Type 2 diabetes and COPD: treatment in the right healthcare setting? An observational study.

Rimke P Willink
Julius Centrum voor Gezondheidswetenschappen en Eerstelijns Geneeskunde
Rimke C Vos
Julius Centrum voor Gezondheidswetenschappen en Eerstelijns Geneeskunde
Ingrid Looijmans-van den Akker
Leidsche Rijn Julius Healthcare Centres
Huberta E Hart (bhart@lrjg.nl)
Julius Centrum voor Gezondheidswetenschappen en Eerstelijns Geneeskunde

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Abstract

Background Type 2 diabetes (T2DM) and COPD are chronic conditions, for which patients need lifelong healthcare. The aim of the study is to examine in which healthcare setting patients with T2DM and COPD receive care, and if they are allocated to the correct setting.

Method T2DM and COPD patients from five primary care centres were included. Data concerning treatment setting, patient- and clinical characteristics were extracted from electronic medical records. The profile of patients treated in primary care was compared with that of those treated in secondary care. For patients treated in secondary care we evaluated whether treatment allocation was according to guidelines and if back-referral to primary care could take place.

Results Of the T2DM and COPD patients 7.6% and 29.6% were treated in secondary care of which 72.7% and 31.4% according to the guideline. T2DM patients treated in primary care were older (63 versus 57 years, $p = 0.001$), had a shorter diabetes duration (8 versus 11 years, $p < 0.001$) and lower HbA1c (53.0 versus 63.5 mmmol/l, $p < 0.001$) than those treated in secondary care. Those with COPD treated in primary care used less inhalation medication (75.2 versus 90.1%, $p < 0.001$) and had better spirometry results (67.39 versus 57.53 FEV_1%pred, $p < 0.001$).

Conclusion The majority of the patients with T2DM and COPD were treated in primary care correctly. Patients treated in primary care on average had a better health condition compared to those in secondary care. The majority of the T2DM patients and the minority of COPD patients were treated correctly in secondary care.

Background

Diabetes Mellitus (DM) and Chronic Obstructive Pulmonary Disease (COPD) are chronic conditions with a high prevalence; in 2017 over 1.1 million people in the Netherlands were diagnosed with DM (1), and almost 600.000 with COPD (2).

In the Netherlands the majority of patients with type 2 Diabetes Mellitus (T2DM) (± 90%) and with COPD (± 74%) are treated in primary care (3). This care is necessary to prevent microvascular complications (retinopathy, nephropathy, and neuropathy) and macrovascular complications (among others stroke and myocardial infaction) in T2DM (4, 5). Continued care for COPD is important to reduce exacerbations, decrease dyspnoea, slow disease progression, improve health status and reduce mortality (6, 7). However, only a small percentage of the total budget for DM care in the Netherlands (9%) is spend in primary care and 27.4% is spend in secondary care (8). From the total budget for COPD, 6% is allocated to primary care and 9.1% to secondary care (9). The rest of the budget is, among other things, spend on devices and homecare. From a cost-effectiveness and a patients perspective it is important to provide healthcare in primary care when possible.

Currently, the government in the Netherlands supports a project to provide healthcare close to patients' homes and only when necessary in secondary care. This project is called in Dutch 'De juiste zorg op de juiste plek' meaning 'The right care at the right place' (10, 11). This national project is set up to keep healthcare accessible for all patients, to prevent from getting too expensive and to blend care when possible with E-health healthcare. In the current study we evaluate the care setting of patients with T2DM and COPD from five primary healthcare centres in the Netherlands, if they were allocated to the right setting according to the Regional Transmural Agreements (RTA) or if there is still room for improvement. In addition it is explored if as desired the profile of patients from primary care differ from those in secondary care.

Method

Study design and setting

Data for this observational study were obtained from electronic medical records from five primary healthcare centres in the center of the Netherlands. Considering that it is an observational study and using pseudonymized routine care data and patients had consented for using their routine care data for research purpose, approval from the Medical Ethical Committee was not obligated.

Data collection

All patients within the five primary healthcare centres with an International Classification of Primary Care (ICPC) code for T2DM (T90.02) and/or COPD (R95) were included. In august 2019 data were extracted from the electronic medical records (over the period January 1st ,2017 until July 26th, 2019).

For patients with T2DM and COPD the treatment setting was determined: treatment in primary care, treatment in secondary care or no care at all. For T2DM and COPD patients who were treated in secondary care the reason for referral was extracted and compared with the RTA for T2DM and COPD (12, 13). The RTA for T2DM provides clear reasons when to refer a patient. For COPD patients different factors determine the treatment setting (Appendix I). When COPD patients treated in secondary care did not met the criteria for treatment in primary care, they were classified as correctly treated in secondary care. For T2DM and COPD patients treated in secondary care it was assessed if a specialist letter was received during the study period. If there was no letter, data found in electronic medical records were used.

Profile characteristics

Type 2 diabetes specific characteristics

Data were extracted from electronic medical records on patient characteristics (age and sex), diabetes duration, systolic blood pressure, glycosylated hemoglobin (HbA1c), LDL-cholesterol, estimated glomerular filtration rate, albumin/creatinine ratio in urine, body mass index, diabetic complications, glucose lowering medication, statin use and lifestyle advise.

Diabetes duration was defined in years and calculated as the duration until 2018. Data on the microvascular complications retinopathy, nephropathy and neuropathy were collected. Retinopathy was defined as retinopathy seen with fundoscopy in one or two eyes. Nephropathy was defined as an eGFR lower than 60 and/or an albumin/creatinine ratio in urine from 3.0 or higher. For the estimated glomerular filtration rate the Chronic Kidney Disease Epidemiology Collaboration formula was used (14). Neuropathy was defined as a deviating sensation of the monofilament on one or both feet and/or a score from two or higher on the modified Sims classification (15). Data on the macrovascular complications angina pectoris (ICPC K74), myocardial infarction (ICPC K75), ischemic heart disease without angina (ICPC K76), transient cerebral incident (ICPC K89), cerebral infarction (ICPC K90.03) and intermittent claudication (ICPC K92.1) were collected. Both micro- and macrovascular complications were defined as the presence of one or more complications per category.

COPD specific characteristics

Data were extracted from the electronic medical records on patient characteristics (age and sex), systolic blood pressure, use of inhalation medication, spirometry results, smoking status, body mass index, Clinical COPD Questionnaire (CCQ) and Medical Research Council (MRC) dyspnea scale scores were obtained.

The CCQ is a questionnaire used to establish the health status of COPD patients. It consists of three domains: symptom state (4 items), functional state (4 items) and mental state (2 items). The outcome is a sum of all domains ranging from zero to six, with a higher outcome meaning a lower health status (16). The MRC dyspnea scale is a scale to establish how much dyspnea patients experience, it ranges from one to five, with a higher score meaning more dyspnea (17). Spirometry represents the percentage of expected on the forced expiratory volume in one second (FEV1%pred).

Chronic disease related characteristics

Polypharmacy was defined as the prescription of five or more chronic medications per patient (18). Frailty of patients was determined according to the Frailty Index (19). Patients were considered frail when the Frailty Index was higher than 0.2. Data on frailty and polypharmacy were only available for patients 60 years and older. Multimorbidity was defined as the presence of two or more chronic conditions selected from a list from the Netherlands institute for health services research (NIVEL) (20, 21)

Statistical analysis

Descriptive statistics were performed using IBM SPSS Statistics (version 25.0, IBM Corporation, Armonk, New York, USA). If more than one measure of the same determinant was present in the study period, the average of the measures was calculated and used for further analysis. Difference in continues characteristics between patients treated in primary care and those treated in secondary care were determined by using the Independent T-test or Mann-Whitney U test when appropriate. Differences in categorical variables were determined by using the χ^2-test or Fisher exact test when appropriate. A p-value of less than 0.05 was considered to be significant.

Results

Study population

In 2018 a total of 43.488 patients were enlisted in the five primary healthcare centres, among which were 1439 patients with T2DM (prevalence 3.3%) and 409 patients with COPD (prevalence 0.9%).

Of the T2DM patients 1329 (92.4%) were treated in primary care and 110 patients (7.6%) in secondary care. Of the COPD patients 270 (66.0%) were treated in primary care and 121 patients (29.6%) in secondary care. There were 18 patients (4.4%) who received no care at all for COPD, they were excluded from further analysis.

Profile of the patient population

Type 2 diabetes

T2DM patients treated in primary care were compared to those treated in secondary care. Primary care patients were older (63 versus 57 years, $p = 0.001$), had a shorter diabetes duration (8 (IQR 9) versus 11 (IQR 12) years, $p < 0.001$), and a lower body mass index (28.73 versus 32.00, $p = 0.016$).

Their HbA1c was lower (53.00 versus 63.50 mmmol/l, $p < 0.001$), as was their median albumin/creatinine ratio (0.70 versus 2.60 mg/mmol, $p = 0.002$). The estimated glomerular filtration rate was higher in primary care patients (83.63 versus 79.31 ml/min/1,73 m^2, $p = 0.046$) (Table 1). Overall, primary care patients had fewer macrovascular complications (19.9 versus 28.2%, $p = 0.040$) and microvascular complications (31.9 versus 48.2%, $p < 0.001$)than patients in secondary care. Patients in primary care were treated more often with lifestyle advice only (28.0 versus 7.3%, $p < 0.001$), used less insulin (14.5 versus 72.7%, $p < 0.001$), less glucagon-like peptide-1 agonists (0.9 versus 5.5%, $p = 0.002$) and less sodium-glucose transport protein 2 inhibitors (0.8 versus 4.5%, $p = 0.004$) than those treated in secondary care.

Specialist letters were available for 94 patients of the 110 treated in secondary care (85.5%) (Table 3). The reason for referral was known in 81 patients (73.6%) and in 64 patients (79.0%) of them it was according to the RTA. Reasons to refer patients were most often insufficient regulated HbA1c and uncertainty about the diagnosis T2DM (Table 4). Of all the patients treated in secondary care 80 patients (72.7%) had a profile that matched eligibility for treatment in secondary care.

COPD

COPD patients treated in primary care compared to those in secondary care had better spirometry (FEV1%pred) results (67.39 versus 57.53, $p < 0.001$), had a lower score on the CCQ (1.15 versus 2.05, $p = 0.015$) and had a lower score on the MRC dyspnea scale (1.49 versus 2.50, $p = 0.001$) They also used less inhalation medication (75.2 versus 90.1%, $p < 0.001$) and polypharmacy was less often present in primary COPD patients (49.0 versus 64.1%, $p = 0.002$) (Table 2).

Pulmonologist letters were available for 102 patients (84.3%) treated in secondary care (Table 3). The reason for the referral was known for 72 (59.5%) of them. Reasons to refer patients were most often; uncertainty about the diagnosis COPD and inadequate treatment with the current medication (Table 4). It was not possible for all patients to determine whether the reason for the referral was according to the RTA or not. The RTA states that the decision to refer a patient to secondary care should be based on patients characteristics. The profile of 38 patients (31.4%) matched eligibility according to the RTA criteria for treatment in secondary care setting. To determine this percentage data from electronic medical records was used.

Discussion

The results of this study showed a relatively low prevalence of T2DM (3.3%) and COPD (0.9%) in the five care centers. Patients with T2DM were in 7.6% of the cases treated in secondary care and in COPD patients this was 29.6%. From the patients with T2DM, 72.7% were correctly treated according to the RTA in secondary care and for COPD this was in 31.4%. In general, as desired, patients correctly treated in primary care had less complex T2DM or COPD compared to those correctly treated in secondary care.

An important strength of our study is that we had a dataset with information from patients in both primary and secondary care, which made it possible to analyze these two different patient groups.

It was difficult to determine if patients were treated correctly in secondary care mainly for the COPD patients, because data were only available over a period of two years. Therefore, conclusions about the number of correctly treated patients in secondary care should be made with caution. Another limitations is that in the current study, data on exacerbations for COPD patients could not be used, due to insufficiently registration. So, the RTA criteria to refer a patient to secondary care, if a patient experienced two or more exacerbations could not be checked. Furthermore, the information that 31.4% of the COPD patients was treated correctly in secondary care should be interpreted with care. As data were incomplete; for example not for all patients referral letters were available.

Nationwide the prevalence for T2DM is 5.3% and for COPD 2.0% (3). In Europe, the prevalence of T2DM is 10.2% in men and 8.5% in women (22). The worldwide prevalence of COPD varies from 8–10% (23). The overall prevalence's found in this study are lower than nationwide, this might be due to the location of the healthcare centres; a Vinex-location with a younger population. Nationwide percentages of patients treated in secondary care are 9.5% for T2DM and 25.9% for COPD (3). Our results for the percentage of patients treated in secondary care seem comparable to the nationwide data.

The current study compared the profile of patients treated in primary and secondary care. A previous Dutch study in T2DM patients, found that patients in secondary care had a longer diabetes duration, used more insulin, had a higher prevalence of complications, a higher BMI and higher HbA1c levels (24). The outcomes of this previous study are in line with our results.

The reason for referral to secondary care was extracted in the current study. Patients with T2DM with an indication for using a glucagon-like peptide-1 receptor agonist were referred. Currently referring for this indication is not necessary anymore, as glucagon-like peptide-1 receptor agonists are included in the recent update of the standard for T2DM of the Dutch College of General Practitioners and can also be prescribed by the general practitioner (15). Therefore, it can be expected that the number of patients treated in secondary care based on this indication will decrease. The question remains if patients currently treated in secondary care because of this indication will be back-referred to primary care.

With regard to the COPD findings, similar to our results a previous Dutch study also found significant worse spirometry measures for their secondary (and tertiary) population compared to the primary care populations (25). Furthermore, the primary care population had the least severe degree of airflow limitations (fitting with the RTA criterium on FEV1%), the least symptoms in daily life and the best functional status. In contrast to our findings where no age difference was found between settings, their secondary care population was significantly older and had the highest comorbidity score (25). When comparing these results with our results, both studies showed a significant difference in spirometry results. Besides, our study showed less symptoms and better functional status in primary care since scores on CCQ and MRC dyspnea scale were significantly lower. This is in line with what is desired to achieve with the RTA.

Conclusions

In conclusion, the current study found percentages of patients with T2DM and COPD treated in secondary care that are in line with national percentages. There are differences in the profile of patients in primary versus secondary care in both T2DM and COPD on various variables, including age and HbA1c for T2DM and the use of inhalation medication and spirometry results for COPD. The majority of T2DM patients were correctly treated in secondary care, this percentage was lower for COPD patients. As a result, patients in primary care had, as desired by the RTA, less complex disease than those in secondary care.

We recommend further research to determine if patients with T2DM and COPD are back-referred to primary care when healthcare in secondary care is no longer necessary based on the RTA and the project ‘The right care at the right place’. If patients are not back-referred, reasons for this need to be explored, so the RTA and care for patients can be improved.

List Of Abbreviations

DM Diabetes Mellitus

COPD Chronic Obstructive Pulmonary disease

T2DM Type 2 Diabetes Mellitus

RTA Regional Transmural Agreements

ICPC International Classification of Primary Care

HbA1c Glycosylated Hemoglobin

CCQ Clinical COPD Questionnaire

MRC Medical Research Council

Declarations

Ethical approval and consent to participate

The Medical Research Ethic Committee of the University Medical Center Utrecht confirmed that the Medical Research Involving Human Subjects Act did not apply to this study and therefore an official approval of this study was not required.

Consent for publication

Not applicable

Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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No funding was received for this study.

Authors' contributions

RPW collected and analyzed data, and wrote the first version of the manuscript, RCV designed the study, analyzed data and reviewed the manuscript, IL designed the study and reviewed the manuscript. HEH

designed the study, collected data, reviewed the manuscript and takes the responsibility for the manuscript.All authors read and approved the final manuscript.

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Tables

Table 1 Profile of the T2DM patients in primary and secondary care

	Diabetes Mellitus type 2		
	Primary care (n = 1329)	**Secondary care (n = 110)**	**p-value**
Sex			
Male, n (%)	741 (55.8)	63 (57.3)	0.76
Age (mean, range) in years	63 (20-95)	57 (22-83)	0.001
Diabetes duration in years (median, IQR)	8.00 (9.00)	11.00 (12.00)	<0.001
Missing, n	18	19	
Systolic blood pressure (mmHg, mean ± SD)	134 ± 15.81	136 ± 17.40	0.36
Missing, n	87	13	
HbA1c (mmol/mol, median, IQR)	53.00 (14.00)	63.50 (22.50)	<0.001
Missing, n	99	19	
LDL-cholesterol (mmol/l, mean ± SD)	2.33 ± 0.84	2.40 ± 0.88	0.51
Missing, n	162	47	
eGFR (ml/min/1,73m^2 mean ± SD)	83.63 ± 19.82	79.31 ± 21.90	0.046
Missing, n	133	18	
ACR (mg/mmol, median, IQR)	0.70 (1.60)	2.60 (4.65)	0.002
Missing, n	205	57	
BMI (kg/m^2, median, IQR)	28.73 (6.16)	32.00 (7.68)	0.016
Missing, n	111	65	
Frailty			0.11
60 years or older (n)	775	51	
Yes, n (%)	489 (63.1)	38 (74.5)	
No, n (%)	138 (17.8)	5 (9.8)	

Missing, n	148 (19.1)	8 (15.7)	
Polypharmacy			
60 years or older (n)	775	51	0.069
Yes, n (%)	480 (61.9)	38 (74.5)	
No, n (%)	149 (19.2)	5 (9.8)	
Missing, n(%)	146 (18.8)	8 (15.7)	
Medication			
No T2DM medication, only lifestyle advise			
Yes, n (%)	372 (28.0)	8 (7.3)	<0.001
Statin			
Yes, n (%)	888 (66.8)	64 (58.2)	0.075
Metformin			
Yes, n (%)	959 (72.2)	72 (65.5)	0.15
Insulin			
Yes, n (%)	193 (14.5)	80 (72.7)	<0.001
GLP1 receptor agonist			
Yes, n (%)	12 (0.9)	6 (5.5)	0.002
SU deritative			
Yes, n (%)	466 (35.1)	32 (29.1)	0.21
Oral combination preparation			
Yes, n (%)	3 (0.2)	0 (0.0)	1.00
Pioglitazone			
Yes, n (%)	2 (0.2)	0 (0.0)	1.00
Repaglinide			
Yes, n (%)	1 (0.1)	1 (0.9)	0.15
SGLT2 inhibitor			
Yes, n (%)	10 (0.8)	5 (4.5)	0.004
DPP4 inhibitor			

Yes, n (%)			
	49 (3.7)	5 (4.5)	0.60
Complications			
Macrovascular			
Yes, n (%)	265 (19.9)	31 (28.2)	0.040
Angina pectoris			
Yes, n (%)	80 (6.0)	11 (10.0)	0.099
Myocardial infarction			
Yes, n (%)	100 (7.5)	14 (12.7)	0.052
Ischemic heart disease without angina			
Yes, n (%)			
Transient cerebral incident	33 (2.5)	1 (0.9)	0.51
Yes, n (%)			
Cerebral infarction	35 (2.6)	5 (4.5)	0.23
Yes, n (%)			
Intermittent claudication	9 (0.7)	5 (4.5)	0.003
Yes, n (%)			
	40 (3.0)	5 (4.5)	0.39
Microvascular			
Yes, n (%)			
No, n (%)	424 (31.9)	53 (48.2)	<0.001
Missing, n (%)	867 (65.2)	41 (37.3)	
	38 (2.9)	16 (14.5)	
Diabetic retinopathy			
Yes, n (%)			
No, n (%)	82 (6.2)	28 (25.5)	<0.001
Missing, n(%)	1140 (85.8)	82 (74.5)	
Neuropathy	107 (8.1)	0 (0.0)	

Yes, n (%)			
No, n (%)	114 (8.6)	11 (10.0)	<0.001
Unclear, n (%)	951 (71.6)	99 (90.0)	
Missing, n(%)	19 (1.4)	0 (0.0)	
Nephropathy	245 (18.4)	0 (0.0)	
Yes, n (%)			
No, n (%)	275 (20.7)	36 (32.7)	0.001
Missing, n(%)	939 (70.7)	58 (52.7)	
	115 (8.7)	16 (14.5)	
Multimorbidity			
Yes, n (%)	890 (67.0)	75 (68.2)	0.82
No, n (%)	350 (26.3)	27 (24.5)	
Missing, n(%)	89 (6.7)	8 (7.3)	

Abbreviations: IQR = interquartile range; SD = standard deviation; HbA1c = glycosylated hemoglobin; eGFR =

estimated glomerular filtration rate; ACR = albumin/creatinine ratio in urine; BMI = body mass index; GLP1 =

glucagon-like peptide-1; SU = sulfonylurea; SGLT2 = sodium-glucose transport protein 2; DPP4 =

dipeptidyl peptidase-4

Table 2 Profile of the COPD patients in primary and secondary care

	COPD		
	Primary care (n = 270)	**Secondary care (n = 121)**	**p-value**
Sex			
Male, n (%)	130 (48.3)	55 (45.5)	0.62
Age (mean, range) in years	67 (38-99)	67 (40-94)	0.89
Systolic blood pressure(mmHg, mean ± SD)	133 ± 14.87	132 ± 16.50	0.62
Missing, n	61	37	
Inhalation medication			<0.001
Yes, n (%)	195 (75.2)	109 (90.1)	
No, n (%)	71 (26.3)	12 (9.9)	
Missing(%)	4 (1.5)	0 (0)	
Spirometry (percentage on FEV_1 of predicted, mean ± SD)	67.39 ± 16.75	57.53 ± 19.14	<0.001
Missing, n	126	37	
Smoking			0.14
Yes, n (%)	110 (40.7)	31 (25.6)	
No, n (%)	14 (5.2)	6 (5.0)	
In the past, n (%)	101 (37.4)	48 (39.7)	
Missing, n(%)	45 (16.7)	36 (29.8)	
BMI (kg/m^2, mean ±SD)	26.70 ± 5.09	27.49 ± 5.52	0.30
Missing, n	58	62	
CCQ (mean ± SD)	1.15 ± 0.73	2.05 ± 0.66	0.015
Missing, n	101	117	
MRC (mean ± SD)	1.49 ± 1.03	2.50 ± 1.29	0.001
Missing, n	142	107	

Frailty			0.11
60 years or older (n)	196	92	
Yes, n (%)	115 (58.7)	68 (73.9)	
No, n (%)	34 (17.3)	11 (12.0)	
Missing, n	47 (24.0)	13 (14.1)	
Polypharmacy			0.002
60 years or older (n)	196	92	
Yes, n (%)	96 (49.0)	59 (64.1)	
No, n (%)	52 (26.5)	10 (10.9)	
Missing, n(%)	48 (24.5)	23 (25.0)	
Multimorbidity			
Yes, n (%)	214 (74.3)	86 (71.1)	0.22
No, n (%)	46 (16.0)	26 (21.5)	
Missing, n(%)	28 (9.7)	9 (7.4)	

Abbreviations: SD = standard deviation; FEV_1 = forced expiratory volume in one second; BMI = body mass index; CCQ = Clinical COPD Questionnaire; MRC = Medical Research Council dyspnea scale

Table 3 Information about patients referred to secondary care

	Diabetes Mellitus type 2 Secondary care	COPD Secondary care
Letter with information from secondary care in the study period		
Total patients, n (%)		
Yes, n (%)	110 (100)	121 (100)
	94 (85.5)	102 (84.3)
Reason referral to secondary care known		
Total patients, n (%)		
Yes, n (%)	110 (100)	121 (100)
	81 (73.6)	72 (59.5)
Reason referral according to RTA when the reason for the referral is known		
Total patients, n (%)		
Yes, n (%)	81 (100)	72 (100)
	64 (79.0)	**Not possible for COPD**
Does the profile of the patient fits in secondary care using data from 2017 until 2019		
Total patients, n (%)		
Yes, n (%)	110 (100)	121 (100)
	80 (72.7)	38 (31.4)

Table 4 Reasons to refer a patient to secondary care, when the referral reason is known

Diabetes Mellitus type 2	COPD
Insufficient regulated glycosylated hemoglobin	Dyspnea (on exertion)
T2DM and pregnancy wish	Coughing
Wish from the patient for a sensor indicator/ insulin pump/ glucose flash monitoring	Exacerbation of COPD
Uncertainty about the diagnosis type 2 diabetes	COPD 'The Global Initiative for Chronic Obstructive Lung Disease' stadium 3 or 4 (fitting with FEV1% <50%)
Starting with a glucagon-like peptide-1 agonist	Pneumonia with COPD
Side effects of the medication	Inadequate treatment with the current medication
Elevated albumin/creatinine ratio in the urine (for advice)	Inconclusive spirometry
Neuropathic pain	The combination of obstructive and restrictive lung disease
Wish of the patient for a referral	Wish of the patient for a referral
The need for a new referral to secondary care (patient went to secondary care in the past)	Uncertainty about the diagnosis COPD
Hypoglycemia	COPD and asthma
Macrovascular complications	High burden of disease

Supplementary Files

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- Appendix.docx