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OPTIMISING SKILL-MIX IN THE PRIMARY HEALTH CARE WORKFORCE FOR THE CARE OF OLDER AUSTRALIANS: A SYSTEMATIC REVIEW

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LIST OF ABBREVIATIONS

ANU – Australian National University
APHCRI – Australian Primary Health Care Research Institute
AHW – Aboriginal Health Workers
AIHW – Australian Institute for Health and Welfare
BA – before and after
CALD – Culturally and linguistically diverse
CBA – controlled before and after
CCT – controlled clinical trial
CINAHL – Cumulative Index to Nursing and Allied Health Literature
DARE – Database of Abstracts of Reviews of Evidence
DM – disease management
EPC – Enhance Primary Care
EPOC – Effective Practice and Organisation of Care
HACC – Home and Community Care
HP – health promotion
ITS – interrupted time series
JBI – Joanna Briggs Institute
NP – nurse practitioner
PA – physician assistant
PC – Productivity Commission
PMOD – physiological measure of disease
QAS – Queensland Ambulance Service
QoL – Quality of life
RCT – randomised controlled trial
UNSW – University of New South Wales
UWS – University of Western Sydney
WHO – World Health Organisation

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BACKGROUND

The demographics of the Australian population are changing with increasing numbers of older people. The proportion of the Australian population aged 65 and over is projected to increase from 13% in 2004 to 16.4% by 2015 and 20.3% by 2025 [1]. This will be accompanied by an increase in the prevalence of chronic diseases. Over 80% of the elderly are living with at least one chronic illness and 50% have two or more [2]. Almost one in five Australians has a cardiovascular condition with heart, stroke and vascular conditions being far more prevalent in older age groups. In the 45-54 age group 28% of Australians report such a condition compared to more than 50% of 65-74 year olds [3]. Chronic disease accounts for a substantial and increasing proportion of health care expenditure and general practitioner (GP) workload [4, 5].

The expectations of the Australian population are also changing. Increasingly Australians are unwilling to accept the limited options for aged care that were available to their parents or grandparents. The range of management options for chronic illness is also expanding and there is a need to explore innovative methods to deliver this care in a cost effective way.

The Productivity Commission on Australia's Health Workforce identified developing technology, growing community expectations and population ageing as drivers of increased demand for health workforce services [6]. These factors combine to increase pressure on health services including primary care services that provide care to older people living in the community. In the area of general practice Australia is experiencing workforce shortages, especially in regional and rural areas [7]. This is in part due to the restraints placed on universities and the GP vocational training program in the 1990s. There have also been substantial changes in workforce participation related to GPs reducing their work hours and feminisation of the GP workforce [6, 8]. Workforce shortages are also an issue in other health professions such as nursing and allied health [6]. There was a projected shortfall of nursing graduates of 4,051 in 2006. In the aged care sector there are particular problems of recruitment and retention of staff because of the low status of the speciality.

The increase in demands of caring for an older population and the increase in prevalence of chronic disease has required new thinking about workface including the distribution of role and responsibilities. Sibbald and others have put forward a model of skill-mix change as a way of thinking about workforce redesign. Skill-mix change can be brought about through the process of job and role enhancement, substitution, delegation and innovation. Skill-mix changes can also be made through a change in the interface between services by transfer, relocation and liaison [9]. There is an emerging literature on skill-mix changes especially in relation to role substitution [10] [11]. In Australia the role of practice nurses is evolving to include multidisciplinary care and chronic illness care [12] but there is also need to examine the roles of nurses in other contexts such as independent practice in rural and remote areas.

OBJECTIVES

The project initially sought to answer the following questions:

1. What is already known about the priorities for skill-mix changes in the primary health care workforce?
2. What are the needs for the provision of care for older people that could be addressed by changing skill-mix in the primary health care workforce?
3. How are these needs affected by context including remote, rural, outer metropolitan, and urban? Issues for groups with special needs such indigenous or non-English speaking Australians will be examined in each of these setting.
4. What do the stakeholders believe are the skill-mix changes required to meet these needs?
5. What does the literature tell us about the optimal skill-mix to meet the needs as identified in questions 1 to 4?
6. What information is there on the cost effectiveness of these skill-mix changes?

7. How are the effective solutions applicable in the Australian context? This will consider how systems of pay/reimbursement in primary care and state/federal regulations governing scope of practice/licensing of various health professions are likely to constrain what can be done in terms of skill-mix change.
8. What are the policy options and investments necessary to implement the solution as identified in question six.

SKILL MIX DEFINITIONS

The World Health Organisation (WHO) in its World Health Report 2000 highlighted the importance of "skill-mix" in health [13]. It acknowledged that determining and achieving the "right mix" of health professionals is challenging for most health care organisations and health systems.

In its definition of "skill mix" the WHO identified two major components:

1. Mix of posts, grades or occupations in an organisation.
2. Combination of skills or competencies needed for each job with the organisation.

Buchan and colleagues [14] defined "skill-mix" as a mix of skills or competencies possessed by an individual; the ratio of senior to junior grade staff within a single discipline; or a mix of different types of staff within a multidisciplinary team.

In this review we have focussed on skill-mix changes in individual health care workers. According to the model proposed by Sibbald et al [9], skill-mix changes in individuals could be obtained through the following:

- **Substitution** – expanding the breadth of a job by working across professional divides. For example, counsellors substituting for doctors for some mental health problems in primary care settings.
- **Enhancement** – increasing the depth of a job by extending the role or skills of workers. For example, community matrons, as in the UK, providing intensive home support to patients with long-term conditions.
- **Delegation** – moving a task up or down a traditional unidisciplinary ladder. For example, an enrolled nurse performing some roles traditionally performed by a registered nurse.
- **Innovation** – creating new jobs by introducing new types of workers. For example, physician-assistant providing some routine care, eg. routine follow-ups for patients with chronic diseases.

PRODUCTIVITY COMMISSION REPORT

The Productivity Commission's report on Australia's Health Workforce described some of the issues at both the professional and health system level that currently affect the primary healthcare workforce in Australia [6].

HEALTH SYSTEM LEVEL

Workforce shortages are occurring across a range of health professionals, including general practitioners and nurses. In 2005 it was estimated that there was a shortfall of 800 to 1300 GPs (which was 4-6% of the workforce at the time) and a shortfall of 10 to 12,000 nurses, which would require a doubling of the number of nursing graduates. The shortages are more acute in rural and remote areas of Australia and include shortages of Aboriginal Health Workers (AHW). These workforce shortages are occurring against a background of an ageing population with an increasing prevalence of chronic disease, which is placing even more demands on the health care system.

The Productivity Commission's report on Australia's Health Workforce identified some key trends affecting the health workforce:

- An ageing workforce.
- Increasing feminisation of the workforce.
- Reduced working hours.
- Increased specialisation of the workforce.
- Poor retention of the workforce. For example, as many as 10% of registered or enrolled nurses are not working as nurses, 5000 registered pharmacists are not working in pharmacy and 19% of occupational therapists leave the health service each year.
- Changing models of care and service delivery.

The National Health Workforce Strategic Framework has been established to try to guide health workforce policy and planning with a focus on long term solutions rather than relying on overseas trained health professionals to fill some of these gaps. An increase in the number of undergraduate training places has been planned with a 30% increase in the number of places for medicine, 4800 extra nursing places and 3600 extra allied health places by 2008. Inevitably there will be a delay before these health professionals graduate and move into the workplace. In the meantime there is a need to modify the way in which health professionals work, such as multidisciplinary teamwork or skill mix changes to fill these gaps in the short term.

The Productivity Commission identified some barriers to effective skill mix and team working in Australia. The current funding and payment systems favour a medical (doctor) workforce, if other health professionals are to provide some aspects of a patient's care then changes need to be made to the payment system to facilitate and support this. The current funding system also favours doctors working in certain specialities creating shortages in less well-reimbursed areas such as general practice. Health professionals are expected to work together in multi-disciplinary teams and yet they are trained separately so they have less understanding of the roles of the other members of the team.

PROFESSIONAL LEVEL ISSUES

Many of the current regulations for different health professionals reinforce professional boundaries and roles and reduce the flexibility of the various professionals to develop new competencies and scopes of practice in response to workforce shortages. These regulations were developed to ensure the competency of the health professionals but also served to protect the workload and potential income. This system of regulation is different for each health profession and often varies from state to state, such as the legal scope of practice of Aboriginal Health Workers. This fragmented system of registration and licensing makes it difficult to have a coordinated approach to workforce planning to address shortages.

There is a further level of fragmentation between those responsible for planning the healthcare workforce and those involved in the education and training which means that universities are not able to respond quickly to changes in workforce need. As the length of time it takes to train suitable qualified health professionals increases this adds further delay in the ability to respond to workforce shortage. A "skills escalator" has been proposed in the UK [15] to address this. Students undertake a shorter generic health degree first and then add more training as needed to specialise in a particular field but this has not been welcomed by the professional organisations in Australia, as they believe that it would reduce the quality of health care.

Turf wars between the different professional groups add to the complexity and pose a significant barrier to the adoption of skill mix innovations in Australia. Many health professionals such as registered nurses, physiotherapists and pharmacists believe that their training equips them to work at a higher level however some professions are resistant to delegation of tasks to other professionals. For example both doctors and pharmacists have been reluctant to accept the role of the nurse practitioner, particularly if this role includes prescribing.

The Productivity Commission proposed a set of national workforce structures to address the issues in the health workforce. The most relevant of these to the issue of skill mix was the establishment of a Workforce Improvement Agency. The proposed role for this agency was to "support local innovation, and to objectively evaluate, facilitate and drive those of national significance". They also recommended changes to the accreditation system for health professional qualifications and the establishment of a single national health professional registration board with professional panels. The Government welcomed the recommendations in the report and the response from the Council of Australian Governments has included making changes to the system of health professional registration and to establish a national accreditation scheme for health professional training. The proposal of a Health Workforce Improvement Agency was recast as establishing a taskforce to conduct studies and provide advice to the Australian Health Ministers Advisory Council on workforce innovation and reform. It is not clear if this taskforce has been established to date.

WORKFORCE SHORTAGES SERVING PARTICULAR COMMUNITIES

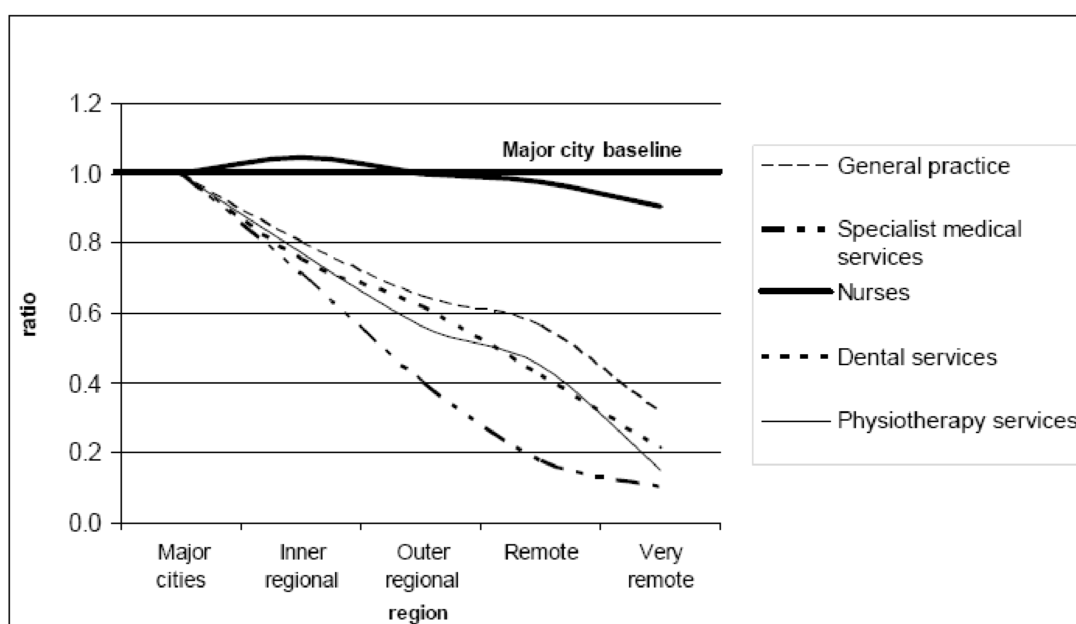

Figure 1 Practitioner to population ratios relative to major city levels

(From Productivity Commission Report [6])

The shortage of doctors, dentists and allied health professionals worsens with increasing distance from major cities in Australia, Figure 1. The ratio of nurses to the population does not decrease with distance from major cities as much as for other professions but the ratio of enrolled to registered nurses increases [16]. In remote areas people have particular difficulty accessing services because of the distances involved. For older people who may require regular or even daily care for chronic disease this poses particular problems in terms of cost and time and many people may be forced to move to nearby regional centres for their care. Skill mix innovations may be important in these areas provided they are well supported by qualified health professionals.

In rural and remote Indigenous communities, workforce shortages can be particularly acute and exacerbated by limited access to Medicare rebates. Aboriginal Community Controlled Health Services provide some primary care and funding for programs to support the training and use of other health workers such as Aboriginal Health Workers. Care by family members is important for older people in the community, but in Indigenous communities the "elders" may not have family members to support them in the community because of the high mortality rates among young and middle aged Indigenous people [17]. Indigenous people have difficulty accessing

mainstream services for elderly because of location, cultural or language difficulties. Their preference is for care provided by Aboriginal workers but there are important issues to be aware of such as the gender of the carer when providing personal care [17].

Aged care as a sector of the health workforce is experiencing specific problems because it has low status and low pay particularly in nursing. Over recent years the number of registered or enrolled nurses has decreased and reliance on personal care assistants has increased [17]. A National Aged Care Workforce Strategy [18] has been established to try to address some of these issues although the focus has been on the residential aged care sector and not community care. Promoting aged care as an area of need would facilitate the development of nurse practitioners and there is need to explore how enrolled nurses could take on some of the medication giving roles. There are specific issues for culturally and linguistically diverse (CALD) populations where workforce shortages are exacerbated by the need to provide health workers with language skills and they are in even shorter supply. This is likely to present even greater problems as the population of older people from culturally and linguistically diverse backgrounds is set to increase by 66% over the next 10 to 15 years [19].

STAKEHOLDER CONSULTATION PROCESS

Key stakeholders were identified from organisations involved in the care of community dwelling older Australians, see Table 1. These stakeholders were invited to take part in semi-structured telephone interviews and gave their informed consent.

Table 1. Organisation of the stakeholders

• Australian Nurse Practitioners Association • Australian Practice Nurses Association • National Aboriginal Community Controlled Health Organisation • Community Services and Heath Industry Skills Council • Centre for Research and Education in Ageing, University of Newcastle • Migrant Resource Centre, Centre North West Region • Australian Nursing Federation • Catholic Health Australia • NSW Transcultural Aged Care Service	• Services for Australian Rural and Remote Allied Health • Australian Centre for Evidence Based Aged Care, La Trobe University • Aged Care Association of Australia • Association for Australian Rural Nurses • Council of Remote Area Nurses of Australia • Frontier Services, NT • Australian Division of General Practice • Divisions of General Practice (metropolitan and rural Divisions)

Table 1 Stakeholder organisations interviewed in the consultation process

The stakeholders were asked their opinions on:

- The health care needs of older community dwelling Australians that could be addressed through skill-mix changes in the primary care workforce.
- The health care needs specific to older Australians from remote, rural, outer metropolitan and urban areas or those from indigenous or culturally and linguistically diverse (CALD) backgrounds as appropriate depending on stakeholder's background or expertise.
- What skill mix changes they were aware of and what further changes they saw as being needed.

The interviews lasted about 30 minutes and were recorded and extensive field notes taken. The field notes were used, and a thematic analysis was undertaken.

RESULTS OF STAKEHOLDER CONSULTATION

Skill mix in the primary care workforce is being driven by necessity, particularly in rural and remote areas where suitably qualified health professionals are in short supply. Some of the main skill mix issues in primary care suggested by the stakeholders as important were:

- Enhancing the role of Home and Community Care (HACC) workers to take on more basic nursing roles with training and supervision.
- Training "assistants" to work under the supervision of health workers such as allied health assistants.
- Ensuring that practice nurses and nurse practitioners have the necessary training and support to take on enhanced roles.
- Enhancing the role of Aboriginal Health Workers in aged care and ensuring minimum competency standards.
- Supporting GPs to delegate tasks to other suitably qualified health professionals

There were some issues specific to older people from CALD backgrounds. Many of the workforce shortages in the wider Australian community are exacerbated in these populations because there is a need for health professionals with language skills. There is an expectation in some CALD communities that care should be provided solely by family members and to accept outside help means that the family are not doing their duty. Some CALD HACC workers and health professionals find themselves under pressure to work beyond their scope of practice out of loyalty to their community.

Training and support were identified as important to support skill mix changes. Many of the stakeholders were concerned that the rapid pace of skill mix changes meant that the education and training of health professionals might not keep pace. There were also concerns that local successful innovations were not being objectively evaluated and generalised to other communities because the structure and processes were not in place for this to occur.

REVIEW QUESTIONS

After the analysis of the stakeholder interviews, the following emerged as the key research questions for the review:

1. What is the impact of skill-mix changes of delegation, enhancement or substitution between doctors and other health professionals in the planning and delivery of continuous* care for community dwelling older people on patient outcomes, process of care, health care utilisation, quality of life (QoL), and satisfaction?
2. What is the impact of skill-mix changes of delegation, enhancement or substitution between registered nurses, enrolled nurses and HACCs (Health and Community Care workers) in the planning and delivery of continuous* care for community dwelling older people on patient outcomes, process of care, health care utilisation, QoL, and satisfaction?
3. What is the impact of the role of new types of health worker or health workers not normally involved in the delivery of continuous care for community dwelling older people in rural and remote areas on patient outcomes, process of care, health care utilisation, QoL, and satisfaction?
4. What are the facilitators, barriers necessary for this to be effective? (Here we were keen to look at support networks, supervision, accountability and applicability to rural, remote, CALD etc)

*By "*continuous care*" we mean ***not*** one-off assessments or hospital out-reach services

METHODS FOR THE SYSTEMATIC REVIEW

SEARCH CRITERIA

Studies meeting the inclusion criteria for the review were identified by searching Medline, Embase, CINAHL, Cochrane Library (Issue 4, 2006), the Database of Abstracts of Reviews of Evidence (DARE) and the Joanna Briggs Institute (JBI) Library from 1990 to February 2007. Terms for skill mix developed by Bonnie Sibbald and colleagues [9, 10] were combined with terms for primary and community care and the EPOC quality filter was applied to include randomised controlled trials (RCTs), controlled clinical trials (CCTs), controlled before and after (CBA) and interrupted time series (ITS) studies (Appendix 1) for the detailed search strategy. Systematic reviews identified in the process were read and all included papers that met the criteria for this particular review were added to the list of papers. In addition to this there was a grey literature search of relevant government and health related websites (Appendix 2). The bibliographies of all experimental papers included in the review were searched to identify additional studies for inclusion.

INCLUSION CRITERIA

Studies were included in the review if they contained male or female adults aged 65 years and over and living in the community. Older people living in hostels or nursing homes were excluded. The interventions were defined as those that involved the planning and delivery of continuous care by primary health care professionals including doctors, nurses, pharmacists, allied health professionals, aboriginal health workers, Home and Community Care Services (HACCS) (nursing care, personal care or domestic help) or others (lay health workers or administrative staff such as receptionists). Papers were not restricted to countries comparable to Australia as long as they were relevant to the question and published in English during or after 1990.

Studies were included in the review if they were randomised or quasi-randomised controlled trials (RCTs), controlled clinical trials (CCT), before and after studies (BAs), or interrupted time series (ITS). The EPOC criteria were used to guide this process but papers were not excluded on the basis of quality because of the nature of many of the studies identified in this area but were summarised (EPOC Checklist 2002). Non-experimental papers such as literature reviews, discussion papers and editorials were identified for inclusion in the non-experimental extraction process.

Experimental studies were included if they objectively measured health service use, quality of care or patient outcomes in a clinical setting or self-report measures with known validity and reliability. Quality of care included process outcomes such as adherence to disease specific guidelines, disease specific measurements such as blood pressure, blood glucose, spirometry, weight, referrals and follow up. Patient outcomes included disease control, self-report measures with known validity and reliability such as well-being, quality of life and disability scores. Patients' health service use, patient satisfaction, provider satisfaction and economic measures were also included.

QUALITY ASSESSMENT FOR EXPERIMENTAL PAPERS

There were four processes undertaken to select the experimental studies for inclusion in this review.

SCREENING

One reviewer (SD) screened the titles and abstracts of all the articles identified from the database and grey literature search strategies. Where there was any doubt as to the relevance of the study it remained in the list. Because of the broad nature of the research questions it was important that the search strategy was sensitive but not too specific. This meant that a

large number of articles that were identified in the initial search were clearly irrelevant to this review and this initial screen simply removed these articles from the list.

Two reviewers (IH and DT) screened the abstracts of the remaining articles independently. Abstracts remained in the list if they did not contain sufficient information for a decision to exclude to be made. The results of the screening were recorded in Excel spreadsheets for comparison. Any disagreements were resolved by a third reviewer (SD).

VERIFICATION

Attempts were made to obtain full-texts of all the articles screened and included in the list for verification. The sources utilised included all online sources, library visits, inter-library loan requests, and purchasing on-line.

A study verification form (Appendix 3) was developed (RG and SD) from those used by JBI and EPOC. Two reviewers (IH and DT) independently verified the papers for relevance to the review questions. Again, the results of the verification process were recorded in Excel spreadsheets for comparison and any disagreements were resolved by a third reviewer (SD).

QUALITY ASSESSMENT

Two reviewers (IH and DT) assessed the quality of the experimental articles. Papers were not excluded on the basis of the quality score but an assessment of the quality of the study was provided.

DATA EXTRACTION

Data were extracted by two reviewers (DT and IH). A data extraction form (Appendix 4) was developed from those used by JBI and EPOC. A Microsoft Access database was developed for data entry. Data were entered directly into the Access database while articles were being read. The skill mix interventions were categorised into four main groups:

- Pharmacists substituting for GPs
- Nurses substituting for GPs
- Enhancement or delegation within the nursing continuum.
- Innovation

Within each of these groups the actual interventions delivered by the health professionals were categorised into three groups. Two reviewers (IH and SD) independently reviewed the intervention description and categorised the interventions as follows:

- Health promotion activities
- Disease management activities
- Both health promotion and disease management activities

SNOWBALLING

One reviewer (IH) screened the bibliographies of all the included papers and identified primary research articles and systematic reviews for inclusion. All the additional articles and reviews identified through the snowballing process underwent the screening, verification, quality assessment and data extraction process as detailed above.

DATA EXTRACTION FOR NON-EXPERIMENTAL DATA

The list of non-experimental papers remaining after verification were categorised according to country of origin / publication, health professional perspective and skill mix component of substitution, enhancement, delegation or innovation. All those papers published in an Australian journal or from an Australian institution were identified and random samples generated stratifying for health professional perspective and skill mix. Data were extracted sample by

sample until saturation of themes was reached. The following headings were used in the data extraction:

- Practice level – competency, acceptability to patients, supervision, payment systems and change management.
- Professional level – training, licensing, acceptability to health professionals, legal scope of practice, legal liability, turf wars and efficiency.
- Health system level – levels of pay, career development, workforce supply, change in service access or demand and health care teams.

A second sample of papers was identified from UK researchers or published in a UK journal. Data were extracted sample-by-sample using the same data extraction template until saturation of themes was reached. The purpose of this sample was to identify how the skill mix debate had moved on in the UK health system and whether there were lessons to be learnt that may be applicable to the Australian context.

CASE STUDIES

There were some innovative examples of skill mix changes that did not meet the inclusion criteria for the experimental papers. They addressed skill mix in the Australian context and arose directly from need within certain Australian populations. These were included as case studies.

DATA SYNTHESIS

We took a vote-counting approach to examine the effectiveness of the skill-mix changes reported in the studies. No studies were discarded on the basis of the disease focus and we took a comprehensive approach to recording outcome measures. As a result of this there was heterogeneity in the extracted data, which prevented us from doing a meta-analysis to explore the effect-sizes.

The outcome measures that we recorded were:

1. Health care professional adherence to guidelines.
2. Patient outcomes:
    - physiological measures of disease,
    - adherence to treatment,
    - health service use,
    - quality of life,
    - risk behaviour,
    - satisfaction,
    - health status, and
    - functional status.

We entered all the key outcome measures recorded in the studies under each of the categories listed above. For each of the categories, if one of the recorded outcome measures showed a statistically significant improvement (p value <0.05) that outcome measure was coded as a statistically significant improvement. For example, if a randomised controlled trial focussing on diabetes reported HbA1c, blood lipids and blood glucose as physiological measures of disease (PMOD) and there was a statistically significant improvement ($P<0.05$) for HbA1c then we recorded the PMOD outcome for that study to have produced a positive outcome irrespective of the results for blood lipids and glucose. The aim of the analysis was to examine how many studies reported at least one outcome measure in one particular category and how many studies reported positive outcome in that particular category. Tables were produced that summarised the effective outcomes by possible skill-mix changes.

All analyses were performed using SPSS 15.0 for Windows, SPSS Inc.

RESULTS

SELECTION OF PAPERS FOR INCLUSION

The initial database search identified 15,148 articles that were published between 1990 and February 2007. An initial screening by a single reviewer reduced this to 566. This number was further reduced to 201 when detailed screening was undertaken by two reviewers through abstract reading. Thirteen relevant systematic reviews were identified during this process and these were added to the list of 11 systematic reviews identified from the DARE and Cochrane databases. As none of the 24 (11+13) systematic reviews solely focussed on skill-mix changes and/or focussed on health care of community dwelling elderly it was decided that relevant primary research papers would be pulled out of the systematic reviews and added to the list of primary papers. This resulted in another 28 papers added to list of the primary research papers to be reviewed. We attempted to obtain full-text of (201+28) 229 research papers for verification but were only able to obtain 217.

122 papers passed the verification stage, which included 55 experimental and 67 descriptive papers. Snowballing of the 55 experimental papers resulted in another 11 papers (two descriptive and nine experimental) added to the review. We did not snowball descriptive papers for reasons explained in the methods. The 64 (55 +9) experimental papers were quality assessed before data extraction. Because of the low number of eligible experimental papers finally included in the review, no paper was discarded on the basis of their quality score.

We were able to extract data from 61 experimental papers. Data could be not be extracted from three papers as two were subsequently found not to be eligible for the review (one in hospital setting and the other was a collaborative approach and did not have any element of skill-mix in its intervention) and the other was inadequately reported. Figure 2 summarises the study selection process.

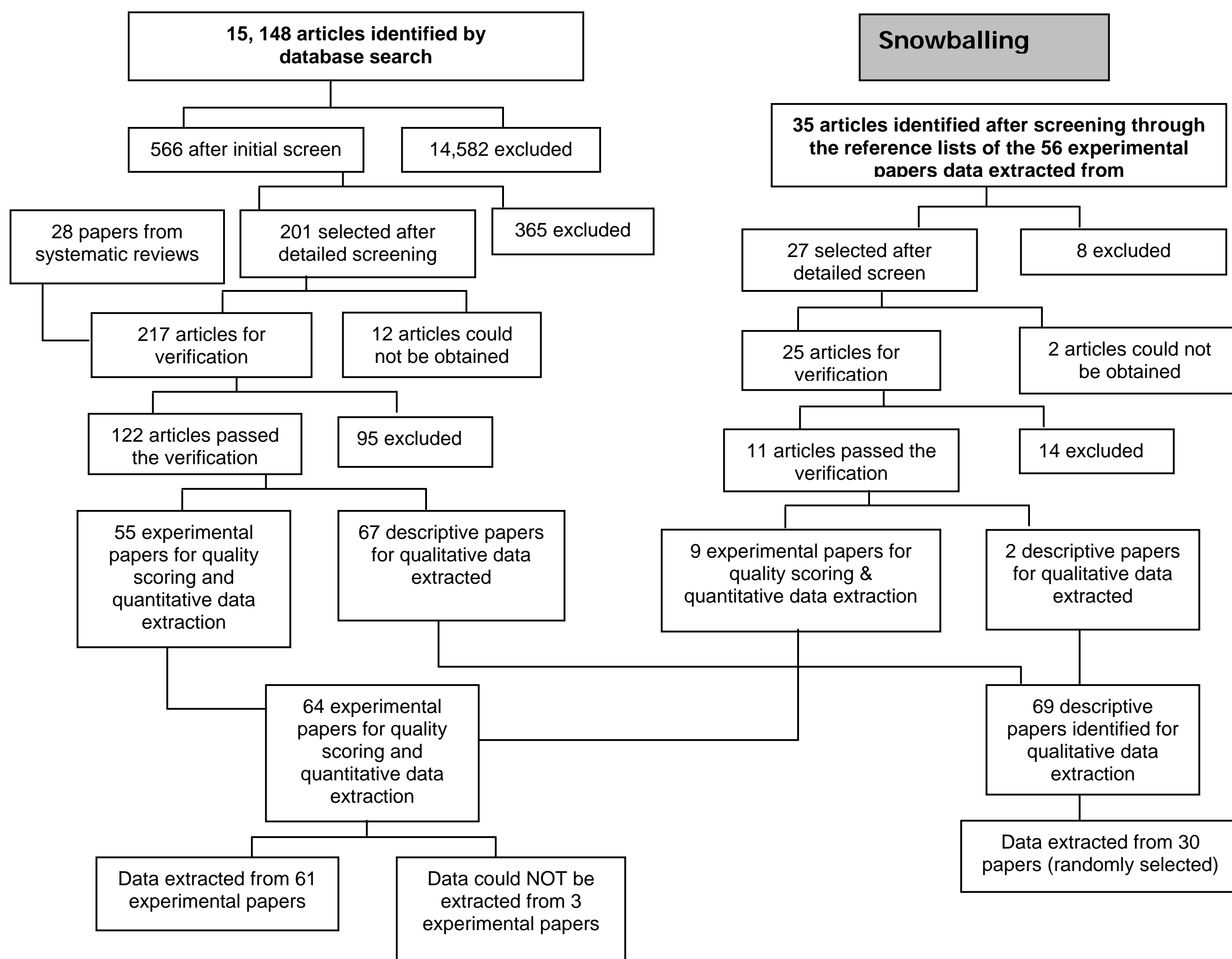

Figure 2: Selection process of the primary research papers

RESULTS FROM THE EXPERIMENTAL PAPERS

CHARACTERISTICS OF THE STUDIES

Of the 61 studies included in data extraction the majority (65.6%) were randomised controlled trials (RCT). The next most common study design was before and after (BA) (16.4%) followed by controlled before and after (CBA) (13.1%). There were three controlled clinical trials (CCT) included in the review. Over four-fifths (82.0%) were published in year 2000 and later and the remaining 12.0% were pre-2000.

Primary care was the location of care for the majority (68.9%) of the papers examined. This was followed by pharmacy (9.8%) and community (9.8%). Three interventions were located in either a managed care organisation or in a community-based organisation.

The majority (68.9%) of the interventions were conducted in an urban setting and another 14.8% in both urban and rural settings followed by 9.8% purely in a rural setting. There were two studies conducted in remote areas.

Over forty per cent (42.6%) of studies were conducted in the USA followed by 27.9% in the UK. There were six studies conducted in the Netherlands and four in Canada and another four in Australia.

Fifteen of the 61 interventions were targeted at patients with cardiovascular conditions, 14 focussed on diabetes and/or related conditions. Twelve studies were not aimed at any particular disease group. The other disease groups targeted included: multiple chronic conditions (7), musculo-skeletal conditions (4), mental conditions (3), and respiratory conditions (2).

Table 2. Study characteristics of the primary research papers

Study characteristics	Number	Percentage
Study design		
Randomised controlled trial	40	65.6
Before and after (no control)	10	16.4
Controlled before & after	8	13.1
Controlled clinical trial	3	4.9
Length of study (in months)		
Mean	15.9 (SD= 9.8)	
Range (min – max)	3 – 48	
Year published		
Pre-2000	11	18.0
2000 and later	50	82.0
Settings		
Primary Care	42	68.9
Pharmacy	6	9.8
Community	6	9.8
Community based care	3	4.9
Managed Care Organisation	3	4.9
Others	1	1.6
Intervention area		
Urban	42	68.9
Urban + rural	9	14.8
Rural	6	9.8
Remote	2	3.3
Not clear	2	3.3
Country		
USA	26	42.6
UK	17	27.9
Netherlands	6	9.8
Australia	4	6.6
Canada	4	6.6
Other	4	6.6
Disease		
Cardiovascular conditions	15	24.6
Diabetes & related conditions	14	23.0
Not mentioned	12	19.7
2 or more chronic conditions	7	11.5
Musculo-skeletal conditions	4	6.6
Mental conditions	3	4.9
Respiratory conditions	2	3.3
Others	4	6.6

A primary care physician was the key health care provider for control groups in the majority (80.3%) of the studies. In intervention groups, 34 (55.7%) studies had nurses as the key

health care provider followed by pharmacists in 25 (41.0%) studies. Physician assistant and AHWs were the key health care providers in one study each.

The roles played by the key health care providers in the 61 interventions included in this review were categorised into two broad categories – disease management (DM) role and health promotion role (HP). Both nurses and pharmacists predominantly performed disease management roles, though nurses were more likely to perform health promotion role only. There were some interventions where nurses and pharmacists performed both disease management and health promotion roles as shown in Table 3. Detailed descriptions of the effective interventions for disease management and health promotion are in Table 15.

Table 3. Health professionals in the intervention group and types of roles played by them

Health Professional	Disease management role only	Health promotion role only	Both DM and HP
Nurses	19	8	7
Pharmacist	14	3	8
Aboriginal HW	0	1	0
Physician assistant	0	0	1

The majority (75.4%) of the interventions assessed doctor substitution by other heath professionals. Nurse enhancement was used as the key element of intervention in 13 studies (Table 4). There was one study in the Netherlands examining the impact of involving physician assistants (innovation) in the health care of patients suffering from respiratory conditions (Table 4).

Table 4. Skill-mix addressed in the interventions

Skill-mix	No.	%
Dr substitution by pharmacist	25	41.0
Dr substitution by nurses	21	34.4
Nurse enhancement	13	21.3
Dr substitution by others eg. AHW	1	1.6
Innovation	1	1.6

Doctor substitution by pharmacists was the most commonly assessed skill-mix change across the majority of the disease groups, although more likely in diabetes and cardiovascular disease. The efficacy of doctor substitution by pharmacists was also examined in patients having multiple chronic conditions. Nurse substituting doctors was tested in diabetes and cardiovascular disease (Table 5). Nurse enhancement was more likely to be used in conditions such as cardiovascular and musculoskeletal conditions (Table 5).

Table 5. Types of skill-mix by disease

Disease	Dr substitution by nurses	Dr substitution by pharmacist	Dr substitution by others	Nurse enhancement	Innovation
Respiratory condition (2)	1	0	0	0	1
Diabetes & related (14)	5	7	1	1	0
Cardiovascular (15)	6	6	0	3	0
Musculo-skeletal (4)	1	1	0	2	0
Mental conditions (3)	1	2	0	0	0
2+ chronic conditions (7)	2	4	0	1	0
Others (4)	0	0	0	4	0
No disease mentioned (12)	5	5	0	2	0
All conditions (61)	21	25	1	13	1

The studies that examined doctor substitution by pharmacists dominated the interventions that were conducted in the USA. The UK studies were dominated by doctor substitution by nurses (Table 6), which was also true for the Netherlands. The impact of nurse enhancement was tested in the USA and the UK.

Table 6. Types of skill-mix by country

Disease	Dr substitution by nurses	Dr substitution by pharmacist	Dr substitution by others	Nurse enhanceme nt	Innovation
USA (26)	9	14	0	3	0
UK (17)	8	4	0	5	0
Netherlands (6)	3	1	0	1	1
Canada (4)	1	1	0	2	0
Australia (4)	0	2	1	1	0
Others (4)	0	3	0	1	0
All conditions (61)	21	25	1	13	1

Irrespective of whether nurses or pharmacists substituted doctors, both the groups predominantly performed a disease management (DM) role (Table 7). The role of nurse enhancement was more likely to include a disease management role. Comparatively, nurses were more likely to perform health promotion (HP) role and pharmacist were more likely to perform a combined DM and HP roles.

Table 7. Types of skill-mix by roles performed by intervention health care providers

Disease	Dr substitution by nurses	Dr substitution by pharmacist	Dr substitution by others	Nurse enhancement	Innovation
Disease management (DM) role only (33)	11	14	0	8	0
Health promotion (HP) role only (12)	5	3	0	3	1
Both DM and HP (16)	5	8	1	2	0
All conditions (61)	21	25	1	13	1

QUALITY SCORES OF THE INCLUDED PAPERS

The included papers were quality assessed independently by two reviewers (DT and IH). An inter-rater reliability test was performed to test the agreement rate between the two scorers. A one-way ANOVA was used to calculate mean squares of the scores and then a Spearman-Brown equation was used to estimate the inter-rater reliability. The agreement rate was 0.9.

The quality scale included eight criteria. For each of the criterion the possible scores were between 0 and 2. Overall, the mean score of all the included papers was 9.9. The studies that involved nurses scored higher than the studies that had pharmacist as the key intervention providers (Table 8).

Table 8. Quality scores of the papers included in the review

Skill-mix	Mean (SD)	Median	Mode	Range
Overall (n=61)	9.9 (2.0)	10.0	11.5	10.0 (5.0 – 15.0)
Nurse substituting doctors (n= 21)	10.2 (1.9)	10.0	8.5	9.5 (5.5 – 15.0)
Pharmacist substituting doctors (n= 25)	9.6 (2.1)	10.0	10.0	7.5 (5.0 -- 12.5)
Nurse enhancement (n=13)	10.3 (1.6)	11.0	11.0	5.5 (6.5 – 12.0
Dr substitution by other eg. AHW (n=1)	6.5*	--	--	--
Innovation (n=1)	11.5*	--	--	--

* only one paper

CHARACTERISTICS OF EFFECTIVE INTERVENTIONS

Results showed that the programs that used doctor substitution by pharmacist were more likely to produce positive outcomes for the intervention groups (Table 9). Pharmacist substituting doctors not only improved health professionals' adherence to the disease management guidelines, but also had positive impact on the number of patient related outcomes measures, which included physiological disease measures, adherence to treatment, patients' health status and patient satisfaction.

In interventions where nurses substituted doctors, patients' physiological disease measures improved and so did health care professional's adherence to disease management guidelines. The evidence suggests that nurse enhancement improved patient adherence to treatment, patient quality of life and functional status.

Table 9. Skill-mix changes and outcome measures

Skill-mix	Outcome Measures							
	Professional adherence to guideline	Patient adherence to treatment	Patient service use	Patient physio-logical measure of disease	Patient quality of life	Patient health status	Patient Satisfaction	Patient functional status
Dr substitution by nurses	8 (10)	0 (1)	2 (12)	6 (9)	3 (8)	2 (8)	3 (8)	0 (2)
Dr substitution by pharmacist	6 (6)	8 (11)	2 (11)	13 (14)	3 (9)	4 (5)	5 (6)	--
Nurse enhancement	1 (2)	3 (4)	3 (7)	2 (4)	2 (3)	3 (6)	--	4 (5)
Innovation eg. physician assistant	--	--	--	0 (1)	0 (1)	1 (1)	--	--

Note1: None of the 61 studies had "nurse delegation" as a component in their intervention.

Note2: Number in cells is the number of studies showing at least one positive outcome for that particular outcome measure.

Note3: Number in bracket is the number of studies reporting at least one outcome measure in that particular category.

THE IMPACT OF SKILL-MIX ON PATIENT SERVICE USE

As shown in Table 9, there were thirty studies that reported at least one outcome measure categorised under patient service use. Irrespective of which skill-mix was used in the interventions, the analysis showed very little impact of skill-mix on patient service use. The outcome measures that were categorised under patient service use included hospital admission, referral, tests, consultation number and time. Table 10 shows the impact of skill-mix on each of these outcome measures.

Table 10. Impact of skill-mix on patient service use

Skill-mix	Patient Service Use				
	Less hospital admission	Less referral to health service/ specialists	Less number of tests	Less number of consultation	Less consultation time
Dr substitution by nurses	1 (7)	0 (8)	--	1 (8)	1 (5)
Dr substitution by pharmacist	1 (7)	1 (4)	0 (1)	1 (7)	0 (4)
Nurse enhancement	1 (5)	1 (4)	--	1 (3)	1 (2)

Note1: None of the 61 studies had "nurse delegation" as a component in their intervention.

Note2: Number in cells is the number of studies showing at least one positive outcome for that particular outcome measure.

Note3: Number in bracket is the number of studies reporting at least one outcome measure in that particular category

EFFECT BY DISEASE

The evidence showed that doctor substitution by nurses produced better outcomes when it involved patients with diabetes (and related conditions) and cardiovascular disease and also in patients with multiple chronic conditions (Table 10). Similar evidence was found for interventions that involved pharmacist substituting doctors. In diabetes, both nurses and pharmacists were able to improve professionals' adherence to disease management guidelines

as well as patients physiological measures. In cardiovascular disease nurses only improved patients' quality of life, whereas, pharmacist in addition improved patients' adherence to treatment, physiological disease measures, and patients' health status (Table 11). In patients having multiple chronic conditions, nurses and pharmacist substituting doctors improved physiological measures of disease (Table 11).

Nurse enhancement was found to have a positive impact when it involved an intervention to target patients with cardiovascular disease (Table 11). The outcomes measures that nurse enhancement positively impacted were patients' adherence to treatment and patients' service use.

Table 11. Skill-mix changes and outcome measures by disease

Skill-mix changes	Outcome Measures							
	Professional adherence to guideline	Patient adherence to treatment	Patient service use	Patient physio-logical measure of disease	Patient quality of life	Patient health status	Patient Satisfaction	Patient functional status
Dr substitution by nurse								
Overall	**8 (10)**	**0 (1)**	**2 (12)**	**6 (9)**	**3 (8)**	**2 (8)**	**3 (8)**	**0 (2)**
Respiratory			0 (1)		0 (1)		0 (1)	
Diabetes & related	5 (5)		0 (1)	3 (5)	0 (2)	1 (2)	0 (2)	0 (1)
Cardiovascular		0 (1)	1 (3)	1 (2)	3 (4)	1 (4)	0 (1)	0 (1)
Musculoskeletal					0 (1)			
Mental condition			0 (1)			0 (1)		
2+ chronic condition	0 (2)		0 (1)	2 (2)				
Others								
Not mentioned	3 (4)		1 (5)			0 (1)	3 (4)	
Dr substitution by pharmacist								
Overall	**6 (6)**	**8 (11)**	**2 (11)**	**13 (14)**	**3 (9)**	**4 (5)**	**5 (6)**	
Respiratory					1 (2)		1 (2)	
Diabetes & related	3 (3)	1 (1)	0 (1)	6 (6)				
Cardiovascular		2 (2)	0 (2)	4 (5)	2 (3)	2 (2)	1 (1)	
Musculoskeletal						1 (1)		
Mental condition	1 (1)	1 (1)	1 (1)			1 (2)	1 (1)	
2+ chronic condition	1 (1)	0 (2)	1 (2)	3 (3)	0 (2)		1 (1)	
Others								
Not mentioned	1 (1)	4 (5)	0 (5)		0 (2)		1 (1)	
Nurse enhancement								
Overall	**1 (2)**	**3 (4)**	**3 (7)**	**2 (4)**	**2 (3)**	**3 (6)**		**4 (5)**
Respiratory								
Diabetes & related		0 (1)	0 (1)	1 (1)		1 (1)		
Cardiovascular		2 (2)	2 (2)	1 (3)	1 (1)	1 (1)		1 (1)
Musculoskeletal	1 (1)		0 (1)			0 (1)		1 (1)
Mental condition								
2+ chronic condition		1 (1)						
Others	0 (1)		0 (1)		1 (2)	1 (2)		0 (1)
Not mentioned			1 (2)			0 (1)		2 (2)

Note1: Number in cells is the number of studies showing at least one positive outcome for that particular outcome measure

Note2: Number in bracket is the number of studies reporting at least one outcome measure in that particular category

EFFECT BY ROLE CHANGE

Findings suggest that, irrespective of whether the interventions involved doctors substituted by nurses or pharmacists or nurse enhancement, as long as the intervention health professionals were performing some sort of disease management roles, those interventions were more likely to produce positive outcomes (Table 12).

When doctors were substituted by nurses with disease management roles the outcomes measures that were improved were professionals' adherence to guidelines and disease measures. Health promotion roles by nurses improved patient's quality of life. A combination of both roles improved professional adherence to guidelines, patients' disease measures and their health status (Table 12).

When doctors were substituted by pharmacists and pharmacists performed disease management roles the outcomes that were improved included professionals' adherence to guidelines, patients' adherence to treatment, disease measures and patient's satisfaction with health care. A combination of disease management and health promotion role by pharmacists had similar impact. A health promotion role by pharmacist was not found to be very effective (Table 12).

Nurse enhancement was found to be effective when the nurse played disease management roles. The outcomes that were improved with nurse enhancement included patients' adherence to treatment, patients' service use, disease measures, patients' quality of life and their functional status.

Table 12. Skill-mix changes and outcome measures by role change of health professionals

Skill-mix changes	**Outcome Measures**							
	Professional adherence to guideline	**Patient adherence to treatment**	**Patient service use**	**Patient physio-logical measure of disease**	**Patient quality of life**	**Patient health status**	**Patient Satisfaction**	**Patient functional status**
Dr substitution by nurse								
Overall	**8 (10)**	**0 (1)**	**2 (12)**	**6 (9)**	**3 (8)**	**2 (8)**	**3 (8)**	**0 (2)**
Disease management role (DM)	6 (8)	0 (1)	1 (8)	3 (4)	0 (4)	0 (3)	3 (6)	0 (1)
Health promotion role (HP)			0 (2)	1 (2)	2 (3)	0 (3)	0 (1)	0 (1)
Both (DM + HP)	2 (2)		1 (2)	2 (3)	1 (1)	2 (2)	0 (1)	
Dr substitution by pharmacist								
Overall	**6 (6)**	**8 (11)**	**2 (11)**	**13 (14)**	**3 (9)**	**4 (5)**	**5 (6)**	
Disease management role (DM)	5 (5)	5 (7)	2 (7)	8 (9)	2 (6)	1 (1)	4 (4)	
Health promotion role (HP)		1 (1)	0 (1)	1 (1)	1 (1)	1 (2)		
Both (DM + HP)	1 (1)	2 (3)	0 (3)	4 (4)	0 (2)	2 (2)	1 (2)	
Nurse enhancement								
Overall	**1 (2)**	**3 (4)**	**3 (7)**	**2 (4)**	**2 (3)**	**3 (6)**		**4 (5)**
Disease management role (DM)	1 (2)	2 (3)	3 (6)	2 (3)	2 (2)	1 (2)		3 (3)
Health promotion role (HP)			0 (1)	0 (1)	0 (1)	1 (3)		1 (1)
Both (DM + HP)		1 (1)				1 (1)		0 (1)

Note1: Number in cells is the number of studies showing at least one positive outcome for that particular outcome measure

Note2: Number in bracket is the number of studies reporting at least one outcome measure in that particular category

ECONOMIC OUTCOMES

Of the 61 studies included in this review only seven reported economic outcomes for their interventions. Skill-mix changes reported in these seven studies included doctor substitution by pharmacist (5), doctor substitution by nurse (1) and nurse enhancement (1).

In all five studies where pharmacists substituted doctors the key role performed by the pharmacist was medication review and compliance check and this did not produce a significant

positive economic outcome. In the two studies that reported significant positive economic outcomes the pharmacists involved played a more active role in patient management by patient monitoring and changing treatment regimen in consultation with doctors, in addition to medication and compliance review.

The other two studies that reported economic outcomes, both involved nurse practitioners performing patient consultations and none reported any reduction in health care costs as a result of the intervention.

RESULTS FROM THE NON-EXPERIMENTAL PAPERS

Summaries of the key themes emerging from the Australian and UK non-experimental literature are presented in Tables 13 and 14. There was a literature review from the UK on task allocation or delegation between nurses and doctors in primary care which highlighted many of the same themes as emerged from the non-experimental data [20]. The review was written from a nursing angle and their key findings were that skill mix should be thought of as task allocation rather than delegation and that sharing of tasks was more equitable. They highlighted the difficulties of inter professional team working.

Skill mix in UK primary care has occurred against the background of the General Medical Services (GMS) contract. The concerns that GPs have regarding the indemnity and safety issues have been addressed by clinical governance arrangements where the responsibility of quality of care for patients is the responsibility of all health professionals.

Practice level	Professional level	System level
Wider role Doctors argue that when they see a patient they are seeing the "whole" patient and that other professions don't do this. Nurses argue that there is more to nursing than simply performing a task and that nursing assistants might not do this. Doctors do not think that nurses should diagnose conditions as they see that as the role of the doctor. **Payment systems** The Medicare payment system hampers changes in skill mix. The fee for service model offers no incentive to restructure care. **Hierarchy / control** There is an assumption that doctors do not make mistakes and that other health professionals might. Many of the doctors concerns address the issues of safeguards, standardisation to minimise error, assessment of competency etc. This may be a symptom of the lack of indemnity arrangements for other health professionals and fear of being liable themselves. **Teamwork** Doctors are less keen to work in a team unless they are in charge of that team. Shared records may help to foster teamwork. **Patient expectations** There is an assumption that patients would not understand skill mix and changing roles of health care professionals	**Safety** Overarching theme is safety. Doctors are concerned about the safety of other health professionals providing care on their behalf. There needs to be adequate indemnity arrangements and checks of other professionals. **Minimum standards** Other health professionals must meet minimum standards to ensure quality of care. This could also be achieved by licensing roles such as Nurse Practitioner, AHW. **Training and ongoing accreditation** Other health professionals must undergo extensive training and preferably with on-going accreditation in order to ensure minimum standards are met. Lack of training opportunities for practice nurses. **Define scope of practice** In order to delegate tasks roles must be clearly defined, both doctors and nurses are reluctant to do this. Scope of practice is influenced by history not always defined by the evidence. **Control / power** Doctors see skill mix as a threat to their skills and knowledge. They see themselves as the primary care team leaders. They are opposed to change that threatens their role such as nurse prescribing. **Continuity of care** Skill mix changes threaten the doctor patient relationship and continuity of care **Understanding of other professions** Professionals are trained separately and then expected to work together in multidisciplinary team care but do not understand the full roles of the professionals in the team.	**Salaries** As team members become more skilled they will demand higher salaries. They may also be less flexible. **Sustainability** Any skill mix solution must be sustainable and not shift workforce shortages to another professional group. Doctors are concerned that if they delegate some simpler tasks they will have no "catch-up" time in their day if all their cases are complex and increase their risk of burn out. **Health care teams** If teams become too large (teams of specialists) then it becomes more difficult for the patients to negotiate their way through the maze. Large teams are more difficult for organisations to manage. Continuity of care will be affected. The professions rather than the skills they bring define teams. **Career structure** Parallel career ladders for different professionals but it is not clear how they relate to one another. Attractive career structure will improve uptake of training for nursing assistants and retention of staff. Nurses are highly trained, without challenges and complex roles more will leave. Career change means you go to the bottom of the ladder again. **Status** Aged care is seen as low status across many professions. Technical or skilled tasks are valued more highly than "caring" or domestic tasks. **Payment** Current Medicare system prevents skill mix changes.

Table 13. Summary of the main themes emerging from Australian non-experimental literature on skill mix

Practice level	Professional level	System level
Clarity of roles Lack of understanding of the roles of different health professionals hampers effective skill mix. If health professionals do not understand the role of other health professionals it makes it difficult to share tasks. Patients do not always understand the roles of different health professionals. Older people wanting home visits would continue to ask for the same GP. **Payment systems** In the UK the new GMS contract has facilitated the use of other health professionals. Practices receive payments for meeting quality standards in four areas: clinical, organisational, patient experience and additional services offered. The drawback is that practices concentrate on services that generate fees more easily rather than those most needed. In order to achieve this GPs have had to make good use of a range of other health professionals. **Efficiency** NPs are able to deal safely with minor illness and same day appointments. Evidence that the use of nurse practitioner did not always reduce the amount of time patients had to wait to see a GP. Some authors reported that NPs did reduce the workload of GPs such that the GP was able to increase the consultation time. Those patients who were seen by the NP were usually happy with the service and felt the nurse had explained things in detail. NP helped to take the pressure off female GPs by providing care to women. **Hierarchy / control** Within a practice there was disagreement over the role of the NP, even between the GPs. NPs reported feeling a lack of support from practice staff. NPs did not always have the same autonomy over their workload as GP colleagues **Supervision** There is evidence that assistants can provide effective nursing care but over time the opportunity for supervision may be reduced. Skills of health care assistants may not be transferable	**Career structure** Medicine and nursing have a hierarchical career structure. Skill mix changes such as NP substituting for GPs takes a nurse out of the nursing hierarchy but they do not fit into the GP hierarchy. Some NPs felt isolated and without a clear role definition. **Professional philosophy** The training of nurses and doctors is different and this has an impact in the way that they approach patients. PAs are trained in the medical model and if nurses took on this role they would not be using their nursing training so better to recruit from science graduates **Control / power** GPs are threatened by the NP. Nurses see skill mix changes as a way of health service managers saving money by employing less skilled nurses. Often resistance to NP role comes from nurses themselves. GPs are threatened by NPs. GPs are concerned that they are losing their monopoly as the gatekeeper of primary care services as nurses and pharmacists take on more roles. There are turf wars between different types of nurses as they are concerned about level of qualifications. GPs did not sign off on protocols for nurses. The health system is changing and the argument as to who does what is becoming increasingly irrelevant in the UK. **Licensing** There is a need for indemnity if nurses are to prescribe.	**Sustainability** The GMS contract supports the role of salaried GPs that may appeal to female GPs who want to work part-time. Solutions to workforce shortages in one profession do not always take shortages in other professionals into account. Support for NP to develop is needed, if they are not supported and if there are not career opportunities then they will leave. **Salaries** Health care assistants were reluctant to take on more roles and tasks if their salary was going to remain the same. NP did not always see their salaries increase. As health professionals become more specialised they will want higher salaries. **Payment structures** The payment structures in the UK have supported the use of a variety of health professionals to meet quality standards. **Health care teams** If multidisciplinary teams are to be effective all members of the team need to be able to influence the decisions of the team. Currently health care assistants do not feel empowered to be able to do this.

Table 14. Summary of the main themes emerging from UK non-experimental literature on skill mix

CASE STUDIES

ABORIGINAL HEALTH WORKERS

SKILL MIX

Current roles of Aboriginal Health Workers (AHW) include cultural brokerage, clinical functions, health promotion and community development [21] [22]. The evolution of the Australian AHW has been that of an indigenous person working in conjunction with a health team providing culturally appropriate primary health care. There has been some confusion about the many roles AHWs have been expected to perform and the legislative framework for these activities.

SETTING

Most AHWs work in Aboriginal Community Controlled Health Organisations or state health facilities [23].

TRAINING

A recent project from the Community Services and Health Industry Skills Council was undertaken to allow national recognition of various competencies and therefore some recognition of skills and potential portability of qualifications [24]. The Aboriginal Health Worker and Torres Strait Islander Health Worker qualifications were signed off by state/territory ministers for Education and Training in 2007. A separation of roles is proposed with Certificate IV qualifications in community care (community development and health promotion) and in Primary Health care (clinical) [24].

It is clear that the new competencies will also describe related vocational streams currently encompassed by the term aboriginal health workers such as liaison, patient transport, alcohol and substance misuse workers, social and emotional well being workers and men's, women's and sexual health workers

It is likely that the new qualifications framework will have an impact on how any moves toward registration or accreditation may be considered, especially in formally defining skills required for scope of practice and identifying career pathways between AHW and other roles.

LICENSING

Licensing of AHW roles currently only occurs in the Northern Territory (NT) and is associated with prescribing registration. With individual state responsibility for training and licensing the new clinical stream Certificate IV will be used as the basis for continuing licensure in the NT. Clinical supervision and line management usually occurs through the employing organisation and often by a senior health worker. For medication dispensing the scope of practice is defined by protocols and clinical practice guidelines. Drug therapy protocols are delivered under medical consultation.

PAYMENT SYSTEMS

Some limited capacity through Medicare in the last few years. In the Northern Territory where there is formal recognition of AHW s approval has been given to extend Medicare item numbers for wound care and immunization and antenatal care previously only given to practice nurses [25].

Liability for AHWs remains with the employer usually Aboriginal Community Controlled Health Organisations (ACCHO) or the State Health employer.

ACCEPTABILITY / PATIENT PREFERENCES

AHWs perform an important and influential role as cultural brokers and interpreters for the health system. In the NT they have legislative support and licensing for a clinical scope of

practice, which has been shown to have positive effects on health of indigenous people [26]. Extending the legislative framework and the opportunity to use and support EPC item numbers would be advantageous for many aboriginal communities in Australia.

EXPANDED PARAMEDIC HEALTH CARE ROLES

SKILL MIX

The Expanded Paramedic health care role change involves retaining and enhancing pre-existing emergency skills of remote paramedics and adding clinical skills to enable them to provide community health services and chronic disease management [27]. The paramedics receive additional training in examination, assessment and management of a range of conditions and administration of pharmaceutical and other therapies. They also develop their skills working with small communities to identify their needs in terms of prevention of disease and injury (population health skills) [28]. The new expanded role for paramedics will involve legislation changes to permit paramedics to deliver some drugs under medical supervision.

SETTING

This project had its genesis in the deep north of Queensland with an exploration of the appropriate roles for paramedics in some of the Cape communities. Often whilst they attended to the infrequent but important emergency stabilisation and management of patients they were aware of other community needs. Delivery of health care in remote areas is often based on perception of need driving existing or available health professionals to move beyond traditional scopes of practice and develop new skills and new linkages within traditional health systems.

A literature review of extended paramedic roles was undertaken by the Australian Centre for Pre-Hospital Research and the University of Queensland [27]. A survey was undertaken to identify possible scope of practice in February 2006 [29].

TRAINING

Existing paramedics complete a Graduate Certificate in Rural and Remote Paramedic Practice, which is part-time over a twelve-month period in an external multimodal form. It has been developed as a collaboration between Queensland Ambulance Service (QAS), Queensland Health and Mount Isa Centre for Rural and Remote Health (MICRRH). In order to integrate the clinical component of the paramedic practice into the broader context of the health system, they complete the modified Remote Isolated Practice for Enhanced Rural Nursing (RIPERN) curriculum. This has been standardized for Queensland nursing and utilizes the shared text "The Primary Health Care Manual" to coordinate protocols across all sectors of rural and remote health in Queensland.

LICENSING

Accountability and maintenance of competent practice are managed via QAS and will be regularly assessed and peer reviewed. Indemnity is also provided by QAS.

Legislative change is a key component of this skill mix innovation with alterations needed to the Drugs and Poisons regulations. This is underway and will be overseen by a committee comprising a range of medical, nursing and ambulance personnel who will monitor health management protocols and drug therapy protocols.

PAYMENT SYSTEMS

The Queensland Ambulance Service is state funded with no current capacity for practitioners to charge for service provision

ACCEPTABILITY / PATIENT PREFERENCES

There is ongoing cross boundary negotiations with other health service providers in the areas to avoid duplication and competition and the co-ordination to support the organisation of new referral networks. There is ongoing licensing and development of clinical quality improvement and audit frameworks. In addition to this there is a need to maximise access to new technologies for ongoing training, clinical supervision and support including improved access to telemedicine.

KEY FINDINGS

Table 15. Summary of the key findings from the primary research papers

Skill-mix change	Effective Interventions	Effective on (outcome measures)	Education and supervision	Facilitators	Barriers
Doctor substitution by nurses	Nurse case-management using guidelines, proactive follow-up and referral as necessary General patient consultation and support, care planning and goal setting. Patient triage and treatment of minor illnesses Patient self-management education	Professional adherence to guidelines Physiological measures of disease	Training of nurses by GPs and/or specialist on disease specific patient management Training of nurse by specialist allied health professionals i.e. diabetes educator, dietician etc. Nurse worked under the supervision of GPs and/or specialist	Nurse practitioners authority (restricted) to prescribe medications was already in place	GP or specialist supervision is required to implement intervention Nurse required additional training in patient management Nurse prescribing authority needs to be in place Nurse payment system needs to be in place
Doctor substitution by pharmacists	Medication review and maintenance (change of medication and/or dose adjustment or making recommendation to physician) as per published therapeutic algorithms and guidelines Proactive patient management, monitoring, goal-setting, follow-up and referral to primary care physician and to other health care professionals as appropriate Regular patient consultation and medication compliance check and medication counselling Pharmacist ensured medication compliance by keeping repeat prescriptions and dispensing when needed Proactive patient screening for disease risk factors and referral as necessary Face-to-face patient self-management education, motivation and distribution of education materials	Professional adherence to guidelines Patients adherence to treatment Physiological measures of disease Patient health status Patient satisfaction with heath care	Training of pharmacists in disease and medication management. Training of pharmacist in disease screening, health promotion, inter-personal skills and patients' behaviour changing technique Pharmacist requiring postgraduate degree and residency training before being granted prescribing privileges Pharmacist supervision by physician and/or specialist	Pharmacists authority (restricted) to prescribe medication and to order laboratory test were already in place Pre-established collaborative relationship between primary care physician and pharmacist for patient management facilitated the implementation of the intervention Pharmacists having the knowledge to interpret laboratory test results and the authority make dose adjustment facilitated the implementation of the intervention	Pharmacists required additional training in patient management Pharmacist prescribing authority need to be in place Pharmacist pathology test ordering authority need to be in place Pharmacist payment system need to be in place Pharmacists are costlier than nurse and often in short supply
Nurse enhancement	General patient consultation, patient home-visits and support, care planning and goal setting Patient self-management education	Patient adherence to treatment Patient quality of life Patient functional status	Training of nurse in disease management and health promotion activities Primary care physician supervised nurse activities	A collaborative arrangement was already in place and nurse worked under supervision of a physician and or specialist	Primary care physicians might be inclined to keep overall control of patient management and use nurses' role and supplement to their own health care
Innovation	Little published experimental evidence				

DISCUSSION

DEFINING SKILL MIX

The concept of skill-mix in health systems is complex. In its broadest term "skill-mix" refers to the mix of staff in the workforce [13]. According to Jarvis [30] skill mix is the use of one type of health professional to carry out roles or tasks traditionally performed by another health care professional. To Buchan and colleagues' [31] skill-mix should include mix of skills or competencies possessed by an individual; or the ratio of senior to junior grade staff within a single discipline; or mix of different types of professionals in a multi-disciplinary team.

Skill-mix changes may involve a variety of developments at different levels of the health care system. In Table 16 we have summarised how skill-mix changes can be obtained at various level of the healthcare system.

Table 16. How skill-mix changes can be obtained at various levels of health system

Skill-mix changes		
Organisation level	**Team-level**	**Individual level**
By mix of post, grades or occupations to meet the needs of the population being served By combination of skills and competencies for each job as demanded by local needs Substituting one type of workers for another and thus changing the ratio with the aim of improving efficiency	By combination of health professionals within a team setting (both in terms of types of professionals and ratio)	Enhancement of roles and skills of individual workers Task substitution across professionals divides Task delegation within same profession By creating new generation of health workers eg. physician assistants

In this review we explored skill-mix changes between individual health care workers. The reason for this focus was primary care for community dwelling elderly population where skill-mix changes at an individual level are more relevant than skill-mix changes in a team setting or within an organisation.

We used the concept proposed by Sibbald et al [32] that skill-mix changes between individuals could be obtained through task substitution, enhancement, delegation and innovation. Though Sibbald's concept provided a useful theoretical framework to examine the impact of skill-mix changes between individual health workers in primary care, the post-review consultations with the stakeholders revealed confusion among people about the skill-mix terms we had used, "substitution" in particular. It was important for us to understand this distinction. At the organisational level "substitution" means replacing one type of health professional by another, but at the individual level "substitution" usually refers to "task substitution", where a person from a one professional background performs a task traditionally performed by another type of health professional.

Another issue that affected the review process was the lack of experimental literature specifically addressing skill mix changes in the continuous care of older community dwelling people. This made it extremely difficult to draw conclusions as to the effectiveness of substitution, enhancement, delegation and innovation in primary care workforce in this context. The published literature tended to focus on skill-mix changes that were already established such

as doctor substitution by nurses and pharmacists and to some extent nurse enhancement. There was lack of evidence examining doctor substitution by other health professionals or the impact of the newer generation health workers such as the physician assistant in primary care in the care of older people living in the community.

EXPERIMENTAL STUDIES

IMPACT ON PATIENT LEVEL OUTCOMES

The evidence presented in this review supports the substitution of doctors by nurses and pharmacists in the role of disease management or health promotion for older people with a range of chronic conditions. There was evidence that physiological measures of disease improved, as did adherence to treatment and health professional adherence to guidelines. The evidence for improved patient outcomes was stronger for pharmacists than for nurses, with pharmacists improving a greater range of patient outcomes compared to nurses substitution of doctors. In disease management programs where pharmacists performed tasks traditionally undertaken by doctors, patients were more likely to comply with their treatment regimen and were more likely to have their disease measures controlled. They were also more likely to have improved health status and higher satisfaction with health care. In disease management programs where nurses substituted for doctors, there were improvements in patient's disease measures but not other patient related outcomes.

There were a few studies examining the impact of nurse enhancement on quality of care and patient outcomes and no studies looking at nurse delegating tasks to other health workers in the nursing spectrum involved in the care of older people living in the community. The impact of the nurse enhancement interventions was to increase motivation of the patients to adhere to their treatment and in addition quality of life and functional status were improved.

IMPACT ON HEALTH SERVICE USE

It was interesting to note that when other health professionals substituted for doctors in disease management or health promotion there was not a reduction in health service use for both nurses and pharmacists. This has been reported elsewhere [33, 34] when nurses undertake disease management roles. The reason for this could be that disease management using guidelines may result in the health professional identifying changes in the health of the patient that necessitate referral back to the doctor or other services. This would not necessarily appear as increased service use if the GP were managing the patient as they could make more changes to treatment before needing to refer. The lack of effect or even potential increase in health service use with skill mix interventions means that skill mix interventions may not always be associated with cost savings.

DISEASE MANAGEMENT OR A COMBINATION OF DISEASE MANAGEMENT AND HEALTH PROMOTION

The evidence presented in this review suggests that the interventions most likely to be successful when performed by another health professional on behalf of a GP are disease management either alone or in combination with health promotion. For nurses, the disease management roles that produced positive results included case-management using guidelines, general patient consultation and support, care planning and goal setting. For pharmacists the disease management roles that were effective included medication review and maintenance using a standard algorithm, proactive patient management, monitoring and goal setting; regular patient consultation, medication compliance check, counselling, and patient screening. For both nurses and pharmacist disease management roles in combination with health promotion activities such as patient self-management education and motivation were likely to produce positive outcomes.

A health promotion alone did not tend to result in positive outcomes. The reason for this could be the nature of the health promotion task health professionals are asked to perform on behalf

of the GP. For example, it is difficult to affect change patient behaviour with a patient education program aimed at changing the life-style of patients with cardiovascular conditions irrespective or whether a doctor, a nurse or any other health professionals provides the education.

MEDICAL CONDITIONS

Search terms for specific chronic disease were not included in the database searches in this review to include/exclude any particular disease group because the focus of the review was older people living in the community. The results revealed that diabetes (and related conditions) and cardiovascular disease were the commonly used conditions to test the effectiveness of skill-mix changes in community dwelling primary care settings. This could be because of the suitability of those conditions for protocol driven disease management and clear unambiguous outcomes measures.

There was little experimental evidence in this review to support the role of the physician assistant in the management of older people in the community. The main reason for this was because physician assistants had tended to be used in more acute situations and so we dropped during the search strategy.

NON-EXPERIMENTAL STUDIES

The themes emerging from the non-experimental literature suggest that there is considerable resistance to skill mix changes such as substitution of doctors by other health professionals as illustrated by a recent press release from the Australian Medical Association [35] yet the evidence suggests that this may not be the case [36]. Some of this opposition may be because of a misunderstanding of the term skill mix and in particular the term "substitution" and also loss of control. In the context of this review "substitution" meant the substitution of tasks usually performed by the GP by another health professional and not substitution of a whole person and their wider role. However, if skill mix changes are viewed in terms of role enhancement then many health professionals believe that their training equips them for extended roles [6].

Many of the barriers to skill mix change in Australia operate at the professional and health system levels. There is resistance from doctors who argue that there are safety concerns to delegating tasks to other health professionals and that to do so would affect continuity of care [37]. Nurses are reluctant to delegate tasks to nursing assistants because they argue that nursing is more than a collection of tasks to be delegated and pharmacists are concerned about the possibility of nurse practitioners prescribing on safety grounds. A further complication of the concept of task substitution is the role of supervision and who provides that supervision. Health professionals in hospital settings work in profession-specific hierarchical structures with supervision provided within the profession. These structures exist in parallel with other professional hierarchies in hospitals. In primary care these hierarchies do not exist to the same extent and the concept of interdisciplinary supervision is not straightforward [20]. The notion of a GP supervising a nurse performing nursing tasks is difficult, it may be more useful to think in terms of clinical governance and accountability and shared responsibility for tasks [38, 39].

Aged care is seen as low status and has experienced particular difficulty recruiting and maintaining health professionals such as nurses [40] in favour of more high-tech nursing [41] and this adds to workforce shortages.

WHAT LESSONS CAN AUSTRALIA LEARN FROM THE UK?

Exploring the non-experimental data from a health system such as the UK provided some insights into the issues around skill mix and the way in which the debate has progressed over time. There was reluctance amongst health professionals initially to consider skill mix innovations and there was resistance from doctors to the expanded role of nurses. Similar concerns about loss of control emerged. The event that changed things in the UK was the General Medical Services (GMS) contract and this facilitated the use of other health professional to provide services in primary care and to meet the targets set by the government. GPs quickly

saw the benefit of practice nurses providing some of the routine care and many have increased their earnings as a result of the Quality and Outcomes Framework [42, 43]. The current fee for service model of payment in Australia does not encourage this type of task transfer in general practice though on a smaller scale GPs have seen the advantage of practice nurses and nurses providing services on contract arrangements contributing to chronic disease care through assisting with health assessments of older people and care plans for those with complex chronic illnesses. .

Increasing skill mix and role enhancement in the UK has not been without its problems. Health professionals exist within an extremely hierarchical unidisciplinary career structure. Skill mix developments such as the role of the nurse practitioner takes nurses out of the traditional nursing career and supervision structure. They report being isolated as they exist somewhere between the nursing structure and the medical structure [44].

POLICY ISSUES AND OPTIONS

SCOPE OF PRACTICE

Health professionals have a limited understanding of the roles and scope of practice of other health professionals in the management of certain conditions. In order for skill mix changes to be effective the Productivity Commission report highlighted the importance of the need for health professionals to define their role [6]. Neither doctors nor nurses are keen to define their role to determine the potential for delegation or enhancement as both consider any contact with patients as important to further develop the doctor patient relationship and continuity of care, or as an opportunity to provide broader nursing care. The trials of allied health assistants in Western Australia highlighted what can be achieved in skill mix when health professionals defined their scope of practice and that of the assistants [45]. This was supported by a comprehensive training and supervision program and the allied health professionals were directly involved in providing this for the assistants [46]. Duckett suggested that a regulatory framework for delegation may help guide health professionals and address their concerns [47].

The role of some health professionals in providing care for older people with complex needs in the community may be dependent on referral from another. For example, pharmacists are able to undertake home medicines reviews, which may highlight medication issues for older people with polypharmacy, but they require doctor referral [48].

HEALTH PROFESSIONAL TRAINING

Some of the lack of awareness about the roles of other health professionals arises during training as health professionals are educated separately and then expected to work together in a team upon graduation [49]. Interprofessional education is being offered at a number of universities such as the University of Queensland and involves students from medicine, physiotherapy, pharmacy, nursing, dietetics, speech pathology and occupational therapy. Pre and post testing indicated that students had a greater understanding of the role of other professionals and improved attitude to multidisciplinary care [50]. It is too early to tell whether this approach to undergraduate teaching will have an impact on perception of professional boundaries in the workplace. Other models of interprofessional education in Australia have included the training of the expanded role of paramedics in north Queensland. The approach there has been to utilise some of the course units from the Rural Isolated Practice Endorsed Registered Nurse (RIPERN) course rather than develop new stand-alone course units for topics such as chronic disease management particularly as they may be working along side each other in many of the rural and remote areas [29].

Not all health professionals in Australia have national standards for training and this makes movement of the workforce into areas of need more problematic on graduation. A national approach to training in Australia is available for undergraduate pharmacy but other disciplines, such as nursing, tends to vary state by state.

LICENSING AND PROFESSIONAL REGULATION

The complexity of the Australian health care system adds to the difficulty of the role of skill mix in the workforce. There are difference in the licensing, professional regulations and scope of practice for health professionals between states. For example, Aboriginal Health workers in the Northern Territory have access to Medicare benefits, which they do not have in other states such as NSW. In Queensland enrolled nurses can undertake additional training to become an advanced practice enrolled nurse [51]. However some professional groups such as community pharmacists and GPs have a national approach to regulation through the Pharmacy Guild and the Royal Australian College of General Practitioners (RACGP).

Some of these differences in registration and licensing are currently being addressed by the National Health Workforce Strategic Framework [52], which held its first forum in May 2007 The aim is to develop a national approach to work force issues such as registration and qualifications. The Community Services and Health Industry Skills Council have developed a national training and qualifications skills framework to assist with the consistency of VET sector training of health professionals [53]. This system would ensure that health workers such as Aboriginal Health Workers do not work unsupervised without a minimum of level IV qualifications [24].

PAYMENT SYSTEMS

Reimbursement for health care in Australia favours a medical model of care particularly in urban and metropolitan areas. In rural and remote areas there may be access to other funding streams outside Medicare to enable other health professionals to provide care. Also health services have been forced to explore ways of using health professionals other than doctors using MBS income from doctors to subsidise this. However, despite some innovation in the Enhanced Care Program, in urban general practice most fee for service payments are linked to provision of care by a single provider rather than team care.

In addition, there is also an expectation from health professionals that pay should increase with increased training. This was seen particularly in the health assistants role as they were reluctant to take on more nursing roles if they were not going to see an increase in their salaries [54]. This may be more pronounced in an area such as institutional aged care, which traditionally has been seen to have low status and offers less opportunity for specialisation and advancement.

Improvements in the quality of care for variety of conditions have occurred through the Quality and Outcomes Framework in the UK [42, 43]. Here the quality of care has been shown to improve in terms of targets met and this is linked to payments to the practice but has been achieved by fully utilising a variety of health professionals in the practice and practice nurses in particular.

RURAL AND REMOTE AUSTRALIA

Communities in rural and remote Australia have tended to lead the way in developing innovative approaches to delivering health care, which includes skill mix such as allied health assistance in Western Australia [45] [46] and the expanded role of paramedics in North Queensland [29]. The most potent driver of this innovation has been need as many of these communities experienced shortages of health professionals and have been forced to take a more flexible approach to the delivery of health services. Skill mix innovations occur differently in that complex multi-disciplinary teams of highly specialised health professionals may not be appropriate and models tend to favour the development of broader skills.

The success of some of these innovative approaches to health care delivery / provisions in rural and remote areas may be because of the lack of rivalry and higher levels of personal knowledge and trust between health professionals. One of the barriers to skill mix identified in the Productivity Commission report was a lack of understanding of the role of other health professionals and a need to define the role. Because there are no other health professionals providing these services then there are fewer problems with overlapping roles or need for other professions to fully understand their roles. Skill mix innovations are not without their problems

in rural and remote areas. As they have developed out of need this may mean that there is not always sufficient supervision and support for health professionals in the field. This has implications for quality and safety if health professionals are functioning at the limits of their competence and confidence.

POLICY OPTIONS

A change in traditional health professional roles is often threatening and difficult to manage. Any change in role requires a high level of trust and collaboration between the health professional groups involved. The logic behind the policy options described here is that in order for changes in role to occur it is important to facilitate dialogue to build and support that process of trust between health professionals.

1. To develop a process for identifying and evaluating the significance of skill mix innovation. Currently innovation is driven by need and often occurs in rural and remote areas but may not be rigorously evaluated or successful changes generalised.
    - Explore how health professionals in other areas, particularly urban areas can learn from skill mix innovation in rural and remote Australia
        a. Funding for projects to evaluate skill mix in a variety of settings including rural, metropolitan, urban and CALD communities.
        b. Dialogue at the level of professional organisations to share information of successful and innovative approaches to skill mix for the care of older people.
2. To develop a process for the implementation of effective skill mix change.
    - Establish a Health Workforce Improvement Agency as recommended by the Productivity Commission.
    - Professional organisations representing doctors and nurses, particularly those in primary care, to discuss professional scope of practice and to identify opportunities for effective and supported task allocation in primary care for older people living in the community.
    - Focus on dialogue involving medicine and nursing as this is where the majority of barriers currently exist in Australia.
3. To streamline professional regulation, accreditation and training to ensure safety and quality of care for older people in the community.
    - A national system of registration within health professions. Removal of inconsistencies between States and Territories will facilitate the movement of health professionals nationally.
    - A national system of regulation of the scope of practice of health professionals. This would include national standards for health professional education and the standards recognised in the legal definitions of scope of practice in all States and Territories.
4. To ensure health professional education programs meet the national standards for accreditation. When other health professionals are performing tasks previously performed by medical practitioners, it is important that the health professional has received the necessary education or training and is well supported to ensure safety and quality of care.
    - Review the structures for dialogue between the health system and the health professional education system. This would support health professional education that is responsive to the workforce need.
    - Facilitate a greater understanding of the roles of health professional in the team by including interprofessional education at a range of levels such as undergraduate

education, vocational training and training provided by organisations such as Divisions of General Practice.

5. To modify the range of payment options that could be implemented to facilitate and support skill mix at a local level to provide ongoing care for a patient with chronic disease. Possible options might include:
   - Explore a payment to the primary care practice (general practice or Aboriginal Community Controlled Health Service) based on achieving benchmarks of quality of care for chronic disease. Payments would not be tied to a particular health professional providing the care to encourage greater local flexibility in task allocation.
   - Explore the expansion of the access to MBS payments for other health professionals to provide chronic disease care such as practice nurses or pharmacists receiving MBS payments for disease management roles.
   - Encourage patients with chronic disease to register with a particular GP for the ongoing management of their condition. This might include incentives for both the GP and the patient in the form of access to a wider range or increased number of items such as allied health visits.
   - Define and deliver roles and support team building at a local level with funding for the time needed to do this. This might include payments through PIP or Divisions to support the development of communication systems, negotiation around roles and team building at a local level.
6. To develop skills in change management in health professionals in primary care. Without an understanding of the process of change management and a readiness for innovation skill mix changes may not be adopted in practice.
   - Support the training of health professionals in change management.
7. Maximise the use of IT and e-health to ensure adequate clinical supervision particularly for clinicians in rural and remote areas and to enhance communication between team members.

SUMMARY

In Australia, workforce shortages are occurring in all health professions and in particular those working in primary care. There is a need for workforce innovation to meet the increasing demands of caring for an older population and the increasing prevalence of chronic disease and this has necessitated new thinking about workforce including the distribution of roles and responsibilities.

The key findings from this review indicate that interventions that addressed task substitution or allocation between doctors and nurses or doctors and pharmacists for the care of community dwelling older people in primary care were associated with improved patient and process outcomes. The enhancement of the role of nurses was also associated with improvements in patient outcomes. However the results suggest that skill mix interventions for the care of older people in the community may not reduce health service use.

The review does not provide a clear solution to some of the barriers or concerns about task substitution although teamwork is a pre-requisite for changing the skill mix in general practice. The policy options presented are multifaceted and operate across a range of levels, including scope of practice, licensing, regulation and accreditation, training, payment systems, health professional and patient acceptance of roles and change management none of which can operate in isolation.

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APPENDICES

APPENDIX 1: SEARCH STRATEGY FOR BLACK LITERATURE

Medline	Embase	CINAHL
Set 1 Health professionals		
1.exp Nurse Practitioners/ 2. exp Community Health Nursing/ 3. exp Nurse Clinicians/, 4. exp Nurses' Aides/ 5. exp Allied Health Personnel/ 6. exp Community Health Aides/ 7. exp Nurse's Role/ 8. nurs$.tw. 9. district nurs$.tw. 10. community nurs$.tw. 11. health care assistant$.tw. 12. exp Home Care Services/ 13. exp Home Nursing/ 14. nurs$ assistant$.tw. 15. personal care aide$.tw. 16. enrolled nurse$.tw. 17. neighbourhood nurs$.tw. 18. ambulatory nurs$.tw. 19. exp Physicians, Family/ 20. exp Pharmacists/ 21. exp Nurse Practitioners/ 22. exp Nurse Clinicians/ 23. exp Allied Health Personnel/ or exp Allied Health Occupations/ 24. exp Rural Health Services/ or exp Health Services, Indigenous/ 25. practice nurse$.tw. 26. nurse practitioner$.tw. 27. aboriginal health worker.tw. 28. indigenous health worker.tw. 29. general practitioner$.tw. 30. (gp or gps).tw. 31. exp Community Pharmacy Services/ 32. pharmacist$.tw. 33. allied health professional$.tw. 34. 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 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	1. exp General Practitioner/ 2. exp PHARMACIST/ 3. exp case manager/ or exp clinical nurse specialist/ or nurse practitioner/ or exp family nurse practitioner/ or exp gerontologic nurse practitioner/ 4. exp rural health nursing/ or exp community health nursing/ 5. exp Rural Health Care/ 6. practice nurse$.tw. 7. nurse practitioner$.tw. 8. aboriginal health worker$.tw. 9. indigenous health worker$.tw. 10. general practitioner$.tw. 11. (gp or gps).tw. 12. pharmacist$.tw. 13. district nurse$.tw. 14. allied health professional$.tw. 15. exp case manager/ or exp expert nurse/ or exp registered nurse/ or exp staff nurse/ or exp advanced practice nurse/ or exp nurse practitioner/ 16. exp NURSING ASSISTANT/ 17. exp "quality of nursing care"/ 18. exp ambulatory care nursing/ or exp community care/ or exp home care/ 19. district nurse$.tw. 20. practice nurse$.tw. 21. enrolled nurse$.tw. 22. health care assistant$.tw. 23. personal care assistant$.tw. 24. community nurse$.tw. 25. nurse$.tw. 26. personal care aide$.tw. 27. 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 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26	1. MH "Pharmacists" 2. MH "Physicians, Family" 3. MH "Nurse Practitioners" or MH "Adult Nurse Practitioners" or MH "Advanced Practice Nurses+" 4. MH "Clinical Nurse Specialists" 5. MH "Allied Health Personnel+" 6. MH "Rural Health Personnel" or MH "Rural Health Nursing" 7. TX practice nurse* 8. TX nurse practitioner* 9. TX aboriginal health worker* or TX indigenous health worker* 10. TX general practitioner* 11. TX general practitioner* or TX gp or TX gps 12. TX pharmacist* 13. TX district nurse* 14. TX allied health professional* 15. MH "Community Health Nursing+" or MH "Home Health Care+" 16. MH "Nursing Assistants" or MH "Team Nursing" 17. MH "Home Health Aides" 18. MH "Nursing Role" 19. TX nurse* or TX community nurse* or TX health care assistant* 20. TX nurse assistant* 21. TX personal care assistant* 22. 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 15 or 16 or 17 or 18 or 19 or 20 or 21
Set 2 APHCRI Stream 4 Primary Health Care Filter		
35. exp Primary Health Care/ 36. exp Comprehensive Health Care/	28. exp general practice/ or exp primary medical care/ 29. exp general practitioner/	23. MH "Family Practice" or MH "Physicians, Family" 24. MH "Primary Health Care"

37. exp Patient Care Management/ 38. exp Family Practice/ 39. exp Physicians, Family/ 40. exp Community Health Services/ 41. (primary adj1 (care or health)).tw. 42. (family adj1 (doct$ or medic$ or pract$ or physic$)).tw. 43. (general adj1 pract$).tw. 44. (gps or gp).tw. 45. 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44	30. (general adj2 practi$).tw. 31. (gps or gp).tw. 32. (family adj2 physician$).tw. 33. exp primary health care/ 34. (family adj2 doctor$).tw. 35. (family adj2 pract$).tw. 36. (primary adj2 care).tw. 37. primary health.tw. 38. family medicine.tw. 39. 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38	25. TX gp or gps 26. TX general W2 practice 27. TX family W2 physician* 28. TX primary W2 care 29. TX primary W2 pract* 30. TX primary health 31. TX family medicine 32. 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31
Set 3 Study Design		
46. exp Research Design/ 47. exp Follow-Up Studies/ 48. exp Single-Blind Method/ 49. exp Prospective Studies/ 50. exp Random Allocation/ 51. exp Randomized Controlled Trials/ 52. exp Clinical Trials/ 53. exp Evaluation Studies/ 54. exp Double-Blind Method/ 55. exp Controlled Clinical Trials/ 56. 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 57. comparative stud$.tw. 58. interupted time series.tw. 59. experimental studies.tw. 60. ((comparative studies and animal) not human).tw. 61. (comparative studies and human).tw. 62. 60 not 59 63. (pretest or pre test or (posttest or post test)).tw. 64. (time adj series$).tw. 65. experiment$.tw. 66. impact$.tw. 67. intervention$.tw. 68. chang$.tw. 69. evaluat$.tw. 70. effect$.tw. 71. 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 59 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70	40. Randomized Controlled Trial/ 41. (randomised or randomized).tw. 42. experiment$.tw. 43. (time adj series).tw. 44. (pre test or pretest or post test or posttest).tw. 45. impact.tw. 46. intervention$.tw. 47. chang$.tw. 48. evaluat$.tw. 49. effect?.tw. 50. compar$.tw. 51. exp pretest posttest control group design/ or methodology/ or exp control group/ or exp double blind procedure/ or exp experimental design/ or exp parallel design/ or exp single blind procedure/ 52. 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51	33. MH Clinical Trials 34. TX controlled W2 study or TX controlled W2 trial 35. TX randomised or TX randomized 36. TX random$ W1 allocat* or TX random$ W1 assign* 37. MH Pretest-Posttest Design 38. MH Quasi-Experimental Studies 39. MH Comparative Studies 40. TX time series 41. TX experiment* 42. TX impact 43. TX intervention* 44. TX evaluat* 45. TX effect* 46. 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45
Set 4 Sibbald Skill Mix Filter		
72. exp Clinical Competence/ 73. exp Cooperative Behavior/ 74. exp Job Description/ 75. exp Professional Autonomy/ 76. clinical practice.tw.	52. exp clinical competence/ or nursing competence/ or exp professional competence/ 53. exp cooperation/ or exp teamwork/	47. MH "Clinical Competence+" or MH "Professional Competence+" 48. MH "Cooperative Behavior" 49. MH "Work Redesign"

77. deleg$.tw. 78. multidisplin$.tw. 79. substitut$.tw. 80. cooperat$.tw. 81. role$.tw. 82. skill mix.tw. 83. health promotion.tw. 84. team$.tw. 85. patient counseling.tw. 86. 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 87. 34 and 45 and 71 and 86	54. clinical practice.tw. 55. deleg$.tw. 56. multidiscip$.tw. 57. substitut$.tw. 58. cooperat$.tw. 59. role$.tw. 60. skill mix.tw. 61. health promotion.tw. 62. team$.tw. 63. patient counseling.tw. 64. 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63	50. MH "Job Description" 51. MH "Professional Autonomy" 52. TX clinical practice 53. TX deleg* 54. TX substitut* 55. TX cooperat* 56. TX role* 57. TX skill mix 58. TX health promotion 59. TX team* 60. TX patient counselling 61. TX multidisciplin* 62. 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61
Limits		
88. limit 87 to (humans and english language and yr="1990 - 2007") 89. exp Child/ 90. exp Child, Preschool/ or exp Infant/ 91. exp Adolescent/ 92. 89 or 90 or 91 93. 88 not 92	65. 27 and 39 and 52 and 64 66. limit 67 to (human and english language and yr="1990 - 2007" and (adult <18 to 64 years> or aged <65+ years>))	63. 22 and 32 and 46 and 62 English langaue Year 1990 to 2007 Adults >18 years old

APPENDIX 2: SEARCH STRATEGY FOR GREY LITERATURE

AIHW http://www.aihw.gov.au/	National Primary and Community Health Network (website under construction, use: http://www.latrobe.edu.au/aipc/cdih/pchnetwork/05abstracts/
Arthritis Australia (AA) http://www.arthritisaustralia.com.au/	National Rural Health Alliance (NRHA) http://www.ruralhealth.org.au/nrhapublic/
Australian College of Rural and Remote Medicine (ACRRM) http://www.acrrm.org.au/	National Stroke Foundation (NSF) http://www.strokefoundation.com.au/
Australian Divisions of General Practice (ADGP) http://www.adgp.com.au/site/index.cfm?display=8	Northern Territory http://www.nt.gov.au/health/cdc/preventable/index.shtml
Australian Drug Foundation (ADF) http://www.adf.org.au/	NSW http://www.health.nsw.gov.au/living/chron.html
Australian Health Ministers' Advisory Council (AHMAC) Rural Subcommittee http://www.ahmac.gov.au/site/home.asp	Office for Aboriginal and Torres Strait Islander Health OATSIH www.health.gov.au/oatsih/cont.htm
Australian Indigenous Healthinfonet http://www.healthinfonet.ecu.edu.au/frames.htm	Osteoporosis Australia (OA) http://www.osteoporosis.org.au/html/index.php
Australian Lung Foundation (ALF) http://www.lungnet.org.au/	Practice nurse association www.apna.asn.au
Australian Medical Association (AMA) http://www.ama.com.au/web.nsf?opendatabase	Productivity commission www.pc.gov.au
Australian Nursing Federation (ANF) http://www.anf.org.au/	Public Health Association of Australia (PHAA) http://www.phaa.net.au/
Community services and health industry skills council www.cshisc.com.au	Queensland http://www.health.qld.gov.au/publications/corporate/chronstrat2005/default.asp
Consumers' Health Forum (CHF) http://www.chf.org.au/index.asp	Royal Australian College of General Practitioners (RACGP) http://www.racgp.org.au/
Cooperative Research Centre for Aboriginal Health http://www.crcah.org.au/	Royal College of Nursing Australia www.rcna.org.au
Department of Health and Ageing (DoHA) http://www.health.gov.au/	Rural Doctors Association of Australia (RDAA) http://www.rdaa.com.au/
DEST-Commonwealth Dept of Education science and Training http://www.dest.gov.au/	South Australia http://www.dh.sa.gov.au/pehs/publications/public-health-bulletin.htm
Diabetes Australia (DA) http://www.diabetesaustralia.com.au/home/index.htm	State and Territory directors of primary health care
Ethnic communities council http://eccv.org.au/doc	State based primary health care research centres attached to universities
Heart Foundation (HF) http://www.heartfoundation.com.au/	Tasmania http://www.dhhs.tas.gov.au/
Kidney Health Australia (KHA) http://www.kidney.org.au/?section=2&subsection=163	Victoria http://www.health.vic.gov.au/harp-cdm/
National Aboriginal Community Controlled Health Organisation (NACCHO) http://www.naccho.org.au/	WA http://www.anf.org.au/
National Asthma Council Australia (NAC) http://www.nationalasthma.org.au/index.htm	www.phcris.com.au

APPENDIX 3: STUDY VERIFICATION FORM

Endnote Record Number ☐☐☐

Author and year ______________________________

Journal ______________________________

Title ______________________________

Name/code of reviewer ______________________________

INSTRUCTION: Please tick the appropriate box(es)

1. General

Published in English language Yes ☐ No ☐ ***Do not continue***

Published in 1990 or later Yes ☐ No ☐ ***Do not continue***

2. Types of Studies

Experimental Design

RCT ☐

CCT ☐

CBA ☐ (with or without control group)

ITS ☐

If experimental design complete ALL sections of this form.

Descriptive Study

Survey ☐

Editorial / discussion ☐

Policy paper ☐

Other ☐ please specify) ______________________________

If descriptive design complete sections 3, and 4 only.

3. Setting

Community setting ☐

Nursing home / hostel ☐ ***If "yes" do not continue***

Hospital setting ☐ ***If "yes" do not continue***

4. Types of skill mix

Doctor substitution Yes ☐ No ☐

Expanding the breadth of a job, in particular by working across professional divides or exchanging one type of worker for another, e.g. GP for pharmacist

Enhancement of role Yes ☐ No ☐

Increasing the depth of a job by extending the role or skills of a particular group of workers, e.g. enhancing the role of practice nurses

Delegation of role Yes ☐ No ☐

Moving a task up or down a traditional unidisciplinary ladder, e.g. an enrolled nurse taking on the tasks normally performed by a registered nurse

Innovation or new role Yes ☐ No ☐

Creating new jobs by introducing a new type of worker, e.g. physician assistant

5. Types of participants

Patients

Adult males and females aged 65 years and over living in the community receiving planned or continuous care in a primary or community care setting.

Sex	Male subjects	☐	Female subjects	☐	
Age	≥ 65 years	☐	≥ 45 years	☐	Include if also includes ≥ 65
Community dwelling		☐			
Hostel or nursing home dwelling		☐	If "yes", exclude		
Receiving one off assessments		☐	If "yes", exclude		
Receiving planned care		☐			
Receiving hospital outreach services		☐	If "yes", exclude		

Others (specify) ____________________

Health care professionals

The intervention to the patient must be delivered by non-hospital health professionals (including doctors, nurses, pharmacists, allied health professionals) or other non-hospital staff (lay health workers or administrative staff) in a primary or community care setting.

Doctors	☐	Pharmacists	☐
Nurse practitioner	☐	Practice nurse	☐
Community nurse	☐	Enrolled nurse	☐
Other nurse	☐	Home and Community Care Workers	☐
Allied health professionals	☐	Aboriginal Health Workers	☐
Administrative staff	☐	Lay health workers	☐
Physician assistant	☐		

Others (specify) ____________________

6. Types of outcome measures

Health professional performance	Yes ☐	No ☐
Patient outcomes (eg blood pressure)	Yes ☐	No ☐
Patient satisfaction	Yes ☐	No ☐
Health professional satisfaction	Yes ☐	No ☐
Quality of life	Yes ☐	No ☐
Health service use	Yes ☐	No ☐
Economic measures	Yes ☐	No ☐

Others (specify) ____________________

APPENDIX 4: QUALITY ASSESSMENT FORMS

For Randomised Controlled Trials & Controlled Clinical Trials

Endnote Record Number ☐☐☐

Author and year ____

Journal ____

Title ____

Name/code of reviewer ____

TOTAL SCORE ____________

Scoring: DONE=2; NOT CLEAR=1; NOT DONE=0

Concealment of allocation (protection against selection bias)

DONE ☐$_2$ NOT CLEAR ☐$_1$ NOT DONE ☐$_0$

DONE = Randomisation process is described explicitly, e.g. random number, coin flips, centralised randomisation scheme, an on-site computer system or sealed opaque envelopes.
NOT CLEAR = The unit of allocation is not described explicitly OR the unit of allocation was by patient or episode of care and the authors report using a 'list' or 'table', 'envelopes' or 'sealed envelopes' for allocation.
NOT DONE = Allocation using date of birth, date of admission, hospital numbers or alternation.

Adequate follow-up (protection against exclusion bias)

DONE ☐$_2$ NOT CLEAR ☐$_1$ NOT DONE ☐$_0$

DONE = Outcome measures obtained for 60-100% of subjects randomised.
NOT CLEAR = Not specified in the paper
NOT DONE = Outcome measures obtained for less than 60% of subjects randomised.

Blinded assessment of primary outcome(s) (protection against detection bias)

DONE ☐$_2$ NOT CLEAR ☐$_1$ NOT DONE ☐$_0$

DONE = Primary outcome(s) were assessed blindly OR the outcome variables are objective, e.g. length of hospital stay.
NOT CLEAR = Not specified in the paper
NOT DONE = The outcome(s) were not assessed blindly
Primary outcome(s) are those variables that correspond to the primary hypothesis or question as defined by the authors. In the event that some of the primary outcome variables were assessed in a blind fashion and others were not, score each separately and label each outcome variable clearly.

Baseline measurement

DONE ☐$_2$ NOT CLEAR ☐$_1$ NOT DONE ☐$_0$

DONE = Outcomes were measured prior to the intervention, and no substantial differences were present across study groups.
NOT CLEAR = Not reported, or if it is unclear whether baseline measures are substantially different across study groups.
NOT DONE = There are differences at baseline in main outcome measures likely to undermine the post intervention differences (e.g. are differences between the groups before the intervention similar to those found post intervention).

Reliable primary outcome measure(s)

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Two or more raters with at least 90% agreement or kappa ≥0.8 OR the outcome is obtained from some automated system e.g. length of hospital stay, drug levels as assessed by a standardised test.
NOT CLEAR = reliability is not reported for outcome measures that are obtained by chart extraction or collected by an individual.
NOT DONE = Agreement is less than 90% or kappa is less than 0.8.
In the event that some outcome variables were assessed in a reliable fashion and others were not, score each separately on the back of the form and label each outcome variable clearly.

Protection against contamination

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Allocation was by community, institution or practice and it is unlikely that the control received the intervention.
NOT CLEAR = Professionals were allocated within a clinic or practice and it is possible that communication between experimental and group professionals could have occurred.
NOT DONE = It is likely that the control group received the intervention (e.g. cross-over trials or if patients rather than professionals were randomised).

Methods of statistical analysis

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

The study should include a statement describing or giving references for all statistical procedures used.

For Before and After and Controlled Before and After Studies

Endnote Record Number ☐☐☐

Author and year ______________________________

Journal ______________________________

Title ______________________________

Name/code of reviewer ______________________________

TOTAL SCORE ____________

Scoring: DONE=2; NOT CLEAR=1; NOT DONE=0

Contemporaneous data collection?

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Pre and post intervention periods for study and control sites are the same.
NOT CLEAR = If it is not clear in the paper
NOT DONE = If data collection was not conducted contemporaneously during pre and post intervention periods for study and control sites

Baseline measurement

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Outcomes were measured prior to the intervention, and no substantial differences were present across study groups.
NOT CLEAR = Not reported, or if it is unclear whether baseline measures are substantially different across study groups.
NOT DONE = There are differences at baseline in main outcome measures likely to undermine the post intervention differences (e.g. differences between the groups before the intervention similar to those found post intervention).

Characteristics for studies using second site as control

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Characteristics of study and control providers are reported and similar.
NOT CLEAR = Not clear in the paper e.g. characteristics are mentioned in the text but no data are presented.
NOT DONE = There is no report of characteristics either in the text or a table OR if baseline characteristics are reported and there are differences between study and control providers.

Blinded assessment of primary outcome(s)* (protection against detection bias)

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Primary outcome(s) were assessed blindly OR the outcome variables are objective, e.g. length of hospital stay.
NOT CLEAR = Not specified in the paper.
NOT DONE = The outcome(s) were not assessed blindly.
Primary outcome(s) are those variables that correspond to the primary hypothesis or question as defined by the authors. In the event that some of the primary outcome variables were assessed in a blind fashion and others were not, score each separately and label each outcome variable clearly.

Protection against contamination (Studies using second site as control)

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Allocation was by community, institution or practice and it is unlikely that the control received the intervention.
NOT CLEAR = Professionals were allocated within a clinic or practice and it is possible that communication between experimental and group professionals could have occurred.
NOT DONE = It is likely that the control group received the intervention (e.g. cross-over trials or if patients rather than professionals were randomised).

Reliable primary outcome measure(s)

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Two or more raters with at least 90% agreement or kappa ≥0.8 OR the outcome is obtained from some automated system e.g. length of hospital stay, drug levels as assessed by a standardised test.
NOT CLEAR = reliability is not reported for outcome measures that are obtained by chart extraction or collected by an individual.
NOT DONE = Agreement is less than 90% or kappa is less than 0.8.
In the event that some outcome variables were assessed in a reliable fashion and others were not, score each separately on the back of the form and label each outcome variable clearly.

Adequate follow-up (protection against exclusion bias)

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

DONE = Outcome measures obtained for 80-100% of subjects randomised.
NOT CLEAR = Not specified in the paper
NOT DONE = Outcome measures obtained for less than 80% of subjects randomised.

Methods of statistical analysis

DONE ☐2 NOT CLEAR ☐1 NOT DONE ☐0

The study should include a statement describing or giving references for all statistical procedures used.

APPENDIX 5: BRIEF DESCRIPTION OF THE 61 EXPERIMENTAL PAPERS

[1] RCT Primary Care Urban, USA Duration: ? months	Control Group Diabetes N = 59 Intervention Group Diabetes N = 86	Skill Mix : Dr substitution by nurse Control intervention Usual care by physicians. Intervention Group intervention Nurse practitioners provided consultation for diabetes patients	Outcome measures Adherence to guidelines Documentation on education: Any teaching: Documentation on education: General diabetes education Documentation on education: Nutrition Documentation on education: Weight Documentation on education: Exercise Health service use Hospitalisation 6 months Specialist visits Quality of life Physical component Mental component Information received: Monitoring blood glucosee Information received: Diet and exercisee Information received: Complications of diabetese Information received: Side effects of medicatione Physiological measures of disease HbA1c Blurred vision Drowsiness Polyuria Nocturia
[2] BA Primary Care Urban, USA Duration: 24 months	Control Group Hypertension Ischaemic heart disease Diabetes N = 436 Same as Control	Skill Mix : Dr substitution by nurse Intervention Nurses undertook comprehensive CVD risk assessment, patient education, and counselling.	Outcome measures Physiological measures of disease SBP (mmHg) DBP (mmHg) LDL (mg/dL)
[3] CBA Primary Care Urban, Netherlands Duration: 36 months	Control Group Diabetes N = 400 Intervention Group Diabetes N = 1127	Skill Mix : Dr substitution by nurse Control intervention Usual care, no extra support for GPs. Intervention Group intervention Diabetes specialist nurse provided annual patient exam, education, and recommendations to GPs. Possibility of GPs sending patients to the nurses for on-demand consultation within primary care setting.	Outcome measures Adherence to guidelines Foot exam Eye exam HbA1c measurement BP measurement Total cholesterol Physiological measures of disease Percentage HbA1C<=7% Percentage BP<=150/85 mmHg Percentage total cholesterol <=5mmol/l
[4] RCT	Control Group Ischaemic heart	Skill Mix : Dr substitution by nurse Control intervention	Outcome measures Health service use

Primary Care Urban and rural, Scotland Duration: 12 months	disease N = 670 Intervention Group Ischaemic heart disease N = 673	Usual care by primary care physician Intervention Group intervention Review of patient's symptoms, treatment, BP, lipid, lifestyle factors and movivation for behavioural changes.	Hospitalisation rate Median length of stay in hospital (day) Median number of GP consultation in 3 months Quality of life SF_36 Role - Physical Health status Hospital anxiety score Depression score Chest pain reported Chest pain worsening reported Chest pain worsening reported
[5] RCT Primary Care Urban, USA Duration: 26 months	Control Group Asthma Diabetes Hypertension N = 510 Intervention Group Asthma Diabetes Hypertension N = 806	Skill Mix : Dr substitution by nurse Control intervention Usual care by primary care physician. Intervention Group intervention Nurse practitioners provided primary care follow up and ongoing care.	Outcome measures Health service use Hospitalisation Specialty visits, Primary care visits Quality of life SF_36 Role - Physical Provider attributes (mean) Overall satisfaction (mean)
[6] RCT Managed Care Organisation Urban, USA Duration: 12 months	Control Group Ischaemic heart disease Hypertension Rheumatoid arthritis N = 100 Intervention Group Ischaemic heart disease Hypertension Rheumatoid arthritis N = 101	Skill Mix : Dr substitution by nurse Control intervention Usual care by primary care physician and access to all activities available to intervention group. Intervention Group intervention Physical activity and chronic illness management counseling by geriatric nurse practitioner.	Outcome measures Health service use Hospitalisation (number)Total emergency visits Quality of life SF_36 Role - Physical Health status Depression-CES-D Health Assessment Questionnaire
[7] RCT Primary Care Urban, UK Duration: 3 months	Control Group N = 49 Intervention Group N = 47	Skill Mix : Dr substitution by nurse Control intervention Usual care by primary care physician Intervention Group intervention Case management for depressed elderly people by community psychiatric nurse.	Outcome measures Health service use Face-to-face visits to intervention nurse (mean) Hours of face-to-face contact over 3 months Health status Short-CARE score
[8] RCT Primary Care Urban and rural, Netherlands	Control Group N = ? Intervention Group N = ?	Skill Mix : Dr substitution by nurse Control intervention Usual care by primary care physician Intervention Group intervention Practices nurses undertook specific elements of	Outcome measures Health service use Number of contacts during surgery hours (mean) Number of contacts out of hours (mean) Quality of life

Duration: ? months		care including: diagnostic tests, patient assessment and education, preventive patient visits and coordinating the care of patients.	GP Subjective workload: Available time (mean score) GP Subjective workload: Job satisfaction (mean score) GP Subjective workload: Inappropriate demands (mean score) GP Subjective workload: Cost benefit (mean score)
[9] RCT Primary Care Urban, UK Duration: 48 months	Control Group N = 670 Intervention Group N = 673	Skill Mix : Dr substitution by nurse Control intervention Usual care by primary care physician Intervention Group intervention Health promotion on medical and lifestyle components, and regular follow up by nurses.	Outcome measures Physiological measures of disease Aspirin management BP management Lipid management Modearte exercise Low fat diet Health status Non-smoking
[10] RCT Primary Care Urban, UK Duration: 12 months	Control Group N = 7308 Intervention Group N = 7184	Skill Mix : Dr substitution by nurse Control intervention Usual care Intervention Group intervention Nurses provided telephone consultations after-hours.	Outcome measures Adherence to guidelines Calls managed with nurse telephone advice (median) Calls managed with GP telephone advice (median) Patient attended primary care centre (median) Patient visited at home by duty GP (median) Health service use Hospitalisation within 24 hours of call (number)Advised to attend emergency or referred for admision (number) Emergency attendance within 3 days of call (number)
[11] CBA Community based care Urban, USA Duration: 12 months	Control Group Heart failure Hypertension Diabetes N = 10 Intervention Group Heart failure Hypertension Diabetes N = 13	Skill Mix : Dr substitution by nurse Control intervention Usual care by cardiologist and cardiac fellows Intervention Group intervention Patient education, medication compliance, diet and nutrition counselling	Outcome measures Quality of life QoL Index-Cardiac Tool: Total Functional capacity
[12] RCT Primary Care Urban, England Duration: ?months	Control Group N = 716 Intervention Group N = 562	Skill Mix : Dr substitution by nurse Control intervention Patient consultations by primary care physician Intervention Group intervention Patient consultations by nurse practitioners	Outcome measures Adherence to guidelines Prescription issued Investigation ordered Referral to secondary care Follow up advised Reconsultated for same problem Health service use Median length of consultation (min) Quality of life Adult patient satisfaction (median) Children patient satisfaction (median)

			Physiological measures of disease
[13] RCT Primary Care Urban and rural, England Duration: ? months	Control Group N = 665 Intervention Group N = 651	Skill Mix : Dr substitution by nurse Control intervention Patient consultations by primary care physician Intervention Group intervention Patient consultations by nurse practitioners	Outcome measures Adherence to guidelines Physical examination Prescription given Antibiotic prescribed Investigation ordered Patient acutally returned Health service use Hospital referral Mean number of return visits Mean total consultation time (min) Quality of life Adult patients: Medical interview satisfation (mean) Adult patients: Communication (mean) Adult patients: Distress relief (mean) Adult patients: Clinical behaviour (mean)
[14] CCT Primary Care Rural, USA Duration: 12 months	Control Group Diabetes N = 252 Intervention Group Diabetes N = 252	Skill Mix : Dr substitution by nurse Control intervention Usual care provided by primary care physician. Intervention Group intervention Trained nurse providing diabetes care following detailed protocols and algorithms under the supervision of a diabetologist.	Outcome measures Adherence to guidelines Timely HbA1c measurement (% pt) Timely lipid profile (% pt) Timely eye exam (% pt) Timely diabetes education (% pt) Timely nutritional counselling (% pt) Physiological measures of disease HbA1c
[15] RCT Primary Care Urban, UK Duration: 6 months	Control Group Diabetes Hypertension N = 60 Intervention Group Diabetes Hypertension N = 60	Skill Mix : Dr substitution by nurse Control intervention Usual care Intervention Group intervention PN follwed BP management guidelines -- BP measured every month, drug compliance reviewed, pt education re: need for BP control and lifestyle changes for BP control. Also initiated drug changes if necessary thru attending physician.	Outcome measures Physiological measures of disease Systolic BP (mean) Diastolic BP (mean) Total cholesterol (mean) HDL (mean) HbA1c
[16] CBA Primary Care Urban, Netherlands Duration: 12 months	Control Group Diabetes N = 47 Intervention Group Diabetes N = 52	Skill Mix : Dr substitution by nurse Control intervention Usual care by internist and specialist nurse in the hospital Intervention Group intervention Quarterly consultation by diabetes specialist nurse in general practice and annualy check up by hospital internist.	Outcome measures Adherence to guidelines Consultations with nurse specialist (mean) Consultation with GP (mean) Consultation with internist (mean) Consultation with nurse specialist+GP+internist (mean) Quality of life COOP/WONCA: Physical fitness Satisfaction about received diabetic care Physiological measures of disease

			HbA1c Total cholesterol (mmol/L) HDL-cholesterol (mmol/L) SBP (mmHg) DBP (mmHg) Health status Knowledge of diabetes
[17] RCT Primary Care Urban, Canada Duration: 12 months	Control Group N = 253 Intervention Group N = 250	Skill Mix : Dr substitution by nurse Control intervention Usual care Intervention Group intervention Nurse home-assessment of elderly people at risk of functional decline and reporting and recommending to pts' PCP for intervention.	Outcome measures Quality of life Functional Autonomy Measurement System Score
[18] RCT Primary Care Urban, USA Duration: 12 months	Control Group Diabetes Hypertension Lipid disorders N = 85 Intervention Group Diabetes Hypertension Lipid disorders N = 84	Skill Mix : Dr substitution by nurse Control intervention Usual care Intervention Group intervention RN assessed pts, orgainsed group-classes, made followup phone calls, and titrate medication using a treatment algorithm based of National guidelines.	Outcome measures Adherence to guidelines Foot exam as per guideline (% of pt) Eye exam as per guideline (% of pt) Flu shot as per guideline (% of pt) Dental exam as per guideline (% of pt) Pneumovax shot as per guideline (% of pt) Health service use HospitalED referral Physician visit per year (mean) Physiological measures of disease HbA1c Cholesterol (Total) LDL BP (systolic) BP (diastolic)
[19] RCT Primary Care Urban and rural, UK Duration: ? months	Control Group N = 915 Intervention Group N = 900	Skill Mix : Dr substitution by nurse Control intervention Usual care by primary care physician Intervention Group intervention Patient with minor illnesses management by practice nurses.	Outcome measures Adherence to guidelines Prescription written Advice about self medication given Advice about general self management given Care managed totally by allocated professional Referred to and seen by doctor at same visit Health service use Self-reported emergency room attendance Returned visits to surgery (mean) Self-reported out of hours calls to GP Mean length of consultation (min) Quality of life General satisfaction (mean) Professional care (mean) Depth of relation (mean) Perceived time (mean) Health status Self-reported heatlh status
[20] RCT Primary Care Urban, USA	Control Group Hypertension N = 294 Intervention Group	Skill Mix : Dr substitution by nurse Control intervention Usual care Intervention Group intervention	Outcome measures Health service use Minute of phone call (average) Quality of life

Duration: 24 months	Hypertension N = 294	Patient-tailored telephone to promote medication adherence and health behaviours.	Self-confidence with hypertension (mean) Health status Hypertension knowledge (median)
[21] RCT Primary Care Urban, USA Duration: 12 months	Control Group Diabetes N = 150 Intervention Group Diabetes N = 182	Skill Mix : Dr substitution by nurse Control intervention Usual care by primary care physician, no interaction with nurse case manager. Intervention Group intervention Nurse case management: behavioral goal setting, care plan, self-management education and patient surveillance.	Outcome measures Adherence to guidelines Eye exam Foot exam Urine albumin screen Pneumonia vaccination Dietician visit Physiological measures of disease SBP (mmHg) DBP (mmHg) LDL HbA1C Weight (kg) Health status Diabetes related distress PAID score
[22] BA Community based care Remote, Australia Duration: 36 months	Control Group Diabetes N = 137 Same as Control	Skill Mix: Dr substitution by others Intervention Aboriginal helath workers provided diabetes care in remote community health centres.	Outcome measures No reportable outcome measure
[23] BA Community Urban, UK Duration: ? months	Control Group N = 143 Same as Control	Skill-mix: Dr substitution by pharmacist Intervention Community pharmacist review medications, identify risks, change medicine regime in liaison with GPs, and medication counselling.	Outcome measures Health service use Length (mins) of adherence support service time (median)
[24] CBA Pharmacy Rural, Australia Duration: ?months	Control Group N = 205 Intervention Group N = 185	Skill-mix: Dr substitution by pharmacist Control intervention Health promotion and cardiovascular risk factor screening service in community pharmacies. Intervention Group intervention Health promotion and cardiovascular risk factor screening service in community pharmacies.	Outcome measures Physiological measures of disease BMI (kg/m2) Total cholesterol (mmol/L) SBP (mmHg) DBP (mmHg) Health status Current smoker Inadequate physical activity
[25] BA Primary Care Urban, USA Duration: ?months	Control Group Diabetes N = 23 Same as control	Skill-mix: Dr substitution by pharmacist Intervention Phamacist provided diabetes education, medication counseling, monitoring and insulininitiation/adustment.	Outcome measures Physiological measures of disease HbA1c Random blood glucose RBG (mg/dL) Fasting blood glucose FBG (mg/dL)
[26] RCT	Control Group N = 1404	Skill-mix: Dr substitution by pharmacist Control intervention	Outcome measures Health service use

Pharmacy Urban and rural, UK Duration: 12 months	Intervention Group N = 905	Usual repeat prescribing system Intervention Group intervention Pharmacist kept repeated prescription and dispensed monthly following a protocol.	Hospital admission
[27] RCT Primary Care Urban and rural, Netherlands Duration: 6 months	Control Group Ischaemic heart disease Hypertension Diabetes N = 78 Intervention Group Ischaemic heart disease Hypertension Diabetes N = 74	Skill-mix: Dr substitution by pharmacist Control intervention Usual care by GPs Intervention Group intervention Community pharmacist provided monthly consultations for patients with heart failure about medication compliance	Outcome measures Health service use Total number of hospitalisation Quality of life COOP/WONCA
[28] RCT Pharmacy Rural and remote, Australia Duration: 6 months	Control Group N = 60 Intervention Group N = 46	Skill-mix: Dr substitution by pharmacist Control intervention Usual care by community pharmacist Intervention Group intervention Extra advice and support to patients with depression provided by rural community pharmacist when despensing medication.	Outcome measures Health status K10 score Drug Attitude Index
[29] RCT Primary Care Urban, UK Duration: 12 months	Control Group N = 580 Intervention Group N = 608	Skill-mix: Dr substitution by pharmacist Control intervention Usual care by primary care physician Intervention Group intervention Pharmacists reviewed repeat prescription.	Outcome measures Health service use Admission to hospital at least once Outpatient appointment (median) General practice consultations (median) Average medication review time by pharmacist/patient (mins)
[30] CBA Managed Care Organisation Urban, USA Duration: 24 months	Control Group Depression N = 129 Intervention Group Depression N = 91	Skill-mix: Dr substitution by pharmacist Control intervention Usual care by primary care physicians. Intervention Group intervention Clinical pharmacist provided medication maintenance and follow up for patients depression.	Outcome measures Health service use Total visits to primary care physicians Mean phone contact with pharmacist (min) Quality of life Overall treatment Personal nature of care HMO overall Explanation why the antidepressants prescribed Health status Work and Social Disability Scale (WSDS) Inventory for Depressive Symptoms (IDS score)
[31]	Control Group	Skill-mix: Dr substitution by pharmacist	Outcome measures

RCT Primary Care Rural, USA Duration: 6 months	Hypertension N = 26 Intervention Group Hypertension N = 25	Control intervention Usual care Intervention Group intervention Community pharmacist as member of interdisciplinary team monitored hypertensive patients.	Health service use Visit to pharmacist (mean) Quality of life SF_36 Role - Physical Overall, program provided a valuable service Satisfied with quality of information provided by pharmacist Better understanding of hypertension Satisfied with consultaiton area Physiological measures of disease SBP (mmHg) DBP (mmHg)
[32] RCT Primary Care Urban, Canada Duration: 5 months	Control Group Hypertension Osteoarthritis Ischaemic heart disease N = 458 Intervention Group Hypertension Osteoarthritis Ischaemic heart disease N = 431	Skill-mix: Dr substitution by pharmacist Control intervention Usual care by primary care physician Intervention Group intervention Pharmacist consultation including medication assessment, recommendation to physician, and patient follow up.	Outcome measures Health service use Admission to hospital (mean)Other heatlh care services/visits to health professional (mean) Lab test/imaging procedures (mean) Physician visits (mean) Time spent with pharmacist (min) Quality of life SF_36 Role - Physical
[33] RCT Primary Care Urban and rural, Other Duration: 6 months	Control Group Hypertension N = 117 Intervention Group Hypertension N = 118	Skill-mix: Dr substitution by pharmacist Control intervention Usual care by hospital or primary care units. Intervention Group intervention Patients medication assessment, counselling, and recommendations for regimen changes by a pharmacist.	Outcome measures Physiological measures of disease SBP (mmHg) DBP (mmHg) Health status Regular exercise
[34] RCT Primary Care Urban, USA Duration: 24 months	Control Group Diabetes N = 39 Intervention Group Diabetes N = 41	Dr substitution by pharmacist Control intervention Usual care by primary care physician Intervention Group intervention Evaluation of patients' therapeutic regimens, disease and medication management.	Outcome measures Adherence to guidelines HbA1C measurement LDL measurement Eye exam within 2 years Urine albumin screen Foot exam Physiological measures of disease HbA1C
[35] BA	Control Group Diabetes	Skill-mix: Dr substitution by pharmacist Intervention	Outcome measures Health service use

Primary Care Urban, USA Duration: 9 months	N = 138 Same as control	Pharmacist provided diabetes education, frequent phone follow up and medication algorithms for high-risk patients with diabetes.	Contact time per patient per month (mins) Physiological measures of disease HbA1C SBP (mmHg)
[36] RCT Primary Care Not clear, USA Duration: 6 months	Control Group Hypertension N = 27 Intervention Group Hypertension N = 26	Skill-mix: Dr substitution by pharmacist Control intervention Usual care Intervention Group intervention Monthly pt visit for appropriate changes to prescribed medication, dosage adjustment & drug counselling as per standard guidelines.	Outcome measures Physiological measures of disease Blood pressure - systolic (Mean) Blood pressure - diastolic (Mean)
[37] BA Pharmacy Urban, USA Duration: 12 months	Control Group Lipid disorders Hypertension N = 25 Same as control	Skill-mix: Dr substitution by pharmacist Intervention Patients with lipid disorders received therapeutic assessment, goal setting, therapy recommendation and follow up by pharmacists, and a visit with a registered dietician.	Outcome measures Quality of life SF_36 Role - Physical MKL: Availability MKL: Consultation MKL: Consideration MKL: Finance Physiological measures of disease Total cholesterol (mg/dL) HDL (mg/dL) LDL (mg/dL) Triglycerids (mg/dL)
[38] RCT Primary Care Urban, UK Duration: 6 months	Control Group N = 164 Intervention Group N = 168	Dr substitution by pharmacist Control intervention Pharmaceutical care issues identified without care planning. Intervention Group intervention Medication review led by a pharmacist	Outcome measures Adherence to guidelines Potential/suspected adverse drug reaction resolved Monitoring issues resolved Potential ineffective therapy resolved Education required resolved Inappropriate dosage regime resolved Health service use Number of admissionNumber of practice nurses contact for drug related or therapy monitoring Number of GPs contact for drug related or therapy monitoring Quality of life SF36 Total SF_36 Role - Physical
[39] RCT Pharmacy Other Duration: 18 months	Control Group N = 1164 Intervention Group N = 1290	Skill-mix: Dr substitution by pharmacist Control intervention Usual care Intervention Group intervention Pharmacist undertook patient assessment, education, and implemented compliance-improving strategies.	Outcome measures Health service use Hospitalisation Number of contact with GPs (mean) Quality of life SF_36 Role - Physical Rating the pharmacist services as excellent Satisfaction with the pharmacist services Overall positive opinion of pharmaceutical care

[40] RCT Community based care Urban and rural, USA Duration: ? months	Control Group N = 331 Intervention Group N = 344	Skill-mix: Dr substitution by pharmacist Control intervention Patients received the same brochure, general advice only with minimal follow-up Intervention Group intervention Community pharmacist provided patient education, point of care cholesterol measurement, and regular follow up, and brochures on risk factors	Outcome measures Adherence to guidelines Performance of a cholesterol panel New prescription of a cholesterol-lowering medication Increase dose of cholesterol-lowering medication Health service use Quality of life SF-12 physical health status General satisfaction with pharmacy services (mean) Satisfaction with pharmacist-physician communication (mean)
[41] CBA Primary Care Urban, USA Duration: ?months	Control Group Lipid disorders Hypertension Diabetes N = 41 Intervention Group Lipid disorders Hypertension Diabetes N = 47	Skill-mix: Dr substitution by pharmacist Control intervention Usual care Intervention Group intervention Pharmacist prescribing and adjusting the drug therapy for patients with elevated LDL.	Outcome measures Physiological measures of disease LDL (mg/dL) HDL (mg/dL) Total cholesterol (mg/dL)
[42] BA Pharmacy Urban, USA Duration: ?months	Control Group N = 111 Same as control	Skill-mix: Dr substitution by pharmacist Intervention Osteoporosis screening and intervention programme directed by a pharmacist in community setting.	Outcome measures Health status Self-rating of awareness of oesteoporosis score Self-rating of risk (median)
[43] CCT Primary Care Urban, USA Duration: ?months	Control Group Diabetes N = 92 Intervention Group Diabetes N = 89	Skill-mix: Dr substitution by pharmacist Control intervention Usual care Intervention Group intervention Pharmacist provided diabetes care following detailed algorithms under supervision of a diabetologist.	Outcome measures Physiological measures of disease HbA1c
[44] BA Primary Care Urban, USA	Control Group Diabetes N = 157 Same as control	Dr substitution by pharmacist Intervention Diabetes management provided by clinical pharmacist.	Outcome measures Adherence to guidelines Eye exam Foot exam Urine microalbumin screening Physiological measures of disease

Duration: ?months			HbA1C LDL (mm/dL) Triglycerids (mg/dL) HDL (mg/dL)
[45] RCT Primary Care Rural, Other Duration: 6 months	Control Group Hypertension N = 41 Intervention Group Hypertension N = 41	Skill-mix: Dr substitution by pharmacist Control intervention Usual care- brief counselling, usual medication review & monitoring for adverse drug reactions. Intervention Group intervention Pharmacist monitor BP; assess pt's adherence to Rx; prevent, detect, and resolve drug related problems; and encourage lifestyle changes that control BP.	Outcome measures Physiological measures of disease Systolic blood pressure (mean) Diastolic blood pressure (mean)
[46] CCT Primary Care Urban, USA Duration: 24 months	Control Group Diabetes % Hypertension N = 75 Intervention Group Diabetes % Hypertension N = 75	Skill-mix: Dr substitution by pharmacist Control intervention Usual care Intervention Group intervention Clinical pharmacist-managed pharmacotherapy clinics in implementing and maximizing therapy with a agents known to reduce mobidity & mortality associated with CVD.	Outcome measures Physiological measures of disease Total cholesterol (mean) Triglyceride (mean) LDL (mean) HDL (mean)
[47] RCT Primary Care Rural, USA Duration: 12 months	Control Group Hypertension Lipid disorders Diabetes N = 36 Intervention Group Hypertension Lipid disorders Diabetes N = 33	Skill-mix: Dr substitution by pharmacist Control intervention Usual care Intervention Group intervention Pharmacists made recommendations to the pt's PCP re: therapy indications, dosage, drug interactions, therapy cost. These are based on published therapeutic algorithms and guidelines.	Outcome measures Adherence to guidelines Pt having at least 1 medication misadventure Pt medication knowledge score (mean) No. of medication prescribed (mean) Health service use Change in the no. of hospitalisationChange in referral to ED Quality of life SF_36 Physical role Satisfaction with pharmacist Physiological measures of disease % of pts having BP within limit (<140/<90) % of pts having HbA1C <7.5% % of pt meeting lipid goals % of pts meeting antocoagulation therapy goal
[48] RCT Primary Care Urban, Netherlands Duration: 24 months	Control Group Asthma COPD Other N = 137 Intervention Group Asthma COPD Other N = 139	Skill-mix : Innovation Control intervention Usual care by GP Intervention Group intervention Education for asthma and COPD patients by general practice assistants about disease	Outcome measures Quality of life Respiratory Illness QoL (mean) Physiological measures of disease Degree of dyspnea (mean) No chronic cough and phlegm production No wheezing

		knowledge, inhalation technique, smoking cessation.	Health status Self-efficacy (mean) Coping style: Avoidance (mean) Coping style: Rational (mean) Coping style: Emotional (median) Coping style: Emotional (median) Correct inhalation technique
[49] RCT Primary Care Urban, USA Duration: 12 months	Control Group Diabetes N = 67 Intervention Group Diabetes N = 71	Skill-mix: Nurse enhancement Control intervention Usual care from primary care physician Intervention Group intervention Case management for diabetic patients	Outcome measures Health service use Admission rate Emergentcy visit rate Physiological measures of disease SBP (mmHg) DBP (mmHg) HbA1C Fasting blood glucose (mg/dL) Weight (kg) Health status Self-reported health status score
[50] BA Community Urban, Australia Duration: ?months	Control Group N = 24 Same as control	Skill-mix: Nurse enhancement Intervention Nurse-initiated medication intervention including assessment, education, support, adherence review.	Outcome measures No reportable outcome measure
[51] BA Managed Care Organisation Urban, USA Duration: ?months	Control Group Heart failure Diabetes Hypertension N = 51 Same as control	Skill-mix: Nurse enhancement Intervention Heart failure case management by a nurse.	Outcome measures Health service use Hospitalisation rate/yearCardiology visit rate Emergency room visit for heart failure rate General medical visits rate Totat contact time/patient (hours) Quality of life Physical component Mental component Physiological measures of disease Dietary sodium intake (mg) Moderate/severe cough Moderate/severe dyspnea on exertion Moderate/severe orthopnea Moderate/severe fatigue
[52] RCT Primary Care Urban, Netherlands Duration: 18 months	Control Group N = 157 Intervention Group N = 159	Skill-mix: Nurse enhancement Control intervention Usual care Intervention Group intervention Community nurse provided assessment for factors causing falls and impairments in mobility at home and advice, referrals for elderly people living in the community	Outcome measures Health status At least one fall More than one fall Injurious fall Fall resulting in medial care Fall resulting in medial care Mental health (mean) Social functioning (mean)

[53] RCT Community Urban, USA Duration: 36 months	Control Group N = 199 Intervention Group N = 215	Skill-mix: Nurse enhancement Control intervention Usual care (medical and social services) Intervention Group intervention Annual inhome comprehensive geriatric assessment and follow up by nurse practitioner	Outcome measures Health service use Hospitalisation rate Mean visits to physicians per month
[54] RCT Community Urban, UK Duration: 12 months	Control Group Other N = 89 Intervention Group Other N = 87	Skill-mix: Nurse enhancement Control intervention Usual care on discharge from rehab unit. Intervention Group intervention Stroke nurses provided outreach education and support to stroke patients and carers	Outcome measures Health status Nottingham: Total score (median) Nottingham: Energy (median) Nottingham: Emotional reaction (median) Nottingham: Physical mobility (median) Nottingham: Physical mobility (median) Nottingham: Pain (median) Nottingham: Social isolation (median)
[55] RCT Community Urban, Canada Duration: 14 months	Control Group Osteoarthritis Hypertension Other N = 69 Intervention Group Osteoarthritis Hypertension Other N = 73	Skill-mix: Nurse enhancement Control intervention Usual care. Intervention Group intervention The nurse provided patient review, assessment, and care plan for patients.	Outcome measures Adherence to guidelines Influenza vaccination Pneumonia vaccination Health service use Hospitalisation Visits to specialist Visits to family physician Days of hospital stay
[56] RCT Community Rural, Other Duration: 18 months	Control Group N = 60 Intervention Group N = 59	Skill-mix: Nurse enhancement Control intervention Usual routine and community care Intervention Group intervention Public health nurse provided preventive home visits for ambulatory housebound elderly.	Outcome measures Health service use Home visit number/18 month (mean) Health status Psycho. status: Self-efficacy for daily activities Psycho. status: Self-efficacy for health promotion Psycho. status: Geriatric Depression Scale Psycho. status: Noguchi Social Support Scale Psycho. status: Noguchi Social Support Scale
[57] CBA Primary Care Urban, UK Duration: 24 months	Control Group N = 66 Intervention Group N = 66	Skill-mix: Nurse enhancement Control intervention Usual care Intervention Group intervention Advanced primary nurses provided case management	Outcome measures Health service use Addmission rate per monthMean length of stay (days)
[58] RCT	Control Group N = 60	Skill-mix: Nurse enhancement Control intervention	Outcome measures Quality of life

Primary Care Urban and rural, UK Duration: 12 months	Intervention Group N = 67	Standard treatment: nurse usual advice Intervention Group intervention Screening and brieft intervention for reducing alcohol consumption.	SF-12 Physical health Health status AUDIT score (mean) Stardard drink units/week (mean) Drinking problem Index (mean)
[59] RCT Primary Care Urban, Canada Duration: 18 months	Control Group Ischaemic heart disease Diabetes N = 63 Intervention Group Ischaemic heart disease Diabetes N = 64	Skill-mix: Nurse enhancement Control intervention Usual care by primary care physician Intervention Group intervention Nurses provided follow up after patients discharge from hospital, monitor lipid level, recommend physician for appropriate intervention, and ensure treatment initiated.	Outcome measures Health service use Consultation time/patient/18months Quality of life Physiological measures of disease Percentage achieved LDL <2.5mmol/L Percentage achieved all lipid tagets
[60] CBA Other Urban, England Duration: 24 months	Control Group Other N = 323 Intervention Group Other N = 293	Skill-mix: Nurse enhancement Control intervention Usual care (Patients in 2 neurological sites not in the programme) Intervention Group intervention Care provided to patients with MS by MS specialist nurse at rehab centres and neurological services.	Outcome measures Adherence to guidelines Information available on Care and Treatment Information available on Living with MS Care quality of named-coordinator Care quality of contact person Care quality of ability to get help in an emergency Quality of life SF_36 Role - Physical MSIS-29: Psychological
[61] RCT Primary Care Urban, UK Duration: 12 months	Control Group N = 567 Intervention Group N = 316 N =	Skill-mix: Nurse enhancement Control intervention Usual care Intervention Group intervention Brief behavioural counselling by practice nurses	Outcome measures Physiological measures of disease Total cholesterol (mmol/l) BMI SBP (mmHg) DBP (mmHg) Body weight (kg) Health status Cigarettes per day Fat score Number of exercise session Smoking quit

APPENDIX 6: LIST OF THE 61 EXPERIMENTAL PAPERS INCLUDED

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APPENDIX 7: LIST OF THE 30 GREY AND DESCRIPTIVE PAPERS INCLUDED

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APPENDIX 8: LIST OF PAPER EXCLUDED FROM THE REVIEW

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