary care plus reported concerns about being left alone at home [8].

Eleven studies reported on admission or referral rates. Three studies which statistically compared rates between primary care plus and usual specialist hospital care either reported no significant differences between the interventions (20% versus 20% at 6 months follow-up, $p = 0.96$) [9] or reported a significant reduction in the number of admission or referral rates in favor of the primary care plus (3% versus 14%, $p < 0.001$ [20], and $d = 0.75$, $p = 0.000$ [23]). The significant reduction in the study of Kemp et al. (2016) was potentially a consequence of the ability of the nurse practitioners to close wounds and to prescribe.

Two studies that compared admission or referral rates between primary care plus and usual care or the national average reported either a comparable number of readmission hospital rates (32% versus 27% [25]), or a substantial reduction (-28%) in 30-day hospital readmission and emergency department visits in favor of the primary care plus [32]. A third study reported a slight increased number of referrals to “external medical consultants” such as orthopedic, neurologic / neurosurgical, wheelchair assessment, general medical, counseling,

ENT and pain clinic (18/243 visits (7%; primary care plus) versus 13/210 visits (6%; usual specialist hospital care) [28]. They reported that the increased number of referrals seemed to be a consequence of the nurse practitioner having more time available during consultations and the ability to make a detailed appraisal of patients' needs.

Studies reporting referral rates of primary care plus to the hospital (without comparing rates with usual specialist hospital care) reported rates ranging from 1,66% - 72% [8, 21, 24, 26, 31]. Maruthachalam et al. (2006) furthermore reported that the median waiting time to the flexible sigmoidoscopy was more than halved when compared to the median waiting time to usual specialist hospital care prior to the implementation of primary care plus (35 versus 87 days). In addition, they reported that more capacity could be generated in the hospital by introducing primary care plus.

(3.5.2) Quality of care (professional-level)

Three studies investigated health care professional experiences with primary care plus services [8, 29, 30]. These studies did not compare outcomes with usual specialist hospital care. All three studies reported positive experiences expressed by nurse practitioners. Nurse practitioners reported e.g. good quality of care, satisfaction with the extent to which they were involved in decision-making [8] and being convinced of the value of primary care plus [30]. Nurse practitioners in one study mentioned that self-perceived confidence levels were however not always optimal [29]. To overcome this, additional medical specialists were added to the team. Another study also reported that the nurse practitioner profession was not always the most appropriate as some patients seemed too complex while other patients did not require specialized nurse practitioner care [8]. An appropriate selection of professionals and patients is therefore of significant importance.

(3.5.3) Costs

Four studies reported on costs related to primary care plus and usual specialist hospital care [20, 23, 24, 28]. These studies reported lower total costs per visit in favour of primary care plus [24, 28], reductions in total and variable costs for all hospitalizations in favour of primary care plus [23], and direct savings in total costs after implementing primary care plus [20]. Only two of these studies, however, statistically compared outcomes between the interventions. Whitaker et al. (2001) reported no significant difference in total cost per visit between the interventions, while Lukas et al. (2013) reported a significant reduction in total and variable costs for all hospitalizations in favour of the primary care plus intervention.

In addition, a fifth study reported costs of primary care plus but did not report nor compared this with usual specialist hospital care. Of notice is that this study needed to stop the primary care plus intervention after two years due to the fact there was lack of funding [21]. Overall, no results are reported about cost-effectiveness since no studies gathered information to perform a cost-effectiveness analysis.

(3.5.4) Facilitators and barriers

Six studies reported facilitators and or barriers related to the implementation of primary care plus. General barriers were the difficulty to obtain equipment and to receive structural funding for primary care plus [8, 21]. Some studies experienced difficulties in obtaining direct access to relevant patient information such as laboratory data or diagnostic tests [8, 29, 32]. In addition, the capacity of the nurse practitioner (e.g. part-time availability) as well as a part-time supply of patients negatively influenced a structural service in two studies [27, 32]. Two studies from the USA furthermore reported that nurse practitioners were not permitted to act autonomously, and physician referral or prescription was needed [21, 32]. In studies where nurse practitioners did have the permission to act autonomously, autonomy was experienced a facilitator [8]. Nurse practitioners in two studies reported to find it challenging to develop relationships with specialized staff or to set up a shared medical appointment [8, 29]. However, as soon as collaboration with multiple caregivers seemed successful, this was deemed a facilitator and a strength of primary care plus service [27, 29, 32]. Support from specialized medical specialists such as having meetings to review patients and tele monitoring improved early detection of patients and improved nurse practitioners' skills. Clear protocols about communication, assessment, co-ordination and management facilitated compliance of health care professionals and are therefore required for successful implementation of primary care plus provided by a nurse practitioner [29, 32].

Table 3. Outcomes of the included studies

FEV1 = Forced Expiratory Volume in the first second; NP = nurse practitioner.

(4). Discussion

This systematic review aimed to gather international literature to get insight in the role of nurse practitioners and physician assistants in primary care plus and in the effectiveness, costs and influencing factors (barriers and facilitators) when implementing primary care plus with nurse practitioners or physician assistants. In summary, this systematic review included 15 studies in which primary care plus was provided by one or more nurse practitioners [8, 9, 20-32]. No studies involved physician assistants. Nurse practitioners mostly worked in a team of professionals and often received supervision from a medical specialist. The majority of the studies aimed at preventing referral to a hospital. A few on early discharge. Overall, the quality of care, both at patient-level and professional-level, appears to be guaranteed with possibly better access to healthcare and fewer referrals to the hospital. When implementing or investigating primary care plus delivered by nurse practitioners, facilitators to optimize success should be taken into account such as the ability to obtain equipment, direct access to patient information, structural funding, collaboration with health care professionals and the ability of the nurse practitioner to work autonomously. Since many studies had an observational or descriptive design, findings should be interpreted with caution.

Regarding its effectiveness, no difference between primary care plus provided by a nurse practitioner and usual specialist hospital care was reported in patient-related outcomes such as health status or quality of life. Our findings are in line with findings of a recently published systematic review in which primary care plus delivered by medical specialists was equally or more effective in nearly all studies in improving health status as compared to usual specialist hospital care [10]. Systematic reviews in which care delivered by nurse practitioners or physician assistants was compared with medical specialists showed that these professionals seem to be able to provide specialist care of equal effectivity [15-17]. This was reported in healthcare for the aging population [16], in primary care [17], in secondary care, acute internal medicine, emergency medicine, trauma and orthopaedics, and mental health [15]. Overall, this underlines that nurse practitioners and physician assistants can provide specialist care effectively, regardless of the setting (hospital, nursing home, primary care or primary care plus).

Our systematic review showed that patients satisfied the primary care plus intervention as it was easy accessible, patients could be treated at home and they were prevented from hospitalisation. This was reported by studies that were nearly all of at least adequate methodological quality. The findings are furthermore in accordance with findings of the systematic review of van Hoof et al. (2016) who reported high patient satisfaction as well [10]. Van Hoof et al. (2019) furthermore reported shorter waiting times and fewer follow-up visits in primary care plus. Our systematic review found either an equal number of hospital referrals/(re-)admissions or a significantly reduced number when compared to usual specialist hospital care. The reduced number could partly rely on the skills and the ability of the nurse practitioner to work autonomously. If the nurse practitioner can perform specialist care in primary care plus such as wound closure and medication prescriptions, no referral to the hospital is needed. A reduction in the number of hospital referrals might in turn reduce waiting times in hospitals.

Only two studies (of high methodological quality) statistically compared costs between the interventions, showing varying results. This is in line with previous performed systematic reviews on substituting physician assistants and nurse practitioners with medical specialists [15-17] and a systematic review on shifting specialist care to primary care by medical specialists [10]. The varying results may be a consequence of the different indicators which were taken into account by calculating costs. For example, one study included in this systematic review calculated costs per visit [28], while another study calculated costs for hospitalisation (e.g. prescription, referral, salary of providers etcetera) [23]. The latter relates more to the number of patients that have been referred or treated in the hospital, while the former relates more to the direct cost of the provided health care itself. To be able to compare costs between interventions, as well as cost outcomes between studies, it should be recommended to analyse costs from a societal and health care sector perspective [33]. Such outcomes in turn, can be used for a cost-effectiveness analysis to determine which intervention should be provided. In this systematic review, no studies performed a cost-effectiveness analysis. Therefore, no conclusions can be drawn at this field.

(4.1) Methodological considerations

A strength of our systematic review was the help of an experienced information specialist in conducting the search. The enhanced search, in combination with a reference check at the end of the procedure, reduced the

risk of missing relevant articles. Another strength of the study was the fact multiple researchers were involved in the selection of articles, the risk of bias assessment and the data extraction. Involving multiple researchers reduces the risk of selection bias, inadequate risk of bias assessment, and incomplete data extraction. Defining primary care plus was, however, challenging. This was due to the fact health care is organized differently in each country. The Dutch health care system is divided into primary care (e.g. family practice) and secondary care (hospital care), and therefore primary care plus can be defined. During the selection procedure, review authors critically appraised whether specialist care was shifted from the hospital setting and integrated to primary care or home care setting. As described in the methods section, review authors discussed interpretation of eligibility criteria of the first 30 records (sorted on best matches) at the start of the selection procedure. Although this optimized the selection procedure, there is still a possibility that relevant studies have been interpreted wrongly and therefore have not been included in this systematic review. Furthermore, we excluded studies investigating solely newly developed “additional” care. Since primary care plus was not always completely identical to usual specialist hospital care and occasionally supplemented with additional care (e.g. McCorkle et al (2000)), this might have caused heterogeneity of the results of primary care plus. Another limitation is that most studies did not report characteristics of the nurse practitioner in detail. Therefore, it is not possible to rule out that all nurse practitioners in the included studies obtained a master’s degree (QLF 7). Most studies furthermore investigated care provided by one professional only (n=1). It may be questioned whether the studies investigated the effectiveness of the intervention or the performance of the individual professional. Finally, no studies were included investigating physician assistants in primary care. An explanation could be that the physician assistant profession in many countries is relatively new. Despite this, we hope health care professionals and researchers will set up and conduct studies about potentials roles of physician assistants in future. Physician assistants in many countries can have similar roles and rights as nurse practitioners [13, 14], and could therefore be of value in primary care plus.

As became clear in this systematic review, primary care plus provided by nurse practitioners is investigated in only a few studies yet and with restricted methodological quality. Most studies used a descriptive design and reported selection procedures, population characteristics and results in insufficient detail. For future, it is recommended to perform cost-effectiveness studies comparing a team of nurse practitioners in primary care plus with usual care in hospitals. Such studies are needed to draw firm conclusions about the potential of nurse practitioners as well as physician assistants in primary care plus.

(4.2) Conclusions

This systematic review shows that primary care plus, an elaboration of integrated care models, provided by a nurse practitioner is still in its infancy, but seems a potential opportunity for well-defined patient populations. The quality of care, both at patient-level and professional-level, appears to be guaranteed with possibly better access to healthcare and fewer referrals to the hospital. Since most studies had an observational or descriptive design, and the methodological quality was restricted, findings should be interpreted with caution. No studies were found reporting on physician assistants in primary care plus. More practices with physician assistants and nurse practitioners in primary care plus should be implemented and evaluated systematically, including a cost-effectiveness analysis. This systematic review will help policy makers and professionals to discuss about shifting specialist care from hospitals to primary or community care, at or close to patients’ home and within this the potential role of physician assistants and nurse practitioners.

(5). Acknowledgements

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Table 1. Characteristics of the included studies

Study	Country	Design	Participants	Education/rights	Specialization	Primary care plus	Control intervention	Aim
Ansari et al. (2009)	UK	Observational cohort study	NP (a team)	N.R.	COPD	Urgent Care Team (a team of NPs) provides 'hospital-at-home' to patients with an acute exacerbation of COPD. NP treats patients with nebulized bronchodilators, prednisolone and doxycycline. Support: N.R.	Usual hospital care	Preventing referral
Bookbinder et al. (2011)	USA	Descriptive study	NP (n=1)	Advanced training in palliative care	Palliative care	Palliative home care team (secondary care NP and social worker) provides consultation and direct home care for homebound elderly with advanced illnesses. Support: Department of Pain Medicine and Palliative Care (nursing, social work, and medicine).	N.A.	Preventing referral
Gunn et al. (2000)	New Zealand	RCT	NS (a team)	Specially skilled nurses with neonatal nursing experience	Preterm infants	Team of NSs provides home support for preterm infants (daily home care visits for 7-10 days after early discharge, including weekends), and are 24h a day available by telephone. Support: N.R.	Routine care; hospital care and daily standard home care including home visits / telephone contact by home care nurses for 5 weekdays after discharge.	Early discharge
Jack et al. (2008)	UK	Descriptive study	CNS (n=1)	CNS does not prescribe opiate substitutes	Hepatitis C virus (HCV)	CNS in hepatitis forms a partnership with drug workers and GPs in a general practice. The CNS provides HCV consultations (screening, diagnosing and treatment). Supervision: secondary-care-based consultant in infectious diseases.	N.A.	Preventing referral
Kemp, A.E. (2016)	UK	Observational study	ANP (n=1)	An independent prescriber and accredited prehospital care practitioner; have master's level post-registration qualifications.	First aid	ANP works alongside an event medical team (paramedics and first aiders) at a mass-gathering event. ANP assesses, diagnoses, and provides treatments and advice (e.g. wound closures, prescribe medication). Support: N.R.	Usual care provided by the event medical team (without ANP).	Preventing referral
Lemelin et al. (2007)	Canada	Descriptive study	NP (n=6)	Licensed as extended class RN's; educated as Primary Care NP's	Family Medicine	NPs provide daily home visits and telephone contact. The NPs performs physical examination and initiates care provision; rehabilitative and supportive care, including education, coordination of services, and counseling. Support and supervision: Family Medicine physicians.	N.A.	Preventing referral
Lucatorto et al. (2016)	USA	Pilot study, Pre-post, single-patient group design	NP (n=1)	Nurses with advanced training and scopes of practice that include diagnosing disease and prescribing treatment	Diabetes and chronic kidney disease	Advanced Practice Registered Nurse (APRN)-Led Specialty Care Team for patients with diabetes and chronic kidney disease. The APRN-team consists of a NP, RN, licensed PN, RN certified diabetes educator, registered dietitian and clinical pharmacist. NP provides clinical examination and medication adjustment, is responsible for communicating the team plan, treatment changes, and summary of care to the primary care provider. Support: virtual technology and clinical decision making tools.	N.A.	Preventing referral
Lukas et al. (2013)	USA	Pre-post, single-group design	NP (n=3)	N.R.	Palliative care	Physicians and NPs within a palliative medicine practice for elderly with advanced complex illness. Outpatient arm provides home-based, non-hospice palliative medicine consultation and management. NPs deliver direct care, e.g. symptom management, advanced care planning, goal-directed care and care coordination. Support: collaborating physician (20%).	Usual care (situation prior to the introduction of the palliative medicine practice)	Preventing referral
Maruthachalam et al. (2006)	UK	Observational study	NS (n=1)	N.R.	Flexible sigmoidoscopy	Flexible sigmoidoscopy clinic developed at GP practice. Secondary care personnel delivers care; nurse endoscopist, colorectal nurse specialist, endoscopy nurse and auxiliary nurse. The colorectal NS manages benign conditions (e.g. haemorrhoids	Secondary care	Preventing referral

McCorkle et al. (2000)	USA	RCT	APN (multiple)	Masters- prepared clinicians	Post-surgical cancer	and anal fissures), provides verbal and written advice, books follow-up appointments. Support: protocols, contact with physician, weekly meetings to review patients (lead consultant and nurse endoscopist). APNs deliver 4-week specialized home care to post-surgical older patients with cancer (3 home visits, 5 telephone contacts). APNs provide education (43%), assessment and monitoring health status (25%), psychological support (16%), referrals (11%), others (5%). APNs are 24/7 available. Support: standardized protocol, physicians.	Usual post-operative hospital care and routine follow-up care in an ambulatory setting	Early discharge
McLachlan et al. (2015)	New Zealand	Cohort study (descriptive)	NP (n=1)	NPs can practice autonomously or as part of team, and have prescribing rights	Post-surgical heart valve	NP-led clinic in community-based ambulatory care setting for patients following valve repair / replacement who require long-term follow-up. NP assesses patients annually / biannually, prepares review letter. Support and supervision: senior cardiologist (patient reviewing).	N.A.	Preventing referral
Moore, J.A. (2016)	USA	Pre-post, single- group design	NP (n=2)	Depending on state: license for prescribing rights and full practice authority	Congestive heart failure	NP-led home-based clinic pathway for patients with congestive heart failure (5 days/week home visits, tele monitoring and weekly telephone contacts). Interdisciplinary team is involved including NPs, RNs, physiotherapists, occupational therapists, a dietician, pharmacists, social workers, and home health aides. NP provides history assessments, physical assessments, education, reconciles medication, reviews clinical pathway and CHF self-management tool, teaches and reviews tele monitoring equipment, and reviews tele monitoring data and follow-up. Support is not reported.	Usual care (situation prior to the introduction of the clinic pathway)	Preventing referral
Regan & Morgan (2015)	UK	Descriptive study	ANP (n=2)	N.R.	Intravenous antibiotic service	Community-based service by two ANPs and core district nursing service for patients requiring IV antibiotics. ANPs assess patients, visits patients at home, functions as clinical leads and coordinators, promote the service in secondary care, and provide training and support for the district nursing team. Consultant in secondary care keeps final responsibility for patients. Support: radiologist, microbiologists and pharmacists.	N.A.	Early discharge
Tozer & Lugton (2007)	UK	Descriptive study	NS (n=2)	N.R.	Genetic cancer screening	Nurse-led community service for people concerned about cancer. NS assesses the level of familial cancer risk, triages and refers patients, writes personalized letters, and provides advice. Support: innovative software.	N.A.	Preventing referral
Whitaker et al. (2001)	UK	RCT	NP (n=1)	N.R.	Botulinum toxin injection for Dystonia	NP provides botulinum toxin injections at home. NP is allowed to make external medical, nursing, or therapy referrals. Support: clinical doctors.	Usual care (injections provided by medical staff in the outpatient clinic)	Preventing referral

NP = nurse practitioner; COPD = Chronic Obstructive Pulmonary Disease; N.R. = not reported; N.A. = not applicable; NS = nurse specialist; RCT = Randomized Controlled Trial; CNS = clinical nurse specialist; ANP = advanced nurse practitioner; APN = advance practice nurse; RN = registered nurse, PN = practice nurse

Table 2. Risk of bias assessment

Studies	Question	Study design	Selection	Subject characteristics	Random allocation	Blinding investigators	Blinding subjects	Outcome	Sample size	Analytic methods	Estimate of variance	Confounding	Results	Conclusion	Summary score*
Ansari et al. (2009)	2	1	1	2	n/a	n/a	n/a	2	2	2	2	0	2	2	18/22 = 0.82
Bookbinder et al. (2011)	1	1	1	2	n/a	n/a	n/a	2	1	2	2	1	2	2	17/22 = 0.77
Gunn et al. (2000)	2	2	2	2	2	n/a	n/a	2	1	2	0	2	2	2	21/24 = 0.88
Jack et al (2008)	1	1	1	1	n/a	n/a	n/a	1	n/a	n/a	n/a	n/a	1	0	6/14 = 0.43
Kemp, A.E. (2016)	2	2	2	1	n/a	n/a	n/a	2	1	2	n/a	0	2	1	15/20 = 0.75
Lemelin, J. et al (2007)	2	2	1	2	n/a	n/a	n/a	1	n/a	n/a	n/a	n/a	2	1	11/14 = 0.79
Lucatorto et al. (2016)	0	1	1	1	n/a	n/a	n/a	1	n/a	n/a	n/a	n/a	1	0	5/14 = 0.36
Lukas et al. (2013)	2	2	2	2	n/a	n/a	n/a	2	1	2	1	2	2	1	19/22 = 0.86
Maruthachalam et al. (2006)	1	2	2	1	n/a	n/a	n/a	1	1	n/a	n/a	n/a	2	1	11/16 = 0.69
McCorkle et al. (2000)	2	2	2	2	2	0	0	2	1	2	2	2	2	2	23/28 = 0.82
McLachlan et al. (2015)	2	2	1	2	n/a	n/a	n/a	2	n/a	2	2	0	2	2	17/20 = 0.85
Moore, J.A. (2016)	2	1	1	1	n/a	n/a	n/a	2	0	1	2	0	2	2	14/22 = 0.64
Regan & Morgan (2015)	1	1	0	0	n/a	n/a	n/a	0	0	n/a	n/a	n/a	0	2	3/16 = 0.19
Tozer & Lugton (2007)	1	1	0	0	n/a	n/a	n/a	n/a	n/a	0	0	n/a	0	1	3/16 = 0.19
Whitaker et al. (2001)	2	2	2	2	2	2	0	1	2	2	2	2	2	2	25/28 = 0.89

*Total sum = (number of "yes" * 2) + (number of "partials" * 1); total possible sum = 28 - (number of "n/a" * 2); summary score = total sum / total possible sum

Table 3. Outcomes of the included studies

Study	Patient outcomes (morbidity, mortality, health status, quality of life, patient satisfaction, patient compliance, and patient safety)	Provider outcomes (job workload, job satisfaction, and the experiences of PAs/APNs)	Costs and cost-effectiveness (including utilization of resources)	Care outcomes (health care activities/roles such as examination, advice, treatments; the quality of the health care; and facilitators and barriers)
Ansari et al. (2009)	<p>Health status FEV₁% pred. (intervention) baseline: 46.9±19.8, follow-up: 48.1±21.6; FEV₁% pred. (comparison) baseline: 45.9±19.0, follow-up: 53.5±18.2.</p> <p>Admission 1/60 patients in the intervention group (UCT) required admission to hospital within 10 days.</p>	-	-	
Bookbinder et al. (2011)	<p>Health status N=45 sign. reduction in physical symptom subscale score (z=-2/390, p=0.003).</p> <p>Admission N=27 (22%) referred from the intervention to hospice. N=32 active cases transitioned to other services for continued care.</p>	-	<p>Costs APN 350 visits (\$67,000 total yearly reimbursement), 140 first time visits (\$238 per visit), 17 inpatient visits (\$300 per visit), 193 follow-up visits (\$102-170 per visit)</p>	<p>Barriers Obtaining services, reimbursement for NP, acquisition of new patients, geographic distribution of patients, no. of visits, medical management by the NP.</p>
Gunn et al. (2000)	<p>Health status Breastfeeding rate or amount, ns.</p> <p>Patient satisfaction Majority satisfied intervention (early discharge).</p> <p>Admission Re-admission to hospital: 6 wk.: 8.8% vs. 11.9%, p=0.37; 6 mo.: 20.2% vs. 20.3%, p=0.96.</p>	-	-	-
Jack et al (2008)	<p>Patient compliance Attendance rate intervention: >85% (usually <40%). Compliance with therapy was good.</p>	-	-	-
Kemp, A.E. (2016)	<p>Admission Referral to local health care resources: 0.03 (23; 3.5%) vs. 0.12 (105; 16.1%), p<.001). Referral to hospital: 0.02 (20; 3.2%) vs. 0.11 (91; 14%), p<.001). Ambulance transport to hospital rate: 0.01 (11; 1,7%) vs. 0.06 (47; 7,2%), p<.001).</p>	-	<p>Costs Estimated direct savings = £22,066.</p>	-
Lemelin, J. et al (2007)	<p>Patient satisfaction High levels of satisfaction = 88-100%. Preferred site = 63% at home, 37% hospital.</p> <p>Adverse events N=0 adverse events or mortality.</p> <p>Admission N=2 re-admitted to the inpatient service.</p>	<p>Experiences physicians Virtually all: at least satisfied with intervention. 88% = did not affect/affect in a positive way practice routine.</p> <p>Experiences NP All: very good quality of care. Majority: satisfied participation in decision-making. Some patients too ill for NP-profession, others not requiring NP-expertise.</p>	-	<p>Facilitators NP could act autonomously.</p> <p>Barriers No direct access to diagnostic tests and specialists, challenges in developing relationships, defining roles and establishing program 'buy-in' with medical staff.</p>
Lucatorto et al. (2016)	<p>Health status Hemoglobin A_{1c} and eGFR stages remained stable.</p> <p>Medication</p>	<p>Experiences NP Self-perceived confidence (diabetes) = 6.2; self-perceived confidence (renal disease) = 4.7; past experiences was related to higher confidence levels.</p>	-	<p>Facilitators Printed materials, collaboration, teamwork, experience, expertise, benchmarking, chance to network.</p> <p>Barriers</p>

	Angiotensin-convertin enzyme inhibitors / angiotensin receptor blockers: 20% increase; cholesterol-lowering medication: 27% increase; insulin: 10% increase; NSAIDs: 7% decrease.			Diverse patients, time to get lab. data, complexity of setting up shared medical appointment, patient transport issues.
Lukas et al. (2013)	Admission Sign. reduction in: no. of hospitalization ($p=0.000$, $d=0.75$), no. of days in hospital ($p=0.000$, $d=0.81$), 30-day readmission ($p=0.02$, $OR=1.66$). No sign. reduction in: emergency department visits (ns , $OR=1.20$).	-	Costs Sign. reduction in: total costs for hospitalisation ($p=0.000$, $d=0.52$), variable costs for hospitalisation ($p=0.000$, $d=0.53$)	-
Maruthachalam et al. (2006)	Patient satisfaction 99% = satisfied clinic service ($n=447$), 76% = had service on time ($n=342$). Patients were willing to be investigated: less anxiety, better facilities, easier access. Admission to flexible sigmoidoscopy Median time in clinic = 35 days (range 1-180), in hospital = 87 days (range NR). Admission to hospital after flexible sigmoidoscopy 72% referral ($n=716$), 28% no referral ($n=284$).	-	Costs Flexible sigmoidoscopy in clinic = £270; flexible sigmoidoscopy in hospital = £396 (including equipment, salary, capital costs, costs for consumables)	-
McCorkle et al. (2000)	Risk of death Adjusted hazard ratio 2.4; CI 1.33-3.12; $p=.001$. 2-year survival rate Early stage patients = 90.3% versus 87.6%, ns . Late stage patients = 67% versus 40%, $p<0.05$. Quality of life No difference between intervention and usual care. Admission 32% intervention versus 27% usual care.	-	-	-
McLachlan et al. (2015)	Medication Sign. increase in aspirin use ($p=0.001$), but not statin, angiotensin converter enzyme inhibitor, calcium channel blocker, beta blocker, thiazide and angiotensin receptor blocker ($p>0.05$). Adverse events 2% stroke ($n=9$), 4% died ($n=18$). Admission / referral 4% referred to cardiologist ($n=18$), 1% redo valve surgery ($n=6$), 1.5% required urgent admission ($n=7$).	-	-	-
Moore, J.A. (2016)	Admission Intervention results in substantial reduction (-28%) in 30-day hospital readmission and emergency department visits.	-	-	Facilitators Daily interactions, tele monitoring, weekly interdisciplinary home health meetings, staff involvement, informative brochures. Barriers Lack of notification new patients, handwritten medical visit information, NP part-time availability, restrictive NP practice privileges.

Regan & Morgan (2015)	<p>Patient satisfaction 1/8 patients stated: 'This is an excellent idea. I feel a lot better in myself by being treated at home. I was in hospital for five wk., only needing one injection a day, and I was getting very frustrated.</p>	-	-	<p>Barriers Unpredictable, sporadic transfers to service, weekends and bank holidays, limited capacity and skills.</p> <p>Facilitators Multidisciplinary professional engagement, communication with medical lead, communication pathways, assessment, co-ordination and patient management.</p>
Tozer & Lugton (2007)	-	<p>Experiences clinicians Clinicians: in favor of the revised pathway. Nurses: convinced of its value. PCT team: has potential to become cost effective.</p>	-	<p>Barriers Distance travelled per visit varied (range 2-99 miles).</p>
Whitaker et al. (2001)	<p>Effectiveness No sign. differences in efficacy, duration and no. of treatments. Time between injection and reinjection was lower in intervention (1.5 wk.) than usual care (3.8 wk.).</p> <p>Patient satisfaction Home service was preferred over usual care (p=0.001), efficacy improved (p=0.001).</p> <p>Adverse events Similar in both groups except for sign. less dysphagia (p=0.018) in the home group (7 versus 24 occasions).</p> <p>Admission N=1 (intervention) was referred back</p>	-	<p>Costs Total cost per visit was not sign. different between the home injection group (\$36.90/£23.36) and clinic group (\$79.00/£50.01).</p>	-

FEV1 = Forced Expiratory Volume in the first second; NP = nurse practitioner.

APPENDIX 1. SEARCH STRATEGY

CINAHL (EBSCO)

- S1 (MH "Physician Assistants") OR (MH "Clinical Nurse Specialists") OR (MH "Advanced Practice Nurses") OR (MH "Nurse Practitioners+") OR (MH "Advanced Nursing Practice") OR (TI ((physician* N1 (assistant* OR associate* OR extender* OR substitute*)) OR (advance* W1 (provider* OR nurs * OR practice*)) OR (((non OR none) W1 physician*) OR nonphysician* OR Midlevel OR (mid W1 level)) W2 (clinic* OR profes-sional* OR provider* OR worker* OR personnel OR practitioner* OR staff OR specialist* OR (first W1 assis-tant*)) OR ((Clinical OR doctor*) W1 assistant*) OR ((nurs* OR Specialist OR emergency) W1 practi-tioner*) OR (Nurse N1 (clinician* OR specialist*)) OR (Academic N1 nurs*) OR APN OR APNS OR Feldsher)) OR (AB ((physician* N1 (assistant* OR associate* OR extender* OR substitute*)) OR (advance* W1 (pro-vider* OR nurs * OR practice*)) OR (((non OR none) W1 physician*) OR nonphysician* OR Midlevel OR (mid W1 level)) W2 (clinic* OR professional* OR provider* OR worker* OR personnel OR practitioner* OR staff OR specialist* OR (first W1 assistant*)) OR ((Clinical OR doctor*) W1 assistant*) OR ((nurs* OR Spe-cialist OR emergency) W1 practitioner*) OR (Nurse N1 (clinician* OR specialist*)) OR (Academic N1 nurs*) OR APN OR APNS OR Feldsher)) OR (SU ((physician* N1 (assistant* OR associate* OR extender* OR sub-stitute*)) OR (advance* W1 (provider* OR nurs * OR practice*)) OR (((non OR none) W1 physician*) OR nonphysician* OR Midlevel OR (mid W1 level)) W2 (clinic* OR professional* OR provider* OR worker* OR personnel OR practitioner* OR staff OR specialist* OR (first W1 assistant*)) OR ((Clinical OR doctor*) W1 assistant*) OR ((nurs* OR Specialist OR emergency) W1 practitioner*) OR (Nurse N1 (clinician* OR special-ist*)) OR (Academic N1 nurs*) OR APN OR APNS OR Feldsher*))
- S2 (MH "Home Health Care+") OR (MH "Health Care Delivery, Integrated") OR (MH "Health Care Reform") OR (MH "Hospital-Physician Joint Ventures") OR (MH "Shared Services, Health Care") OR (TI (((Transmural OR Integrat*) N2 (care OR health* OR service*)) OR (((Co W1 located) OR Shifting OR Substitution) N1 care) OR (consultation N1 liaison*) OR (Nurs* N1 led*) OR Nurseled* OR (Hospital N1 Based N1 Home N1 Car*) OR (relocation N2 (service* OR care)) OR ((care OR health*) N1 Reform*))) OR (AB (((Transmural OR Inte-grat*) N2 (care OR health* OR service*)) OR (((Co W1 located) OR Shifting OR Substitution) N1 care) OR (consultation N1 liaison*) OR (Nurs* N1 led*) OR Nurseled* OR (Hospital N1 Based N1 Home N1 Car*) OR (relocation N2 (service* OR care)) OR ((care OR health*) N1 Reform*))) OR (SU (((Transmural OR Inte-grat*) N2 (care OR health* OR service*)) OR (((Co W1 located) OR Shifting OR Substitution) N1 care) OR (consultation N1 liaison*) OR (Nurs* N1 led*) OR Nurseled* OR (Hospital N1 Based N1 Home N1 Car*) OR (relocation N2 (service* OR care)) OR ((care OR health*) N1 Reform*)))
- S3 MH "Primary Health Care" OR (TI (primary N1 (care OR health*))) OR (AB (primary N1 (care OR health*))) OR (SU (primary N1 (care OR health*)))
- S4 MH "Hospitals+" OR MH "Secondary Health Care" OR (TI (hospital OR hospitals OR (secondary N1 (care OR health*))) OR (AB (hospital OR hospitals OR (secondary N1 (care OR health*)))) OR (SU (hospital OR hospi-tals OR (secondary N1 (care OR health*))))
- S5 S3 AND S4
- S6 S2 OR S5
- S7 S1 AND S6

Cochrane Database of Systematic Reviews

- #1 ((physician* NEAR/1 (assistant* OR associate* OR extender* OR substitute*)) OR (advance* NEAR/1 (pro-vider* OR nurs * OR practice*)) OR (((non OR none) NEAR/1 physician*) OR nonphysician* OR Midlevel OR (mid NEAR/1 level)) NEAR/2 (clinic* OR professional* OR provider* OR worker* OR personnel OR prac-titioner* OR staff OR specialist* OR (first NEAR/1 assistant*)) OR ((Clinical OR doctor*) NEAR/1 assis-tant*) OR ((nurs* OR Specialist OR emergency) NEAR/1 practitioner*) OR (Nurse NEAR/1 (clinician* OR specialist*)) OR (Academic NEAR/1 nurs*) OR APN OR APNS OR Feldsher):ti,ab,kw
- #2 (((Transmural OR Integrat*) NEAR/2 (care OR health* OR service*)) OR (((Co NEAR/1 located) OR Shifting OR Substitution) NEAR/1 care) OR (consultation NEAR/1 liaison*) OR (Nurs* NEAR/1 led*) OR Nurseled* OR (Hospital NEAR/1 Based NEAR/1 Home NEAR/1 Car*) OR (relocation N2 (service* OR care)) OR ((care OR health*) NEAR/1 Reform*)):ti,ab,kw

- #3 (primary NEAR/1 (care OR health*)):ti,ab,kw
- #4 (hospital OR hospitals OR (secondary NEAR/1 (care OR health*))):ti,ab,kw
- #5 #3 AND #4
- #6 #2 OR #5
- #7 #1 AND #6

Embase (Ovid)

- 1 physician assistant/ OR nurse specialist/ or advanced practice nurse/ or clinical nurse specialist/ OR exp nurse practitioner/ OR advanced practice nursing/ OR ((physician* ADJ1 (assistant* OR associate* OR extender* OR substitute*)) OR (advance* ADJ1 (provider* OR nurs* OR practice*)) OR (((non OR none) ADJ1 physician*) OR nonphysician* OR Midlevel OR (mid ADJ1 level)) ADJ2 (clinic* OR professional* OR provider* OR worker* OR personnel OR practitioner* OR staff OR specialist* OR (first ADJ1 assistant*))) OR ((Clinical OR doctor*) ADJ1 assistant*) OR ((nurs* OR Specialist OR emergency) ADJ1 practitioner*) OR (Nurse ADJ1 (clinician* OR specialist*)) OR (Academic ADJ1 nurs*) OR APN OR APNS OR Feldsher).ti,ab,kw.
- 2 exp home care/ OR integrated health care system/ OR (((Transmural OR Integrat*) ADJ2 (care OR health* OR service*)) OR (((Co ADJ1 located) OR Shifting OR Substitution) ADJ1 care) OR (consultation ADJ1 liaison*) OR (Nurs* ADJ1 led*) OR Nurseled* OR (Hospital ADJ1 Based ADJ1 Home ADJ1 Car*) OR (relocation ADJ2 (service* OR care)) OR ((care OR health*) ADJ1 Reform*)):ti,ab,kw.
- 3 primary medical care/ OR (primary ADJ1 (care OR health*)):ti,ab,kw.
- 4 exp secondary health care/ OR (hospital OR hospitals OR (secondary ADJ1 (care OR health*))):ti,ab,kw.
- 5 3 AND 4
- 6 2 OR 5
- 7 1 AND 6
- 8 limit 7 to conference abstract status
- 9 7 NOT 8
- 10 limit 9 to yr="1990 -Current"

PubMed

- #1 "Physician Assistants"[mesh] OR physician assistant*[tiab] OR physician associate*[tiab] OR physician extender*[tiab] OR physicians assistant*[tiab] OR physicians extender*[tiab] OR physician substitute*[tiab] OR "nurse practitioners"[mesh] OR "Advanced Practice Nursing"[mesh] OR advance nurs*[tiab] OR advanced nurs*[tiab] OR nurse practitioner*[tiab] OR "Nurse Specialists"[Mesh] OR Nurse clinician*[tiab] OR Nurse specialist*[tiab] OR Academic nurs*[tiab] OR APN[tiab] OR APNS[tiab] OR APN S[tiab] OR specialist nurs*[tiab] OR Assistant physician*[tiab] OR advance practi*[tiab] OR advanced practi*[tiab] OR advanced providers[tiab] OR emergency practitioner*[tiab] OR feldsher*[tiab] OR mid level clinicians[tiab] OR mid level health care professionals[tiab] OR mid level health care provider*[tiab] OR mid level health care workers[tiab] OR mid level health professionals[tiab] OR mid level health providers[tiab] OR mid level health workers[tiab] OR mid level healthcare workers[tiab] OR mid level medical workers[tiab] OR mid level personnel[tiab] OR mid level practitioners[tiab] OR mid level professionals[tiab] OR mid level provider[tiab] OR mid level staff[tiab] OR mid level workers[tiab] OR midlevel clinician*[tiab] OR midlevel health care professional*[tiab] OR midlevel health care provider*[tiab] OR midlevel health care[tiab] OR midlevel health provider*[tiab] OR midlevel health worker*[tiab] OR midlevel personnel[tiab] OR midlevel practitioner*[tiab] OR midlevel professional*[tiab] OR midlevel provider*[tiab] OR non physician clinic staff[tiab] OR non physician clinicians[tiab] OR non physician first assistants[tiab] OR non physician health care personnel[tiab] OR non physician health care professionals[tiab] OR non physician health care providers[tiab] OR non physician health care workers[tiab] OR non physician health professionals[tiab] OR non physician health providers[tiab] OR non physician health workers[tiab] OR non physician healthcare professionals[tiab] OR non physician healthcare providers[tiab] OR non physician healthcare workers[tiab] OR non physician medical personnel[tiab] OR non physician personnel[tiab] OR non physician practice staff[tiab] OR non physician primary care providers[tiab] OR non physician professionals[tiab] OR non phy-

sician provider[tiab] OR non physician providers[tiab] OR nonphysician clinic*[tiab] OR nonphysician medical personnel[tiab] OR nonphysician personnel[tiab] OR nonphysician practitioner*[tiab] OR nonphysician primary care clinicians[tiab] OR nonphysician primary care providers[tiab] OR nonphysician specialists[tiab] OR nonphysician staff[tiab] OR Clinical assistant*[tiab] OR Doctor s assistant*[tiab] OR Doctors assistant*[tiab] OR Specialist practitioner*[tiab]

- #2 "Home Care Services"[Mesh:NoExp] OR "Home Care Services, Hospital-Based"[Mesh] OR "Delivery of Health Care, Integrated"[Mesh] OR "Hospital-Physician Joint Ventures"[Mesh:NoExp] OR Integrated care[tiab] OR Integrated health*[tiab] OR Substitution of care[tiab] OR Shifting care[tiab] OR Co-located care[tiab] OR consultation liaison*[tiab] OR transmural care[tiab] OR transmural health care[tiab] OR integrated service*[tiab] OR "Int J Integr Care"[ta] OR care integration*[tiab] OR integrated comprehensive car*[tiab] OR Integrated Managed Car*[tiab] OR integrated primary care[tiab] OR Nurse led*[tiab] OR Nursing led*[tiab] OR Nurseled*[tiab] OR Care substit* OR Hospital Based Home Car*[tiab] OR relocation of service*[tiab] OR relocation of care*[tiab] OR care relocation*[tiab] OR services relocation*[tiab] OR "Health Care Reform"[Mesh] OR Healthcare Reform*[tiab] OR care Reform*[tiab] OR health reform*[tiab]
- #3 "Primary Health Care"[Mesh:NoExp] OR primary care[tiab] OR primary health*[tiab]
- #4 "Hospitals"[Mesh] OR "Secondary Care"[Mesh] OR hospital[tiab] OR hospitals[tiab] OR secondary care[tiab]
- #5 #3 AND #4
- #6 #2 OR #5
- #7 #1 AND #6

Web of Science

- #1 TS=((physician* NEAR/1 (assistant* OR associate* OR extender* OR substitute*)) OR (advance* NEAR/1 (provider* OR nurs * OR practice*)) OR (((("non" OR "none") NEAR/1 physician*) OR nonphysician* OR Midlevel* OR ("mid" NEAR/1 "level")) NEAR/2 (clinic* OR professional* OR provider* OR worker* OR "personnel" OR practitioner* OR "staff" OR specialist* OR ("first" NEAR/1 assistant*))) OR ((("Clinical" OR doctor*) NEAR/1 assistant*) OR ((nurs* OR "Specialist" OR "emergency") NEAR/1 practitioner*) OR ("Nurse" NEAR/1 (clinician* OR specialist*)) OR ("Academic" NEAR/1 nurs*) OR "APN" OR "APNS" OR Feldsher*))
- #2 TS=(((("Transmural" OR Integrat*) NEAR/2 ("care" OR health* OR service*)) OR (((("Co" NEAR/1 "located") OR "Shifting" OR "Substitution") NEAR/1 "care") OR ("consultation" NEAR/1 liaison*) OR (Nurs* NEAR/1 led*) OR Nurseled* OR ("Hospital" NEAR/1 "Based" NEAR/1 "Home" NEAR/1 Car*) OR ("relocation" N2 (service* OR "care")) OR ((("care" OR health*) NEAR/1 Reform*)))
- #3 TS=("primary" NEAR/1 ("care" OR health*))
- #4 TS=("hospital" OR "hospitals" OR ("secondary" NEAR/1 ("care" OR health*)))
- #5 #3 AND #4
- #6 #2 OR #5
- #7 #1 AND