Do guidelines create uniformity in medical practice?

Judith D. de Jong [a,*], Peter P. Groenewegen [a,b], Peter Spreeuwenberg [a], François Schellevis [a,c], Gert P. Westert [d,e]

[a] NIVEL, Utrecht University, Netherlands
[b] Utrecht University, Utrecht, Netherlands
[c] Vrije Universiteit Medical Centre, Amsterdam, Netherlands
[d] RIVM, Bilthoven, Netherlands
[e] Tilburg University, Tilburg, Netherlands

ARTICLE INFO

ABSTRACT

This article aimed to test the general hypothesis that guidelines create uniformity, or reduce variation, in medical practice. Medical practice variation has policy interest and is one of the reasons for developing guidelines. The development and implementation of guidelines was considered in the broader context of processes of rationalization. We focused on the influence of voluntary guidelines developed by the professional organization for family physicians in the Netherlands on variation in drug prescription.

Data were used from the First and Second Dutch National Survey of General Practice (DNSGP1 and DNSGP2), collected in 1987 and 2001 respectively. DNSGP1 consisted of 103 practices and 161 GPs serving 335.000 patients. DNSGP2 consisted of 104 practices and 195 GPs serving 390.000 patients. Two groups of diagnoses were created, one containing all diagnoses for which guidelines were introduced and one containing all other diagnoses. For both groups a measure of concentration, Herfindahl-Hirschman Index (HHI), was used to represent variation. This measure of concentration was compared between both groups using multilevel analysis.

Results showed that although there was an overall increase in variation (a significantly lower HHI) in prescription, the increase was less in the cases of diagnoses for which guidelines were introduced. Guidelines, primarily, had an effect on variations in single-handed practices. The overall conclusion is that the introduction of guidelines, although it probably tempered the increase in variation, did not reduce variation.

Introduction

In the classical conception of medicine as a profession, medical practice is largely uniform through the shared body of (theoretical) knowledge. Variation originates from the necessity to apply this theoretical knowledge to individual patients. However, when clinical variables and patient characteristics are taken into account, there is variation left. Whatever the origin of this part of variation, it is striking that this variation has been found to show clear patterns by country, region, hospital and practice. Explanations for variation are sought in differences in opinions or enthusiasm for certain procedures between individual physicians, and in differences in constraints and social influences for groups of physicians (Chassin, 1993; de Jong, 2008; Landon, Reschovsky, Reed, & Blumenthal, 2001; Wennberg & Gittelsohn, 1975; Westert & Groenewegen,

1999). Variation in medical practice is not a bad thing by definition; without variation there probably will be no progress. However, it is the downside of variation that attracts attention from third parties. Evidence of variations in medical practice suggests the possibility of inappropriate servicing, wasting of resources and even actual harm to patients (Evans, 1990). The existence of variation has policy interest and is one of the reasons, besides rising health care costs, for developing guidelines. The use of clinical guidelines that give recommendations about appropriate health care is a way of reducing variation and maintaining, or improving, the quality of health care (Grilli, Magrini, Penna, Mura, & Liberati, 2000; Hutchinson, McIntosh, Cox, & Gilbert, 2003; Langley, Faulkner, Ch. Watkins, Gray, & Harvey, 1998; Lomas et al., 1989). A wide variety of guidelines has been developed in the last decades for hospitals and physicians (Grimshaw et al., 2004; Hibble, Kanka, Pencheon, & Pooles, 1998). In this article guidelines for family physicians in the Netherlands will be studied.

In The Netherlands guidelines are developed for family physicians by the Dutch College of General Practitioners. The first appeared in 1989 and over 80 guidelines for different diagnoses

* Corresponding author. NIVEL, Research, PO Box 1568, 3500 Utrecht, BN, Netherlands. Tel.: +31 302729702.
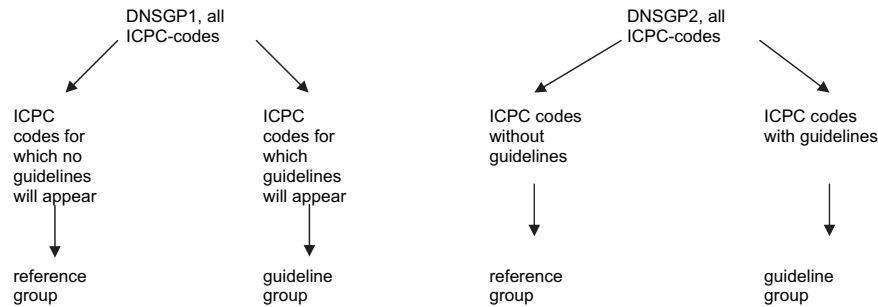E-mail address: j.dejong@nivel.nl (J.D. de Jong).

Fig. 1. Creating the guideline and the reference group.

have appeared ever since. While several studies examined the adherence to guidelines (e.g. Grol, 2001; Hermens, Hak, Hulscher, Braspenning, & Grol, 2001; Schers, Braspenning, Drijver, Wensing, & Grol, 2000; Tiemeier et al., 2002; Groenhof, Bettink, van Dijk, van der Veen, & Meyboom-de Jong, 2006), the impact on variation among physicians is hardly ever studied (e.g. Mourad et al., 2008; Verstappen et al., 2003).

The development and implementation of clinical guidelines can be seen in the light of broader processes of rationalization, which occur everywhere in modern society. Processes of rationalization lead to more uniformity; guidelines introduced and followed by physicians create uniformity. Still, processes of rationalization do not lead to more uniformity in all respects. Although guidelines may specify for instance the therapeutic substances of drugs that are preferred for certain conditions, many different brands of drugs, containing the same therapeutic substances, can coexist.

This article focuses on the influence of guidelines on variation in drug prescription. It will not look at the contents of the guidelines, nor test whether guidelines are being followed, nor whether the quality of medical treatment is increased by the introduction of guidelines. It will test the general hypothesis that guidelines create uniformity. The general question addressed is: *Is variation reduced after guidelines are introduced?* In other words: *Do guidelines indeed create uniformity?*

Background and hypotheses

To answer this question we will discuss rationalization in medicine. Secondly, the subject of guidelines will be discussed. Thirdly, more information about family physicians and guidelines in the Netherlands will be given. Finally, hypotheses will be formulated on when to expect a decrease in variation after guidelines are introduced. More specific expectations can then follow.

Rationalization in medicine

Worldwide, the profession of medicine is increasingly subject to the influences of market competition, forcing it towards standardization (Hafferty & Light, 1995; Ritzer & Walczak, 1988). The production and diffusion of medical knowledge and technology are increasingly international. There is a change from professional dominance to managerial market orientation (Scott, Ruef, Mendel, & Caronna, 2000). The United States is in front but Europe is on its heels with the introduction of guidelines, protocols, diagnostic related groups or similar reimbursement systems that exert pressure to make more efficient use of health care resources. The profession is changing from being led by social values when making rational choices, to being controlled by rules and regulations (Ritzer & Walczak, 1988). The institutional changes in the health care sector that lead to increased formal rationality are expected to

reduce variation in medical practice as physicians are increasingly operating in a predictable manner. Based on a literature review, Groenewegen and Westert (2004) concluded that there is indeed a downward trend in medical practice variation.

Guidelines can be developed by different stakeholders such as insurance companies and organizations of medical professionals. They are supposed to increase the quality of care, or reduce costs, depending on which body is producing the guideline. The source of the guidelines is important as this is related to their acceptance by physicians. It determines too whether they are normative, meaning that there are no formal sanctions when the guidelines are not followed, or regulative, including formal sanctions (Onion & Wally 1995; Tunis et al., 1994). For instance insurance companies can develop guidelines in order to reduce costs. This goal in itself limits the acceptance amongst physicians. These guidelines, however, may still be followed because insurance companies can exert regulative pressure using formal sanctions such as through the authorization and rules on reimbursement for hospitals, physicians and patients.

In this article guidelines developed by the professional organization for family physicians in the Netherlands will be studied. These guidelines are normative, or voluntary rules, thus in essence it is up to the individual physician whether they are followed.

The Netherlands

The role of family physicians in the Netherlands is described in Box 1. The Netherlands are a precursor in the development of clinical guidelines compared to other European countries. Guidelines are developed by the Dutch College of General Practitioners (NHG), they have developed and published guidelines since 1989. The guidelines were developed in order to improve the quality of family physicians' practice and can be used to support family physicians in their daily practice, protect them from mistakes and legitimize medical behavior. The guidelines relate to diagnostics, treatment, referral, and prescribing. The NHG aims to achieve evidence-based practical guidelines that are widely accepted. In order to increase acceptance, the target group is involved in their development (see Box 2). The idea is that guidelines are more readily accepted and acted upon if made and implemented by the profession itself (Brindis & Sennett, 2003; Francke, Smit, de Veer, & Mistiaen, 2008; Grol, 2001).

Why and when would variation be reduced by the introduction of guidelines?

Variation is expected to decrease when guidelines are followed. It is not certain that people will follow guidelines, for being different can be valued more than being similar (Brunsson & Jacobsson, 2000). Being different is important when people need to

Box 1. Family physicians in the Netherlands.

Family physicians in the Netherlands have a gate-keeping role. All publicly insured patients[1] (all patients with an income below 30.700 Euro for the year 2002, 60 percent of the total population) are on the patient list of a family physician or practice. Publicly insured patients have no direct access to specialist care; they have to consult their family physician first. Most of the privately insured patients also visit their family physician before consulting a medical specialist. Family physicians treat over 90 percent of all complaints themselves (Cardol, de Bakker, & Westert, 2006; Committee of the Health Council, 2004), family physicians prescribe 75 percent of all drugs, and 65 percent of all consultations end with a prescription (van Dijk, 2006).

Family physicians are working in single-handed practices (42 percent), in duo practices (33 percent), or in group practices (25 percent). (van den Berg, Kolthof, de Bakker & van der Zee, 2004). The number of family physicians working in single-handed practices is decreasing over time.

Box 2. Guideline development procedure.

The procedure to develop guidelines is as follows: the NHG selects a topic for which a guideline should be formulated, they mostly concern medical practice or organization; a working group of family physicians develops the guideline and this is sent to another 50 family physicians for comment. After the guideline is revised, it is sent to an independent scientific committee for authorization (Geijer et al., 1999). Then, the guideline is published in the official journal of the Dutch College of Family Physicians. Both members and non-members of the NHG react positively to the procedure and consider the NHG capable of formulating widely accepted guidelines to be used in family practice.

distinguish oneself from the other, for instance when there are many physicians it will be more important to have specific skills in order to be able to offer different treatments from the others. However, people will try not to be different if there is a degree of uncertainty. In situations where one is unsure about what to do, it is safer to demonstrate similar behavior to the others. By following guidelines, it is easier to explain what has been done, and to achieve acceptance. We will discuss two important mechanisms that influence the reduction of variation when guidelines are introduced: the uncertainty of the outcomes of, or the appropriateness of, medical behavior and social integration in the profession. With these mechanisms differences between physicians working in single-handed practices and physicians working in group practices can be expected.

Guidelines are developed to support family physicians in their daily practice, and in this way ensure the quality of care (Grimshaw & Russell, 1993; Grol, 2001; Lomas et al., 1989). Support is mostly appreciated in cases where one is uncertain. In general, people are most influenced by peers when there is a high degree of uncertainty, and objective, unambiguous information is not available (Bandura, 1986; Berkman, Glass, Brisette, & Seeman, 2000; Cialdini & Trost, 1998). Hence, the ones most likely to use the guidelines to reduce uncertainty, are those family physicians who do not have colleagues around them to whom they might turn; physicians in single-handed practices. Physicians surrounded by colleagues are expected to show similar behavior to those colleagues (Berkman et al., 2000; Eddy, 1984). This behavior could be based on professional guidelines, but also on local standards.

Family physicians in single-handed practice rely more on patients for social approval, while family physicians sharing their work environment with colleagues rely more on these role equivalents for their social approval (Burkhardt, 1994; Freidson, 1970). Family physicians working in single-handed practices may be less likely to spend more time in activities other than those directly related to patient care. Family physicians working in partnerships increase social approval by engaging in professional activities. This is related to following guidelines because the ones most likely to work according to the guidelines are the ones most integrated in the profession, those who are most likely to spend time keeping up

with professional developments, and those who risk being sanctioned by colleagues (Coleman, Katz, & Menzel, 1966). Family physicians who do not share their work environment with colleagues are less likely to be disciplined by colleagues because their behavior is less visible to colleagues (Lulofs, 1981). The literature supports this. Family physicians spending more time in direct patient care were more likely to deviate from indicators derived from guidelines (Hutten, 1998).

Besides disciplining each other, other physicians are an important source of information. Grol (2001) studied the successes and failures of the implementation of guidelines and found as sources of information: scientific journals; discussion of the guideline with a local group of physicians; and contact with other physicians and course attendance. Discussion and contact with colleagues goes without saying for physicians sharing their work environment, but it is less easy for family physicians working in single-handed practices (O'Neill & Kuder, 2005).

One runs the risk of being criticized only when behavior is visible. Although behavior is not always visible in a shared work environment, it is more visible there than in a single-handed practice, as colleagues in shared practices see each others' patients. To avoid the risk of being criticized they will imitate those close colleagues with status and success, and behavior within a group will show similarities (Burkhardt, 1994). Thus it is expected that family physicians working in groups developed their own, local standards, even in the absence of guidelines. Therefore, when guidelines are introduced little change in variation between physicians in group practices is expected. A change in behavior is, however, perfectly conceivable when guidelines deviate from local standards. So differences can be expected in the reduction of variation between family physicians in single-handed and those in group practices. In this article we will study the reduction in variation for drug prescription. It is hypothesized that:

1. Variation in drug prescription has decreased with the introduction of guidelines.
2. Variation in drug prescription has decreased more for family physicians working in single-handed practices than for family physicians working in group practices.

Data and method

First and Second Dutch National Survey of General Practice

Data were used from the First and Second Dutch National Survey of General Practice (DNSGP1 and DNSGP2), collected in 1987 and 2001 respectively. In 1987 there were no guidelines, while in 2001 75 guidelines were available (http://www.nhg.artsennet.nl/guidelines). Data were collected on contacts, patients, family

---

[1] In 2006 the difference between public and private insurance was abolished with the introduction of a new health insurance system.

Table 1
Summary of differences between the First and Second Dutch National Survey on General Practice.

	DNSGP1	DNSGP2
Year	1987–1988	2000–2002
Number of practices	103	104
Number of FPs	161	195
Number of patients	335.000	390.000
Registration period	3 months	1 year
Data collection	On registration forms	FP information systems

Table 2
Number of diagnoses, practices, family physicians and FPs diagnoses in our study.

	DNSGP1 guideline group	DNSGP1 reference group	DNSGP2 Guideline group	DNSGP2 Reference group
ICPC-codes	77	57	77	57
Practices	102	102	69	69
FPs	160	160	108	108
FPs diagnoses	7858	5115	7093	4460

physicians and practices. For a description of the data-collection and comparability we refer to Westert et al. (2005). A summary of differences between both surveys can be found in Table 1. We will elaborate on two differences between the surveys that influenced the design of the analyses: the registration period and the method of data collection.

From all family physicians participating in DNSGP2, data for one year were retrieved from the electronic medical records. Family physicians participating in DNSGP1 were divided into four groups. Each recorded information on sheets during one of four consecutive three month periods.

During DNSGP1 the data were collected on paper registration forms, while the data for DNSGP2 were retrieved from Electronic Medical Records (EMR), including diagnoses, prescription, and referral. The problem of differences in data collection and registration period between DNSGP1 and DNSGP2 was solved by comparing differences within one study to differences within the other study.

Groups of diagnoses with and without guidelines

In order to make a comparison possible, we decided to examine differences within studies between groups of diagnoses. For DNSGP1 two groups were created, one containing all diagnoses for which guidelines were about to appear, and one for which no guidelines were developed until DNSGP2 (Fig. 1). For DNSGP2 we also made two groups of diagnoses, one for which guidelines have appeared and one for which there were no guidelines in 2001. So the diagnoses in both studies were divided into two groups, a guideline group and a reference group. The first group was made by selecting codes of the international classification of primary care (ICPC-codes) (Lamberts, Wood, & Hofmans-Okkes, 1993) related to 75 NHG guidelines (see Web Appendix 1). In the reference group we have all ICPC-codes for which no guideline existed in 2001.

Exclusions

Practices were excluded from the analyses if the data recorded were far from complete, for example if the period of recording data was only a few weeks, or ICPC-codes were scarcely recorded. Cases were excluded too for which no drugs could be identified, based on the ATC-5 code (Anatomical Therapeutic Chemical, 1993). Diagnoses that occurred less frequently, defined as less than 100 patients per diagnosis per study, were excluded. Furthermore, in DNSGP1 and DNSGP2 the same diagnoses were included.

In total 36 practices were thus excluded from the analyses, 32 due to incomplete recording. And 11735 cases were excluded because no drugs could be identified based on the ATC-5 code. The actual numbers of diagnoses in the study population, practices, family physicians and "family physician diagnoses" in our study can be found in Table 2. The diagnoses are counted per family physician, "family physician diagnoses" is the sum of all these different diagnoses counted per physician. The exclusions did not have an important negative effect on how representative this study was (Table 3).

Dependent variable

In this article variation will be represented as a concentration; the higher the concentration the less variation in drug prescription.

As dependent variable a measure of concentration was used, the Herfindahl-Hirschman Index (HHI) (Zwanziger, Melnick, & Bamezai, 2000). This measure was based on the "market share" of the drugs prescribed per diagnosis. The kind of drugs was identified based on the ATC-5 code. The HHI was measured as $\sum(a/b)^2$; where a is the number of times a specific drug was prescribed per diagnosis, and b is the total number of times any drug is prescribed for this diagnosis. This was measured for each drug prescribed per diagnosis and these values were added for all drugs prescribed per diagnosis. The range of this index goes from a low point of 1 divided by the number of drugs prescribed per diagnosis to a maximum of 1. A low index means that all drugs are equally often prescribed while 1 means that there is only one drug prescribed. The HHI was multiplied by 100 for computational reasons. Example: if 5 different drugs are prescribed for one diagnoses and the first is prescribed 300 times, the second 100 times, the third 3 times, the fourth 50 times and the fifth 500 times, the HHI is $(300/953)^2 + (100/953)^2 + (3/953)^2 + (50/953)^2 + (500/953)^2 = 0.39$.

Analyses

Because our data are hierarchically structured, multi-level models are the appropriate statistical approach (Hox, 1995; Leyland & Groenewegen, 2003; Snijders & Bosker, 1999). In our case the hierarchy is as follows: family physicians are nested within practices and patients are nested within family physicians.

As a dependent variable we used a measure of concentration, the HHI. The concentration index is not a characteristic of a single patient but of the aggregate of patients with the same diagnosis. It is measured per diagnosis per physician. Therefore the level of the patients is not relevant. The diagnoses per physician are populations, consisting of patients, with certain characteristics, including diagnosis, which are important in our analyses. These populations are nested within family physicians and therefore modeled as a level (see Web Appendix 2 for the full model, INSERT LINK WEB SUPP FILE). The total variation in prescription is separated into three parts: a part due to differences between populations, a part due to differences between family physicians, and a part due to differences between practices (Diez Roux, 2002; Leyland & Groenewegen, 2003).

Since different family physicians have populations with the same diagnoses the different HHIs are dependent between family physicians. What family physicians can prescribe does also depend on the diagnosis, and if they have populations with the same diagnoses, it is more likely that they will act the same. Therefore we produced a model, which allows for dependence between observations. The estimated means of the HHI will be presented.

To account for differences in patient population between family physicians, we included the mean age and sex of the patient populations of a family physician. Furthermore the number of patients per diagnosis as well as the number of different drugs available per

Table 3
A comparison between our population, the study population and the total population of Dutch FPs at the time of data gathering. The distribution of sex, age and types of practice in percentages.

	Our population DNSGP1 (%)	Study population DNSGP1[a] (%)	Total population in 1987[a] (%)	Our population DNSGP2 (%)	Study population DNSGP2[b] (%)	Total population in 2001[b] (%)
Sex						
Male	85	85	92	78	73	74
Female	15	15	8	22	27	26
Age						
<35	13	32	9	1	4	6
35–39	31	30	27	10	15	15
40–44	26	12	23	13	18	20
45–49	13	12	11	35	30	25
50–54	7	7	8	24	25	22
55–59	8	6	9	16	8	10
60+	3	1	12	1	1	2
Type of practice						
Solo	32	32	56	34	31	43
Shared	36	37	30	18	28	33
Group/Health centre	32	31	14	48	42	25

[a] Foets, van der Velden, & de Bakker, 1992.
[b] Schellevis, Westert, de Bakker, & Groenewegen, 2004.

diagnosis, measured as the total number of different drugs prescribed by all family physicians per diagnosis, the number of months from 1987 until the guidelines were introduced, and the number of family practitioners working in a practice were centered around a meaningful value, so that the estimated HHI has an interpretable meaning, and included in the model.

Testing hypotheses

The hypothesis that variation in prescription has decreased with the introduction of guidelines was tested by comparing the difference in HHIs between the reference and the guideline group for DNSGP1 and DNSGP2. If guidelines reduce variation:

- The HHI for the guideline group would have increased between DNSGP1 and DNSGP2 while the HHI for the reference group remained the same, increased less, or decreased (results are in Table 5, A and B).

The hypothesis that variation in prescription for the guideline group has decreased more for family physicians in single-handed practices than for family physicians in group practices was tested by examining differences between family physicians in single-handed and group practices, for the guideline and reference group separately. Besides it was tested if guidelines work differently for family physicians in group practices and for family physicians in single-handed practices:

- There would be a difference in HHI between single-handed practices and group practices for both the guideline and the reference group during DNSGP1. The HHI would be higher for the group practices (results are in Table 5, E and F);
- There would be a difference in HHI between single-handed practices and group practices for the reference group during DNSGP2. The HHI would be higher for the group practices (results are in Table 5, G);
- The difference in HHI for the guideline group between DNSGP1 and DNSGP2 for single-handed practices would be large compared to this difference for group practices (results are in Table 5, L and K);
- The difference in HHI for the guideline group between DNSGP1 and DNSGP2 for single-handed practices would be large compared to the difference for the reference group (results are in Table 5, L and J);
- The difference in HHI for the guideline group between DNSGP1 and DNSGP2 for group practices would be comparable to the difference for the reference group (results are in Table 5, K, I and M).

Results

A summary of hypotheses, tests, and results can be found in Table 7.

Table 4
Mean HHI for the reference and guideline group during DNSGP1 and DNSGP2.

Description of the group	Mean HHI (standard error)
DNSGP1, reference group	82.7 (0.8)
DNSGP1, guideline group	74.3 (0.7)
DNSGP2, reference group	73.6 (1.0)
DNSGP2, guideline group	68.4 (0.9)

Table 5
Differences between the HHI for the guideline and the reference group during DNSGP1 and DNSGP2.

Description of the difference	Difference	p-value
A: DNSGP1 reference group and DNSGP2, reference group	9.1	<0.001
B: DNSGP1 guideline group and DNSGP2, guideline group	5.9	<0.001
C: DNSGP1 reference group and DNSGP1, guideline group	8.3	<0.001
D: DNSGP2 reference group and DNSGP2, guideline group	5.2	<0.001
E: DNSGP1 reference group, group practice and DNSGP1 reference group, single handed practice	4.5	=0.002
F: DNSGP1 guideline group, group practice and DNSGP1 guideline group, single handed practice	2.5	=0.06
G: DNSGP2 reference group, group practice and DNSGP2 reference group, single handed practice	−2.6	=0.16
H: DNSGP2 guideline group, group practice and DNSGP2 guideline group, single handed practice	−4.3	=0.01
I: DNSGP1 reference group, group practice and DNSGP2 reference group, group practice	12.4	<0.001
J: DNSGP1 reference group, single handed practice and DNSGP2 reference group, single handed practice	5.3	<0.001
K: DNSGP1 guideline group, group practice and DNSGP2 guideline group, group practice	9.2	<0.001
L: DNSGP1 guideline group, single-handed practice and DNSGP2 guideline group, single-handed practice	2.4	=0.06
M: I and K	3.2	=0.13

Table 6
Mean HHI for the reference and guideline group, single-handed and group practices during DNSGP1 and DNSGP2.

Description of the group	Mean HHI (standard error)
DNSGP1 reference group, group practice	83.8 (1.0)
DNSGP1 reference group, single handed practice	79.3 (1.1)
DNSGP1 guideline group, group practice	75.1 (0.9)
DNSGP1 guideline group, single handed practice	72.5 (1.1)
DNSGP2 reference group, group practice	71.4 (1.4)
DNSGP2 reference group, single handed practice	73.9 (1.2)
DNSGP2 guideline group, group practice	65.8 (1.2)
DNSGP2 guideline group, single handed practice	70.1 (1.2)

Is variation reduced after guidelines are introduced?

Tables 4 and 5 show that the HHI is higher during DNSGP1 than during DNSGP2. More different drugs were prescribed per diagnosis during DNSGP2. This is true for both the guideline and the reference group (Table 5, A and B). The difference in HHI between the reference and the guideline group decreased, because the HHI decreased more for the reference than for the guideline group (Table 5, C, D). The number of different drugs prescribed per diagnosis increased more for the reference than for the guideline group. The hypothesis that variation decreased after the introduction of guidelines was not confirmed. The results indicate that guidelines did not reduce variation in drug prescription, but tempered the increase of variation in prescription.

Is there a difference between group and single-handed practices?

For all groups the HHI is higher during DNSGP1 than during DNSGP2 (Table 6).

First the assumption was tested that group practices have local standards. This implies that there is a difference in HHI between single-handed practices and group practices for the guideline group as well as for the reference group. Table 5 shows that there is no difference for the guideline group (F), but there is a difference for the reference group (E). In line with the assumption, the HHI is higher for the group practices, indicating that less different drugs are prescribed in group practices. Table 5 (G) shows that there is no difference in HHI between family physicians in single-handed practices and family physicians in group practices for the reference group during DNSGP2.

The difference in HHI for the guideline group between DNSGP1 and DNSGP2 for single-handed practices was not found to be large compared to this difference for group practices (Table 5, K and L). Table 5 (L and J) also shows that the difference in HHI for the guideline group between DNSGP1 and DNSGP2 for single-handed practices is not large compared to the difference for the reference group. Finally, it was found that the difference for the guideline group between DNSGP1 and DNSGP2 for group practices is comparable to the difference for the reference group (Table 5, K, I and M).

The results in Table 5 (I,J,K,L) generally give indications of an increase in the total number of drugs prescribed for the reference as well as the guideline group, for both single-handed and group practices. It also shows that the number of drugs increased more for the reference group compared to the guideline group and that this effect applies most to single-handed practices. Between DNSGP1 and DNSGP2 the difference between single-handed and group practices reversed. During DNSGP1 there were less different drugs prescribed in group practices, while during DNSGP2 there were less different drugs prescribed in single-handed practices. Based on these results, we conclude that guidelines tempered the increase in the number of different drugs prescribed primarily for family physicians working in single-handed practices. The hypothesis that variation in drug prescription has decreased more for family physicians working in single-handed practices than for family physicians working in group practices was not confirmed.

Discussion

Due to processes of global rationalization, more uniformity occurs throughout the world. Since those rationalization processes

Table 7
Description of hypotheses, testing and results.

General Hypothesis	Assumption	Test	Result in Table	Test result in line with expectation?
Variation in prescription has decreased with the introduction of guidelines		The HHI for the guideline group would have increased between DNSGP1 and DNSGP2	Table 5, B	No
		The HHI for the reference group remained the same, increased less, or decreased	Table 5, A	Yes
Variation in prescription has decreased more for family physicians working in single-handed practices than for family physicians working in group practices	Group practices have local standards.	A difference in HHI between single-handed practices and group practices for both the guideline (1) and the reference group during DNSGP1 (2) The HHI would be higher for the group practices (3)	Table 5, E and F	(1) No (2) Yes (3) Yes
		A difference in HHI between single-handed practices and group practices for the reference group during DNSGP2 (1) The HHI would be higher for the group practices (2)	Table 5, G	(1) No (2) No
	Standards (guidelines) in single-handed practices (group practices already used local standards)	The difference in HHI for the guideline group between DNSGP1 and DNSGP2 for single-handed practices is large compared to this difference for group practices	Table 5, L and K	No
		The difference in HHI for the guideline group between DNSGP1 and DNSGP2 for single-handed practices is large compared to the difference for the reference group	Table 5, L and J	No
		The difference in HHI for the guideline group between DNSGP1 and DNSGP2 for group practices is comparable to the difference for the reference group	Table 5, K, I and M	Yes

also take place in medicine, for instance through the introduction of guidelines, more uniformity is to be expected.

We found in this study that although more different drugs are prescribed during DNSGP2 for both the reference and the guideline group, the change is higher for the reference group. The overall increase in the number of different drugs prescribed can be explained by the fact that there are far more different drugs available during DNSGP2 than during DNSGP1. That the increase in the number of different drugs prescribed is lower for the guideline group indicates that guidelines temper the effect of the availability of more drugs.

We found no significant difference between the reference group and the guideline group for family physicians in group practices between DNSGP1 and DNSGP2. This suggests that guidelines did not have an effect on the variation for family physicians in group practices. In single-handed practices a significant increase in variation was found for the reference group, while no significant increase was found for the guideline group. In group practices a significant increase in variation was found for both groups. Therefore it was concluded that in line with the hypothesis, guidelines primarily had an effect on variation in single-handed practices.

The importance of reducing the number of different drugs prescribed lies in the idea that family physicians become more familiar with the drugs, which results in better quality for patients and lower health care expenses (Denig, Haaijer-Ruskamp, & Zijsking, 1988; Hill-Smith, 1996).

In this study we tested whether more uniformity in prescription, in other words less variation in drugs prescribed, is created after the introduction of guidelines. In order to do so, we analyzed data from two national medical record studies, one held before the introduction of NHG-guidelines, and the other held after introduction of those guidelines. Although this sounds straightforward, it was complicated to analyze. Two developments go together in the analysis.

First, the number of available drugs has increased by almost 10 percent in the period between 1995 and 2001 (Medicines Evaluation Board 1999, 2005), which would imply an increase in the variation in prescription. Moreover, the pharmaceutical industry influences prescription by introducing more different drugs onto the market, and patients might ask for certain drugs, resulting in more different drugs prescribed during DNSGP2. This would lead to less uniformity in prescribing.

Second, guidelines were introduced which would imply a decrease in the variation in prescription. Guidelines themselves could also be a cause of more variation in prescription for in some of the guidelines it is recommended to start with one drug and then follow it with another. All guidelines are not introduced at the same time, but over a 15 year period. With respect to variation the effect of the introduction of a guideline would be a certain amount of variation at the beginning, more variation at a later stage when more physicians are beginning to work according to the guideline, and less variation when the introduction is completed and all physicians are working according to the guidelines (Coleman et al., 1966; Rogers, 2005). Variation is thus influenced by the stage at which guidelines are introduced in this process. In order to control for the different stage in which each guideline might be found, the number of months since 1987 until the guidelines were introduced, were included in the analyses. In spite of these complications affecting the analysis, a measure had to be chosen that could be used to compute variation in prescription.

One possibility would be to count the number, or range of different drugs prescribed, but this measure is insensitive to the number of times a drug is prescribed. For example, the range is two if both drugs are each prescribed ten times, but also when one drug is prescribed ten times and the other is prescribed a hundred times. Measures of concentration are sensitive to the number of times a drug is prescribed. Therefore the Herfindahl-Hirschman Index (HHI), which is a measure of concentration, was used; the higher the HHI, the more concentrated the 'market', or the less different drugs are often prescribed.

We conclude that the introduction of guidelines, although it probably tempered the increase in variation, did not reduce variation. The introduction of guidelines alone is not enough to change behavior and reduce variation. A step further is to intervene in physicians' daily routines, instead of using rules and regulations (de Jong, Groenewegen, Spreeuwenberg, Westert, & de Bakker, 2009).

Appendix. Supplementary data

Supplementary data associated with this article can be found in the online version, at doi:10.1016/j.socscimed.2009.10.016.

References

Anatomical therapeutic chemical (ATC) classification index. (1993). Oslo: WHO Collaborating Centre for Drug Statistics Methodology.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

Berkman, L. F., Glass, T., Brisette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. Social Science & Medicine, 51(6), 843–857.

Brindis, R. G., & Sennett, C. (2003). Physician adherence to clinical practice guidelines: does it really matter? American Heart Journal, 145(1), 13–15.

Brunsson, N., & Jacobsson, B. (Eds.). (2000). A world of standards. Oxford: Oxford University Press.

Burkhardt, M. E. (1994). Social interaction effects following a technological change. Academy of Management Journal, 37(4), 869–898.

Cardol, M., de Bakker, D. H., & Westert, G. P. (2006). The activities of general practitioners: are they still gatekeepers? In G. P. Westert, L. Jabaaij, & F. G. Schellevis (Eds.), Morbidity, performance and quality in primary care: Dutch general practice on stage (pp. 107–114) Oxford: Radcliffe Publishing.

Chassin, M. R. (1993). Explaining geographic variations; the enthusiasm hypothesis. Medical Care, 31(5), YS37–YS44, Suppl.

Cialdini, R. B., & Trost, M. R. (1998). Social influence: social norms, conformity and compliance. In G. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), The handbook of social psychology (pp. 151–192). Oxford: Oxford University press.

Coleman, J. S., Katz, E., & Menzel, H. (1966). Medical innovation. A diffusion study. New York: The Bobbs-Merrill Company, Inc.

Committee of the Health Council. (2004). Gepaste zorg. Zoetemeer: RVZ.

Denig, P., Haaijer-Ruskamp, F. M., & Zijsking, D. H. (1988). How physicians choose drugs? Social Science & Medicine, 27, 1381–1386.

Diez Roux, A. V. (2002). A glossary for multilevel analysis. Journal of Epidemiology and Community Health, 56, 588–594.

van Dijk, L. (2006). Prescription in Dutch general practice. In G. P. Westert, L. Jabaaij, & F. G. Schellevis (Eds.), Morbidity, performance and quality in primary care: Dutch general practice on stage (pp. 115–124). Oxford: Radcliffe Publishing.

Eddy, D. M. (1984). Variations in physician practice: the role of uncertainty. Health Affairs, 3(2), 74–89.

Evans, R. G. (1990). The dog in the night-time: medical practice variations and health policy. In T. F. Andersen, & G. Mooney (Eds.), The challenges of medical practice variations (pp. 117–152). London: Macmillan Press.

Foets, M., van der Velden, J., & de Bakker, D. (1992). Dutch national survey of general practice. A summary of the survey design. Utrecht: NIVEL.

Francke, A. L., Smit, M. C., de Veer, A. J. E., & Mistiaen, P. (2008). Factors influencing the implementation of clinical guidelines for health care professionals: a systematic meta-review. BMC Medical Informatics and Decision Making, 8, 38.

Freidson, E. (1970). Profession of medicine. A study of the sociology of applied knowledge. New York: Dodd, Mead & Company.

Geijer, R. M. M., Burgers, J. S., van der Laan, J. R., Wiersma, T., Rosmalen, C. F. H., & Thomas, S. (1999). NHG-standaarden voor de huisarts I (2nd ed.). Maarssen: Elsevier/Bunge.

Grilli, R., Magrini, N., Penna, A., Mura, G., & Liberati, A. (2000). Practice guidelines developed by specialty societies: the need for a critical appraisal. The Lancet, 355, 103–106.

Grimshaw, J. M., & Russell, I. T. (1993). Effect of clinical guidelines on medical practice: a systematic review of rigorous evaluations. Lancet, 342(8883), 1317–1322, 27.

Grimshaw, J. M., Thomas, R. E., MacLennan, G., Fraser, C., Ramsay, C. R., Vale, L., et al. (2004). Effectiveness and efficiency of guideline dissemination and implementation strategies. Health Technology Assessment, 8(6).

Groenewegen, P. P., & Westert, G. P. (2004). Is there a time trend in medical practice variations? A review of the literature and a critical analysis of theoretical approaches. *Journal of Public Health, 12*, 229–236.

Groenhof, F., Bettink, W., van Dijk, L., van der Veen, W., & Meyboom-de Jong, B. (2006). Adherence to pharmacotherapeutic advice in the guidelines of the Dutch college of general practitioners. In G. P. Westert, L. Jabaaij, & F. G. Schellevis (Eds.), *Morbidity, performance and quality in primary care: Dutch general practice on stage* (pp. 219–225). Oxford: Radcliffe Publishing.

Grol, R. (2001). Successes and failures on the implementation of evidence-based guidelines for clinical practice. *Medical Care, 39*(8), II-46–II-54, Suppl. 2.

Hafferty, F. W., & Light, D. W. (1995). Professional dynamics and the changing nature of medical work. *Journal of Health and Social Behavior*(extra issue), 132–153.

Hermens, R. P. M. G., Hak, E., Hulscher, M. E. J. L., Braspenning, J. C. C., & Grol, R. P. T. M. (2001). Adherence to guidelines on cervical cancer screening in general practice: programme elements of successful implementation. *British Journal of General Practice, 51*(472), 897–903.

Hibble, A., Kanka, D., Pencheon, D., & Pooles, F. (1998). Guidelines in general practice: the new Tower of Babel? *British Medical Journal, 317*, 862–863.

Hill-Smith, I. (1996). Sharing resources to create a district drug formulary: a county controlled trial. *British Journal of General Practice, 46*, 271–275.

Hox, J. J. (1995). *Applied multilevel analysis*. Amsterdam: TT-Publications.

Hutchinson, A., McIntosh, A., Cox, S., & Gilbert, C. (2003). Towards efficient guidelines: how to monitor guideline use in primary care. *Health Technology Assessment, 7*(18), 1–97, iii.

Hutten, J. B. F. (1998). *Workload and provision of care in general practice*. Utrecht: NIVEL.

de Jong, J. D. (2008). *Explaining medical practice variation: Social organization and institutional mechanisms*. Utrecht: NIVEL.

de Jong, J. D., Groenewegen, P. P., Spreeuwenberg, P., Westert, G. P., & de Bakker, D. H. (2009). Do decision support systems influence variation in prescription? *BMC Health Services Research, 9*, 20.

Lamberts, H., Wood, M., & Hofmans-Okkes, I. (1993). *The international classification of primary care in the European community*. New York: Oxford University Press.

Landon, B. E., Reschovsky, J., Reed, M., & Blumenthal, D. (2001). Personal, organizational, and market level influences on physicians' practice patterns: results of a national survey of primary care physicians. *Medical Care, 39*(8), 889–905.

Langley, C., Faulkner, A., Gray, Ch. Watkins, S., & Harvey, I. (1998). Use of guidelines in primary care-physicians' perspectives. *Family Practice, 15*(2), 105–111.

Leyland, A. H., & Groenewegen, P. P. (2003). Multilevel modelling and public health policy. *Scandinavian Journal of Public Health, 31*, 267–274.

Lomas, M. A., Anderson, G. M., Domnick-Pierre, K., Vayda, E., Enkin, M. W., & Hannah, W. J. (1989). Do practice guidelines guide practice? The effect of a consensus statement on the practice of physicians. *The New England Journal of Medicine November 9, 321*, 1306–1311.

Lulofs, J. G. (1981). Een markttheoretische benadering van professies. *Mens en Maatschappij, 4*(56), 349–377.

Medicines Evaluation Board. (1999). *Annual report 1998*. Den Haag: Medicines Evaluation Board.

Medicines Evaluation Board. (2005). *Annual report 2004*. Den Haag: Medicines Evaluation Board.

Mourad, S. M., Nelen, W. L., Hermens, R. P., Bancsi, L. F., Braat, D. D., Zielhuis, G. A., et al. (2008). Variation in subfertility care measured by guideline-based performance indicators. *Human Reproduction, 23*(11), 2493–2500.

O'Neill, L., & Kuder, J. (2005). Explaining variation in physician practice patterns and their propensities to recommend services. *Medical Care Research and Review, 62*, 339.

Onion, C. W. R., & Wally, T. (1995). Clinical guidelines: development, implementation, and effectiveness. *Postgraduate Medical Journal, 71*, 3–9.

Ritzer, G., & Walczak, D. (1988). Rationalization and the deprofessionalization of physicians. *Social Forces, 67*, 1–22.

Rogers, E. M. (2005). *Diffusion of innovations*. New York: Free Press.

Schers, H., Braspenning, J., Drijver, R., Wensing, M., & Grol, R. (2000). Low back pain in general practice: reported management and reasons for not adhering to the guidelines in The Netherlands. *British Journal of General Practice August, 50*(457), 640–644.

Schellevis, F. G., Westert, G. P., de Bakker, D. H., & Groenewegen, P. P. (2004). *Tweede nationale studie naar ziekten en verrichtingen in de huisartspraktijk: vraagstellingen en methoden*. Utrecht: NIVEL.

Scott, W. R., Ruef, M., Mendel, P. J., & Caronna, C. A. (2000). *Institutional change and healthcare organizations. From professional dominance to managed care*. London: The University of Chicago Press, Ltd.

Snijders, T. A. B., & Bosker, R. J. (1999). *Multilevel analysis. An introduction to basic and advanced multilevel modeling*. London: SAGE Publications Ltd.

Tiemeier, H., de Vries, W. J., van het Loo, M., Kahan, J. P., Klazinga, N., Grol, R., et al. (2002). Guideline adherence rates and interprofessional variation in a vignette study of depression. *Quality and Safety in Health Care, 11*(3), 214–218.

Tunis, S. R., Hayward, R. S., Wilson, M. C., Rubin, H. R., Bass, E. B., Johnston, M., et al. (1994). Internists' attitudes about clinical practice guidelines. *Annals of Internal Medicine, 120*(11), 956–963.

van den Berg, M. J., Kolthof, E. D., de Bakker, D. H., & van der Zee, J. (2004). *Tweede Nationale Studie naar ziekten en verrichtingen in de huisartspraktijk: de werkbelasting van huisartsen*. Utrecht: NIVEL.

Verstappen, W. H. J. M., van der Weijden, T., Sijbrandij, J., Smeele, I., Hermsen, J., Grimshaw, J., et al. (2003). Effect of a practice-based strategy on test ordering performance of primary care physicians. *Journal of the American Medical Association, 289*, 2407–2412.

Wennberg, J. E., & Gittelsohn, A. (1975). Health care delivery in Maine I: patterns of use of common surgical procedures. *The Journal of the Maine Medical Association, 66*(5), 123–149.

Westert, G. P., & Groenewegen, P. P. (1999). Medical practice variations: changing the theoretical approach. *Scandinavian Journal of Public Health, 27*, 173–180.

Westert, G. P., Schellevis, F. G., de Bakker, D. H., Groenewegen, P. P., Bensing, J. M., & van der Zee, J. (2005). Monitoring health inequalities through general practice: the second Dutch national survey of general practice. *European Journal of Public Health., 15*(1), 59–65.

Zwanziger, J., Melnick, G. A., & Bamezai, A. (2000). The effects of selective contracting on hospital costs and revenues. *Health Services Research, 35*(4), 849–867.