

# Effects Of Nurse Prescribing Of Medication: A Systematic Review

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## Abstract

### Background

:Nurse prescribing is being implemented increasingly. This article reviews the literature on the effects of it.

### Methods

:Eleven databases and 6 websites were searched. The quality of the studies was determined. Outcomes were classified by the effects on medication prescribed, on patients, on professionals and on the health care system.

### Results

: Twenty-three studies were included. All but two studies had a high risk of bias. Nurses sometimes differ from physicians in the number of patients they prescribe or in the choice of type of medication. Clinical parameters were the same or better for treatment by nurses; perceived quality of care by nurses is similar or better. The effects on professionals or on the health care system could not be described.

### Conclusion

:The effects of nurse prescribing seem positive, although the high risk of bias in the studies means they must be regarded with caution.

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## BACKGROUND

Nurses can legally prescribe medication in several countries nowadays, e.g. Sweden, USA, UK, Australia, New Zealand, Canada and South Africa. Nurse prescribing is not yet allowed in the Netherlands, although specific groups of nurses do prescribe (1). Amendments to the law are currently being prepared in the Netherlands to give nurses legal authority to prescribe medication. These legal changes are considered important, since nurse prescribing is expected to have several benefits, e.g. an improvement in quality of care for patients, improvement in patients' access to health care, better use of the skills and experience of nurses, more recognition for their competences and expertise, an improved working relationship between health care professionals, a reduction in the workload of medical staff, and time savings for patients and medical practitioners (2,3,4). Furthermore, nurse prescribing is expected to lead to

potential cost reductions, as nurse involvement is less costly than doctor involvement (2,5,6).

Other parties see potential drawbacks to nurse prescribing in the form of a higher risk of prescription errors, over-prescribing and incorrect diagnosis that will threaten patient safety and potentially damage the health of patients, e.g. (7,8). Nuzzo (1998 page 45) states that "Non-supervised prescribing authority wielded by independent nurse practitioners does present a greater possibility for a drug disaster" and "there is an increased risk to the public health" (9). Others stress that supplementary nurse prescribing in particular (i.e. nurse prescribing under the supervision of a physician) will lead to a reduction in errors (10).

There is a lack of systematic knowledge, however, on the effects that nurse prescribing has had to date (2). Although several literature reviews have been published on nurse prescribing, most reviews focus on the characteristics of nurse prescribing, the implementation process of nurse

prescribing, or its legal implications. Very few reviews focus on the effects of nurse prescribing in practice and those reviews that did focus on the effects of nurse prescribing have limitations. They lack clear methodology, are narrative reviews in stead of systematic reviews, or have restricted the studies they include on the grounds of publication years or country (5,11,12,13).

The purpose of this systematic review is to review the effects of medication being prescribed by nurses.

The following four research questions have been formulated with regard to effects:

- What are the effects of nurse prescribing compared to physician prescribing, on the quantity and types of medication being prescribed?
- What are the effects of nurse prescribing on patient outcomes?
- What are the effects of nurse prescribing on physician and nurse outcomes?
- What are the effects of nurse prescribing on characteristics of the health care system?

### WHAT IS NURSE PRESCRIBING?

Buchan and Calman (2004) discern three categories of nurse prescribing, viz. independent, supplementary and by group protocols.

Independent nurse prescribing, also known as initial, autonomous or substitutive prescribing, refers to a nurse being able to prescribe the type and dose of medication without the supervision of a medical practitioner.

Supplementary prescribing, also called dependent, collaborative, semi-autonomous or complementary prescribing, means that a nurse works with a supervising independent prescriber, usually a physician.

The third category is prescribing through the use of group protocols. The group protocols, also called patient group directions, allow nurses to administer medications subject to the terms of a predetermined protocol for a particular group of patients (2).

A category called “approaching” independent nurse prescribing was added in this review, in order to describe situations in which a nurse is fully responsible for the choice of type and doses of medication, but a physician still signs

the prescription without seeing the patient. The nurse does not have formal prescriptive authority in this case, but studies with this form of nurse prescribing were nevertheless considered relevant to this review.

### METHODS

The systematic review was conducted in five phases, viz. the search for relevant studies, selection of relevant studies, quality assessment of the studies included, data extraction and data synthesis.

### SEARCH FOR RELEVANT STUDIES

To identify all relevant studies up to February 2006 a sensitive search was performed in the following eleven literature databases and six relevant websites, viz. Pubmed, Embase, Cinahl, Cochrane Library, Picarta, SCI, Invert, Biomed central, Virginia Henderson Library, Current Control Trials and NIVEL catalog, the website of the UK Department of Health ([www.doh.gov.uk](http://www.doh.gov.uk)), the website of the World Health Organisation ([www.who.org](http://www.who.org)), and other websites for health professionals ([www.nurse-prescriber.co.uk](http://www.nurse-prescriber.co.uk), [www.escriber.com](http://www.escriber.com)). Google ([www.google.com](http://www.google.com)) was also searched.

The search was highly sensitive using the following search terms for the database PubMed:

(“Nurse prescribing”) OR (Nurs\* [tiab] AND Prescri\* [tiab]) OR (Nurs\* AND prescriptions, drug [MeSH])

Comparable search strategies were used in the other databases (the specific search strategies are available on request). References cited in the reviews of the effects of nurse prescribing were also collected (5,11,12,13). There was no limitation on the searches by country, language or year of publication.

### SELECTION

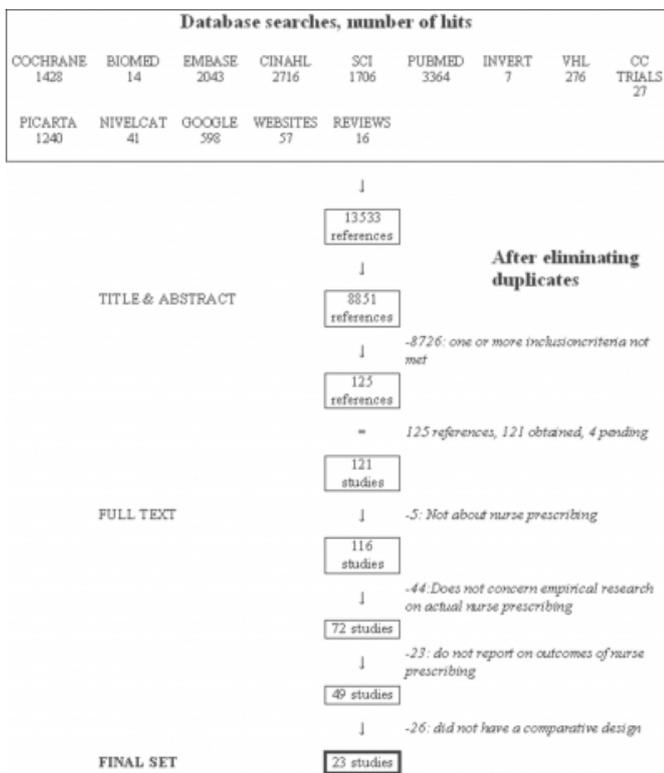
Studies with all sorts of patients were included. There was no restriction on the type of patients for whom medication was being prescribed; all studies in which nurses had actually prescribed medication for patients were included, with the exception of group protocols for child vaccination or travel vaccination. Furthermore, studies were only included if they had a comparative design, e.g. comparing nurse prescribing to physician prescribing, or comparing nurse prescribing over time. All studies had to be empirical research, others such as letters, abstracts, reviews and editorials were excluded. All studies included had to report on the effects of nurse prescribing. The selection of studies

was not limited by the types of effects.

A total of 8851 non-duplicate references were found (see figure 1). All references found in the literature search of databases and websites were initially studied by title and abstract by one reviewer and were included when they met the aforementioned criteria. A second reviewer took a 10% sample from these and agreement with the first reviewer was analysed. High agreement (95% and Cohen's kappa = 0.60) meant that the first reviewer completed the first selection round alone, in which 125 of the 8851 studies were included on the basis of the selection criteria.

**Figure 1**

Figure 1: Flow diagram of the inclusion process



All articles were studied independently on a full text basis by both reviewers in the second selection round. Differences were discussed until both reviewers agreed on inclusion or exclusion, and a third reviewer was called in to decide if necessary.

Both reviewers agreed that 23 of the 125 studies met the inclusion criteria.

**QUALITY ASSESSMENT**

All studies were assessed independently by both reviewers on methodological quality. Differences were resolved by consensus, with a third reviewer if necessary. The EPOC,

which is the data collection checklist of the Cochrane Effective Practice and Organisation of Care Review Group, was used to determine the methodological quality. The EPOC includes seven quality criteria that studies have to meet (see table 1).

**Figure 2**

Table 1: The criteria of the EPOC list used to determine quality of the studies with score options

Criteria of the EPOC* list	Score
1. Concealment of allocation (protection against selection bias)	Done, not done, not clear
2. Follow-up of professionals (protection against exclusion bias)	Done, not done, not clear, not applicable
3. Follow-up of patients or episodes of care	Done, not done, not clear
4. Blinded assessment of primary outcome(s) (protection against detection bias)	Done, not done, not clear
5. Baseline measurement	Done, not done, not clear
6. Reliable primary outcome measure(s)	Done, not done, not clear
7. Protection against contamination	Done, not done, not clear

\* EPOC = (Cochrane Effective Practice and Organisations of Care Review Group)

A study was judged as having a low risk of bias if it met all seven criteria, a moderate risk of bias if it met four, five or six criteria, and a high risk of bias if it met three criteria or less (14). This list is only applicable to RCTs, CCTs, Controlled before and after studies and interrupted time series designs. Other designs, such as pre-experimental post-test only designs, were regarded as having a high risk of bias, since these have a general low evidence strength when studying the effects of interventions.

**DATA EXTRACTION**

Data was extracted from each relevant study by the first reviewer using a pre-designed table (see Appendix 1), and the data were subsequently checked by the second reviewer. All data extracted from the studies were based on the results sections and not on the conclusions of the study.

**DATA SYNTHESIS**

The outcomes were grouped together into effects on medication being prescribed (e.g. number of patients being prescribed medication, quantity of medication being prescribed, type and dose of medication being prescribed), effects on patients (e.g. quality of care, satisfaction with care, clinical parameters for patients), effects on professionals (e.g. workload, time savings) and effects on the health care system (e.g. accessibility of care, cost of care).

### POOLING

Pooling of outcomes was considered if studies reported similar outcomes, presented raw data and had either all continuous or all dichotomous outcomes. Standardised mean differences and a random effects model were used for continuous outcomes, while relative risks and a random effects model were used for dichotomous outcomes. Confidence intervals were set at 95% (15). The decision to pool studies was based on their clinical homogeneity, according to similarity in the care setting and in the type of illness affecting the patients included in the study. Furthermore, the results of the poolings are only reported when the pooled studies showed acceptable statistical homogeneity. Studies were considered to be statistically homogenous when the chi-square test value was lower than the degrees of freedom, the P value was above 0.1 and the inconsistency test  $I^2$  was lower than 50% (15,16).

### SUBGROUP ANALYSIS

Subgroup analysis was considered for country and type of nurse who was prescribing. Although sensitivity analysis on the basis of the methodological quality of the studies was considered, this was not carried out since almost all studies had a high risk of bias.

Subgroup analysis was not attempted for the category of nurse prescribing, because these categories are mostly not clearly stated in the studies and have to be deduced from the setting, type of nurse who is prescribing, year of publication and country. The categories of nurse prescribing were not used as a basis for subgroup analysis, therefore, and are stated to give an indication of the different forms of prescribing included in the review.

### RESULTS

A total of 23 studies were eventually included in this review. The methodological quality assessment of the 23 studies included will be given first, followed by their characteristics and ending with the effects of nurse prescribing on medication being prescribed, on patient outcomes, on physician and nurse outcomes, and on characteristics of the health care system. The effect on the percentage of patients for whom medication was being prescribed was the only factor appropriate for pooling in this review. For this factor a sub-group pooling was done for country. Other poolings were not appropriate, due to the large clinical heterogeneity or large statistical heterogeneity of the studies. No other subgroup-poolings were possible by country or by type of nurse prescriber.

### METHODOLOGICAL QUALITY ASSESSMENT

Only seven of the 23 studies included were Randomized Controlled Trials (RCTs) (17,18,19,20,21,22,23), and one was a Controlled Clinical Trial (CCT) (24). The other studies had pre-test post-test designs without a comparison group, or pre-experimental post-test only designs. All of these other studies, non-RCT or non-CCT, have an inherently weak methodological evidence base for establishing effects and were rated as having a high risk of bias as a consequence.

The eight studies using a randomised or non-randomised controlled design were reviewed on methodological quality using the EPOC checklist. None of the RCT or CCT studies met all the criteria; two studies had a moderate risk of bias (18,19), while the other studies had a high risk of bias because less than four of the criteria on the EPOC list were met.

### CHARACTERISTICS OF STUDIES INCLUDED

Seven of the 23 studies involved independent nurse prescribing, one study involved supplementary nurse prescribing, five studies described a mix of independent and supplementary prescribing, and five studies looked at prescribing by group protocols. Five studies showed “approaching” independent nurse prescribing.

The publication years of the selected studies varied from 1974 to 2005. Seven of the 23 studies were conducted in the USA, eleven in the UK, three in the Netherlands, one in Canada and one in Colombia. Sixteen studies were conducted in primary care and seven in secondary care.

### PRIMARY CARE

Ten of the sixteen studies that were conducted in primary care involved nurses prescribing for various patients (21,22,23,24,25,26,27,28,29,30); one focused only on patients with acute minor illnesses (31), and three studies included only patients with sore throats or upper respiratory throat infections (32,33,34). There was one study in primary care of patients with diabetes (18) and one study of women seeking contraceptive services (17). In these primary care studies, nurse practitioners, physician assistants, nurse-midwives or community nurses were prescribing a variety of medication or antibiotics and diabetes-related medication in one case.

### SECONDARY CARE

Three of the seven studies carried out in secondary care were conducted in the field of mental health care and involved patients with a diagnosis of schizophrenia, depression, dysthemia or bipolar II disorders (35,36,37). Three studies

involved patients with diabetes (19,20,38) and there was one study in a radiotherapy and oncology department, which involved patients with diagnoses that included acute radiation toxicity causing proctitis from pelvic radiotherapy, and erythema of the scalp due to cranial irradiation (39). Advanced practice psychiatric nurses with prescriptive authority (APRNs) prescribed psychotropic drugs, diabetes specialist nurses prescribed insulin, and clinical nurse specialists prescribed antifungal preparations, mouth care lotions, etc.

**EFFECTS ON MEDICATION PRESCRIBED  
NUMBER OF PATIENTS BEING PRESCRIBED  
MEDICATION**

Nine out of eleven studies report that the number of patients for whom a nurse prescribes medication is similar to or lower than the number for whom a physician prescribes. Two studies show nurses prescribing medication for a higher percentage of patients than physicians do (see Table 2.). These eleven studies will be discussed below in more detail.

Several studies in primary care in the UK found no differences in the percentage of patients that had a prescription issued by nurses or by general practitioners (21,23,24,31). Two studies also found no difference between nurses and general practitioners regarding the percentage of patients being prescribed antibiotics for sore throats or viral upper respiratory tract infections (33,34), while one study in secondary care also found no difference in the percentage of patients being prescribed anti-depressants (35).

**Figure 3**

Table 2: Number of patients being prescribed medication by nurses versus physicians/psychiatrists

Study	Country	Type of Patients	Number of patients being prescribed by nurse as compared to physician/psychiatrist		
			Same	Less	More
<b>Primary care</b>					
Kinnesley et al. 2000	UK	Various	X		
Pritchard et al. 2001	UK	Various	X		
Shum et al. 2000	UK	Various	X		
Yenning et al. 2000	UK	Various	X		
Cox & Jones 2000	UK	Sore throats	X		
Butler et al. 2001	UK	URT1**	X	X	
Ladd 2005	USA	URT1**	X		
Batey & Holland 1985	USA	Various		X***	X <sup>1</sup>
Hooker & CIPHER 2005	USA	Various	X		X <sup>1</sup>
Rounie et al. 2005	USA	various			X
<b>Secondary care</b>					
Feldman et al. 2003	USA	Psychotropic drugs claims	X		

\* moderate risk of bias, all other studies have high risk of bias, \*\* URT1 = upper respiratory tract infections, \*\*\* = significance is unclear, 1 = only NP in rural areas

Two studies found that nurses prescribed medication for fewer patients than physicians did (25,32). Batey & Holland (1985), however, only report the percentage of patients being prescribed for by nurses (49.7%) and by physicians (63%), but do not report whether this difference is statistically significant. In contrast to the findings described above, two

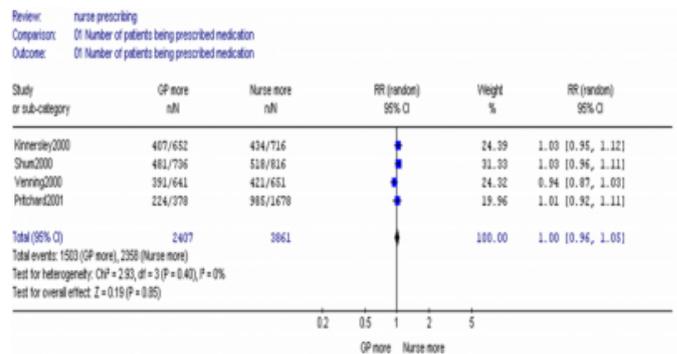
studies found that nurses prescribed medication for more patients (27,30). Hooker & CIPHER (2005) found no difference in the overall number of patients being prescribed for, but when rural areas alone were taken into consideration, they found that nurse practitioners prescribed medication for significantly more patients than physicians did, whereas physician assistants wrote the fewest prescriptions (27).

**SUB-ANALYSIS**

A pooling of studies concerned with the number of patients being prescribed medication was only possible for 6 studies that reported raw dichotomous data and were conducted in a primary care setting with various patients. This pooling has not been reported here due to substantial statistical heterogeneity. Analysis of a subgroup of this pooling per country, however, shows that four studies in the UK taken together show no difference in the number of patients being prescribed medication by nurses and GPs (see figure 2) (21,23,24,31). This is in contrast to two other similar studies (primary care setting and involving various patients) that were conducted in the USA, both of which found that nurses prescribed medication for a larger percentage of patients (27,30).

**Figure 4**

Figure 2: Number of patients being prescribed medication in primary care in the UK



**TOTAL QUANTITY OF MEDICATION BEING  
PRESCRIBED**

Four studies report that nurses prescribed a similar or lower total quantity of medication overall, compared to physicians or psychiatrists. One of these also reports that nurses prescribe more medication than physicians or psychiatrists in some cases (see Table 3).

Figure 5

Table 3: Total quantity of medication being prescribed by nurses versus physicians/psychiatrists

Study	Country	Type of Patients	Total quantity of medication being prescribed by nurse as compared to physician/psychiatrist		
			Same	less	more
<b>Primary care</b>					
Ferguson et al. 1998	UK	Various	X		
<b>Secondary care</b>					
Fisher et al. 2003	USA	schizophrenia or depression	X	X***1	
Jacobs 2005	USA	depression, dysthymia or bipolar II disorders	X***2	X***2	X***2
Houweling 2005 cb5***	Netherlands	Diabetes	X	X	

\* moderate risk of bias, all other studies have high risk of bias, \*\* URTI = upper respiratory tract infections, \*\*\* = significance is unclear, 1. only for total quantity of benzodiazepines being prescribed, 2 = outcome depends on therapy type and/ or the type of medication being prescribed.

A study of nurse prescribing in primary care in the UK showed that the increase in the volume of prescribing following the introduction of nurse prescribing was similar to the national increase in the volume of prescribing for the same period. It would appear, therefore, that nurse prescribing did not increase the volume of prescribing (26).

Fisher et al. (2003) found in secondary mental health care that psychiatrists prescribed a total quantity of 155 medications and advanced practice registered nurses 119, although this difference was not statistically significant. Two studies in mental health care found that psychiatric nurses, on the whole, prescribed less benzodiazepines for anxiety (36,37). Jacobs (2005) also found they prescribed less mood stabilizers, less secondary anti-depressants and less new-age antipsychotic medication than psychiatrists. A minimal difference in the prescription of selective serotonin reuptake inhibitors (SSRIs) was found. Furthermore, Jacobs (2005) found that differences in medication prescription between psychiatric nurses and psychiatrists also depended on type of therapy. Where split therapy was concerned (when psychotherapy is separate from medication management), the prescription of benzodiazepine anti-anxiety agents was slightly greater in patients being prescribed by psychiatric nurses (20%) than in those being prescribed by psychiatrists (15%). In the case of other types of therapy, the prescription of mood stabilizers and secondary anti-depressants by psychiatric nurses and psychiatrists was similar. Both studies (36,37), however, did not clearly report the statistical significance of the above findings.

In the field of diabetes care, the quantity of medication prescribed by specialist nurses and medical specialists were the same for glucose and blood pressure lowering medication. The specialist nurses prescribed a significantly lower quantity of cholesterol lowering medications (20).

**NUMBER OF MEDICATIONS BEING**

**PRESCRIBED PER PATIENT VISIT**

Two studies reported on the number of medications being prescribed. One study found that the mean number of medications prescribed per patient during a visit was similar for physicians, physician assistants and nurse practitioners (27), while another study found that the average number of medications used by patients is 1.33 per medication visit for nurse prescribing, compared to 1.87 for physician prescribing (25). The statistical significance of this finding was not reported.

**TYPE OF MEDICATION AND DOSE PRESCRIBED**

There were few overall differences in types of medication and doses prescribed; two studies in mental health care for patients with depression and schizophrenia reported mostly similar types of medication prescription by nurses and psychiatrists (35,36). One study of family planning reported several differences in type of medication, but no differences in clinical outcomes (17).

Drug selection within a therapeutic class was mostly similar for psychiatric nurses and psychiatrists, with anti-depressant medications being prescribed most frequently (35,36).

Although SSRI anti-depressants were prescribed most frequently by both groups, nurses preferentially prescribed SSRI antidepressants, whereas psychiatrists prescribed more types of antidepressant medication other than SSRI. Benzodiazepines were prescribed in similar proportions (36).

Furthermore, Feldman et al. (2003) found no difference between the groups where adult therapeutic dose was concerned, although psychiatrists more often augmented and switched medication and titrate doses. Psychiatric nurses had fewer patients with concomitant sedative/hypnotic medication use or a combination of central nervous system stimulants.

A study in a family planning clinic found that nurses inserted fewer intrauterine devices (IUDs), were more likely to keep the client on conventional methods, and prescribed more temporary methods until the next visit. It is unclear whether these differences are statistically significant. The number of patients to receive IUDs on their next visit was similar for nurses and physicians. Clinical outcomes for patients (reported later) were the same (17).

**EFFECTS ON PATIENT OUTCOMES CLINICAL PARAMETERS**

Most of the nine studies reporting on clinical parameters of

patients found no differences between prescribing nurses and GPs and some found that the patients who were given prescriptions by nurses had better clinical parameters (see table 4).

There were no significant differences between patients being treated by a nurse or by a GP in the resolution of symptoms and concerns (24); in patients' rating of their health status or in terms of clinical improvement after two weeks (21); in health status outcome (23); in the number of sore throats that had settled (33); in the physical status level, emotional function and social function, and crude death rates (22); and in pregnancy rates, method continuation and side effects for contraceptive services (17).

**Figure 6**

Table 4: Clinical outcomes of patients being prescribed by nurses or physicians

Study	Country	Type of Patients	Clinical outcomes		
			No difference	Favours nurse	Favours physician
<b>Primary care</b>					
Kinnersley 2000	UK	Various	X		
Spitzer et al., 1974	Canada	Various	X		
Shum 2000	UK	Various	X		
Venning 2000	UK	Various	X		
Cox 2000	UK	Sore throats	X	X	
Spitzer 1974	Canada	various	X		
Einhorn 1978	Colombia	Women seeking contraceptives	X		
Houweling 2005ch4*	Netherlands	Diabetes	X		
<b>Secondary care</b>					
Houweling 2005ch5*	Netherlands	Diabetes	X		X
James 2004	UK	Diabetes		X	

\* moderate risk of bias, all other studies have high risk of bias, 1 = number of patients whose sore throats had settled, 2 = median number of days for sore throats to settle and patients' perception of being back to normal health, 3 = only for cholesterol/HDL-ratio.

Cox and Jones (2000) found that the median number of days for a sore throat to settle was lower for nurses' patients than for GP patients. Furthermore, patients' perception of being back to normal health were more favourable for nurses.

A study of diabetes care found that there was a 22% reduction in hypoglycaemic events compared to the period before nurse prescribing, that no errors or adverse events occurred as a result of nurse prescribing, and 74% of the target population experienced improved glycaemic control or symptomatic relief or both. Staff members stated that care had greatly improved. The statistical significance of these findings was not reported (38).

Houweling (2005 ch.4 and ch.5) conducted two studies in the field of diabetes care and found no significant differences in clinical outcomes, quality of life or diabetes-related symptoms (as perceived by patients) for patients being treated by practice nurses or diabetic specialist nurses compared to a GP or a medical specialist (18,19), with the exception of the cholesterol/HDL ratio, which improved more for patients being treated by a medical specialist in the secondary care setting (19).

**SATISFACTION WITH CARE**

Eight studies all found that patients being treated by nurses were just as satisfied or more satisfied than patients being treated by physicians (see table 5).

**Figure 7**

Table 5: Differences in patient satisfaction with care by nurses or physicians

Study	Country	Type of Patients	Patient satisfaction with care delivered by nurse		
			Same	More satisfied	Less satisfied
<b>Primary care</b>					
Cox & Jones, 2000	UK	Sore throats	X		
Spitzer et al., 1974	Canada	Various	X		
Kinnersley et al., 2000	UK	Various	X	X <sup>3</sup>	
Venning et al., 2000	UK	Various	X	X	
Shum et al., 2000	UK	Various		X	
Pritchard & Kendrick, 2001	UK	Various	X		
Houweling, 2005ch4*	Netherlands	Diabetes		X	
<b>Secondary care</b>					
Houweling, 2005ch5*	Netherlands	Diabetes		X	

\* moderate risk of bias, all other studies have high risk of bias, 1 = Children are more satisfied, adults only in three out of the ten practices.

Four studies in primary care found that satisfaction with the health care received was similar (22,24,31,33) and two studies found that patients were more satisfied with care received from nurses compared to care received from GPs (21,23).

Kinnersley et al. (2000) found in three of the ten practices researched that adult patients were more satisfied with care received from the prescribing nurses and that children were also more satisfied in general.

Furthermore, two studies conducted in the field of diabetes care found that patients were more satisfied with care provided by the prescribing nurse than by a physician or medical specialist (18,19).

**PATIENT ENABLEMENT**

Two studies report that patient enablement, i.e. the extent to which patients understand their illness and are able to cope, is similar for nurse practitioners and GPs (23,31), although health visitors have better results in this respect than either nurse practitioners or GPs (31).

**QUALITY OF CARE**

Three studies in primary care report that quality of care provided by nurses is similar to or better (in some cases) than that provided by GPs.

The first study is by Spitzer et al. (1974), who found no significant differences between nurses and GPs in quality of care or in adequate prescription of drugs (assessed by criteria pre-developed by group of physicians) for the 2058 families included in the research.

The second study, by Luker et al. (1998), reports that nurses

are considered to be in a better position to prescribe than GPs in some fields, due to a unique knowledge of patients and their circumstances, and the expertise of the nurses in activities such as wound management and baby care.

A third study in primary care for diabetes patients showed that all process indicators for quality of care were better for nurses than physicians, except for intensifying glucose level lowering therapy or intensifying cholesterol reducing therapy, for which there was no difference (18).

### CONSULTATION TIME

Six of the seven studies reporting on consultation times found that nurses generally spent more time with patients and one found no difference.

Three of the studies that found that nurses had longer consultation times than GPs were conducted in the UK in the field of primary care (21,23,24).

Two studies in secondary mental health care in the USA found that psychiatric nurses spent more time with patients during medication visits (36)(37), although Jacobs (2005) does not report the statistical significance of this finding.

A study in primary diabetes health care in the Netherlands found that the total duration of the consultations per patient was higher for the practice nurse than for the physicians (18). In the case of secondary diabetes health care, no differences were found in the total duration of all consultations (20).

### INFORMATION AND DOCUMENTATION

Three studies report that prescribing nurses give either more or the same amount of information to patients and that documentation is similar.

Nurses were found to give more advice than GPs about home remedies (33), self-medication and general self-management (21). Kinnersley et al. (2000) found that nurse practitioners gave similar amounts of information in seven practices, but patients managed by nurse practitioners in three of the ten practices reported receiving more information about their illnesses.

Documentation of clinical records in mental health care was not qualitatively different for advanced practice psychiatric nurses compared with psychiatrists (35).

### INVESTIGATIONS, REFERRALS AND RECONSULTATIONS

As will be discussed below, several studies show that the

number of investigations by nurses is similar or higher than by GPs and that there are no differences in referrals to secondary care. Most studies show no difference between nurses and GPs where reconsultation rates of patients are concerned.

One study in primary care found that that nurses were more likely to initiate investigations (23,31), whereas another study found that GPs were more likely to initiate investigations (31). Venning et al. (2000) also found that the number of patients that had a physical examination was similar and Kinnersley et al. (2000) found no difference between nurses and GPs in the number of investigations done.

Three studies in primary care reported no differences between nurses and GPs in the number of referrals to secondary care (23,24,31). A study of patients with diabetes in secondary care found that more patients of the specialist nurse were referred back from the hospital to treatment by their GP (primary care) than was the case for patients of the medical specialist (19).

Four studies in primary care found no differences between patients of nurses and patients of GPs where reconsultations were concerned (24,31,32,33). Venning et al. (2000), however, found that nurses asked patients to return more often and that patients treated by nurses were more likely to make a return visit to the clinic. A study on contraceptive services showed that nurses have significantly more scheduled revisits for method changes and less unscheduled revisits (17). A study in primary diabetes care reported that the total number of consultations by patients was higher for nurses than for GPs (18).

Only two of the seven studies reporting reconsultation results could be pooled on reconsultations (Butler et al, 2001 and Cox & Jones, 2000). The studies show no significant effect when taken separately, but pooled together they show that nurses have slightly more reconsultations than GPs. The risk of reconsultation is low (between 6% –10%) for GPs and nurses, however, and the effect size found is a minor one (1.68, confidence level 1.04 –2.73).

### ADHERENCE TO MEDICATION PRESCRIPTION

Only one study in mental health care reported on adherence to medication and found no significant difference between being treated by a psychiatrist or by an advanced practice registered nurse (37).

## **EFFECTS ON PROFESSIONAL OUTCOMES**

### **WORKLOAD REDUCTION AND TIME SAVINGS**

Only three studies investigated professional outcomes of nurse prescribing with regard to workload reduction and time savings.

One study reported that the workload of the GP had been reduced, with 13% of the urgent appointments now being managed by a practice nurse or health visitor with prescribing tasks. It is unclear whether this is a statistically tested and significant finding (31).

Two studies reported time savings due to nurse prescribing. One study reported that the independent treatment of some patients (102 of the 206) by a prescribing practice nurse saved the GPs a total of 2825 minutes (about 47 hours) over a period of fourteen months. If all patients had been treated by a practice nurse, the GPs would have had to spend a total of 536 minutes (about nine hours) discussing consultations with nurses in the fourteen-month period (18). Ferguson et al. (1998) reported a mean weekly time saving of one hour per district nurse and a mean weekly time saving of 50 minutes per GP.

### **EFFECTS ON COSTS AND OTHER CHARACTERISTICS OF HEALTH CARE SYSTEM**

#### **ACCESSIBILITY OF CARE**

Four studies show positive effects of nurse prescribing on accessibility of health care. The perceived benefits of nurse prescribing reported by all four studies are greater accessibility and approachability, such as reduced waiting times in obtaining medication, and reduction of the number of health professionals to be seen by the patient (28;29;38;39). Luker et al. (1997) also reported reduction in the number of journeys some carers had to make, earlier start of treatment, and that clients felt more able to discuss concerns with nurses. Some disadvantages were reported in the form of dissatisfaction with new methods of obtaining prescriptions (28).

The statistical significance of all the above findings is unclear.

#### **COSTS**

Four studies that report on the health care costs of nurse prescribing show either no difference in costs or some (potential) cost savings of nurse prescribing compared with prescribing by another clinician. These studies will be

discussed in more detail below.

Venning et al. (2000) found that there was no significant difference in health service costs between nurse practitioner prescribing and GP prescribing in primary care general practices.

The second study, by Ferguson et al (1998), which used eight scenarios to compare the actual costs of nurse prescribing with the estimated costs had nurse prescribing not been introduced, showed that the introduction of nurse prescribing at the practices had resulted in net savings on six scenarios. Net increases in costs emerged in only two scenarios. The outcomes, depending on best, neutral or worst scenarios, range from net savings of 158,653 pounds to net costs of 82,841 pounds (26). The statistical significance of these findings is unclear.

Spitzer et al. (1974) stated that their study showed that nurse practitioner care (including nurse prescribing) was cost-effective from society's point of view, but not financially profitable for doctors, because of the restrictions on reimbursement for nurse practitioner services at that time.

Finally, the study by Houweling (2005c) in diabetes care in the Netherlands showed that the costs incurred for personnel were lower for the group of patients being treated and prescribed for by the specialist nurse. The lower number of laboratory tests and lower quantity of cholesterol lowering medication prescribed by the specialist nurses meant that the costs for these were also lower. The costs incurred for glucose medication and blood pressure medication were the same in both groups (20).

### **CONCLUSION AND DISCUSSION**

The overall effects of nurse prescribing seem positive.

Nurses mostly prescribed medication for a similar or lower percentage of patients than physicians did, although caution is advisable here, since two studies actually showed that nurses prescribed medication for a higher percentage of patients than physicians did. Although nurses sometimes seem to differ from physicians in their choice of the kind of medication prescribed, the overall health care outcomes for patients prescribed for by nurses compared to patients prescribed for by physicians were positive; clinical parameters were the same or better for treatment by nurses, quality of care by nurses is similar or better and patients treated by nurses were just as satisfied or more satisfied. The results also show that consultation times are similar or more

commonly longer for prescribing nurses, that they give either more or the same amount of information, that the number of investigations by prescribing nurses is similar or higher than by GPs, and that there are generally no differences in referrals to secondary care or reconsultation rates. These results are consistent with the results of a review by Horrocks et al. (2002) of care provided by nurses compared to physicians. Horrocks et al. (2002) found in a meta-analysis, however, that nurses carried out more investigations.

The anticipated benefits for professionals, in the form of workload and time savings, or for the health care system with regard to accessibility and costs, cannot be confirmed because of a lack of substantial comparative research in this area. Available results show a potential improvement in accessibility of health care, but there is scarcely any evidence of potential reductions in workload, or savings on time or costs. No research was found to report on the following anticipated benefits referred to in the introduction, viz. better use of the skills and experience of nurses, recognition of their competences and expertise, and improved working relationships between health care professionals.

Considering the methodological quality of the studies reviewed, the effects of nurse prescribing on all outcomes can only be seen as indications of possible effects and conclusions must be approached with caution. Doubts on overall safety and damage to patients' health have not been confirmed, however. As yet, no reasons have been discovered why nurses should not prescribe under certain conditions, but the question of whether nurse prescribing delivers all the anticipated benefits needs to be explored by further research.

### LIMITATIONS

One limitation of this review concerns the fact that nurse prescribing in the studies reviewed was embedded in other tasks, such as consultation, diagnosis and treatment. It is difficult to distinguish nurse prescribing from these other tasks and focus solely on the effects directly resulting from nurse prescribing, and so it remains unclear to what extent the effects found are the direct result of nurse prescribing or are more the result of the entire task substitution of physicians by nurses. Horrocks et al (2002) suggest in their review comparing care provided by nurses with care provided by physicians that the factors that lead to greater satisfaction should be elucidated, such as the extra

consultation time, the consultation skills of nurses, or patients' expectations. Longer consultation time or greater skill on the part of the nurses may lead to greater patient satisfaction, regardless of whether the nurse is also prescribing medication (40).

Another limitation relates to the fact that the heterogeneity of the research made it difficult to make a general comparison of the studies included. The studies considered various different categories of nurse prescribing, various settings and various patients, were done in various countries and, last but not least, used various outcomes and outcome measurements. Although the results mainly point in the same direction, they are difficult to compare.

Furthermore, it must be taken into account that the methodological quality of the studies included was generally very poor for determining the effects of nurse prescribing. With the exception of two studies with a moderate risk of bias, all of the studies had a high risk of bias and the results of this review must therefore be viewed with caution. They can only be regarded as studies that provide indications of existing effects on medication prescription, patients, professionals and the health care system, and the evidence for the reported outcomes is weak as a consequence.

It must also be taken into account that most results for the quantity and type of medications being prescribed by nurses and physicians are not directly linked to the clinical outcomes, potential medication errors or adverse effects on patients, and so it is unclear whether similar, smaller or greater quantities of medication being prescribed, and similar or different choices of type of medication result in adequate, better or worse care. Ladd (2005), for example, shows that even though the prescribing of antibiotics is not appropriate for viral upper respiratory tract infections, both nurses and physicians prescribe similar numbers of patients antibiotics for this condition. Studies that did assess the clinical appropriateness of prescribing by nurses found that the nurse prescribed appropriately (41,42).

Furthermore, the results of the pooling seem to indicate possible differences in nurse prescribing between countries, although this result could also be caused by differences in prescribing categories, by differences in the type of nurse who is prescribing, or by possible differences in design between the studies. These results need to be viewed with caution, especially since there are only 2 studies from the USA as comparative material.

## **FURTHER RESEARCH**

Future research, preferably using randomised controlled designs, is needed to obtain more evidence on all effects of nurse prescribing, and specifically the effects of nurse prescribing on professionals and on the health care system. More research is needed on potential differences or similarities in medication adherence, quality of care, consultation time, information, investigations, referrals and reconsultations, and these should preferably be studied in combination with their effects on (clinical health) outcomes for patients, for professionals and for the health care system as a whole.

Future research should also indicate whether differences in the type of medication being prescribed have any implications for clinical health outcomes or how the quantity of medication being prescribed affects the health care system in its entirety, by demonstrating possible cost per year per practice for example.

Attention is also required for the consequences that differences between nurses and physicians in the type of medication being prescribed may have for the appropriateness of prescribing, potential adverse effects, or medication errors.

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