

Substitution of doctors by nurses in primary care (Review)

Laurant M, Reeves D, Hermens R, Braspenning J, Grol R, Sibbald B



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[Intervention Review]

Substitution of doctors by nurses in primary care

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ABSTRACT

Background

Demand for primary care services has increased in developed countries due to population ageing, rising patient expectations, and reforms that shift care from hospitals to the community. At the same time, the supply of physicians is constrained and there is increasing pressure to contain costs. Shifting care from physicians to nurses is one possible response to these challenges. The expectation is that nurse-doctor substitution will reduce cost and physician workload while maintaining quality of care.

Objectives

Our aim was to evaluate the impact of doctor-nurse substitution in primary care on patient outcomes, process of care, and resource utilisation including cost. Patient outcomes included: morbidity; mortality; satisfaction; compliance; and preference. Process of care outcomes included: practitioner adherence to clinical guidelines; standards or quality of care; and practitioner health care activity (e.g. provision of advice). Resource utilisation was assessed by: frequency and length of consultations; return visits; prescriptions; tests and investigations; referral to other services; and direct or indirect costs.

Search methods

The following databases were searched for the period 1966 to 2002: Medline; Cinahl; Bids, Embase; Social Science Citation Index; British Nursing Index; HMIC; EPOC Register; and Cochrane Controlled Trial Register. Search terms specified the setting (primary care), professional (nurse), study design (randomised controlled trial, controlled before-and-after-study, interrupted time series), and subject (e.g. skill mix).

Selection criteria

Studies were included if nurses were compared to doctors providing a similar primary health care service (excluding accident and emergency services). Primary care doctors included: general practitioners, family physicians, paediatricians, general internists or geriatricians. Primary care nurses included: practice nurses, nurse practitioners, clinical nurse specialists, or advanced practice nurses.

Data collection and analysis

Study selection and data extraction was conducted independently by two reviewers with differences resolved through discussion. Meta-analysis was applied to outcomes for which there was adequate reporting of intervention effects from at least three randomised controlled trials. Semi-quantitative methods were used to synthesize other outcomes.

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Main results

4253 articles were screened of which 25 articles, relating to 16 studies, met our inclusion criteria. In seven studies the nurse assumed responsibility for first contact and ongoing care for all presenting patients. The outcomes investigated varied across studies so limiting the opportunity for data synthesis. In general, no appreciable differences were found between doctors and nurses in health outcomes for patients, process of care, resource utilisation or cost.

In five studies the nurse assumed responsibility for first contact care for patients wanting urgent consultations during office hours or out-of-hours. Patient health outcomes were similar for nurses and doctors but patient satisfaction was higher with nurse-led care. Nurses tended to provide longer consultations, give more information to patients and recall patients more frequently than did doctors. The impact on physician workload and direct cost of care was variable.

In four studies the nurse took responsibility for the ongoing management of patients with particular chronic conditions. The outcomes investigated varied across studies so limiting the opportunity for data synthesis. In general, no appreciable differences were found between doctors and nurses in health outcomes for patients, process of care, resource utilisation or cost.

Authors' conclusions

The findings suggest that appropriately trained nurses can produce as high quality care as primary care doctors and achieve as good health outcomes for patients. However, this conclusion should be viewed with caution given that only one study was powered to assess equivalence of care, many studies had methodological limitations, and patient follow-up was generally 12 months or less.

While doctor-nurse substitution has the potential to reduce doctors' workload and direct healthcare costs, achieving such reductions depends on the particular context of care. Doctors' workload may remain unchanged either because nurses are deployed to meet previously unmet patient need or because nurses generate demand for care where previously there was none. Savings in cost depend on the magnitude of the salary differential between doctors and nurses, and may be offset by the lower productivity of nurses compared to doctors.

PLAIN LANGUAGE SUMMARY

In primary care, it appears that appropriately trained nurses can produce as high quality care and achieve as good health outcomes for patients as doctors. However, the research available is quite limited.

Many countries have sought to shift the provision of primary care from doctors to nurses in order to reduce the demand for doctors and improve healthcare efficiency. The expectation is that nurses working as substitutes can provide as high quality care as doctors at lower cost. This review found that quality of care is similar for nurses and doctors but it is not known if it decreases the doctor's workload. Nurses tend to provide more health advice and achieve higher levels of patient satisfaction compared with doctors. Even though using nurses may save salary costs, nurses may order more tests and use other services which may decrease the cost savings of using nurses instead of doctors.

BACKGROUND

Demand for primary care services has increased in many countries due to population ageing, rising patient expectations, and reforms that shift care from hospitals to the community. At the same time, the supply of physicians is constrained and there is increasing pressure to contain costs. Shifting care from doctors to nurses, is one possible response to these challenges (Jenkins-Clarke 1998; Whitecross 1999). A review of research into the substitutability of nurses for doctors suggested that 25% to 70% of the work under-

taken by doctors might be moved to nurses (Richardson 1998). In primary care, nurses may undertake much of the health promotion work of family practice (Family HSG 1994; Muir 1995), and play a leading role in the routine management of chronic diseases such as asthma, diabetes and coronary heart disease (Aubert 1998; Charlton 1991; Kirkman 1994). The expectation is that primary care nurses working in extended roles can:

a) enhance the quality of services provided by doctors;

b) safely substitute for doctors in an wide array of services, so reducing demand for doctors; and

c) reduce the direct costs of services because nurse are cheaper to hire than physicians.

Nurses may work either as doctor supplements or as doctor substitutes. Nurses working as doctor supplements provide services which complement or extend those provided by doctors. The aim is to improve the quality of care and extend the range of services available to patients. In contrast, nurses working as doctor substitutes provide services which otherwise would be provided by doctors alone. The aim is to reduce the demand for doctors. Gains in service efficiency may be achieved if doctors give up providing the services they have delegated to nurses, and instead invest their time in activities that only doctors can perform (Richardson 1999). This review is focused on the impact of nurses working as substitutes for primary care doctors.

Previous systematic reviews of doctor-nurse substitution in primary care have sought to identify whether nurses differ from doctors in terms of patient outcomes, process of care or resource utilisation. In 1995, Brown and Grimes conducted a meta-analysis of American and Canadian research into doctor-nurse substitution in primary care (Brown 1995). Thirty-eight studies were included in the review, covering a wide range of nursing roles and encompassing both (quasi) experimental and observational research designs. The findings suggested that, as compared with doctor-led care, nurse-led care was associated with higher levels of patient compliance and satisfaction, longer consultations, and higher rates of laboratory testing. Health outcomes for patients were similar. These findings are supported by the more recent systematic review of Horrocks et al in 2002 (Horrocks 2002). They included 11 randomised controlled trials and 23 prospective observational studies of nurses acting as doctor substitutes for patients with undifferentiated healthcare problems in primary care settings in developed countries. The findings suggested that patient health care outcomes were similar for doctors and nurses, but that nurse-led care was associated with higher levels of patient satisfaction, longer consultations and higher rates of investigation.

Both reviews are flawed in their inclusion of observational research which is susceptible to producing biased estimates of differences between doctors and nurses through failure to control for other factors that may affect outcome. In addition, by combining a diversity of nurse roles, it remains unclear whether the observed differences or similarities between nurses and doctors vary with the particular type of role substitution. We aimed to address these deficiencies.

OBJECTIVES

Our aim was to investigate the impact of nurses working as substitutes for primary care doctors on:

- Outcomes for patients
- Process of care
- Resource utilisation
- Direct (service) and indirect (societal) costs

METHODS

Criteria for considering studies for this review

Types of studies

Three types of study were eligible for inclusion:

- Randomised controlled trials (RCT): Random or quasi-random allocation of subjects to intervention and control groups.
- Controlled before and after studies (CBA): the intervention group is compared with a control group selected by non-random processes. Outcomes must be measured before as well as after the intervention.
- Interrupted time series (ITS). Longitudinal examination of outcomes with at least three observations before and again after the intervention.

Types of participants

- Doctors - primary care physicians which could include general practitioners, family doctors, paediatricians, general internists or geriatricians.
- Nurses - any qualified nurse working as a substitute to a primary care physician. This could include: nurse practitioners, clinical nurse specialists, advanced practice nurses, practice nurses, health visitors, etc. As the job title, education, and experience of nurses varies considerably among and within countries, we did not select nurses by virtue of their job title. Only trainee nurses and mental health nurses were excluded.
- Patients - presenting in primary care, excluding accident and emergency.

The review is limited to primary health care services that provide first contact and ongoing care for patients with all types of health problems. It includes family practice or general practice, outpatient settings, and ambulatory primary care settings (excluding accident and emergency).

Types of interventions

Our focus was on nurses working as substitutes for primary care doctors. Substitution refers to the situation where task(s) formerly performed by one type of professional (i.e. doctor) are transferred

to a different type of professional (i.e. nurse), usually with the intention of reducing cost or addressing workforce shortages. Substitution studies typically examine the case where a nurse is responsible for providing the same health care as a doctor, and the performance of these two practitioners is compared. For example, a nurse-led clinic for a particular disease or condition is compared to a doctor-led clinic.

Supplementation refers to the situation where a nurse supplements or extends the care of the doctor by providing a new primary care service. The aim is generally to improve the quality of care rather than reduce cost or address workforce shortages. Supplementation studies typically compare usual care by a doctor to an innovative service provided by a nurse working alongside a doctor. For example, a family practice with a nurse-led diabetes clinic is compared to a family practice without such a clinic. This type of study risks confounding two aspects of care provision:

- a) type of service (specialised clinic vs routine consultation), and
- b) who provides that service (doctor or nurse)

Supplementation studies have been excluded from this review.

Some studies investigated complex interventions where practitioner care was combined with other interventions. Where a factorial study design was employed, the nurse can be compared with the doctor independently of other interventions. In such cases, we report only the effect attributable to the nurse compared with the doctor.

Types of outcome measures

Four types of outcomes were considered for this review, patient outcomes, process of care outcomes, resource utilisation outcomes and cost outcomes.

Patient outcomes

- Morbidity.
- Mortality.
- Quality of life.
- Satisfaction.
- Patient compliance.
- Other (knowledge, preference for doctor or nurse).

Process of care outcomes

- Practitioner adherence to clinical guidelines.
- Standards or quality of care.
- Practitioner health care activity (examinations, provision of advice).

Resource utilisation outcomes

- Frequency and length of consultations.
- Return visits.
- Prescriptions.
- Tests and investigations.
- Referral/use of other services.

Cost outcomes

- Direct (service) .

- Indirect (societal) costs.

Search methods for identification of studies

The following databases were searched: Medline; Cinahl; Bids Embase; Social Science and Citation Indexes; British Nursing index; HMIC; EPOC Register; Cochrane Controlled Trial Register (CCTR); and the National Primary Care Research and Development Centre's own database. The search terms combined Medical Subject Headings (MeSH) and free text words as shown in the strategy below. The search was conducted first in 1999 (1966 till 1999) and then updated in 2002 (1999 till 2002). The updated search was restricted by study design.

Search methods

#1 ('Family-Practice' / all topical subheadings / all age subheadings in DE) or ('Physicians-Family' / all topical subheadings / all age subheadings in DE) or ('Primary-Health-Care' / all topical subheadings / all age subheadings in DE) or ('Primary-Nursing' / all topical subheadings / all age subheadings in DE) or ('Nursing-Care' / all topical subheadings / all age subheadings in DE)

#2 primary near care

#3 #1 or #2

#4 ('Community-Health-Nursing' / all topical subheadings / all age subheadings in DE) or ('Nurse-Administrators' / all topical subheadings / all age subheadings in DE) or ('Nurse-Midwives' / all topical subheadings / all age subheadings in DE) or ('Nurse-Practitioners' / all topical subheadings / all age subheadings in DE) or ('Clinical-Nurse-Specialists' / all topical subheadings / all age subheadings in DE)

#5 nurse*

#6 nurse manager*

#7 district nurs*

#8 practice nurs*

#9 health visit*

#10 #4 or #5 or #6 or #7 or #8 or #9

#11 ('Cooperative-Behavior' / all topical subheadings / all age subheadings in DE) or ('Job-Description' / all topical subheadings / all age subheadings in DE) or ('Professional-Autonomy' / all topical subheadings / all age subheadings in DE) or ('Clinical-Competence' / all topical subheadings / all age subheadings in DE)

#12 clinical practice

#13 deleg*

#14 multidisplin*

#15 substitut*

#16 cooperat*

#17 role*

#18 skill mix

#19 health promotion

#20 team*

#21 patient counselling
 #22 nurs* near5 general pract*
 #23 #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22
 #24 ('Clinical-Trials' / all topical subheadings / all age subheadings in DE) or ('Double-Blind-Studies' / all topical subheadings / all age subheadings in DE) or ('Evaluation-Research' / all topical subheadings / all age subheadings in DE) or ('Prospective-Studies' / all topical subheadings / all age subheadings in DE) or ('Single-Blind-Studies' / all topical subheadings / all age subheadings in DE) or ('Study-Design' / all topical subheadings / all age subheadings in DE)
 #25 random allocation
 #26 rct
 #27 (randomised controlled trial*) or (randomized controlled trial*)
 #28 comparative stud*
 #29 interrupted time series
 #30 #24 or #25 or #26 or #27 or #28 or #29
 #31 #3 and #10 and #23 and #30 with limitations
 #32 #31 and (PY=1999-2001) and (DT=JOURNAL-ARTICLE) and (LA=ENGLISH)
 Medline SEARCH STRATEGY UPDATE:
 Combination Set 1 + Set 2 + Set 3 + Set 4 (with limitations)
 #31 #30 and (PY=1999-2001) and (LA=ENGLISH) and (PT=JOURNAL-ARTICLE) (59 records)
 #30 #3 and #10 and #23 and #29 (95 records)
 Set 4: Design/methodology
 #29 #24 or #25 or #26 or #27 or #28 (141427 records)
 #28 interrupted time series (0 records)
 #27 Comparative stud* (4656 records)
 #26 (randomised controlled trial*) or (randomized controlled trial*) (14922 records)
 #25 rct (350 records)
 #24 ('Clinical-Trials' / all subheadings in MIME,MJME) or ('Controlled-Clinical-Trials' / all subheadings in MIME,MJME) or ('Double-Blind-Method' / all subheadings in MIME,MJME) or ('Evaluation-Studies' / all subheadings in MIME,MJME) or ('Follow-Up-Studies' / all subheadings in MIME,MJME) or ('Prospective-Studies' / all subheadings in MIME,MJME) or ('Random-Allocation' / all subheadings in MIME,MJME) or ('Randomized-Controlled-Trials' / all subheadings in MIME,MJME) or ('Single-Blind-Method' / all subheadings in MIME,MJME) or ('Research-Design' / all subheadings in MIME,MJME) (134715 records)

Set 3: Substitution

#23 #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 (255757 records)
 #22 nurs* near5 general pract* (156 records)
 #21 patient counseling (263 records)
 #20 team* (11973 records)

#19 health promotion (6052 records)
 #18 skill mix (53 records)
 #17 role* (189215 records)
 #16 cooperat* (14653 records)
 #15 substitut* (30365 records)
 #14 multidisplin* (4 records)
 #13 deleg* (428 records)
 #12 clinical practice (8293 records)
 #11 ('Cooperative-Behavior' / all subheadings in MIME,MJME) or ('Job-Description' / all subheadings in MIME,MJME) or ('Professional-Autonomy' / all subheadings in MIME,MJME) or ('Clinical-Competence' / all subheadings in MIME,MJME) (10749 records)
 Set 2: Nurse
 #10 #4 or #5 or #6 or #7 or #8 or #9 (50752 records)
 #9 health visit* (335 records)
 #8 practice nurs* (2311 records)
 #7 district nurs* (110 records)
 #6 nurse manager* (192 records)
 #5 nurs* (50649 records)
 #4 ('Nurse-Administrators' / all subheadings in MIME,MJME) or ('Nurse-Clinicians' / all subheadings in MIME,MJME) or ('Nurse-Midwives' / all subheadings in MIME,MJME) or ('Nurse-Practitioners' / all subheadings in MIME,MJME) or ('Community-Health-Nursing' / all subheadings in MIME,MJME) (6662 records)
 Set 1: Setting
 #3 #1 or #2 (18096 records)
 #2 primary near care (12217 records)
 #1 ('Family-Practice' / all subheadings in MIME,MJME) or ('Primary-Health-Care' / all subheadings in MIME,MJME) or ('Primary-Nursing-Care' / all subheadings in MIME,MJME) or ('Physicians-Family' / all subheadings in MIME,MJME) (12588 records)

The titles and abstracts of articles uncovered by the above searches were independently screened by two reviewers. The full text of potentially relevant articles was obtained for further evaluation. The reference lists of included articles, and of existing published reviews of doctor-nurse substitution, were checked for other potentially relevant studies. Only articles written in English or Dutch were included.

Data collection and analysis

Each potentially relevant study was independently assessed for inclusion in the review by two reviewers. Differences between the reviewers were resolved by discussion. Excluded studies along with the reasons for their exclusion are given below (See Reference list, excluded studies). A data extraction form based on the standard EPOC checklist was designed for this review (See Group Details). Data from each included study were extracted independently by two reviewers. Differences were resolved by discussion.

If a single publication reported two or more separate studies, then each study was extracted separately. If the findings of a single study were spread across two or more publications, then the publications were extracted as one. For each study with more than one control or comparison group for the nurse intervention, we report only the results for the control condition in which doctors provided the same intervention as the nurse.

Standard EPOC criteria were used to assess the methodological quality of the studies (See Assessment of Methodological Quality in Group Details).

Analysis

Studies were grouped by nurse role for analysis, as follows:

- First contact and ongoing care for undifferentiated patients.
- First contact care for patients wanting urgent attention during office hours or out-of-hours.
- Routine management of patients with chronic conditions.

For each group, meta-analysis was applied to outcomes for which there was adequate reporting of intervention effects from at least three randomised controlled trials. We excluded non-randomised studies from meta-analysis due to their inherently greater potential for bias, and we excluded outcomes for which less than three randomised controlled trials were available on the grounds that a meta-analysis would not add substantial value to a semi-quantitative examination. Outcomes not amenable to meta-analysis were subjected to semi-quantitative synthesis. All results reported below are statistically significant unless otherwise stated.

A fixed-effects (FE) model was used for all meta-analyses. A general recommendation is that, when there is evidence of substantial heterogeneity between study results, a Random Effects (RE)

model should also be applied (Petitti 2001). Despite significant heterogeneity, we decided against the use of RE models for two main reasons: (i) we had very small numbers of studies in each analysis - three at most; and (ii) we had no basis for assuming that effect sizes are normally distributed. These factors can result in RE estimates of overall effect and confidence intervals that are quite inaccurate (Alderson 2004; Biggerstaff 1997; Maas 2004) and, in our view, the risk of drawing an inappropriate conclusion from the analysis was too large to justify the use of RE models. In contrast, the FE model is known to provide accurate estimates of the average effect (and confidence interval) within the included studies even when the number of studies is small (Brockwell 2001), but does not provide a statistical basis for generalising beyond the studies in hand (Bailey 1987).

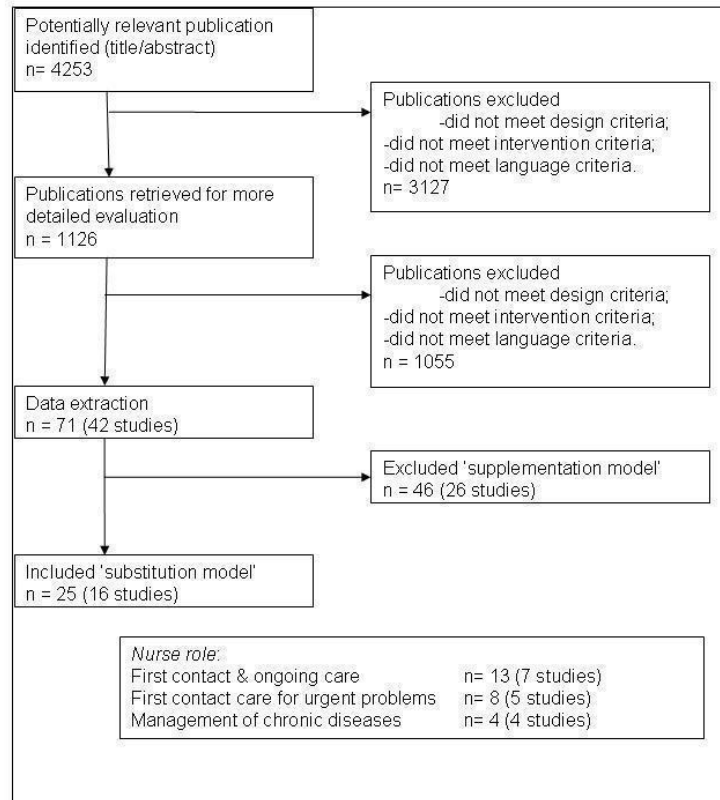
RESULTS

Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#).

The initial searches identified 4253 potentially relevant articles (3784 in the original search, and 469 in the updated search) of which 25 publications, relating to 16 studies met our inclusion criteria (Figure 1). We identified a further 46 studies which investigated the role of nurses working as supplements to primary care doctors; these have been excluded from the review and will be reported separately.

Figure 1. Trial Flow



We included 16 studies. In seven studies (Chambers 1977; Chambers 1977; Flynn 1974; Hemani 1999, Munding 2000, Spitzer 1973), the nurse assumed responsibility for first contact and ongoing care for all presenting patients. In five studies the nurse assumed responsibility for first contact care for patients wanting urgent consultations during routine practice hours (Kinnersley 2000; Myers 1997; Shum 2000; Venning 2000) or out-of-hours (Lattimer 1998). In four studies (Lewis 1969; McIntosh 1997; Moher 2001; Spitzer 1973) the nurse had responsibility for the ongoing management of patients with particular chronic conditions. In one of these studies (McIntosh 1997) the nurse provided counselling to problem drinkers. In all studies, the control or comparison group consisted of doctors providing the same services to patients as the nurses.

Risk of bias in included studies

Of the 16 studies included, three were controlled before-and-after studies (Chambers 1977, Gordon 1974, Myers 1997) and 13 were randomised or quasi-randomised controlled trials (Chambers 1978; Flynn 1974; Hemani 1999; Kinnersley 2000; Lattimer 1998; Lewis 1969; McIntosh 1997; Moher 2001; Munding 2000; Shum 2000; Spitzer 1973; Stein 1974; Venning 2000) (See Characteristics of Included Studies). The methodological quality of controlled before-and-after studies (Chambers 1977; Gordon 1974; Myers 1997) was assessed by nine quality criteria (Table 1). None of the three controlled before-and-after studies reported the statistical power. In one study (Chambers 1977) the unit of allocation was the community, whereas the unit of analysis was the patient with no allowance for clustering. In all three studies the intervention and control groups appeared to be comparable. Each study fulfilled four of the nine quality criteria.

The methodological quality of randomised controlled trials (Chambers 1978; Flynn 1974; Gordon 1974; Hemani 1999, Kinnersley 2000, Lattimer 1998, Lewis 1969, Moher 2001, Munding 2000, Shum 2000, Spitzer 1973, Stein 1974, Venning 2000) was also assessed by nine criteria (Table 2). All studies had methodological shortcomings. The power was reported in five of 13 trials (Kinnersley 2000; Lattimer 1998; McIntosh 1997; Munding 2000; Shum 2000), and two studies (Chambers 1978; Hemani 1999) reported that the study lacked the statistical power to detect clinically meaningful differences. Two studies (Chambers

1978; Spitzer 1973) used cluster randomisation without correcting for clustering in the analysis. Concealment of allocation was not reported in seven studies (Chambers 1978; Flynn 1974; Lewis 1969; McIntosh 1997; Moher 2001; Munding 2000; Spitzer 1973). In 12 out of 13 trials (Chambers 1978; Flynn 1974; Gordon 1974; Hemani 1999; Kinnersley 2000; Lattimer 1998; Lewis 1969; McIntosh 1997; Munding 2000; Myers 1997; Shum 2000; Spitzer 1973; Stein 1974; Venning 2000) it was unclear whether or not contamination had occurred. Of the 13 trials, none fulfilled eight or more criteria; seven studies met four to seven criteria; and six studies met three or fewer criteria.

Effects of interventions

A. First contact and ongoing care for all presenting patients.

Patient outcomes were assessed in five studies (Chambers 1978; Flynn 1974; Gordon 1974; Munding 2000; Spitzer 1973). Health status was investigated in four of these (Chambers 1978; Gordon 1974; Munding 2000; Spitzer 1973); 25 outcomes were measured of which two were significantly better with nurse-led care and 23 showed no significant difference. One of the two observed differences between nurses and doctors is untrustworthy in that the study (Chambers 1978) made no allowance for cluster randomisation in the analysis. Patient satisfaction was assessed in three studies (Gordon 1974; Munding 2000; Spitzer 1973); 15 outcomes were measured of which one was significantly better with doctor-led care and 14 showed no significant difference. Patient compliance was assessed in two studies (Flynn 1974; Gordon 1974); four outcomes were measured and none differed significantly between doctors and nurses. Patient knowledge was assessed in one study; three outcomes were measured of which one was significantly better with nurse-led care and two showed no significant difference (Table 3).

Process of care was assessed in four studies (Chambers 1977; Flynn 1974; Gordon 1974; Spitzer 1973). Of the 12 outcomes measured, three were significantly better with nurse-led care. In 2 cases the nurse was significantly more likely than the doctor to provide lifestyle advice (Flynn 1974). In one case, sub-group analysis suggested that the nurse had significantly fewer lapses in care when treating patients with unstable chronic disease (Gordon 1974). The remaining nine outcomes showed no significant difference (Table 4).

Resource utilisation was assessed in three studies (Flynn 1974; Hemani 1999; Munding 2000). Consultation rates were investigated in two studies (Hemani 1999; Munding 2000) and neither found a significant difference between doctors and nurses. Tests and investigations were assessed in two studies (Flynn 1974; Hemani 1999); 22 outcomes were measured of which four showed significantly higher rates for nurses and the remainder showed no difference. Use of other health care services was assessed in all three studies; seven outcomes were measured of which one showed a significantly higher rate for nurses and the remainder showed no

significant difference (Table 5).

Direct costs were assessed in two studies (Chambers 1977; Spitzer 1973) and no significant differences were found (Table 6).

B. First contact care for patients wanting urgent attention.

Patient outcomes were assessed in four studies (Kinnersley 2000; Lattimer 1998; Shum 2000; Venning 2000). Health status was investigated in all four studies; five outcomes were measured and none differed significantly between doctors and nurses. Patient satisfaction was assessed in 3 studies (Kinnersley 2000; Shum 2000; Stein 1974); 19 outcomes were measured of which 12 were significantly better with nurse-led care and seven showed no significant difference. Meta-analysis of three studies (Kinnersley 2000; Shum 2000; Venning 2000) showed that patient satisfaction was higher with nurse-led care as compared with doctor-led care (standardised mean difference 0.28, 95% confidence interval: 0.21, 0.34) but the effect size was highly variable between studies (See Comparison 01.02). Patient compliance and enablement were measured in one study (Venning 2000) and no significant differences were found (Table 3).

Process of care was assessed in three studies (Kinnersley 2000; Shum 2000; Venning 2000). Of the eight outcomes measured, six were significantly better with nurse-led care - all showing nurses provided more information to patients than did doctors. The remaining two outcomes showed no significant difference (Table 4). Resource utilisation was assessed in five studies (Kinnersley 2000; Lattimer 1998; Myers 1997; Shum 2000; Venning 2000). Consultation length was measured in three studies (Kinnersley 2000; Shum 2000; Venning 2000) and all showed significantly longer consultations for nurses. Consultation rate was investigated in three studies (Kinnersley 2000; Shum 2000; Venning 2000); five outcomes were measured of which three showed significantly higher rates for nurses and the remainder showed no difference. Meta-analysis of these three studies showed that nurses were more likely than doctors to recall a patient (relative risk nurse will recall patient compared with doctor = 1.34, 95% confidence interval: 1.20, 1.49) but with considerable heterogeneity across studies (See Comparison 01.03). Prescribing rate was investigated in three studies (Kinnersley 2000; Shum 2000; Venning 2000); five outcomes were measured of which one showed a lower rate for nurses and the remainder showed no difference. Meta-analysis of these three studies suggested there was no significant difference between doctors and nurses in prescribing rates (relative risk nurse will prescribe compared to doctor = 1.00, 95% confidence limit: 0.96, 1.05) (See Comparison 01.04). Tests and investigations were examined in two studies (Kinnersley 2000; Venning 2000); two outcomes were measured of which one showed a higher rate for nurses. Use of other services was investigated in five studies (Kinnersley 2000; Lattimer 1998; Myers 1997; Shum 2000; Venning 2000); nine outcomes were measured and none showed a significant difference between nurses and doctors. Meta-analysis of three studies (Kinnersley 2000; Lattimer 1998; Venning 2000) suggested that

there were no significant differences between doctors and nurses in referral rates to hospital (relative risk of referral by nurse compared to doctor = 0.79, 95% confidence interval: 0.58, 1.07) (Comparison 01.05). Doctors' workload was assessed in one study (Lattimer 1998); three outcomes were assessed, all of which showed a reduction in doctors' workload with nurse-led care (Table 5). Costs were assessed in two studies (Lattimer 1998; Venning 2000). One study (Lattimer 1998) showed a net reduction in direct costs with nurse-led care while the other (Venning 2000) found no difference (Table 6).

C. Routine management of patients with chronic conditions.

Patient outcomes were assessed in four studies (Lewis 1969; McIntosh 1997; Moher 2001; Stein 1974). Health status was assessed in all four studies; eight outcomes were measured of which one was significantly better with nurse-led care and seven showed no significant difference. Patient satisfaction was assessed in one study (Lewis 1969) and was found to be significantly higher with nurse-led care. Compliance was assessed in one study (Lewis 1969) and no significant difference was found. Patient knowledge was assessed in one study (Stein 1974) and was found to be significantly higher with nurse-led care (Table 3).

Process of care was investigated in one study (Moher 2001). Of the four outcomes measured, none differed significantly (Table 4). Resource utilisation was assessed in two studies (Moher 2001; Stein 1974). Consultation rate was examined in one study (Stein 1974) and no significant difference was found. Prescribing rates were investigated in both studies; four outcomes were measured and none showed a significant difference (Table 5).

Direct cost of care was assessed in one study (Lewis 1969) and no significant difference was found (Table 6).

DISCUSSION

The findings suggest that nurses and doctors generate similar health outcomes for patients, at least in the short-term, over the range of care investigated. This work included the provision of first contact and/or ongoing care for unselected patients and the management of patients with specific chronic conditions. The findings must be viewed with caution, however, given that only 1 study (in which nurses provided first contact care for patients wanting urgent attention out-of-hours) was powered to assess equivalence of care.

Patient satisfaction was higher when nurses, as opposed to doctors, provided first contact care for people wanting urgent attention. Patient satisfaction with chronic disease management was also found to be higher with nurse-led care, although this was investigated in only one study. The reason for this difference is unclear and may relate to a number of factors. Nurses tended to have longer consultations than doctors, and patient satisfaction is higher with longer consultations (Freeman 2002). Nurses also tended to provide more

information to patients than did doctors which might also have enhanced satisfaction.

High satisfaction with nurse care did not, however, mean that patients inevitably preferred nurses to doctors. Patient preferences in most studies were mixed with some patients preferring to see nurses while others preferred to see doctors. Preference might partly relate to the nature of the presenting problem. Nurses may be preferred when the patient believes their problem to be 'minor' or 'routine' but doctors are preferred when the problem is thought to be 'serious' or 'difficult' (Drury 1988).

Productivity was lower when nurses, as opposed to doctors, provided first contact care for people wanting urgent attention. Nurses tended to have longer consultation lengths and higher rates of patient recall while achieving the same health outcomes as doctors. This might be a learning effect whereby nurse productivity would improve as nurses gained more experience in their role. However, two of the three studies which assessed productivity used experienced nurses (Kinnersley 2000; Venning 2000) and only one (Shum 2000) did not. Moreover, no appreciable differences were found between doctors and nurses in other aspects of resource utilisation such as prescribing, use of tests or investigations, or referrals to other services. It therefore seems unlikely that the lower productivity of nurses as compared with doctors reflects their relative inexperience.

While no appreciable differences in resource use were found when nurses substituted for doctors in providing ongoing care for undifferentiated patients or those with particular chronic conditions, caseload (number of patients seen per unit of time) was not measured so productivity is unknown.

Only one of five studies (Lattimer 1998) in which nurses provided first contact care for patients wanting urgent attention out-of-hours, demonstrated clear cost savings with nurse-led services. In all other studies - spanning all three of the nursing roles considered in this review - the lower salary costs of nurses were offset by their increased use of resources or lower productivity. As salary differentials between nurses and doctors may vary from place to place and over time, the net saving to health care services, if any, will be highly context dependent (Richardson 1998).

Only 1 study investigated the impact of nurses on doctors' workload and this showed reductions in the demand for doctors (Lattimer 1998) in which nurses provided first contact care for patients wanting urgent attention out-of-hours). However, a recent controlled trial of adding nurses to doctors' teams showed no reduction in physician workload (Laurant 2004). This may be because nurses addressed previously unmet need or because nurses generated demand where previously there was none. In either case, the findings suggest that the addition of nurses to physician teams may not reduce workload unless active steps are taken to ensure doctors discontinue providing the services that have been transferred to nurses. Efficiency gains are possible if doctors invest this

'saved' time in activities that only doctors can perform (Richardson 1999).

It is self-evident that nurses must be adequately trained to act as substitutes for doctors. There is, however, no agreement as to the level of training required for nurses to undertake the specific roles covered by this review, and no consistency in the qualifications nurses must have to merit job titles such as nurse practitioner. Few studies contained detailed information on the nature of nurses' training for the specific role under investigation, making it impossible for us to draw any conclusions as to whether or how training affects outcomes. All the studies included in this review adopted the position that the nurses they investigated were competent to carry out the clinical role assigned to them and, indeed, the evidence supports that assumption. Additional research is therefore needed to examine the relationship between training and outcome.

The limitations of this review need to be considered. Our search strategy was designed to maximise sensitivity (detection of relevant research) at the expense of specificity (excluding irrelevant research). Even so, relevant research proved difficult to identify and some papers may have been missed, particularly in the 'grey' literature that we did not search. Publication bias seems unlikely as the clinical and research communities are interested equally in whether nurses outperform doctors or the reverse. The inclusion of only English and Dutch language publications risks excluding potentially relevant work. We did, however, screen the English abstracts of papers published in other languages and found none that appeared relevant. Research into doctor-nurse substitution in primary care appears primarily to have been conducted in Canada, the USA and the UK which are English-speaking countries.

We restricted our meta-analyses to Fixed Effect (FE) models. The FE approach provides reliable estimates of the average effect (and confidence interval) across included studies, but findings cannot be generalised beyond these studies to the wider population of practitioners and practices. Therefore, where we have generalised beyond the studies in hand, this has been a qualitative judgement based on assessment of all the available evidence of which the meta-analysis is just one component.

Most studies included only small numbers of nurses and very few considered the potential for variation in outcomes by practitioner. This may have led to over precision in the estimates of differences between doctors and nurses. In addition, studies intended to demonstrate the comparability of nurse and doctor care need to be powered to assess the equivalence, not difference, of outcomes. This was done in only one study (Lattimer 1998). A final concern is the narrow range of nurse roles that has been subjected to rigorous evaluation. Nurses in many countries provide a far wider range of care than is represented in the current research literature. Nurse-doctor substitution in the management of patients with particular chronic diseases has been infrequently studied.

AUTHORS' CONCLUSIONS

Implications for practice

The findings suggest that appropriately trained nurses can produce as high quality care as primary care doctors and achieve as good health outcomes for patients. Indeed nurses providing first care for patients needing urgent attention tend to provide more health advice and achieve higher levels of patient satisfaction compared with doctors.

Nurse-doctor substitution has the potential to reduce doctors' workload. However this benefit will not be realised in practise if doctors continue to provide the types of care that have been transferred to nurses. Doctors' workload may remain unchanged either because there was previously unmet need that nurses now fulfil or because nurses generate demand for care where previously there was none.

Nurse-doctor substitution has the potential to reduce the direct costs of care. Cost savings are, however, highly dependent on salary differentials between doctors and nurses and these may vary across locations and over time. In addition, savings on nurse salaries may be offset by nurses' longer consultation length and increased rate of patient recall relative to doctors, leading to no overall savings on cost.

Implications for research

Cost, particularly societal cost, has not been well investigated despite the widely held view that nurse-led care will generate savings. Future studies of nurse-doctor substitution should give more attention to the financial aspects of care. Related to this is the question of what impact nurses have on doctor behaviour and workload. This has rarely been evaluated despite the widely held view that nurses can 'save' doctors' time.

The methodological quality of studies is variable. Future studies should seek to maximise the numbers of practitioners (particularly nurses), rather than numbers of patients, in order to reduce the effect of any individual practitioner on outcomes. Studies also need to adopt methods of statistical analysis that account for variation in outcomes between practitioners, to avoid over precision and an inflated risk of type 1 errors (false positive results). Studies intended to demonstrate the comparability of nurse and doctor care need to be powered to assess the equivalence, not difference, of outcomes. A final concern is the narrow range of nurse roles that has been subjected to rigorous evaluation. Nurses in many countries provide a far wider range of care than is represented in the current research literature. Related to this is the question of what levels of training and experience are required by nurses working as doctor substitutes. The characteristics of nurses and doctors (numbers, training, experience) need to be reported more often and more consistently in studies in order to shed light on this issue.

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REFERENCES

References to studies included in this review

Chambers 1977 *{published data only}*

Black DP, Riddle RJ, Sampson E. Pilot project: The family practice nurse in a Newfoundland rural area. *Canadian Medical Association Journal* 1976;**114**:945.

* Chambers LW, Bruce-Lockhart P, Black DP, Sampson E, Burke M. A controlled trial of the impact of the family practice nurse on volume, quality and cost of rural health services. *Medical Care* 1977;**XV**(12):971–81.

Chambers 1978 *{published data only}*

* Chambers LW, West AE. St John's Randomized trial of the family practice nurse: health outcomes of patients. *International Journal of Epidemiology* 1978;**7**(2):153–61.

Flynn 1974 *{published data only}*

Flynn BC. The effectiveness of nurse clinicians service delivery. *American Journal of Public Health* 1974;**64**(6):604–11.

Gordon 1974 *{published data only}*

* Gordon DW. Health maintenance service: ambulatory patient care in the general medical clinic. *Medical Care* 1974;**XII**(8):648–58.

Hemani 1999 *{published data only}*

* Hemani A, Rastegar DA, Hill C, Al-Ibrahim MS. A comparison of resource utilization in nurse practitioners and physicians. *Effective Clinical Practice* 1999;**2**(6):258–65.

Kinnersley 2000 *{published data only}*

* Kinnersley P, Anderson E, Parry K, Clement J, Arcarhd L, Turton P, Stainthorpe A, Fraser A, Butler CB, Rogers C. Randomised controlled trial of nurse practitioner versus general practitioner care for patients requesting "same day" consultations in primary care. *BMJ* 2000;**320**:1043–8.

Lattimer 1998 *{published data only}*

* Lattimer V, George S, Thompson F, Thomas E, Mulle M, Turnbull J, Smith H, Moore M, Bond H, Glasper A (the South Wiltshire Out of Hours Project (SWOOP) Group). Safety and effectiveness of nurse telephone consultation in out of hours primary care: randomised controlled trial. *BMJ* 1998;**317**:1054–9.

Lattimer V, Sassi F, George S, Moore M, Turnbull J, Mulle M. Cost analysis of nurse telephone consultation in out of

hours primary care: evidence from a randomised controlled trial. *BMJ* 2000;**320**:1053–7.

South Wiltshire Out of Hours Project (SWOOP) Group. Nurse telephone triage in out of hours primary care: a pilot study. *BMJ* 1997;**314**:198–9.

Thompson F, George S, Lattimer V, Smith H, Moore M, Turnbull J, Mulle M, Thomas E, Bond H, Glasper A.

Overnight calls in primary care: randomised controlled trial of management using nurse telephone consultation. *BMJ* 1999;**319**:1408.

Lewis 1969 *{published data only}*

* Lewis CE, Resnik BA. Nurse clinics and progressive ambulatory patient care. *New England Journal of Medicine* 1969;**1969**(23):1236–41.

McIntosh 1997 *{published data only}*

* McIntosh MC, Leigh G, Baldwin NJ, Marmulak J. Reducing alcohol consumption. Comparing three brief methods in family practice. *Canadian Family Physician* 1997;**43**:1959–67.

Moher 2001 *{published data only}*

* Moher M, Yudkin P, Wright L, Turner R, Fuller A, Schofield T, Mant D for the Assessment of Implementation Strategies (ASSIST) Trial Collaborative Group. Cluster randomised controlled trial to compare three methods of promoting secondary prevention of coronary heart disease in primary care. *BMJ* 2001;**322**:1338–42.

Mundinger 2000 *{published data only}*

* Mundinger MO, Kane RI, Lenz ER, Totten AM, Tsji WY, Cleary Pd, Friedewald WT, Siu AL, Shelanski ML. Primary care outcomes in patients treated by nurse practitioners or physicians. A randomized trial. *JAMA* 2000;**283**(1):59–68. Sox HC. Independent primary care practice by nurse practitioners. [editorial]. *JAMA* 2000;**283**(1):106–108.

Myers 1997 *{published data only}*

* Myers PC, Lenci B, Sheldon MG. A nurse practitioner as the first point of contact for urgent medical problems in a general practice setting. *Family Practice* 1997;**14**(6):492–7.

Shum 2000 *{published data only}*

* Shum C, Humphreys A, Wheeler D, Cochrane MA, Skoda S, Clement S. Nurse management of patients with minor illnesses in general practice: multicentre randomised controlled trial. *BMJ* 2000;**320**:1038–43.

Spitzer 1973 {published data only}

* Sackett DL, Spitzer WO, Gent M, Roberts RS (in collaboration with: Hay WI, Lefroy GM, Sweeny GP, Vandervlist I, Sibley JC, Chambers IW, Goldsmith CH, Macpherson AS, McAuley RG). The Burlington randomized trial of the nurse practitioner: health outcomes of patients. *Annals of Internal Medicine* 1974;**80**:137–42.

Spitzer WO, Kergin DJ. Nurse practitioners in primary care. I. The McMaster University educational program. *Canadian Medical Association Journal* 1973;**108**:991–5.

Spitzer WO, Roberts RS, Delmore T. Nurse practitioners in primary care. V. Development of the utilization and financial index to measure effects of their deployment. *Canadian Medical Association Journal* 1976;**114**:1099–1102.

Spitzer WO, Roberts RS, Delmore T. Nurse practitioners in primary care. VI. Assessment of their deployment with the utilization and financial index. *Canadian Medical Association Journal* 1976;**114**:1103–8.

Sweeny GP, Ian Hay WI. The Burlington experience: a study of nurse practitioners in family practice. *Canadian Family Physician* 1973;**19**:101–10.

Stein 1974 {published data only}

* Stein GH. The use of a nurse practitioner in the management of patients with diabetes mellitus. *Medical Care* 1974;**XII**(10):885–90.

Venning 2000 {published data only}

* Venning P, Durie A, Roland M, Roberts C, Leese B. Randomised controlled trial comparing cost effectiveness of general practitioners and nurse practitioners in primary care. *BMJ* 2000;**320**:1048–53.

References to studies excluded from this review**Bakx 1997 {published data only}**

* Bakx JC, Stafleu A, van Staveren WA, van den Hoogen HJM, van Weel C. Long-term effect of nutritional counseling: a study in family medicine. *American Journal of Clinical Nutrition* 1997;**65**(suppl):1946S–50S.

van Ree, JW, van Gerwn W, van den Hoogen H. [Interventie bij een verhoogd risico op hart-en vaatziekten. 1. Resultaten op langere termijn van interventie bij hypercholesterolemie, adipositas en roken]. *Huisarts en Wetenschap* 1985;**28**:21–4.

van Ree, JW, van Gerwn W, van den Hoogen H. [Interventie bij een verhoogd risico op hart-en vaatziekten. 2. Resultaten op langere termijn bij de behandeling van hypertensie]. *Huisarts en Wetenschap* 1985;**28**:54–8, 77.

Batchelor 1975 {published data only}

* Batchelor GM, Spitzer WO, Comley AE, Anderson GD. Nurse practitioners in primary care IV. Impact of an interdisciplinary team on attitudes of a rural population. *Canadian Medical Association Journal* 1975;**112**:1415–20.

Chenoy NC, Spitzer WO, Anderson GD. Nurse practitioners in primary care II. Prior attitudes of a rural population. *Canadian Medical Association Journal* 1973;**108**:998–1003.

Spitzer WO, Kergin DJ. Nurse practitioners in primary care. I. The McMaster University educational program.

Canadian Medical Association Journal 1973;**108**:991–5.

Spitzer WO, Roberts RS, Delmore T. Nurse practitioners in primary care. V. Development of the utilization and financial index to measure effects of their deployment. *Canadian Medical Association Journal* 1976;**114**:1099–1102.

Spitzer WO, Roberts RS, Delmore T. Nurse practitioners in primary care. VI. Assessment of their deployment with the utilization and financial index. *Canadian Medical Association Journal* 1976;**114**:1103–8.

Campbell 1998 {published data only}

* Campbell NC, Thain J, Deans HG, Ritchie LD, Rawles JM, Squair JL. Secondary prevention clinics for coronary heart disease: randomized trial of effect on health. *BMJ* 1998;**316**:1434–7.

Cargill 1991 {published data only}

* Cargill VA, Conti M, Neuhauser D, McClish D. Improving the effectiveness of screening for colorectal cancer by involving nurse clinicians. *Medical Care* 1991;**29**(1):1–5.

Cherkin 1996 {published data only}

* Cherkin DC, Deyo RA, Street JH, Hunt M, Barlow W. Pitfalls of patient education. Limited success of a program for back pain in primary care. *Spine* 1996;**21**(3):345–55.

Cupples 1994 {published data only}

Cupples ME, McKnight A. Five year follow up of patients at high cardiovascular risk who took part in randomized controlled trial of health promotion. *BMJ* 1999;**319**:687–8.

* Cupples ME, McKnight A. Randomised controlled trial of health promotion in general practice for patients at high cardiovascular risk. *BMJ* 1994;**309**:993–6.

Cupples ME, McKnight A, O'Neill C, Normand C. The effect of personal health education on the quality of life of patients with angina in general practice. *Health education journal* 1996;**55**:75–83.

Fall 1997 {published data only}

* Fall M, Walters S, Read S, Deverill M, Lutman M, Milner P, Rodgers R. An evaluation of a nurse-led ear care service in primary care: benefits and costs. *British Journal of General Practice* 1997;**47**:699–703.

Family Heart 1994 a {published data only}

Family Heart Study Group. Its design and method, and prevalence of cardiovascular risk factors. *British Journal of General Practice* 1994;**44**:62–7.

* Family Heart Study Group. Randomised controlled trial evaluating cardiovascular screening and intervention in general practice: principal results of British family heart study. *BMJ* 1994;**308**:313–20.

Wonderling D, McDermott, Buxton M, Knmonth A, Pyke S, Thompson S, Wood D. Costs and cost effectiveness of cardiovascular screening and intervention: the British family heart study. *BMJ* 1996;**312**:1269–73.

Fullard 1987 {published data only}

Fullard E. Extending the roles of practice nurses and facilitators in preventing heart disease. *The Practitioner* 1987;**231**:1283–6.

* Fullard E, Fowle G, Gray M. Promoting prevention in

- primary care: controlled trial of low technology, low cost approach. *BMJ* 1987;**294**:1080–2.
- Goldberg 1991** *{published data only}*
 * Goldberg HI, Mullen M, Ries Rk, Psatty Bm, Ruch BP. Alcohol counseling in a general medicine clinic. A randomized controlled trial of strategies to improve referral and show rates. *Medical Care* 1991;**29**(7 Supplement): JS49–JS56..
- Jamrozik 1984** *{published data only}*
 * Jamrozik K, Vessey M, Fowler G, Wald N, Parker G, van Vunakis H. Controlled trial of three different antismoking interventions in general practice. *British Medical Journal* 1984;**288**:1499–1503.
- Klerman 1987** *{published data only}*
 * Klerman GL, Budman S, Berwick D, Weissman MM, Damico-White J, Demby A, Feldstein M. Efficacy of a brief psychosocial intervention for symptoms of stress and distress among patients in primary care. *Medical Care* 1987; **25**(11):1078–88.
- Mann 1998** *{published data only}*
 * Mann AH, Blizard R, Murray J, Smith JA, Botega N, Macdonald E, Wilkinson G. An evaluation of practice nurses working with general practitioners to treat people with depression. *British Journal of General Practice* 1998;**48**: 875–9.
- Margolis 1996** *{published data only}*
 * Margolis PA, Lannon CM, Stevens R, Harlan C, Bordley WC, Carey T, Leininger L, Keyes LL, Earp JaL. Linking clinical and public health approaches to improve access to health care for socially disadvantaged mothers and children. *Archives of Pediatric Adolescent Medicine* 1996;**150**:815–21.
- Muir J 1995** *{published data only}*
 Langham S, Thorogood M, Normand C, Muir J, Jones L, Fowler G. Costs and cost effectiveness of health checks conducted by nurses in primary care: the OXCHECK study. *BMJ* 1996;**312**:265–8.
 * Muir J, Lancaster T, Jones L, Yudkin P (for the Imperial Cancer Research Fund OXCHECK Study Group). Effectiveness of health checks conducted by nurses in primary care: final results of the OXCHECK study. *BMJ* 1995;**310**:1099–1104.
 Muir J, Mant D, Jones L, Yudkin P (the Imperial Cancer Research Fund OXCHECK Study Group). Effectiveness of health checks conducted by nurses in primary care: results of the OXCHECK study after one year. *BMJ* 1994;**308**: 308–12.
 O'Neill C. The OXCHECK study: a nursing perspective. *Health reports* 1994;**6**(1):160–5.
 Wonderling D, Langham S, Buxton M, Normand C, McDermott C. What can be concluded from the OXCHECK and british family heart studies: commentary on cost effectiveness analyses.. *BMJ* 1996;**312**:1274–8.
- Mynors-Wallis 1997** *{published data only}*
 * Mynors-Wallis L, Davies I, Gray A, Barbour F, Gath D. A randomized controlled trial and cost analysis of problem-solving treatment for emotional disorders given by community nurses in primary care. *British Journal of Psychiatry* 1997;**170**:113–9.
- Pine 1997** *{published data only}*
 * Pine DA, Madlon-Kay DJ, Sauser M. Effectiveness of a nurse-based intervention in a community practice on patients' dietary fat intake and total serum cholesterol level. *Archives of Family Medicine* 1997;**6**:129–34.
- Ridsdale 1996 a** *{published data only}*
 Ridsdale L, Robins D, Cryer C, Williams H, and the Epilepsy Care Evaluation Group. Feasibility and effects of nurse run clinics for patients with epilepsy in general practice: randomized controlled trial. *BMJ* 1997;**314**: 120–2.
 Ridsdale L, Robins D, Fitzgerald A, Jeffery S, McGee L (Epilepsy Care Evaluation Group). Epilepsy in general practice: patients' psychological symptoms and their perception of stigma. *British Journal of General Practice* 1996;**46**:365–6.
 * Ridsdale L, Robins D, Fitzgerald A, Jeffery S, McGee L (Epilepsy Care Evaluation Group). Epilepsy monitoring and advice recorder: general practitioners' views, current practice and patients' preferences. *British Journal of General Practice* 1996;**46**:11–4.
 Scambler A, Scambler G, Ridsdale L, Robins D. Towards an evaluation of the effectiveness of an epilepsy nurse in primary care. *Seizure* 1996;**5**:255–8.
- Robson 1989** *{published data only}*
 * Robson J, Boomla K, Fitzpatrick S, Jewell AJ, Taylor J, Self J, Colyer M. Using nurses for preventive activities with computer assisted follow up: a randomized controlled trial. *BMJ* 1989;**298**:433–6.
- Sanders 1989** *{published data only}*
 * Sanders D, Fowler G, Mant D, Fuller A, Jones L, Marzillier J. Randomized controlled trial of anti-smoking advice by nurses in general practice. *Journal of the Royal College of General Practitioners* 1989;**39**:273–6.
 Sanders D, Peveler R, Mant D, Fowler G. Predictors of successful smoking cessation following advice from nurses in general practice. *Addiction* 1993;**88**:1699–1705.
- Sharp 1996** *{published data only}*
 * Sharp DJ, Peters TJ, Bartholemew J, Shaw A. Breast screening: a randomized controlled trial in UK general practice of three interventions designed to increase uptake. *Journal of Epidemiology and Community Health* 1996;**50**: 72–6.
- Thompson 1982** *{published data only}*
 * Thompson S, Basden P, Howell LJ. Evaluation of initial implementation of an organized adult health program employing family nurse practitioners. *Medical Care* 1982; **XX**(11):1109–27.
- Vetter 1984** *{published data only}*
 Vetter NJ, Jones DA, Victor CR. A health visitor affects the problems others do not reach. *The Lancet* 1986;**2**:30–2.
 * Vetter NJ, Jones DA, Victor CR. Effect of health visitors working with elderly patients in general practice: a

- randomized controlled trial. *British Medical Journal* 1984; **288**:369–72.
- Vetter 1992** *{published data only}*
* Vetter NJ, Lewis PA, Ford D. Can health visitors prevent fractures in elderly people?. *BMJ* 1992;**204**:888–90.
- Wilkinson 1993** *{published data only}*
* Wilkinson G, Allen P, Marshall E, Walker J, Browne W, Mann AH. The role of the practice nurse in the management of depression in general practice: treatment adherence to antidepressant medication. *Psychological Medicine* 1993;**23**:229–37.
- Woollard 1995** *{published data only}*
* Woollard J, Beilling L, Lord T, Puddey I, MacAdam D, Rouse I. A controlled trial of nurse counseling on lifestyle change for hypertensives treated in general practice: preliminary results. *Clinical and Experimental Pharmacology and Physiology* 1995;**22**:466–8.
- Additional references**
- Alderson 2004**
Alderson P, Green S, Higgins JPT, editors. Cochrane Reviewers' Handbook 4.2.2 [updated March 2004]. In: The Cochrane Library [database on CDROM]. Oxford: The Cochrane Collaboration, Update Software; 2005, issue 1.
- Aubert 1998**
Aubert RE, Herman WH, Waters J, Moore W, Sutton D, Peterson BL, et al. Nurse case management to improve glycaemic control in diabetic patients in a health maintenance organization.. *Annals of Internal Medicine* 1998;**129**:605–12.
- Bailey 1987**
Bailey, KR. Inter-study differences: how should the influence the interpretation and analysis of the results?. *Statistics in Medicine* 1987;**6**(3):351–60.
- Biggerstaff 1997**
Biggerstaff, BJ, Tweedie, RL. Incorporating variability in estimates of heterogeneity in the random effects model in meta-analysis. *Statistics in Medicine* 1997;**16**:753–68.
- Brockwell 2001**
Brockwell, SE, Gordon, IR. A comparison of statistical methods for meta-analysis. *Statistics in Medicine* 2001;**20**: 825–40.
- Brown 1995**
Brown, SA, Grimes, DE. A meta-analysis of nurse practitioners and nurse midwives in primary care. *Nursing Research* 1995;**44**:332–9.
- Charlton 1991**
Charlton I, Charlton G, Broomfield J, Mullee MA. Audit of the effect of a nurse run asthma clinic on workload and patient morbidity in a general practice. *British Journal of General Practice* 1991;**41**(347):227–31.
- Drury 1988**
Drury M, Greenfield S, Stillwell B, Hull FM. A nurse practitioner in general practice: patients perceptions and expectations.. *Journal of the Royal College of General Practitioners* 1988;**38**:503–5.
- Family HSG 1994**
Family Heart Study Group. Randomised controlled trial evaluating cardiovascular screening and intervention in general practice: principal results of British Family Heart Study.. *BMJ* 1994;**308**:313–20.
- Freeman 2002**
Freeman GK, Horder JP, Howie JGR, Hungin AP, Hill AP, Shah NC, Wilson A. Evolving general practice consultation in Britain: issues of length and context.. *BMJ* 2002;**324**: 880–2.
- Horrocks 2002**
Horrocks, S, Anderson, E, Salisbury, C. Systematic review of whether nurse practitioners working in primary care can provide equivalent care to doctors. *BMJ* 2002;**324**:819–23.
- Jenkins-Clarke 1998**
Jenkins-Clarke S, Carr-Hill R, Dixon P. Teams and Seams: skill mix in primary care.. *Journal of Advanced Nursing* 1998;**28**:1120–6.
- Kirkman 1994**
Kirkman MS, Weinberger M, Landsman PS, Sams GP, Shortlife EA, Simel DL, et al. A telephone-delivered intervention for patients with NIDDM.. *Diabetes Care* 1994;**17**:840–6.
- Laurant 2004**
Laurant, M, Hermens, R, Braspenning, J, Grol, R, Sibbald, B. Nurse practitioners do not reduce the workload of GPs - a randomized controlled trial. *BMJ* 2004;**328**:927–30.
- Maas 2004**
Maas, CMJ, Hox, JJ. Robustness issues in multilevel regression analysis. *Statistica Neerlandica* 2004;**58**(2): 127–37.
- Muir 1995**
.Muir J, Lancaster T, Jones L, Yudkin P, for the OXCHECK Study Group. Effectiveness of health checks conducted by nurses in primary care: final results of the OXCHECK study.. *BMJ* 1995;**310**:1099–104.
- Petitti 2001**
Petitti, D. Approaches to heterogeneity in meta-analysis. *Statistics in Medicine* 2001;**30**:3625–33.
- Richardson 1998**
Richardson G, Maynard A, Cullum N, Kindig, D. Skill mix changes: substitution or service development?. *Health Policy* 1998;**45**(2):119–32.
- Richardson 1999**
Richardson MSC. Identifying, evaluating and implementing cost-effective skill mix. *J Nurse Manage* 1999;**5**:265–270.
- Whitecross 1999**
Whitecross L. Collaboration between GPs and nurse practitioners. The overseas experience and lessons for Australia.. *Australian Family Physician* 1999;**28**:349–53.
- * Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Chambers 1977

Methods	CBA	
Participants	2313 patients, all ages, 52% male 1 nurse Unknown number of doctors	
Interventions	Intervention: two villages allocated to nurse-led care Control: neighbouring villages allocated to doctor-led care	
Outcomes	Process of care: standards of care Resource utilisation: direct costs	
Notes	Nurse title: practice nurse Nurse role: First contact care and ongoing primary care Study period: 12 months	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Unclear	D - Not used

Chambers 1978

Methods	RCT	
Participants	868 patients, all ages, 34% male 1 nurse 1 doctor	
Interventions	Intervention: families allocated to nurse-led primary care Control: families allocated to doctor-led primary care	
Outcomes	Patient outcomes: health status	
Notes	Nurse title: practice nurse Nurse role: First contact and ongoing primary care Study period: 12 months	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Flynn 1974

Methods	RCT
Participants	60 patients, age unknown, gender unknown 4 nurses Unknown number of doctors
Interventions	Intervention: patients allocated to nurse-led primary care Control: patients allocated to doctor-led primary care
Outcomes	Patient outcomes: compliance with medication and diet; knowledge Process of care: suggested lifestyle changes Resource utilisation: tests and investigations; use of other health services
Notes	Nurse title: nurse clinician Nurse role: First contact and ongoing primary care Study period: 6-12 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Gordon 1974

Methods	CBA
Participants	169 patients, all ages, 38% female. Unknown number of nurses and doctors
Interventions	Intervention: patients allocated to nurse-led primary care Control: patients allocated to doctor-led primary care
Outcomes	Patient outcomes: health status; satisfaction; compliance with medication and follow-up attendance. Process of care: lapses in care
Notes	Nurse title: nurse clinician Nurse role: First contact and ongoing primary care Study period: 12 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	D - Not used

Hemani 1999

Methods	RCT
Participants	450 patients, mean age 61 years, 98% male 9 nurses 45 doctors
Interventions	Intervention: patients allocated to nurse-led primary care Control 1: patients allocated to trainee doctors (2nd ,3rd year residents) Control 2: patients allocated to fully trained doctors (attending physicians)
Outcomes	Resource utilisation: consultation rate; tests; use of other services-hospital admission, emergency room visits, specialty visits
Notes	Nurse role: First contact and ongoing primary care Study period: 12 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Kinnersley 2000

Methods	RCT
Participants	1465 patients, all ages, 40% male 10 nurses Unknown number of doctors in 10 practices
Interventions	Intervention: patients allocated to nurse Control: patients allocated to doctor
Outcomes	Patient outcomes: health status; satisfaction; provider preference Process of care: provision of information Resource utilisation: length of consultation; return visits; prescriptions; investigations; use other services - referral
Notes	Nurse title: nurse practitioner Nurse role: First contact care for patients with urgent problems Study period: 2-4 weeks

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Lattimer 1998

Methods	RCT
Participants	10134 patients, all ages, 48% male 6 nurses 55 doctors
Interventions	Intervention: incoming phone calls on randomly selected days were allocated to nurse telephone consultation. Control: incoming phone calls on other days were answered by a receptionist who passed the message to a doctor
Outcomes	Patient outcomes: mortality Resource utilisation: physician workload, use of other services - hospital referral and admission, emergency room visits, direct costs
Notes	Nurse title: not clear Nurse role: First contact care for patients with urgent problems out-of-hours Study period: 3-7 days

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Lewis 1969

Methods	RCT
Participants	66 patients, 16+ years, 12% male Unknown number of nurses and doctors
Interventions	Intervention: patients allocated to nurse-led care Control: patients allocated to doctor-led care
Outcomes	Patient outcomes: health status; provider preference; compliance with follow-up attendance Resource utilisation - direct costs
Notes	Nurse title: not clear Nurse role: Ongoing primary care for patients with stable chronic disease Study period: 12 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

McIntosh 1997

Methods	RCT
Participants	119 patients, mean age 31.5 years, 50% male 1 nurse 1 doctor
Interventions	Intervention: patients allocated to nurse Control: patients allocated to doctor who provided identical treatment
Outcomes	Patient outcomes: alcohol consumption
Notes	Nurse title: nurse practitioner Nurse role: Counselling to problem drinkers Study period: 12 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Moher 2001

Methods	RCT
Participants	1347 patients, mean age 66 years, 69% male Unknown number of nurses and doctors in 21 practices
Interventions	Intervention: patients allocated to nurse-led follow-up Control: patients allocated to doctor-led follow-up
Outcomes	Patient outcomes: cardiovascular risk factors Process of care: adherence to guidelines. Resource utilisation: prescriptions
Notes	Nurse title: practice nurse Nurse role: Ongoing primary care for patients with coronary heart disease Study period: 18 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Mundinger 2000

Methods	RCT
Participants	1316 patients, mean age 44.5 years, 25.5% male 7 nurses 17 doctors
Interventions	Intervention: patients allocated to nurse-led care Control: patients allocated to doctor-led care
Outcomes	Patient outcomes: health status; satisfaction Resource utilisation: consultation rate; use of other services -hospital admissions, emergency room visits, specialty visits
Notes	Nurse title: nurse practitioner Nurse role: First contact and ongoing primary care Study period: 6 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Myers 1997

Methods	CBA
Participants	1000 patient contacts, mean age 35.5 years, 40% male 2 nurses 6 doctors
Interventions	Intervention: patients choosing nurse Control: patients choosing doctor
Outcomes	Resource utilisation:prescriptions; use of other services - referral
Notes	Nurse title: nurse practitioner Nurse role: First contact care for patients with urgent problems Study period: 14 days

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	D - Not used

Shum 2000

Methods	RCT
Participants	1815 patients, mean age 27.5 years, 40% male 5 nurses 19 doctors
Interventions	Intervention: patients allocated to nurse Control: patients allocated to doctor
Outcomes	Patient outcomes: health status; satisfaction; provider preference Process of care: provision of information Resource utilisation: length of consultation; return visits; prescriptions; use other services - emergency room visits, use of out-of-hour services
Notes	Nurse title: practice nurse Nurse role: First contact care for patients with urgent problems Study period: 2 weeks

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Spitzer 1973

Methods	RCT
Participants	4325 patients, all ages, 42.5% male 2 nurses 2 doctors
Interventions	Intervention: families allocated to nurse Control: families allocated to doctor
Outcomes	Patient outcomes: health status; satisfaction, provider preference Process of care: Standards of care Resource utilisation: direct costs
Notes	Nurse title: nurse practitioner Nurse role: First contact and ongoing primary care Study period: 12 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Stein 1974

Methods	RCT
Participants	23 patients, mean age 56 years, 0% male 1 nurse Unknown number of doctors
Interventions	Intervention: patients allocated to nurse-led care Control: patients allocated to doctor-led care
Outcomes	Patient outcomes: health status; mortality; knowledge Resource utilisation: consultation rate; prescriptions
Notes	Nurse title: nurse practitioner Nurse role: Ongoing care for patients with diabetes mellitus Study period: 6 months

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	C - Inadequate

Venning 2000

Methods	RCT
Participants	1316 patients, all ages, 42% male 20 nurses Unknown number of doctors
Interventions	Intervention: patients allocated to nurse Control: patients allocated to doctor
Outcomes	Patient outcomes: health status; satisfaction; compliance with follow-up attendance; enablement Process of care: examinations Resource utilisations: length of consultation; return visits; prescriptions; investigations; use of other services- hospital referral, direct costs
Notes	Nurse title: nurse practitioner Nurse role: First contact care for patients with urgent problems Study period: 2 weeks

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Participants: Where the mean age or proportion of males in the study group as a whole was not reported, we have estimated these values by averaging the figures given for each intervention group.

Outcomes: Only usable outcomes (i.e. amenable to statistical analysis) are listed

Allocation Concealment: A - Adequate; B - Unclear; C- Inadequate; D - Not used.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bakx 1997	Nurses working as supplements
Batchelor 1975	Nurses working as supplements
Campbell 1998	Nurses working as supplements
Cargill 1991	Nurses working as supplements
Cherkin 1996	Nurses working as supplements
Cupples 1994	Nurses working as supplements
Fall 1997	Nurses working as supplements
Family Heart 1994 a	Nurses working as supplements
Fullard 1987	Nurses working as supplements
Goldberg 1991	Nurses working as supplements
Jamrozik 1984	Nurses working as supplements
Klerman 1987	Nurses working as supplements
Mann 1998	This paper describes to two studies, both are excluded because nurses work as supplements
Margolis 1996	Nurses working as supplements
Muir J 1995	Nurses working as supplements
Mynors-Wallis 1997	Nurses working as supplements
Pine 1997	Nurses working as supplements
Ridsdale 1996 a	Nurses working as supplements
Robson 1989	Nurses working as supplements

(Continued)

Sanders 1989	Nurses working as supplements
Sharp 1996	Nurses working as supplements
Thompson 1982	Nurses working as supplements
Vetter 1984	Nurses working as supplements
Vetter 1992	Nurses working as supplements
Wilkinson 1993	Nurses working as supplements
Woollard 1995	Nurses working as supplements

DATA AND ANALYSES

Comparison 1. Doctor-Nurse substitution study results

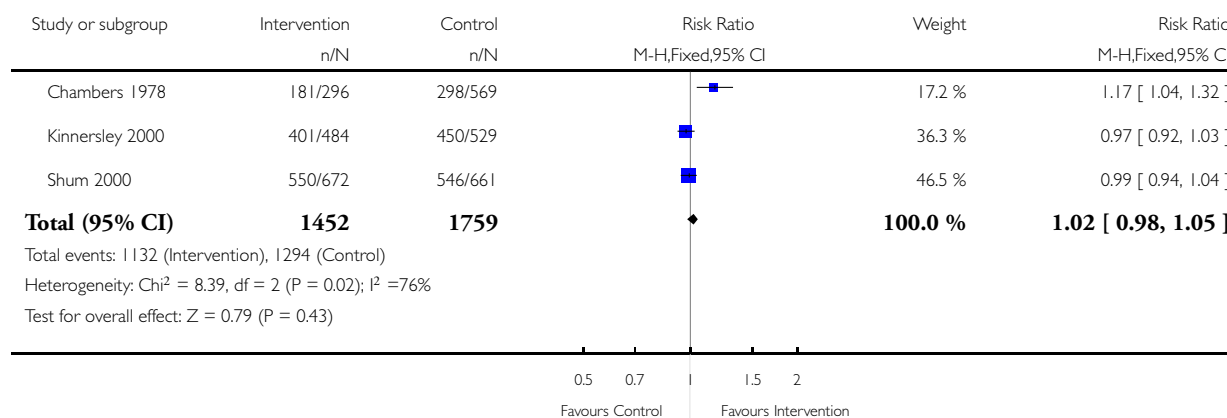
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Physical function (better vs not better)	3	3211	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.98, 1.05]
2 Patient satisfaction	3	3611	Std. Mean Difference (IV, Fixed, 95% CI)	0.28 [0.21, 0.34]
2.1 Sub-category	3	3611	Std. Mean Difference (IV, Fixed, 95% CI)	0.28 [0.21, 0.34]
3 Scheduled return visits	3	4022	Risk Ratio (M-H, Fixed, 95% CI)	1.34 [1.20, 1.49]
4 Prescription ordered	3	4212	Risk Ratio (M-H, Fixed, 95% CI)	1.00 [0.96, 1.05]
5 Hospital referral	3	17152	Risk Ratio (M-H, Fixed, 95% CI)	0.79 [0.58, 1.07]
6 Attendance at Accident&Emergency	3	17140	Risk Ratio (M-H, Fixed, 95% CI)	1.04 [0.94, 1.15]
7 Hospital admission	3	15860	Risk Ratio (M-H, Fixed, 95% CI)	1.17 [1.04, 1.31]

Analysis 1.1. Comparison 1 Doctor-Nurse substitution study results, Outcome 1 Physical function (better vs not better).

Review: Substitution of doctors by nurses in primary care

Comparison: 1 Doctor-Nurse substitution study results

Outcome: 1 Physical function (better vs not better)

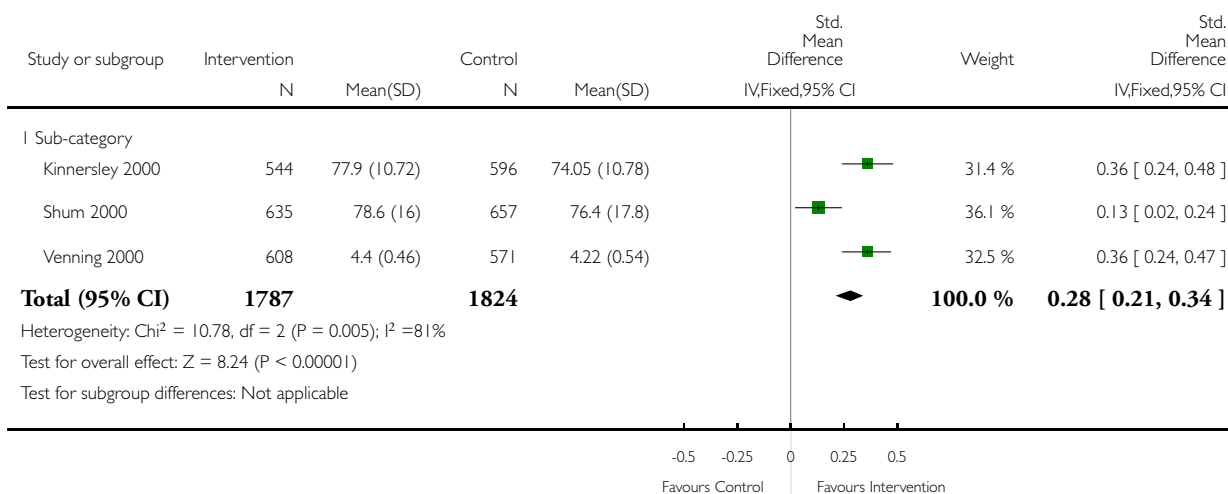


Analysis 1.2. Comparison 1 Doctor-Nurse substitution study results, Outcome 2 Patient satisfaction.

Review: Substitution of doctors by nurses in primary care

Comparison: 1 Doctor-Nurse substitution study results

Outcome: 2 Patient satisfaction

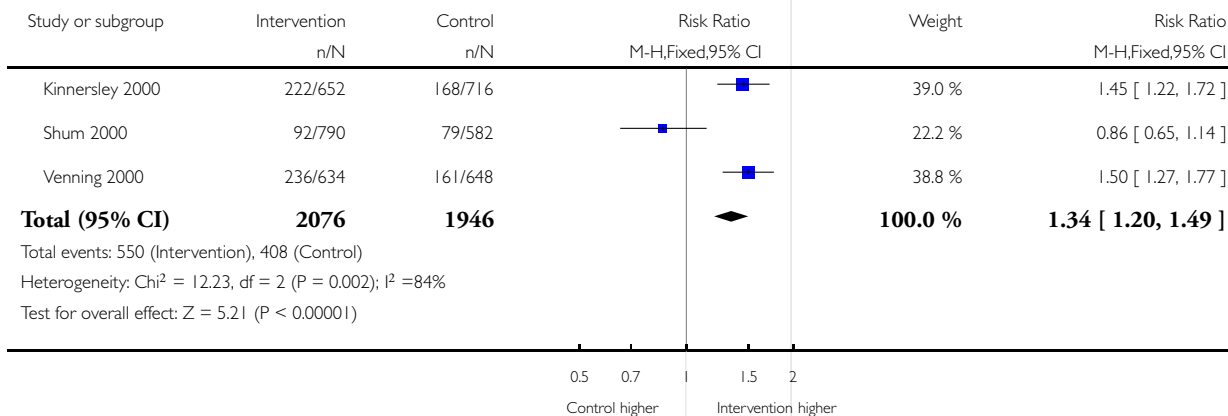


Analysis 1.3. Comparison 1 Doctor-Nurse substitution study results, Outcome 3 Scheduled return visits.

Review: Substitution of doctors by nurses in primary care

Comparison: 1 Doctor-Nurse substitution study results

Outcome: 3 Scheduled return visits

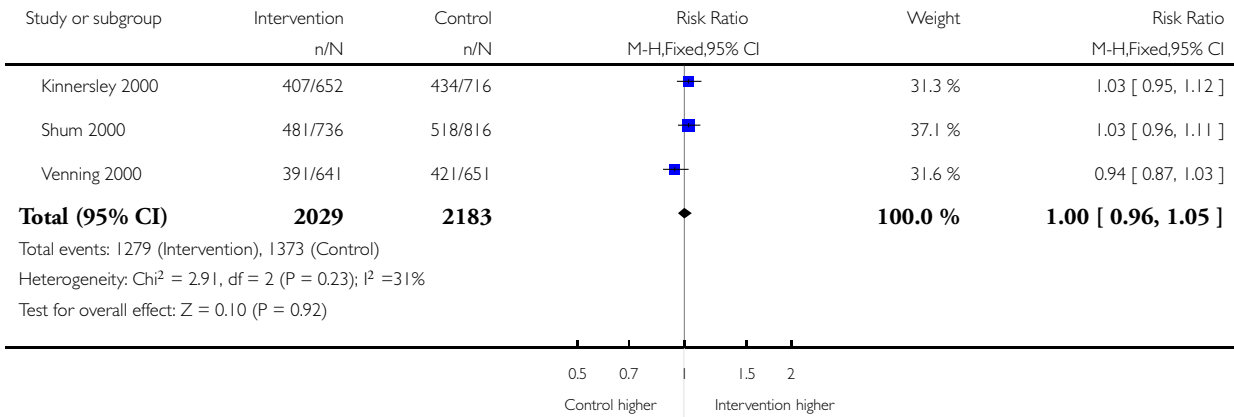


Analysis 1.4. Comparison 1 Doctor-Nurse substitution study results, Outcome 4 Prescription ordered.

Review: Substitution of doctors by nurses in primary care

Comparison: 1 Doctor-Nurse substitution study results

Outcome: 4 Prescription ordered

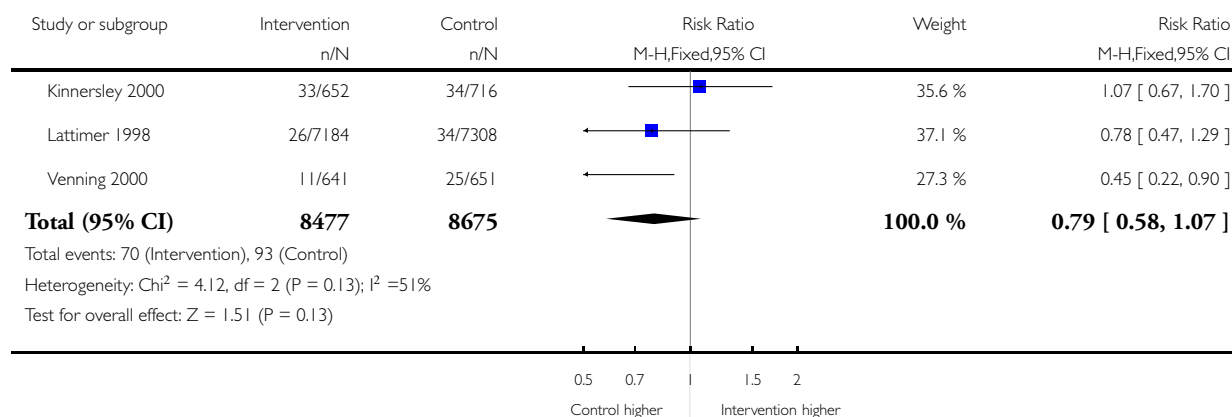


Analysis 1.5. Comparison 1 Doctor-Nurse substitution study results, Outcome 5 Hospital referral.

Review: Substitution of doctors by nurses in primary care

Comparison: 1 Doctor-Nurse substitution study results

Outcome: 5 Hospital referral

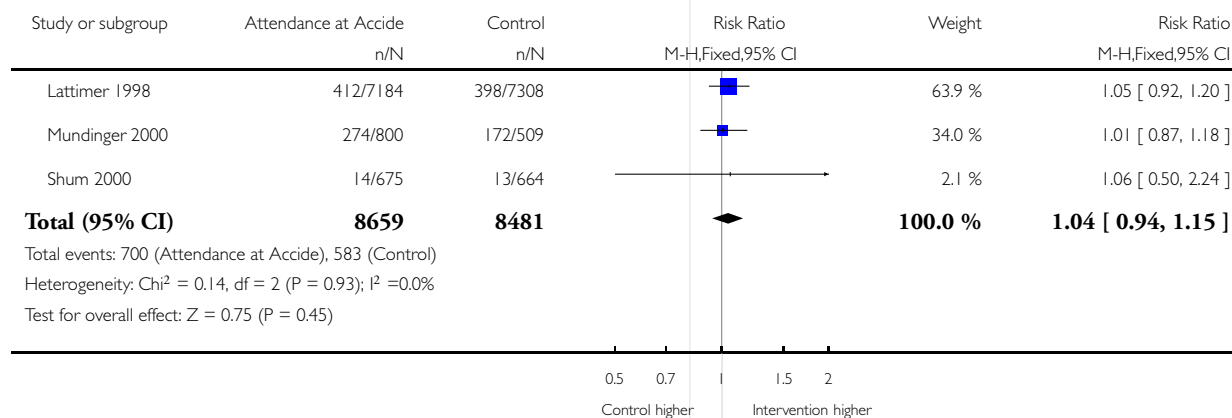


Analysis 1.6. Comparison 1 Doctor-Nurse substitution study results, Outcome 6 Attendance at Accident&Emergency.

Review: Substitution of doctors by nurses in primary care

Comparison: 1 Doctor-Nurse substitution study results

Outcome: 6 Attendance at Accident&Emergency

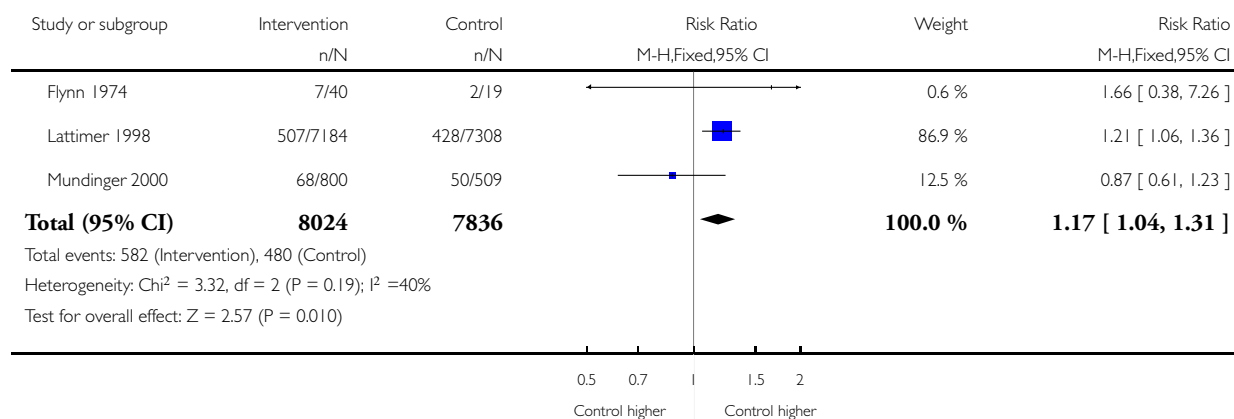


Analysis 1.7. Comparison 1 Doctor-Nurse substitution study results, Outcome 7 Hospital admission.

Review: Substitution of doctors by nurses in primary care

Comparison: 1 Doctor-Nurse substitution study results

Outcome: 7 Hospital admission



ADDITIONAL TABLES

Table 1. Methodological Quality of controlled before and after studies

Study (no)	Power	Unit Analysis Error	80% follow-up	Comparability	Baseline Assessment	Blinded Assessment	Reliable Outcomes	Contamination
Chambers 1977	Not clear	Yes	Professional - Not clear; Patients - Done	Done	Done	Done	Not clear	Not clear
Gordon 1974	Not clear	No	Professional - Not clear; Patients - Done	Done	Not clear	Resource - Done; Patient - Not done	Not clear	Not clear

Table 1. Methodological Quality of controlled before and after studies (Continued)

Myers 1997	Not clear	No	Professional - Not clear; Patients - Done	Done	Not clear	Done	Not clear	Not done
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Table 2. Methodological quality of randomized controlled trials

Study (no)	Power	Unit Analysis Error	80% follow-up	Concealment	Baseline Assessment	Blinded Assessment	Reliable Outcomes	Contamination
Chambers 1978	Not done	Yes	Professional - Not clear; Patient - not done	Not clear	Done	Not clear	Not clear	Not clear
Flynn 1974	Not clear	No	Professional - Not clear; Patient - done	Not clear	Not clear	Not done	Not done	Not clear
Hemani 1999	Not done	No	Professional - Not clear; Patient - done	Done	Not clear	Done	Done	Not clear
Kinnersley 2000	Done	No	Professional - Not clear; Patient - Not done	Done	Not clear	Not done	Done	Not clear
Lattimer 1998	Done	No	Professional - Not clear; Patient - done	Done	Not clear	Done	Done	Not clear
Lewis 1967	Not clear	No	Professional - Not clear; Patient - done	Not clear	Not clear	Done	Not clear	Not clear
McIntosh 1997	Done	No	Professional - Not clear; Patient - done	Not clear	Done	Not done	Done	Not clear
Moher 2001	Not clear	No	Professional - Not clear; Patient -	Not clear	Done	Done	Not clear	Done

Table 2. Methodological quality of randomized controlled trials (Continued)

			done					
Munding 2000	Done	No	Professional - Not clear; Patient - Not done	Not clear	Done	Resource - Done; Patient - Not clear	Resource - Done; Patient - Not clear	Not clear
Shum 2000	Done	No	Professional - Not clear; Patient - Done	Done	Not clear	Not done	Done	Not clear
Spitzer 1974	Not clear	Yes	Profes- sional - Not clear; patient - Not clear	Not clear	Done	Mortal- ity - Done; Others - Not clear	Mortal- ity - Done; Others - Not clear	Not clear
Stein 1974	Not clear	No	Professional - Not clear; Patient - Done	Not done	Not clear	Not clear	Not clear	Not clear
Venning 2000	Not clear	No	Professional - Not clear; Patient - Not done	Done	Not clear	Not done	Health status - done; Others - Not clear	Not clear

Table 3. Patient outcomes

Study (no)	Nurse Role	Health status	Satisfaction	Compliance	Other
Chambers 1978	First contact and on- going care	Health status: -Physical function: nurse better - Emotional function: no difference -Social function: no difference			
Flynn 1974	First contact and on- going care			Medication: no dif- ference Diet: no difference	Patients' knowledge: - Exercise: nurse sig- nificantly better - Disease complica- tions: no difference - Diet: no difference

Table 3. Patient outcomes (Continued)

Gordon 1974	First contact and on-going care	Health Status: no difference	Subjective perceptions of clinical care (10 dimensions): no difference	Medication: no difference Kept appointment: no difference	
Mundinger 2000	First contact and on-going care	Number of Health Complaints - no difference Health Status (10 dimensions) : No difference Objective Measures of patient health: - Asthma - peak flow: no difference - Diabetes - blood sugar: no difference - Hypertension: systolic pressure: no difference - Hypertension: diastolic pressure: nurse better	Satisfaction (3 dimensions) no difference in overall satisfaction, but nurse worse on 1 dimension Would recommend provider to others: no difference		
Spitzer 1973	First contact and on-going care	Health status: -Physical function (3 indicators): no difference - Emotional function: no difference -Social function: no difference Mortality: no difference	Satisfaction: no difference		
Kinnersley 2000	First contact care for urgent problems	Health status: -resolution of symptoms: no difference resolution of concerns: no difference	Satisfaction: - child care: nurse better -adult care: no difference Provider preference: no difference		
Latimer 1998	First contact care for urgent problems	Mortality: no difference			
Shum 2000	First contact care for urgent problems	Health status: no difference	Satisfaction: -general: nurse significantly better		

Table 3. Patient outcomes (Continued)

			<p>-professional care: nurse significantly better</p> <p>-relationship to provider: no difference</p> <p>-adequacy of time: nurse significantly better</p> <p>- explanation helpful: no difference</p> <p>-advice helpful: no difference</p> <p>Provider preference: patients preferred nurse significantly more often</p>		
Venning 2000	First contact care for urgent problems	<p>Health status: no difference</p> <p>Objective measures of patient health:</p> <p>-Asthma - peak flow: no difference</p> <p>-Diabetes - blood sugar: no difference</p> <p>-Hypertension - systolic blood pressure: no difference</p> <p>-Hypertension - diastolic blood pressure: nurse significantly better</p>	<p>Satisfaction:</p> <p>Adults</p> <p>-General: nurse significantly better</p> <p>-Communication: nurse significantly better</p> <p>- Distress relief: nurse significantly better</p> <p>-Professional care: nurse significantly better</p> <p>Children</p> <p>-General: nurse significantly better</p> <p>-Communication with parent: no difference</p> <p>-Communication with child: nurse significantly better</p> <p>- Distress relief: nurse significantly better</p> <p>-Adherence intent: no difference</p>		

Table 3. Patient outcomes (Continued)

Lewis 1967	Management of patients with chronic conditions	Health status: resolution of symptoms: nurse better.	Provider preference: nurse better	Kept appointment: no difference	
McIntosh 1997	Management of patients with chronic conditions	Health status: -reduction in alcohol consumption: no difference			
Moher 2001	Management of patients with chronic conditions	Objective measurement health status: -Blood pressure: no difference - Cholesterol: No difference - Not Smoking: No Difference			
Stein 1974	Management of patients with chronic conditions	Objective measurement health status: -Blood sugar: no difference - Weight: no difference Mortality: no difference			Knowledge: nurse better

Table 4. Process of Care Outcome

Study (No)	Nurse Role	Provider Care
Chambers, 1977	First contact and ongoing care	Adequate care: - clinical assessment: no difference - drug treatment: no difference
Flynn, 1974	First contact and ongoing care	Recommendations on: Ordered diet: - diabetic: no difference - low salt: nurse significantly higher frequency - low calorie: no difference - bland: no difference Exercise: - Increase activities: nurse significantly higher frequency
Gordon, 1974	First contact and ongoing care	Lapses in care: no difference Subgroup:

Table 4. Process of Care Outcome (Continued)

		- stable patients: no difference - unstable patients: nurse significantly fewer lapses
Kinnersley, 2000	First contact and ongoing care	Provision of information: - Cause of illness: nurse significantly more - Relief of symptoms: nurse significantly more - Duration of illness: nurse significantly more - Reduce recurrence: nurse significantly more - Action if problem persists: no difference
Shum, 2000	First contact and ongoing care	Provision of information:- Self-medication: nurse significantly more- Self-management: nurse significantly more
Spitzer, 1973	First contact and ongoing care	Adequate treatment:- Drug treatment: no difference- Management of episodes: no difference
Venning, 2000	First contact and ongoing care	Examinations: no difference
Moher, 2001	Management of patients with chronic conditions	Adequate assessment: - clinical assessment: no difference - blood pressure: no difference - cholesterol: no difference - smoking status: no difference

Table 5. Resource Utilisation Outcomes

Study (no)	Nurse role	Consultations	Presc'n. & Invest'n.	Other services
Flynn, 1974	First contact and ongoing care		Investigations & tests (11 indicators): -nurse significantly more tests for 4 indicators (electrocardiogram; bacteriology; urinalysis; minor X-ray); the remainder showed no difference	Nurse-led care was associated with a significantly higher use of other services
Hemani, 1999	First contact and ongoing care	Consultation rate: No difference compared to qualified doctors; Nurse significantly more visits compared to trainee doctors	Lab tests: (6 indicators) no difference	Hospital admission: no difference Emergency room visits: no difference Specialty visits: no difference

Table 5. Resource Utilisation Outcomes (Continued)

Munding, 2000	First contact and ongoing care	Consultation rate: no difference		Hospital admissions: no difference Emergency room visits: no difference Speciality visits: no difference
Kinnersley, 2000	First contact care for urgent problems	Consultation length: Nurse significantly longer Return Visit: Recommended: No difference Re-attend for same problem: No difference	Prescriptions: No difference Investigation ordered: no difference	Referral to hospital: no difference
Lattimer, 1998	First contact care for urgent problems	Impact on doctors' workload: Telephone advice from doctor: significantly fewer with nurse led care Surgery visits: Significantly fewer with nurse-led care Home visits: Significantly fewer with nurse-led care		Hospital admission within 24 hours: no difference Hospital admission with 3 days: no difference Emergency room visits: no difference Referred to hospital emergency room: no difference
Myers, 1997	First contact care for urgent problems		Prescriptions: Nurse significantly less	Referral: no difference
Shum, 2000	First contact care for urgent problems	Consultation length: Nurse significantly longer Return visit: no difference	Prescriptions: No difference	Emergency room visit: no difference Out-of-hours-calls: no difference
Venning, 2000	First contact care for urgent problems	Consultation length: Nurse significantly longer Return visit: All visits: nurse significantly more Asked to return: Nurse significantly more	Prescriptions: All: no difference Antibiotics: no difference Investigations: Nurse significantly more	Referral to hospital: no difference
Moher, 2001	Management of patients with chronic conditions		Prescriptions: Antihypertensives: no difference Lipid lowering: no difference	

Table 5. Resource Utilisation Outcomes (Continued)

			Antiplatelet: no difference	
Stein, 1974	Management of patients with chronic conditions	Consultation rate: no difference	Prescriptions: Changed medication: no difference	

Table 6. Cost Outcomes

Study (no)	Nurse role	Cost outcomes	Notes
Chambers, 1977	First contact and ongoing primary care	Direct cost per 1000 patients per year: nurses - increase of 26% from \$68130 to \$85.690 doctors - increase of 21% from \$93190 to \$112.730	
Lattimer, 1998	First contact for patients with urgent problems out-of-hours	Annual direct cost nurse-led service - £81.237 more than doctor-led service Savings: generated in reduced hospital and primary care utilisation £94.422 Net reduction in costs with nurse-led service £3728 - £12.3824 (determined by sensitivity analysis)	
Spitzer, 1973	First contact and ongoing primary care	Average cost per patient per year: nurses - \$297.01 doctors - \$285.67	Spitzer reported an overall reduction in practice costs following the introduction of nurse practitioners but this finding was based on observational before-and-after data. Data obtained from the related randomised controlled trial (reported above) did not support this finding
Venning, 2000	First contact care for patients with urgent problems	Total direct cost per consultation: Nurses - mean £18.11 (range £0.66 - £297.1) Doctors - mean £20.70 (range £0.78 - £300.6) not significantly different	
Lewis, 1967	Ongoing care for patients with stable chronic diseases	Total direct cost per year: nurses - \$3.251 doctors - \$4.199 Average cost per patient per year: nurses - \$98.51 doctors - \$127.24	

WHAT'S NEW

Last assessed as up-to-date: 15 July 2004.

Date	Event	Description
24 June 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 4, 1998

Review first published: Issue 2, 2005

Date	Event	Description
16 July 2004	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Miranda Laurant and Bonnie Sibbald wrote the protocol, performed the searching, read the abstracts and retrieved and appraised relevant evidence. Two researchers (ML, BS) extracted the necessary data using a checklist developed by EPOC, modified and amended for the purposes of this review. David Reeves conducted the meta-analyses. Rosella Hermens, Jozé Braspenning, and Richard Grol acted as supervisors to these processes. Miranda Laurant wrote the first draft of the review. All authors were involved in the discussion.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Centre for Quality of Care Research (WOK), University of Nijmegen, Netherlands.
- National Primary Care Research and Development Centre (NPCRDC), University of Manchester, UK.

External sources

- Ministry of Health, Welfare and Sports, Netherlands.
- Department of Health, UK.

INDEX TERMS

Medical Subject Headings (MeSH)

Family Practice [economics; *organization & administration]; Health Services Needs and Demand [economics; *organization & administration]; Nurse Practitioners [organization & administration]; Nurses [*organization & administration]; Personnel Delegation [*organization & administration]; Primary Health Care [economics; *organization & administration]

MeSH check words

Humans