博士論文

An assessment of the clinical and health service outcomes of introducing Nurse Practitioners in a Japanese community setting

（日本の地域におけるナースプラクティショナーの導入による健康上及び医療サービス利用上の効果に関する研究）

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Abstract

Objectives: Japan is the world's fastest-ageing country, and faces huge health workforce challenges. Task-shifting between medical doctors (MDs) and allied health professionals is one of the necessary responses to a workforce shortage. Advanced practice nurses such as nurse practitioners (NPs) are an important task-shifting option, but in Japan, NPs have only been practicing since 2011. Although the variety of NP clinical practice are specified and the level of autonomy in Japan is more limited compared to NP in the US and the UK, NPs in three countries provide similar roles and types of practice. This study aims to review global evidence on NP practice systematically and to apply this experience to the Japanese context.

Methods: A systematic review and combined meta-analysis and equivalence test following Cochrane guidelines was done to examine whether NP services result in equivalent outcomes to standard care by MDs in a community setting. A retrospective cohort study in two long-term health care facilities (LCHFs) was conducted to assess the impact of NP introduction on clinical and health system outcomes in the Japanese context**.**

Results: The systematic review of RCTs in the North America and the UK found NPs

provided higher quality of services in patient mortality and intervention costs than MDs, and NP practice was found to be statistically equivalent to or higher quality than MD practice in blood lipid control. However, most outcomes including hospitalization risk, biological data, functional status, patient satisfaction and self-perceived health status were found to be neither statistically significant different nor statistically equivalent between NP and MD practice. The retrospective study found a statistically significant reduction in hospitalization risk after NP introduction compared to its pre-intervention level, but no significant changes in clinical outcomes.

Conclusions and Recommendations: NPs can support community-based health service workforces in ageing societies with limited human resources, without significant reduction in quality or acceptability of services. Introduction and utilisation of NP could be one option for task-shifting in community care without impairing service quality. Further investigation of the effectiveness of NP, rigorous assessment of the effect of NPs on health system outcomes and discussion on expanding nursing autonomy and practice are recommended.

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List of Abbreviations

ADL	Activities of Daily Living
APN	Advanced Practice Nurse
BMI	Body Mass Index
BT	Body Temperature
DBP	Diastolic Blood Pressure
GNP	Geriatric Nurse Practitioner
GP	General Practice
HT	Hypertension
IADL	Instrumental Activities of Daily Lives
ICN	International Council of Nurses
IOM	Institute of Medicine
JONPF	Japanese Organization of Nurse Practitioner Faculties
LCHF	Long-term Care Health Facility
LDL-C	Low Density Lipoprotein-Cholesterol
MD	Medical Doctor
MHLW	Ministry of Health, Labour and Welfare
NCDs	Non-communicable Diseases
NP	Nurse Practitioner
OR	Odds ratio
RCT	Randomised Controlled Trial
SBP	Systolic Blood Pressure
SMD	Standardised mean differences
UHC	Universal Health Coverage
WHO	World Health Organization

1. Introduction

1.1. The global challenge of ageing

The world population is ageing rapidly. The global average life expectancy at birth in 2013 was 71.2 years, 18.8 years longer than in 1960 [1], and will continue to increase. Many countries, not only in Europe and North America but also in Asia, are projected to have greater than 30% of their proportion of population aged 60 years or older in 2050 [2]. This rapid global ageing is due to rapid reductions in child and young-adult mortality and low fertility [3]. This is a common demographic transition experienced by many countries in the course of development [4, 5], but has happened particularly rapidly in Japan over the past 30 years [3]. As an ageing society leads to reductions in the workforce and the productive proportion of the population, many countries seek strategies to maintain and sustain the social system. These strategies can include natalist policies to increase the birth rate, typically by reducing barriers to both parenting and employment through mechanisms such as the civil solidarity pact (PACS) in France [6, 7]; and demographic policies that promote migration and extend the retirement age [4, 5]. Ageing societies also face particular challenges in their health care systems. As society ages the prevalence of non-communicable diseases (NCDs) increases, placing a growing burden on health expenditure. Increased physical and

intellectual disabilities from diseases of the elderly, such as dementia and other neurological disorders, requires continuous, integrated medical care provided by several types of health care services and personnel, which will demand a major reorientation of the health system [2, 8-10].

Japan is the world's most rapidly ageing country. It has the highest life expectancy at birth of 83.5 years in both sexes [11] and its population has the largest proportion of elderly people, with one in four of the population aged 65 years and over and 12.3% of the population aged over 75 years in 2013 [12]. These proportions are forecasted to increase to about 40% and 27% by 2060, respectively [12]. As a result, Japan's health care system faces major challenges:

- Sustaining universal health coverage (UHC) will become more difficult, since Japanese UHC is based on a social insurance system which will see a declining revenue base and increasing demand as the proportion of the elderly increases [13, 14]. The proportion of health expenditure in gross domestic product (GDP) is projected to rise from 9.5% to 13% by 2030 [15, 16], as demand for increasingly expensive advanced medical technologies leads to increased costs.
- The ageing population will lead to a shortage of healthcare workforces, especially

nurses and care workers. The Japanese government estimates that demand for nurses already exceeds supply [17, 18] and that by 2025 demand for care workers will outstrip supply by 300,000 people [19].

- As a result of the focus on health care coverage and structures, improvements in quality and efficiency of care have lagged, especially in primary care and inpatient chronic care. Lack of standardized benchmarking for performance assessment will hold back health care delivery [13], and innovations throughout the primary care and community health system are needed to improve quality.

The Japanese policy response to the ageing of society is based on the *Basic Law on Measures for the Ageing Society* enacted in 1995 [20]. The latest version of the *General Principles Concerning Measures for the Aged Society* [21], developed by the Ageing Society Policy Council (ASPC) and approved by the Cabinet meeting in 2012, serves as a comprehensive guideline for mid- and long-term strategies to manage the ageing of society. Basic principles outlined in this document include: changing concepts of elderly people and ideas about their role in society, flexible opportunities to utilize elderly people's skills and rebuilding and strengthening community power. The guidelines present policies in many fields including employment, social participation, living environments, and health and welfare.

In response to the enactment of the *Basic Law on Measures for the Ageing Society* and the first version of the *General Principles Concerning Measures for the Aged Society*, the Japanese government enacted the *Long-Term Care Insurance Act* in 1997 [22]. Through revision of the *Gold Plan 21* established in 1999, which showed the direction of health and welfare policies for the elderly over the next five years [23], the long-term care insurance system was established in 2000 [22, 24]. This system aims to provide adequate social support, including user-centered and quality long-term care services with multiple options for elderly people and their families [22]. It targets people aged 65 years and over as primary insured persons who pay premiums and receive benefits, and those who are aged between 40 and 64 years, the secondary-insured, only pay premiums in anticipation of future need. This insurance system is funded equally by public expenditure and premiums from insured people. Several types of services including in-home, facility and community-based services are provided for the primary-insured, depending on the need for care and the type of lifestyle supported [25], and users pay 10% or 20% of the service cost depending on their annual income [26].

In the 15 years since this system started, the government amended the *Long-Term Care Insurance Act* several times [24]. It aimed to stabilize and enhance the long-term care

services in the face of the rapidly ageing society through focusing on disease prevention, balancing payments between facility- and home-based services and introducing public information systems in order to maintain quality of services [27]. At the time of revision in 2012, the integrated community-based care system was introduced in response to the comprehensive reform of social security and tax reported by the Cabinet since 2010 [28, 29]. The integrated community-based care system aims to enable people to have secure and quality lifestyles in their community to the end of their lives by utilizing living environment modification and health care services [30]. Municipalities are responsible for the establishment and arrangement of this system in collaboration with community general support centers and professional organizations such as medical and nursing associations.

In order to build the integrated community-based care system successfully, it is crucial that elderly people are able to stay at home as long as possible utilizing home- and facility-based services, which means a greater emphasis is needed on prevention of hospitalization [27]. The revisions of the long-term care insurance system in 2012 and 2015 focused on enhancing long-term care provision, through improvement of the quality of long-term care, collaboration between medical and long-term care services, strengthening of the support system for people with dementia, and introducing prefectural-level funds to use increased

consumption tax revenue for care provision [31]. Other policies implemented in this reform include shortening length of hospital days covered by the medical payment schedule and graduating the payment to long-term care health facilities (LCHFs) on the basis of the rate of return to private homes covered by the long-term care payment schedule. These policy reforms aimed to promote the return of elderly people independent home-based living. However, the proportion of people aged 65 years or over living alone rose to 11.1% for men and 20.3% for women in 2013 [32] and will continue to increase, which will require the corresponding level and quality of services. In this context, this system also needs to provide health care resources for prevention and control of diseases, especially NCDs, with well-functioning coordination among hospitals, clinics and home-based services, as well as promotion of social participation of elderly people [27, 30].

1.1.1. Health workforce challenges in an ageing society

Ageing societies pose many challenges to the quantity and quality of health workforce [33]. Among health professionals, there is a shortage and maldistribution of Medical Doctors (MDs) [34, 35]. The number of MDs is insufficient in remote and rural areas where primary care is a vital healthcare resource. In response to the shortage of MDs, task-shifting between MDs and related health professionals—better integration and sharing of medical care

tasks—are an important solution [36, 37]. Task-shifting is a reallocation and delegation of clinical and non-clinical tasks from one level or type of health professional to another in order to provide health services effectively and efficiently [38, 39]. This has been a long-standing part of health service reorientation in both developed and developing countries. Although not MDs, mid-level providers such as nurses, midwives, non-physician clinicians and surgical technicians provide clinical services in community settings and at hospitals [40], and are important personnel for undertaking tasks from MDs, the educational provision and practice of mid-level providers varies between countries, but they usually complete shorter or similar periods of training than MDs and are accredited to provide services autonomously [40, 41]. In African countries, delivery and monitoring of antiretroviral therapy (ART) for HIV are often delegated to nurses or clinical officers [42-44], and surgical technicians perform caesarean delivery [45]. In developed countries, midwives are often responsible for perinatal care [46-48], and nurses including nurse practitioners and clinical nurse specialists undertake the management of NCDs such as diabetes mellitus, hypertension, heart failure, and bronchiectasis [40, 49, 50].

Although task-shifting has been promoted globally, it must be developed and sustained under an effective human resources management policy, supervision and political commitment [51]

and should not replace the development of improved health care systems [52]. Task-shifting should be seen as a workforce policy for improved efficiency rather than a cost-saving end in and of itself, in order to maintain the quality of health care services. Therefore, allied health professionals, especially nurses should attain higher qualifications, practice to the full extent of their education and training and expand the scope of nursing practice [53]. For developed countries such as Japan with robust health systems, introducing and utilizing Advanced Practice Nurses (APNs) who acquire higher nursing competencies than general nurses would be one of the solutions to alleviate health workforce shortages in primary care settings, especially in rural areas and to realize sufficient health care provision through task-shifting between MDs and APNs [54, 55].

1.2. Nurse practitioners

The nurse practitioner (NP) is a type of advanced practice nurse (APN), defined by the International Council of Nurses (ICN) as:

> "a registered nurse who has acquired the expert knowledge base, complex decision-making skills and clinical competencies for expanded practice, the characteristics of which are shaped by the context and/or country in which s/he is credentialed to practice. A master's degree is recommended for entry level" [56].

The NP was introduced in the 1960s in the United States to be responsible for primary health care services in rural areas where medical doctors (MDs) were not available and to ensure community-based continuity of care [57]. NPs have since been introduced in other countries such as the United Kingdom, Australia and New Zealand. However, the status of education, regulations, code of practice and competencies required for NPs varies substantially across countries and regions [58-60]. For example in Asia, although the NP position was created in 2004 and 1984 in Singapore and Taiwan, respectively, both countries only started a national NP certification system in 2006 [61-64]. NPs in Singapore practise in acute care, medical/surgical, community care and mental health fields [61, 62], and their scope of practice follows global standards. In contrast, NPs in Taiwan perform in medical/surgical, paediatric, psychiatric, and obstetric/gynaecologic specializations and their scope of practice is still developing, since the legislation was first enacted in 2014 [63, 64]. However, the NP position has not been introduced in other areas and countries such as Japan, mainland China and Malaysia even though those societies are rapidly ageing, and face major health transition and health workforce pressures which will require expansion of advanced practice nurses and their scope of operation [65, 66].

1.2.1. Nurse practitioners in Japan

In Japan, nurses are registered under a national license issued by the Minister of Health, Labour and Welfare and the practice is regulated by the *Act on Public Health Nurses, Midwives and Nurses* [67]. In the *Act*, a nurse is defined as a professional providing medical treatment or assistance in medical care for injured and ill persons or postpartum mothers. In the 67 years since its enactment in 1948, the *Act* has been revised over 20 times to enhance nursing services provision [68]. In addition to these revisions of the nursing regulation system, a nursing credentialing system was established by the Japanese Nursing Association in 1994 in order to meet the social need for higher quality nursing services in an ageing society with fewer children. This system regulates the Certified Nurse Specialist and Certified Nurse who provide high-quality nursing practice with advanced nursing knowledge and skills in specialized areas after completion of the designated education courses [69].

In 2009 the *Act* was changed to add major reforms in nursing education, including:

- Graduation from a four-year university course as an eligibility criterion for nursing licensure examination;
- Extension of the training terms for public health nurses and midwives from six months to a year; and

- Professional improvement obligations for entry-level nurses.

In addition to the reforms to nursing education in 2009, the introduction of a new type of nurse who provides advanced practice, such as the NP, was clearly mentioned for the first time in the three-year plan for the promotion of regulatory reform by the Cabinet Office. This advanced practice nurse was recommended in order to increase the capacity of health care services through task-shifting between MDs and other health care professionals [70]. After Prime Minister Taro Aso urged the Ministry of Health, Labour and Welfare (MHLW) to start discussion about expanded nursing practice and the associated practice conditions [71] a series of review meetings were held. After seven months of discussion, the review issued a report recommending a trial of activities of *Specific Practice Nurse (tentative name)* who would perform specific medical interventions including relatively invasive medical interventions [72].

Based on this decision, the MHLW conducted a pilot training program from April 2011, followed by a trial project to collect example data [73, 74]. Evaluation of the trial and formulation of the new system, including a training system and types of specific allowed medical interventions, were conducted by the Medical Ethics Council of the MHLW [75].

In June 2014, a training system for nurses to perform specific medical interventions was established. This was a part of the *Amendatory Law to the Related Acts for Securing Comprehensive Medical and Long-Term Care in the Community* [26], and the *Act on public health nurses, midwives and nurses* was revised along with the introduction of this system [67]. Through these changes, nurses who complete designated training are able to perform 38 specified medical interventions in 21 categories, shown in Table 1. The defined procedures would enable a sufficient and effective response to increasing demands on health care provision especially in long-term care settings, without compromising safety. The incorporation of these nursing reforms into laws relating to community care and public health indicate that from its inception the Japanese NP program was intended as a response to human resource pressures associated with the ageing society.

Table 1. Specified medical categories and procedures

Category	Procedure
Respiratory (airway management)	Positioning of oral/nasal tracheal intubation tubes
Respiratory (artificial respiratory therapy)	Changing of mode-setting conditions for artificial respirator
	Analgesia management under artificial respirator management
	Weaning of patients wearing artificial respirator
	Changing of mode-setting conditions for non-invasive positive pressure ventilation (NPPV)
Respiratory (long-term respiratory therapy)	Replacement of tracheal cannula
Arterial blood gas analysis	Blood collection by direct arterial puncture
	Maintenance of radial artery line
Circulatory	Operation and management of temporary pace maker wire
	Removal of temporary pace maker wire
	Operation and management of assisted circulation
	Adjustment of assistance frequency for intra-aortic balloon pumping secession
Dialysis management	Operation and management of dialysis/diafiltration devices pertaining to acute blood purification
Intraperitoneal drain management	Removal of intraperitoneal drain (including needle removal after intraperitoneal puncture)
Thoracostomy drain management	Removal of thoracostomy drain
	Setting and changing of suction force under low-pressure continuous suction of thoracostomy drain
Pericardial drain management	Removal of pericardial drain
Postoperative pain management	Administration of analgesics via epidural tubes, dose adjustment
Wounded area drain management	Removal of wounded area drain
Wound management	Removal of necrotic tissues with no blood flow at bedsore or chronic wounds
	Vacuum-assisted closure therapy on wounds
Drug administration pertaining to circulatory dynamics	Adjustment of drug for continuous infusion (hypotensive) in accordance with conditions
	Adjustment of drug for continuous infusion (catecholamine) in accordance with conditions
	Adjustment of drug for continuous infusion (diuretic) in accordance with conditions
	Adjustment of drug for continuous infusion (K, Cl, Na) in accordance with conditions
	Adjustment of drug for continuous infusion (saccharic transfusion, electrolytic transfusion) in accordance with conditions
Drug administration pertaining to glycaemic control	Adjustment of insulin dose in accordance with conditions

Category	Procedure
Drug administration pertaining to nutritional and/or moisture management	Judgement of the degree of dehydration and correction by transfusion Adjustment of drug for continuous infusion (total parenteral nutrition) in accordance with conditions
Catheter management pertaining to nutrition (central catheter)	Removal of central venous catheter
Catheter management pertaining to nutrition (PICC)	Insertion of PICC (Peripherally inserted central catheter)
Drug administration pertaining to mental/neurologic manifestation	Administration of temporary drug (anticonvulsant) Administration of temporary drug (antipsychotic) Administration of temporary drug (anti-anxiety)
Drug administration pertaining to infection	Administration of temporary drug (drug used for signs of infection)
Drug administration pertaining to skin injury	Adjustment/local injection of steroid on leakage of anticancer drug on the skin
Fistula management	Replacement of gastric/intestinal fistula tube, gastric fistula button Replacement of vesical fistula catheter

(Source: Ministry of Health, Labour and Welfare [76])

1.2.2. Education and practice of nurse practitioner in Japan

Prior to the emergence of these policy activities, The master's degree NP program started at Oita University of Nursing and Health Sciences for the first time in Japan in 2008 [77]. This course aimed to provide education for nurses to acquire seven types of ability as an NP based on the global standard [56, 78, 79]: 1) nursing assessment, 2) nursing practice, 3) clinical practice, 4) nursing management, 5) team work and collaboration, 6) utilization and development of medical, health and welfare system and 7) ethical decision making. The enrolment requirement for the NP program is a minimum five years of nursing experience in a clinical setting. The program is provided based on the educational curriculum shown in

Table 2 [80]. This curriculum emphasizes acquisition of fundamental clinical skills and knowledge in the three areas of physical assessment, pharmacology and pathophysiology (the 3Ps). Those courses are taught by MDs and the course level and periodical examination content are equivalent to the national examination for MDs, in order to maintain the quality of education [80-82]. After Oita, other universities started NP programs and by 2015 seven universities ran NP programs in primary care and critical care. As of 2015 a total of 195 graduates, including 64 in primary care and 131 in critical care, were certified as Nurse Practitioners by the Japanese Organization of Nurse Practitioner Faculties (JONPF) [83]. Most NPs work at hospitals and a few work in community settings such as home-visiting nursing stations or geriatric facilities.

Table 2. NP program curriculum of Oita University of Nursing and Health Sciences

	Course	Credit
Basic course	Basic NP lecture	2
	Physical assessment	2
	Pathophysiology	2
	Biophysiology	2
	Nursing ethics	2
	Nursing policy	2
	Nursing management	2
Research	Critical appraisal	2
	Basic research methods	1
	Research project	3
Specialized course in the geriatric major	Geriatric NP lecture	2
	Geriatric disease management	2
	Geriatric clinical diagnosis	2
	Geriatric clinical pharmacology	3
	Geriatric assessment training	2
	Geriatric pharmacology training	2
	Geriatric practice training	2
	Geriatric NP clinical training	14
	Geriatric NP advanced seminar	1
	Total	50

Evaluation	Fundamental ability assessment at the time of enrolment Interim examination including OSCE (Objective Structured Clinical Examination) before starting clinical training Final examination at the end of program

The NP role in Japan is defined by the Japanese Organization of Nurse Practitioner Faculties (JONPF) as

> "a nurse who acquires abilities to provide initial medical treatment in order to improve patients' QOL effectively and efficiently and in a timely manner by

collaborating with physicians and other medical professionals" [81].

Since the curriculum requires skill development for providing initial treatment in primary care, NPs can perform all types of medical procedures included in the nursing training program shown in Table 1. However, the competencies of NPs are wider than that of nurses who complete a designated program under the training system, since NPs are expected to provide integrated treatment and care based on comprehensive professional judgement incorporating logical, objective and wide-ranging analytical and problem-solving skills acquired through the master's degree NP program, while trained nurses are only expected to acquire the technical ability to perform specific additional medical procedures [81]. Moreover, NPs develop nursing management and leadership abilities through the master's program, empowering them to better manage nursing teams as well as to collaborate with multi-disciplinary team members [77, 80-82]. These diverse talents can be nurtured through the two years of master's program [55] and are different from other types of health professionals such as physician assistants, nurse administrators or certified nurses that also have been undertaking task-shifting from MDs, since the extension training for these other health professionals puts a greater stress on specific and limited clinical or nursing competencies [69, 84, 85]. With expanded clinical competencies based on a nursing

foundation, NPs are the health care professionals best suited to take part in task-shifting in multi-disciplinary settings where primary care is the main service.

Table 3 shows an overview of nurse practitioner roles and context in the US, the UK and Japan. NPs in Japan started their practice in April 2011, while NPs in the US and the UK started practice several decades ago. NPs in the US are under the national licensure scheme and most of their practice can be provided autonomously. Some NPs run clinics independently and their practice is target to medical payment. In the UK, NPs are not regulated under the national licensure scheme and their clinical practice depends on their specific job description. Japanese NPs provide clinical practice within a protocol and under supervision by MDs. Although Japanese NPs are limited to specific types of clinical practice with a lower level of autonomy, the definition and role of NP and types of NP practice among these three countries are similar, and the Japanese NP system has been developed based on global standard [56, 78, 79].

Table 3. Overview of nurse practitioner roles and context in different countries

	The United States	The United Kingdom	Japan
Title	Nurse practitioner	Advanced nurse practitioner	Nurse practitioner
Definition	Members of the health delivery system, practicing autonomously in diverse areas. NPs are prepared to diagnose and treat patients with undifferentiated symptoms as well as those with established diagnoses. NP provide initial, ongoing and comprehensive care [86]	"A registered nurse who has undertaken a specific course of study of at least first degree (Honours) and can conduct specific additional practice (described below)" [87]	"A nurse who acquires abilities to provide initial medical treatment in order to improve patients' QOL effectively and efficiently and in a timely manner by collaborating with physicians and other medical professionals" [81]
Education program	Master's degree or doctor's degree	A specific course of study of at least first degree (Honours) level	Master's degree
National licensure	Yes (State-level)	No	No
Specialty	Acute care, adult health, family health, gerontology, neonatal health, oncology, paediatric/child health, psychiatric/mental health and women's health	Primary care and secondary care	Geriatric, critical, paediatric and anaesthesia
Total number	Around 160,000 as of 2008	Unknown	195 as of 2015
Diagnostic testing	Yes, autonomously	Yes, depends on job description	Yes, based on the protocol and under the supervision by MDs
Diagnosis	Yes, autonomously	Yes, depends on job description	Yes, based on the protocol and under the supervision by MDs
Prescription	Yes, narcotic analgesics are allowed except in two states.	No, requires nurse prescriber license	Yes, limited to some types of medication based on the protocol and under supervision by MDs

	The United States	The United Kingdom	Japan
Practice	• Ordering, performing and interpreting diagnostic tests such as lab work and x-rays. • Diagnosing and treating acute and chronic conditions such as diabetes, high blood pressure, infections, and injuries. • Prescribing medications and other treatments. • Managing patients' overall care. • Counselling. • Educating patients on disease prevention and positive health and lifestyle choices.	• Making professionally autonomous decisions. • Receiving patients with undifferentiated and undiagnosed problems and making an assessment of their healthcare needs. • Screening patients for disease risk factors and early signs of illness. • Making differential diagnoses. • Developing an ongoing nursing care plan for health. • Ordering necessary investigations, and providing treatment and care both individually, as part of a team, and through referral to other agencies. • Having a supportive role in helping people to manage and live with illness • Having the authority to admit or discharge patients and refer patients to other health care providers. • Working collaboratively with other healthcare professionals and disciplines. • Providing a leadership and consultancy function.	Specified medical categories and procedures (Table 1) are provided based on the protocol agreed with MDs and under the supervision by MDs. • Holistic assessment of targeted population from physical, mental and socio-economic aspects at individual, family and community level. Physical assessment is conducted based on examination, ordered by NPs. • Offering diagnoses based on the holistic assessment followed by providing initial treatment and adjustment of medication for symptom management in a timely manner. • Offering referrals to other types of facilities for consultation. • Demonstrating nursing leadership within and beyond nursing teams to improve nursing quality. • Promoting multi-disciplinary approach.
References	[86, 88]	[87]	[80, 82]

1.3. Rationale and objectives of the thesis

The Japanese national policy for an ageing society has just begun to focus on integrated community-based care [30]. Although hospitals are the part of the integrated community-based care system according to the MHLW definition, strengthening in-home or facility-based services is an important strategy in order to prevent hospitalization and reduce the burden on inpatient facilities. Given that Japan has the highest proportion of elderly people globally, Japan's approach to managing ageing societies will be the first example of how to overcome the challenges to health care services provision and to realize a healthy ageing society by providing sufficient services in a community setting. Specifically, Japan is the first country to establish an integrated community-based care system in the context of limited human resources for health in an ageing and declining health workforce. The lessons learnt in Japan about human resources promotion and allocation will therefore be vital to other countries facing the same workforce challenges in the future.

However, the Japanese nursing system has also just begun to expand its scope of nursing practices. Establishment of a training system for nurses to perform specific medical interventions is the first step to promote further task-shifting with MDs, especially outside of hospitals where nurses could help to develop and sustain an integrated community-based care

system successfully by relieving hospitalization pressure and enabling elderly people to stay at home as long as possible [27]. Therefore, it is important to learn from previous evidence on NP practice and to apply this experience to the Japanese context. This would contribute to evidence for NP practice in Japan's ageing society, which would lead to further discussion of task-shifting between MDs and other health care providers as well as the effective allocation of human resources for health.

Although the types of clinical practice provided by Japanese NPs are specified and the level of autonomy are lower than NPs in the US and the UK due to the historical background and regulation system, the definition and role of NP and types of NP practice among these three countries are broadly similar. Therefore, learning the effectiveness of NP practice in the community setting from previous examples in countries with wider scope of NP practice would provide partial evidence in support of Japanese NP practice. The overall objectives of this thesis are to understand the evidence in other countries for the effectiveness of NP practice, to examine the practice of Japanese nurse practitioners in long-term care health facilities, and to consider the future direction of introduction and utilization of nurse practitioners, especially focusing on the integrated community-based care system in an ageing society. In this thesis, services in a community setting are defined so as to exclude

inpatient hospital services, as I would like to focus on health care services outside of hospitals where service goals can include prevention of hospitalization as part of the integrated community-based care system.

The thesis aims:

(1) To assess whether Nurse Practitioners practicing in the community-based health services can provide equivalent services to Medical Doctors;

(2) To examine the effect of introducing and utilizing Nurse Practitioners on clinical and health service outcomes in long-term care health facilities in the Japanese context; and

(3) To provide lessons for Japanese nursing and integrated community care policy based on the previous experience of NP practice, and to use the experience of reformation of Japan's integrated care system to provide lessons for policy-makers in other countries facing the challenge of ageing.

These objectives will be met through a meta-analysis of published literature on NP practice, and a comprehensive and rigorous evaluation of the introduction of NPs to geriatric care facilities in Japan.

1.4. Organization of the thesis

This thesis is organized into four chapters including two independent studies. Chapter 2 presents a systematic review and meta-analysis of the effectiveness of NP services compared to MD services in a community setting. Chapter 3 presents a rigorous evaluation of the impact of introducing NPs on clinical and health outcomes using data from a retrospective cohort study in two long-term care health facilities in Japan between April 2009 and March 2013. Chapter 4 provides a summary and recommendations for future policy and research about NP introduction and utilization in Japan.

2. The effectiveness of community-based health services by nurse practitioners: A systematic review and meta-analysis

2.1. Introduction

Previous studies showed several evidence of NP practice. For example, a study conducted in the U.S has found that NP intervention at nursing home reduced the risk of mortality and preventable hospitalizations [89]. Another study conducted at general practice in the Netherlands has found NP practice were statistically equivalent to usual care provided by general practitioner in patient satisfaction, number of prescription and referrals [90]. However, quality and representativeness of these studies has been mixed, size of individual NP studies can be relatively small and the findings between studies sometimes contradictory [91, 92]. This makes it difficult to describe the effect of NP practice without a comprehensive method for summarizing these studies.

Systematic review and meta-analysis is a structured method which enables the identification, appraisal and synthesis of research-based evidence [93]. A systematic review can detect all relevant studies regardless of size, and provides tools for assessing their quality, enabling the full capture of all global evidence on NP practice. Meta-analysis can synthesize the evidence

from these studies into single summary statistics, and statistically adjust for heterogeneity between studies, incorporating the size of studies [94]. The findings of the systematic review and meta-analysis can provide a global consensus based on the best existing evidence. Therefore, conducting a systematic review and meta-analysis with rigorously defined eligibility criteria is the best method to examine an evidence for NP practice collected in the recent past. In addition to exploring the individual evidence narratively, it enables a quantitative, comprehensive summary of the overall effect of NP practice. In this thesis, findings from the global evidence for the effectiveness of NP practice will lead the study examining the effectiveness of the NP in the Japanese context.

2.1.1. Objectives

This chapter aims to examine whether services provided through substitution of NPs for MDs result in statistically equivalent patient and health system utilization outcomes compared to standard care delivered by MDs in a community setting. The definition of NPs in this review is the same as the ICN definition, with expanded clinical practice with expert knowledge and skills. Additionally, in order to examine equivalence of services between NPs and MDs, NPs in this review provide services as MDs do, autonomously or in an independent setting in the community. This study aims to provide evidence on the effectiveness of NP practice through

a systematic review of published studies on the effectiveness and impact of nurse practitioners.

2.2. Methods

This study employs a systematic review and meta-analysis of randomized controlled trials (RCTs) conducted following the *Cochrane Handbook for Systematic Reviews of Interventions* ("the *Handbook*") [93].

2.2.1. Eligibility criteria

The included studies were examined if they met specific inclusion/exclusion criteria based on participants, intervention, comparison and outcomes (PICO) domains [93], which are summarized below.

a. Participants: Adults who received treatment and care by NPs or standard care by MDs in community settings.

b. Study design: RCTs and cluster RCTs

c. Intervention site: Nursing homes, geriatric health care facilities, home-visit nursing agencies, patient homes, and clinics.

d. Intervention: NPs provide services autonomously or in an independent setting in the

community. All types of treatment and care were included, such as care in which NPs:

- Perform assessments, order diagnostic and laboratory tests as a first contact for patients or clients
- Offer diagnoses, prescribe medications and treatments
- Implement procedures
- Take responsibility for care management
- Follow up monitoring of patient health and medical plan adherence
- Provide counselling and education for preventing non-communicable diseases (NCDs)
- Ensure continuity of care and hospital re-admission
- Manage disease symptoms

e. Outcome: Hospitalization, patient mortality and biological data such as blood cholesterol level and blood pressure were included as primary outcomes. For secondary outcomes, cost, patient satisfaction, self-reported perceived health, functional status and emergency department visits were included. Inpatient care at hospitals, trials targeting only children and non-academic articles and articles published before 1990 were excluded.

2.2.2. Search methods, study selection and data extraction

I used five databases including the Cochrane Central Register of Controlled trials (CENTRAL), MEDLINE, EMBASE, CINAHL and the British Nursing Index (July 2015). I undertook a separate search of Web of Science to capture any grey literature. No language restriction was applied to the searches and the search strategy of all databases is shown in Appendix A. In order to cover all possible studies, and as independent screening of studies was conducted, the search strategy was chosen to capture the broadest possible of possible titles and names of the NP and a community setting. The selected papers were then screened to ensure that only studies that actually included NPs were reviewed. I also conducted reference list reviews of relevant articles and previous systematic reviews.

Study titles and abstracts were independently screened by two collaborators to identify eligible articles. Two collaborators in the study group manually extracted data in eligible articles independently using a standard data extraction form based on the *Handbook* [93] to confirm the eligibility of the systematic review and meta-analysis. Any disagreement was solved by discussion and when two collaborators could not agree, I consulted with other collaborators for expert opinion.

2.2.3. Risk of bias assessment in included studies

The two collaborators in the study group assessed the risk of bias using the *Risk of Bias* tool based on the *Handbook* [93] to evaluate the internal validity of the included studies. Quality was assessed in the following domains: sequence generation, which describes the quality of randomization; allocation sequence concealment, which describes whether those responsible for allocating study membership were blinded; blinding of study personnel and participants which identifies whether those conducting or participating in the study were blinded to their treatment allocation; blinding of outcome data, which indicates that the analyst was blinded to treatment group allocation; selective outcome reporting, which indicates how well the analysis followed the study plan; and other bias [93]. I applied a three-point scale (low risk, high risk and unknown) for assessing each domain and when I could not reach consensus, I consulted an expert.

2.2.4. Statistical analysis

In order to examine the statistical equivalence between NP practice and MD practice, a combination of meta-analysis and equivalence testing were conducted [95, 96]. First, the statistical difference in each outcome was examined using meta-analysis. For outcomes that were found to be not statistically significantly different in meta-analysis, equivalence tests

were conducted and the statistical equivalence was judged based on the pooled results produced in meta-analysis.

Meta-analysis

Meta-analysis was undertaken using RevMan 2014 [97] and Stata 13/MP [98]. Odds ratios (ORs) were assessed for dichotomous outcomes such as hospitalization, patient mortality, biological data and emergency department visits. Standardized mean differences (SMDs) were calculated for continuous outcomes including biological data, cost, patient satisfaction, self-reported perceived health and functional status (Activities of Daily Lives: ADL/Instrumental Activities of Daily Lives: IADL). Confidence intervals (CI) of ORs or SMDs in individual studies were reported at the 95% level and the CI of pooled effects in each outcome was calculated depending on the number of parallel comparisons using a Bonferroni adjustment.

Result synthesis

A fixed-effect model was used when there was only one study included for the outcome. A random-effects model was used when the interventions in the studies are considered to have clinical heterogeneity or there is substantial heterogeneity between studies [93]. For each

analysis, Tau-squared and I-squared statistics were calculated. The quality of the individual outcomes such as hospitalization, patient mortality, biological data, cost, patient satisfaction and self-reported perceived health was assessed using the GRADE approach [99]. This enables to assess the quality of a body of evidence that how much the quantified estimates of each outcome can be confident [93]. The results of assessment were shown using a summary of the intervention effect and the quality of individual outcomes based on five factors: study limitations, consistency of effect, imprecision, indirectness and publication bias [99].

Subgroup and sensitivity analysis

A subgroup analysis was conducted for any outcomes where substantial heterogeneity was identified from the Tau-squared and I-squared statistics.

Equivalence test

An equivalence test was conducted when the outcomes showed no statistically significant results in meta-analysis. The equivalence margin was established based on a power calculation of each study, and when the pooled OR or SMD and its CI lay within the lower and upper bounds of the equivalence margin, NP and MD practice are considered to be statistically equivalent in outcome [95, 96]. If either or both edge of the CI touched or lay

outside the equivalence margin, NP and MD practice were judged not to be statistically equivalent.

2.2.5. Trial registration

This review protocol has been registered with the International Prospective Register of Systematic Reviews (PROSPERO) at the National Institute for Health Research and Center for Reviews and Dissemination (CRD) at the University of York (registration number: CRD42014009627).

2.2.6. Ethical considerations

This study did not require ethical approval, as it used only published articles

2.2.7. Funding

This study was funded by the Japanese Society for Promotion of Science Grants in Aid for Scientific Research (A) 25253051 and (B) 26293480, and National Center for Child Health and Development grant 26A-5. The funders did not have any role in study design, data collection, data analysis, interpretation or writing of the study.

2.3. Results

2.3.1. Study selection

After screening 3,105 titles and abstracts and reviewing 119 full texts, 104 articles were excluded due to type of intervention or control, study design (Figure 1). Two studies identified from reference lists and hand search were included. 19 papers referring to 16 separate randomised controlled trials met the inclusion criteria, and 11 studies were included in the meta-analysis.

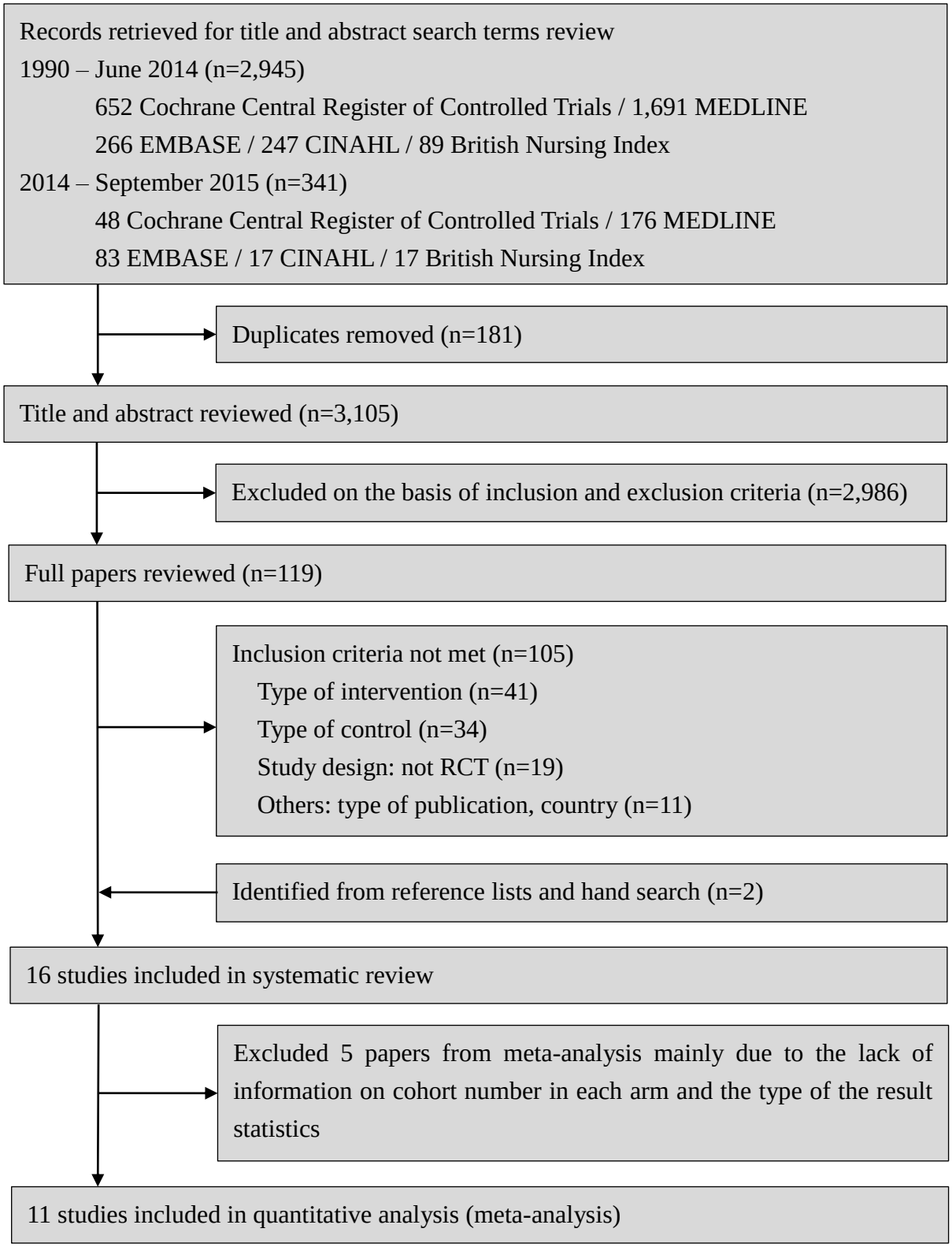

Figure 1. Study selection strategy

2.3.2. Study and participant characteristics

Table 4 shows a summary of the characteristics of the 16 studies included in this review. Seven studies were conducted in the United States, five were in the United Kingdom, two were in Canada, and one study was held in Australia and the Netherlands. Of the 16 studies, 13 were held at clinics, including six studies at special clinics such as rheumatology outpatient clinics and heart failure clinics, four studies at General Practice (GP) in the United Kingdom and the Netherlands, and three studies at general clinics. Services in two studies were provided at home and one study reported services provided at community facilities.

Table 4. Characteristics of included studies

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Becker 2005. USA	To compare a community-based intervention to reduce coronary heart disease (CHD) risk provided by NP with an intervention by MD. To examine the sustainability of the intervention.	Community 10 sites	Aged 30-59 years, African American siblings of family members with premature coronary heart disease. No previous history of CHD and autoimmune disease, not under chronic glococorticostreroid and cancer therapy, and no immediate life threatening co-morbidity. Currently smoking, a fasting LDL-C<130mg/dL, or average systolic blood pressure (SBP)>140 mmHg, or a diastolic blood pressure (DBP) <90 mmHg. Excluded: Siblings with none of these risk factors.	Intervention: n=196 Control: n=167	Community-based care (CBC) including physical assessment, evaluation for pharmacotherapy and monitoring adherence.	Enhanced primary care (EPC) including providing materials and recommendations for risk factor management.	[100, 101]
Chan 2009. UK	To compare the effectiveness and cost of follow-up between gastro-intestinal nurse practitioner (GNP) and general practitioners in dyspeptic patients after gastroscopy.	GNP-led outpatient clinic 1 site	Patients with mild gastro-oesophageal reflux disease, non-ulcer dyspepsia and normal findings from the results of gastroscopy. Excluded: Patients with symptoms of dysphagia, vomiting, anaemia, rapid weight loss. Those with history of gastric surgery. Those found to have peptic ulcer, tumour, severe oesophagitis, Barrett's oesophagus and anatomical abnormality from the results of gastroscopy.	Intervention: n=89 Control: n=86	Structured clinical management was provided based on national and local guidelines in response to each patient's predominant symptoms. Counselling and lifestyle advice, supplemented with relevant locally devised leaflets, and an individualised treatment plan agreed with them were given.	Usual care: advised to see their GP after discharges.	[102]

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Dierick - van Daele 2009. The Netherland	To evaluate process and outcomes of services provided by general practitioner (GP) compared to specially trained NP as first point of contact in patients with common complaints.	GP in the southern region of the Netherlands 15 sites	Patients aged 16 years and over who attended in GP for an appointment during the study period. Excluded: Patients meeting the following criteria: no registration in the practice, language or reading problems, children aged under 16 years, follow-up consultation, and/or did not give reason for the appointment to the study recruiter.	Intervention: n=817 Control: n=684	Symptom assessment, physical examination, diagnoses and decision making on decision on further treatment, including writing prescriptions, referrals to primary or secondary services and clinical investigations. Prescriptions and referrals required validation by GP due to the level of authority.	Usual care	[90]
Driscoll 2008. Australia	To compare the optimisation of Beta-blockers (BBs) by between general practitioner (GP) and heart failure NP	Clinic for the patients with Chronic systolic heart failure (CHF) 1 site	Patients with CHF and took less than half optimal BB dose.	Total n=16 Intervention and control: not available	Optimization of BB treatment regimens over 6 months.	Optimization of BBs by GP.	[91]

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Enguidanos 2012. USA	To examine the impact of NP intervention on care transition provided to hospitalized elderly people after discharges to home.	Large, managed care medical centre (HMO) 1 site	Aged 50 years or older; discharged to home without home health, palliative care, or hospice care; and have either no care giver or a care-giver who was unable to provide the care needed in the home. Patients met one of the criteria: 1. Take more than seven medications. 2. Have difficulty in one or more ADL. 3. Been previously hospitalized within 30 days of the current admission.	Intervention: n=100 Control: n=99	Immediately after discharge, up to three home visits and two telephone calls from a registered NP were provided including medication review, care coordination, assessment of medical care needs, and brief coaching in self-management skills.	All standard medical care, including access to case management services.	[92]
Hill 1994. UK	To assess the effectiveness, acceptability and safety of services by a rheumatology nurse practitioner (RNP) compared to consultant rheumatologist (CR).	Rheumatology outpatient clinics 6 sites	Patients who attended the rheumatology clinic at least three occasions previously.	Intervention: n=35 Control: n=35	Follow-up by RNP over 21 months.	Follow-up by CR over 21 months.	[103]

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Hill 2003. UK	To assess the outcome for patients with rheumatoid arthritis (RA) attending rheumatology nurse practitioner (RNP) clinic comparing to those attending the clinic run by a junior hospital doctor (JHD).	Rheumatology outpatient clinic of a large teaching hospital. 1 site	Patients aged 18 years or over, diagnosed as RA using American Rheumatism Association 1987 criteria, attended to the rheumatology clinic on at least three previous occasions. Excluded: Patients unwilling to receive care from an RNP or JHD, with inability to read or write, awaiting hospital admission, and who had already received care from the RNP or JHDs involved in the study.	Intervention: n=39 Control: n=41	Periodical assessment including managing disease activity and patients' symptoms, improving psychological status and increasing patients' knowledge of the diseases by RNP.	Periodically assess patients at traditional JHD clinic.	[104]
Kinnersley 2000. UK	To examine differences between services by nurse practitioner (NP) and by general practitioner (GP) in primary care.	General practices in south Wales and south west England. 10 sites	Patients willing to have a 'same day' consultation Excluded: Patients who 1. Seemed too ill. 2. Were unable to understand the research. 3. Women seeking emergency contraceptive advice.	Intervention: n=652 Control: n=716	Consultation by NP.	Consultation by GP.	[105]

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Kubo 2009. USA	To examine the impact of nurse practitioners on the enhancement of cardiology practice in an outpatient setting.	Heart clinic, providing independent cardiology practice. 1 site	Patients with LVEF (Left Ventricular Ejection Fraction) <45%. All patients who had at least one outpatient visit.	Intervention: n=677 Control: n=805	NP engaged to initiate and titrate medication, and to provide daily life instruction for basic heart failure management such as sodium restriction and daily weights control, and to refer to device therapy, in combination with physician visits	Only physician visit.	[106]
Limoges-Gonzalez 2011. USA	To examine the accuracy, safety and patient satisfaction in screening colonoscopy performed by board certified gastroenterologists (GI-MD) comparing to gastroenterology-trained nurse practitioners (GI-NP).	University affiliated endoscopy center. 1 site	All patients aged 50 years or over referred for a screening colonoscopy and willing to have moderate sedation. Excluded: Signs or symptoms of gastrointestinal pathology, past medical history of inflammatory bowel disease, adenomatous colon polyp, first degree family history of colon cancer and adenomatous colon polyp, language problems, or cognitive impairment	Intervention: n=50 Control: n=100	Colonoscopy by GI-NP	Colonoscopy by GI-MD	[107]

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Mundinger 2000. USA	To assess the outcomes for patients receiving follow-up and ongoing care after an emergency department or urgent care visit provided by nurse practitioner (NP) comparing to medical doctor (MD).	Community-based primary care clinics and primary care clinic 5 sites	Adults who had no current primary care provider at the time of recruitment and planned to be in the area for the next six months.	Intervention: n=806 Control: n=510	Primary care follow-up and ongoing care after an emergency department or urgent care unit including consultation, prescriptions referrals and admission to the hospitals provided by NP.	Primary care follow-up and ongoing care after an emergency department or urgent care visit provided by MD.	[108, 109]
Sawatzky 2011. Canada	To compare the outcomes of NP management on post-operative cardiac surgery follow-up and the standard model of post discharge care by primary care physicians	Post-operative cardiac surgery follow-up clinic 1 site	Post-operative patients received coronary artery bypass graft (CABG).	Total N=200	Telephone assessment three days post discharge, and additional follow-up clinic visits including counselling, care and referrals by NP.	The standard model of post discharge care by primary care physicians.	[110, 111]

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Smith 1997. USA	To assess the effect of long-term, multi-dimensional intervention provided by primary care provider on improvement of medically unexplained symptoms (MUS) patients' mental health.	HMO 1 site	Aged 18-65 years, HMO member at least 2 years. Speaks English, literate, access to a telephone. not under care by a mental health professional more often than once a month, and planning to be in the HMO for at least 1 year Excluded: pregnancy, substance use disorders, suicidal ideation, organic mental syndromes, and psychosis.	Intervention: n=101 Control: n=105	Provide treatment in a stepped-care fashion based on standardized methods. Treatment includes medication adjustment, physical therapy, and referrals.	Usual care provided by HMO physicians	[112]
Stewart 2009. Canada	To examine the comparability of follow-up care provided by NP and MD.	Inflammatory bowel disease (IBD) clinic 1 site	Patients attending to IBD clinic	Total n=86 Intervention and control: not available	Follow-up care provided by NP specializing in IBD	Standard care by MD	[113]

Study ID, year and country	Study objective	Study setting Number of sites	Participants	Number of participants	Intervention (NP role)	Comparison (MD role)	References
Stuck 1995. USA	To examine the effect of combining intervention including rehabilitation and home visits on disability in elderly people in the community.	Community setting 1 site	Elderly people aged 75 years and over, living in the community Excluded: Severe cognitive and functional impairment, language problems, planning to move to nursing home or out the area, self-reported terminal disease, and participating in another randomized control.	Intervention: n=215 Control: n=199	Annual comprehensive geriatric assessments including physical examination, examining functional status, oral health and mental status, quality of social support and safety environment. Provide recommendations about self-care and usage of community services, and facilitate compliance.	Regular medical care by MD	[114]
Venning 2000. UK	To examine the cost effectiveness of general practitioners (GP) compared to nurse practitioner (NP) as a first point of contact in primary care.	Primary care in England and Wales 20 sites	Patients who can attend the experimental session with both GP and NP on the same day. Excluded: Temporarily resident or not yet registered with the practice. Patient with language or reading problems, those who were too ill, and unaccompanied children under 16 years of age.	Intervention: n= 641 Control: n=651	Consultation including assessment, diagnosis, examination, tests, prescriptions and referrals provided by NP	Consultation provided by GP	[115]

2.3.3. Intervention characteristics

A range of NP intervention types were observed in the 16 studies, and are shown in Table 4. Since NP practice was conducted in a community setting, NPs performed assessments in all studies. Diagnoses were offered in three studies at clinic and prescription of new medication or adjustment of medication dose was given in nine studies held at the clinic. Counselling, such as instruction for daily life activities, was provided in seven studies. In order to ensure continuity of care and to manage the cases requiring high levels of medical care, referrals to MD and hospital, and home-based care and social support coordination were provided in 10 studies.

Studies and type of outcomes are shown in Table 5. Hospitalization was examined in four studies [91, 92, 108, 109, 114], patient satisfaction in 11 studies [90, 92, 103-105, 107-113, 115] and self-reported perceived health in five studies [90, 92, 102, 108, 109, 112]. Some outcomes could not be included in meta-analysis because the outcomes were shown using different statistics such as median.

Table 5. Types of outcomes in included studies

Study ID	Outcome	Outcome type	Measurement	Results	Meta-analysis inclusion (reason)
Becker 2005	Biological data (Blood pressure)	Dichotomous	<140/90 mmHg	In the NP CBC group, the proportion of participants controlling blood pressure below 140/90 mmHg at five-year follow-up was significantly higher than at baseline and at one-year follow-up (base to 5 years: p< .0001, 1 year to 5 years: p=0.0004). The EUC (control) group did not have any significant difference in proportion between baseline and five-year follow-up, and one-year and five-year follow-up. There was no significant difference between groups comparing baseline to five-year follow-up, and one-year and five-year follow-up.	Yes
	Biological data (Blood Low-Density Lipoprotein-Cholesterol: LDL-C)	Dichotomous	<130 mg/dL	The proportion of participants controlling LDL-C increased significantly from baseline to five-year follow-up in both intervention and control groups. However, there was no significant difference between groups in proportion of participants achieving the goal.	Yes
	Biological data (LDL-C)	Continuous	mg/dL	Participants in both groups showed significant reduction of LDL-C level from baseline to five-year follow-up.	Yes
	Biological data (Systolic blood pressure: SBP)	Continuous	mmHg	SBP levels in both groups did not significantly change from baseline to five-year follow-up.	Yes
	Biological data (Diastolic blood pressure: DBP)	Continuous	mmHg	DBP in the intervention group became significantly lower at five-year follow-up. However, no changes were seen in the control group.	Yes
	Biological data (Body Mass Index: BMI)	Continuous	kg/㎡	There was no statistically significant difference in BMI between groups from baseline to five-year follow-up, and from one-year to five-year follow-up.	Yes

Study ID	Outcome	Outcome type	Measurement	Results	Meta-analysis inclusion (reason)
Chan 2009	Costs	Continuous	UK pound	Adjusted mean difference (95% CI) in costs of ulcer healing drugs (UHD) at six-month follow-up was 39.60 (24.20–55.10) UK pounds (p =< 0.001) in favour of NP arm.	Yes
	Self-reported perceived health	Continuous	Health Status Short Form (SF-12)	Adjusted mean difference (95% CI) in SF-12 at six-month follow-up was 140.6 (96.5–184.8) (p=< 0.001) in favour of NP arm.	Yes
Dierick-van Daele 2009	Patient satisfaction	Continuous	Likert-scale 0-10	There was no statistically significant difference in mean score between NP arm (8.19 (SD: 1.18)) and GP arm (8.20 (SD: 1.26)).	Yes
	Self-reported perceived health	Continuous	EQ5-D	There was no statistically significant difference in mean score between NP arm (0.82 (SD: 0.19)) and GP arm (0.80 (SD: 0.19)) before the consultation. Two weeks after the consultation, both NP and GP arms showed a mean improvement of 0.05 (SD: 0.17) and 0.04 (SD: 0.15), respectively.	Yes
Driscoll 2008	Hospitalization	Dichotomous	Proportion	At six-month follow-up, 33% of patients in the NP group and 67% of patients in the general practitioner group (33% in total) were admitted to hospital (p=0.14).	Yes
Enguidanos 2012	Hospitalization	Dichotomous	Proportion	There was no statistically significant difference in hospital readmission rate at six-month follow-up between NP group (40%) and usual care group (44.4%) (p=0.526).	Yes
	Patient satisfaction	Continuous	Home care Satisfaction measure	In NP group, there was a statistically significant improvement in mean patient satisfaction scores between baseline (74.78 (SD: 19.6)) and three-month follow-up (81.77 (SD: 18.7)), (p=0.008), while there was no statistically significant change in patients in the usual care group.	Yes
	Emergency department visit	Continuous	Number of times	There was no statistically significant difference in the mean number of emergency department visit at six-month follow-up between NP group (0.50 (SD: 1.2), range: 0–10) and usual care group (0.99 (SD: 0.99), range: 0–15), (p=0.096).	Yes

Study ID	Outcome	Outcome type	Measurement	Results	Meta-analysis inclusion (reason)
	Length of hospital stay	Continuous	Number of days	There was no statistically significant difference in mean length of hospital days at six-month follow-up between NP group (3.78 (SD: 8.8), range: 0–67) and usual care group (3.49 (SD: 6.5, range: 0–44), (p=0.514).	No (number of cohort was not available)
	Self-reported perceived health	Continuous	Self-efficacy survey	In the NP group, there was a statistically significant improvement in confidence level in performing certain activities relating to their health from baseline (90 (SD: 28.1)) to follow-up (103 (SD: 30.1)), (p=0,001). There were no significant changes in the usual care group between baseline (100 (SD: 25.6)) and follow-up (106 (SD: 27.8)), and the difference in change was not significant in between-group analysis (p=0.18).	Yes
Hill 1994	Patient satisfaction	Continuous	Leeds Satisfaction Questionnaire (LSQ)	There was no significant difference in LSQ mean score between the Rheumatology Nurse Practitioner (RNP) clinic (6.90) and the Consultant Rheumatologist (CR) clinic (6.86) on entry (p=0.01). At 48 week follow-up, patients in the RNP clinic showed statistically significant satisfaction with care compared to those in CR clinic (p<0.0001).	No (standard deviation was not available)
Hill 2003	Patient satisfaction	Continuous	Leeds Satisfaction Questionnaire (LSQ)	On entry, there was no significant difference in LSQ median score between Rheumatology Nurse Practitioner (RNP) patients (3.60) and Junior Hospital Doctor (JHD) patients (3.57). At 48 week follow-up, RNP patients were shown to have significantly higher scores (4.1) than JHD patients (3.56) (p=0.000).	No (median and range were used for outcome)
	Biological data Plasma viscosity	Continuous	mPa.s	There was no significant difference in median value of plasma viscosity between RNP group and JHD group over the follow-up period from baseline to week 48.	No (median and range were used for outcome)
Kinnersley 2000	Patient satisfaction	Continuous	The consultation satisfaction questionnaire	The score in the GP group immediately after the consultation showed negatively skewed distribution while that of the NP group followed normal distribution. Three of ten types of practice showed significantly higher satisfaction levels for NP consultation than GP.	No (median and range were used for outcome)

Study ID	Outcome	Outcome type	Measurement	Results	Meta-analysis inclusion (reason)
Kubo 2009	Patient mortality	Dichotomous	Proportion	At two-year follow-up, 86.1% of patients seen by heart failure nurse practitioner (HF-NP) survived, compared to 82.4% of those seen by physicians.	Yes
Limoges -Gonzalez 2011	Patient satisfaction	Continuous	3 item post-procedure questionnaire	On the day of colonoscopy, participants in the gastroenterology-trained nurse practitioner (GI-NP) group showed statistically significant higher level of satisfaction than those in board-certified gastroenterologists (GI-MD).	No (inverse scale direction was used)
Munding er 2000	Hospitalization	Dichotomous	Proportion	There was no statistically significant difference in proportion of patients with hospitalization at six-month and one-year follow-up between NP group and physician group.	Yes
	Emergency department visit	Dichotomous	Proportion	There was no statistically significant difference in number of emergency department and urgent care visits at six-month and one-year follow-up between NP group and physician group.	Yes
	Patient satisfaction	Continuous	15-item satisfaction questionnaire	There were no significant differences in all categories of satisfaction scores between NP group and physician group after the first visit. At six-month follow-up, only the provider attributes mean score showed a significant difference between NP group (4.12) and physician group (4.22) (p=0.05). However, other categories and overall satisfaction did not show any significant differences.	No (standard deviation was not available)
	Self-reported perceived health	Continuous	SF-36	All health status scores were improved in both groups. However, there were no statistically significant differences between NP group and physician group using either unadjusted or adjusted model.	No (standard deviation was not available)
Sawatzky 2011	Patient satisfaction	Continuous	NA	At baseline, there was no significant difference between NP care and standard care by primary care physicians. At two-week and six-week follow-up, patients in NP group showed significant higher level of patient satisfaction than those who received standard care.	No (any score was not available)

Study ID	Outcome	Outcome type	Measurement	Results	Meta-analysis inclusion (reason)
Smith 1997	Patient satisfaction	Continuous	Satisfaction questionnaire (0-100)	At baseline, there was no significant difference between NP and physician group. At six-month and one-year follow-up, a higher proportion of patients in the NP group scored 80 or more on satisfaction scales (6 months: p<.0001, 12 months: p<.01).	Yes
	Self-reported perceived health	Continuous	Physical component summary (PCS)	At baseline, there was no significant difference between NP group and physician group.	Yes
Stewart 2009	Patient satisfaction	Continuous	Satisfaction survey	There was no statistically significant difference in satisfaction scores between NP group and MD group either at enrollment (p=0.274) or at 12 months (p=0.420).	No (standard deviation was not available)
Stuck 1995	Hospitalization	Dichotomous	Proportion	There was no statistically significant difference in the number of admissions to acute care hospital between NP group and control group at one-year follow-up (18% and 21%), at two-year follow-up (21% and 20%) and at three-year follow-up (24% and 25%).	Yes
	Patient mortality	Dichotomous	Proportion	Patient mortality at three-year follow-up in NP group (11%) and control group (13%) was similar (Odds ratio: 0.8, 95% CI: 0.5–1.5).	Yes
	Length of hospital stay	Continuous	Number of days / 100 persons / year	There was no difference in the mean length of stay per acute care admission between NP group (6.3 days) and control group (5.1 days), (p=0.7). When adding self-reported hospital admission days outside of study area, the estimated hospital admission days / 100 subjects / year for NP group and control group were 203 days and 180 days, respectively.	No (number of cohort was not available)
	Functional Status	Continuous	Basic ADL and IADL	At three-year follow-up, participants in NP group (75.6 (SD: 73.2–77.9)) showed statistically significant higher mean ADL and IADL score than those in control group (72.7 (SD: 70.2–75.2)), with changed mean difference between groups from 0.4 to 5.4 (p=0.03).	Yes

Study ID	Outcome	Outcome type	Measurement	Results	Meta-analysis inclusion (reason)
Venning 2000	Patient satisfaction	Continuous	The medical interview satisfaction scale	After consultation, patients in the NP group (4.40 (SD: 0.46)) showed higher satisfaction than those in the GP group (4.24 (SD: 0.52)), adjusted for confounders ($p<0.001$). After additionally adjusting for length of interview, the difference between groups was still significant (mean difference: 0.16 (95% CI: 0.08–0.24).	Yes

2.3.4. Risk of bias

All studies were judged to be at high risk of bias in at least one category (Table 6). For selection bias, no studies were judged to be high risk of bias. Because the intervention was directly provided by NPs or MDs, performance bias in all studies was assessed as high risk. Detection bias was judged to be high risk except in three studies that had independent investigators. At least one domain was judged unclear in all studies.

Table 6. Risk of bias in the included studies

Study (year)	Risk of bias					
	Sequence generation	Allocation concealment	Blinding participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective outcome reporting
Becker (2005)	Low	Unclear	High	High	Low	Unclear
Chan (2009)	Low	Low	High	High	Low	Unclear
Dierick-van Daele (2009)	Low	Low	High	High	Low	Unclear
Driscoll (2008)	Unclear	Unclear	High	High	Unclear	Unclear
Enguidanos (2012)	Low	Low	High	High	High	Unclear
Hill (1994)	Unclear	Unclear	High	High	Unclear	Unclear
Hill (2003)	Unclear	Unclear	High	Low	High	Unclear
Kinnersley (2000)	Low	Low	High	High	Low	Unclear
Kubo (2009)	Unclear	Unclear	High	High	Unclear	Unclear
Limoges-Gonzalez (2011)	Low	Unclear	High	High	Low	Unclear
Mundinger (2000)	Unclear	Unclear	High	High	Low	Unclear
Sawatzky (2011)	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Smith (1997)	Low	Low	High	High	Low	Low
Stewart (2009)	Unclear	Unclear	High	High	Unclear	Unclear
Stuck (1995)	Low	Low	High	Low	Low	Unclear
Venning (2000)	Low	Low	High	High	Low	Unclear

2.3.5. Summary of findings for the main outcomes

A summary of findings table was produced for six main outcomes in this study (Table 7). Most of the outcomes showed only moderate evidence quality due to the high risk of *performance* and *detection* bias. Evidence for hospitalization at two-year and three-year follow up was graded high quality, while evidence for hospitalization at one-year follow up was graded moderate quality due to high risk of bias and inconsistency of setting between studies.

Table 7. Summary of findings for the main outcomes

Outcomes	Anticipated absolute effects (95% CI)		Relative effect (CI)	Number of participants (studies)	Quality of the evidence (GRADE)
	Risk with Usual care provided by MD	Risk with Health services provided by NP			
Hospitalization Follow up: 6 months	Study population		OR 0.85 (99%: 0.37 to 1.92)	1630 (3 RCTs)	⊕⊕⊕◯ MODERATE [1]
	127 per 1000	108 per 1000 (68 to 168)			
	Moderate				
	57 per 1000	48 per 1000 (31 to 76)			
Hospitalization Follow up: 1 year	Study population		OR 0.84 (99%: 0.57 to 1.25)	1730 (2 RCTs)	⊕⊕⊕◯ MODERATE [1]
	130 per 1000	112 per 1000 (86 to 145)			
	Moderate				
	155 per 1000	133 per 1000 (102 to 173)			
Hospitalization Follow up: 2 years	Study population		OR 1.05 (99%: 0.56 to 1.97)	414 (1 RCT)	⊕⊕⊕⊕ HIGH
	201 per 1000	209 per 1000 (143 to 306)			
	Moderate				
	201 per 1000	209 per 1000 (143 to 306)			
Hospitalization Follow up: 3 years	Study population		OR 0.95 (99%: 0.53 to 1.71)	414 (1 RCT)	⊕⊕⊕⊕ HIGH
	251 per 1000	241 per 1000 (173 to 339)			
	Moderate				
	251 per 1000	241 per 1000 (173 to 339)			
Patient mortality Follow up: 2-3 years	Study population		OR 0.77 (95%: 0.59 to 0.99)	1896 (2 RCTs)	⊕⊕⊕◯ MODERATE [1]
	167 per 1000	134 per 1000 (107 to 166)			
	Moderate				
	176 per 1000	141 per 1000 (113 to 175)			
Blood Pressure control <140/90 At baseline	Study population		OR 0.76 (98%: 0.46 to 1.26)	363 (1 RCT)	⊕⊕⊕◯ MODERATE [1]
	437 per 1000	371 per 1000 (280 to 474)			
	Moderate				
	437 per 1000	3712 per 1000 (280 to 474)			

Outcomes	Anticipated absolute effects (95% CI)		Relative effect (CI)	Number of participants (studies)	Quality of the evidence (GRADE)
	Risk with Usual care provided by MD	Risk with Health services provided by NP			
Blood Pressure control < 140/90 Follow up: 1 year	Study population		OR 1.63 (98%: 0.97 to 2.74)	363 (1 RCT)	⊕⊕⊕◯ MODERATE [1]
	599 per 1000	709 per 1000 (613 to 791)			
	Moderate				
	599 per 1000	709 per 1000 (613 to 791)			
Blood Pressure control < 140/90 Follow-up: 5 years	Study population		OR 1.12 (98%: 0.69 to 1.83)	363 (1 RCT)	⊕⊕⊕◯ MODERATE [1]
	533 per 1000	561 per 1000 (458 to 660)			
	Moderate				
	533 per 1000	561 per 1000 (458 to 660)			
Systolic blood pressure At baseline	The mean systolic blood pressure was 137 mmHg	The mean systolic blood pressure in the intervention group was 0.12 standard deviations mmHg higher (98% CI: 0.12 lower to 0.37 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Systolic blood pressure Follow up: 1 year	The mean systolic blood pressure was 134 mmHg	The mean systolic blood pressure in the intervention group was 0.26 standard deviations mmHg lower (98% CI: 0.50 lower to 0.01 lower)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Systolic blood pressure Follow up: 5 years	The mean systolic blood pressure was 138 mmHg	The mean systolic blood pressure in the intervention group was 0.12 standard deviations mmHg higher (98% CI: 0.13 lower to 0.36 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Diastolic blood pressure At baseline	The mean diastolic blood pressure was 86 mmHg	The mean diastolic blood pressure in the intervention group was 0.29 standard deviations mmHg higher (98% CI: 0.04 higher to 0.53 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]

Outcomes	Anticipated absolute effects (95% CI)		Relative effect (CI)	Number of participants (studies)	Quality of the evidence (GRADE)
	Risk with Usual care provided by MD	Risk with Health services provided by NP			
Diastolic blood pressure Follow up: 1 year	The mean diastolic blood pressure was 85 mmHg	The mean diastolic blood pressure in the intervention group was 0.11 standard deviations mmHg lower (98% CI: 0.14 lower to 0.35 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Diastolic blood pressure Follow up: 5 years	The mean diastolic blood pressure was 86 mmHg	The mean diastolic blood pressure in the intervention group was 0.11 standard deviations mmHg higher (98% CI: 0.14 lower to 0.35 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Blood LDL-C control < 130 mg/dL At baseline	Study population		OR 1.05 (98%: 0.63 to 1.73)	363 (1 RCT)	⊕⊕⊕◯ MODERATE [1]
	377 per 1000	389 per 1000 (292 to 492)			
	Moderate				
	377 per 1000	389 per 1000 (292 to 492)			
Blood LDL-C control < 130 mg/dL Follow up: 1 year	Study population		OR 2.30 (98%: 1.39 to 3.81)	363 (1 RCT)	⊕⊕⊕◯ MODERATE [1]
	467 per 1000	668 per 1000 (551 to 808)			
	Moderate				
	467 per 1000	668 per 1000 (551 to 808)			
Blood LDL-C control < 130 mg/dL Follow up: 5 years	Study population		OR 1.12 (98%: 0.68 to 1.83)	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
	539 per 1000	567 per 1000 (464 to 664)			
	Moderate				
	539 per 1000	567 per 1000 (464 to 664)			
Blood LDL-C level At baseline	The mean blood LDL-C level was 136 mg/dL	The mean blood LDL-C level in the intervention group was 0.08 standard deviations mg/dL higher (98% CI: 0.17 lower to 0.32 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]

Outcomes	Anticipated absolute effects (95% CI)		Relative effect (CI)	Number of participants (studies)	Quality of the evidence (GRADE)
	Risk with Usual care provided by MD	Risk with Health services provided by NP			
Blood LDL-C level Follow up: 1 year	The mean blood LDL-C level was 131 mg/dL	The mean blood LDL-C level in the intervention group was 0.33 standard deviations mg/dL lower (98% CI: 0.58 lower to 0.09 lower)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Blood LDL-C level Follow up: 5 years	The mean blood LDL-C level was 126 mg/dL	The mean blood LDL-C level in the intervention group was 0.02 standard deviations mg/dL lower (98% CI: 0.27 lower to 0.22 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
BMI At baseline	The mean BMI was 31	The mean BMI in the intervention group was 0.15 standard deviations higher (98% CI: 0.09 lower to 0.40 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
BMI Follow up: 1 year	The mean BMI was 31	The mean BMI in the intervention group was 0.15 standard deviations higher (98% CI: 0.09 lower to 0.40 higher)	-	363 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
BMI Follow up: 5 years	The mean BMI was 32	The mean BMI in the intervention group was equal standard deviations (98% CI: 0.25 lower to 0.25 higher)	-	359 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Costs Follow up: 6 months	The mean costs was 71.7 UK pound	The mean costs in the intervention group was 0.65 standard deviations UK pound lower (95% CI: 0.95 lower to 0.35 lower)	-	175 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Patient satisfaction At baseline	The mean patient satisfaction ranged from 4.24 - 77.5	The mean patient satisfaction in the intervention group was 0.12 standard deviations higher (98% CI: 0.11 lower to 0.35 higher)	-	2625 (4 RCTs)	⊕⊕⊕◯ MODERATE [1]

Outcomes	Anticipated absolute effects (95% CI)		Relative effect (CI)	Number of participants (studies)	Quality of the evidence (GRADE)
	Risk with Usual care provided by MD	Risk with Health services provided by NP			
Patient satisfaction Follow up: 3-6 months	The mean patient satisfaction was 77.17	The mean patient satisfaction in the intervention group was 0.24 standard deviations higher (98% CI: 0.09 lower to 0.58 higher)	-	199 (1 RCT)	⊕⊕⊕◯ MODERATE [3]
Self-reported perceived health At baseline	The mean self-reported perceived health ranged from 0.8 - 100	The mean self-reported perceived health in the intervention group was 0.01 standard deviations lower (98% CI: 0.36 lower to 0.33 higher)	-	1723 (3 RCTs)	⊕⊕⊕◯ MODERATE [1]
Self-reported perceived health Follow up: 3-6 months	The mean self-reported perceived health ranged from 106 - 634.8	The mean self-reported perceived health in the intervention group was 0.3 standard deviations higher (98% CI: 0.64 lower to 1.24 higher)	-	374 (2 RCTs)	⊕⊕⊕◯ MODERATE [1]

2.3.6. Meta-analysis results

A total of 11 studies were analysed for eight outcomes. Six analyses of three outcomes showed statistically significant results favouring NP interventions and one analysis showed statistically significant results favouring standard care by MDs. In other outcomes, there were no significant results. Results are summarized in Table 8, and forest plots for all results are shown in Appendix B.

Table 8. Meta-analysis results in eight outcomes

Outcome (follow-up term)	№ of study	Relative effect	Forest plot (Appendix B)
Hospitalization			
Six month	3	OR: 0.85 (99% CI: 0.37 – 1.92)	1
One year	2	OR: 0.84 (99% CI: 0.57 – 1.25)	2
Two year	1	OR: 1.05 (99% CI: 0.56 – 1.97)	3
Three year	1	OR: 0.95 (99% CI: 0.53 – 1.71)	4
Mortality			
Two to three year	2	OR: 0.77 (95% CI: 0.59 – 0.99)	5
Biological data			
Blood pressure<140/90 mmHg			
Baseline	1	OR: 0.76 (98% CI 0.46 – 1.26)	6
One year	1	OR: 1.63 (98% CI 0.97 – 2.74)	7
Five year	1	OR: 1.12 (98% CI 0.69 – 1.83)	8
Systolic blood pressure			
Baseline	1	SMD: 0.12 (98% CI -0.12 – 0.37)	9
One year	1	SMD: -0.26 (98% CI -0.50 – -0.01))	10
Five year	1	SMD: 0.12 (98% CI -0.13 – 0.36)	11
Diastolic blood pressure			
Baseline	1	SMD: 0.29 (98% CI 0.04 – 0.53)	12
One year	1	SMD: -0.11 (98% CI -0.35 – 0.14)	13
Five year	1	SMD: 0.11 (98% CI -0.14 – 0.35)	14
Blood LDL-C<130 mg/dL			
Baseline	1	OR: 1.05 (98% CI 0.63 – 1.73)	15
One year	1	OR: 2.30 (98% CI 1.39 – 3.81)	16
Five year	1	OR: 1.12 (98% CI 0.68 – 1.83)	17
Blood LDL-C			
Baseline	1	SMD: 0.08 (98% CI -0.17 – 0.32)	18
One year	1	SMD: -0.33 (98% CI -0.58 – -0.09)	19
Five year	1	SMD: -0.02 (98% CI -0.27 – 0.22)	20
Body mass index			
Baseline	1	SMD: 0.15 (98% CI -0.09 – 0.40)	21
One year	1	SMD: 0.15 (98% CI -0.09 – 0.40)	22
Five year	1	SMD: 0.00 (98% CI -0.25 – 0.25)	23
Costs			
Six month	1	SMD: -0.65 (95% CI -0.96 – -0.35)	24
Patient satisfaction			
Baseline	4	SMD: 0.12 (98% CI -0.11 – 0.35)	25
Three to six month	1	SMD: 0.24 (98% CI -0.09 – 0.58)	26
Self-reported patient perceived health			
Baseline	3	SMD: -0.01 (98% CI -0.36 – 0.33)	27
Six month	2	SMD: 0.30 (98% CI -0.64 – 1.24)	28
Functional status			
Three year	1	SMD: 0.19 (95% CI -0.03 – 0.41)	29
Emergency department visit			
Six month	1	OR: 0.87 (98% CI 0.64 – 1.19)	30
One year	1	OR: 1.01 (98% CI 0.77 – 1.34)	31
Six month	1	SMD: -0.25 (95% CI -0.53 – 0.03)	32

Hospitalization

Four studies reported hospitalization at six-month, one-year, two-year and three-year follow-up [91, 92, 108, 109, 114]. No study showed a statistically significant odds ratio of hospitalization at any follow-up time (Appendix B, Figures 1-4).

Mortality

Two studies reported the dichotomous outcome of patient mortality at two- to three-year follow-up [106, 114]. The odds ratio of patient mortality in the NP practice group was significantly lower than that in MDs (0.77 (95% CI: 0.59–0.99), p=0.04, I-square=0%) (Appendix B, Figure 5).

Biological data

a. Blood pressure control

One study reported the number of participants who controlled blood pressure below 140/90 mmHg at baseline, one-year and five-year follow up [100, 101]. No study showed statistically significantly different odds ratio of blood pressure control. (Appendix B, Figures 6-8).

Only one study reported mean values of systolic blood pressure (SBP) and diastolic blood

pressure (DBP) at baseline, one-year and five-year follow-up [100, 101]. The NP practice group at one-year follow-up showed statistically significantly lower standardised mean differences in SBP than that in the MD group (-0.26 (98% CI: -0.50–-0.01), p=0.01) (Appendix B, Figure 10), while the standardised mean difference at other follow-up points did not show any significant results (Appendix B, Figures 9 and 11). The standardised mean difference in DBP was statistically significant (0.29 (98% CI: 0.04–0.53), p=0.007), favouring MD practice only at baseline (Appendix B, Figure 12), while the results at other follow-up points were not significantly different (Appendix B, Figures 13 and 14).

b. Blood Low Density Lipoprotein-Cholesterol (LDL-C) control

One study reported the number of participants who controlled blood LDL-C level below 130 mg/dL at baseline, one-year and five-year follow-up [100, 101]. The NP practice group showed significantly higher odds ratio than MD group (2.30 (98% CI: 1.39–3.81), p=0.0001) only at one-year follow-up (Appendix B, Figure 16), while the outcomes at other follow-up points did not show any significant results (Appendix B, Figures 15 and 17). The standardised mean difference in blood LDL-C level was statistically significant (-0.33 (99% CI: -0.58–-0.09), p=0.002) favouring NP practice at one-year follow-up (Appendix B, Figure 19), however the outcomes at other follow-up points were not significant (Appendix B,

Figures 18 and 20).

c. Body mass index (BMI)

Only one study reported BMI measurement at baseline, one-year and five-year follow-up [100, 101]. None of the standardised mean differences in BMI were statistically significant (Appendix B, Figures 21-23).

Costs

One study [102] reported statistically significant standardised mean difference in costs favouring NP practice compared to MD practice (-0.65 (95% CI: -0.96–-0.35), $p<0.0001$) (Appendix B, Figure 24).

Patient satisfaction

Four studies reported patient satisfaction at baseline and at three- to six-month follow-up [90, 92, 112, 115]. None of the standardised mean difference scores showed significant results (Appendix B, Figures 25 and 26).

Self-reported patient perceived health

Four studies reported self-reported perceived health at baseline and three- to six-month follow-up [90, 92, 102, 112]. However no outcomes were statistically significant (Appendix B, Figures 27 and 28).

Functional status

One study reported functional status at three-year follow-up [114]. No standardised mean difference scores showed significant results (Appendix B, Figure 29).

Emergency department visit

Two studies reported emergency department visits at six-month and one-year follow-up [92, 108, 109]. Both dichotomous and continuous outcomes at six-month follow-up and dichotomous outcome at one-year follow-up did not show any statistically significant difference (Appendix B, Figures 30-32).

2.3.7. Subgroup and sensitivity analysis

Subgroup analysis was conducted in three outcomes that showed heterogeneity in pooled analysis. Results are summarized in Table 9, and forest plots for all results are shown in

Appendix B.

Table 9. Sub-group analysis results

Outcome (sub-group)	Number of studies	Relative effect	I-squared (%)	Figure in App. B
Hospitalization in six month follow-up				
Total	3	OR: 0.85 (99% CI: 0.37–1.92)	56.4	
Clinic	2	OR: 0.59 (99% CI: 0.19–1.86)	20.7	33
Home based services	1	OR: 1.26 (99% CI: 0.67–2.39)	-	
Patient satisfaction at baseline				
Total	4	SMD: 0.12 (98% CI: -0.11–0.35)	78.5	
General practice	2	SMD: 0.16 (98% CI: -0.23–0.54)	92.5	34
Clinic	1	SMD: 0.12 (98% CI: -0.21–0.44)	-	
Home based services	1	SMD: 0.01 (98% CI: -0.32–0.34)	-	
Patient satisfaction at baseline				
Total	4	SMD: 0.12 (98% CI: -0.11–0.35)	78.5	
Scale 0-100	2	SMD: 0.07 (98% CI: -0.17–0.30)	0	35
Scale 0-30	2	SMD: 0.16 (98% CI: -0.23–0.54)	92.5	
Self-reported patient perceived health at baseline				
Total	3	SMD: -0.01 (98% CI: -0.36–0.33)	81.1	
Clinic	2	SMD: 0.12 (98% CI: -0.00–0.24)	0	36
Home based services	1	SMD: -0.37 (98% CI: -0.70–-0.04)	-	
Self-reported patient perceived health in three to six month follow-up				
Total	2	SMD: 0.30 (98% CI: -0.64–1.24)	93.2	
General practice	1	SMD: 0.71 (98% CI: 0.34–1.07)	-	37
Home	1	SMD: -0.10 (98% CI: -0.43–0.23)	-	

Subgroup analysis of hospitalization at six-month follow-up

Pooled analysis on hospitalization at six-month follow-up showed a moderate level of heterogeneity. When the studies were categorized depending on the study settings including clinic [91, 108, 109] and home-based service [92], there was no significant difference in odds

ratio in either clinic (0.59 (99% CI: 0.19–1.86)) or at home (1.26 (99% CI: 0.67-2.39)) (Appendix B, Figure 33).

Subgroup analysis of patient satisfaction at baseline

Since pooled analysis of hospitalization at baseline showed high heterogeneity, a subgroup analysis was conducted by study setting and after dichotomizing the measurement scale at a threshold score of 30. Analysis based on study setting including GP [90, 115], clinic [112] and home [92] did not show significant differences (Appendix B, Figure 34). Similarly, there was no significant difference after categorizing the measurement scale (Appendix B, Figure 35).

Subgroup analysis of self-reported perceived health at baseline

Pooled analysis of self- reported perceived health at baseline showed high heterogeneity. When the studies were categorized by study setting, the standardised mean difference was significantly different in favour of MD practice for care provided at home [92] compared to NP practice (-0.37 (98% CI: -0.70–-0.04), p=0.010) (Appendix B, Figure 36).

Subgroup analysis of self-reported perceived health at three- to six-month follow-up

Pooled analysis on self-reported perceived health showed a high level of heterogeneity (I^2=93.2%). When two studies were categorized based on study setting including home [92] and GP [102], the standardised mean difference at GP showed a statistically significant difference (0.70 (98% CI: 0.34–1.07), p<0.00001), while the score for the home intervention did not show any significant difference (Appendix B, Figure 37).

2.3.8. Equivalence test results

Equivalence test was conducted in six outcomes that did not show statistically significant results in meta-analysis. Results are shown in Table 10. Two outcomes, including biological data and emergency department visit, had at least one statistically equivalent result and blood Low Density Lipoprotein-Cholesterol (LDL-C) control was found to be statistically equivalent almost consistently over those follow-up periods. However, most outcomes did not show statistical equivalence in any follow-up period.

Table 10. Equivalence test results

Outcome (follow-up term)	Number of studies	Thresholds	Relative effect	Equivalent
Hospitalization				
Six month	3	0.54 to 1.85	OR: 0.85 (99% CI 0.37 – 1.92)	No
One year	2	0.58 to 1.71	OR: 0.84 (99% CI 0.57 – 1.25)	No
Two year	1	0.56 to 1.89	OR: 1.05 (99% CI 0.56 – 1.97)	No
Three year	1	0.56 to 1.78	OR: 0.95 (99% CI 0.53 – 1.71)	No
Mortality				
Two to three year	2	Exclude	OR: 0.77 (95% CI 0.59 – 0.99)	-
Biological data				
Blood pressure<140/90 mmHg				
Baseline	1	0.55 to 1.81	OR: 0.76 (98% CI 0.46 – 1.26)	No
One year	1	0.53 to 1.88	OR: 1.63 (98% CI 0.97 – 2.74)	No
Five year	1	0.55 to 1.82	OR: 1.12 (98% CI 0.69 – 1.83)	No
Systolic blood pressure				
Baseline	1	-0.30 to 0.30	SMD: 0.12 (98% CI -0.12 – 0.37)	No
One year	1	Exclude	SMD: -0.26 (98% CI -0.50 – -0.01)	-
Five year	1	-0.30 to 0.30	SMD: 0.12 (98% CI -0.13 – 0.36)	No
Diastolic blood pressure				
Baseline	1	Exclude	SMD: 0.29 (98% CI 0.04 – 0.53)	-
One year	1	-0.28 to 0.28	SMD: -0.11 (98% CI -0.35 – 0.14)	No
Five year	1	-0.28 to 0.28	SMD: 0.11 (98% CI -0.14 – 0.35)	No
Blood LDL-C<130 mg/dL				
Baseline	1	0.55 to 1.81	OR: 1.05 (98% CI 0.63 – 1.73)	Yes
One year	1	Exclude	OR: 2.30 (98% CI 1.39 – 3.81)	-
Five year	1	0.54 to 1.84	OR: 1.12 (98% CI 0.68 – 1.83)	Yes
Blood LDL-C				
Baseline	1	-0.28 to 0.28	SMD: 0.08 (98% CI -0.17 – 0.32)	No
One year	1	Exclude	SMD: -0.33 (98% CI -0.58 – -0.09)	-
Five year	1	-0.29 to 0.29	SMD: -0.02 (98% CI -0.27 – 0.22)	Yes
Body mass index				
Baseline	1	-0.28 to 0.28	SMD: 0.15 (98% CI -0.09 – 0.40)	No
One year	1	-0.28 to 0.28	SMD: 0.15 (98% CI -0.09 – 0.40)	No
Five year	1	-0.28 to 0.28	SMD: 0.00 (98% CI -0.25 – 0.25)	Yes
Costs				
Six month	1	Exclude	SMD: -0.65 (95% CI -0.96 – -0.35)	-
Patient satisfaction				
Baseline	4	-0.20 to 0.20	SMD: 0.12 (98% CI -0.11 – 0.35)	No
Three to six month	1	-0.40 to 0.40	SMD: 0.25 (98% CI -0.09 – 0.58)	No
Self-reported patient perceived health				
Baseline	3	-0.22 to 0.22	SMD: -0.01 (98% CI -0.36 – 0.33)	No
Six month	2	-0.40 to 0.40	SMD: 0.30 (98% CI -0.64 – 1.24)	No
Functional status				
Three year	1	-0.32 to 0.32	SMD: 0.19 (95% CI -0.03 – 0.41)	No
Emergency department visit				
Six month	1	0.70 - 1.42	OR: 0.87 (98% CI 0.64 – 1.19)	No
One year	1	0.72 - 1.39	OR: 1.01 (98% CI 0.77 – 1.34)	Yes
Six month	1	-0.32 to 0.32	SMD: -0.25 (95% CI -0.53 – 0.03)	No

Hospitalization

No results in hospitalization were found to be statistically equivalent between NP practice and MD practice. This indicates that there is neither statistically significant difference in nor equivalence between NP practice and MD practice.

Biological data

a. Blood pressure control

The odds ratio of blood pressure below 140/90 mmHg in the NP practice group did not show any statistically equivalent results to to the MD practice group. When incorporating meta-analysis results, NP practice had neither statistically significant results nor equivalent results to MD practice.

For systolic blood pressure, although the standardised mean difference of systolic blood pressure at one-year follow-up showed statistically significant results favouring NP practice, the standardised mean difference of systolic blood pressure at baseline and five-year follow-up did not show statistically equivalent results.

The standardised mean difference of diastolic blood pressure at baseline showed statistically

significant results favouring MD practice in meta-analysis, but other analyses at one-year and five-year follow-up did not show statistically equivalence in equivalence test. Since statistical significance at baseline means the superiority of the cohort, overall results of statistical analysis indicate that there is neither statistically significant differences nor equivalence between NP practice and MD practice.

b. Blood Low Density Lipoprotein-Cholesterol (LDL-C) control

The odds ratio of blood LDL-C under 130 mg/dL showed that the NP practice group was statistically equivalent to the MD practice group at baseline and at five-year follow-up. When incorporating the meta-analysis result, NP practice was equivalent to or higher quality than MD practice.

The standardised mean difference of blood LDL-C level of NP practice showed statistically equivalent results to MD practice at baseline and five-year follow-up. After incorporating meta-analysis result, the quality of NP practice was equivalent to or higher than that of MD practice after one-year follow-up.

c. Body mass index (BMI)

The standardised mean difference in BMI was found to be statistically significant only at five-year follow-up.

Patient satisfaction

None of the standardized mean difference scores showed statistically equivalent results. This indicates that the practice difference between NPs and MDs had neither statistically difference nor equivalence.

Self-reported patient perceived health

No outcome was found to be statistically equivalent, which means there was neither statistically significant difference nor equivalence between NP practice and MD practice.

Functional status

No standardised mean difference scores showed statistically equivalent results, indicating NP and MD provided neither statistically different nor equivalent services.

Emergency department visit

The standardised mean difference of emergency department visits in the NP group had

statistically equivalent results to the MD group only at one-year follow-up.

2.4. Discussion

2.4.1. Summary and interpretation of findings

This systematic review identified 16 studies of RCTs that examined whether services provided by NPs have equivalent outcomes to those by MDs in a community setting. Of the 16 studies, 12 (75%) had statistically significant higher results in one or more outcomes in NP services than MD services. In meta-analysis of 11 studies, most outcomes did not show a statistically significant difference. Among analyses that had statistically significant results, almost all outcomes favoured NP practice except the analysis of diastolic blood pressure at baseline. The outcomes are summarised in Table 11.

Table 11. Significant results in meta-analysis

Outcome	Follow-up time	Relative effect (99% CI)	Practice favoured by result
Mortality	Two to three years	OR: 0.77 (95% CI: 0.59–0.99)	NP
Biological data			
Systolic blood pressure	One year	SMD: -0.26 (98% CI -0.50 – -0.01)	NP
Diastolic blood pressure	Baseline	SMD: 0.29 (0.01–0.56)	MD
Blood LDL-C<130 mg/dL	One year	OR: 2.30 (98% CI: 1.32–4.02)	NP
Blood LDL-C	One year	SMD: -0.33 (98% CI: -0.60–-0.06)	NP
Costs	Six months	SMD: -0.65 (95% CI: -0.96–-0.35)	NP

Two outcomes that showed statistically significant results in sub-group analysis are summarized in Table 12.

Table 12. Significant results in sub-group analysis

Outcome	Sub-group	Relative effect	Practice favoured by result
Self-reported patient perceived health at baseline	Total	SMD: -0.01 (98% CI: -0.36–0.33)	-
	Clinic	SMD: 0.12 (98% CI: -0.00–0.24)	NP
	Home based services	SMD: -0.37 (98% CI: -0.70–-0.04)	MD
Self-reported patient perceived health in three to six month follow-up	Total	SMD: 0.30 (98% CI: -0.64–1.24)	-
	General practice	SMD: 0.71 (98% CI: 0.34–1.07)	NP
	Home based services	SMD: -0.10 (98% CI: -0.43–0.23)	-

Equivalence tests were conducted in seven outcomes that did not show statistically significant results in meta-analysis. Statistical equivalence between NP practice and MD practice was found in blood lipid control at baseline and five-year follow-up, BMI at five-year follow-up and emergency department visit at five-year follow-up.

Overall, patient mortality and costs were found to be statistically significant, favouring NP practice compared to MD practice. Additionally, NP practice was equivalent to or higher quality than MD practice in blood LDL-C control. However, most outcomes showed neither statistically significant differences nor statistical equivalence between NP and MD groups.

Since those cases likely represent the low power of the studies in meta-analysis, bigger and better studies would be needed to investigate statistically significant differences in some of those outcomes.

2.4.2. Comparison with previous studies

Two previous comprehensive systematic reviews have assessed NP practice [49, 50]. One review, conducted in 2002, examined the equivalence of services provided by NPs and by MDs in primary care [49]. This systematic review and meta-analysis of 11 trials and 23 observational studies identified higher levels of patient satisfaction with service provided by NPs than those provided by MDs, and no significant difference in patient health status, prescriptions and return consultations. This study applied different methods from our study. It included prospective observational studies in addition to RCTs and also included studies where nurses provided the first point of contact, made an initial assessment, and managed practice autonomously even if nurses were not clearly described as NPs. Patient satisfaction was also meta-analysed as an outcome and three studies overlapped those analysed in with our study. Although this study found statistically significant standardised mean difference favouring NP practice compared to MD practice, our study did not find any significant result. This may be because one RCT conducted in 1981, which was not included in our study

because the study period started before our inclusion criterion of 1990, found extremely large SMDs in favour of NP practice compared to other RCTs.

The other review quantified advanced practice nurse outcomes, including NPs, from articles published in the United States between 1990 and 2008 [50]. This study identified 14 trials including 12 studies scaled as high quality and 23 observational studies. From those trials, NP practice outcomes were summarised in dimensions of patient satisfaction, self-rated health, physical function and biological data such as blood sugar control, lipid control and blood pressure. These outcomes were compared with the same outcomes in patients whose care was managed exclusively by MDs. This systematic review summarised 11 patient outcomes using narratively graded results (equivalent, favouring NPs or MDs). All outcomes in most studies were found to be equivalent except for blood lipid control, where the results favoured NPs. However this review did not focus on NP practice specifically in a community setting and did not conduct meta-analysis, which adjusts the effects based on the cohort size of each study.

Given those differences and similarities, this systematic review and meta-analysis provide sensible results based on strict eligibility criteria and rigorous statistical analysis methods. Furthermore, this study is more up-to-date since it includes studies conducted between 1990

and 2015 with the RCTs from several countries where NP was in practice in a community setting.

2.4.3. Strengths and limitations of the study

This is the first study to examine the statistical equivalence of community-based health services provided by NPs and MDs. As the community setting includes different types of services such as clinic and home-based services, my analysis produced comprehensive results. Following the methods in the *Handbook* [93] enabled me to conduct this study in a rigorous manner, and including only RCTs in the review resulted in the higher degree of evidence. There are, however, several limitations in this study.

First, this study examined outcomes using subjective measurements such as patient satisfaction and self-reported perceived health, which may cause social desirability response bias as it is difficult to blind participants, care providers or outcome assessors due to the intervention characteristics. Second, I could not include any RCTs done in Asia, although several Asian countries such as Taiwan and Singapore have already introduced NPs in their health systems [61-64]. Examining NP practice using RCTs in Asian countries and updating systematic review and meta-analysis would be desirable to reduce geographical bias. Third,

many of the RCTs included in this study date from before 2010, in time periods of lower population ageing. Although some studies targeted elderly people, RCTs examining NP practice, specifically including elderly people in the environment of an ageing society, would provide useful evidence for NP effectiveness in a rapidly ageing society. Finally, this review could not include expected outcomes such as pressure ulcer management and length of hospital stay in the protocol [116]. As those outcomes are important indicators for quality of treatment and care to elderly people, further RCTs included those outcomes are needed.

2.5. Conclusion

This systematic review and meta-analysis found neither significant difference nor equivalence in community-based health services between NPs and MDs in most outcomes examined in this review. However, three outcomes–patient mortality, blood lipid control and costs–were found to be improved in NP practice. As no analysis showed a statistically significant result disfavouring NP practice, my analysis indicates that at least NPs could provide services with no risk of reduction in quality compared to services by MDs in a community setting. This evidence suggests that utilizing NPs in community settings may be one of the solutions to provide sufficient community-based health services under limited human resources, especially where there is a shortage of MDs. However, the lack of evidence

for equivalence suggests that the true impact of NPs in community-based health care is not fully understood, and larger and better studies are needed in the future to ensure the statistical equivalence between NP and MD practice.

3. Impact of introducing nurse practitioners in long-term care health facility

3.1. Introduction

3.1.1. Long-term care health facilities in Japan

Long-term care health facilities (LCHFs) are one of the services covered by the long-term care insurance system [22]. LCHFs target elderly people aged over 65 years with certified care level between one and five based on the standards for long-term care certification. Care level was certified based on estimated required caring time for daily activities, with level five the most severe condition requiring the most intensive care [117]. The major purpose of LCHFs was to improve residents' physical function so that they can return home quickly [22]. With an intermediate bridging role between hospital and home, they provide medical care, rehabilitation, nursing and daily care services [118]. However, the average care level of residents in LCHFs gradually increased from 3.11 to 3.32 over the 10 years to 2011 and the mean length of stay increased dramatically from 185 days in 2000 to 329 days in 2010. Moreover, the proportion of discharges direct to hospital also increased from 39.3% in 2001 to 48.9% in 2010, while the percentage of discharges direct to home decreased from 40.5% in 2001 to 23.8% in 2010 [119-123]. LCHFs are now required to manage residents with

increasingly severe care needs and worsening health conditions [124], reducing their ability to achieve their founding goal of promoting residents' return to the family home [22].

3.1.2. NP practice in long-term care health facilities

Elderly people are vulnerable to potentially preventable risk factors for dehydration, aspiration and falls that demand medical services, including hospitalization [125]. Once hospitalized their activity levels decline, requiring a longer period of time to regain their pre-hospitalization physical condition, disease prevention and control and health promotion is essential to manage health system capacity [12, 126, 127]. At a LCHF, the NP plays an administrative nursing role, undertakes certain medical procedures and makes decisions about conditions such as fever, pressure ulcers and emergency hospital referral within protocols agreed with the facility director, under a medical doctor's supervision [128]. Given these competencies and responsibilities, NPs are expected to reduce hospitalization by managing the main causes of preventable hospitalization [77, 129]. NPs are one possible solution to meet the long-term health care needs of Japan's rapidly ageing society, with limited human resources for health.

NP in this study are defined based on the definition of the Japanese NP previously described

(1.2.2. Education and practice of nurse practitioner in Japan) and the role and practice of NPs are similar to those in the US and the UK. However, NP practice is regulated under the training system for nurses to perform specific medical interventions, so the types of clinical practice available to NPs are more clearly specified and the level of autonomy is limited compared to NPs overseas. The types of clinical practice in this type of facility included 1) physical assessment and diagnostic testing and diagnoses, 2) first point of contact for medical emergency, 3) adjustment and prescription of medications for constipation and cutaneous symptoms, 4) adjustment of medication for controlling diabetes mellitus, hypertension and hyperlipidaemia, 5) diagnostic tests for infectious diseases (Influenza and norovirus), 6) maintenance of gastric fistula catheter and buttons, 7) nutrient order for tube feeding, and 8) seasonal influenza vaccination [130-133]. These practices were provided based on the protocol agreed with and under supervision by MD who was the director of the facility. The specific changes in practice at the LCHF during the trials of the NP nursing training system are described below [130-133].

- *Reduction in the number of emergency transfer to hospitals*: NP's rapid initial assessment at the time of emergency and daily physical assessment of residents based on the evaluation of treatment through tests and initial screening enabled prevention of worsening health conditions and detection of early signs of illness.

- *Management of pressure ulcers*: In addition to ordinal pressure ulcer management performed by a specialised team, NP's practice of debridement, medication selection based on assessment of pressure ulcer status, and nutrition management enabled management and cure of severe levels of pressure ulcer. The NP judged that the number of new pressure ulcer cases with severe level after NP introduction period was reduced by half compared to the period before NP introduction.
- *Control of diabetes mellitus and hypertension*: NP's comprehensive assessment at the time of admission enabled continuous monitoring and early detection of changes in health condition especially for those with multiple NCDs.
- *Activation of multi-disciplinary approach*: NP's leadership, counselling and mentorship enabled maximization of the competencies of each health care provider in the facility, ensuring effective human resource utilization of each type of provider's specific clinical knowledge and skills.

These changes in practice form the basis for judging which outcomes to assess in this retrospective cohort study.

3.1.3. Previous studies

Previous studies conducted in the U.S, that examined the practice of geriatric nurse

practitioners (GNP) in nursing homes, showed some reduction in hospital admissions compared to those nursing homes without GNP [134-136] and found that they can adequately meet resident needs [137]. Although characteristics of Japanese LCHFs are slightly different from overseas nursing homes [138] due to their temporary residential purpose, the basic care provided is largely similar. The systematic review and meta-analysis presented in Chapter 2 found that NPs provided statistically significantly higher quality services than MDs in some outcomes, such as patient mortality, blood lipid control, and costs. However, most outcomes were found to be neither statistically significantly different nor statistically equivalent to MD services. Limited findings of improved quality of care were identified in blood lipid control and costs, favouring NP practice. As the studies included in the systematic review were conducted mainly in North America and the UK where NPs have higher levels of autonomy than those in Japan, but the definition and the fundamental aspects of NP practice are similar between countries in the systematic review and Japan, a separate assessment of outcomes in LCHFs is necessary. Given the increasingly critical role that LCHFs play in Japan's integrated community care system and the unclear findings of the systematic review, further detailed research specific to Japanese settings will help to inform the future development of the Japanese NP system and contribute to global evidence on the role of NPs. One comparative Japanese study done in LCHFs found improvements in daily health status and a

reduction in health conditions requiring ambulance transfer and hospitalization [129]. However, it is essential to explore the impact of NP practice on clinical outcomes in the Japanese context rigorously.

In this chapter I will extend the review from Chapter 2 to conduct original research on the effectiveness and acceptability of NP practice in Japanese LCHFs.

3.1.4. Objectives

This chapter aims to assess time trends in clinical and health services outcomes, and to compare the risk of clinical outcomes including hypertension control, hypertension management and fever, and hospitalization as a health services outcome between long-term care health facilities with and without practicing NP in the Japanese context. This study examines NP practice specifically at long-term care facilities, as the improved services provided at places other than hospitals are important determinants of the quality of the integrated community-based care system, which enables elderly people to stay at home as long as possible in the community.

3.2. Methods

3.2.1. Study design and setting

A retrospective cohort study was done using data from two long-term care health facilities (LCHFs) [22]. Both facilities are located in rural areas, one (intervention facility) in south-western Japan with a population of 75,000 and the other (control facility) in central Japan with a population of 55,800. The cities are experiencing ageing at different rates, with 35.4% and 26.1% of their population over the age of 65 in 2015, respectively compared to a national average rate of 26.0% in 2014 [12]. Despite their different locations, these facilities were similar in protocols and admission policies, which are set by municipal bylaw shown in Table 13. Both facilities had the same personnel structure, which met the requirements laid down in the *Long-term Care Health Facility Standards* [139], consisting of a full-time medical doctor as facility director, nurses, occupational therapists or physical therapists, care managers, support consultants, care workers and dieticians. The NP joined the intervention facility at the time of facility opening and started NP practice in April, 2011, when she had 17 years' experience as a nurse. The NP served as a deputy director of the facility and did not belong to the nursing department, both before and after the NP introduction period [131, 133]. The personnel structure in the facility did not change over the four years of the study period [133]. Both facilities had between 10 and 13 nurses and assistance nurses at any time, and

their experience varied individually from 5 to 43 years.

Table 13. Characteristics of the facility

	Intervention facility		Control facility	
Place	South-western Japan		Central Japan	
Opening year	March, 2007		May, 1997	
Founding body	Healthcare corporation		Incorporated association	
Foundation principles	1. Provide resident- and family-oriented quality services 2. Provide hospitable environment with home-like atmosphere respecting individual personality. 3. Provide enjoyable and effective rehabilitation		1. Protect residents' dignity, respect individual personality and provide resident-oriented services 2. Provide support which enables residents to live independently depending on individual care level 3. Provide support which enables residents and their family to live in a state of feeling secure 4. Play a role as welfare service base in the area by collaborating with people in the community	
Number of beds	100		100	
Admission policy	Care level 1 to 5 Exclusion criteria: Dialysis, end of life care (as of study time)		Care level 1 to 5 Exclusion criteria: Those who require end of life care (as of study time) and medical procedures including home oxygen therapy, dialysis, central venous hyper-alimentation, malignant tumor treatment, advanced cancer care, hormone therapy, MRSA and tuberculosis infection control, nasogastric tube feeding	
Workforce	2009	2011	2009	2011
Medical doctor	1 (full time)	1 (full time)	1 (full time), 1 (part time)	1 (full time), 1 (part time)
Deputy director	1 (full time)	1 (full time)	0	0
Nurse practitioner	0		0	0
Nurse	9 (full time), 2 (part time)	9 (full time), 2 (part time)	6 (full time), 5 (part time)	6 (full time), 5 (part time)
Care manager	1 (full time)	1 (full time)	1 (full time)	1 (full time)
Support consultant	2 (full time)	2 (full time)	2 (full time)	2 (full time)
Care worker	22 (full time), 2 (part time)	18 (full time), 2 (part time)	30 (full time), 5 (part time)	30 (full time), 5 (part time)
Physical therapist	-	-	1 (full time), 3 (part time)	1 (full time), 3 (part time)
Occupational therapist	4 (full time)	4 (full time)	-	-
Dietitian	1 (full time)	1 (full time)	1 (full time)	1 (full time)
Pharmacologist	1 (part time)	1 (part time)	1 (part time)	1 (part time)

3.2.2. Inclusion and exclusion criteria

The study was conducted between April 1, 2009 and March 31, 2013 and a nurse started NP practice from April 1, 2011 in the intervention facility. The control facility did not employ any nurse in an NP role. All residents of the two facilities during the study period were included. Residents who were not eligible for facility admission and those with missing information on variables such as body temperature, activities of daily living (ADL) and body mass index (BMI) were excluded.

3.2.3. Data collection

Basic characteristics of the cohort such as date of birth, sex, length of facility stay, discharge destination and care level were obtained from the facility's electronic database (Wiseman) [140]. Care level was rated from one to five based on the standards for long-term care requirement certification [117], which estimates required caring time for daily activities, with level five the most severe condition requiring the most intensive care. Medical history including hypertension, diabetes mellitus, hyperlipidaemia, kidney diseases and heart failure, and treatment and care including prescription and nutrition order were obtained from medical records. Axillary body temperature, blood pressure, height and weight measurements were obtained from temperature charts. The ADL scale was also collected from care assessment

information which is required to be conducted every three months by law [139]. This scale includes functional morbidity, bathing, dressing, self-feeding, personal hygiene, grooming, toilet hygiene and communication [139] and assessment is made by all health care providers in the facility based on the Barthel index modified by the facilities [141]. All covariates in this study are shown in Table 14.

Table 14. Variables in the study

Explanatory variables	Definition
Sex	0=Male, 1=Female
Age group	1=50-69, 2=70-79, 3=80-89, 4=90+
Care level	1-5
Body Mass Index (BMI) group	1: BMI<18.5, 2: BMI 18.5-25.0, 3: BMI>=25.0
Medical history	
Hypertension	0=No, 1=Yes
Diabetes mellitus	0=No, 1=Yes
Hyperlipidaemia	0=No, 1=Yes
Heart failure	0=No, 1=Yes
Kidney disease	0=No, 1=Yes
Salt intake restriction	0=No, 1=Yes
Activities of daily living (ADL)	
Functional morbidity	0=Independent, 1=Walks with walking stick, 2=Walks with rollator, 3=Wheelchair independent, 4=Wheelchair with full assistance
Self-feeding	0=Independent, 1=Needs supervision, 3=Some help required, 4=Full assistance
Toilet	0=Independent, 1=Needs supervision, 3=Some help required, 4=Full assistance
Grooming	0=Independent, 1=Needs supervision, 3=Some help required, 4=Full assistance
Dressing	0=Independent, 1=Needs supervision, 3=Some help required, 4=Full assistance
Bathing	0=Independent, 1=Needs supervision, 3=Some help required, 4=Full assistance
Communication	0=Independent, 1=Needs assistance , 2= Unable

3.2.4. Outcomes

In order to examine the effect of NP practice in LCHFs comprehensively, clinical and health services outcomes were examined. Clinical outcomes were chosen based on narrative assessment of NP practice and data feasibility. As described in section 3.1.2, one of the key areas of clinical practice NP is routinely involved in is management of NCDs [130-133]. Among several areas of NCD control, however, data was only available for hypertension control and management, so this study used only this clinical outcome to measure effectiveness of NCD control.

Clinical outcomes

a. Hypertension control

All residents diagnosed as hypertensive before facility admission, at the time of the admission or during the facility stay were included in this analysis. In both facilities, blood pressure in all residents was measured twice weekly by care workers using automated blood pressure monitoring devices. For this study, blood pressure measurements of those with hypertension were collected every two weeks. Hypertension was judged to be controlled if the measurements of both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were below the treatment target. Measurements of either SBP or DBP above the treatment target

were considered to be uncontrolled based on the criteria shown in Table 15, which are drawn from the *Guidelines for the Management of Hypertension 2014* [142]. In this hypertension control analysis, I examined whether the duration of blood pressure measurements controlled under the treatment target became longer after the NP started practice. In this survival analysis, therefore, blood pressure measurement that rose above the treatment target was treated as a clinical endpoint. Analysis time was the time period for which blood pressure was controlled under the treatment target, calculated from the second blood pressure measurement date which had consecutive blood pressure values below the treatment target to the first measurement date with blood pressure values above the treatment target, the end date of the study period or withdrawal (Figure 2).

Table 15. Treatment target blood pressure values

	Under 75 years of age	75 years of age and over	With diabetes mellitus
SBP	140	150	130
DBP	90	90	80

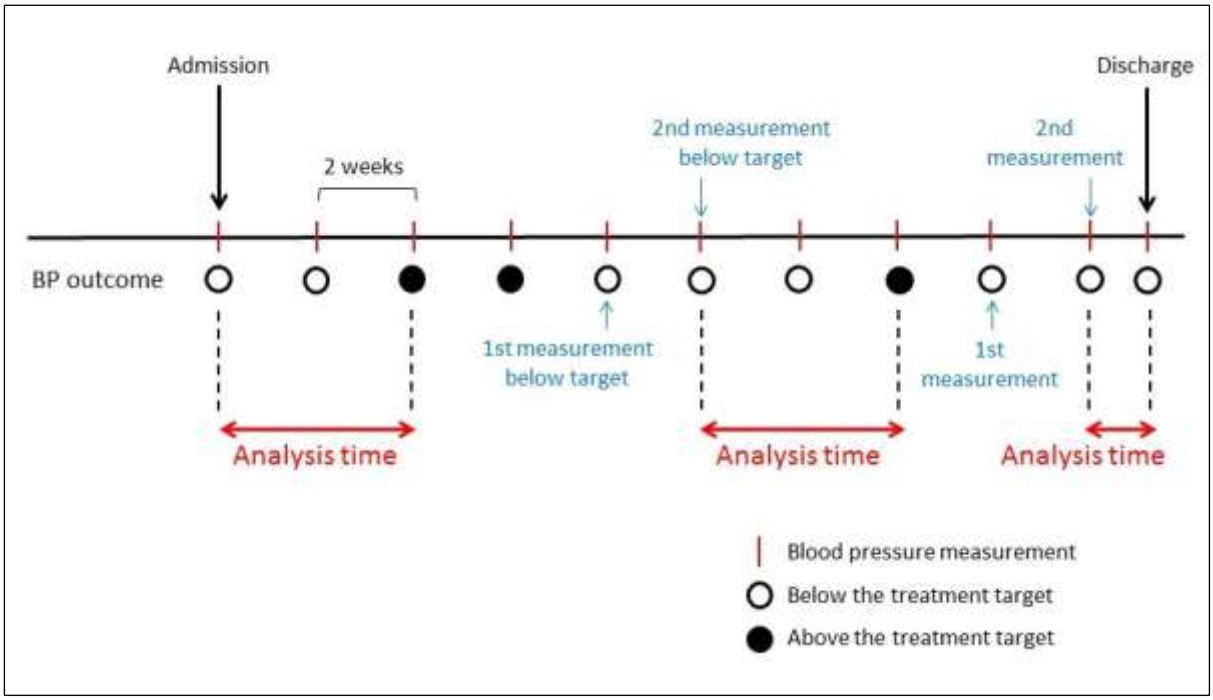

Figure 2. Example of analysis time definition for hypertension control

b. Hypertension management

In all diagnosed hypertension cases I also analysed whether NP practice statistically shortened the duration of uncontrolled blood pressure. Analysis time was the time period for which blood pressure was uncontrolled over the treatment target, calculated from the date when blood pressure values rose above the treatment target to the second consecutive blood pressure measurement date when both SBP and DBP values were below the treatment target, the end date of the study period or withdrawal (Figure 3).

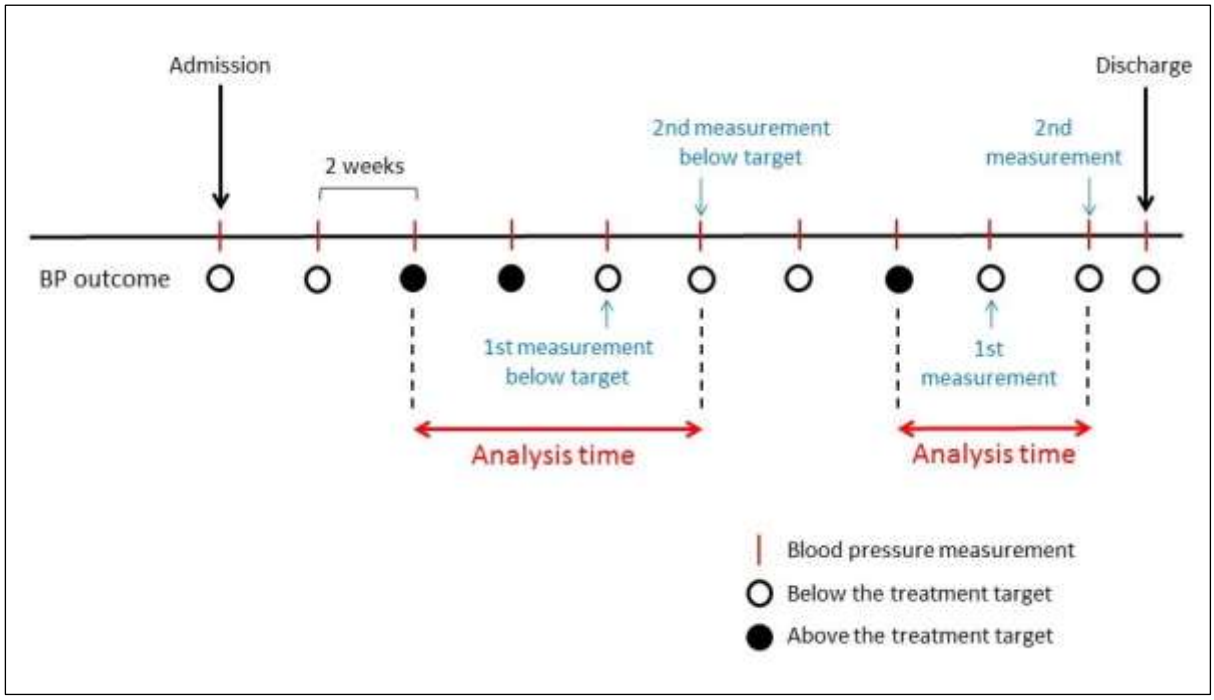

Figure 3. Example analysis time definition for hypertension management

c. Fever

All residents were included in this analysis. Body temperature (BT) in all residents was measured every morning by care workers and recorded in the temperature chart. I used an axillary body temperature threshold of 37.0 degrees Celsius (C) to define fever onset based on the previous studies [143-145]. The date when BT rose above 37.0 C was defined as the start of a study period and the date when body temperature returned below 37.0 C as the end of period if any intervention such as cooling, dehydration therapy and prescribing antibiotics was conducted during the period. Analysis time was the duration with no fever calculated from the date of no fever to the first date of the fever.

Health service outcome

Since hospitalization is an outcome that reflects improved clinical and non-clinical management of elderly residents in LCHFs, all types of inpatient hospitalization, including both planned discharges for tests and procedures and emergency discharges directly to hospital due to worsening condition, were treated as an event, but hospital outpatient episodes were not included. Analysis time was assessed using person-days, which were calculated from admission date to the end of the study period, date of hospitalization, or withdrawal.

3.2.5. Statistical analysis

In order to capture time trends in outcomes in the two facilities, six-monthly rates of all outcomes were calculated using the number of events per 100 person-days in each six month period. Trends in event rates and the differences in trends between facilities were examined using a Poisson regression model. These time periods were included in our final model as a time-varying covariate only if the test of trend in outcomes and its interaction with facility were found to be significant.

In Chapter 2, a combined meta-analysis and equivalence test was conducted to examine the equivalence of practice between NPs and MDs. However, few studies have undertaken these

methods [95, 96] and results of no superiority or inferiority are often treated as equivalence [49]. Since there were clear findings of superiority in physical management in this meta-analysis, survival analysis was conducted to examine the difference between NPs and MDs. The study period was delimited by April 1, 2011, defining the pre- and post- NP introduction period. For the clinical outcomes, the survival time was calculated as the time duration between the date of admission and event, the date of two events within one admission episode, or the date of event and censorship, and censorship was defined as discharge, the end of study period (March 31, 2011 and March 31, 2013) or death, whichever occurred first. For the hospitalization outcome, survival time was calculated as the time duration between date of admission and discharge for an event, or date of censorship, and with censorship defined as discharge to any non-hospital destination, the end of study period or death, whichever occurred first.

In order to investigate the difference in effects between facilities and study periods, difference-in-difference analysis was conducted. This analysis method calculates the additional effect of the intervention in the intervention facility, after adjusting for any period-specific changes in the control facility that may have occurred at the same time, and is the gold standard for non-randomized intervention evaluations [146].

Kaplan-Meier plots of probability of events were produced to describe the cumulative risk of events before- and after- NP introduction period in the intervention facility compared with the control facility. Analysis was started at the beginning of the study for the period before NP introduction and at the time the NP started practice for the period after NP introduction.

A Cox proportional hazards regression model was used to examine the impact of introduction of NP practice. The model was developed using backwards stepwise model selection to select confounders, including individual level confounders such as care level, BMI, nutrition type and ADL using the significance level of p-value = 0.05. The experimental variables, sex and age were retained in the model regardless of significance. After developing the final regression model, linear combinations of coefficients were calculated to express explicitly the results of NP introduction. All analyses were done using Stata/MP 12 [147].

3.2.6. Fever sensitivity analysis

In fever control analysis, each fever episode was difficult to identify when BT was fluctuating around 37.0 C intermittently, especially in the intervention facility. In order to examine the effect of fever control using uniform episode definitions throughout the study period in both

facilities, sensitivity analysis was conducted. When the time duration between the first and the second fever occurrence dates was less than seven days, we considered two episodes as one and combined them into one episode [148]. After adjusting the number of fever episodes, statistical analysis was conducted using the same methods explained in section 3.2.5.

3.2.7. Ethical considerations

This study was approved by the University of Tokyo ethics committee (Registration No. 10782). All information in this study was anonymized.

3.2.8. Funding

This work was supported by a Japan Society for the Promotion of Science Grants-in-Aid for Scientific Research (B) 26293480, and a Japan Ministry of Health, Labour and Welfare grant for scientific research (*Chikyu kibo ippan*-001). The funders had no role in study design, data collection and analysis, decision to publish, and preparation of the manuscript.

3.3. Results

3.3.1. Characteristics of cohort

Table 16 shows the characteristics of the cohorts in two facilities. Over the four years there

were 473 residents with 791 admission episodes in two facilities. In both facilities, there were more female residents than male residents, and residents aged between 80 and 89 years accounted for more than half of all residents. Residence duration varied in a wide range and half of residents stayed over half a year (>180 days).

Table 16. Characteristics of cohort

	Total	Intervention facility	Control facility	p-value*
Number of residents	473	207	266	-
Number of facility admissions	791	368	423	<0.001
Sex (%)				
Male	257 (32.5)	122 (33.2)	135 (31.9)	0.7
Female	534 (67.5)	246 (66.9)	288 (68.1)	
Age at admission (%)				
50-69	52 (6.6)	33 (6.6)	19 (4.5)	
70-79	182 (23.0)	80 (21.7)	102 (24.1)	0.05
80-89	432 (54.6)	203 (55.2)	229 (54.1)	
90+	125 (15.8)	52 (14.1)	73 (17.3)	
Care level at admission (%)				
1	276 (34.9)	138 (37.5)	138 (32.6)	
2	132 (16.7)	54 (14.7)	78 (18.4)	
3	157 (19.9)	81 (22.0)	76 (18.0)	<0.001
4	137 (17.3)	68 (18.5)	69 (16.3)	
5	89 (11.3)	27 (7.3)	62 (14.7)	
Number of days of facility stay (%)				
Mean (SD)	292.2 (327.3)	262.0 (288.1)	318.4 (356.1)	0.3
89－	274 (34.6)	137 (37.2)	137 (32.4)	
90-179	134 (16.9)	55 (15.0)	79 (18.7)	
180-359	157 (19.9)	81 (22.0)	76 (18.0)	0.006
360-719	137 (17.3)	68 (18.5)	69 (16.3)	
720+	89 (11.3)	27 (7.3)	62 (14.7)	

*Cohort between facilities was examined using Chi-square test.

3.3.2. Clinical outcomes

a. Hypertension control

A total of 241 residents with 887 hypertension control episodes were included in this analysis.

Basic characteristics are shown in Table 17.

Table 17. Characteristics of cohort for hypertension control analysis

	Intervention facility (n=108)		Control facility (n=133)		P-value **
	Before*	After*	Before*	After*	
Total number of hypertension control episodes	219	240	198	220	0.9
Sex (%)					
Male	53 (24.2)	50 (20.8)	53 (26.8)	41 (18.6)	0.5
Female	166 (75.8)	190 (79.2)	145 (73.2)	179 (81.4)	
Age at the beginning of the episode (%)					
50-69	14 (6.4)	25 (10.4)	18 (9.1)	11 (5.0)	0.5
70-79	57 (26.3)	37 (15.4)	57 (28.8)	41 (18.6)	
80-89	118 (53.9)	136 (56.7)	102 (51.5)	145 (65.9)	
90+	30 (13.7)	42 (17.5)	21 (10.6)	23 (10.4)	
Care level at the beginning of the episode (%)					
1	51 (23.3)	38 (15.8)	25 (12.6)	44 (20.0)	<0.001
2	46 (21.0)	59 (24.6)	33 (16.7)	55 (25.0)	
3	48 (21.9)	38 (15.8)	54 (27.3)	46 (20.9)	
4	43 (20.0)	54 (22.5)	72 (36.4)	49 (22.3)	
5	31 (14.2)	51 (21.3)	14 (7.1)	26 (11.8)	
BMI at the beginning of the episode (%)					
<18.5	90 (41.1)	98 (40.8)	57 (28.8)	57 (25.9)	0.03
18.5-25.0	118 (53.9)	135 (56.3)	132 (66.7)	139 (63.2)	
≧25.0	11 (5.0)	8 (2.9)	9 (4.6)	24 (10.9)	
Receiving antihypertensive medication at the beginning of the episode (%)					
No	15 (6.9)	14 (5.8)	9 (4.6)	16 (7.3)	0.3
Yes	204 (93.2)	226 (94.2)	189 (95.5)	204 (92.7)	
Salt intake restriction at the beginning of the episode (%)					
No	119 (54.3)	125 (52.1)	123 (62.1)	114 (51.8)	0.1
Yes	100 (45.7)	115 (47.9)	75 (37.9)	106 (48.2)	

*Before- and after- NP introduction periods were delimited by April 1, 2011.

**Base-line cohort between facilities was examined using Chi-square test.

Time trends in hypertension control rates

The hypertension control rate per 100 person-days by six-month period is shown in Figure 4. The intervention facility had higher hypertension control rate than the control facility throughout the study period, which means residents of the intervention facility experienced higher rates of uncontrolled hypertension. The intervention facility experienced a gradual increase in rate from 1.29 to 2.10 per 100 person-days over the study period while the control facility had a stable rate between 0.44 and 0.62 per 100 person-days. The Poisson regression model showed no significant time effect and no significant difference in slope between those two facilities, so time period was not included in the survival analysis.

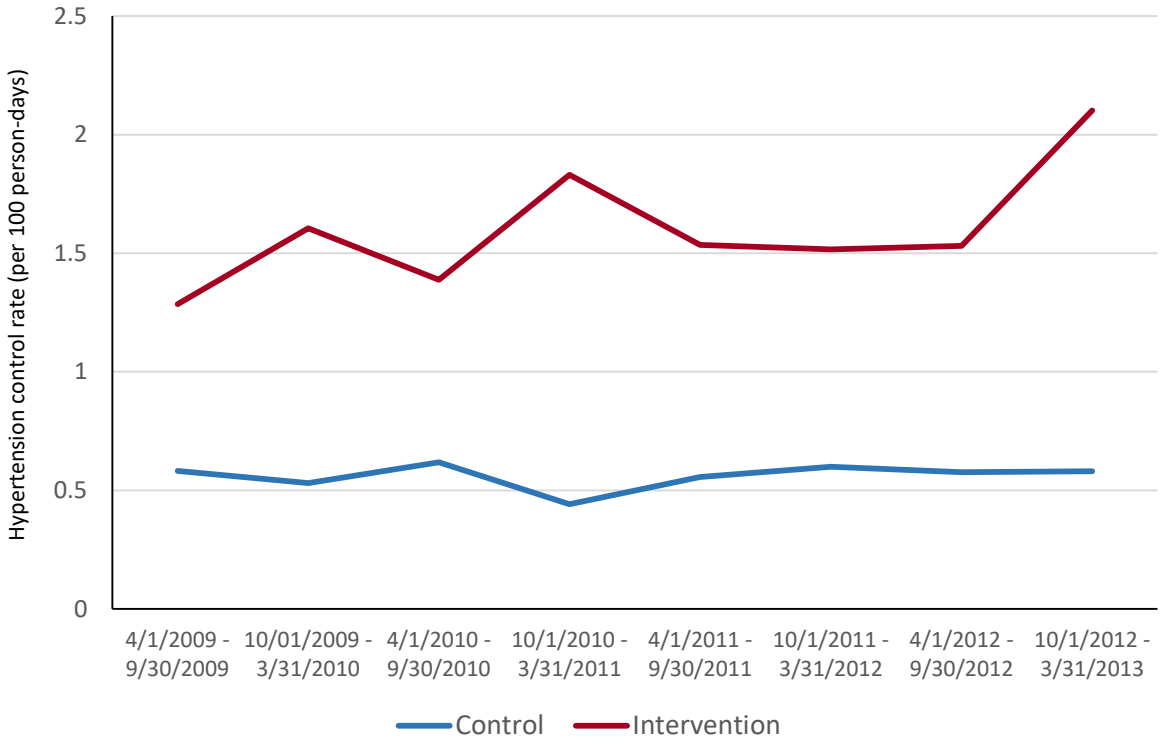

Figure 4. Hypertension control rate per 100 person-days by six-month period in two facilities

Kaplan-Meier estimates of hypertension control probability

Figure 5 shows the estimated probability of hypertension control by facility and before- and after- NP introduction. The intervention facility experienced lower hypertension control probability than the control facility in both before- and after- NP introduction. The intervention facility had lower probability of hypertension control and longer survival time after NP introduction while the control facility did not change between study periods.

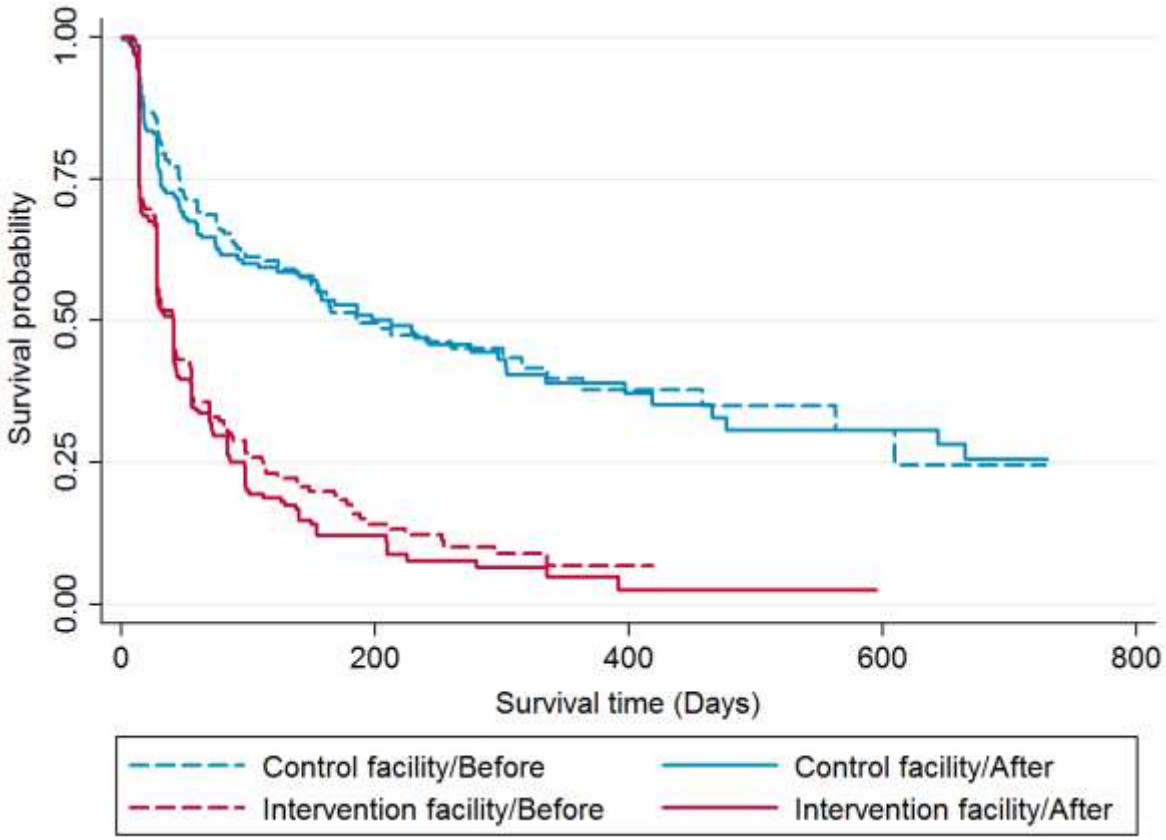

Figure 5. Estimated hypertension control probability by facility and time period

Multiple regression analysis of hypertension control

The result of the Cox proportional hazards regression model is summarized in Table 18. The intervention facility had a statistically significantly higher hazard ratio of hypertension control of 4.02 (95% CI: 3.00–5.38), and the risk of hypertension control did not change after NP started practice. When the interaction between facility and NP introduction period was added to the model, the hazard ratio of hypertension control in the intervention facility after NP introduction became 1.03 (95% CI: 0.72–1.49), however this was not statistically significant, after adjusting for sex, care level, functional morbidity, hygiene and grooming, bathing, and morbidity of heart failure, diabetes mellitus and hyperlipidaemia. Care level and morbidity of heart failure, diabetes mellitus and hyperlipidaemia were found to be significant in hypertension control.

Table 18. Multiple regression model of hypertension control

Variable	Hazard ratio	95% confidence interval	Z statistics	P-value
Facility				
Control	1.00	NA		
Intervention	4.02	3.00 to 5.38	9.33	<0.001
NP introduction				
Before	1.00	NA		
After	1.33	0.84 to 1.51	0.82	0.4
Facility*NP introduction	1.03	0.72 to 1.49	0.18	0.9
Sex				
Male	1.00	NA		
Female	1.21	1.97 to 1.51	1.70	0.09
Age group				
50-69	1.00	NA		
70-79	1.12	0.76 to 1.65	0.56	0.6
80-89	1.38	0.96 to 1.99	1.75	0.08
90+	1.42	0.93 to 2.17	1.63	0.1
Care level				
1	1.00	NA		
2	0.69	0.51 to 0.92	-2.48	0.01
3	0.63	0.46 to 0.87	-2.85	0.004
4	0.41	0.28 to 0.60	-4.58	<0.001
5	0.41	0.25 to 0.67	-3.55	<0.001
Functional morbidity				
1	1.00	NA		
2	0.55	0.39 to 0.78	-3.42	0.001
3	1.02	0.42 to 2.48	0.05	0.96
4	0.83	0.59 to 1.17	-1.07	0.3
5	0.74	0.47 to 1.17	-1.30	0.2
Hygiene and Grooming				
1	1.00	NA		
2	1.32	1.02 to 1.71	2.10	0.04
3	0.80	0.59 to 1.08	-1.44	0.1
4	0.75	0.46 to 1.21	-1.19	0.2
Bathing				
1	1.00	NA		
2	0.55	0.19 to 1.62	-1.08	0.3
3	1.23	045 to 3.35	0.40	0.7
4	2.15	0.74 to 6.23	1.40	0.1
Heart failure morbidity				
No	1.00	NA		
Yes	0.73	0.58 to 0.93	-2.58	0.01
Diabetes mellitus morbidity				
No	1.00	NA		
Yes	2.35	1.89 to 2.93	7.69	<0.001
Hyperlipidaemia morbidity				
No	1.00	NA		
Yes	1.41	1.02 to 1.95	2.07	0.04

b. Hypertension management

A total of 183 residents with 682 episodes were included in the analysis of hypertension management. There were significant differences in age, care level and BMI between facilities at baseline. Table 19 shows the basic characteristics of cohort included in this analysis,

Table 19. Characteristics of cohort for hypertension management analysis

	Intervention facility (n=103)		Control facility (n=80)		P-value
	Before*	After*	Before*	After*	**
Total number of hypertension controlled episodes	203	235	112	132	0.9
Sex (%)					
Male	50 (24.6)	58 (24.7)	35 (31.3)	23 (17.4)	0.2
Female	153 (75.4)	177 (75.3)	77 (68.8)	109 (82.6)	
Age at the beginning of the episode (%)					
50-69	13 (6.4)	22 (9.4)	15 (13.4)	7 (5.3)	0.007
70-79	54 (26.6)	42 (17.9)	38 (33.9)	32 (24.2)	
80-89	107 (52.7)	132 (56.2)	54 (48.2)	88 (66.7)	
90+	29 (14.3)	39 (16.6)	5 (4.5)	5 (3.8)	
Care level at the beginning of the episode (%)					
1	46 (22.7)	38 (16.2)	20 (17.9)	32 (24.2)	<0.001
2	53 (26.1)	61 (26.0)	20 (17.9)	37 (28.0)	
3	40 (19.7)	37 (15.7)	27 (24.1)	22 (16.7)	
4	34 (16.8)	50 (21.3)	44 (39.3)	27 (20.4)	
5	30 (14.8)	49 (20.9)	1 (0.9)	14 (10.6)	
BMI at the beginning of the episode (%)					
<18.5	86 (42.4)	101 (43.0)	22 (19.6)	26 (19.7)	<0.001
18.5-25.0	106 (52.2)	128 (54.5)	85 (75.0)	88 (66.7)	
≧25.0	11 (5.4)	6 (2.6)	6 (5.4)	18 (13.6)	
Receiving antihypertensive medication at the beginning of the episode (%)					
No	12 (5.9)	12 (5.1)	6 (5.4)	9 (6.82)	0.8
Yes	191 (94.1)	223 (94.9)	106 (94.6)	123 (93.2)	
Salt intake restriction at the beginning of the episode (%)					
No	99 (48.8)	117 (49.8)	49 (43.8)	54 (40.9)	0.4
Yes	104 (51.2)	118 (50.2)	63 (56.3)	78 (59.1)	

*Before- and after- NP introduction periods were delimited by April 1, 2011.

**Base-line cohort between facilities was examined using Chi-square test.

Time trends in hypertension management rates per 100 person-days

Figure 6 shows the time trends in hypertension management rates per 100 person-days in two facilities. The intervention facility experienced lower hypertension management rate than the control facility throughout the study period, which means the intervention facility had lower rate of residents becoming controlled. In the Poisson regression model, there was neither statistically significant trends in rate nor in trends between facilities. Therefore, I did not include time trends in the model.

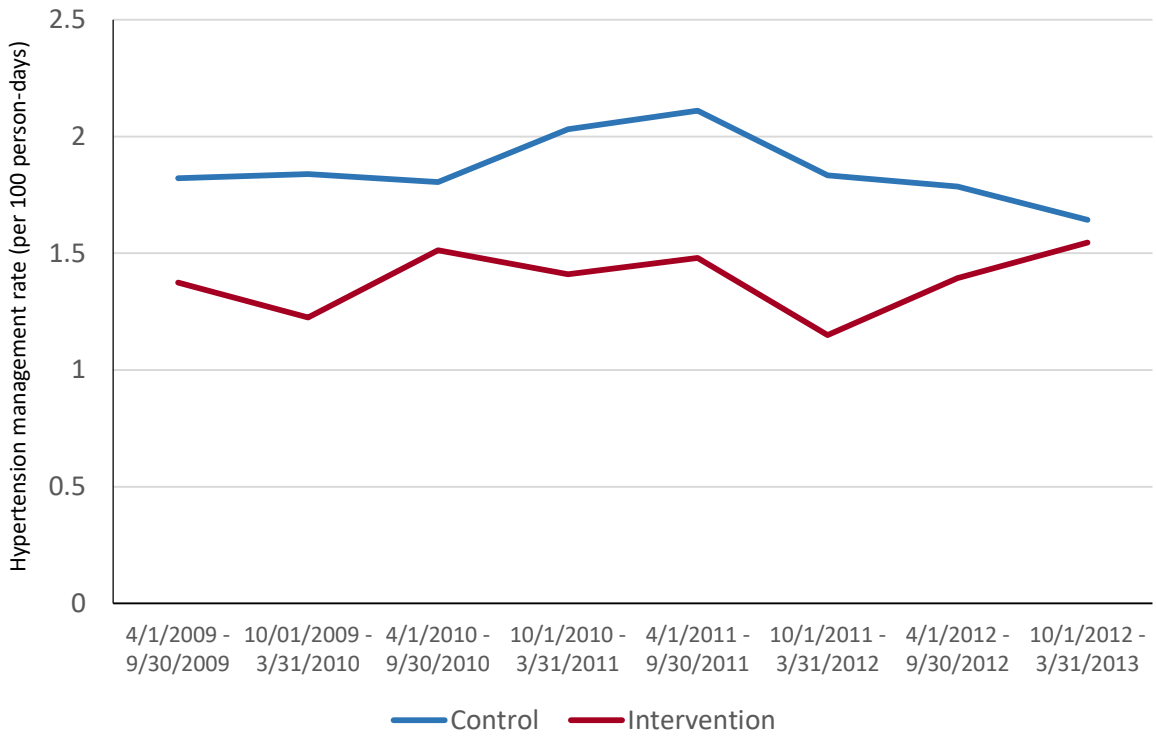

Figure 6. Hypertension management rate per 100 person-days by six-month period in two facilities

Kaplan-Meier estimates of hypertension management probability

Figure 7 shows the cumulative probability of hypertension management by facility and time period. The intervention facility experienced longer periods of survival time than the control facility, however the probabilities in both facilities in the first 40 days were almost the same. In both facilities, hypertension management probability in the period after NP started practice became lower than the period before NP introduction.

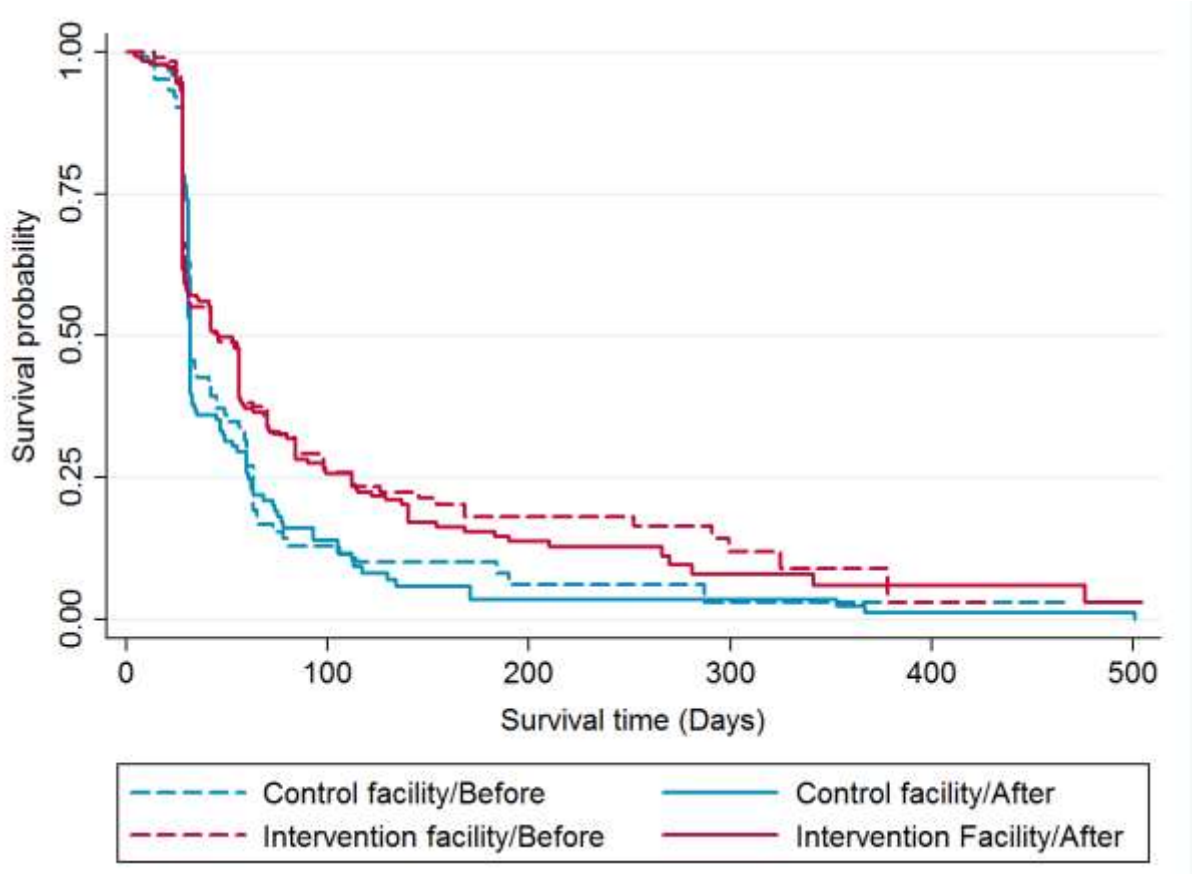

Figure 7. Estimated hypertension management probability by facility and time period

Multiple regression model of hypertension management

Table 20 summarizes the results of the final model of hypertension management. The intervention facility had a statistically significant lower hazard ratio of 0.51 (95% CI: 0.38–0.69) and there was no significant difference between study periods. The result of interaction between facility and study period showed that the intervention facility in the period after NP introduction had a hazard ratio of 1.25 (95% CI: 0.86–1.83) compared with the period before NP introduction, however with no statistically significant difference after adjusting for sex, age group, BMI group, functional morbidity, toilet, and morbidity of diabetes mellitus and hyperlipidaemia. Sex, and morbidity of diabetes mellitus and hyperlipidaemia were found to be significantly associated with hypertension management outcome.

Table 20. Multiple regression model of hypertension management

Variable	Hazard ratio	95% confidence interval	Z statistics	P-value
Facility				
Control	1.00	NA		
Intervention	0.51	0.38 to 0.69	-4.41	<0.001
NP introduction				
Before	1.00	NA		
After	0.95	0.71 to 1.28	-0.33	0.7
Facility*NP introduction	1.25	0.86 to 1.83	1.18	0.2
Sex				
Male	1.00	NA		
Female	0.65	0.51 to 0.83	-3.49	<0.001
Age group				
50-69	1.00	NA		
70-79	1.07	0.72 to 1.58	0.32	0.7
80-89	0.90	0.63 to 1.30	-0.56	0.6
90+	1.08	0.70 to 1.67	0.35	0.7
BMI				
<18.5	1.00	NA		
18.5-25.0	0.84	0.68 to 1.04	-1.63	0.1
≧25.0	1.38	0.91 to 2.09	1.53	0.1
Morbidity				
1	1.00	NA		
2	0.98	0.72 to 1.33	-0.12	0.9
3	1.32	0.58 to 2.99	0.66	0.5
4	0.62	0.45 to 0.87	-2.81	0.005
5	0.57	0.37 to 0.87	-2.59	0.01
Toilet				
1	1.00	NA		
2	0.70	0.49 to 0.99	-2.01	0.04
3	0.99	0.75 to 1.31	-0.05	0.96
4	1.33	0.94 to 1.87	1.62	0.1
Diabetes mellitus morbidity				
No	1.00	NA		
Yes	0.49	0.39 to 0.63	-5.80	<0.001
Hyperlipidaemia morbidity				
No	1.00	NA		
Yes	1.47	1.04 to 2.09	2.15	0.03

c. Fever

A total of 455 residents with 2,595 episodes were included in the fever analysis. The intervention facility had more residents who experienced fever during their stay than the control facility despite hosting a smaller total number of residents. Basic characteristics of both facilities are shown in Table 21.

Table 21. Characteristics of fever analysis cohort

	Intervention facility (n=196)		Control facility (n=259)		P-value**
	Before*	After*	Before*	After*	
Total number of episodes	695	608	673	619	0.524
Sex (%)					
Male	194 (27.9)	159 (26.2)	214 (31.8)	167 (27.0)	0.116
Female	501 (72.1)	449 (73.8)	459 (68.2)	452 (73.0)	
Age at the beginning of the episode (%)					
50-69	67 (9.6)	67 (11.0)	31 (4.6)	23 (3.7)	<0.001
70-79	192 (27.6)	89 (14.6)	177 (26.3)	139 (22.5)	
80-89	363 (53.7)	367 (60.4)	353 (52.5)	363 (58.6)	
90+	63 (9.1)	85 (14.0)	112 (16.6)	94 (15.2)	
Care level at the beginning of the episode (%)					
1	86 (12.4)	54 (8.9)	62 (9.2)	93 (15.0)	<0.001
2	138 (19.9)	140 (23.0)	118 (17.5)	130 (21.0)	
3	138 (19.9)	90 (14.8)	167 (24.8)	146 (23.6)	
4	146 (21.0)	133 (21.9)	243 (36.1)	158 (25.5)	
5	187 (26.9)	191 (31.4)	83 (12.3)	92 (14.9)	
BMI at the beginning of the episode (%)					
<18.5	356 (51.2)	311 (51.2)	217 (32.2)	212 (34.3)	<0.001
18.5-25.0	319 (45.9)	273 (44.9)	421 (62.6)	364 (58.8)	
≧25.0	20 (2.9)	24 (4.0)	35 (5.2)	43 (7.0)	
Number of residents with fever	101	44	78	45	<0.001
Total number of fever cases	355	291	180	113	<0.001
Number of facility admissions without fever	113	111	280	316	<0.001

*Before- and after- NP introduction periods were delimited by April 1, 2011.

**Base-line cohort between facilities was examined using Chi-square test.

Time trends in fever rates

Figure 8 shows the time trends in fever rates per 100 person-days by six-month period in the two facilities. The intervention facility had significantly higher fever rate throughout the study period than the control facility. The rate in the intervention facility gradually declined with a sudden drop in rate in the second six-month period after NP introduction. The control facility had a slight reduction in rate over the study period. The Poisson regression model revealed statistically significant in trends and difference in trends between facilities, so I included time trends in the model as a time-varying covariate.

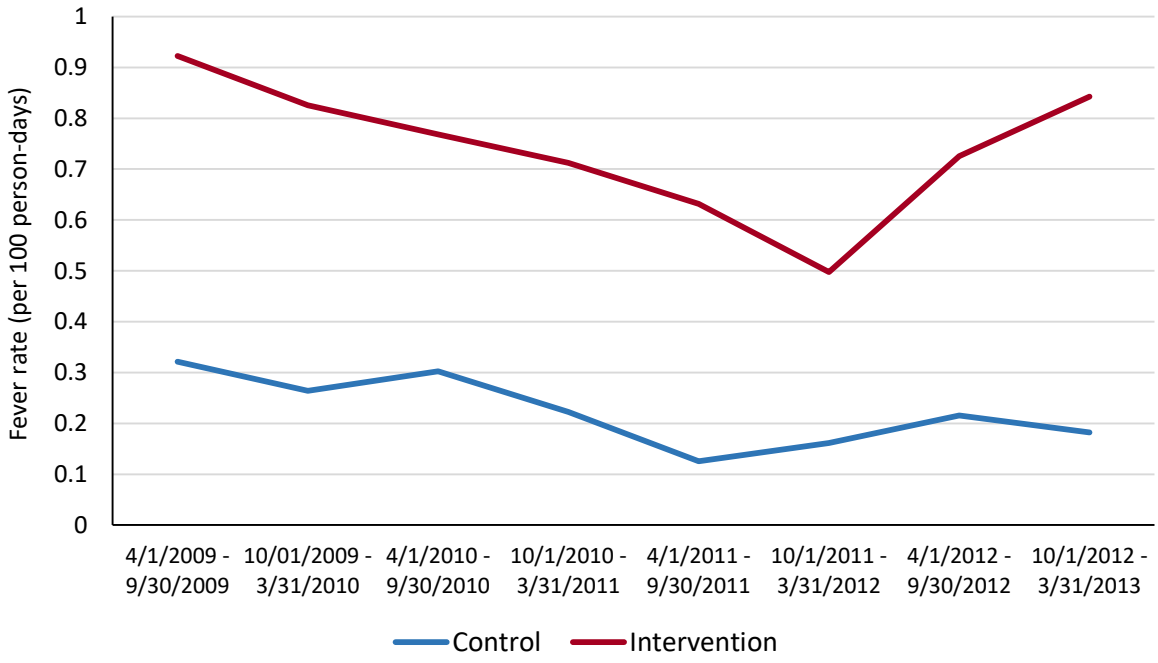

Figure 8. Fever rate per 100 person-days by six-month period in two facilities

Kaplan-Meier estimates of fever probability

Figure 9 shows the Kaplan-Meier estimates of fever probability by facility and time period. As I split the study data in each six month to incorporate time trends accurately, maximum survival time was 182 days (i.e. 6 months). Both facilities had a large reduction in fever probability after NP introduction.

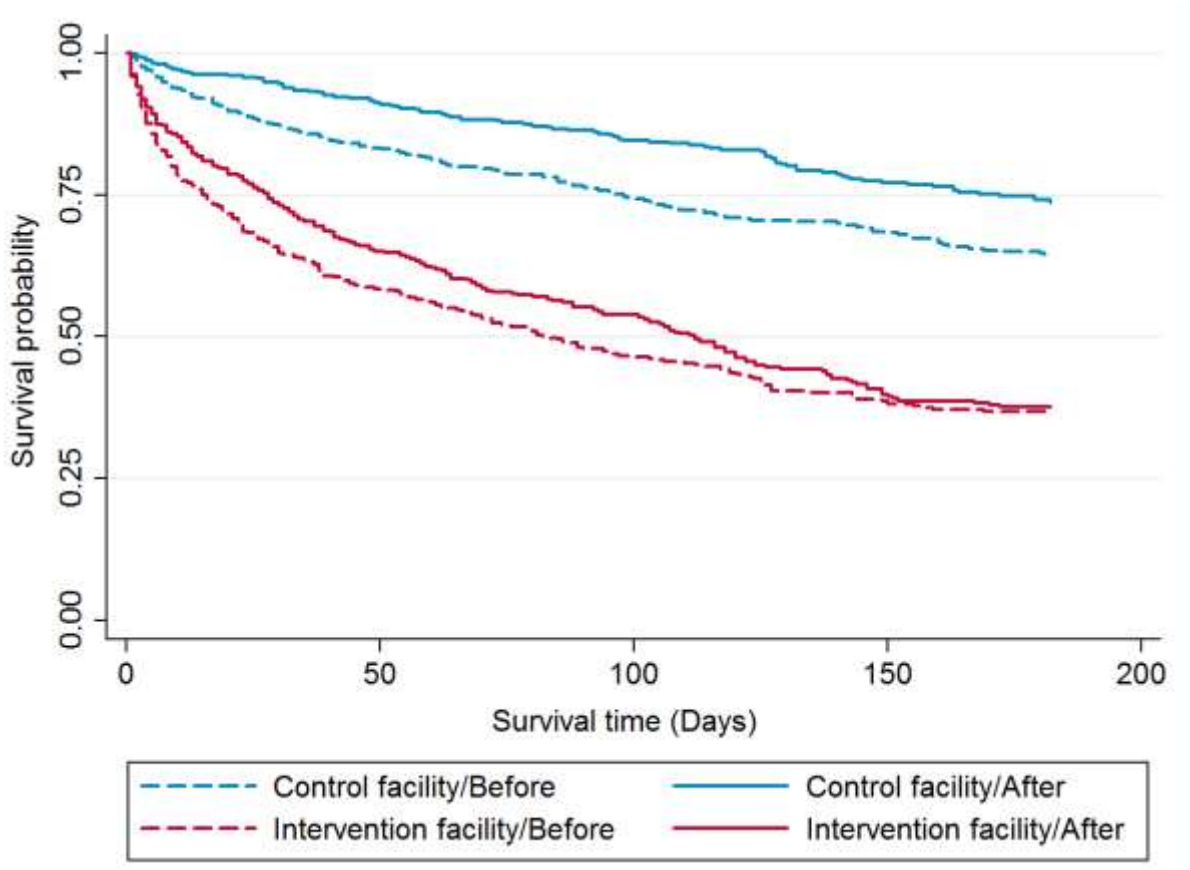

Figure 9. Estimated fever probability by facility and time period

Multiple regression analysis of fever

The results of the Cox-proportional hazards regression model are summarized in Table 22. The intervention facility showed a statistically significantly higher hazard ratio of 2.58 (95% CI: 2.14–3.12) in the period before NP was introduced and there was no difference between study periods. The hazard ratio of interaction of facility and study period was 1.16 (95% CI: 0.87–1.54), which was non-significant after adjusting for sex, age group, feeding, communication and six month period.

Table 22. Hazard ratios of fever

Variable	Hazard ratio	95% confidence interval	Z statistics	P-value
Facility				
Control	1.00	NA		
Intervention	2.58	2.14 to 3.12	9.82	<0.001
NP introduction				
Before	1.00	NA		
After	0.74	0.53 to 1.03	-1.80	0.07
Facility*NP introduction	1.16	0.87 to 1.54	1.04	0.3
Sex				
Male	1.00	NA		
Female	0.93	0.80 to 1.08	-0.96	0.3
Age group				
50-69	1.00	NA		
70-79	0.84	0.64 to 1.11	-1.23	0.2
80-89	0.98	0.76 to 1.25	-0.20	0.8
90+	0.91	0.67 to 1.24	-0.58	0.6
Feeding				
1	1.00	NA		
2	1.53	1.25 to 1.88	4.11	<0.001
3	0.97	0.76 to 1.24	-0.24	0.8
4	0.99	0.73 to 1.35	-0.04	0.97
Communication				
1	1.00	NA		
2	1.20	1.02 to 1.41	2.17	0.03
3	2.22	1.70 to 2.91	5.82	<0.001
Six-month period	0.98	0.92 to 1.04	-0.77	0.4

3.3.3. Hospitalization

A total of 468 (intervention: n=204, control: n=264) residents with 784 facility admission episodes were included in this study. Although the founding principle of these facilities was to enhance resident health status and to promote return them to home, more than half of residents discharged to hospitals, which accounted for the largest proportion of all discharge cases, and indicates the difficulty of maintaining residents' health status in these facilities. There were significant differences in care level and discharge destination between facilities at baseline. Basic characteristics of the subjects are shown in Table 23.

Table 23. Characteristics of hospitalization cohort

	Intervention facility (n=204)		Control facility (n=264)		P-value**
	Before*	After*	Before*	After*	
Total number of facility admissions	232	199	261	254	0.3
Sex (%)					
Male	77 (33.2)	60 (30.2)	92 (35.3)	70 (27.6)	0.6
Female	155 (66.8)	139 (69.8)	169 (64.8)	184 (72.4)	
Age at admission (%)					
50-69	22 (9.5)	19 (9.6)	16 (6.1)	7 (2.8)	0.2
70-79	62 (26.7)	29 (14.6)	74 (28.4)	47 (18.5)	
80-89	121 (52.2)	118 (59.3)	127 (48.7)	154 (60.6)	
90+	27 (11.6)	33 (16.6)	44 (16.9)	46 (18.1)	
Care level at admission (%)					
1	39 (16.8)	22 (11.1)	22 (8.5)	37 (14.6)	<0.001
2	51 (22.0)	50 (25.1)	45 (17.3)	51 (20.1)	
3	48 (20.7)	39 (19.6)	65 (25.0)	56 (22.1)	
4	40 (17.2)	44 (22.1)	86 (33.1)	71 (28.0)	
5	54 (23.3)	44 (22.1)	42 (16.2)	39 (15.4)	
Total number of facility discharges	166	134	166	167	0.06
Discharge destination (%)					
Hospital	122 (73.5)	89 (66.4)	92 (55.4)	108 (64.7)	<0.001
Home	12 (7.2)	25 (18.7)	36 (21.7)	35 (21.0)	
Intensive care home for the elderly	19 (11.5)	10 (7.5)	28 (16.9)	23 (13.8)	
Long-term care health facility	1 (0.6)	4 (3.0)	8 (4.8)	1 (0.6)	
Death	2 (1.2)	1 (0.8)	2 (1.2)	0 (0.0)	
Other	10 (6.0)	5 (3.7)	0 (0.0)	0 (0.0)	

*Before- and after- NP introduction periods were delimited by April 1, 2011.

**Baseline cohort between facilities was examined using Chi-square test.

Time trends in hospitalization rates

Figure 10 shows the hospitalization rate per 100 person-days in six-month period in both facilities. The intervention facility experienced higher hospitalization rates than the control facility throughout the study period. The intervention facility had a gradual decrease in six-month hospitalization rate over time from 0.28 to 0.17 per 100 person-days with the exception of the last six-month period prior to the introduction of NP. The control facility had stable hospitalization rates between 0.11 and 0.17 per 100 person-days with a sudden increase to 0.21 per 100 person-days in the first six-month period after NP was introduced. The Poisson regression model showed no significant time effect and no significant difference in slope between those two facilities, so time period was not included in the survival analysis.

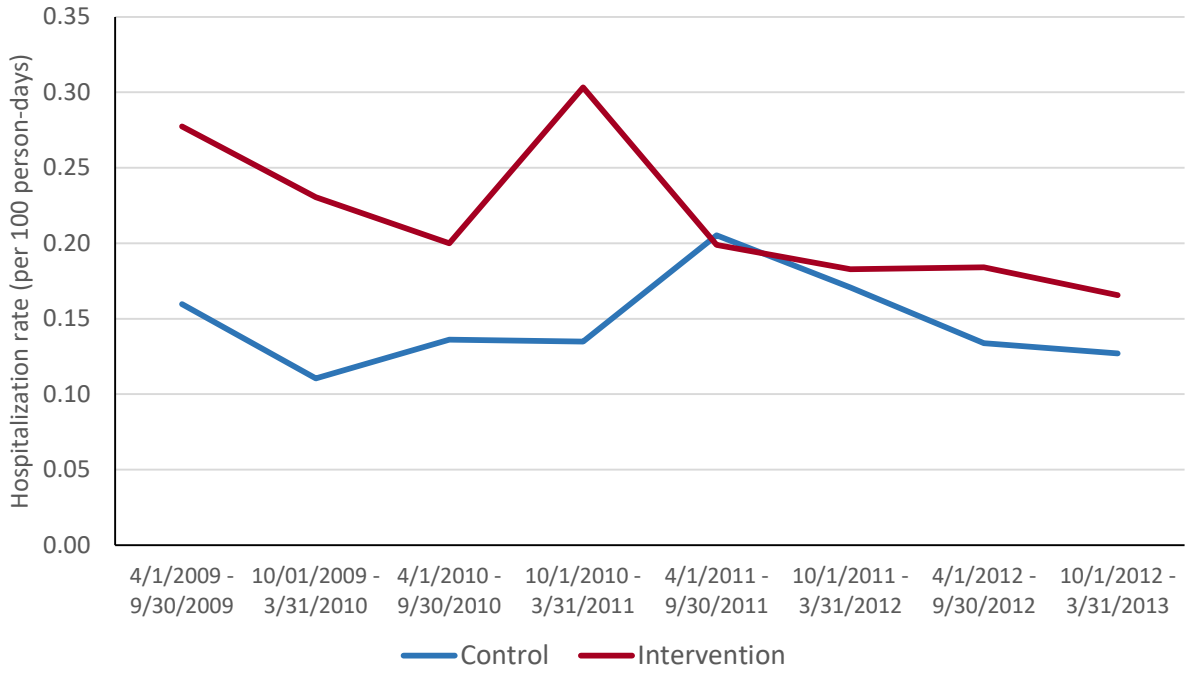

Figure 10. Hospitalization rate per 100 person-days by six-month period in two facilities

Kaplan-Meier estimates of hospitalization probability

Cumulative probability of hospitalization before and after NP introduction in each facility are shown in Figure 11. The intervention facility had large changes in hospitalization risk, with a significant reduction in hospitalization probability after NP introduction, while the control facility showed no change over time.

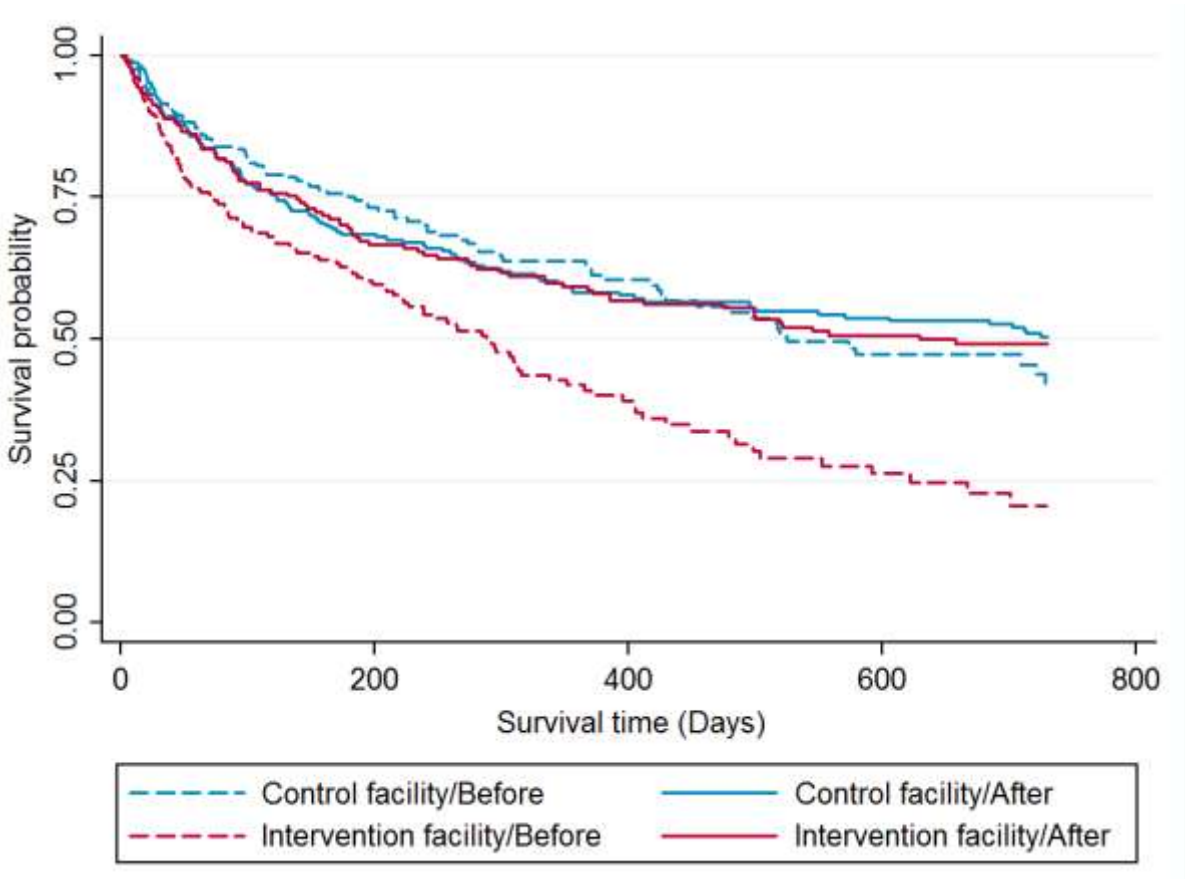

Figure 11. Estimated hospitalization probability by facility and time period

Multiple regression analysis of hospitalization

Table 24 shows the results of the Cox proportional hazards regression model. The intervention facility had a statistically significantly higher hazard ratio of hospitalization of 1.84 (95% CI: 1.39–2.42), and the hospitalization risk did not change in the period after NP introduction, after adjusting for sex, age and care level. When adding the difference-in-difference interaction variable between facility and NP introduction period, the

hazard ratio of hospitalization in the intervention facility became 0.55 (95% CI: 0.37–0.82) times that of its pre-intervention level, indicating that the intervention facility after NP started practice was around 45% less likely to have hospitalization compared to before NP introduction, after adjusting for sex, age group and care level, period effects common to both facilities. The linear combination of facility and interaction of facility and NP introduction showed a hazard ratio of 1.01 (95% CI: 0.76–1.34, $p>0.933$), indicating that the introduction of NP in the intervention facility was associated with a reduction of hospitalization rates from their initial higher levels to the same as the control facility, even after adjusting for sex, age group and care level.

Table 24. Hazard ratios of hospitalization

Variable	Hazard ratio	95% confidence interval	Z statistics	P-value
Facility				
Control	1.00	NA		
Intervention	1.84	1.39 to 2.42	4.33	<0.001
NP introduction				
Before	1.00	NA		
After	0.99	0.74 to 1.31	-0.10	0.9
Facility*NP introduction	0.55	0.37 to 0.82	-2.97	0.003
Sex				
Male	1.00	NA		
Female	1.64	1.34 to 2.02	4.76	<0.001
Age group				
50-69	1.00	NA		
70-79	0.86	0.57 to 1.30	-0.71	0.5
80-89	1.03	0.71 to 1.50	0.16	0.9
90+	1.32	0.87 to 2.00	1.29	0.2
Care level				
1	1.00	NA		
2	1.11	0.75 to 1.63	0.52	0.6
3	1.53	1.06 to 2.19	2.28	0.02
4	1.59	1.11 to 2.28	2.53	0.01
5	1.72	1.19 to 2.48	2.88	0.004

3.3.4. Sensitivity analysis

A total of 455 residents (intervention: n=196, control: n=259) with 2,484 fever control episode were included in the sensitivity analysis. Compared to the original fever analysis in Section 3.3.2, the number of fever cases reduced by 96 and 15 in the intervention and control facility, respectively, with a large number of fever cases being combined in the intervention facility. This was because many fever cases in the intervention facility fluctuated around 37.0

C and cycled in and out of fever episodes. Basic characteristics of the cohort in Table 25 showed no changes in all variables.

Table 25. Characteristics of fever control cohort (Sensitivity analysis)

	Intervention facility (n=196)		Control facility (n=259)		P-value**
	Before*	After*	Before*	After*	
Total number of episodes	631	576	659	618	0.7
Sex (%)					
Male	184 (29.2)	154 (26.7)	207 (31.4)	167 (27.0)	0.4
Female	447 (70.8)	422 (73.3)	452 (68.6)	451 (73.0)	
Age at the beginning of the episode (%)					
50-69	66 (10.5)	62 (10.8)	31 (4.7)	23 (3.7)	<0.001
70-79	179 (28.4)	86 (14.9)	175 (26.6)	139 (22.5)	
80-89	325 (51.5)	344 (59.7)	342 (51.9)	362 (58.6)	
90+	61 (9.7)	84 (14.6)	111 (16.8)	94 (15.2)	
Care level at the beginning of the episode (%)					
1	78 (12.4)	54 (9.4)	62 (9.4)	93 (15.1)	<0.001
2	134 (21.2)	137 (23.8)	118 (17.9)	130 (21.0)	
3	134 (21.2)	87 (15.1)	163 (24.7)	145 (23.5)	
4	133 (21.1)	128 (22.2)	237 (36.0)	158 (25.6)	
5	152 (24.1)	170 (29.5)	79 (12.0)	92 (14.9)	
BMI at the beginning of the episode (%)					
<18.5	309 (49.0)	288 (50.0)	212 (32.2)	211 (34.1)	<0.001
18.5-25.0	302 (47.9)	264 (45.8)	412 (62.5)	364 (58.9)	
≧25.0	20 (3.2)	24 (4.2)	35 (5.3)	43 (7.0)	
Number of residents with fever	101	84	78	64	<0.001
Total number of fever cases	291	259	166	112	
Number of facility admissions without fever	113	111	280	316	<0.001

*Before- and after- NP introduction periods were delimited by April 1, 2011.

**Baseline cohort between facilities was examined using Chi-square test.

Time trends in fever rates

Figure 12 shows the time trends in fever rates in sensitivity analysis. The fever rate in the first two six-month periods in the intervention facility became lower than the fever rate in the original analysis (Figure 8) after adjusting the number of fever episodes in both facilities. The Poisson regression model showed a statistically significant difference in both trends and the difference in trends between facilities.

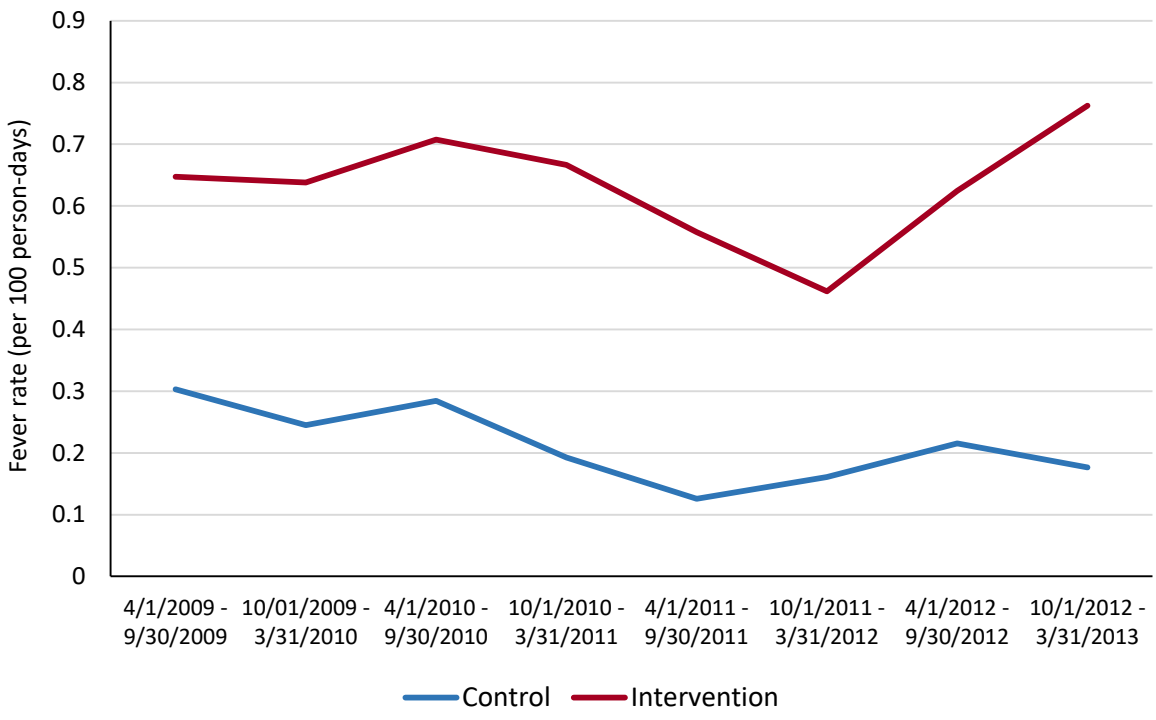

Figure 12. Fever control rate per 100 person-days by six-month period in two facilities (Sensitivity analysis)

Kaplan-Meier estimates of fever probability in sensitivity analysis

The cumulative probability of fever was the same as the original fever analysis after adjusting the number of fever episodes in both facilities, as shown in Figure 13.

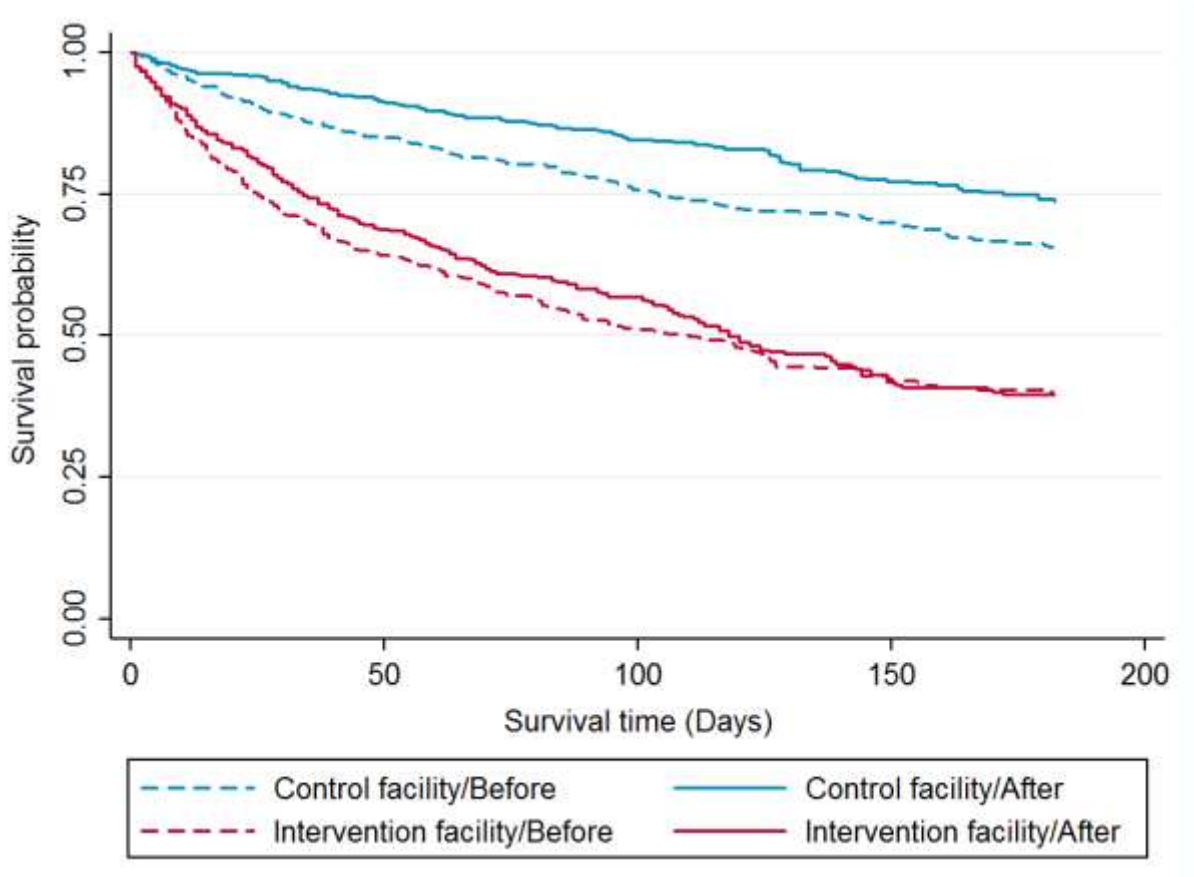

Figure 13. Estimated fever control probability by facility and time period (Sensitivity analysis)

Multiple regression model of fever incidence

The final covariates included in the Cox proportional hazards regression model shown in Table 26 were exactly the same as those in the original fever analysis (Table 17) and all hazard ratios were similar, showing that NP practice did not statistically significant affect

fever control regardless of changes in the criteria for defining fever incidence.

Table 26. Hazard ratios of fever (Sensitivity analysis)

Variable	Hazard ratio	95% confidence interval	Z statistics	P-value
Facility				
Control	1.00	NA		
Intervention	2.44	1.99 to 2.98	8.71	<0.001
NP introduction				
Before	1.00	NA		
After	0.71	0.50 to 1.00	-1.94	0.05
Facility*NP introduction	1.16	0.86 to 1.56	0.98	0.3
Sex				
Male	1.00	NA		
Female	0.98	0.84 to 1.14	-0.29	0.8
Age group				
50-69	1.00	NA		
70-79	0.85	0.64 to 1.12	-1.16	0.2
80-89	0.93	0.71 to 1.20	-0.57	0.6
90+	0.95	0.70 to 1.30	-0.30	0.8
Feeding				
1	1.00	NA		
2	1.54	1.24 to 1.90	3.98	<0.001
3	0.98	0.76 to 1.27	-0.13	0.9
4	1.00	0.73 to 1.39	0.03	0.98
Communication				
1	1.00	NA		
2	1.27	1.07 to 1.50	2.73	0.006
3	2.00	1.49 to 2.69	4.57	<0.001
6-month period	1.00	0.94 to 1.07	0.10	0.9

3.3.5. Overall outcomes

The hazard ratios of the effects of NP practice on clinical and health services outcomes in the intervention facility are shown in Figure 14. Only the hazard ratio of hospitalization showed a statistically significant reduction after NP introduction compared to its pre-intervention level. All clinical outcomes after NP introduction showed only slightly higher hazard ratios compared to those in the period before NP introduction, however none of them was found to be statistically significant. Sensitivity analysis of fever did not differ in results from the original analysis. This confirms my findings are robust to small differences in outcome definition.

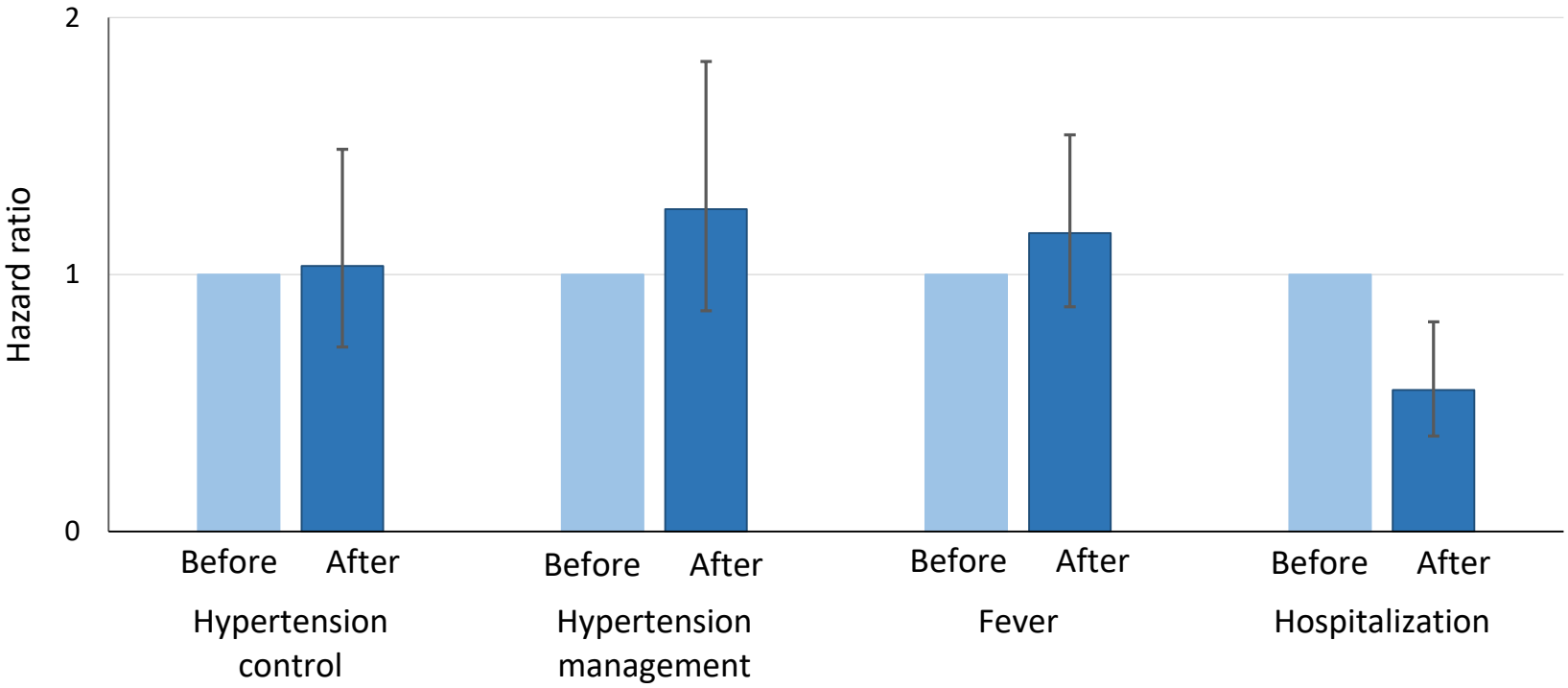

Figure 14. Summary of Hazard Ratio (HR) and 95% CI of the effects of Nurse Practitioner practice on clinical and health services outcomes in the long-term care health facility

3.4. Discussion

3.4.1. Summary and interpretation of findings

This study found that the facility with a practicing NP reduced risk of hospitalization by 45% after adjusting for sex, age and care level, while there was no significant effect of NP practice on hypertension control, hypertension management and fever. Japanese long-term care health facilities (LCHFs) are required to operate subject to the limited resources and pharmaceutical regimens covered by the long-term care insurance system [149]. However, early detection and management of residents health condition can contribute to better health outcomes in elderly people [150, 151]. In this context, NP practice of early assessment, diagnosis, implementation and hospitalization decision-making, along with teaching and mentoring of other health care providers, may have contributed to improvements in management of residents' health condition, preventing the need for hospitalization in many cases [129, 130, 133].

However, no significant effect of NP practice was found on any clinical outcomes in this study despite past published positive narrative assessments of NP practice [131, 133]. There are two possible reasons for this. One may be because in both facilities the residents' environmental and physical conditions are totally managed. The standard services provided in

the facility and mandated by the *Long-term Care Health Facility Standards* [139] enable hypertension control by monitoring blood pressure more than twice a week, prescribing and adjusting hypertensive drugs, restricting salt intake, and supporting daily activities. The other reason is that the changes specifically in clinical practice between pre- and post- NP introduction may not be enough to influence the clinical outcomes within the length of the study period [152]. The NP in the intervention facility was deputy director from the time of facility opening [131, 133], taking administrative responsibility for all nursing services and having authority to manage non-clinical services to some degree. Therefore, it would be difficult to capture the advancement of NP's clinical competencies by examining those clinical outcomes quantitatively in the short terms of the study period.

Additionally, there was no abrupt reduction in the time trends of event at the time of NP introduction, but a gradual and consistent change over the study period in the intervention facility in all outcomes. This makes it difficult to conclude that the NP practice alone contributed to changes in outcomes. Generally a facility that can introduce an NP may have a larger capacity to hire nurses who could be potentially NP and understand the importance of nursing development, or may have a better understanding of how to integrated nursing practice into advanced care. However, there are other reasons to explain this gradual changes

besides this institutional culture. One possible reason is that the NP's clinical way of thinking and management skills acquired from the NP program were displayed while the NP was attending the program from 2008 to 2011. Even though the NP did not have the authority to provide clinical interventions before April 2011, the NP could utilise lessons from the NP program, which was the effective translational process from learning to practice. This might affect the overall services in the facility and lead to the gradual decline in the rate of the events. Another reason is the characteristics of cohort and outcomes. It is difficult to see the effect of NP practice in clinical outcomes immediately after NP introduction because those measurements and events depend on residents' health status, which takes time to change, and hospitalization outcome also requires non-clinical management which would take time to disseminate throughout the facility even after the NP obtained authority for autonomous practice. Thus, although the conclusions of this study cannot be viewed definitively, it is likely that the NP's training and change in practice were at least partially responsible for the changes observed.

3.4.2. Strengths and limitations of the study

This is the first study to investigate the impact of NP practice on clinical and health services outcomes in LCHFs using survival analysis. Since the NP in this study is the only nurse

playing a NP role in an LCHF in Japan, this study provides the best and most up-to-date evidence for the effectiveness of NP. Conducting a retrospective cohort study in both an intervention and control facility provides more robust evidence of effectiveness than an evaluation conducted only in an intervention facility [129]. Moreover, using difference-in-difference methods in survival analysis allowed me to incorporate facility factors [146], ensuring that our final estimate of the effect of NP introduction was adjusted for any changes common to both facilities that might otherwise confound the effect of the NP. Finally, there was very little missing information on admission, basic characteristics including care level and ADL in either facility, and data quality was assured because those data were directly connected to the payment system and legally mandated in these facilities. Although some clinical information such as BMI, blood pressure and BT, the missing rate in all analyses were lower than five percent, which is considered to be relatively low.

This study has several limitations. First, there was only one control facility. Although the facilities had similar basic characteristics, it is difficult to generalise the result of this study to the overall Japanese context. However, there is presently only one NP in a long-term care health facility in Japan, so even with multiple control facilities the generalizability would be questionable. Second, in the hospitalization analysis, information on clinical outcomes of

residents after hospitalization was not available, so we could not examine the clinical relevance of the decision in each hospitalization case. Hospitalization decisions depend on non-clinical factors such as resident and family preferences and the available capacity of the destination hospitals [153], none of which were measured in this study. However, there is no reason to expect that these factors changed over time in the facilities. Third, the NP in this study was the deputy director of the facility, holding high levels of authority over bed control and financial and human resources management. This may cause over-estimation of the effectiveness of NP relative to the practice of NP without such facility management authority. Finally, the outcomes might have been affected by unidentified environmental factors such as geriatric welfare policy at national or prefectural level and changes in economic or social conditions; however, we do not have any evidence that any changes occurring in these factors differed between the two facilities we studied.

3.4.3. Introduction and utilization of NP in long-term care health facilities

In order to better utilise the integrated community care system, one of the solutions envisaged to alleviate the shortage of geriatric health services capacity is to reduce hospital admission pressure by providing quality medical care and daily life support. However, this policy goal requires better management of resources to ensure that hospitalization does not interfere with

this reintegration process. Although this study relies on the practice provided by only one NP, this study provides evidence that introducing and utilizing NP could enable LCHFs to reduce hospitalization, through better management of residents' health conditions. Improved health management and reduced hospitalization will in turn reduce the burden on over-stretched hospital systems and better enable the government's community care goals to be realized. In order to tackle the urgent challenges of an ageing society and to build the integrated community-based care system successfully, NPs could contribute to effect more efficient service provision and management in the community-based care system.

3.5. Conclusion

This study shows that NP practice in the long-term care health facility reduces the risk of hospitalization by 45% compared to that of the period before NP introduction after adjusting for sex, age and care level. However, there was no significant effect on clinical outcomes. This indicates NPs may contribute to managing health services utilization, which requires the full extent of NP's clinical and non-clinical competencies, although they may not bring improvements in management of clinical outcomes when supported by basic routine care in a facility with significant inter-professional collaboration. Although introducing and utilizing NPs will not necessarily improve clinical outcomes, it may be a reasonable strategy to ensure

more efficient health services use and human resources allocation in the integrated community-based care system.

4. Conclusion and recommendations

This thesis conducted a full systematic review and meta-analysis which assessed whether nurse practitioners (NPs) in substitution for medical doctors (MDs) in community-based health services provided care that is statistically equivalent to standard care provided by MDs. This review was supplemented by an empirical study that examined the effect of introducing and utilizing NPs on clinical and health services outcomes in a Japanese long-term care health facility. This chapter aims to synthesize the findings and interpretation of these studies, to provide suggestions on the future strategy of introduction and utilization of NPs in ageing society, and recommendations for future research.

4.1. Summary

The meta-analysis has shown that there were neither statistically significantly different nor statistically equivalent results between community based services provided by NPs, mainly in the North America and the UK, and standard care provided by MDs. Significant improvements were only found in patient mortality, blood lipid control and intervention costs. This result suggests that NPs could provide services with no risk of reduction in quality and better, but the evidence remains unclear and larger studies are needed to examine equivalence

of services between NPs and MDs.

Although the regulation status of NP and autonomy of practice are limited in Japan, the types and role of NP practice are similar between the US, the UK and Japan. To ensure a properly rigorous assessment of the role and effect of NPs in Japan, I conducted a retrospective cohort study of the impact of introducing NPs in a long-term care health facility (LCHF). This study found that NP practice reduced hospitalization risk by 45% compared to the period without NP practice. This suggests that the NP may be able to produce efficiencies in the health care system which may reduce health care resource challenges expected to arise as the Japanese population ages.

There are similarities and differences in results between the two studies. In both studies, there was no statistically significant difference in clinical outcomes. The retrospective cohort study found reduced hospitalization risk in NP practice, while there was no statistically significant difference in hospitalization in the meta-analysis. This difference is likely due to the study setting. The meta-analysis included studies in clinics and homes, which requires people to maintain clinical adherence and to independently manage clinical conditions in order to avoid hospitalization, while facility based services in retrospective cohort study control resident's

daily lives perfectly [139]. Additionally, the targeted populations differed between studies. Meta-analysis included all adults while the participants in the retrospective cohort study were limited to elderly people aged 65 years and older. Since elderly people are more vulnerable and management of their health status may be more difficult because of the frail nature of elderly people [125], the effectiveness of interventions to elderly people is more likely to be seen compared to those to adults without severe diseases in meta-analysis.

Overall results of the two studies indicate introducing and utilizing NPs could provide adequate services without reduction in quality by serving as a substitution for MDs and reduce the risk of hospitalization in a long-term care health facility. For countries such as Japan that have structured education systems and recognised credentialing systems for nurses, but also suffer from health workforce restrictions, these findings support the need for further investigation of NP practice and discussion of the establishment of an advanced practice nursing system. This could benefit these ageing societies by ensuring adequate provision of health care in a community setting.

4.2. Future direction of nurse practitioners in Japan

The Japanese government has moved ahead with the establishment of the integrated

community-based care system in recent years [30]. In 2014, it developed a training system for nurses to perform specific medical interventions [128]. The findings of the present study support the use of this regulated training system to meet the demands of health care provision in community settings.

However, the nursing profession also faces shortages due to high turn-over and low-reinstatement rate [17, 18]. An ageing nursing workforce is also a problem, since there will be shortages in nursing schools and nursing administration as these ageing nurses retire, and many nurses may have to extend retirement age to meet the demands of health care [154]. Under this situation, task-shifting with MDs could be an additional burden on nursing workforce. However, utilizing NPs would still be a solution to alleviate workforce shortages and to coordinate the new multi-disciplinary approach. Specifically, the NP can support nursing work as well as enable task-shifting in the following ways:

- The NP acquires management and coordinating skills that lead nursing teamwork and collaboration, improving nursing workforce utilization and enhancing health system development [80-82, 131, 133]
- As my study showed, NPs may have contributed to reduced hospitalization risk, which will in turn reduce the workforce burden in hospitals, and influence nursing

workforce allocation in the wider health system

- Expanding task-shifting between NPs and general nurses, nursing assistants and care workers, and delegating care and routine work that do not require nursing professional skills to non-nursing professionals will enable nurses to concentrate on providing quality nursing care, and to supervise certified care workers as they, in turn, shift tasks from nurses under the *Certified Social Worker and Certified Care Worker Act* revisions [155]

There is always constant friction among groups of health care professionals in the process of advancement of task-shifting between MDs and nurses and the establishment of NP systems globally [156-161]. For instance in the United States, barriers for NPs and their employers to expand codes of NP practice were put in place by health providers, professional organizations, groups, and individuals in the 1970s [162, 163], when the NP regulation system was not well-established, and these barriers persisted into the 1990s [157]. Recommendations on utilization of NPs proposed by the Institute of Medicine in 2010 [53] encouraged the States to revise regulations that enabled NPs to provide practice independently. However, there are still differences between policy recommendations and the supply and scope of practice of NPs in primary care [156, 158]. Other countries such as the United Kingdom and Canada

experienced the similar challenges in the 2000s and 2010s, respectively [160, 161].

Similar phenomena are also seen in Japan. During the discussion of the training system for nurses in Japan, the Japanese Medical Association objected to establishment of this system due to the safety concerns [164]. This influenced the discussion and shrunk the original idea of introducing a training system equivalent to national licensure [72]. Although it is important to examine carefully when a new system is introduced, the possibility that the training system would disturb a multi-disciplinary approach and all medical acts should be implemented under concrete orders by MDs remained a potent concern, despite the need for effective resource allocation in a restricted health workforce and an ageing society.

This study showed NP practice had no risk of reduction in quality, and was found to reduce hospitalization, which could be beneficial to MDs and the community when task-shifting occurs within the frameworks identified here. However, in order to overcome the health care resources challenges that Japan faces as it ages, and to provide adequate health care in an ageing society, multi-disciplinary representative teams should discuss further advances in the nursing role based on scientific evidence in an integrated manner. This may lead to improvements in the integrated community-based care system and enable Japan to contribute

globally as an example of excellence in management of human resources for health in an ageing society.

4.3. Future recommendations

In order to provide further evidence for discussion on expansion of nursing practice including NP regulation system globally and domestically, I would like to make recommendations for future research.

- *Larger and better RCTs:* Systematic review and meta-analysis found neither statistically significant results nor statistically equivalent results between NP and MD practice in a community setting due to the low power of studies. The lack of clear findings on whether services are equivalent or different is likely due to study size, as equivalence is much easier to confirm in large studies. In order to ensure a full understanding of the effect of task-shifting to NPs, larger studies are needed.
- *Expansion of numbers and types of facilities*: Since NP practice in Japan has started from April 2011, it is an ideal opportunity to comprehensively assess a new human resources program by establishing baseline monitoring in facilities where NPs are expected to be in practice in future. Further study that expands the number of

control facilities and includes other types of facilities where NPs are in practice is needed. These studies can examine the effectiveness of NP rigorously and comprehensively in the context of a broader integrated community-based care system.

- *Comprehensive health and health system outcomes assessment*: This study was unable to analyse outcomes such as pressure ulcer control, diabetes mellitus control despite a positive assessment of the NP's role in their management, and could not study resident mortality. This was due to insufficient coverage and quality of data, and data incomparability between facilities. Using the same scale for pressure ulcer, unified time duration for outcome measurement of diabetes mellitus between facilities, based on electronic databases where possible, would enable improvements in the quality of data management and collection.
- *Longitudinal assessment and evaluation*: As there were no statistically significant results in clinical outcomes within the two years of study period, longitudinal studies to assess the effectiveness of NP practice over longer time periods are needed.
- *Health economic impact assessment*: In order to support the establishment of a national NP regulation system, the health economic impact of NP practice should

be examined. A cost-effectiveness analysis is needed to provide firm and robust evidence for further discussion and contribute to decision making on policy for human resources for health.

As many countries are experiencing ageing and the status of NP regulation, education, and codes of practice vary depending on the countries and regions [58-60], these further studies would help other countries to learn from the Japanese health system's efforts to deal with shortages of health care personnel provision in the integrated community-based care system and realize an ageing society where the population are able to live independent, healthy lives and have high quality of life.

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Appendix A: Systematic review search strategy

Search strategy (1990 – June 2014)

Original literature search was conducted between 1990 and June 2014.

Search 1. Cochrane Central Register of Controlled trials

ID	Search	Hits
#1	MeSH descriptor: [Nurse Practitioner] explode all trees	306
#2	"nurse practitioner*":ti,ab	369
#3	MeSH descriptor: [Advanced Practice Nurse] this term only	12
#4	("advanced practice" near/3 nurs*):ti,ab	91
#5	MeSH descriptor: [Nurse Clinicians] this term only	182
#6	"nurse clinician*":ti,ab	19
#7	"nurse specialist*":ti,ab	192
#8	"specialist nurse*":ti,ab	152
#9	MeSH descriptor: [Home Health Nursing] this term only	3
#10	MeSH descriptor: [Nurses, Community Health] this term only	1
#11	"community health nurs*":ti,ab	36
#12	"community nurse*":ti,ab	88
#13	"community matron*":ti,ab	1
#14	"district nurse*":ti,ab	47
#15	MeSH descriptor: [Nurses, Public Health] this term only	0
#16	MeSH descriptor: [Public Health Nursing] this term only	71
#17	"public health nurs*":ti,ab	103
#18	(#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #16 or #17)	1,318
#19	communit*:ti,ab	15,834
#20	MeSH descriptor: [Nursing Homes] this term only	953
#21	"nursing home*":ti,ab	1,577
#22	"assisted living":ti,ab	55
#23	"residential care":ti,ab	189
#24	MeSH descriptor: [Homes for the Aged] this term only	485
#25	((long-term or longterm) near/7 facilit*):ti,ab	358
#26	(care near/7 facilit*):ti,ab	1,113
#27	((long-term or longterm) near/7 facilit*):ti,ab	358

ID	Search	Hits
#28	((long-term or longterm) near/7 care):ti,ab	1,112
#29	(nursing near/7 facilit*):ti,ab	329
#30	home:ti,ab	14,377
#31	MeSH descriptor: [House Calls] this term only	301
#32	MeSH descriptor: [Home Care Services] explode all trees	2,163
#33	MeSH descriptor: [Outpatients] this term only	840
#34	(outpatient* or out-patient*):ti,ab	18,479
#35	(clinic or clinics):ti,ab	15,109
#36	#19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35	56,967
#37	#18 and #36	715
#38	#37 in Trials	652

Search 2. MEDLINE

No	Search	Results
1	exp Nurse Practitioners/	15,136
2	nurse practitioner*.tw.	8,323
3	Advanced Practice Nursing/	792
4	(advanced practice adj3 nurs*).tw.	2,584
5	Nurse Clinicians/	7,424
6	nurse clinician*.tw.	446
7	nurse specialist*.tw.	2,883
8	specialist nurse*.tw.	996
9	Home Health Nursing/	36
10	Nurses, Community Health/	62
11	community health nurs*.tw.	1,212
12	community nurse*.tw.	1,501
13	community matron*.tw.	85
14	district nurse*.tw.	1,079
15	Nurses, Public Health/	13
16	Public Health Nursing/	9,636
17	public health nurs*.tw.	4,598
18	or/1-17	41,611
19	communit*.tw.	336,590
20	Nursing Homes/	28,333
21	nursing home*.tw.	21,998
22	assisted living.tw.	1,363
23	residential care.tw.	2,031
24	Homes for the Aged/	11,113
25	(geriatric adj7 care).tw.	3,733
26	(care adj7 facilit*).tw.	25,798
27	((long-term or longterm) adj7 facilit*).tw.	6,966
28	((long-term or longterm) adj7 care).tw.	20,019
29	(nursing adj7 facilit*).tw.	5,316
30	home.tw.	146,909
31	House Calls/	2,466
32	exp Home Care Services/	39,913
33	Outpatients/	8,994
34	(outpatient* or out-patient*).tw.	124,370
35	(clinic or clinics).tw.	206,315

No	Search	Results
36	or/19-35	800,545
37	18 and 36	10,906
38	randomized controlled trial.pt.	378,560
39	controlled clinical trial.pt.	88,833
40	randomized.ab.	298,871
41	randomised.ab.	59,924
42	placebo.ab.	155,925
43	randomly.ab.	215,923
44	trial.ab.	310,452
45	groups.ab.	1,372,175
46	or/38-45	2,009,609
47	37 and 46	1,691
48	exp animals/ not humans.sh.	3,966,435
49	47 not 48	1,691

Search 3. Embase

No	Query	Results
#49	#47 NOT #44	0
#48	#44 NOT #47	0
#47	#43 AND #46	318
#46	#35 AND #45	3,441
#45	#2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13	7,142
#44	#36 AND #43	318
#43	#37 OR #38 OR #39 OR #40 OR #41 OR #42	387,318
#42	'trial':ab,ti AND [embase]/lim NOT [medline]/lim	189,028
#41	'randomly':ab,ti AND [embase]/lim NOT [medline]/lim	92,510
#40	randomised:ab,ti AND [embase]/lim NOT [medline]/lim	33,581
#39	randomized:ab,ti AND [embase]/lim NOT [medline]/lim	165,675
#38	'controlled clinical trial'/exp AND [embase]/lim NOT [medline]/lim	80,338
#37	'randomized controlled trial'/exp AND [embase]/lim NOT [medline]/lim	72,358
#36	#14 AND #35	3,440
#35	#15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28OR #29 OR #30 OR #31 OR #32 OR #33 OR #34	370,989
#34	clinic:ab,ti OR clinics:ab,ti AND [embase]/lim NOT [medline]/lim	134,357
#33	'out patient':ab,ti OR outpatient:ab,ti AND [embase]/lim NOT [medline]/lim	59,169
#32	'outpatient department'/de AND [embase]/lim NOT [medline]/lim	17,862
#31	'outpatient'/de AND [embase]/lim NOT [medline]/lim	44,244
#30	'visiting nursing service'/de AND [embase]/lim NOT [medline]/lim	40
#29	'home':ab,ti AND [embase]/lim NOT [medline]/lim	66,668
#28	'home care'/exp AND [embase]/lim NOT [medline]/lim	11,636
#27	(nursing NEAR/7 facilit*):ab,ti AND [embase]/lim NOT [medline]/lim	2,058
#26	(('long term' OR longterm) NEAR/7 care):ab,ti AND [embase]/lim NOT [medline]/lim	7,428
#25	(('long term' OR longterm) NEAR/7 facilit*):ab,ti AND [embase]/lim NOT [medline]/lim	2,663
#24	(care NEAR/7 facilit*):ab,ti AND [embase]/lim NOT [medline]/lim	11,468
#23	(geriatric NEAR/7 care):ab,ti AND [embase]/lim NOT [medline]/lim	2,189
#22	'home for the aged'/de AND [embase]/lim NOT [medline]/lim	2,145
#21	'residential care':ab,ti AND [embase]/lim NOT [medline]/lim	769
#20	'assisted living':ab,ti AND [embase]/lim NOT [medline]/lim	476
#19	'assisted living facility'/de AND [embase]/lim NOT [medline]/lim	461

No	Query	Results
#18	(nursing NEXT/1 home*):ab,ti AND [embase]/lim NOT [medline]/lim	7,552
#17	'nursing home'/de AND [embase]/lim NOT [medline]/lim	10,410
#16	communit*:ab,ti AND [embase]/lim NOT [medline]/lim	124,575
#15	'community'/de AND [embase]/lim NOT [medline]/lim	55,226
#14	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13	7,142
#13	('public health' NEXT/1 nurse*):ab,ti AND [embase]/lim NOT [medline]/lim	229
#12	(district NEXT/1 nurse*):ab,ti AND [embase]/lim NOT [medline]/lim	170
#11	(community NEXT/1 matron*):ab,ti AND [embase]/lim NOT [medline]/lim	28
#10	(community NEXT/1 nurs*):ab,ti AND [embase]/lim NOT [medline]/lim	377
#9	('community health' NEAR/1 nurs*):ab,ti AND [embase]/lim NOT [medline]/lim	72
#8	(specialist NEXT/1 nurse*):ab,ti AND [embase]/lim NOT [medline]/lim	1,097
#7	(nurse NEXT/1 specialist*):ab,ti AND [embase]/lim NOT [medline]/lim	1,303
#6	(nurse NEXT/1 clinician*):ab,ti AND [embase]/lim NOT [medline]/lim	107
#5	('advanced practice' NEAR/3 nurs*):ab,ti AND [embase]/lim NOT [medline]/lim	429
#4	'advanced practice nursing'/de AND [embase]/lim NOT [medline]/lim	85
#3	'advanced practice nurse'/exp AND [embase]/lim NOT [medline]/lim	4,126
#2	(nurse NEXT/1 practitioner*):ab,ti AND [embase]/lim NOT [medline]/lim	2,317
#1	'nurse practitioner'/exp AND [embase]/lim NOT [medline]/lim	3,028

Search 4. CINAHL

#	Query	Limiters/Expanders	Last Run Via	Results
S43	S32 AND S42	Limiters – exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	247
S42	S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	47,381
S41	TI allocat* random* OR AB allocat*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	57
S40	MH "Quantitative Studies"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	6,218
S39	TI random* allocat* OR AB random* allocat*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	770
S38	MH "Random Assignment"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	8,771
S37	TI randomi* control* trial* OR AB randomi* control* trial*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	6,914
S36	TI(singl* N1 blind*) OR AB(singl* N1 blind*) OR TI(singl* N1 mask*) OR AB(singl* N1 mask*) OR TI(doubl* N1 blind*) OR AB(doubl* N1 blind*) OR TI(doubl* N1 mask*) OR AB(doubl* N1 mask*) OR TI(tripl* N1 blind*) OR AB(tripl* N1 blind*) OR TI(tripl* N1 mask*) OR AB(tripl* N1 mask*) OR	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	2,481

#	Query	Limiters/Expanders	Last Run Via	Results
	TI(trebl* N1 blind*) OR AB(trebl* N1 blind*) OR TI(trebl* N1 mask*) OR AB(trebl* N1 mask*)			
S35	TI clinic* N1 trial* OR AB clinic* N1 trial*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	7,579
S34	PT Clinical trial	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	6,783
S33	MH "Clinical Trials+"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	30,885
S32	S13 AND S31	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	9,150
S31	S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	137,855
S30	TI clinic OR AB clinic OR TI clinics OR AB clinics	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	14,026
S29	TI out patient OR AB out patient OR TI out-patient OR AB out-patient OR TI outpatient OR AB outpatient	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	5,716
S28	MW "Outpatients"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	14,719
S27	TI home OR AB home	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	27,897
S26	MH "Home Health	Limiters - exclude	Interface - EBSCOhost Research	16,251

#	Query	Limiters/Expanders	Last Run Via	Results
	Care+"	MEDLINE records Search modes - Boolean/Phrase	Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	
S25	TI nursing N7 facilit* OR AB nursing N7 facilit*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,516
S24	TI (long-term OR longterm) N7 care OR AB (long-term OR longterm) N7 care	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	4,742
S23	TI (long-term OR longterm) N7 facilit* OR AB (long-term OR longterm) N7 facilit*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,050
S22	TI care N7 facilit* OR AB care N7 facilit*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	3,885
S21	TI geriatric N7 care OR AB geriatric N7 care	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	634
S20	TI residential care OR AB residential care	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,058
S19	TI assisted living OR AB assisted living	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	702
S18	MH "Assisted Living"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,428
S17	TI nursing home* OR AB nursing home*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	5,673
S16	MH "Nursing Homes+"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	9,294

#	Query	Limiters/Expanders	Last Run Via	Results
S15	TI communit* OR AB communit*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	40,148
S14	MW Communit*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	40,581
S13	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	26,276
S12	TI public health nurs* OR AB public health nurs*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,174
S11	TI community matron* OR AB community matron*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	104
S10	TI community nurs* OR AB community nurs*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	3,156
S9	TI community health nurs* OR AB community health nurs*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	668
S8	MH "HOME NURSING, PROFESSIONAL"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	2,909
S7	TI specialist nurse* OR AB specialist nurse*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	832
S6	TI nurse specialist* OR AB nurse specialist*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,365
S5	TI nurse clinician* OR AB nurse clinician*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full	146

#	Query	Limiters/Expanders	Last Run Via	Results
			Text	
S4	TI advanced practice N3 nurs* OR AB advanced practice N3 nurs*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	1,778
S3	MH "Advanced Nursing Practice"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	4,470
S2	MH "Advanced Practice Nurses+"	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	14,075
S1	TI nurse practitioner* OR AB nurse practitioner*	Limiters - exclude MEDLINE records Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Plus with Full Text	3,827

Search 5. British Nursing Index

[Note: the British Nursing Index does not provide details on the numbers of search outcomes at each sub-unit of the search, so the search is provided here as a single boolean string]

Set#: S1

Searched for: ((SU("Nurse Practitioner") OR (TI("nurse practitioner*") OR AB("nurse practitioner*")) OR (TI("advanced practice" NEAR/3 nurs*) OR AB("advanced practice" NEAR/3 nurs*)) OR (TI("nurse clinician*") OR AB("nurse clinician*")) OR SU("Nurse Specialist") OR (TI("nurse specialist*") OR AB("nurse specialist*")) OR (TI("specialist nurse*") OR AB("specialist nurse*")) OR SU("community nursing") OR (TI("community health nurs*") OR AB("community health nurs*")) OR (TI("community nurs*") OR AB("community nurs*")) OR (TI("community matron*") OR AB("community matron*")) OR (TI("district nurse*") OR AB("district nurse*")) OR SU("Public Health Nursing") OR (TI("public health nurs*") OR AB("public health nurs*"))) AND (SU(Community) OR (TI(communit*) OR AB(communit*)) OR SU("Nursing Homes") OR (TI("nursing home*") OR AB("nursing home*")) OR SU("Residential Care") OR (TI("residential care") OR AB("residential care")) OR (TI("assisted living") OR AB("assisted living")) OR (TI(geriatric NEAR/7 care) OR AB(geriatric NEAR/7 care)) OR (TI(care NEAR/7 facilit*) OR AB(care NEAR/7 facilit*)) OR (TI(("long term" OR longterm) NEAR/7 facilit*) OR AB(("long-term" OR longterm) NEAR/7 facilit*)) OR (TI(nursing NEAR/7 facilit*) OR AB(nursing NEAR/7 facilit*)) OR SU(home) OR (TI(home) OR AB(home)) OR SU("Outpatients Department") OR (TI(outpatient*) OR AB(outpatient*)) OR (TI(clinic OR clinics) OR AB(clinic OR clinics)))) AND ((TI(“clinic* trial*”) OR AB(“clinic* trial*”)) OR "TI(“singl* blind*”) OR AB(“singl* blind*”) OR TI(“singl* mask*”) OR AB(“singl* mask*”) OR TI(“doubl* blind*”) OR AB(“doubl* blind*”) OR TI(“doubl* mask*”) OR AB(“doubl* mask*”) OR TI(“tripl* blind*”) OR AB(“tripl* blind*”) OR TI(“tripl* mask*”) OR AB(“tripl* mask*”) OR TI(“trebl* blind*”) OR AB(“trebl* blind*”) OR TI(“trebl* mask*”) OR AB(“trebl* mask*”)" OR (TI(“randomi* control* trial*”) OR AB(“randomi* control* trial*”)) OR (TI("random* allocat*") OR AB("random* allocat*")) OR (TI("allocat* random*") OR AB("allocat* random*")))

Databases: British Nursing Index

Results: 89°

Duplicates are removed from your search and from your result count.

Search Strategy (2014 – September 2015)

Update literature search was conducted between 2014 and September 2015.

Search 6. Cochrane Central Register of Controlled trials

ID	Search	Hits
#1	MeSH descriptor: [88] explode all trees	316
#2	"nurse practitioner*":ti,ab	436
#3	MeSH descriptor: [78] this term only	14
#4	("advanced practice" near/3 nurs*):ti,ab	105
#5	MeSH descriptor: [Nurse Clinicians] this term only	183
#6	"nurse clinician*":ti,ab	20
#7	"nurse specialist*":ti,ab	213
#8	"specialist nurse*":ti,ab	179
#9	MeSH descriptor: [Home Health Nursing] this term only	3
#10	MeSH descriptor: [Nurses, Community Health] this term only	3
#11	"community health nurs*":ti,ab	39
#12	"community nurse*":ti,ab	100
#13	"community matron*":ti,ab	1
#14	"district nurse*":ti,ab	48
#15	MeSH descriptor: [Nurses, Public Health] this term only	0
#16	MeSH descriptor: [Public Health Nursing] this term only	73
#17	"public health nurs*":ti,ab	111
#18	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #16 or #17	1,474
#19	communit*:ti,ab	18,620
#20	MeSH descriptor: [Nursing Homes] this term only	992
#21	"nursing home*":ti,ab	1,790
#22	"assisted living":ti,ab	75
#23	"residential care":ti,ab	213
#24	MeSH descriptor: [Homes for the Aged] this term only	501
#25	((long-term or longterm) near/7 facilit*):ti,ab	405
#26	(care near/7 facilit*):ti,ab	1,345
#27	((long-term or longterm) near/7 facilit*):ti,ab	405
#28	((long-term or longterm) near/7 care):ti,ab	1,271
#29	(nursing near/7 facilit*):ti,ab	251

ID	Search	Hits
#30	home:ti,ab	15,851
#31	MeSH descriptor: [House Calls] this term only	317
#32	MeSH descriptor: [Home Care Services] explode all trees	2,253
#33	MeSH descriptor: [Outpatients] this term only	893
#34	(outpatient* or out-patient*):ti,ab	20,666
#35	(clinic or clinics):ti,ab	17,717
#36	#19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35	652,54
#37	#18 and #36	790
#38	#37 in Trials	724
#39	#37 Publication Year from 2014 to 2015, in Trials	48

Search 7. MEDLINE

No	Search	Results
1	exp Nurse Practitioners/	15,759
2	nurse practitioner*.tw.	8,665
3	Advanced Practice Nursing/	952
4	(advanced practice adj3 nurs*).tw.	2,817
5	Nurse Clinicians/	7,545
6	nurse clinician*.tw.	467
7	nurse specialist*.tw.	3,069
8	specialist nurse*.tw.	1,113
9	Home Health Nursing/	81
10	Nurses, Community Health/	157
11	community health nurs*.tw.	1,246
12	community nurse*.tw.	1,619
13	community matron*.tw.	94
14	district nurse*.tw.	1,131
15	Nurses, Public Health/	39
16	Public Health Nursing/	9,718
17	public health nurs*.tw.	4,715
18	or/1-17	43,257
19	communit*.tw.	375,559
20	Nursing Homes/	29,567
21	nursing home*.tw.	23,561
22	assisted living.tw.	1,515
23	residential care.tw.	2,221
24	Homes for the Aged/	11,659
25	(geriatric adj7 care).tw.	4,076
26	(care adj7 facilit*).tw.	29,093
27	((long-term or longterm) adj7 facilit*).tw.	7,739
28	((long-term or longterm) adj7 care).tw.	21,858
29	(nursing adj7 facilit*).tw.	5,812
30	home.tw.	160,221
31	House Calls/	2,635
32	exp Home Care Services/	41,356
33	Outpatients/	9,919
34	(outpatient* or out-patient*).tw.	135,097
35	(clinic or clinics).tw.	226,258

No	Search	Results
36	or/19-35	880,001
37	18 and 36	11,537
38	randomized controlled trial.pt.	410,648
39	controlled clinical trial.pt.	91,598
40	randomized.ab.	334,164
41	randomised.ab.	68,161
42	placebo.ab.	168,451
43	randomly.ab.	240,770
44	trial.ab.	348,922
45	groups.ab.	1,500,562
46	or/38-45	2,199,235
47	37 and 46	1,835
48	exp animals/ not humans.sh.	4,111,231
49	47 not 48	1,835
52	limit 49 to yr="2014 - 2015"	176

Search 8. Embase

No	Query	Results
#45	#36 AND #43 AND [1-6-2014]/sd	83
#44	#36 AND #43	321
#43	#37 OR #38 OR #39 OR #40 OR #41 OR #42	389,885
#42	'trial':ab,ti AND [embase]/lim NOT [medline]/lim	190,347
#41	'randomly':ab,ti AND [embase]/lim NOT [medline]/lim	93,225
#40	randomised:ab,ti AND [embase]/lim NOT [medline]/lim	33,907
#39	randomized:ab,ti AND [embase]/lim NOT [medline]/lim	166,704
#38	'controlled clinical trial'/exp AND [embase]/lim NOT [medline]/lim	81,088
#37	'randomized controlled trial'/exp AND [embase]/lim NOT [medline]/lim	73,003
#36	#14 AND #35	3,446
#35	#15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34	373,739
#34	clinic:ab,ti OR clinics:ab,ti AND [embase]/lim NOT [medline]/lim	134,999
#33	'out patient':ab,ti OR outpatient:ab,ti AND [embase]/lim NOT [medline]/lim	59,403
#32	'outpatient department'/de AND [embase]/lim NOT [medline]/lim	17,929
#31	'outpatient'/de AND [embase]/lim NOT [medline]/lim	44,399
#30	'visiting nursing service'/de AND [embase]/lim NOT [medline]/lim	40
#29	'home':ab,ti AND [embase]/lim NOT [medline]/lim	66,975
#28	'home care'/exp AND [embase]/lim NOT [medline]/lim	11,684
#27	(nursing NEAR/7 facilit*):ab,ti AND [embase]/lim NOT [medline]/lim	2,068
#26	(('long term' OR longterm) NEAR/7 care):ab,ti AND [embase]/lim NOT [medline]/lim	7,444
#25	(('long term' OR longterm) NEAR/7 facilit*):ab,ti AND [embase]/lim NOT [medline]/lim	2,676
#24	(care NEAR/7 facilit*):ab,ti AND [embase]/lim NOT [medline]/lim	11,536
#23	(geriatric NEAR/7 care):ab,ti AND [embase]/lim NOT [medline]/lim	2,202
#22	'home for the aged'/de AND [embase]/lim NOT [medline]/lim	2,144
#21	'residential care':ab,ti AND [embase]/lim NOT [medline]/lim	767
#20	'assisted living':ab,ti AND [embase]/lim NOT [medline]/lim	477
#19	'assisted living facility'/de AND [embase]/lim NOT [medline]/lim	464
#18	(nursing NEXT/1 home*):ab,ti AND [embase]/lim NOT [medline]/lim	7,580
#17	'nursing home'/de AND [embase]/lim NOT [medline]/lim	10,438
#16	communit*:ab,ti AND [embase]/lim NOT [medline]/lim	125,451
#15	'community'/de AND [embase]/lim NOT [medline]/lim	55,516

No	Query	Results
#14	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR#13	7,167
#13	('public health' NEXT/1 nurse*):ab,ti AND [embase]/lim NOT [medline]/lim	229
#12	(district NEXT/1 nurse*):ab,ti AND [embase]/lim NOT [medline]/lim	171
#11	(community NEXT/1 matron*):ab,ti AND [embase]/lim NOT [medline]/lim	28
#10	(community NEXT/1 nurs*):ab,ti AND [embase]/lim NOT [medline]/lim	377
#9	('community health' NEAR/1 nurs*):ab,ti AND [embase]/lim NOT [medline]/lim	72
#8	(specialist NEXT/1 nurse*):ab,ti AND [embase]/lim NOT [medline]/lim	1,096
#7	(nurse NEXT/1 specialist*):ab,ti AND [embase]/lim NOT [medline]/lim	1,307
#6	(nurse NEXT/1 clinician*):ab,ti AND [embase]/lim NOT [medline]/lim	107
#5	('advanced practice' NEAR/3 nurs*):ab,ti AND [embase]/lim NOT [medline]/lim	430
#4	'advanced practice nursing'/de AND [embase]/lim NOT [medline]/lim	86
#3	'advanced practice nurse'/exp AND [embase]/lim NOT [medline]/lim	4,148
#2	(nurse NEXT/1 practitioner*):ab,ti AND [embase]/lim NOT [medline]/lim	2,321
#1	'nurse practitioner'/exp AND [embase]/lim NOT [medline]/lim	3,047

Search 9. CINAHL

#	Query	Limiters/Expanders	Last Run Via	Results
S44	S43	Limiters Date of publish: 2014010120150931 Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	17
S43	S32 AND S42	Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	253
S42	S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41	Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	49,202
S41	TI allocat* random* OR AB allocat* random*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	64
S40	MH "Quantitative Studies"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	7,086
S39	TI random* allocat* OR AB random* allocat*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	724
S38	MH "Random Assignment"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	9,276
S37	TI randomi* control* trial* OR AB randomi* control* trial*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	5,900
S36	TI(singl* N1 blind*) OR AB(singl* N1 blind*) OR TI(singl* N1 mask*) OR AB(singl* N1 mask*) OR TI(doubl* N1 blind*) OR AB(doubl* N1 blind*) OR TI(doubl* N1 mask*) OR AB(doubl* N1 mask*) OR TI(tripl* N1 blind*) OR	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	2,572

#	Query	Limiters/Expanders	Last Run Via	Results
	AB(tripl* N1 blind*) OR TI(tripl* N1 mask*) OR AB(tripl* N1 mask*) OR TI(trebl* N1 blind*) OR AB(trebl* N1 blind*) OR TI(trebl* N1 mask*) OR AB(trebl* N1 mask*)			
S35	TI clinic* N1 trial* OR AB clinic* N1 trial*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	7,649
S34	PT Clinical trial	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	7,054
S33	MH "Clinical Trials+"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	31,713
S32	S13 AND S31	Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	9,457
S31	S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30	Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	144,526
S30	TI clinic OR AB clinic OR TI clinics OR AB clinics	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	15,005
S29	TI out patient OR AB out patient OR TI outpatient OR AB outpatient OR TI outpatient OR AB outpatient	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	6,118
S28	MW "Outpatients"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	15,505
S27	TI home OR AB home	Limiters exclude MEDLINE records	Interface EBSCOhost Research Databases	29,223

#	Query	Limiters/Expanders	Last Run Via	Results
		Search modes Boolean/Phrase	Search Screen Advanced Search Database CINAHL Plus with Full Text	
S26	MH "Home Health Care+"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	17,120
S25	TI nursing N7 facilit* OR AB nursing N7 facilit*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	1,615
S24	TI (longterm OR longterm) N7 care OR AB (longterm OR longterm) N7 care	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	4,980
S23	TI (longterm OR longterm) N7 facilit* OR AB (longterm OR longterm) N7 facilit*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	1,104
S22	TI care N7 facilit* OR AB care N7 facilit*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	4,169
S21	TI geriatric N7 care OR AB geriatric N7 Care	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	667
S20	TI residential care OR AB residential care	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	1,144
S19	TI assisted living OR AB assisted living	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	737
S18	MH "Assisted Living"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	1,508
S17	TI nursing home* OR AB nursing home*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	5,880
S16	MH "Nursing Homes+"	Limiters exclude	Interface EBSCOhost Research	9,804

#	Query	Limiters/Expanders	Last Run Via	Results
		MEDLINE records Search modes Boolean/Phrase	Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	
S15	TI communit* OR AB comm Limiters MEDLINE unit*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	42,814
S14	MW Communit*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	41,510
S13	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12	Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	27,383
S12	TI public health nurs* OR AB public health nurs*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	1,206
S11	TI community matron* OR AB community matron*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	105
S10	TI community nurs* OR AB community nurs*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	3,248
S9	TI community health nurs* OR AB community health nurs*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	687
S8	MH "HOME NURSING, PROFESSIONAL"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	2,995
S7	TI specialist nurse* OR AB specialist nurse*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	854
S6	TI nurse specialist* OR AB nurse specialist*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	1,381

#	Query	Limiters/Expanders	Last Run Via	Results
S5	TI nurse clinician* OR AB nurse clinician*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	150
S4	TI advanced practice N3 nurs* OR AB advanced practice N3 nurs*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	1,882
S3	MH "Advanced Nursing Practice"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	4,729
S2	MH "Advanced Practice Nurses+"	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	14,719
S1	TI nurse practitioner* OR AB nurse practitioner*	Limiters exclude MEDLINE records Search modes Boolean/Phrase	Interface EBSCOhost Research Databases Search Screen Advanced Search Database CINAHL Plus with Full Text	4,010

Search 10. British Nursing Index

Set#: S1

Searched for: ((SU("Nurse Practitioner") OR (TI("nurse practitioner*") OR AB("nurse practitioner*")) OR (TI("advanced practice" NEAR/3 nurs*) OR AB("advanced practice" NEAR/3 nurs*)) OR (TI("nurse clinician*") OR AB("nurse clinician*")) OR SU("Nurse Specialist") OR (TI("nurse specialist*") OR AB("nurse specialist*")) OR (TI("specialist nurse*") OR AB("specialist nurse*")) OR SU("community nursing") OR (TI("community health nurs*") OR AB("community health nurs*")) OR (TI("community nurs*") OR AB("community nurs*")) OR (TI("community matron*") OR AB("community matron*")) OR (TI("district nurse*") OR AB("district nurse*")) OR SU("Public Health Nursing") OR (TI("public health nurs*") OR AB("public health nurs*"))) AND (SU(Community) OR (TI(communit*) OR AB(communit*)) OR SU("Nursing Homes") OR (TI("nursing home*") OR AB("nursing home*")) OR SU("Residential Care") OR (TI("residential care") OR AB("residential care")) OR (TI("assisted living") OR AB("assisted living")) OR (TI(geriatric NEAR/7 care) OR AB(geriatric NEAR/7 care)) OR (TI(care NEAR/7 facilit*) OR AB(care NEAR/7 facilit*)) OR (TI(("long term" OR longterm) NEAR/7 facilit*) OR AB(("long-term" OR longterm) NEAR/7 facilit*)) OR (TI(nursing NEAR/7 facilit*) OR AB(nursing NEAR/7 facilit*)) OR SU(home) OR (TI(home) OR AB(home)) OR SU("Outpatients Department") OR (TI(outpatient*) OR AB(outpatient*)) OR (TI(clinic OR clinics) OR AB(clinic OR clinics)))) AND ((TI(“clinic* trial*”) OR AB(“clinic* trial*”)) OR "TI(“singl* blind*”) OR AB(“singl* blind*”) OR TI(“singl* mask*”) OR AB(“singl* mask*”) OR TI(“doubl* blind*”) OR AB(“doubl* blind*”) OR TI(“doubl* mask*”) OR AB(“doubl* mask*”) OR TI(“tripl* blind*”) OR AB(“tripl* blind*”) OR TI(“tripl* mask*”) OR AB(“tripl* mask*”) OR TI(“trebl* blind*”) OR AB(“trebl* blind*”) OR TI(“trebl* mask*”) OR AB(“trebl* mask*”)" OR (TI(“randomi* control* trial*”) OR AB(“randomi* control* trial*”)) OR (TI("random* allocat*") OR AB("random* allocat*")) OR (TI("allocat* random*") OR AB("allocat* random*")))

Databases: British Nursing Index

Results: 17°

limit to years 2014-2015

Duplicates are removed from your search and from your result count.

Appendix B: Forest plots from individual meta-analyses

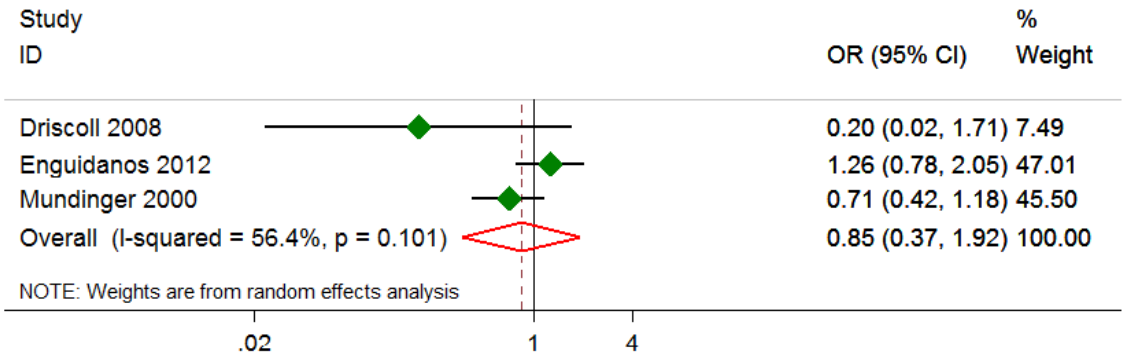

Figure 1. Odds ratios (OR) comparing hospitalization in NP services and MD services at six-month follow-up.

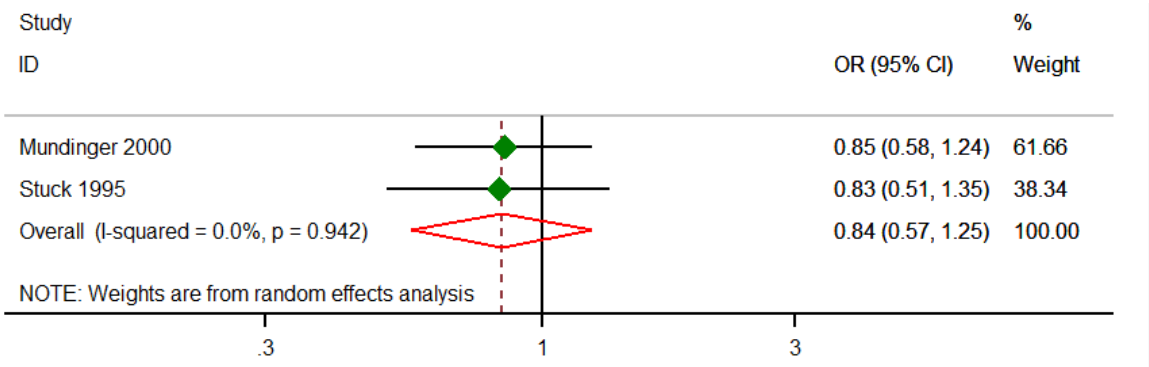

Figure 2. Odds ratios (OR) comparing hospitalization in NP services and MD services at one-year follow-up.

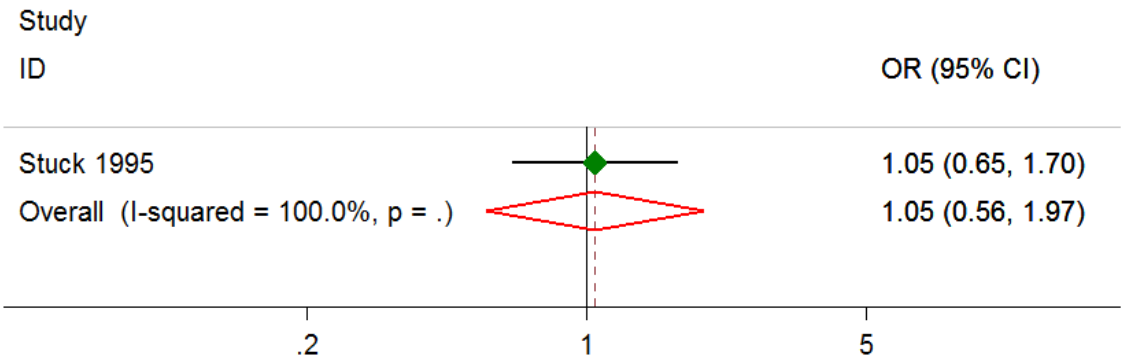

Figure 3. Odds ratios (OR) comparing hospitalization in NP services and MD services at two-year follow-up.

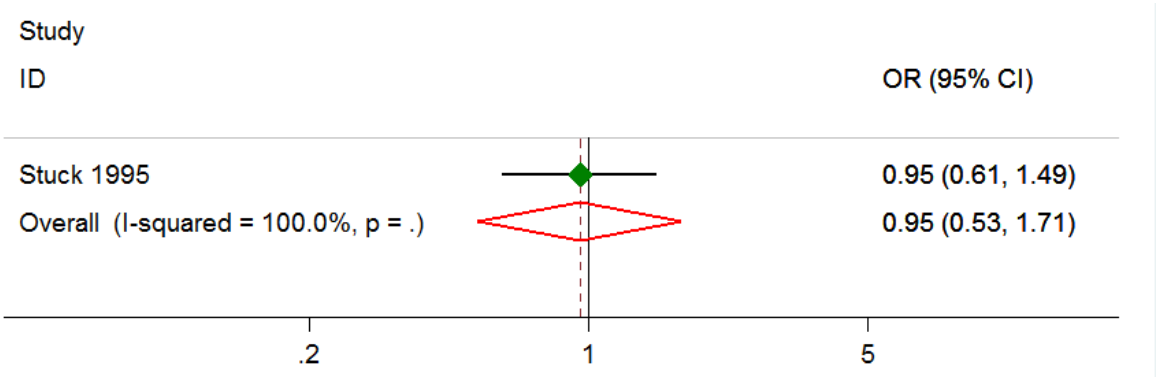

Figure 4. Odds ratios (OR) comparing hospitalization in NP services and MD services at three-year follow-up.

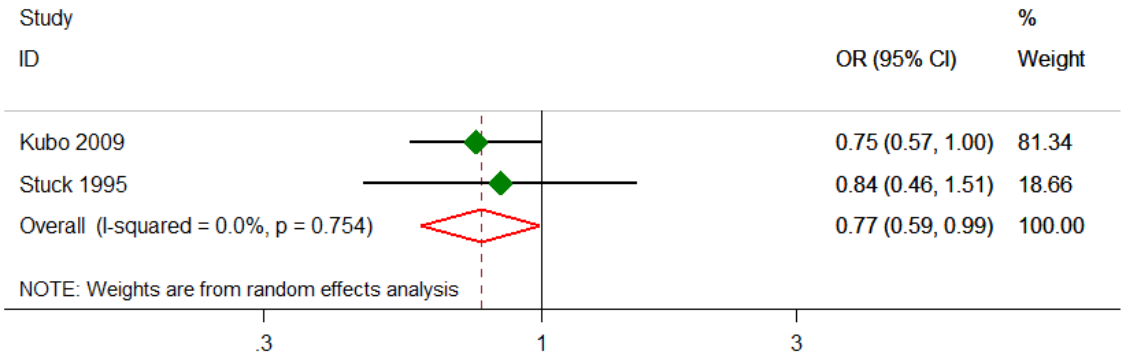

Figure 5. Odds ratios (OR) comparing patient mortality in NP services and MD services at two to three-year follow-up.

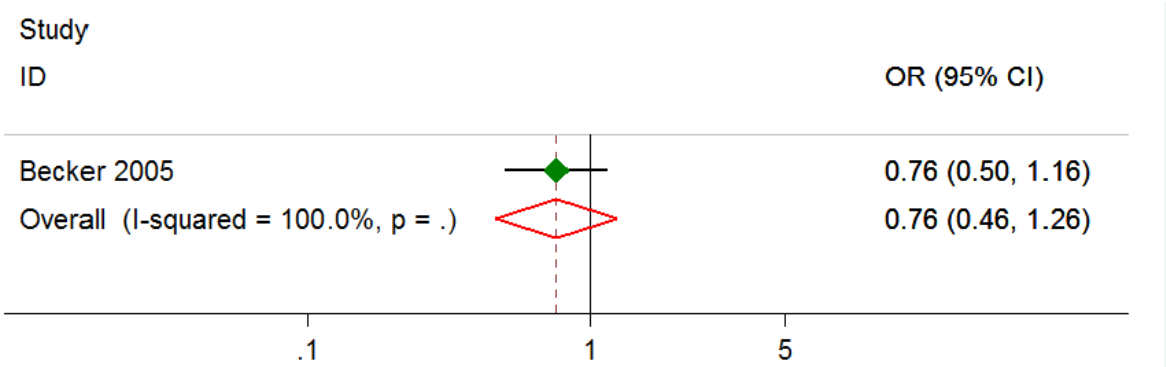

Figure 6. Odds ratios (OR) comparing blood pressure value <140/90mmHg in NP services and MD services at baseline.

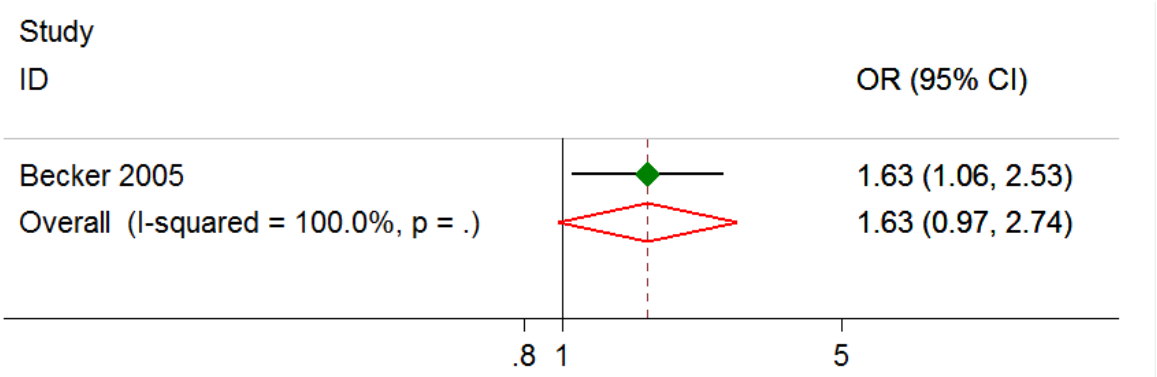

Figure 7. Odds ratios (OR) comparing blood pressure value <140/90mmHg in NP services and MD services at one-year follow-up.

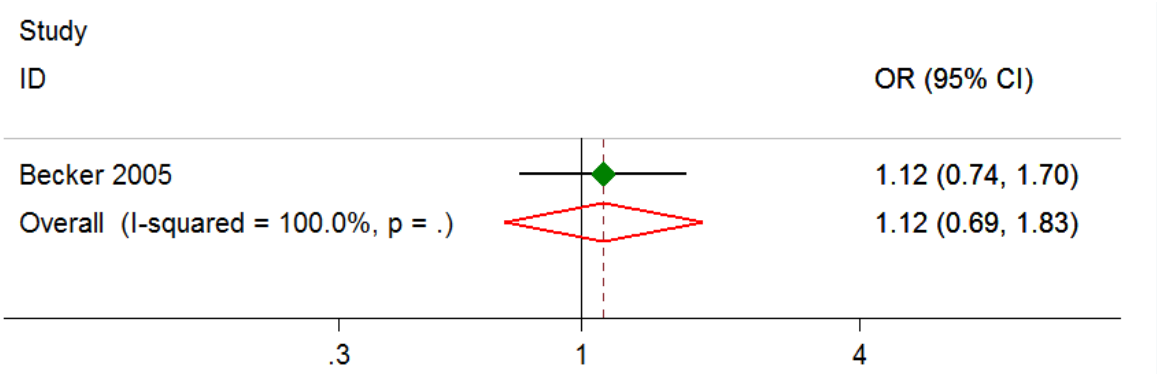

Figure 8. Odds ratios (OR) comparing blood pressure value <140/90mmHg in NP services and MD services at five-year follow-up.

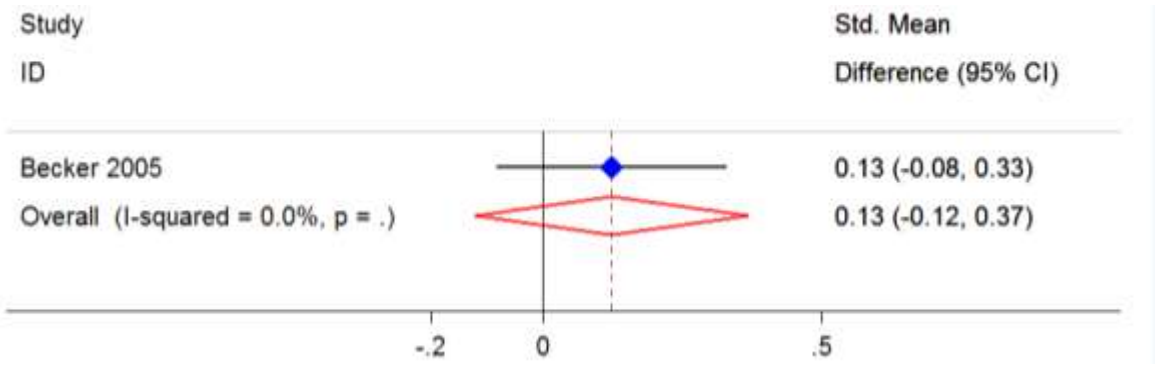

Figure 9. Standardized mean difference (SMD) comparing systolic blood pressure control in NP services and MD services at baseline.

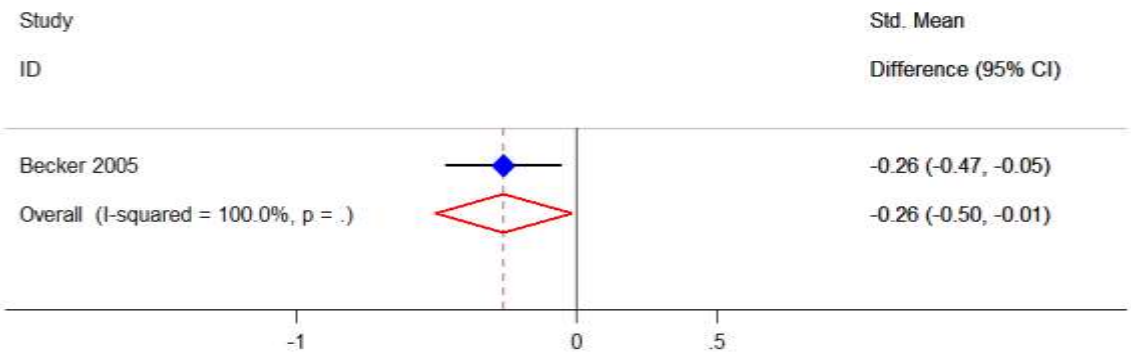

Figure 10. Standardized mean difference (SMD) comparing systolic blood pressure control in NP services and MD services at one-year follow-up.

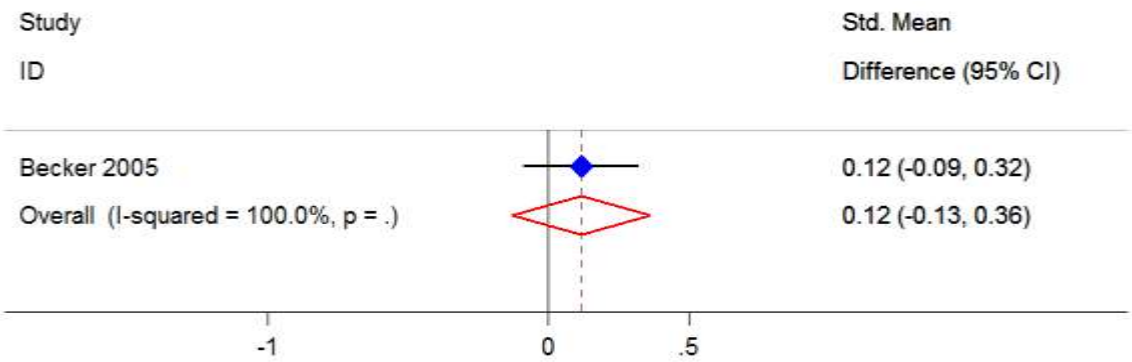

Figure 11. Standardized mean difference (SMD) comparing systolic blood pressure control in NP services and MD services at five-year follow-up.

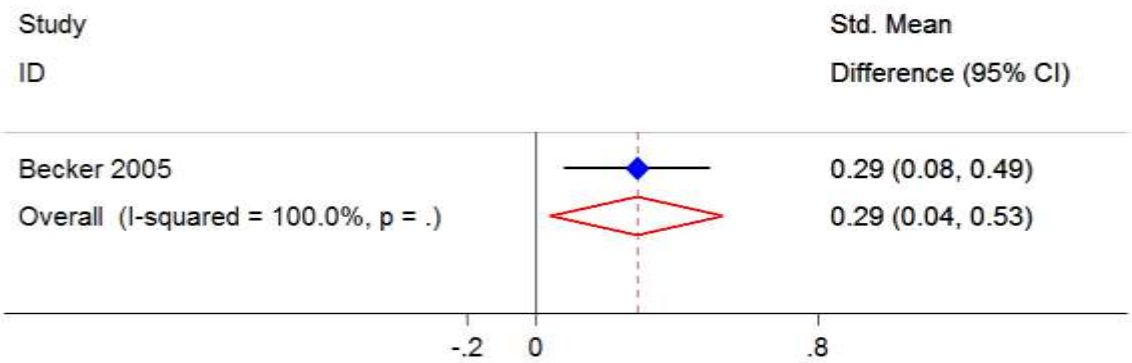

Figure 12. Standardized mean difference (SMD) comparing diastolic blood pressure control in NP services and MD services at baseline.

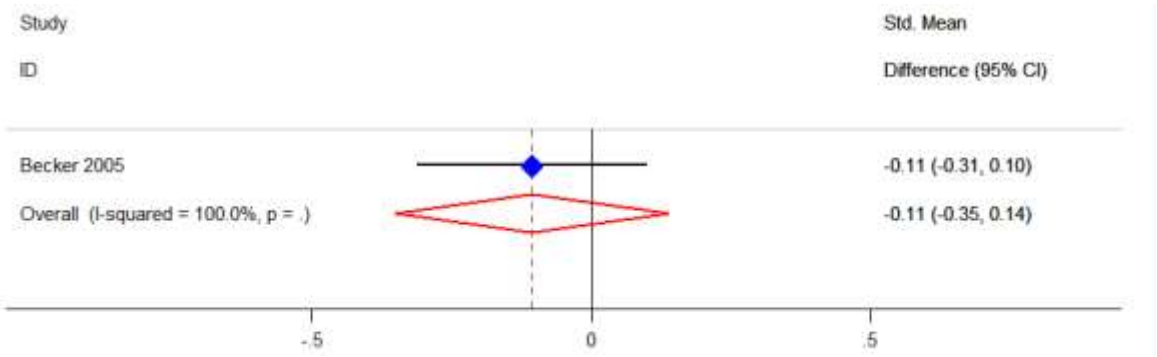

Figure 13. Standardized mean difference (SMD) comparing diastolic blood pressure control in NP services and MD services at one-year follow-up.

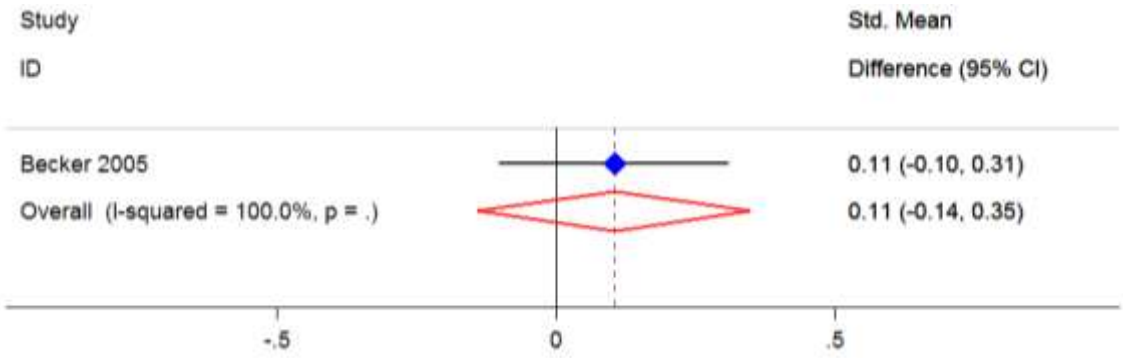

Figure 14. Standardized mean difference (SMD) comparing diastolic blood pressure control in NP services and MD services at five-year follow-up.

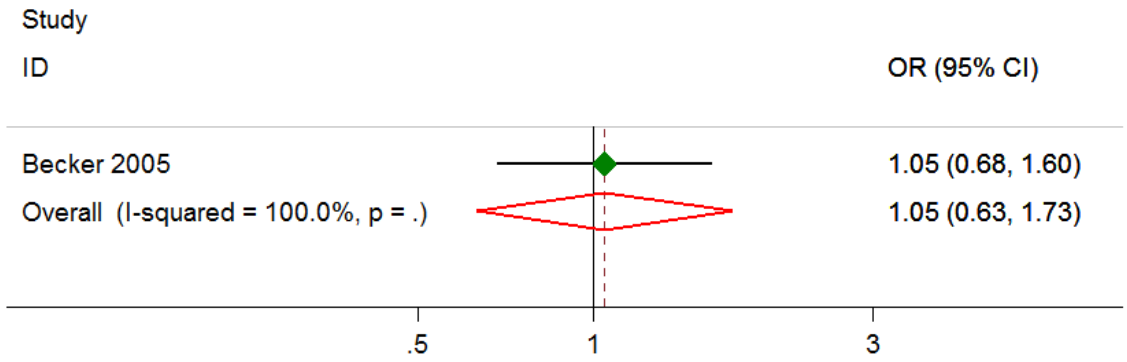

Figure 15. Odds ratio (OR) comparing blood Low Density Lipoprotein-Cholesterol (LDL-C) value <130mg/dL in NP services and MD services at baseline.

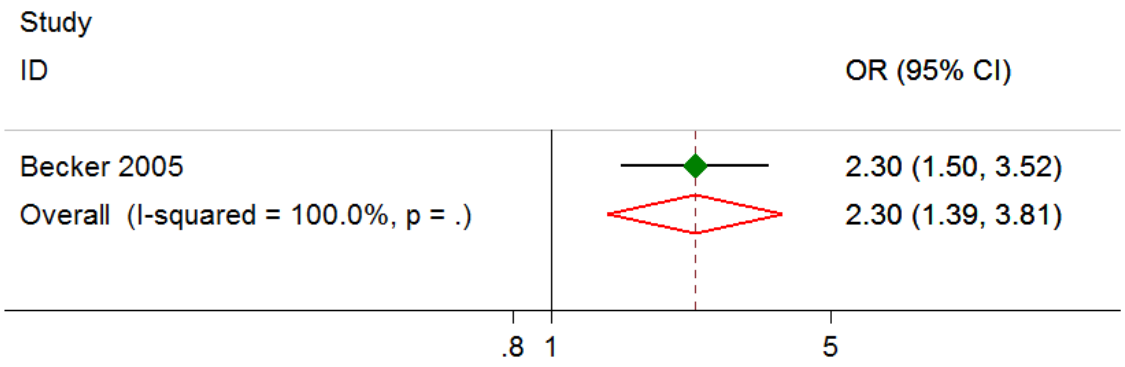

Figure 16. Odds ratio (OR) comparing blood Low Density Lipoprotein-Cholesterol (LDL-C) value <130 mg/dL in NP services and MD services at one-year follow-up.

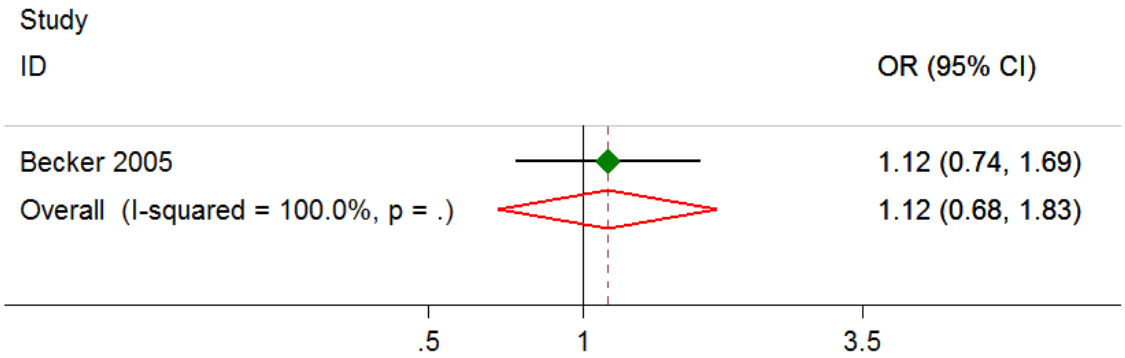

Figure 17. Odds ratio (OR) comparing blood Low Density Lipoprotein-Cholesterol (LDL-C) value <130 mg/dL in NP services and MD services at five-year follow-up.

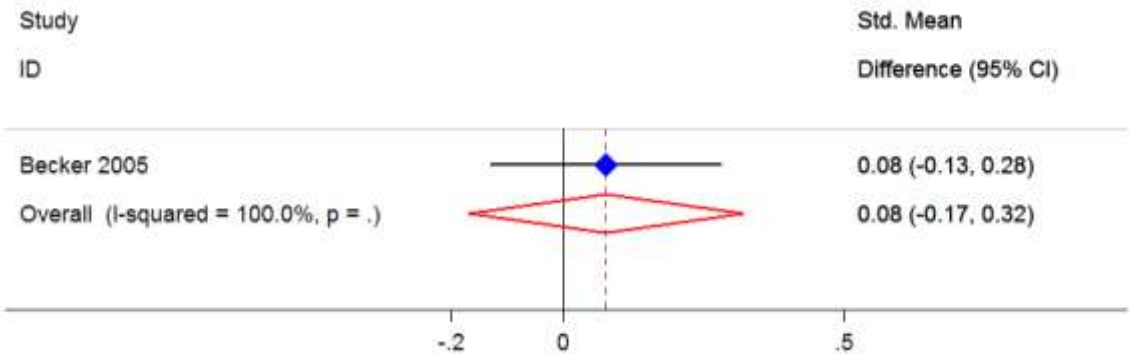

Figure 18. Standardized Mean Difference (SMD) comparing blood Low Density Lipoprotein-Cholesterol (LDL-C) value in NP services and MD services at baseline.

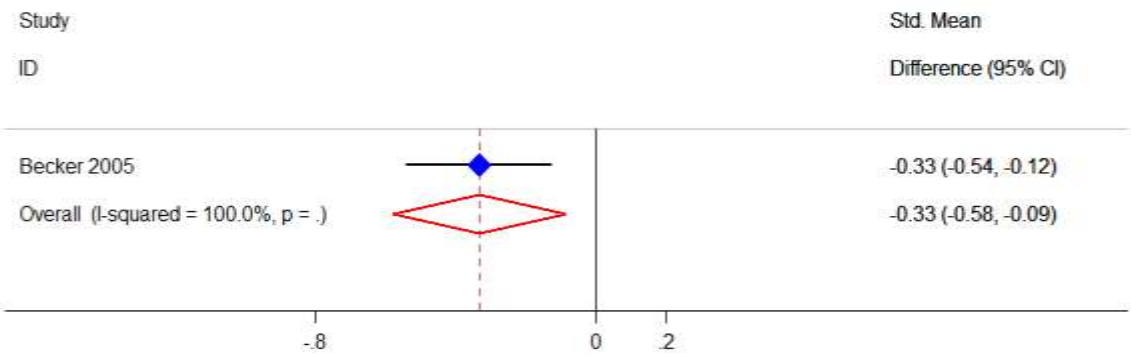

Figure 19. Standardized Mean Difference (SMD) comparing blood Low Density Lipoprotein-Cholesterol (LDL-C) value in NP services and MD services at one-year follow-up.

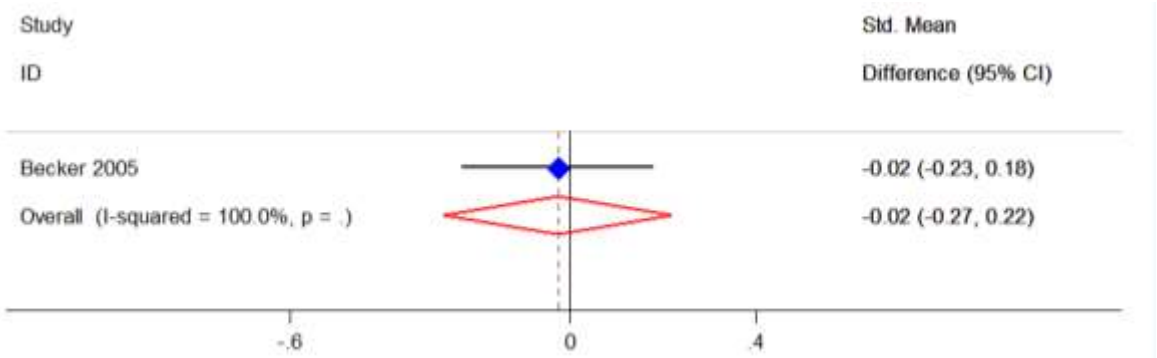

Figure 20. Standardized Mean Difference (SMD) comparing blood Low Density Lipoprotein-Cholesterol (LDL-C) value in NP services and MD services at five-year follow-up.

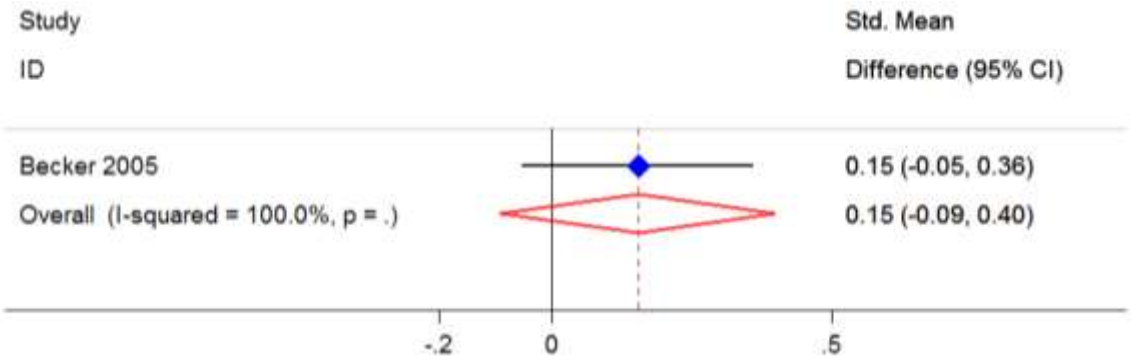

Figure 21. Standardized Mean Difference (SMD) comparing Body Mass Index (BMI) value in NP services and MD services at baseline.

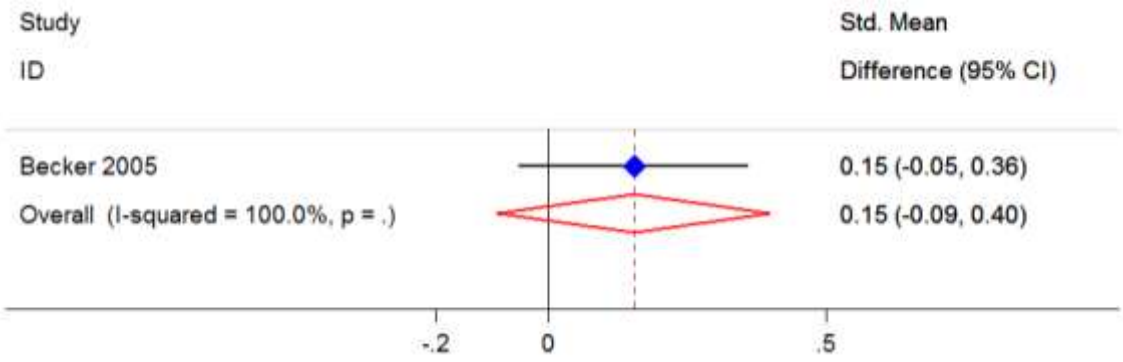

Figure 22. Standardized Mean Difference (SMD) comparing Body Mass Index (BMI) value in NP services and MD services at one-year follow-up.

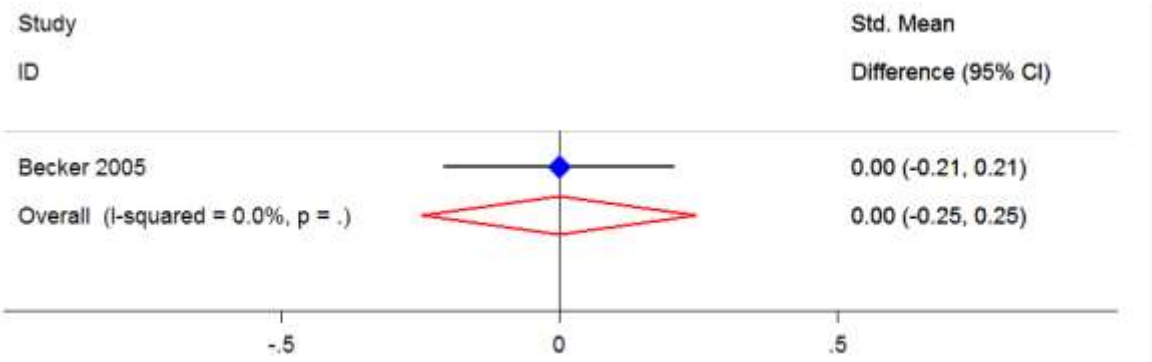

Figure 23. Standardized Mean Difference (SMD) comparing Body Mass Index (BMI) value in NP services and MD services at five-year follow-up.

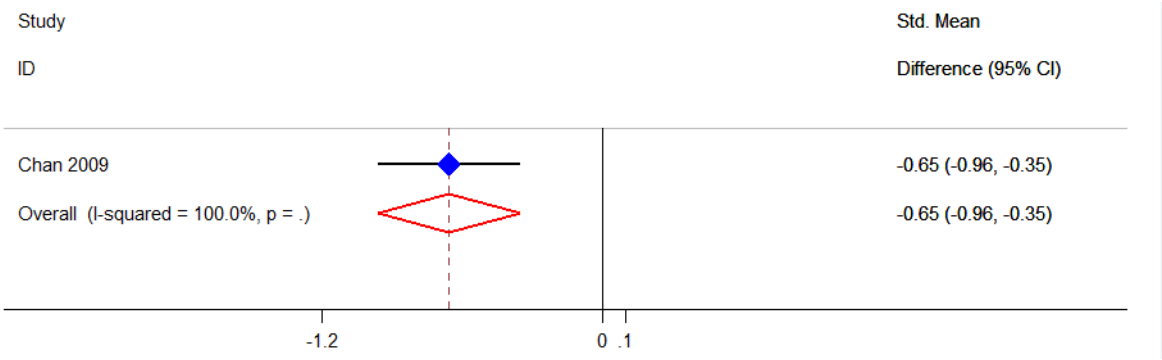

Figure 24. Standardized Mean Difference (SMD) comparing costs value in NP services and MD services at six-month follow-up.

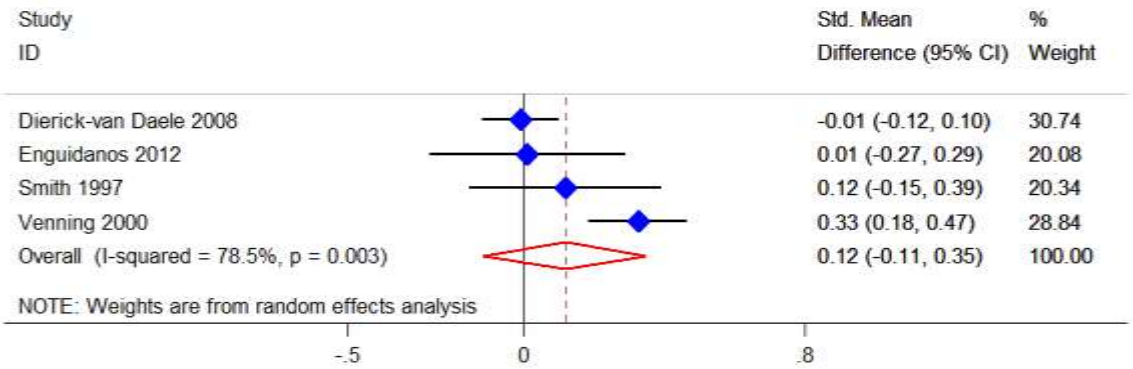

Figure 25. Standardized Mean Difference (SMD) comparing the score in patient satisfaction score in NP services and MD services at baseline.

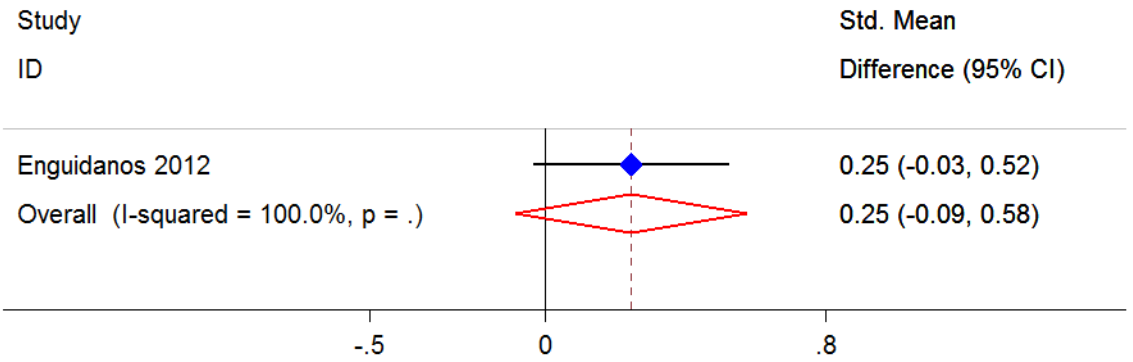

Figure 26. Standardized Mean Difference (SMD) comparing the score in patient satisfaction scale in NP services and MD services at three- to six-month follow-up.

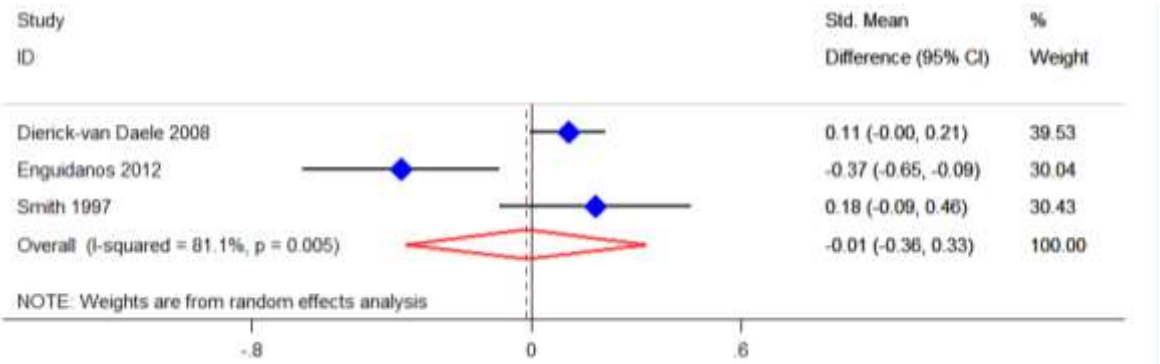

Figure 27. Standardized Mean Difference (SMD) comparing the score in self-reported patient perceived health scale in NP services and MD services at baseline.

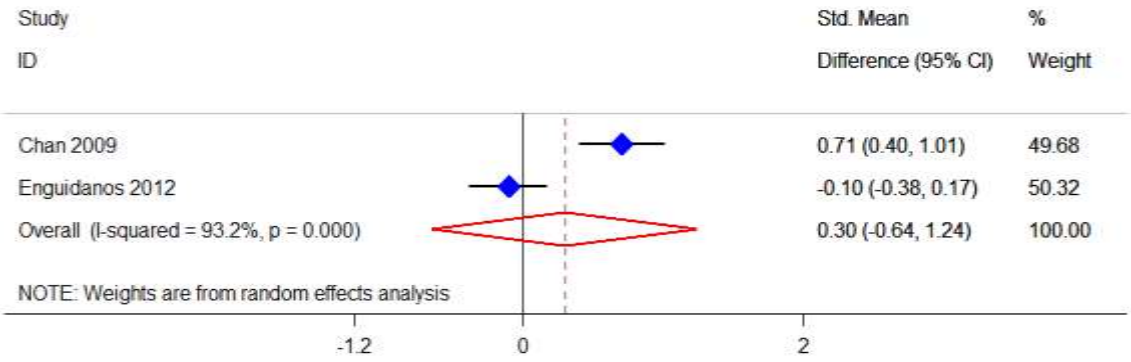

Figure 28. Standardized Mean Difference (SMD) comparing the score in self-reported patient perceived health scale in NP services and MD services at three- to six-months follow-up.

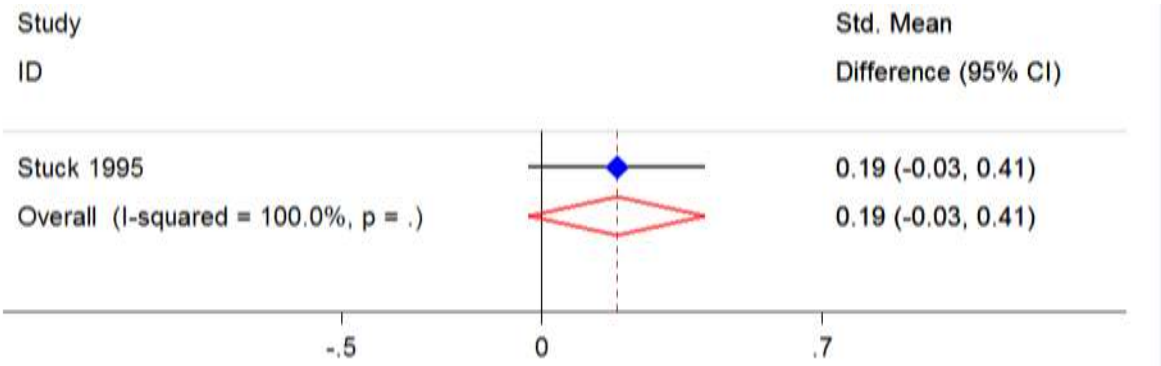

Figure 29. Standardized Mean Difference (SMD) comparing the score in functional status scale in NP services and MD services at three-year follow-up.

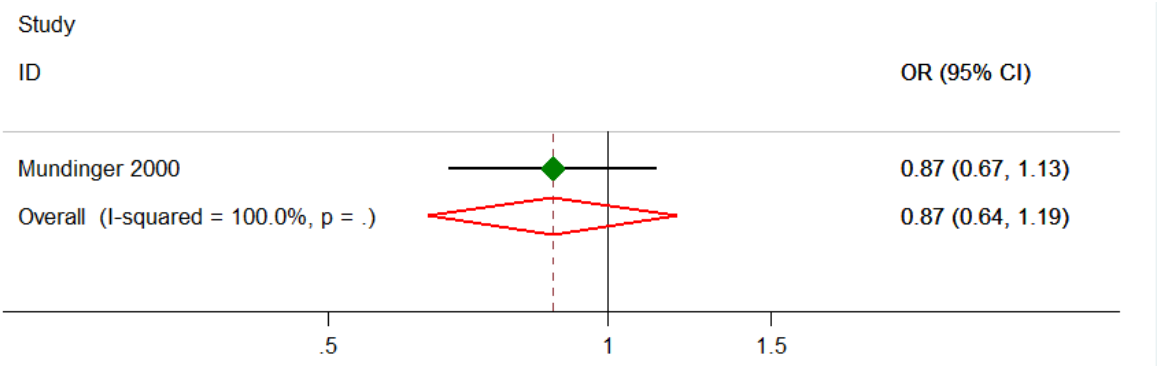

Figure 30. Odds ratios (OR) comparing emergency department visit in NP services and MD services at six-month follow-up.

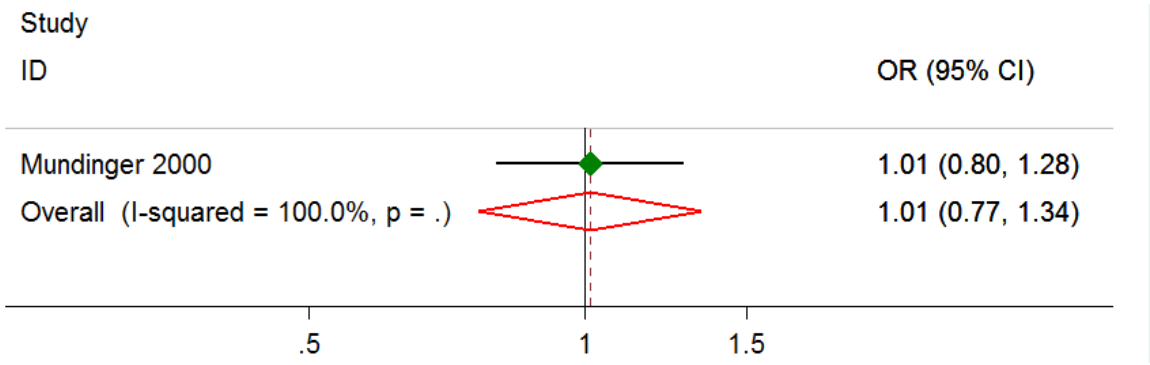

Figure 31. Odds ratios (OR) comparing emergency department visit in NP services and MD services at one-year follow-up.

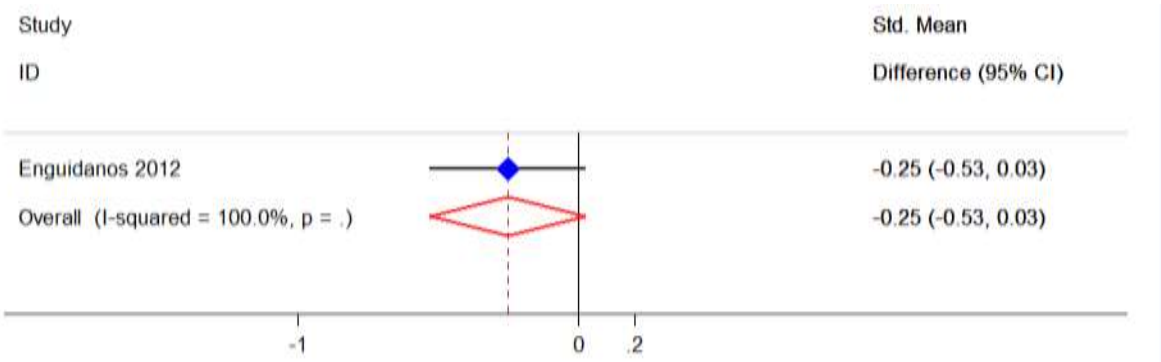

Figure 32. Standardized Mean Difference (SMD) comparing emergency department visit in NP services and MD services at six-month follow-up.

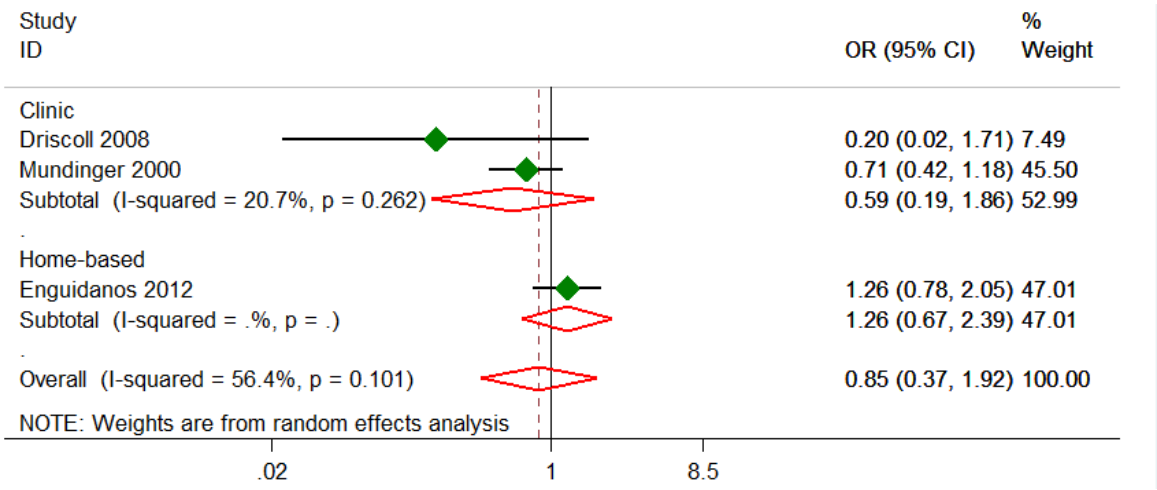

Figure 33. Service setting sub-group analysis: Odds ratios (OR) comparing hospitalization in NP services and MD services at six-month follow-up.

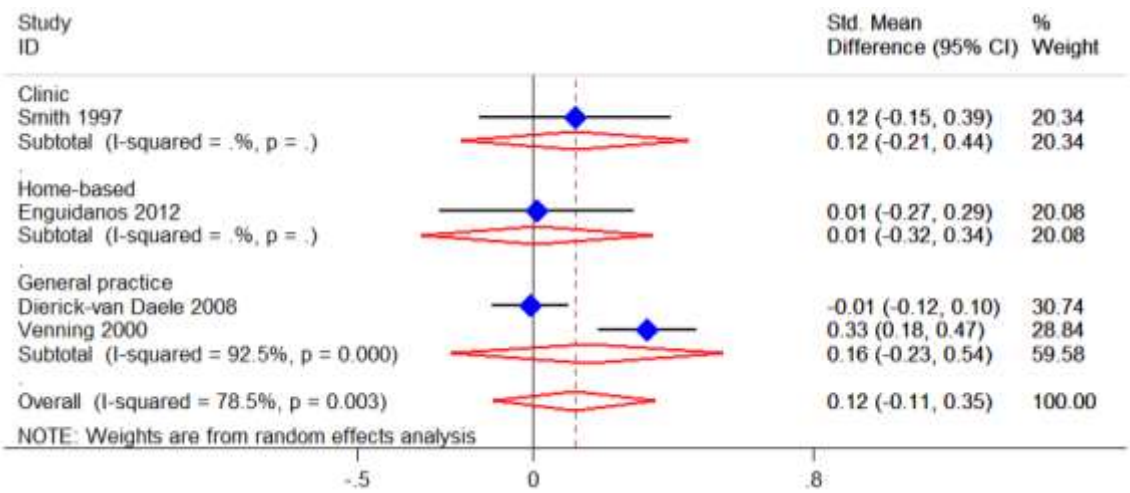

Figure 34. Service setting sub-group analysis: Standardized Mean Difference (SMD) comparing patient satisfaction at baseline.

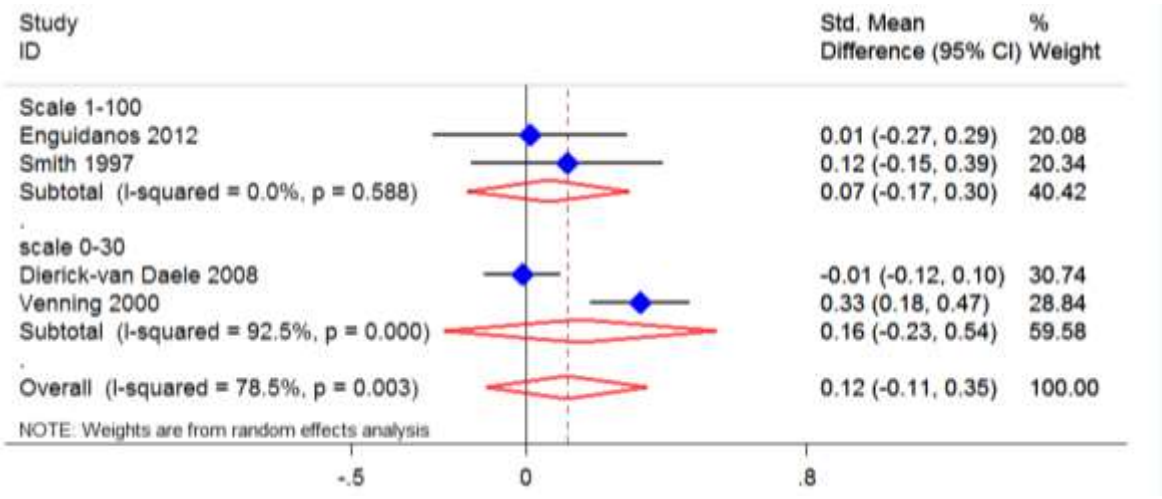

Figure 35. Measurement scale sub-group analysis: Standardized Mean Difference (SMD) comparing patient satisfaction at baseline.

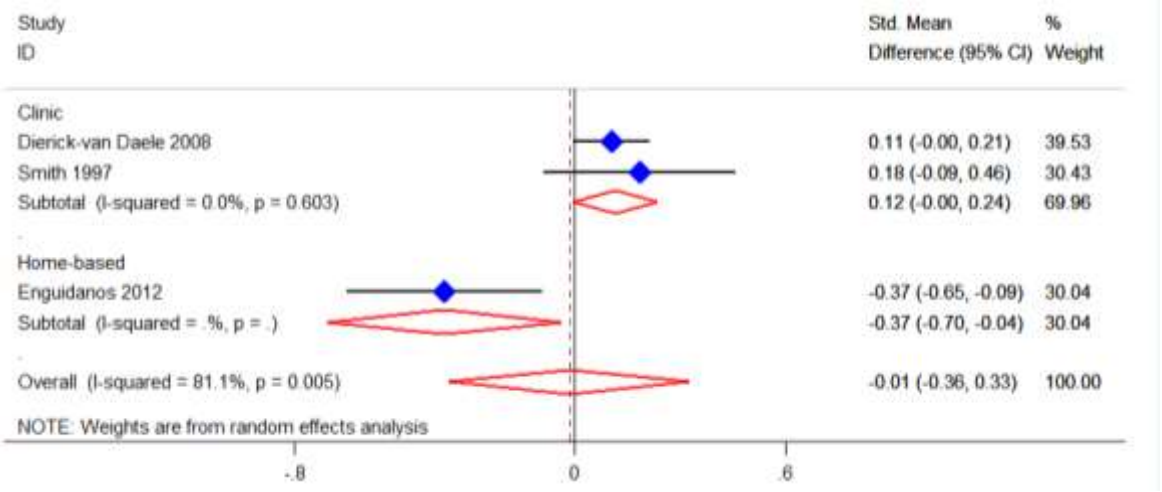

Figure 36. Service setting sub-group analysis: Standardized Mean Difference (SMD) comparing the score in self-reported patient perceived health scale in NP services and MD services at baseline.

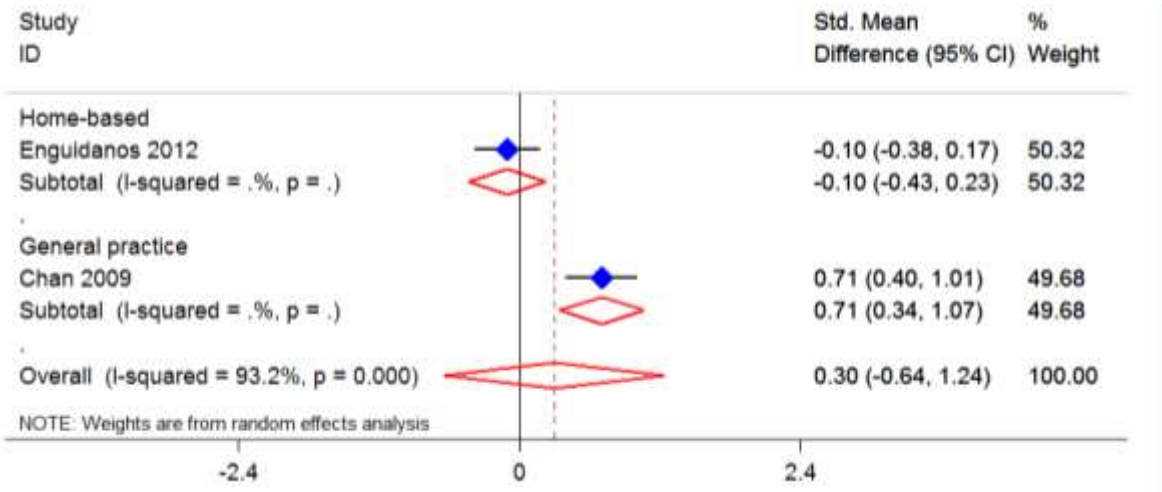

Figure 37. Service setting sub-group analysis: Standardized Mean Difference (SMD) comparing the score in self-reported patient perceived health scale in NP services and MD services at three- to six-months follow-up.