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Chronic care services and variation between Danish general practices: A nationwide cohort study

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Abstract

Background

Little is known about variations in the provision of chronic care services in primary care.

Aim

To describe the frequency of chronic care services provided by GPs and analyse the extent of non-random variation in service provision.

Design and setting

Nationwide cohort study in Denmark in 2016.

Method

Information on chronic care services was obtained from national health registers, including annual chronic care consultations, chronic care procedures, outreach home visits, and talk therapy. The associations between provided services, patient morbidity, and socioeconomic factors were estimated. Service variations were analysed, and excess variation related to practice-specific factors was estimated while accounting for random variation.

Results

Chronic care provision was associated with increasing patient age, increasing number of long-term conditions, and indicators of low socioeconomic status. Variation across practices ranged from 1.4 to 128 times more than expected after adjusting for differences in patient population and random variation. Variation related to practice-specific factors was present for all investigated chronic care services. Older patients with lower socioeconomic status and multimorbidity were clustered in practices with low propensity to provide certain chronic care services.

Conclusion

Chronic care was provided to patients typically in need of healthcare, i.e. the old, those with multimorbidity, and those with low socioeconomic status, but service provision varied more than expected across practices. GPs provided slightly fewer chronic care services than expected in practices where many patients with multimorbidity and low socioeconomic status were clustered, suggesting inverse care law mechanisms.

Key words: Chronic Disease, Health Services Research, Primary Health Care, General Practitioners, Cohort Studies

How this fits in

There has been limited examination of variation in chronic care provision between practices. This study found that chronic care was provided to patients typically in need of healthcare, including the socioeconomically deprived. However, variation in the provision of chronic care services could not be explained by patient population characteristics or by randomness; variation related to practice-specific factors was present. Fewer chronic care services than expected were provided by the general practices with the most multimorbid and socioeconomically deprived patients, which could suggest potential inverse care law mechanisms.

Introduction

Modern healthcare is challenged by a significant burden from long-term chronic conditions that accumulate over time and lead to the development of multiple chronic conditions, or multimorbidity. Increasing numbers of middle-aged and elderly people are living with multimorbidity, adding significantly to the need for chronic care.^{1,2} In the Danish healthcare system (Box 1), general practitioners (GPs) provide most chronic care for long-term conditions at the community level; this model ensures a high degree of continuity of care, which is valued by patients and known to improve health outcomes.^{3–9}

Chronic care provision may vary among GP practices. This could reflect differences in the patient population served, e.g. morbidity level, patient age profiles, and socioeconomic status. However, it could also be related to practice-specific factors, reflected in the *practice chronic care profile*, i.e. practice-level differences in capacity, affiliated clinical and non-clinical staff, geographical setting, access to specialised care, and GP treatment preferences. While homogeneity in care provision does not ensure optimal care, heterogeneity, i.e. variation that cannot be explained by differences in patient characteristics, reflects over- and/or undertreatment of a condition. This leads to either suboptimal quality of care or inefficiency from a health-economic perspective.^{10–12} Further, service provision variation originating from socioeconomic differences may exacerbate health inequalities.^{13,14} Yet, it is essential to acknowledge that some variation is expected solely due to randomness.

Variation in healthcare is well studied, e.g. the Dartmouth Atlas.¹⁵ However, the evidence on variation in chronic care management in primary care remains limited.^{3,16–19} In this exploratory study, we describe the association between patient characteristics and chronic care service provision and we analyse the extent of non-random variation related to the practice chronic care profile.

Methods and materials

Study population and setting

We conducted a register-based nationwide cohort study in Denmark. Our study population included all Danish citizens above 18 years of age listed with a general practice and residing in Denmark for at least five consecutive years (Box 1). The cohort was followed from 1 January 2016 until death, emigration, or end-of-study on 31 December 2016, whichever came first. Practices with less than 500 listed patient-years were excluded from the study (N=184) as these were considered abnormally small and could represent newly started or liquidated practices, or special administrative unit. All Danish residents have a unique identification number that can be used to link individuals across administrative registers.²⁰ We obtained information on all patients from the Danish national health registers and used the Patient List Database to link patients to a specific general practice.²¹

Outcomes

The main outcomes were chronic care services provided by GPs, i.e. annual chronic care consultations, chronic care procedures, outreach home visits, and talk therapy (Box 1). Additionally, we included other general contacts to the GP that were not necessarily related to chronic care, i.e. ordinary daytime consultations, e-mail consultations, telephone contacts, and home visits (codes in Supplementary Table 1).

Covariates

The Danish Civil Registration System and Statistics Denmark provided information on the patients' age, sex, ethnicity, cohabitation status, household income, working status, and educational attainment at the start of follow-up, and on emigration and vital status during follow-up (Supplementary Table 2).^{20,22}

The Danish Multimorbidity Index²³ provided us with information on 39 long-term conditions, which allowed us to assess disease and multimorbidity status (defined as two or more long-term conditions) for the patients (Supplementary Table 3).^{23,24}

Statistical analyses

First, we constructed multivariate Poisson models for the prediction of the number of each of the service code outcomes based on time-at-risk and baseline covariate status for each patient in the population. These models produced incidence rate ratios (IRRs). Second, we summed the observed and the predicted number of outcomes for all patients listed with each practice. Subsequently, we divided these two aggregate measures to obtain a practice-specific observed-to-expected (O/E) ratio expressing whether a practice provided more ($O/E > 1$) or fewer ($O/E < 1$) services than expected given the composition of the patient population. The practice O/E ratios were ranked and presented graphically. To quantify the amount of variation in the O/E ratios, we used the interdecile ratio (IDR), i.e. the 90th percentile divided by the 10th percentile. The IDR is a flexible measure that does not require assumptions regarding the distribution of the data, and it focusses on the high and low ends of the variation curve. The IDR is an actual factor of difference in provision of service between the practices and may be more easily interpreted for the common reader than e.g. standard deviations. For example, an IDR of 10 would mean that the practice representing the 90th percentile provided 10 times as many services as the practice representing the 10th percentile (adjusted for patient characteristics).

As a measure of the variation related to the chronic care profile of the individual general practices, we calculated the excess variation; this was done by dividing the observed IDR by a reference IDR corresponding to the variation expected due to chance alone (i.e. if no true differences existed between practice profiles). We calculated this reference IDR by using a sampled reference population of patients from other practices (matched by sex, age, and a propensity score based on the remaining covariates).²⁵

Third, to estimate the association between patient characteristics and the propensity for providing services in the individual practices, we constructed a series of Poisson regression models; one for each covariate-outcome combination. The inputs were the number of observed service code outcomes for each person's practice, with a given covariate as the exposure, and the expected number of service code outcomes as the offset. Both the expected and the observed number of service code outcomes were analysed using a jack-

knife type approach, i.e. the contribution of each patient's service code outcome was subtracted from the overall practice score.

To assess the correlation between annual chronic care consultations and general contacts, we calculated a Pearson coefficient between the two.

All analyses were performed in Stata 16, College Station, TX.

Results

We identified 1,885 GP practices comprising a total patient population of 4.23 million patients over 18 years of age (94% of the adult population). The practices had a median of approximately 2,900 patients (interquartile range: 1,700–4,500). The characteristics of the study population are shown in Table 1.

GP service provision and patient characteristics

During follow-up, the practices provided an average of 16.7 annual chronic care consultations per 100 patient-years (Table 2). The rates of annual chronic care consultations and chronic care procedures were independently associated with patient age (peaking at 70-79 years), low income, and low educational level (Figure 1). Most long-term conditions were associated with higher rates of annual chronic care consultations, e.g. hypertension (IRR 2.24; 95%CI, 2.23-2.26) and diabetes (IRR 1.50; 95%CI, 1.49-1.51), but with notable exceptions, e.g. dementia (IRR 0.67; 95%CI, 0.65-0.68) and chronic kidney disease (IRR 0.68; 95%CI, 0.67-0.70). Outreach visits were associated with older age, living alone, unemployment, and certain conditions, e.g. dementia (IRR 4.00; 95%CI, 3.87-4.12). Talk therapy was associated with younger age, female sex, low income, most mental health conditions, and several physical conditions. Higher rates of general contacts were seen in older patients, women, and those with low income. General contacts were associated with almost all long-term conditions. All studied services were associated with the number of long-term conditions in a dose-response manner (Supplementary Table 4).

Practice variation in service provision

For all types of GP service code outcomes, the observed variation in the service provision across general practices was higher than expected based on the composition of the patient populations (Figure 2).

The magnitude of the variation, measured by the IDR, differed by GP service code outcome: The annual chronic care consultation was subject to an IDR of 9.95 across practices after adjustments (Table 2). The reference variation (due to chance alone) was 1.17, resulting in an excess variation of 8.54. Chronic care procedures had an adjusted IDR of 8.41 with an excess variation of 7.21. The largest variation was found for outreach home visits and talk therapy. These varied by a factor of 80 and 194, each with excess variations of 38 and 128, respectively, which was mainly due to very low implementation of these services in some practices. The general contacts showed an adjusted IDR of 1.53 and an excess variation of 1.42.

GP service propensity and patient characteristics

Figure 3 presents associations between patient characteristics and the propensity for service provision in general practices. Patients who were older, unemployed, less well educated, or had more long-term conditions were clustered in practices with a lower propensity to provide annual chronic care consultations and talk therapy, i.e. practices that provided fewer than expected chronic care services based on their patient population. Conversely, the less well educated and patients with multimorbidity were clustered in practices with a high propensity to provide chronic care procedures. High education and high income were associated with a high propensity for GPs to provide outreach home visits. In comparison, patients who were older, unemployed, less well educated, and had multimorbidity were clustered in practices with an overall lower propensity to offer general contacts to their patients.

General practices with low propensity to provide annual chronic care consultations did not tend to compensate by offering more general contacts; a positive correlation was found between propensity for provision of annual chronic care consultations and general contacts (Pearson's $r=0.11$, $p<0.001$).

Discussion

Summary

In this nationwide study, we found associations between chronic care services provided by Danish GPs and patient characteristics, such as old age, low education, low income, and high number of long-term conditions. However, the chronic care provision varied considerably across practices, and the variation could not be explained by differences in the patient populations or by random variation. The excess variation related to the practice chronic care profile was seen for all types of services, ranging from 1.4 to 128 times more than expected. Furthermore, general practices with low propensity to provide certain chronic care services, including annual chronic care consultations, and general consultations had relatively more patients of high age, low socioeconomic status, and multimorbidity.

Interpretation

Our study showed that GPs generally provide chronic care services to the patients in need of medical treatment. Patients with low socioeconomic status often have multimorbidity and a high disease burden. Thus, providing chronic care services may mitigate social inequality in health. This is in accordance with previous studies on healthcare utilization in general^{26–28} and on primary care services in particular.^{29,30} In our study, the GPs tended to conduct fewer chronic care services for some long-term conditions, which could reflect barriers on the patient level, or that the GPs might have considered the service redundant if chronic care was provided elsewhere, e.g. at nursing homes for those with dementia or hospital outpatient clinics for those with chronic kidney disease.

The chronic care variation between general practice populations clearly exceeded the expected random variation (even after composition adjustment). The excess variation might be interpreted as an expression of the chronic care profile of the individual practice.¹⁰ This suggests that differences exist between the GPs in terms of knowledge, attitudes towards chronic care, experience, organizational skills, interpretation of guidelines, implementation of chronic care services, and remuneration coding practices. However, the treatment patterns may also be influenced by work load level, time constraints, staffing level of doctors and nurses, patient contact patterns, and local access to diagnostic tests and specialised healthcare.¹¹

Comparison with existing literature

To our knowledge, no other study has described the variation in chronic care services provided by GPs. Variation in healthcare utilization has previously been studied,^{15,31} and several variation measures exist.^{32–34} Between-practice variation is commonly estimated through the coefficient of variation or using multilevel modelling.^{35–37} Yet, to estimate excess context-related variation, it must be taken into account that some variation is expected solely due to randomness.²⁵

Variation may represent suboptimal treatment practices at either end of the utilisation spectrum (under-treatment or overtreatment).¹² Identifying sources of potentially inappropriate variation is difficult because variation occurs at patient level, provider level, and healthcare system level.¹² We had extensive information on the patient level, which is known to account for the majority of the variation.³⁸

Underuse of chronic care services among general practices with high proportions of patients with low socioeconomic status and multimorbidity may indicate social inequality in the provision of healthcare. This phenomenon has been described in the literature as the *inverse care law*, i.e. the availability of good medical care tends to vary inversely with the need of the population served.¹³ The underlying reason for the low propensity to use chronic care services in some practices cannot be determined in our data. High workloads and GP burnout may impede the implementation of chronic care services.³⁹ Notably, although

the effect sizes of the associations related to practice propensities were small, they were still statistically significant for important patient characteristics.

Strength and limitations

The strengths of this study included the nationwide population-based design and the comprehensive data on almost all Danish adults and general practices. We obtained prospectively collected individual-level information on all remunerated GP services and on demographic/socioeconomic characteristics from high-quality administrative health registers^{20,21} and long-term conditions from the Danish Multimorbidity Index.²³ This made it possible to extensively control for confounding at the patient level. As GP services were incentivised, high completeness is expected for these data.⁴⁰ The sampling approach accounted for random variation, even if all GPs had the exact same provision propensity. This allowed us to isolate and study the variation related to the chronic care profile of the individual practices.³²

The study also had several limitations. The data on remunerated services were only available for the entire general practice. Thus, in practices with more than one GP, we observed the mean service provision among the entire group of GPs, and we may have underestimated the true variation. Information on practice staffing was not available in the registers and may have bearing on levels of service delivery. However, examining the service provision at practice level is a reasonable approach as GPs often distribute work across their team and share the same setting. It is up to the GP to initiate the service whenever it is found relevant, as there is no central register of patients with chronic conditions qualifying for the services. Hence, the whole population is eligible for the services investigated in the study. Most long-term conditions that could justify chronic care service were included, but some may have been missed, which holds a risk of under-identification of long-term conditions. We would anticipate this under-identification to be quite evenly distributed between practices after our comprehensive adjustment for patient characteristics, reducing the concern about systematic bias on the relative between-practices comparisons.

Implications

The substantial variation found in the chronic care profiles of the included practices suggests that suboptimal treatment may occur, particularly in practices with populations characterised by high morbidity burden and socioeconomic deprivation. Despite a higher need, these practices provided chronic care to a relatively lesser extent. Although chronic care consultations were well remunerated, this economic incentive seems to be little effective in counteracting these *inverse care law* mechanisms. Caution should be taken when comparing the specific service provision between different healthcare systems. Nevertheless, when such provider variation exists in a universal healthcare system, they are likely to exist in other healthcare systems, and this might increase inequality in health. Many countries are introducing incentives for chronic disease management, but simply incentivising such care may not benefit the patients at highest risk because the practices they attend may have less capacity to take on additional workload. Further research is needed to explore the causal explanations for variation in chronic care services and the implications for patient health outcomes such as mortality or hospital admissions. Such knowledge may improve our understanding of the *inverse care law* and help design health systems that address health inequalities.⁴¹

Conclusion

Chronic care was provided to the patients in most need of healthcare, i.e. those with old age, multimorbidity, and low socioeconomic status. However, the service provision varied across practices to an extent that could not be explained by differences in patient populations or by random variation. In practices with clustering of patients with multimorbidity and low socioeconomic status, the GPs provided fewer chronic care services than expected. The variation related to the chronic care profile of the practice might involve suboptimal chronic care delivery, which could suggest *inverse care law* mechanisms.

Additional information

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Ethical approval

The Danish Data Protection Agency, the Danish Health Data Authority, and Statistics Denmark approved the study. Ethical approval and informed consent were not needed as the study was based on de-identified register data encrypted and stored by Statistics Denmark.

Competing interests

The authors declare no competing interests.

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Box 1. The Danish healthcare system and chronic care services

In the Danish tax-funded universal healthcare system, all residents have free access to a GP for medical advice or referrals to the secondary healthcare system (gatekeeper system). Virtually all residents (98%) are listed with a specific general practice.⁴² The list of each practice comprises approximately 1,600 patients per GP. At the time of the data collection, approximately 30% of practices were solo practices, 45% consisted of two to three GPs, and 25% consisted of four GPs or more.

GPs work as independent primary care contractors for the health authorities and are remunerated through a mix of per capita and fee-for-service payments.⁴³ Remunerated services include e.g. daytime consultations, e-mail consultations, telephone contacts, home visits, laboratory services, and specific chronic care services (see below). Invoices for the provided services are sent to the Regional Health Administration who performs automated checks. They also check if there are practice outliers regarding use of specific services and if so, they contact the practice for an explanation or correction. Data on remunerated services, reported by the practices using specific service codes, are available from the Danish National Health Service Register at the level of practices.⁴⁰

GP chronic care services

The annual chronic care consultation: A consultation dedicated to a specific chronic condition; it can be provided once a year per condition (with a maximum of four conditions per year) and may include a patient health overview, medication review, lifestyle talk, and goal setting. The remuneration is approximately 2.5 times that of an ordinary consultation.

Chronic care procedures: Para-clinical measurements related to chronic care management, including blood-glucose measurements, electrocardiograms, lung function tests, and home blood pressure measurements.

Outreach home visits: Home visits initiated by the GP for frail individuals over 70 years of age to provide an overview of the health situation.

Talk therapy: This encompasses psychotherapy provided by the GP in consecutive sessions (a maximum of seven sessions per year) for patients with mental health conditions.⁴⁴

Table 1. Characteristics of the study population

Characteristics	Total	%
N	4,230,260	100.0
Age, years		
18-29	764,902	18.1
30-39	596,835	14.1
40-49	757,795	17.9
50-59	739,794	17.5
60-69	662,096	15.7
70-79	471,838	11.2
80-89	194,750	4.6
90-99	41,220	1.0
+100	1,030	0.0
Sex		
Female	2,154,965	50.9
Male	2,075,295	49.1
Ethnicity		
Danish	4,013,918	94.9
Western	99,365	2.3
Non-western	116,977	2.8
Cohabitation status		
Cohabiting	2,719,951	64.3
Single	1,510,309	35.7
Household income		
1st quartile	1,007,447	23.8
2nd quartile	1,059,814	25.1
3rd quartile	1,053,596	24.9
4th quartile	1,109,403	26.2
Working status		
Employed	3,283,076	77.6
Unemployed	947,184	22.4
Education		
≤ 10 years	1,185,720	28.0
> 10 & ≤ 15 years	1,990,605	47.1
> 15 years	965,732	22.8
Unknown	88,203	2.1
Number of conditions		
0	2,210,240	52.2
1	835,410	19.7
2	474,951	11.2
3	304,977	7.2
+4	404,682	9.6
<i>Specific conditions</i>		
Circulatory conditions		
Hypertension	823,918	19.5
Dyslipidaemia	406,320	9.6
Ischemic heart disease	229,371	5.4
Atrial fibrillation	111,401	2.6
Heart failure	43,471	1.0
Peripheral artery occlusive disease	77,255	1.8
Stroke	115,669	2.7
Endocrine conditions		
Diabetes mellitus	225,323	5.3
Thyroid disorder	148,985	3.5
Gout	19,021	0.4
Pulmonary and allergic conditions		
Chronic pulmonary disease	244,465	5.8
Allergy	172,671	4.1
Gastrointestinal conditions		
Ulcer/chronic gastritis	73,103	1.7
Chronic liver disease	33,127	0.8
Inflammatory bowel disease	47,741	1.1
Diverticular disease of intestine	75,352	1.8
Urogenital conditions		
Chronic kidney disease	25,255	0.6
Prostate disorders	107,640	2.5
Musculoskeletal conditions		

Connective tissue disorders	77,653	1.8
Osteoporosis	134,987	3.2
Painful condition	405,404	9.6
Haematological conditions		
HIV/AIDS	3,818	0.1
Anaemias	87,418	2.1
Malignant conditions		
Cancers	121,684	2.9
Neurological conditions		
Vision problem	188,446	4.5
Hearing problem	207,163	4.9
Migraine	59,623	1.4
Epilepsy	38,723	0.9
Parkinson's disease	6,182	0.1
Multiple sclerosis	12,913	0.3
Neuropathies	34,943	0.8
Mental health conditions		
Mood, stress-related or anxiety disorders	9,239	0.2
Psychological distress	306,093	7.2
Alcohol problems	7,309	0.2
Substance abuse	1,483	0.0
Anorexia/bulimia	444	0.0
Bipolar affective disorder	11,133	0.3
Schizophrenia or schizoaffective disorder	9,969	0.2
Dementia	26,885	0.6

Table 2. Chronic care provision - observed, reference, and excess variation

GP service	Mean ¹	Observed variation			Reference (expectable) variation ³			Excess variation ⁴
		p10	p90	Adjusted IDR ²	p10	p90	Adjusted IDR ²	
Annual chronic care consultations	16.65	0.18	1.74	9.95	0.92	1.07	1.17	8.54
Chronic care procedures ⁵	33.76	0.03	2.21	8.41	0.64	1.32	1.17	7.21
Outreach home visits	2.55	0.21	1.75	79.55	0.91	1.07	2.07	38.48
Talk therapy	6.48	0.01	2.10	193.73	0.79	1.19	1.52	127.70
General contacts	752.01	0.80	1.23	1.53	0.96	1.03	1.07	1.42

IDR: interdecile ratio, i.e. 90th percentile/10th percentile of the observed/expected ratio. p10: 10th percentile. p90: 90th percentile.

1: Observed service outcomes per 100 patient-years (unadjusted).

2: Adjusted for age, sex, ethnicity, cohabitation status, household income, working status, educational attainment, and 39 individual mental and physical long-term conditions.

3: Based on randomly sampled patients from other practices (matched by sex, age, and a propensity score based on the remaining covariates).

4: Excess variation (variation related to practice chronic care profile), i.e. adjusted IDR/reference IDR.

5: Blood-glucose measurements, electrocardiograms, lung function tests, and home blood pressure measurements.

Figure 1. Associations between patient characteristics and chronic care services

The forest plot presents mutually adjusted incidence rate ratios (IRRs) with 95% confidence intervals. The reference IRR for each condition is not having that specific condition.

Figure 2. Observed/expected ratios and reference variation in chronic care services across general practices

Blue curve: Observed/expected ratios in chronic care services across practices adjusted for age, sex, ethnicity, cohabitation status, household income, working status, educational attainment, and 39 individual mental and physical long-term conditions.

Grey curve: Observed/expected ratios in chronic care services across practices based on randomly sampled patients from other practices (matched by sex, age, and a propensity score based on the remaining covariates)

Adjacent practices were arranged in groups of five on the plot to preserve anonymity.

Figure 3. Associations between patient characteristics and general practice propensity to provide chronic care services

The forest plot presents mutually adjusted incidence rate ratios (IRRs) with 95% confidence intervals. The reference IRR for each condition is not having that specific condition