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General practitioners' home visit tendency and readmission-free survival after COPD hospitalisation: a Danish nationwide cohort study

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BACKGROUND: The tendency of general practitioners (GPs) to conduct home visits is considered an important aspect of practices' accessibility and quality of care.

AIMS: To investigate whether GPs' tendency to conduct home visits affects 30-day readmission or death after hospitalisation with chronic obstructive pulmonary disease.

METHODS: All Danish patients first-time hospitalised with COPD during the years 2006–2008 were identified. The association between the GP's tendency to conduct home visits and the time from hospital discharge until death or all-cause readmission was analysed by means of Cox regression adjusted for multiple patient and practice characteristics.

RESULTS: The study included 14,425 patients listed with 1,389 general practices. Approximately 31% of the patients received a home visit during the year preceding their first COPD hospitalisation, and within 30 days after discharge 19% had been readmitted and 1.6% had died without readmission. A U-shaped dose–response relationship was found between GP home visit tendency and readmission-free survival. The lowest adjusted risk of readmission or death was recorded among patients who were listed with a general practice in which >20–30% of other listed first-time COPD-hospitalised patients had received a home visit. The risk was higher if either 0% (hazard rate ratio 1.18 (1.01–1.37)) or >60% (hazard rate ratio 1.23 (1.04–1.44)) of the patients had been visited.

CONCLUSION: A moderate GP tendency to conduct home visits is associated with the lowest 30-day risk of COPD readmission or death. A GP's tendency to conduct home visits should not be used as a unidirectional indicator of the ability to prevent COPD hospital readmissions.

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INTRODUCTION

In general practice, quality indicators based on the average provision of care of practices are increasingly used to benchmark practices and to enable pay for performance.¹ In most countries, general practitioners (GPs) conduct home visits to patients for whom it is too difficult to come to the surgery, or for whom a home visit for other reasons is relevant. The tendency of GPs to conduct home visits is part of practices' accessibility, which is generally considered important for the quality of care.² However, GP home visit tendency (GPHVT) is rarely included in studies on quality and has not been related to major patient-related outcomes.

A recent editorial in the *Lancet* explicitly mentioned home care as a way to cope with the supposedly increasing health-care burden of ageing populations.³ On the other hand, a *BMJ* editorial argued that there is no solid evidence on the ability of community-based medical services to reduce elderly peoples' use of acute hospitalisations.⁴ GP home visits is an important feature of community-based care, but the rate has been internationally declining for three decades.^{5–7} The lowest rates have been observed in countries where GPs act as gatekeepers to hospital treatment.⁸ This has led to the concern that more elderly patients may be acutely admitted to hospital, because of the GP's reluctance to conduct enough home visits.^{6,7} In particular, it has been suggested that a reduced rate of GP home visits may increase the risk of hospital readmission.⁹ Therefore, new GP guidelines recommend more home visits, and special fees have

been implemented to increase GPHVT.^{10,11} However, there are currently no studies on the association between GPHVT and hospital readmission.

Chronic obstructive pulmonary disease (COPD) is among the most common causes of hospitalisation, and patients who have been hospitalised with COPD have the highest rate of readmission.^{12–14} Furthermore, they have frequent contacts with their general practice, although their poor condition reduces their ability to visit the practice surgery.^{15,16} Therefore, in COPD compared with most other diseases a possible association between GPHVT and hospital readmission may be easier to demonstrate and would be more important to the overall optimisation of the use of health-care resources.

This study investigated how 30 days' readmission-free survival of patients first-time hospitalised with COPD is associated with GPHVT.

MATERIALS AND METHODS

Design

Using national registers, 30 days' readmission-free survival was analysed for all patients first-time hospitalised with COPD in Denmark during the years 2006–2008.

Setting

Denmark has 5.4 million citizens. The Danish health-care system is universally tax-funded and GP and hospital services are virtually free of

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charge. Nearly 98% of the population is listed with a general practice of the patient's choice. Practices are usually small with one or a few GPs, and around 1,600 listed patients per GP. GPs work on contract for the public funder with mixed 1/3 capitation and 2/3 fee-for-service payments. GPs carry out most prevention and care for chronic diseases and act as the main coordinators and gatekeepers to hospital and specialist treatment. GPs are obliged to make home visits to their listed patients when necessary. More than 99% of hospitalisations with COPD are in public hospitals. GP referral is required, except for emergency cases.^{15,17}

The Danish National Patient Registry records administrative data on all admissions to Danish hospitals, including diagnoses classified according to the International Classification of Diseases 10th revision (ICD-10). All data are registered with the patient's unique civil registration number, which allows data linkage between many registers covering all citizens.

Study population

In the Danish National Patient Registry, we identified all patients aged over 45 who had been hospitalised with COPD in Denmark for the first time in the period between 1 January 2006 and 31 December 2008. In COPD studies, age limits around 45 years are commonly used to reduce inclusion of misclassified patients with asthma.¹⁵

Patients were excluded if they had changed practice, or if the practice's registration number changed during the year before hospitalisation. The latter would be the case if the practice either merged with another practice or split up into smaller practices. In addition, patients were excluded if they were listed with a practice that did not have at least one listed first-time COPD-hospitalised patient in each of the three study years. Thus, all included patients were listed with a practice that was active throughout the study period and which had at least two other patients in the study.

COPD hospitalisation was defined as any hospitalisation with ICD-10 codes either J41–44 (COPD, chronic bronchitis or emphysema) as primary diagnosis or J13–18 (pneumonia) or J96 (respiratory failure) as primary diagnosis combined with J41–44 as a secondary diagnosis.¹⁸

As a patient's number of previous COPD hospitalisations is the strongest predictor of readmission and therefore could bias the study, it was decided to include only patients with first-time COPD hospitalisation.¹⁹ First-time COPD hospitalisation was defined as any COPD hospitalisation of a patient who had not been hospitalised with COPD within a period of 8 years before the present hospitalisation.^{15,20}

Data and sources

For each patient, the Central Person Register provided information on gender and dates of birth and death, and the National Health Insurance Register provided dates of all GP home visits as well as the number, gender and age of all GPs in the practice. Each patient's Charlson Comorbidity Index was calculated on the basis of all in- and out-patient ICD-10-coded Danish National Patient Registry diagnoses in the 8-year retrospective period, excluding COPD.²¹ For calculation of travel distance to the hospital, the Central Person Register provided each patient's home address at the time of hospitalisation. For the year 2008, Statistics Denmark provided the average household income in each GP's postal area and the urbanisation degree of the municipality.

Analyses

In order to reduce confounding by indication, for each patient, GPHVT was defined as the proportion of their practice's other first-time COPD-hospitalised patients who received a home visit from one of the practice's GPs during the year before their hospitalisation. The primary analysis related GPHVT to the time from hospital discharge until death or all-cause readmission. Death was included as a failure event in the analysis, because it might be associated with GPHVT, is considered worse than readmission to hospital and precludes the patient from readmission. Whether GPHVT based on other patients could be interpreted as an indicator of the patient's own access to GP home visits was tested in a secondary analysis relating GPHVT to the patient's odds of having received a home visit during the year before hospitalisation.

The association between GPHVT and time from hospital discharge until either death or the next all-cause hospitalisation was analysed by means of Cox regression, and the association between GPHVT and whether the patient received a home visit was analysed by means of logistic regression. Both analyses were adjusted for the possible confounding factors: (i) the patient's age, gender, comorbidity and travel distance to hospital; (ii) the average age, gender, comorbidity, in-hospital mortality and travel distance to hospital of other patients first-time hospitalised with COPD listed with the patient's practice and the number of other first-time COPD-hospitalised patients relative to the number of GPs in the practice; (iii) the patient's practice's number of GPs and their age and sex composition; (iv) the average household income and percentage of urbanisation in the practice area; and (v) the calendar year. All factors were treated as categorical variables. Clustering at the practice level was accounted for by robust cluster estimation.

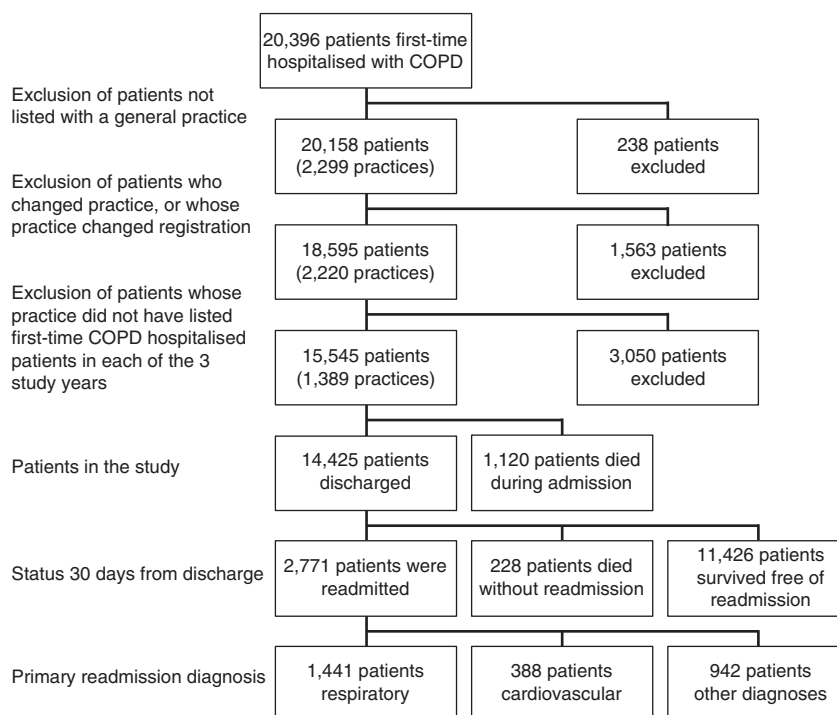


Figure 1. Flowchart.

Adjustments for number, age, comorbidity and in-hospital mortality of the practice's other first-time COPD-hospitalised patients were included as proxies for the practice's experience and workload with COPD patients and its severity threshold for admitting patients with COPD to hospital.

All analyses were performed using STATA Release 13.0 (STATACorp, College Station, TX, USA).

Ethics

The study was approved by the Danish Data Protection Agency (No. 2009-41-3337). According to Danish legislation, as the study was register-based, no approval from the Biomedical Research Ethics Committee was required.

RESULTS

During the study period, 20,396 patients were first-time hospitalised with COPD in Denmark. The study included 15,545 patients listed with a total of 1,389 practices, whereas 4,851 patients were excluded (Figure 1, Table 1). The mean age of the patients was 72 years and 53% were female. Approximately 7.2% of the patients died during the hospitalisation. Among the 14,425 patients who were discharged alive, 31% had received a home visit from their GP in the year before hospitalisation, and 30 days from discharge 2,771 patients (19%) had been readmitted to hospital and 228 patients (1.6%) had died without readmission. More than half of the readmissions were coded with a respiratory diagnosis (Figure 1).

Compared with the study patients, the 4,851 excluded patients were similar to the patients in the study with regard to age, gender, comorbidity index, average area household income and the proportions of patients home visited, dead or readmitted to hospital. Excluded patients were listed with practices with fewer GPs and lived in areas with higher population density (Table 1).

A significant positive dose-response relationship was found between GPHVT and the odds of having received a home visit (Table 2). Female gender, high age, high comorbidity index, low travel distance to hospital and being listed with a practice with a high number of GPs and more male GPs increased the odds of being visited (Table 2). High age, high comorbidity index and low travel distance to hospital for other first-time COPD-hospitalised patients listed with the patient's practice reduced the odds of the patient being visited (Table 2).

A U-shaped dose-response relationship was found between GPHVT and readmission-free survival (Table 2 and Figure 2). The lowest adjusted risk of readmission or death was observed in the middle group of patients whose GP had visited >20–30% of other

listed first-time COPD-hospitalised patients. Compared with this group, the risk was significantly higher if either 0% (hazard rate ratio 1.18 (1.01–1.37)) or >60% (hazard rate ratio 1.23 (1.04–1.44)) had been visited (Table 2 and Figure 2). The Kaplan–Meier curves in Figure 3 show that the readmission-free survival is increasingly poorer, the more GPHVT is either higher or lower than >20–30% of patients receiving a home visit.

DISCUSSION

Main findings

The principal finding of this study is the U-shaped dose-response relationship between GP home visit tendency (GPHVT) and the risk of all-cause readmission or death after first hospitalisation with COPD. Both too high and too low GPHVT is associated with increased risk. Half of all first-time COPD-hospitalised patients are listed with a general practice with a GPHVT above the one associated with the lowest risk.

Interpretation of findings in relation to previously published work

Some studies have suggested that home visits generally prevent hospital readmission of elderly people. In most of these studies hospital personnel conducted the home visits,^{22–25} and in the only study where GPs conducted the home visits they were conducted on a strictly planned schedule together with the district nurse in tight coordination with the local hospital.⁹ Because of the unpredictable nature of acute disease, this planned type of GP home visits is rarely feasible and only accounts for a small part of all GP home visits.

The present study included all GP home visits, not only the planned ones. It investigated the largest and most frequently readmitted group of hospitalised elderly patients. Furthermore, by defining GPHVT independently of the patient's own number of home visits, the study findings are not susceptible to be confounded by indication.

The explanation of the U-shaped dose-response relation between GPHVT and hospital readmission is probably multifactorial. GPHVT reflects a practice's average decision on whether to conduct a home visit. GPs, practice personnel, patients, relatives, home-care personnel and other persons involved take part in these decisions, which are thought to depend on demand, supply and personal preferences.^{8,16,26}

In line with previous studies, the present study finds that old age, female gender, high comorbidity index and having a general

Table 1. Baseline characteristics of in-patients and excluded patients first-time hospitalised with COPD and the general practice at which they were listed at the time of admission to hospital

	Included (95% CI)	Excluded (95% CI)	P _{difference}
Number of patients	15,545	4,851	
Mortality during hospitalisation	7.2% (6.8–7.6)	7.2% (6.5–7.9)	0.98
Readmitted or dead 30 days after discharged alive	20.8% (20.1–21.5)	21.0% (19.8–22.2)	0.80
GP home visit in the year before hospitalisation	32.9% (32.1–33.6)	32.5% (31.2–33.8)	0.66
[Age] in years	72.4 (72.2–72.6)	71.8 (71.5–72.2)	< 0.01
Proportion of females	52.8% (52.0–53.6)	55.9% (54.6–57.3)	< 0.01
[Charlson comorbidity index excluding COPD]	1.25 (1.22–1.27)	1.22 (1.18–1.27)	0.36
[Number of GPs in the practice]*	2.33 (2.31–2.36)	1.49 (1.46–1.51)	< 0.01
[Age of GPs in the practice] in years*	54.0 (53.9–54.1)	53.8 (53.5–54.0)	0.05
[Proportion of female GPs in the practice]*	28.5% (28.0–29.0)	32.7% (31.5–33.9)	< 0.01
[Area average annual household income] in 1,000 USD	82.6 (82.5–82.8)	82.5 (81.9–83.0)	0.30
[Travel distance to hospital] in kilometres	15.7 (15.3–16.0)	13.9 (13.2–14.5)	< 0.01
[Municipality urbanisation percentage]	87.7% (87.4–87.9)	90.5% (90.2–90.8)	< 0.01

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; GP, general practitioner; USD, United States Dollars.

[Squared brackets] indicate the means. In year 2008, 1 USD = 5.28 Danish crowns. The *-marked estimates disregarded the 238 patients who were excluded for not being listed with a general practice.

Table 2. Analysis of the odds of having had a GP home visit and the readmission-free survival for patients first-time hospitalised with COPD

	Total		GP home visit		30 Days' readmission or death		
	%		%	OR _{adjusted} (95% CI)	%	HR (95% CI)	HR _{adjusted} (95% CI)
Total	100		31		21		
<i>Practice home visit tendency (%)</i>							
0	7		22	1	23	1.20 (1.03–1.40)	1.18 (1.01–1.37)
> 0–20	18		25	1.21 (0.87–1.69)	21	1.07 (0.95–1.21)	1.05 (0.93–1.17)
> 20–30	24		27	1.32 (0.97–1.80)	20	1	1
> 30–40	20		33	1.83 (1.32–2.54)	20	1.03 (0.92–1.16)	1.04 (0.93–1.17)
> 40–60	25		38	2.32 (1.73–3.10)	21	1.10 (0.98–1.23)	1.09 (0.98–1.22)
> 60	6		40	2.47 (1.74–3.54)	24	1.25 (1.06–1.47)	1.23 (1.04–1.44)
<i>Gender</i>							
Female	53		35	1	19	1	1
Male	47		27	0.63 (0.59–0.68)	23	1.23 (1.14–1.32)	1.20 (1.11–1.29)
<i>Age (years)</i>							
45–59	13		12	1	16	1	1
60–79	59		26	2.33 (2.03–2.68)	20	1.25 (1.11–1.41)	1.21 (1.07–1.36)
> 79	28		51	7.07 (6.10–8.20)	24	1.39 (1.22–1.58)	1.38 (1.22–1.57)
<i>Charlson comorbidity index</i>							
0	45		23	1	16	1	1
1	22		35	1.63 (1.48–1.79)	21	1.35 (1.22–1.49)	1.33 (1.20–1.46)
> 1	33		39	2.02 (1.86–2.20)	27	1.76 (1.61–1.91)	1.73 (1.59–1.89)
<i>Travel distance to hospital (km)</i>							
0–2	16		35	1	21	1	1
> 2–5	21		31	0.92 (0.82–1.04)	21	1.01 (0.90–1.14)	0.98 (0.87–1.10)
> 5–10	14		28	0.82 (0.71–0.94)	21	1.01 (0.89–1.16)	1.00 (0.88–1.14)
> 10–20	20		30	0.79 (0.69–0.91)	21	0.97 (0.86–1.11)	1.03 (0.89–1.18)
> 20–30	14		30	0.75 (0.64–0.87)	20	0.93 (0.81–1.08)	0.95 (0.81–1.11)
> 30	15		31	0.80 (0.68–0.93)	20	0.97 (0.85–1.11)	0.97 (0.83–1.13)
<i>Practice number of GPs</i>							
1	38		30	1	21	1	1
2	24		31	1.10 (0.98–1.22)	22	1.03 (0.93–1.13)	1.04 (0.92–1.18)
3	19		32	1.20 (1.04–1.38)	21	0.97 (0.87–1.08)	1.01 (0.86–1.18)
> 3	19		32	1.28 (1.08–1.50)	19	0.88 (0.79–0.98)	0.94 (0.78–1.14)
<i>Practice gender of GPs</i>							
Female	10		28	1	21	1	1
Both sexes	44		31	0.98 (0.84–1.14)	21	0.96 (0.84–1.09)	1.05 (0.89–1.23)
Male	46		32	1.16 (1.02–1.32)	21	0.97 (0.86–1.10)	0.99 (0.88–1.13)
<i>[Age of GPs] (years)</i>							
30–45	6		30	1	20	1	1
46–60	81		31	1.05 (0.91–1.20)	21	1.05 (0.91–1.22)	1.09 (0.94–1.27)
> 60	13		31	1.10 (0.93–1.30)	20	0.98 (0.83–1.17)	0.96 (0.80–1.14)
<i>[Patients per GP per year]</i>							
> 0–1	4		32	1	21	1	1
> 1–2	38		32	1.03 (0.85–1.26)	20	0.95 (0.78–1.16)	1.04 (0.84–1.27)
> 2–3	37		31	1.03 (0.84–1.27)	21	1.00 (0.82–1.22)	1.12 (0.90–1.39)
> 3	21		30	0.97 (0.78–1.22)	21	0.98 (0.80–1.21)	1.07 (0.85–1.35)
<i>[Share of male patients]</i>							
0–1/3	15		31	1	22	1	1
> 1/3–2/3	72		31	1.04 (0.93–1.15)	21	0.93 (0.84–1.03)	0.99 (0.89–1.09)
> 2/3–1	13		30	1.06 (0.92–1.21)	21	0.96 (0.84–1.10)	1.02 (0.89–1.17)
<i>[Age of patients] (years)</i>							
45–70	23		30	1	20	1	1
> 70–75	55		32	0.90 (0.82–0.98)	21	0.99 (0.90–1.10)	1.03 (0.94–1.13)
> 75	22		32	0.82 (0.73–0.91)	21	1.04 (0.93–1.16)	1.02 (0.92–1.14)
<i>[Patients' Charlson comorbidity index]</i>							
0–0.5	6		32	1	22	1	1
> 0.5–1	30		32	0.89 (0.76–1.04)	21	0.92 (0.79–1.08)	0.91 (0.78–1.06)
> 1–1.5	39		30	0.82 (0.71–0.96)	20	0.87 (0.75–1.01)	0.87 (0.75–1.02)
> 1.5–2	18		32	0.84 (0.71–0.98)	21	0.91 (0.78–1.07)	0.89 (0.75–1.05)
> 2	7		31	0.80 (0.67–0.96)	24	1.11 (0.91–1.36)	1.02 (0.84–1.24)
<i>[Patients' travel distance to hospital] (km)</i>							
0–2	3		29	1	20	1	1
> 2–5	19		31	1.10 (0.90–1.34)	22	1.10 (0.87–1.37)	1.15 (0.93–1.42)
> 5–10	17		30	1.14 (0.92–1.40)	20	0.98 (0.78–1.23)	1.08 (0.86–1.36)
> 10–20	29		30	1.14 (0.92–1.41)	20	0.94 (0.76–1.17)	1.08 (0.85–1.36)
> 20–30	20		32	1.30 (1.04–1.63)	21	0.99 (0.80–1.24)	1.19 (0.93–1.52)
> 30	12		34	1.36 (1.07–1.74)	22	1.07 (0.85–1.33)	1.23 (0.95–1.59)

Table 2. (Continued)

	Total		GP home visit		30 Days' readmission or death	
	%	%	OR _{adjusted} (95% CI)	%	HR (95% CI)	HR _{adjusted} (95% CI)
<i>Proportion of the practice's patients who died in hospital (%)</i>						
0	41	31	1	21	1	1
>0–5	6	28	0.81 (0.68–0.96)	19	0.84 (0.72–0.99)	0.96 (0.81–1.15)
>5–10	21	31	0.94 (0.84–1.04)	20	0.95 (0.86–1.05)	1.01 (0.90–1.13)
>10–15	16	32	0.98 (0.88–1.09)	21	0.95 (0.85–1.06)	0.97 (0.87–1.09)
>15–20	6	33	1.05 (0.92–1.18)	22	0.99 (0.84–1.16)	1.03 (0.89–1.20)
>20	10	31	0.94 (0.83–1.06)	20	0.95 (0.83–1.09)	0.91 (0.80–1.04)
<i>Practice area average household income percentiles (%)</i>						
0–10	10	33	1	19	1	1
>10–25	14	30	0.87 (0.76–0.99)	22	1.16 (0.99–1.35)	1.19 (1.02–1.38)
>25–50	28	31	0.95 (0.84–1.08)	21	1.09 (0.94–1.25)	1.12 (0.97–1.30)
>50–75	27	31	0.98 (0.86–1.12)	21	1.11 (0.96–1.28)	1.16 (1.00–1.35)
>75–90	14	33	1.00 (0.87–1.15)	21	1.07 (0.91–1.25)	1.16 (0.99–1.36)
>90–100	7	29	0.90 (0.77–1.06)	20	1.06 (0.87–1.29)	1.09 (0.90–1.33)
<i>Practice area urbanisation percentage (%)</i>						
0–65	5	32	1	22	1	1
>65–75	18	31	0.97 (0.83–1.14)	20	0.90 (0.77–1.06)	0.95 (0.82–1.11)
>75–85	20	31	0.99 (0.84–1.16)	19	0.83 (0.72–0.96)	0.91 (0.79–1.06)
>85–95	21	33	1.10 (0.92–1.30)	21	0.92 (0.80–1.07)	1.00 (0.85–1.18)
>95–99	17	32	0.98 (0.81–1.18)	21	0.94 (0.81–1.10)	1.05 (0.87–1.26)
>99	19	28	0.86 (0.71–1.05)	22	1.03 (0.88–1.19)	1.14 (0.95–1.38)

Abbreviations: adjusted, adjusted for calendar year and all variables listed in the table; CI, confidence interval; COPD, chronic obstructive pulmonary disease; GP, general practitioner; HR, hazard rate ratio; OR, odds ratio; Total, all 15,525 first-time COPD-hospitalised patients. [Squared brackets] denote means. Patients referred to in the squared brackets are the other first-time COPD-hospitalised patients listed with the same general practice as the patient in question.

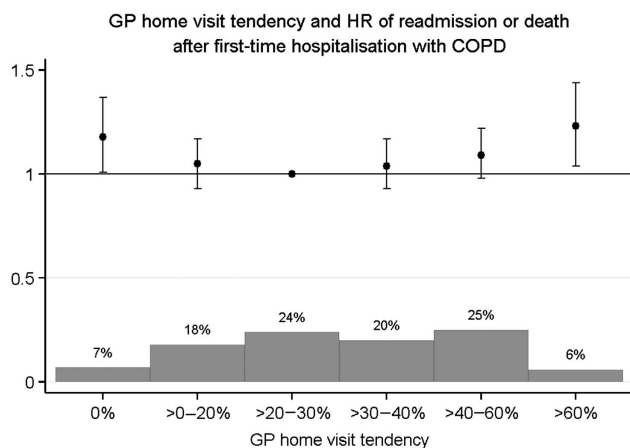


Figure 2. The x axis shows the general practice home visit tendency, that is, the proportion of other first-time COPD-hospitalised patients listed with the patient's practice who had a home visit in the year before hospitalisation. The bars show the distribution of all first-time COPD-hospitalised patients according to their practice's home visit tendency. The dots show adjusted hazard rate ratios (HRs) compared with the reference group of patients whose practice had a home visit tendency of >20–30%. Vertical lines show 95% confidence intervals for the HRs.

practice with a higher share of male GPs are associated with higher chances of receiving a home visit.^{8,26–28} After adjustment for these and other characteristics of patients, practices and practice areas, there is a considerable positive association between GPHVT and the patients' odds of having received a home visit. This supports the fact that GPHVT indicates a patient's access to GP home visits.

If a patient is unable to visit the GP surgery, physical examination and face-to-face conversation with the GP require a

home visit, and it is likely that under these circumstances a home visit is necessary for the GP to provide optimal care and thereby prolong the patient's readmission-free survival. This may explain why too low GPHVT is associated with shorter readmission-free survival.

The increased risk of readmission or death among patients listed with a practice with high GPHVT is less straightforward to explain. It might be due to confounding—for example, if practices with high GPHVT were more concerned about their patients or had a lower severity threshold for admitting them to hospital. However, the association between GPHVT and readmission-free survival was adjusted for a number of indicators of the practices' severity threshold for COPD hospitalisation—for example, age, comorbidity and in-hospital mortality of its COPD-hospitalised patients. Moreover, factors that are usually considered to be associated with a general practice's concern for its patients were also adjusted for. This includes GP age, gender and number of GPs.

The mechanisms relating high GPHVT to low readmission-free survival may involve various social and care-related factors. Other studies have found that living alone and being unmarried are associated with a higher risk of COPD hospitalisation.^{29,30} We suggest that the association between high GPHVT and readmissions to some extent may be due to decreased engagement from relatives and home-care personnel in taking care of the patient. The more willingly the practice agrees on a home visit, the less prompted the relatives and home-care personnel will be to take responsibility—for example, by intensifying home-care or arranging transport to the practice surgery. If a GP home visit is too quickly and easily arranged, the relatives and home-care personnel may not realise the need to be present, and at the home visit the patient might appear to the GP to have few and unreliable caretakers and is therefore more likely to be admitted to hospital. On the other hand, if relatives or home-care personnel in dealing with practices with low GPHVT feel obliged to take the patient to the GP surgery, the GP is more likely to be confident in

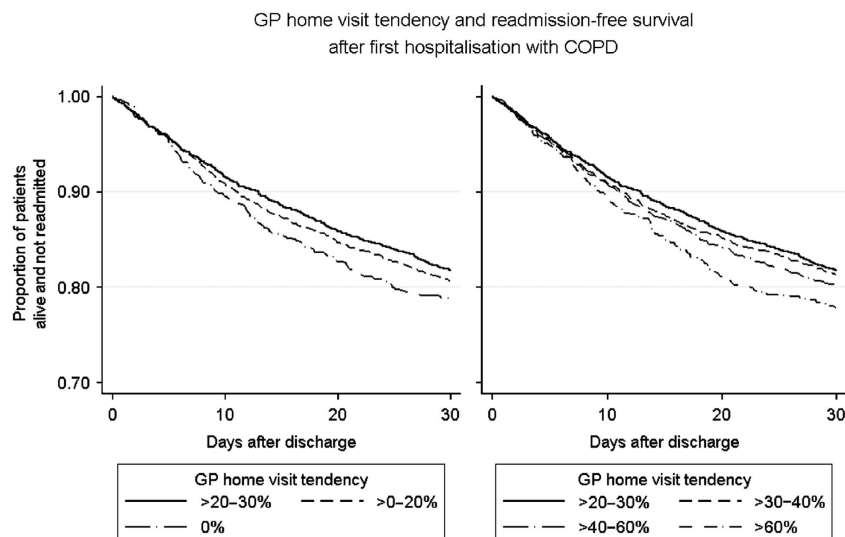


Figure 3. Kaplan–Meier curves of first-time COPD-hospitalised patients’ readmission-free survival according to the practice’s home visit tendency. Readmission-free survival is poorer, the more general practitioner home visit tendency (GPHVT) is either lower (left) or higher (right) compared with >20–30% of patients receiving a home visit.

the caretakers’ support for the patient. Furthermore, in the surgery the GP will be able to run some confirmatory laboratory tests, which might increase confidence in treating the patients outside hospital. In short, high GPHVT may lead to low GP confidence in the feasibility of treatment outside hospital and thus increase the risk of readmission.

Strengths and limitations of this study

The study used national Danish registers that are almost complete and have virtually no loss to follow-up. All data used in the study were collected for administrative purposes and are considered and tested to be highly valid.¹⁸ However, spirometry data could have supported the COPD diagnoses and enabled adjustment for COPD severity. Furthermore, current consensus suggests inclusion of patients between 40 and 45 years of age.³¹

Compared with patients with a primary COPD diagnosis, patients with respiratory failure or pneumonia have higher mortality.¹⁵ However, we believe that the patients’ primary diagnoses are independent of GPHVT and thus unlikely to confound the analyses.

Mortality is high and patients who died in the post-discharge period had a shorter risk time for receiving a home visit, which could have introduced an immortal time bias. Therefore, GPHVT was based on home visits conducted before rather than after the patients’ first COPD hospitalisation. This approach may be applied as very few elderly patients change their GP during a 30-day period,^{32,33} and as the demand, supply and personal preferences that are thought to determine a practice’s GPHVT are not likely to depend on whether the patient has been hospitalised with COPD.

Danish general practices are open around 40 h per week, whereas acute exacerbations of COPD and admissions to hospital occur at all hours. This means that many of the patients were hospitalised by other GPs working in an out-of-hours primary care corporation. The possible bias from the patients’ out-of-hours exposure to the GPHVT of another set of GPs is most likely undifferential and might therefore mask an even stronger association between the patient’s own practice’s GPHVT and readmission-free survival.

Some selection bias might have been introduced if patients with higher risk of readmission tended to be listed with a practice with high GPHVT. However, most patients choose their practice

many years before they develop symptomatic COPD, and at a time in life when the practice’s GPHVT is less likely to be a concern. Very few elderly patients voluntarily change practice even if they are not satisfied with their current practice.^{32,33} Therefore, which practice a patient is listed with at the time of first COPD hospitalisation is unlikely to depend on the practice’s GPHVT.

There are about 2,100 general practices in Denmark,¹⁷ but only 1,389 practices were included in the study (Figure 1). Patients listed with practices with few GPs were more often excluded (Table 1). As practices were required to have at least three patients hospitalised with COPD, patients may have been more often excluded if they had been listed with practices with fewer, younger or healthier patients, or with practices effective in preventing COPD hospitalisation. In addition, patients were excluded if they changed practice—for example, if they moved residence, or were listed with a practice that was divided, merged with another practice, newly started with no patients or closed down with no succeeding GP. In-patients and excluded patients did not differ markedly with regard to the proportions of GP home visited, dead or readmitted patients or with regard to the factors associated with these events. Therefore, we find no reason to believe that the associations found in this study could not be generalised to all first-time COPD-hospitalised patients, including patients listed with small practices.

Implications for future research, policy and practice

The study clearly indicates an influence of GPHVT on COPD readmissions. Until future research has explored the mechanisms behind this influence, it is our view that best clinical practice regarding requests for GP home visits will be always to encourage that the patient is brought to the surgery but never to refuse necessary home visits.

Conclusion

A moderate GP tendency to conduct home visits is associated with the lowest 30-day risk of COPD readmission or death. A general practice’s tendency to conduct home visits should not be used as a unidirectional indicator of its ability to prevent COPD hospital readmissions.

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CONTRIBUTIONS

JL and JS designed the study. JL obtained and validated the data, performed the analyses, interpreted the results and wrote the first article draft. PVL, MSP and JS contributed to the data analyses and the interpretation of results and made critical revision of the manuscript. All authors approve the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. JL is the guarantor. All authors had full access to the data and take responsibility for the integrity of the data and the accuracy of the data analyses.

COMPETING INTERESTS

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (i) JL has support from the Governmental Region of Southern Denmark for the submitted work; (ii) the authors have had no relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners or children have had no financial relationships that may be relevant to the submitted work; and (4) the authors have no non-financial interests that may be relevant to the submitted work.

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