Established in 1871
Formerly: Schweizerische Medizinische Wochenschrift
Swiss Medical Weekly
The European Journal of Medical Sciences

General practitioners' adherence to the COPD GOLD guidelines: baseline data from the Swiss COPD Cohort Study

A. Jochmann, F. Neubauer, D. Miedinger, S. Schafroth, P.N. Chhajed, M. Tamm, J.D. Leuppi

Department of Respiratory Medicine and Department of Internal Medicine, University Hospital Basel, Switzerland

This study was financially supported by Boehringer Ingelheim (Switzerland) GmbH, Basel, and Pfizer (Switzerland) AG, Zurich.

Summary

Principles: Chronic obstructive pulmonary disease (COPD) is a major burden on patients and healthcare systems. Diagnosis and the management of COPD are often administered by general practitioners (GPs). This analysis investigated the adherence of GPs in Switzerland to the Global Initiative for Chronic Obstructive Lung Diseases (GOLD) guidelines.

Methods: As part of an ongoing investigation into the effect of GPs prescriptions on the clinical course of COPD, 139 GPs submitted a standardised questionnaire for each COPD patient recruited. Information requested included spirometric parameters, management and demographic data. Participating GPs were provided with and received instruction on a spirometer with automatic feedback on quality. Patients were grouped by the investigators into the GOLD COPD severity classifications, based on spirometric data provided. Data from the questionnaires were compared between the groups and management was compared with the recommendations of GOLD.

Results: Of the 615 patients recruited, 44% did not fulfil GOLD criteria for COPD. Pulmonary rehabilitation was prescribed to 5% of all patients and less than one-third of patients exercised regularly. Less than half the patients in all groups used short-acting bronchodilators. Prescribing long-acting bronchodilators or inhaled corticosteroids conformed to GOLD guidelines in two-thirds of patients with GOLD stage III or IV disease, and approximately half of the less severe patients. Systemic steroids were inappropriately prescribed during stable disease in 6% of patients.

Conclusions: Adherence to GOLD (COPD) guidelines is low among GPs in Switzerland and COPD is often misdiagnosed or treated inappropriately. This is probably due to poor knowledge of disease definitions.

Key words: COPD; GOLD; management; primary care; guidelines; bronchodilators; inhaled corticosteroids; pulmonary rehabilitation

Introduction

Chronic obstructive pulmonary disease (COPD), a common disease frequently associated with pulmonary and extra-pulmonary co-morbidities, is an increasing cause of morbidity and mortality in contrast to some other major chronic diseases, such as coronary artery disease for which the mortality rate has been declining in developed countries [1]. The Global Burden of Disease studies predicted that COPD will be the third most common cause of death and the fourth most common cause of morbidity by 2020 [2].

In response to the increasing burden, the Global Initiative for Chronic Obstructive Lung Diseases (GOLD) was developed to increase awareness and decrease morbidity and mortality from COPD [3]. GOLD aims to improve prevention and management of COPD through a concerted worldwide effort of people involved in all facets of healthcare, and published guidance [3].

GOLD defines COPD as a disorder characterised by expiratory airflow limitation that is not fully reversible, is usually progressive and is associated with an abnormal inflammatory response of the lungs to noxious particles or gases [3]. In nine out of 10 cases, COPD is associated with extensive cigarette smoking and is most often seen in patients older than 40 years [4]. However, diagnosis of COPD can be difficult and requires confirmation by spirometry [3].

Although a serious burden, COPD is under- and misdiagnosed in primary care, which likely contributes to the increase in prevalence, morbidity and mortality associated with this disease [5]. This is unfortunate because COPD progression can be stopped or slowed by smoking cessation, especially in the early stages of disease, and symptoms can be treated effectively [6]. One reason for the difficulty in correctly diagnosing COPD in primary care may be that disease-related impairment is often not noticed until the more advanced stages of the disease. In addition, spirometry is not performed on a routine basis in primary care and questionnaire-based medical history is inferior to spirometry for the identification of patients with COPD [7].

Accurate data on the prevalence of COPD is dependent on the diagnosis of COPD within primary care. In the past, patients at risk of developing COPD were not referred to specialist care as often as patients with other chronic conditions, such as diabetes or chronic heart disease. Up-to-date epidemiological data on the diagnosis and treatment of COPD should therefore be obtained in the affected countries [8].

We have developed an ongoing, questionnaire-based study designed to survey the standard of diagnosis of COPD by general practitioners (GPs) and the effect of prescriptions on the clinical course of COPD in patients seen by GPs in Switzerland. Frequent GP practice-based spirometry was required in the protocol of the study. We report here analysis of the baseline data with particular respect to adherence to the GOLD guidance on diagnosis of COPD and treatment recommendations.

Material and methods

A generic invitation letter to participate in the study was sent to 225 GPs in 23 Swiss cantons (see Acknowledgements). A total of 139 GPs agreed to participate, which represents 4% of the 3512 GPs listed on the register maintained by the Swiss Medical Association (FMH) [9]. 85% of the participating GPs recruited 2–20 patients. 15% recruited only one patient. The study was approved by the ethics committee for each canton and all patients included provided written documentation of informed consent. The study began in January 2007.

GPs were asked to recruit COPD patients for an initial study examination (baseline) and then for re-examination at 3-month intervals over a total period of 24 months. Information from patients' notes and interviews on past symptoms and treatment were recorded by GPs at the baseline visit using a standardised questionnaire. At each visit, the patient was clinically examined by the GP who recorded symptoms, comorbidities and treatment. Patients were asked to perform post-bronchodilatator spirometry at least every 6 months. Data collected are summarised in table 1. Data was entered into an online database either directly by GPs or by the study team after receiving data from physicians by facsimile transmission.

Spirometry

Spirometry was performed using an EasyOne™ spirometer (n.d.d. Medizintechnik AG, Zürich, Switzerland). Before starting the study, GPs were instructed on how to perform spirometry according to the American Thoracic Society guidelines [10] by representatives of the spirometer sales company. The EasyOne™ spirometer used ultrasonic time measurement technology with integrated software for quality control and feedback for the examiner [11]. All spirometries were performed in a seated position using a disposable mouthpiece and required the use of a nose clip. The reference values by Brändli et al. (Swiss study on Air Pollution and Lung Diseases in Adults [SAPALDIA]) were used for predicted values [12].

Assessment of severity of COPD

Severity of COPD was assessed centrally by the investigators at the University Hospital Basel. Spirometry data provided by the GPs were interpreted according to the criteria of the GOLD committee [5]. According to the GOLD criteria, airway obstruction was defined as having a forced expiratory volume in 1 second (FEV_1)/forced vital capacity (FVC) <70% [13]. Severity classes are as follows:

Stage 1 (Mild):	FEV_1/FVC <0.70
	FEV_1 ≥80% predicted
Stage II (Moderate):	FEV_1/FVC <0.70
	50% ≤FEV_1 <80% predicted
Stage III (Severe):	FEV_1/FVC <0.70
	30% ≤FEV_1 <50% predicted
Stage IV (Very Severe):	FEV_1/FVC <0.70
	FEV_1 <30% predicted or FEV_1 <50% predicted plus chronic respiratory failure

Not all patients performed post-bronchodilator spirometry at baseline. The analysis of baseline data reported here is limited to the patients for whom spirometry data at baseline were available. The quality grade of spirometry was not reported by most GPs. The study team only received the spirometric measurement values.

Comparison of prescribed medication with recommendations of GOLD

We compared the use of bronchodilators and inhaled corticosteroids (ICS) currently prescribed to patients with assumed COPD, with that recommended by the GOLD guidelines [6] according to the GOLD severity of COPD grades assigned following confirmation of COPD through spirometry (as described above). GOLD recommends that short-acting bronchodilators should be prescribed for all severities of COPD, if required. Long-acting bronchodilators should be reserved for prescription to those with COPD of GOLD stage II or worse, if required. Similarly, prescription of ICS (whether alone or in combination with a long-acting bronchodilator) should be reserved for GOLD stage III and IV, if the patient experiences repeated exacerbations. GPs were not coached on prescribing treatment adhering to the GOLD guidelines as part of this study. Data were analysed according to appropriate prescription of long-acting bronchodilators and ICS recommended by the GOLD guidelines. Acceptable prescription was

assumed if the prescribed medication could not be shown to differ from prescription recommendations in the GOLD guidelines. Non-conformity was defined as prescriptions that varied from the recommended prescription of long-acting bronchodilators and ICS medications. Since prescription of ICS for co-morbid asthma could confound the analysis for GOLD stages I and II, data were also analysed considering use of ICS as acceptable for these patients and they were not counted as non-conformity to the GOLD guidelines.

Statistical analysis

The current analysis was on data from the baseline visit for patients for whom baseline spirometry data were available. Continuous variables are expressed as means (± standard deviation [SD]) and categorical variables are demonstrated as relative frequencies and percentages. Comparisons were made using cross-tabulation for categorical data and summary statistics for metric data. Analyses were performed using the R version 2.7.1 software (R Development Core Team-2008. R: A language and environment for statistical computing).

Results

Demographic and lung function characteristics

At the time of this analysis, 615 patients (64% male, mean age 69 years) had data available from the baseline visit that included spirometry. Table 2 shows the demographic and lung function characteristics of these patients according to COPD severity, assigned centrally according to GOLD severity classifications. Of the COPD patients originally diagnosed with COPD, 44% did not fulfil GOLD criteria for COPD. The majority of the remaining 56% of COPD patients had moderate to severe COPD (GOLD II or III).

Exacerbations

From all patients included in this analysis, 23% experienced an exacerbation requiring pharmacological treatment in the 3 months prior to the baseline visit as determined by GPs (table 3). This percentage increased to 25% if only those patients who fulfilled GOLD spirometry criteria for COPD were considered. The need for treatment of an exacerbation increased with the severity of COPD. In total, 31% of GOLD stage IV patients had needed treatment for an exacerbation, compared with 10% of the GOLD stage I patients. Among those requiring treatment for an exacerbation, 80% of GOLD stage IV patients required systemic steroids, compared with 33% of GOLD stage I patients. GPs also noted symptoms indicative of an exacerbation (table 3). Of these worsening symptoms, an increase in dyspnoea and/or sputum was more common than discoloured sputum, irrespective of whether a diagnosis of COPD was confirmed by spirometry.

Treatment

Table 4 lists the number of patients who received non-pharmacological and pharmacological treatment, according to GOLD severity class. Approximately one-third of the patients in each of the No COPD, GOLD stage I and GOLD stage II COPD severity classes were reported as exercising at least twice a week. The proportion of patients claiming to exercise was less among patients at GOLD stage III and GOLD stage IV. Pulmonary rehabilitation had been prescribed to 5% of all patients. Short-acting β_2-agonists (SABAs) were used by 47% of patients in the GOLD stage IV group, and by approximately one-third of all other patients. When considered as one class, SABA and/or short-acting anticholinergics were used by 30% of patients in the No-COPD group and by 38%, 39%, 42% and 47% of the GOLD stages I to IV groups, respectively. Between 21% and 38% of the patients in the different groups used long-acting β_2-agonists (LABAs). Approximately half of the patients in the GOLD stage III and IV groups were prescribed long-acting anticholinergic agents, compared with approximately one-third of GOLD stage I and II patients. Notably, 38% of GOLD stage I patients and 57% of GOLD stage II patients were prescribed combination therapy (ICS and long-acting bronchodilator). A methylxanthine or N-acetylcysteine was each used by less than 10% of patients with a diagnosis of COPD confirmed by spirometry; use of N-acetylecysteine was reported in a greater percentage (20%) of patients who did not have COPD confirmed with spirometry. Systemic steroids were prescribed during the stable phases of disease to 6% of all COPD patients.

Comparison of prescribed medication with recommendations of GOLD

The overall use of long-acting bronchodilators and ICS according to GOLD COPD severity stage assessed centrally from the spirometry provided by GPs is summarised in table 5. Prescriptions that conformed with the GOLD recommendations occurred in approximately two thirds of patients with GOLD stage III and IV COPD, whereas non-conformity was frequent in patients with GOLD stage I and II COPD (69% and 82% of patients, respectively) (table 5 and fig. 1). Prescription of ICS (either alone or within combination therapy) in patients who had asthma reported as a co-morbidity (see below) occurred with seven patients with GOLD stage I COPD and 44 patients with GOLD stage II COPD. Assessment of these patients, as having had acceptable prescriptions within GOLD stage I and II, suggested acceptable prescriptions to have occurred in 55% of GOLD stage I and 46% of GOLD stage II patients, compared with 65% and 66% of GOLD stage III and IV patients, respectively (fig. 1).

Co-morbidities

Co-morbidities of the patients in the different groups, as reported by GPs, are presented in table 6. Arterial hypertension was the most prevalent co-morbidity and was greatest in the group without COPD. Diabetes also occurred most frequently in the No-COPD group. Co-existence of diagnosed asthma was prevalent, being reported in 32% of patients with GOLD stage I and II COPD and 18% of patients with GOLD stage IV COPD. The highest prevalence of coronary heart disease or chronic heart failure occurred with GOLD stages II and III.

Half of all COPD patients suffering from cancer had lung cancer, which was found in 3–4% of the patients with GOLD stages I to III. No case of lung cancer was recorded at the baseline visit in GOLD stage IV.

Ability to work

Ability to work within employment was reported by patients, or GPs on behalf of the patient, as unrestricted in 52% of patients with GOLD stage I COPD, while 38% were already retired or voluntarily occupying themselves with personal house-keeping at the time of the study. More than half of the patients with GOLD stages II to IV COPD were already retired and, in the COPD stage IV group, only one patient (3% of patients) remained unrestricted in their employment. Mean scoring of ability to work among those that were reported as having restricted ability to work was similar between GOLD severity groups, ranging between 54% (GOLD stage III) and 62% (GOLD stage II).

Discussion

This study had three main findings:

– COPD is often misdiagnosed

– Non-pharmacological treatment, such as pulmonary rehabilitation is infrequently considered for the treatment of COPD

– Adherence to the pharmacological treatment recommended in the GOLD guidelines is remarkably poor in all COPD groups.

This study asked GPs in Switzerland to recruit patients with COPD. Data from spirometry testing at baseline, when subsequently analysed centrally, identified 44% of the patients recruited not to have overt COPD according to the criteria by GOLD for the mildest form of COPD (GOLD stage I) [5]. One potential cause for the frequent misdiagnosis of COPD may be that many patients were diagnosed prior to the study commencing, according to their respiratory symptoms and their diagnosis was not confirmed with spirometry. Given the fact that the participating GPs are interested in research and studies, the reality of misdiagnosis of COPD in general practice might be even worse. Two studies, one in Switzerland and the other in Germany, indicated that only half of COPD diagnoses, made in general practice in these countries, were made based on spirometric criteria [14, 15]. A study of 632 patients from COPD registers in primary care practices in the UK suggested that spirometry confirmed the diagnosis in 73% of patients diagnosed with COPD, another 15% of patients had normal spirometries and the other 12% had asthma, cardiac failure or restrictive disorders only [16]. Data collected on co-morbidities from our study suggest that many of the patients without COPD, like those with COPD, had co-morbidities which could complicate a diagnosis of COPD from symptoms alone. Notably, one-fifth of these patients without COPD had asthma and nearly one-seventh had cardiac failure.

Symptoms presented by patients in our study were similar between patients with COPD GOLD stage I, II or those having No COPD. For example, 67% of the COPD GOLD stage II patients suffered from coughing, compared with 65% of the No COPD group. Of the COPD GOLD stage I patients, 40% had Medical Research Council (MRC) Dyspnoea Grade 2, which was again comparable to that of 45% of the No COPD patients. These findings further highlight that diagnosis of COPD based on clinical symptoms might be difficult. In this regard, a meta-analysis has suggested that differentiating between asthma and COPD can be challenging due to the overlap in clinical features [17]. Hence, the authors suggested use of lung function testing and other diagnostic modalities (e.g. radiographic imaging) to achieve a correct diagnosis influencing management and prognosis.

The quality of spirometric testing by GPs has been questioned. Schermer et al. showed that FEV_1 values from spirometric testing in a pulmonary function laboratory varied by up to 0.5 L compared with testing in general practices [18]. The reason for the unacceptable quality of spirometry in general practice may be due, in part, to unsatisfactory patient-compliance in spirometry, but also may be due to insufficient training of general practice staff. The EasyOne™ spirometer used in the current study employs ultrasonic time-measurement technology with integrated software for quality control and feedback for the examiner [10]. Using the EasyOne™ spirometer, Leuppi et al. analysed 29000 spirometries in general practice in Switzerland and found that 60% of measurements were of acceptable quality with reproducible spirometry [19]. However, despite considerable effort to improve the quality of spirometry in general practice, further training and education is still required before reliable estimates on the prevalence of COPD can be made. The quality of spirometry provided in this study was not assessed and may have influenced the classification of

COPD patients. As this study is ongoing, repeated spirometry will allow us to make further judgement on the quality of our data in the future.

Our data suggest that less emphasis is put on non-pharmacological treatments for COPD than on pharmacological treatment in Switzerland. Only one-third of patients in each of the No-COPD, COPD GOLD stage I and II groups were reported as exercising at least twice a week in our study. Pulmonary rehabilitation was not prescribed to any patient in the GOLD stage I group and was prescriped to fewer than 5% in the GOLD stage II group, compared with 9% of the patients in the GOLD stage III group. Non-pharmacological treatment, such as pulmonary rehabilitation, is recommended [6]. A study from the UK recently showed that patients from all MRC grades benefit statistically significantly in exercise performance from pulmonary rehabilitation [6, 20].

Approximately 40% of GOLD stage I to III and nearly 50% of COPD stage IV patients used a SABA or short-acting anticholinergic, which, according to the GOLD guidelines, every patient should use as rescue medication when required [6]. Long-acting bronchodilatators or long-acting anticholinergics (LAACs) are recommended for GOLD stage II to IV, when required. Only 56% of the patients forming GOLD stage II to IV had a LAAC or LABA, which have been shown to improve the mean absolute FEV_1 value significantly when compared with placebos, and to reduce exacerbation rates per year [21, 22], while the combination of these classes of bronchodilator is superior to the single components [22].

ICS or combination therapy (ICS and LABA) are recommended by GOLD for stage III and IV if the patient experiences repeated exacerbations [6]. Despite this, 48% of GOLD stage I and 63% of GOLD stage II patients were prescribed an ICS. Nearly half of the patients in the No-COPD group had an ICS as well. This may partly be due to asthma being a co-morbidity, which was a reported diagnosis in 22% of all patients. Similar findings were reported from the COPD Care Gap Evaluation (Cage) study in Canada [23], from which 63% of the patients with mild COPD were prescribed ICS, and from the Devon primary care audit from the UK [16], which stated an over-prescription of ICS in 43% of cases. Prescription of ICS is unjustified in patients with GOLD stage I or II COPD and with no diagnosis of asthma since no data currently supports ICS efficacy in these severity stages [24]. Furthermore, use of ICS can have important undesirable side effects. For example, the Towards a Revolution in COPD Health (TORCH) study found a statistically higher incidence of pneumonia in patients receiving fluticasone than in those taking the placebo [25]. A *post-hoc* analysis of the TORCH study came to the conclusion that age over 55 years, COPD exacerbations in the year prior to the study, high MRC Dyspnoea scores and BMI <25 kg/m² were risk factors for developing a pneumonia when treated with ICS [26].

Systemic steroids are not recommended as long-term therapy for COPD [6]. Nevertheless 5.7% of all patients received systemic steroids in stable disease. Rutschmann et al. suggested that 42% of GPs use oral corticosteroids in stable COPD [14]. Systemic steroid use is associated with several adverse effects such as adreno-cortical suppression that are dose and duration dependent [27].

Our data suggest that there is considerable deviation from the recommendations for the prescription of medications by GOLD. In total, 41% of patients with COPD confirmed by spirometry were classed as having prescriptions of long-acting bronchodilators and ICS that conformed with the recommended prescriptions in the GOLD guidelines [6]. Considering the prescriptions of ICS for co-morbid asthma, still only 56% of patients were considered to have acceptable prescriptions. These statistics compare well with the CAGE study, in which only 34% of patients had pharmaceutical prescriptions that matched Canadian Thoracic Society Guidelines, using a similar analysis to our own [23].

Moreover, 69% and 82% of patients with GOLD stage I and II, respectively, were classed as having prescriptions inconsistent with the GOLD guidelines, largely due to the use of ICS. Again, consideration of prescriptions of ICS for co-morbid asthma (assuming correct diagnosis) would suggest that these statistics are reduced to 45% in GOLD stage I and 54% in GOLD stage II; however, this still only suggests an adherence to GOLD guidelines in approximately half of these patients. In GOLD stage III and IV, approximately one-third of the patients were classed as not conforming to the GOLD guidelines because of the under-prescription of long-acting bronchodilators or, less frequently, ICS. Despite data reporting a significant reduction in exacerbation rates, improvement of health status and spirometric values shown by administration of ICS to patients with these disease stages [25], 28% of patients with GOLD stage III and 16% of patients with GOLD stage IV did not receive ICS in our study. Long-acting bronchodilators were under-prescribed in one-third of the patients with GOLD stage III and IV. These data are similar to that of the Devon audit, which found that long-acting bronchodilators were under-prescribed in 15–18% of patients in whom they were indicated. Data from the CAGE study suggested non-prescription of long-acting bronchodilators in 51% of patients with severe COPD, which is considerably greater than suggested in our study [16, 23].

Overall, our data suggest that GPs are not compliant for diagnosing and treating COPD appropriately, according to the GOLD guidelines. The study from which these baseline data were taken aims to investigate whether better compliance to GOLD will result in better outcomes with respect to symptoms, exacerbation rates and overall mortality over a period of 2 years. Whether or not spirometry in primary care is a useful tool remains controversial due to the question of the quality of spirometry. Currently, Siebeling et al. are developing a practical COPD risk-index with a prospective cohort of primary care patients in Switzerland and the Netherlands [28]. This tool should help predict the

clinical course of COPD patients with GOLD stages II to IV and, therefore, enable GPs to select treatment based on a patient's prognosis. Further studies on the best mode of diagnosis and treatment in COPD are required.

Conclusion

The present study assesses the management and treatment of COPD by Swiss GPs. The study demonstrates that respiratory symptoms are often misdiagnosed as COPD and treated inappropriately. Lack of knowledge of disease definitions may underlie these failings, since spirometric testing was obligatory in this cohort. The frequent misdiagnosis in general practice could make data on prevalence of COPD from general practice less reliable. The recommendations for pulmonary rehabilitation were seldom followed. Furthermore, poor adherence to the GOLD guidelines for pharmaceutical treatment of COPD was suggested. This was mostly due to prescription of ICS in mild COPD, which may have been justifiable in some cases due to co-morbid asthma. Bronchodilators were under-prescribed in 44% of patients. Further improvements on adherence to diagnosis and treatment guidelines within primary care are required.

Participating cantons were: Aargau, Appenzell-Ausserrhoden Basel Stadt, Basel Land, Bern, Fribourg, Glarus, Graubünden, Jura, Luzern, Neuchatel, Nidwalden, Obwalden, St. Gallen, Schaffhausen, Schwyz, Solothurn, Thurgau, Uri, Wallis, Zug, Zurich.

We are grateful for the editorial support of Dr. David Macari of PAREXEL MMS Ltd, whose assistance was jointly funded by Boehringer Ingelheim (Switzerland) GmbH and Pfizer (Switzerland) AG.

Correspondence:
Jörg D. Leuppi, MD, PhD
Department of Internal Medicine
University Hospital Basel
Petersgraben 4
CH-4031 Basel
Switzerland
E-Mail: jleuppi@uhbs.ch

References

1 Mannino DM, Brown C, Giovino GA. Obstructive lung disease deaths in the United States from 1979 through 1993. An analysis using multiple-cause mortality data. Am J Respir Crit Care Med. 1997;156:814–8.
2 Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. Lancet. 1997;349:1436–42.
3 www.gold.com. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. Update 2008.
4 Russi EW, Leuenberger P, Brändli O, et al. Management of chronic obstructive pulmonary disease: the Swiss guidelines. Official Guidelines of the Swiss Respiratory Society. Swiss Med Wkly. 2002;132:67–78.
5 Pauwels RA, Buist AS, Calverley PM, Jenkins CR, Hurd SS; GOLD Scientific Committee. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop summary. Am J Respir Crit Care Med. 2001;163:1256–76.
6 Rabe KF, Hurd S, Anzueto A, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2007;176:532–55.
7 Buffels J, Degryse J, Decramer M; DIDASCO Study. Office spirometry significantly improves early detection of COPD in general practice: the DIDASCO Study. Chest. 2004;125:1394–9.
8 Wouters EF. The burden of COPD in The Netherlands: results from the Confronting COPD survey. Respir Med. 2003;97(Suppl C):S51–9.
9 © Bundesamt für Statistik, N. Anzahl und Dichte der berufstätigen Ärzte und Zahnärzte. 2007. http://www.bfs.admin.ch/bfs/portal/de/index/themen/14/03/03/key/01.html.
10 Standardization of Spirometry, 1994 Update. American Thoracic Society. Am J Respir Crit Care Med. 1994;152:1107–36.
11 Perez-Padilla R, Vazquez-Garcia JC, Márquez MN, et al. The long-term stability of portable spirometers used in a multinational study of the prevalence of chronic obstructive pulmonary disease. Respir Care. 2006;51:1167–71.
12 Brändli O, Schindler C, Künzli N, Keller R, Perruchoud AP. Lung function in healthy never smoking adults: reference values and lower limits of normal of a Swiss population. Thorax. 1996;51:277–83.
13 Global Initiative for Chronic Obstructive Lung Disease strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease: an Asia-Pacific perspective. Respirology. 2005;10:9–17.
14 Rutschmann OT, Janssens JP, Vermeulen B, Sarasin FP. Knowledge of guidelines for the management of COPD: a survey of primary care physicians. Respir Med. 2004;98:932–7.
15 Schneider A, Gantner L, Maag I, Borst MM, Wensing M, Szecsenyi J. Are ICD-10 codes appropriate for performance assessment in asthma and COPD in general practice? Results of a cross sectional observational study. BMC Health Serv Res. 2005;5:11.
16 Jones RC, Dickson-Spillmann M, Mather MJ, Marks D, Shackell BS. Accuracy of diagnostic registers and management of chronic obstructive pulmonary disease: the Devon primary care audit. Respir Res. 2008;9:62.
17 Yawn BP. Differential assessment and management of asthma vs chronic obstructive pulmonary disease. Medscape J Med. 2009;11:20.
18 Schermer TR, Jacobs JE, Chavannes NH, Hartman J, Folgering HT, Bottema BJ, van Weel C. Validity of spirometric testing in a general practice population of patients with chronic obstructive pulmonary disease (COPD). Thorax. 2003;58:861–6.
19 Leuppi JD, Miedinger D, Chhajed PN, Buess C, Schafroth S, Bucher HC, Tamm M. Quality of spirometry in primary care for case finding of airway obstruction in smokers. Respiration. 2009; [E-pub ahead of print].
20 Evans RA, Singh SJ, Collier R, Williams JE, Morgan MD. Pulmonary rehabilitation is successful for COPD irrespective of MRC dyspnoea grade. Respir Med. 2009;103:1070–5 [E-pub 13 Feb 2009].
21 Tashkin DP, Celli B, Senn S, et al. A 4-year trial of tiotropium in chronic obstructive pulmonary disease. N Engl J Med. 2008;359:1543–54.

22 Tashkin DP, Donohue JF, Mahler DA, et al. Effects of arformoterol twice daily, tiotropium once daily, and their combination in patients with COPD. Respir Med. 2009;103:516–24.
23 Bourbeau J, Sebaldt RJ, Day A, et al. Practice patterns in the management of chronic obstructive pulmonary disease in primary practice: the CAGE study. Can Respir J. 2008;15:13-9.
24 Gartlehner G, Hansen RA, Carson SS, Lohr KN, et al. Efficacy and safety of inhaled corticosteroids in patients with COPD: a systematic review and meta-analysis of health outcomes. Ann Fam Med. 2006;4:253–62.
25 Calverley PM, Anderson JA, et al. Salmeterol and fluticasone propionate and survival in chronic obstructive pulmonary disease. N Engl J Med. 2007;356:775–89.
26 Crim, C., P. M. Calverley, et al. "Pneumonia risk in COPD patients receiving inhaled corticosteroids alone or in combination: TORCH study results." Eur Respir J. 2009;34(3):641–7.
27 Vondracek SF, Hemstreet BA. Is there an optimal corticosteroid regimen for the management of an acute exacerbation of chronic obstructive pulmonary disease? Pharmacotherapy. 2006;26:522–32.
28 Siebeling L, Ter Riet G, van der Wal WM, et al. ICE COLD ERIC – International Collaborative Effort on Chronic Obstructive Lung Disease: Exacerbation Risk Index Cohorts – study protocol for an international COPD cohort study. BMC Pulm Med. 2009;9:15.
29 Wedzicha JA, Bestall JC, Garrod R, Garnham R, Paul EA, Jones PW. Randomized controlled trial of pulmonary rehabilitation in severe chronic obstructive pulmonary disease patients, stratified with the MRC dyspnoea scale. Eur Respir J. 1998;12:363–9.

Table 1
Requested data.

Demographic data	**Surgery ID • Patient ID • Date of visit • Patient initials • Age-group • Gender • Height • Ethnic group • Agricultural worker • Current smokers**
Symptoms	Sputum • Cough • MRC dyspnoea score 1–5* [29]
Exacerbations	Increased sputum production • Discoloured sputum • Shortness of breath
Treatment of exacerbation in preceding 3 months	Antibiotics • Systemic steroids
Spirometry	FVC (L) • FVC (% of reference value) • FEV_1 (L) • FEV_1 (% of reference value) • FEV_1/FVC (% – Tiffeneau-Index)
Treatment	
Non-pharmacological treatment	Physical exercise (minimum twice a week) • Pulmonary rehabilitation
Pharmacological treatment	Short-acting β_2-sympathomimetics • Short-acting anticholinergics • Long-acting β_2-sympathomimetics • Long-acting anticholinergics • Inhaled steroids Combination: Long-acting β_2-sympathomimetics and inhaled steroids • Methylxanthines • N-acetyl-cysteine • Systemic long-term steroids
Vaccinations	Influenza • Pneumococcus
Comorbidities	Asthma • Coronary heart disease • Chronic heart failure • Hypertension • Peripheral arterial occlusive disease • Cerebral vascular insult • Diabetes • Cancer • Lung cancer
Working ability	Not restricted • Retired • Reduced (if reduced, by what percentage? Assessed by patient or GP?)
Death	If patient died, was it related to COPD?

Abbreviations: FEV_1: forced expiratory volume in 1 second; FVC: forced vital capacity; GP: general practitioner; COPD: chronic obstructive pulmonary disease.

* The MRC defines breathlessness as follows: Grade 1: Not troubled by breathlessness except on strenuous exercise. Grade 2: Short of breath when walking up a slight hill. Grade 3: Walks slower than contemporaries on level ground because of breathlessness. Grade 4: Stop for breath after 100 yards or after a few minutes on level ground. Grade 5: Too breathless to leave the house or breathless when dressing [28].

Table 2

Demographic baseline spirometry and symptom data.

	COPD Severity				
	No COPD	**GOLD I**	**GOLD II**	**GOLD III**	**GOLD IV**
Subjects, n (%)	269 (44)	29 (5)	155 (25)	130 (21)	32 (5)
Age (y ± SD)	67 ± 12.8	64 ± 10.4	68 ± 12.2	70 ± 10.6	70 ± 9.1
Gender, n (%)					
Male	165 (62)	17 (59)	94 (61)	96 (74)	24 (75)
Female	103 (38)	12 (41)	60 (39)	34 (26)	8 (25)
Height (m ± SD)	1.68 ± 0.09	1.68 ± 0.10	1.68 ± 0.08	1.69 ± 0.08	1.67 ± 0.07
Current smokers					
n (%)	145 (54)	16 (55)	89 (57)	71 (55)	18 (56)
Pack (y ± SD)	38 ± 11.4	39 ± 6.9	37 ± 13.6	40 ± 12.1	39 ± 11.5
Spriometry ± SD					
FEV_1 (L)	1.97 ± 0.79	2.31 ± 0.68	1.69 ± 0.44	1.08 ± 0.31	0.67 ± 0.19
FEV_1 (% pred)	70.62 ± 19.91	90.21 ± 10.45	62.75 ± 8.66	38.77 ± 5.80	23.84 ± 3.73
FVC (L)	2.77 ± 1.00	3.56 ± 1.00	2.87 ± 0.78	2.40 ± 0.78	1.86 ± 0.55
FVC (% pred)	81.58 ± 21.58	102.93 ± 24.74	86.95 ± 16.75	70.69 ± 18.13	56.19 ± 15.19
FEV_1/FVC (%)	83.79 ± 12.00	61.69 ± 6.91	58.56 ± 8.67	50.08 ± 10.92	40.72 ± 11.79
Respiratory symptoms, n (%)					
Sputum	128 (48)	15 (52)	87 (56)	84 (65)	24 (75)
Cough	175 (65)	20 (69)	104 (67)	97 (75)	26 (81)
Dyspnoea MRC 1	50 (34)	6 (60)	26 (28)	14 (13)	1 (4)
Dyspnoea MRC 2	65 (45)	4 (40)	50 (54)	44 (42)	10 (38)
Dyspnoea MRC 3	24 (17)	0	15 (16)	41 (39)	12 (46)
Dyspnoea MRC 4	6 (4)	0	1 (1)	6 (6)	3 (12)

Abbreviations: COPD: chronic obstructive pulmonary disease; GOLD: Global Initiative for Chronic Obstructive Lung Diseases; SD: standard deviation; FEV_1: forced expiratory volume in 1 second; FVC: forced vital capacity; MRC: Medical Research Council.

Figures are mean ± standard deviation or number (% of group or population, as appropriate)

Table 3

Number of patients with indicators of past exacerbations.

	No COPD	GOLD I	GOLD II	GOLD III	GOLD IV
Treated exacerbations,*n (%)	53 (20)	3 (10)	38 (25)	35 (27)	10 (31)
Change in symptom, n (%)					
Increase in sputum (n)	67 (25)	5 (17)	47 (30)	44 (34)	11 (34)
Discoloured sputum (n)	30 (11)	2 (7)	23 (15)	23 (18)	4 (13)
Increase in dyspnoea (n)	49 (18)	3 (10)	31 (20)	45 (35)	12 (38)
If treated (n, % of treated)					
Antibiotics	30 (57)	1 (33)	21 (55)	25 (71)	3 (30)
Steroids	24 (45)	1 (33)	17 (45)	23 (66)	8 (80)

Abbreviations: COPD: chronic obstructive pulmonary disease; GOLD: Global Initiative for Chronic Obstructive Lung Diseases.

* Exacerbation and decision to treat as an exacerbation determined by GP (definition of historical exacerbations unknown)

Table 4
Number of patients receiving treatment.

	No COPD	GOLD I	GOLD II	GOLD III	GOLD IV
Non-pharmacological intervention					
Sport exercise (≥twice/wk)	71 (28)	9 (33)	41(28)	18 (14)	7 (23)
Pulmonary rehabilitation	3 (1)	0	8 (5)	11 (9)	6 (19)
Pharmacological treatment					
SABA	76 (29)	10 (34)	55 (35)	46 (35)	15 (47)
Short-acting anticholinergic	22 (8)	1 (3)	22 (14)	25 (19)	7 (22)
LABA	55 (21)	9 (31)	37 (24)	38 (29)	12 (38)
Long-acting anticholinergic	63 (24)	10 (34)	54 (35)	64 (50)	17 (53)
ICS	43 (16)	8 (28)	32 (21)	33 (26)	12 (38)
Combination therapy*	102 (38)	11 (38)	88 (57)	79 (61)	23 (72)
Methylxanthine	6 (2)	0 (0)	9 (6)	12 (9)	3 (9)
N-acetyl-cysteine	53 (20)	3 (10)	9 (6)	12 (9)	3 (9)
Systemic steroid	15 (6)	(0)	7 (5)	11 (8)	2 (6)
Vaccinations					
Influenza	143 (55)	19 (66)	100 (65)	85 (67)	24 (77)
Pneumococcal	67 (26)	9 (32)	61 (41)	50 (40)	15 (48)

Abbreviations: COPD: chronic obstructive pulmonary disease; GOLD: Global Initiative for Chronic Obstructive Lung Diseases; SABA: short-acting β_2-agonist; LABA: long-acting β_2-agonist; ICS: inhaled corticosteroid.

Figures are number (% of group)

* ICS and long-acting bronchodilator

Table 5

Assessment of conformity to GOLD recommended use of long-acting bronchodilators and ICS.

	LABA/LAAC	ICS/ICS+LABA	Conformity	Non-conformity
No COPD	104 (39)	126 (47)		
GOLD I	15 (52)	14 (48)	9 (31)	20 (69)
GOLD II	74 (48)	98 (63)	28 (18)	127 (82)
GOLD III	83 (65)	93 (72)	83 (65)	45 (35)
GOLD IV	21 (66)	27 (84)	21 (66)	11 (34)

Abbreviations: LABA: long-acting β-agonist; LAAC: long-acting anticholinergic; ICS: inhaled corticosteroid; COPD: chronic obstructive pulmonary disease; GOLD: Global Initiative for Chronic Obstructive Lung Diseases.

Figures are number (% of group)

Table 6

Common diagnosed condition other than COPD.

	No COPD	**GOLD I**	**GOLD II**	GOLD III	**GOLD IV**
Asthma	49 (20)	8 (32)	46 (32)	28 (25)	5 (18)
Coronary heart disease	57 (23)	2 (8)	31 (22)	29 (25)	5 (18)
Chronic heart failure	36 (15)	3 (12)	30 (21)	20 (18)	4 (14)
Hypertension	157 (64)	10 (40)	70 (49)	61 (54)	14 (50)
PAOD	27 (11)	0	23 (16)	21 (18)	2 (7)
Cerebrovascular insult	6 (2)	0	10 (7)	2 (2)	0
Diabetes	34 (14)	0	15 (10)	12 (11)	1 (4)
Malignancy	8 (3)	2 (8)	8 (6)	7 (6)	0
Lung cancer	6 (2)	1 (4)	4 (3)	3 (3)	0

Abbreviations: COPD: chronic obstructive pulmonary disease; GOLD: Global Initiative for Chronic Obstructive Lung Diseases; PAOD: peripheral arterial occlusive disease.

Figures are number (% of group)

Figure 1

Non-conformity to GOLD guidelines.

Abbreviations: GOLD: Global Initiative for Chronic Obstructive Lung Diseases; ICS: inhaled corticosteroid. * Considering ICS prescription for co-morbid asthma