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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 workforce 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 specialties creating shortages in less well-reimbursed areas such as general practice. Health professionals are expected to work together in multidisciplinary 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.

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<th>Table 1. Organisation of the stakeholders</th>
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<td>• Australian Division of General Practice</td>
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<td>• Divisions of General Practice (metropolitan and rural Divisions)</td>
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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

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

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

<table>
<thead>
<tr>
<th>Health Professional</th>
<th>Disease management role only</th>
<th>Health promotion role only</th>
<th>Both DM and HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurses</td>
<td>19</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>14</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Aboriginal HW</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Physician assistant</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

The majority (75.4%) of the interventions assessed doctor substitution by other health 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

<table>
<thead>
<tr>
<th>Skill-mix</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr substitution by pharmacist</td>
<td>25</td>
<td>41.0</td>
</tr>
<tr>
<td>Dr substitution by nurses</td>
<td>21</td>
<td>34.4</td>
</tr>
<tr>
<td>Nurse enhancement</td>
<td>13</td>
<td>21.3</td>
</tr>
<tr>
<td>Dr substitution by others eg. AHW</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>Innovation</td>
<td>1</td>
<td>1.6</td>
</tr>
</tbody>
</table>

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

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

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

<table>
<thead>
<tr>
<th>Disease</th>
<th>Dr substitution by nurses</th>
<th>Dr substitution by pharmacist</th>
<th>Dr substitution by others</th>
<th>Nurse enhancement</th>
<th>Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA (26)</td>
<td>9</td>
<td>14</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>UK (17)</td>
<td>8</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Netherlands (6)</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Canada (4)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Australia (4)</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Others (4)</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>All conditions (61)</td>
<td>21</td>
<td>25</td>
<td>1</td>
<td>13</td>
<td>1</td>
</tr>
</tbody>
</table>

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

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

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

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

* 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

<table>
<thead>
<tr>
<th>Skill-mix</th>
<th>Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Professional adherence to guideline</td>
</tr>
<tr>
<td>Dr substitution by nurses</td>
<td>8 (10)</td>
</tr>
<tr>
<td>Dr substitution by pharmacist</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Nurse enhancement</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Innovation eg. physician assistant</td>
<td>--</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Skill-mix</th>
<th>Patient Service Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less hospital admission</td>
</tr>
<tr>
<td>Dr substitution by nurses</td>
<td>1 (7)</td>
</tr>
<tr>
<td>Dr substitution by pharmacist</td>
<td>1 (7)</td>
</tr>
<tr>
<td>Nurse enhancement</td>
<td>1 (5)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Skill-mix changes</th>
<th>Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Professional adherence to guideline</td>
</tr>
<tr>
<td>Dr substitution by nurse</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>8 (10)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>0 (1)</td>
</tr>
<tr>
<td>Diabetes &amp; related</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>0 (1)</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>0 (1)</td>
</tr>
<tr>
<td>Mental condition</td>
<td>0 (1)</td>
</tr>
<tr>
<td>2+ chronic condition</td>
<td>0 (2)</td>
</tr>
<tr>
<td>Others</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Dr substitution by pharmacist</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Diabetes &amp; related</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Mental condition</td>
<td>1 (1)</td>
</tr>
<tr>
<td>2+ chronic condition</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Others</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Nurse enhancement</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Diabetes &amp; related</td>
<td>0 (1)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Mental condition</td>
<td>1 (1)</td>
</tr>
<tr>
<td>2+ chronic condition</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Others</td>
<td>0 (1)</td>
</tr>
<tr>
<td>Not mentioned</td>
<td>1 (2)</td>
</tr>
</tbody>
</table>

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

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

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

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.

Professional level

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.

System level

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.

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

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.

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.

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

<table>
<thead>
<tr>
<th>Practice level</th>
<th>Professional level</th>
<th>System level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wider role</td>
<td>Safety</td>
<td>Salaries</td>
</tr>
<tr>
<td>Doctors argue</td>
<td>Overarching theme</td>
<td>As team members become more skilled they will demand higher salaries. They may also be less flexible.</td>
</tr>
<tr>
<td>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.</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Professional level</td>
<td>Minimum standards</td>
<td>Sustainability</td>
</tr>
<tr>
<td>Safety</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>Training and ongoing accreditation</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Control / power</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Continuity of care</td>
<td>Skill mix changes threaten the doctor patient relationship and continuity of care</td>
<td></td>
</tr>
<tr>
<td>Understanding of other professions</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

Table 13. Summary of the main themes emerging from Australian non-experimental literature on skill mix
<table>
<thead>
<tr>
<th>Practice level</th>
<th>Professional level</th>
<th>System level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarity of roles</td>
<td>Career structure</td>
<td>Sustainability</td>
</tr>
<tr>
<td>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.</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>Payment systems</td>
<td>Professional philosophy</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>Control / power</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>Hierarchy / control</td>
<td>Licensing</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td>There is a need for indemnity if nurses are to prescribe.</td>
<td>Payment structures</td>
</tr>
<tr>
<td>Supervision</td>
<td></td>
<td>The payment structures in the UK have supported the use of a variety of health professionals to meet quality standards.</td>
</tr>
<tr>
<td>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</td>
<td>Health care teams</td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

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**

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

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

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 differences 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.
REFERENCES


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APPENDICES
## APPENDIX 1: SEARCH STRATEGY FOR BLACK LITERATURE

### Medline

<table>
<thead>
<tr>
<th>Set 1 Health professionals</th>
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<td>1. exp General Practitioner/</td>
<td>1. MH &quot;Pharmacists&quot;</td>
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<tr>
<td>2. exp Community Health Nursing/</td>
<td>2. exp PHARMACIST/</td>
<td>2. MH &quot;Physicians, Family&quot;</td>
</tr>
</tbody>
</table>
| 3. exp Nurse Clinicians,/ | 3. exp case manager/ or exp clinical nurse specialist/ or nurse practitioner/ or exp family nurse practitioner/ or exp gerontologic nurse practitioner/ | 3. MH "Nurse Practitioners" or MH "Adult Nurse Practitioners" or MH "Advanced Practice Nurses+"
| 4. exp Nurses' Aides/ | | 4. MH "Clinical Nurse Specialists"
| 5. exp Allied Health Personnel/ | | 5. MH "Allied Health Personnel+"
| 6. exp Community Health Aides/ | | 6. MH "Rural Health Personnel" or MH "Rural Health Nursing"
| 7. exp Nurse's Role/ | | 7. TX practice nurse*
| 8. nurs$.tw. | | 8. TX nurse practitioner*
| 9. district nurs$.tw. | | 9. TX aboriginal health worker* or TX indigenous health worker*
| 10. community nurs$.tw. | | 10. TX general practitioner*
| 11. health care assistant$.tw. | | 11. TX general practitioner* or TX gp or TX gps
| 12. exp Home Care Services/ | | 12. TX pharmacist*
| 13. exp Home Nursing/ | | 13. TX district nurse*
| 14. nurs$.assistant$.tw. | | 14. TX allied health professional*
| 15. personal care aide$.tw. | | 15. MH "Community Health Nursing+" or MH "Home Health Care+
| 16. enrolled nurse$.tw. | | 16. MH "Nursing Assistants" or MH "Team Nursing"
| 17. neighbourhood nurs$.tw. | | 17. MH "Home Health Aides"
| 18. ambulatory nurs$.tw. | | 18. MH "Nursing Role"
| 19. exp Physicians, Family/ | | 19. TX nurse* or TX community nurse* or TX health care assistant*
| 20. exp Pharmacists/ | | 20. TX nurse assistant*
| 21. exp Nurse Practitioners/ | | 21. TX personal care assistant*
| 22. exp Nurse Clinicians/ | | 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
| 23. exp Allied Health Personnel/ or exp Allied Health Occupations/ | | 23. MH "Family Practice" or MH "Physicians, Family"
| 24. exp Rural Health Services/ or exp Health Services, Indigenous/ | | 24. MH "Primary Health Care"
| 25. practice nurse$.tw. | | 25. MH "Primary Health Care"
| 26. nurse practitioner$.tw. | | 26. MH "Primary Health Care"
| 27. aboriginal health worker.tw. | | 27. MH "Primary Health Care"
| 28. indigenous health worker.tw. | | 28. MH "Primary Health Care"
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| 30. (gp or gps).tw. | | 30. MH "Primary Health Care"
| 31. exp Community Pharmacy Services/ | | 31. MH "Primary Health Care"
| 32. pharmacist$.tw. | | 32. MH "Primary Health Care"
| 33. allied health professional$.tw. | | 33. MH "Primary Health Care"
| 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 | | 34. MH "Primary Health Care"

### Embase

| Set 2 APHCRI Stream 4 Primary Health Care Filter | | |
| 35. exp Primary Health Care/ | 28. exp general practice/ or exp primary medical care/ | 23. MH "Family Practice" or MH "Physicians, Family"
| 36. exp Comprehensive Health Care/ | 29. exp general practitioner/ | 24. MH "Primary Health Care" |
### Set 3 Study Design

| 37. exp Patient Care Management/ | 30. (general adj2 practi$).tw. |
| 38. exp Family Practice/ | 31. (gps or gp).tw. |
| 40. exp Community Health Services/ | 33. exp primary health care/ |
| 41. (primary adj1 (care or health)).tw. | 34. (family adj2 doctor$).tw. |
| 42. (family adj1 (doct$ or medic$ or pract$ or physic$)).tw. | 35. (family adj2 pract$).tw. |
| 43. (general adj1 pract$).tw. | 36. (primary adj2 care).tw. |
| 44. (gps or gp).tw. | 37. primary health.tw. |
| 45. 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 | 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 |

<p>| 46. exp Research Design/ | 40. Randomized Controlled Trial/ |
| 47. exp Follow-Up Studies/ | 41. (randomised or randomized).tw. |
| 48. exp Single-Blind Method/ | 42. experiment$.tw. |
| 49. exp Prospective Studies/ | 43. (time adj series).tw. |
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| 58. interrupted time series.tw. | 52. 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 |
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| 61. (comparative studies and human).tw. | 35. TX randomised or TX randomized |
| 62. 60 not 59 | 36. TX random$ W1 allocat* or TX random$ W1 assign* |
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| 64. (time adj series$).tw. | 38. MH Quasi-Experimental Studies |
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| 70. effect$.tw. | 44. TX evaluat* |
| 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 | 45. TX effect* |
| 72. exp Clinical Competence/ | 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 |
| 73. exp Cooperative Behavior/ | 52. exp clinical competence/ or nursing competence/ or exp professional competence/ |
| 74. exp Job Description/ | 53. exp cooperation/ or exp teamwork/ |
| 75. exp Professional Autonomy/ | 47. MH &quot;Clinical Competence+&quot; or MH &quot;Professional Competence+&quot; |
| 76. clinical practice.tw. | 48. MH &quot;Cooperative Behavior&quot; |
|  | 49. MH &quot;Work Redesign&quot; |</p>
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<td>88. limit 87 to (humans and english language and yr=&quot;1990 - 2007&quot;)</td>
<td>65. 27 and 39 and 52 and 64 66. limit 67 to (human and english language and yr=&quot;1990 - 2007&quot; and (adult &lt;18 to 64 years&gt; or aged &lt;65+ years&gt;))</td>
<td>63. 22 and 32 and 46 and 62 English launge Year 1990 to 2007 Adults &gt;18 years old</td>
</tr>
<tr>
<td>89. exp Child/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90. exp Child, Preschool/ or exp Infant/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>91. exp Adolescent/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>92. 89 or 90 or 91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>93. 88 not 92</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Limits**

- Limit 87 to (humans and english language and yr="1990 - 2007")
- Exp Child/
- Exp Child, Preschool/ or exp Infant/
- Exp Adolescent/
- 89 or 90 or 91
- 88 not 92

- Limit 67 to (human and english language and yr="1990 - 2007" and (adult <18 to 64 years> or aged <65+ years>))
- 27 and 39 and 52 and 64
- 22 and 32 and 46 and 62
- English language
- Year 1990 to 2007
- Adults >18 years old
## APPENDIX 2: SEARCH STRATEGY FOR GREY LITERATURE

<table>
<thead>
<tr>
<th>Organisation/Website</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative Research Centre for Aboriginal Health <a href="http://www.crcah.org.au/">http://www.crcah.org.au/</a></td>
<td>Royal College of Nursing Australia <a href="http://www.rcna.org.au">www.rcna.org.au</a></td>
</tr>
<tr>
<td>Diabetes Australia (DA) <a href="http://www.diabetesaustralia.com.au/home/index.htm">http://www.diabetesaustralia.com.au/home/index.htm</a></td>
<td>State and Territory directors of primary health care</td>
</tr>
<tr>
<td>Ethnic communities council <a href="http://eccv.org.au/doc">http://eccv.org.au/doc</a></td>
<td>State based primary health care research centres attached to universities</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Male subjects</th>
<th></th>
<th>Female subjects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>≥ 65 years</td>
<td></td>
<td>≥ 45 years</td>
<td></td>
</tr>
<tr>
<td>Include if also includes ≥ 65</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Doctors</th>
<th></th>
<th>Pharmacists</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse practitioner</td>
<td></td>
<td>Practice nurse</td>
<td></td>
</tr>
<tr>
<td>Community nurse</td>
<td></td>
<td>Enrolled nurse</td>
<td></td>
</tr>
<tr>
<td>Other nurse</td>
<td></td>
<td>Home and Community Care Workers</td>
<td></td>
</tr>
<tr>
<td>Allied health professionals</td>
<td></td>
<td>Aboriginal Health Workers</td>
<td></td>
</tr>
<tr>
<td>Administrative staff</td>
<td></td>
<td>Lay health workers</td>
<td></td>
</tr>
<tr>
<td>Physician assistant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others (specify)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. **Types of outcome measures**

<table>
<thead>
<tr>
<th>Health professional performance</th>
<th>Yes □</th>
<th>No □</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient outcomes (eg blood pressure)</td>
<td>Yes □</td>
<td>No □</td>
</tr>
<tr>
<td>Patient satisfaction</td>
<td>Yes □</td>
<td>No □</td>
</tr>
<tr>
<td>Health professional satisfaction</td>
<td>Yes □</td>
<td>No □</td>
</tr>
<tr>
<td>Quality of life</td>
<td>Yes □</td>
<td>No □</td>
</tr>
<tr>
<td>Health service use</td>
<td>Yes □</td>
<td>No □</td>
</tr>
<tr>
<td>Economic measures</td>
<td>Yes □</td>
<td>No □</td>
</tr>
<tr>
<td>Others (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 4: QUALITY ASSESSMENT FORMS
For Randomised Controlled Trials & Controlled Clinical Trials

<table>
<thead>
<tr>
<th>Endnote Record Number</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Author and year</th>
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</thead>
<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Journal</th>
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</thead>
<tbody>
<tr>
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</table>

<table>
<thead>
<tr>
<th>Title</th>
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</thead>
<tbody>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Name/code of reviewer</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**TOTAL SCORE**

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

**Concealment of allocation (protection against selection bias)**

<table>
<thead>
<tr>
<th>DONE</th>
<th>NOT CLEAR</th>
<th>NOT DONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**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)**

<table>
<thead>
<tr>
<th>DONE</th>
<th>NOT CLEAR</th>
<th>NOT DONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**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)**

<table>
<thead>
<tr>
<th>DONE</th>
<th>NOT CLEAR</th>
<th>NOT DONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>DONE</th>
<th>NOT CLEAR</th>
<th>NOT DONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Contemporaneous data collection?</th>
</tr>
</thead>
<tbody>
<tr>
<td>DONE 2</td>
</tr>
<tr>
<td>DONE = Pre and post intervention periods for study and control sites are the same.</td>
</tr>
<tr>
<td>NOT CLEAR = If it is not clear in the paper</td>
</tr>
<tr>
<td>NOT DONE = If data collection was not conducted contemporaneously during pre and post intervention periods for study and control sites</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Baseline measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>DONE 2</td>
</tr>
<tr>
<td>DONE = Outcomes were measured prior to the intervention, and no substantial differences were present across study groups.</td>
</tr>
<tr>
<td>NOT CLEAR = Not reported, or if it is unclear whether baseline measures are substantially different across study groups.</td>
</tr>
<tr>
<td>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).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics for studies using second site as control</th>
</tr>
</thead>
<tbody>
<tr>
<td>DONE 2</td>
</tr>
<tr>
<td>DONE = Characteristics of study and control providers are reported and similar.</td>
</tr>
<tr>
<td>NOT CLEAR = Not clear in the paper e.g. characteristics are mentioned in the text but no data are presented.</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blinded assessment of primary outcome(s)* (protection against detection bias)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DONE 2</td>
</tr>
<tr>
<td>DONE = Primary outcome(s) were assessed blindly OR the outcome variables are objective, e.g. length of hospital stay.</td>
</tr>
<tr>
<td>NOT CLEAR = Not specified in the paper.</td>
</tr>
<tr>
<td>NOT DONE = The outcome(s) were not assessed blindly.</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protection against contamination (Studies using second site as control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DONE 2</td>
</tr>
</tbody>
</table>
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 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

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type</th>
<th>Duration</th>
<th>Study Setting</th>
<th>Control Group</th>
<th>Intervention Group</th>
<th>Skill Mix</th>
<th>Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
<td>RCT</td>
<td>? months</td>
<td>Urban, USA</td>
<td>Diabetes N = 59</td>
<td>Diabetes N = 86</td>
<td>Dr substitution by nurse</td>
<td>Adherence to guidelines, Documentation on education: Any teaching, Documentation on education: General diabetes education, Documentation on education: Nutrition, Documentation on education: Exercise, Health service use, Hospitalisation 6 months, Specialist visits, Quality of life, Physical component, Mental component, Information received: Monitoring blood glucose, Information received: Diet and exercise, Information received: Complications of diabetes, Information received: Side effects of medication, Physiological measures of disease, HbA1c, Blurred vision, Drowsiness, Polyuria, Nocturia</td>
</tr>
<tr>
<td>[2]</td>
<td>BA</td>
<td>24 months</td>
<td>Urban, USA</td>
<td>Hypertension, Ischaemic heart disease, Diabetes N = 436</td>
<td>Same as Control</td>
<td>Nurse substitution by nurse</td>
<td>SBP (mmHg), DBP (mmHg), LDL (mg/dL)</td>
</tr>
<tr>
<td>[3]</td>
<td>CBA</td>
<td>36 months</td>
<td>Urban, Netherlands</td>
<td>Diabetes N = 400</td>
<td>Diabetes N = 1127</td>
<td>Dr substitution by nurse</td>
<td>Adherence to guidelines, Foot exam, Eye exam, HbA1c measurement, BP measurement, Total cholesterol, Physiological measures of disease, Percentage HbA1c &lt;= 7%, Percentage BP &lt;= 150/85 mmHg, Percentage total cholesterol &lt;= 5 mmol/l</td>
</tr>
<tr>
<td>[4]</td>
<td>RCT</td>
<td></td>
<td></td>
<td>Ischaemic heart</td>
<td>Control intervention</td>
<td>Dr substitution by nurse</td>
<td>Health service use</td>
</tr>
<tr>
<td>Study Type</td>
<td>Primary Care</td>
<td>Urban and rural, Scotland</td>
<td>Duration: 12 months</td>
<td>Disease</td>
<td>N = 670</td>
<td>Intervention Group</td>
<td>Ischaemic heart disease N = 673</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>---------------------------</td>
<td>---------------------</td>
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</tr>
<tr>
<td>[5] RCT</td>
<td>Primary Care</td>
<td>Urban, USA</td>
<td>Duration: 26 months</td>
<td>Control Group</td>
<td>Asthma Diabetes Hypertension N = 510</td>
<td>Intervention Group</td>
<td>Asthma Diabetes Hypertension N = 806</td>
</tr>
<tr>
<td>[6] RCT</td>
<td>Managed Care Organisation</td>
<td>Urban, USA</td>
<td>Duration: 12 months</td>
<td>Control Group</td>
<td>Ischaemic heart disease Hypertension Rheumatoid arthritis N = 100</td>
<td>Intervention Group</td>
<td>Ischaemic heart disease Hypertension Rheumatoid arthritis N = 101</td>
</tr>
<tr>
<td>[7] RCT</td>
<td>Primary Care</td>
<td>Urban, UK</td>
<td>Duration: 3 months</td>
<td>Control Group</td>
<td>N = 49</td>
<td>Intervention Group</td>
<td>N = 47</td>
</tr>
<tr>
<td>[8] RCT</td>
<td>Primary Care</td>
<td>Urban and rural, Netherlands</td>
<td>Duration: 3 months</td>
<td>Control Group</td>
<td>N = ?</td>
<td>Intervention Group</td>
<td>N = ?</td>
</tr>
</tbody>
</table>
### Table: Primary Care Research Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Location</th>
<th>Duration</th>
<th>Control Group</th>
<th>Intervention Group</th>
<th>Skill Mix</th>
<th>Control Intervention</th>
<th>Intervention Intervention</th>
<th>Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>[9]</td>
<td>RCT</td>
<td>Urban, UK</td>
<td>48 months</td>
<td>N = 670</td>
<td>N = 673</td>
<td>Dr substitution by nurse</td>
<td>Usual care by primary care physician</td>
<td>Health promotion on medical and lifestyle components, and regular follow up by nurses.</td>
<td>Physiological measures of disease, Aspirin management, BP management, Lipid management, Mode arte exercise, Low fat diet, Health status, Non-smoking</td>
</tr>
<tr>
<td>[10]</td>
<td>RCT</td>
<td>Urban, UK</td>
<td>12 months</td>
<td>N = 7308</td>
<td>N = 7184</td>
<td>Dr substitution by nurse</td>
<td>Usual care</td>
<td>Intervention Group intervention</td>
<td>Nurses provided telephone consultations after-hours.</td>
</tr>
<tr>
<td>[11]</td>
<td>CBA</td>
<td>Urban, USA</td>
<td>12 months</td>
<td>Heart failure N = 10</td>
<td>Heart failure N = 13</td>
<td>Dr substitution by nurse</td>
<td>Usual care by cardiologist and cardiac fellows</td>
<td>Intervention Group intervention</td>
<td>Patient education, medication compliance, diet and nutrition counselling</td>
</tr>
<tr>
<td>[12]</td>
<td>RCT</td>
<td>Urban, England</td>
<td>?months</td>
<td>N = 716</td>
<td>N = 562</td>
<td>Dr substitution by nurse</td>
<td>Patient consultations by primary care physician</td>
<td>Intervention Group intervention</td>
<td>Patient consultations by nurse practitioners</td>
</tr>
<tr>
<td>[13] RCT</td>
<td>Primary Care</td>
<td>Urban and rural, England</td>
<td>Duration: 7 months</td>
<td></td>
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</tr>
<tr>
<td>Control Group</td>
<td>N = 665</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Intervention Group</td>
<td>N = 651</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Skill Mix: Dr substitution by nurse</td>
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</tr>
<tr>
<td>Control intervention</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Patient consultations by primary care physician</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Group intervention</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Patient consultations by nurse practitioners</td>
<td></td>
<td></td>
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<td>Outcome measures</td>
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<td>Adherence to guidelines</td>
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<td>Quality of life</td>
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<td>Adult patients: Medical interview satisfaction (mean)</td>
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<td>Adult patients: Distress relief (mean)</td>
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<td>Adult patients: Clinical behaviour (mean)</td>
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<table>
<thead>
<tr>
<th>[14] CCT</th>
<th>Primary Care</th>
<th>Rural, USA</th>
<th>Duration: 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>Diabetes</td>
<td></td>
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<tr>
<td>N = 252</td>
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<tr>
<td>Intervention Group</td>
<td>Diabetes</td>
<td></td>
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<tr>
<td>N = 252</td>
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<tr>
<td>Skill Mix: Dr substitution by nurse</td>
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<tr>
<td>Control intervention</td>
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<tr>
<td>Usual care provided by primary care physician</td>
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<tr>
<td>Intervention Group intervention</td>
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<tr>
<td>Trained nurse providing diabetes care following detailed protocols and algorithms under the supervision of a diabetologist.</td>
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<tr>
<td>Outcome measures</td>
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<tr>
<td>Adherence to guidelines</td>
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<tr>
<td>Timely HbA1c measurement (pt)</td>
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<td>Timely lipid profile (pt)</td>
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<tr>
<td>Timely eye exam (pt)</td>
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<tr>
<td>Timely diabetes education (pt)</td>
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<tr>
<td>Timely nutritional counselling (pt)</td>
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<tr>
<td>Physiological measures of disease</td>
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<tr>
<td>HbA1c</td>
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<table>
<thead>
<tr>
<th>[15] RCT</th>
<th>Primary Care</th>
<th>Urban, UK</th>
<th>Duration: 6 months</th>
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<td>Control Group</td>
<td>Diabetes Hypertension</td>
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<td>N = 60</td>
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<tr>
<td>Intervention Group</td>
<td>Diabetes Hypertension</td>
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<tr>
<td>N = 60</td>
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<tr>
<td>Skill Mix: Dr substitution by nurse</td>
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<tr>
<td>Control intervention</td>
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<tr>
<td>Usual care</td>
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<tr>
<td>Intervention Group intervention</td>
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<tr>
<td>PN followed 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.</td>
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<tr>
<td>Outcome measures</td>
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<tr>
<td>Physiological measures of disease</td>
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<tr>
<td>Systolic BP (mean)</td>
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<tr>
<td>Diastolic BP (mean)</td>
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<tr>
<td>Total cholesterol (mean)</td>
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<tr>
<td>HDL (mean)</td>
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<tr>
<td>HbA1c</td>
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<table>
<thead>
<tr>
<th>[16] CBA</th>
<th>Primary Care</th>
<th>Urban, Netherlands</th>
<th>Duration: 12 months</th>
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<tbody>
<tr>
<td>Control Group</td>
<td>Diabetes</td>
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<tr>
<td>N = 47</td>
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<tr>
<td>Intervention Group</td>
<td>Diabetes</td>
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<tr>
<td>N = 52</td>
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<tr>
<td>Skill Mix: Dr substitution by nurse</td>
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<tr>
<td>Control intervention</td>
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<tr>
<td>Usual care by internist and specialist nurse in the hospital</td>
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<tr>
<td>Intervention Group intervention</td>
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<tr>
<td>Quarterly consultation by diabetes specialist nurse in general practice and annually check up by hospital internist.</td>
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<tr>
<td>Outcome measures</td>
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<tr>
<td>Adherence to guidelines</td>
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<tr>
<td>Consultations with nurse specialist (mean)</td>
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<td>Consultation with GP (mean)</td>
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<tr>
<td>Consultation with internist (mean)</td>
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<tr>
<td>Consultation with nurse specialist+GP+internist (mean)</td>
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<td>Quality of life</td>
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<tr>
<td>COOP/WONCA: Physical fitness</td>
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<tr>
<td>Satisfaction about received diabetic care</td>
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<tr>
<td>Physiological measures of disease</td>
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<tr>
<td>Reference</td>
<td>Study Type</td>
<td>Setting</td>
<td>Duration</td>
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<tr>
<td>[17]</td>
<td>RCT</td>
<td>Primary Care</td>
<td>Urban, Canada</td>
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<td></td>
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<td>12 months</td>
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<tr>
<td>[18]</td>
<td>RCT</td>
<td>Primary Care</td>
<td>Urban, USA</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>12 months</td>
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<tr>
<td>[19]</td>
<td>RCT</td>
<td>Primary Care</td>
<td>Urban and rural, UK</td>
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<td>? months</td>
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<tr>
<td>[20]</td>
<td>RCT</td>
<td>Primary Care</td>
<td>Urban, USA</td>
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</table>
### Hypertension

Duration: 24 months  
N = 294  
Patient-tailed telephone to promote medication adherence and health behaviours.

**Self-confidence with hypertension (mean)**  
**Health status**  
**Hypertension knowledge (median)**

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Setting</th>
<th>Country</th>
<th>Duration</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Control Intervention</th>
<th>Outcome Measures</th>
</tr>
</thead>
</table>
| [21]  | RCT    | Primary Care | Urban, USA | 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. | 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 | 36 months | Control Group Diabetes N = 137  
Same as Control | Skill Mix: Dr substitution by others  
Intervention  
Aboriginal health workers provided diabetes care in remote community health centres. | 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  
No reportable outcome measure |
| [23]  | BA     | Community | Urban, UK | 7 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. | 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  
Health service use  
Length (mins) of adherence support service time (median) |
| [24]  | CBA    | Pharmacy | Rural, Australia | ?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. | 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  
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 | ?months | Control Group Diabetes N = 23  
Same as control | Skill-mix: Dr substitution by pharmacist  
Intervention  
Pharmacist provided diabetes education, medication counseling, monitoring and insulininitiation/adjustment. | 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  
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 | 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  
Health service use |
<table>
<thead>
<tr>
<th>Study ID</th>
<th>Study Design</th>
<th>Setting</th>
<th>Duration</th>
<th>Control Group Details</th>
<th>Intervention Group Details</th>
<th>Outcome Measures</th>
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<tr>
<td>[27]</td>
<td>RCT</td>
<td>Primary Care</td>
<td>Urban and rural, Netherlands</td>
<td>N = 78</td>
<td>Ischaemic heart disease, Hypertension, Diabetes</td>
<td>Ischaemic heart disease, Hypertension, Diabetes</td>
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<tr>
<td>[28]</td>
<td>RCT</td>
<td>Pharmacy</td>
<td>Rural and remote, Australia</td>
<td>N = 60</td>
<td>Ischaemic heart disease, Hypertension, Diabetes</td>
<td>Ischaemic heart disease, Hypertension, Diabetes</td>
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<tr>
<td>[29]</td>
<td>RCT</td>
<td>Primary Care</td>
<td>Urban, UK</td>
<td>N = 580</td>
<td>Depressions</td>
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<td>[30]</td>
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<td>Managed Care Organisation</td>
<td>Urban, USA</td>
<td>N = 129</td>
<td>Depression</td>
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<td>[31]</td>
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<td>Control Group</td>
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<td>Skill-mix: Dr substitution by pharmacist</td>
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<td>Study</td>
<td>Type</td>
<td>Setting</td>
<td>Duration</td>
<td>Control Group</td>
<td>Intervention Group</td>
<td>Skill-mix</td>
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<tr>
<td>[32] RCT</td>
<td>Primary Care</td>
<td>Rural, USA</td>
<td>6 months</td>
<td>Hypertension N = 26</td>
<td>Hypertension N = 25</td>
<td>Community pharmacist as member of interdisciplinary team monitored hypertensive patients.</td>
</tr>
<tr>
<td>[33] RCT</td>
<td>Primary Care</td>
<td>Urban, Canada</td>
<td>5 months</td>
<td>Hypertension Osteoarthritis Ischaemic heart disease N = 458</td>
<td>Hypertension Osteoarthritis Ischaemic heart disease N = 431</td>
<td>Pharmacist consultation including medication assessment, recommendation to physician, and patient follow up.</td>
</tr>
<tr>
<td>[34] RCT</td>
<td>Primary Care</td>
<td>Urban and rural, Other</td>
<td>6 months</td>
<td>Hypertension N = 117</td>
<td>Hypertension N = 118</td>
<td>Patients medication assessment, counselling, and recommendations for regimen changes by a pharmacist.</td>
</tr>
<tr>
<td>[35] BA</td>
<td>RCT</td>
<td>Urban, USA</td>
<td>24 months</td>
<td>Diabetes N = 39</td>
<td>Diabetes N = 41</td>
<td>Dr substitution by pharmacist</td>
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<td>Control Group Diabetes N = 26 Intervention Group Diabetes N = 25</td>
<td>Control intervention</td>
<td>Usual care by hospital or primary care units.</td>
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<tr>
<td>Study</td>
<td>Design</td>
<td>Location</td>
<td>Duration</td>
<td>Control Group</td>
<td>Intervention Group</td>
<td>Outcome Measures</td>
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<tr>
<td>[36]</td>
<td>RCT</td>
<td>Primary Care Not clear, USA</td>
<td>6 months</td>
<td>N = 27</td>
<td>N = 26</td>
<td>Physiological measures of disease</td>
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<td>Hypertension</td>
<td>Hypertension</td>
<td>Blood pressure - systolic (Mean) Blood pressure - diastolic (Mean)</td>
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<td>N = 25</td>
<td>N = 26</td>
<td>Skill-mix: Dr substitution by pharmacist</td>
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<td>Intervention Group</td>
<td>Monthly pt visit for appropriate changes to prescribed medication, dosage adjustment &amp; drug counselling as per standard guidelines.</td>
</tr>
<tr>
<td>[37]</td>
<td>BA</td>
<td>Pharmacy Urban, USA</td>
<td>12 months</td>
<td>N = 25</td>
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<td>Physiological measures of disease</td>
</tr>
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<td>Lipid disorders</td>
<td>Hypertension</td>
<td>Total cholesterol (mg/dL) HDL (mg/dL) LDL (mg/dL) Triglycerids (mg/dL)</td>
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<td>N = 25</td>
<td>N = 26</td>
<td>Skill-mix: Dr substitution by pharmacist</td>
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<td></td>
<td>Intervention Group</td>
<td>Patients with lipid disorders received therapeutic assessment, goal setting, therapy recommendation and follow up by pharmacists, and a visit with a registered dietician.</td>
</tr>
<tr>
<td>[38]</td>
<td>RCT</td>
<td>Primary Care Urban, UK</td>
<td>6 months</td>
<td>N = 164</td>
<td>N = 168</td>
<td>Quality of life</td>
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<td>Intervention Group</td>
<td>SF_36 Role - Physical MKL: Availability MKL: Consultation MKL: Consideration MKL: Finance</td>
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<td>Physiological measures of disease</td>
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<td>Total cholesterol (mg/dL) HDL (mg/dL) LDL (mg/dL) Triglycerids (mg/dL)</td>
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<tr>
<td>[39]</td>
<td>RCT</td>
<td>Pharmacy Other</td>
<td>18 months</td>
<td>N = 1164</td>
<td>N = 1290</td>
<td>Health service use</td>
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<td>Intervention Group</td>
<td>Hospitalisation Number of contact with GPs (mean)</td>
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<td>Quality of life</td>
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<td>SF_36 Role - Physical Rating the pharmacist services as excellent</td>
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<td>Satisfaction with the pharmacist services Overall positive opinion of pharmaceutical care</td>
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<td>Skill-mix: Dr substitution by pharmacist</td>
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<td>Intervention Group</td>
<td>Pharmaceutical care issues identified without care planning.</td>
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<td>Medication review led by a pharmacist</td>
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<td>Outcome measures</td>
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<td></td>
<td>Potential/suspected adverse drug reaction resolved Monitoring issues resolved Potential ineffective therapy resolved Education required resolved Inappropriate dosage regime resolved</td>
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<td>Health service use</td>
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<td>Number of admissionNumber of practice nurses contact for drug related or therapy monitoring Number of GPs contact for drug related or therapy monitoring</td>
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<td>Quality of life</td>
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<td>SF36 Total SF_36 Role - Physical</td>
</tr>
</tbody>
</table>

**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.

**[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.

**[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

**[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**

- 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 Rating the pharmacist services as excellent Satisfaction with the pharmacist services Overall positive opinion of pharmaceutical care
<table>
<thead>
<tr>
<th>Study</th>
<th>Study Design</th>
<th>Setting</th>
<th>Duration</th>
<th>Control Group</th>
<th>Intervention Group</th>
<th>Skill-mix</th>
<th>Control intervention</th>
<th>Intervention intervention</th>
<th>Outcome measures</th>
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<tbody>
<tr>
<td>[40]</td>
<td>RCT</td>
<td>Community based care</td>
<td>Urban and rural, USA</td>
<td>N = 331</td>
<td>N = 344</td>
<td>Dr substitution by pharmacist</td>
<td>Control intervention</td>
<td>Patients received the same brochure, general advice only with minimal follow-up</td>
<td>Community pharmacist provided patient education, point of care cholesterol measurement, and regular follow up, and brochures on risk factors</td>
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<td>Performance of a cholesterol panel</td>
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<td>New prescription of a cholesterol-lowering medication</td>
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<td>Increase dose of cholesterol-lowering medication</td>
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<td>General satisfaction with pharmacy services (mean)</td>
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<td>Satisfaction with pharmacist-physician communication (mean)</td>
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<td>[41]</td>
<td>CBA</td>
<td>Primary Care</td>
<td>Urban, USA</td>
<td>N = 41</td>
<td>N = 47</td>
<td>Dr substitution by pharmacist</td>
<td>Control intervention</td>
<td>Usual care</td>
<td>Pharmacist prescribing and adjusting the drug therapy for patients with elevated LDL.</td>
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<td>LDL (mg/dL)</td>
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<td>HDL (mg/dL)</td>
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<td>Total cholesterol (mg/dL)</td>
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<td>[42]</td>
<td>BA</td>
<td>Pharmacy</td>
<td>Urban, USA</td>
<td>N = 111</td>
<td>Same as control</td>
<td>Dr substitution by pharmacist</td>
<td>Intervention</td>
<td>Osteoporosis screening and intervention programme directed by a pharmacist in community setting.</td>
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<td>Self-rating of awareness of osteoporosis score (median)</td>
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<td>[43]</td>
<td>CCT</td>
<td>Primary Care</td>
<td>Urban, USA</td>
<td>N = 92</td>
<td>N = 89</td>
<td>Dr substitution by pharmacist</td>
<td>Control intervention</td>
<td>Usual care</td>
<td>Pharmacist provided diabetes care following detailed algorithms under supervision of a diabetologist.</td>
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<td>Physiological measures of disease</td>
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<td>HbA1c</td>
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<td>[44]</td>
<td>BA</td>
<td>Primary Care</td>
<td>Urban, USA</td>
<td>N = 157</td>
<td>Same as control</td>
<td>Dr substitution by pharmacist</td>
<td>Intervention</td>
<td>Diabetes management provided by clinical pharmacist.</td>
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<td>Physiological measures of disease</td>
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63
<table>
<thead>
<tr>
<th>Duration: ?months</th>
<th>Control Group</th>
<th>Intervention Group</th>
<th>Skill-mix: Dr substitution by pharmacist</th>
<th>Control intervention</th>
<th>Usual care brief counselling, usual medication review &amp; monitoring for adverse drug reactions.</th>
<th>Outcome measures</th>
<th>Physiological measures of disease</th>
<th>HbA1C LDL (mm/dL) Triglycerids (mg/dL) HDL (mg/dL)</th>
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<tbody>
<tr>
<td>[45] RCT Primary Care</td>
<td>Hypertension N = 41</td>
<td>Hypertension N = 41</td>
<td>Control Group Hypertension N = 41</td>
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<td>Duration: 6 months</td>
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<td>Skill-mix: Dr substitution by pharmacist</td>
<td>Control intervention</td>
<td>Usual care brief counselling, usual medication review &amp; monitoring for adverse drug reactions.</td>
<td>Outcome measures</td>
<td>Physiological measures of disease</td>
<td>Systolic blood pressure (mean) Diastolic blood pressure (mean)</td>
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<tr>
<td>[46] CCT Primary Care</td>
<td>Diabetes % Hypertension N = 75</td>
<td>Diabetes % Hypertension N = 75</td>
<td>Control Group Diabetes % Hypertension N = 75</td>
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<tr>
<td>Urban, USA</td>
<td>Duration: 24 months</td>
<td></td>
<td>Skill-mix: Dr substitution by pharmacist</td>
<td>Control intervention</td>
<td>Usual care brief counselling, usual medication review &amp; monitoring for adverse drug reactions.</td>
<td>Outcome measures</td>
<td>Physiological measures of disease</td>
<td>Total cholesterol (mean) Triglyceride (mean) LDL (mean) HDL (mean)</td>
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<tr>
<td>[47] RCT Primary Care</td>
<td>Hypertension Lipid disorders Diabetes N = 36</td>
<td>Hypertension Lipid disorders Diabetes N = 33</td>
<td>Control Group Hypertension Lipid disorders Diabetes N = 36</td>
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<tr>
<td>Urban, USA</td>
<td>Duration: 12 months</td>
<td></td>
<td>Skill-mix: Dr substitution by pharmacist</td>
<td>Control intervention</td>
<td>Usual care brief counselling, usual medication review &amp; monitoring for adverse drug reactions.</td>
<td>Outcome measures</td>
<td>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</td>
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</tr>
<tr>
<td>[48] RCT Primary Care</td>
<td>Asthma COPD Other N = 137</td>
<td>Asthma COPD Other N = 139</td>
<td>Control Group Asthma COPD Other N = 137</td>
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<tr>
<td>Urban, Netherlands</td>
<td>Duration: 24 months</td>
<td></td>
<td>Skill-mix : Innovation</td>
<td>Control intervention</td>
<td>Usual care by GP</td>
<td>Outcome measures</td>
<td>Quality of life Respiratory Illness QoL (mean) Physiological measures of disease</td>
<td>Degree of dyspnea (mean) No chronic cough and phlegm production No wheezing</td>
</tr>
<tr>
<td>Study</td>
<td>Type</td>
<td>Setting</td>
<td>Duration</td>
<td>Control Group</td>
<td>Intervention Group</td>
<td>Skill-mix</td>
<td>Control intervention</td>
<td>Intervention</td>
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<tr>
<td>[49]</td>
<td>RCT</td>
<td>Urban, USA</td>
<td>12 months</td>
<td>N = 67 Diabetes</td>
<td>N = 71 Intervention Group Diabetes</td>
<td>Nurse enhancement</td>
<td>Control intervention</td>
<td>Usual care from primary care physician</td>
</tr>
<tr>
<td>[50]</td>
<td>BA</td>
<td>Urban, Australia</td>
<td>? months</td>
<td>N = 24 Same as control</td>
<td>Nurse-initiated medication intervention including assessment, education, support, adherence review.</td>
<td>Nurse enhancement</td>
<td>Intervention</td>
<td>Heart failure case management by a nurse.</td>
</tr>
<tr>
<td>[51]</td>
<td>BA</td>
<td>Urban, Netherlands</td>
<td>? months</td>
<td>N = 51 Same as control</td>
<td>Nurse enhancement</td>
<td>Community nurse provided assessment for factors causing falls and impairments in mobility at home and advice, referrals for elderly people living in the community</td>
<td>Community nurse provided assessment for factors causing falls and impairments in mobility at home and advice, referrals for elderly people living in the community</td>
<td>Heart failure</td>
</tr>
<tr>
<td>RCT Code</td>
<td>Study Type</td>
<td>Location</td>
<td>Duration</td>
<td>Control Group</td>
<td>N</td>
<td>Intervention Group</td>
<td>N</td>
<td>Skill Mix</td>
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<tr>
<td>[53]</td>
<td>RCT</td>
<td>Community Urban, USA</td>
<td>36 months</td>
<td>Control Group</td>
<td>199</td>
<td>Intervention Group</td>
<td>215</td>
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<td>[54]</td>
<td>RCT</td>
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<td>12 months</td>
<td>Control Group</td>
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<td>Intervention Group</td>
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<td>Community Urban, Canada</td>
<td>14 months</td>
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<td>RCT</td>
<td>Community Rural, Other</td>
<td>18 months</td>
<td>Control Group</td>
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<td>Intervention Group</td>
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<td>Nurse enhancement</td>
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<td>[57]</td>
<td>CBA</td>
<td>Primary Care Urban, UK</td>
<td>24 months</td>
<td>Control Group</td>
<td>66</td>
<td>Intervention Group</td>
<td>66</td>
<td>Nurse enhancement</td>
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<td>[58]</td>
<td>RCT</td>
<td>Control Group</td>
<td>N = 60</td>
<td>Nurse enhancement</td>
<td>Control intervention</td>
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<td>Study Type</td>
<td>Setting</td>
<td>Duration</td>
<td>Control Group</td>
<td>Intervention Group</td>
<td>Outcome Measures</td>
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<tr>
<td>Primary Care</td>
<td>Urban and rural, UK</td>
<td>12 months</td>
<td>N = 63</td>
<td>N = 67</td>
<td>SF-12 Physical health, AUDIT score (mean), Standard drink units/week (mean), Drinking problem Index (mean)</td>
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<tr>
<td>RCT</td>
<td>Primary Care</td>
<td>Urban, Canada</td>
<td>18 months</td>
<td>N = 63</td>
<td>N = 64</td>
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<tr>
<td>Control Group</td>
<td>Ischaemic heart disease Diabetes</td>
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<td>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.</td>
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<tr>
<td>Control intervention</td>
<td>Usual care by primary care physician</td>
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<tr>
<td>Intervention Group intervention</td>
<td>Nurses provided follow up after patients discharge from hospital, monitor lipid level, recommend physician for appropriate intervention, and ensure treatment initiated.</td>
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<tr>
<td>Outcome measures</td>
<td>Health service use, Consultation time/patient/18 months, Quality of life, Physiological measures of disease, Percentage achieved LDL &lt;2.5mmol/L, Percentage achieved all lipid targets</td>
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<td>Other</td>
<td>Urban, England</td>
<td>24 months</td>
<td>N = 323</td>
<td>N = 293</td>
<td>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.</td>
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<tr>
<td>Control intervention</td>
<td>Usual care (Patients in 2 neurological sites not in the programme)</td>
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<tr>
<td>Intervention Group intervention</td>
<td>Care provided to patients with MS by MS specialist nurse at rehab centres and neurological services.</td>
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<tr>
<td>Outcome measures</td>
<td>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</td>
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<tr>
<td>Primary Care</td>
<td>Urban, UK</td>
<td>12 months</td>
<td>N = 567</td>
<td>N = 316</td>
<td>Skill-mix: Nurse enhancement, Control intervention, Usual care, Intervention Group intervention, Brief behavioural counselling by practice nurses</td>
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<tr>
<td>Control Group</td>
<td>N = 567</td>
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<tr>
<td>Intervention Group</td>
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<td>N = 316</td>
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<tr>
<td>Outcome measures</td>
<td>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</td>
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APPENDIX 6: LIST OF THE 61 EXPERIMENTAL PAPERS INCLUDED


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


20. Judy Parker and David Dunt, Victorian Nurse practitioner project-Evaluation of Phase 1 demonstration projects.


29. Ian Cameron, Middle Level Clinicians – A Role in Rural Australia?, NSW Rural Doctors Network.

30. Ivan Lin, Emma Birch, and Belinda Goodale, Rural and remote therapy assistants in Western Australia: the development of a statewide approach, in NSW RRAH Conference. 2005.
APPENDIX 8: LIST OF PAPER EXCLUDED FROM THE REVIEW


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