

Reorganisation of acute referral to an emergency department resulted in fewer admissions for chronic obstructive pulmonary disease but in higher rates of non-invasive ventilation

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ABSTRACT

INTRODUCTION: We performed an audit on all admissions with chronic obstructive pulmonary disease (COPD) in exacerbation to the Department of Emergency Medicine, Odense University Hospital (DEM) in the second half of 2012 to evaluate if an organisational change had altered visitation, treatment, initiation of non-invasive ventilation (NIV) and monitoring. We chose not to include the entire year to avoid data influenced by organisational start-up difficulties. The hypothesis was that NIV was initiated according to guidelines to the same extent as prior to the implementation of DEM.

METHODS: Data from medical records were retrieved from two COPD cohorts: 1) all patients admitted to DEM between 1 July and 31 December 2012 and 2) all patients admitted to the Medical Emergency Ward, Odense University Hospital (MEW) in 2010.

RESULTS: There were 300 eligible admissions comprising 236 unique patients in DEM in the second half of 2012 compared with 393 admissions in MEW in the second half of 2010, a 24% reduction. The groups were similar in gender and age, but patients admitted in 2012 had higher registered co-morbidity rates, but no significant difference in lung function values. NIV was indicated in 91 admissions (30%) and initiated in 58 admissions (19.3%) in 2012. By comparison NIV was indicated in 193 admissions (24%) and initiated in 151 admissions (18.8%) in 2010.

CONCLUSION: There was a statistically significant increase in NIV indication without initiation of treatment in 2012 (28 admissions; 9.3%) compared with 2010 (36 admissions; 4.5%), but no referrals to the intensive care unit or deaths were registered during the hospitalisation in either of the groups, but one patient died within 30 days after admission from the DEM.

FUNDING: This project was funded by an Odense University Hospital research grant.

TRIAL REGISTRATION: The study was approved by the Danish Data Protection Agency (record no. 2011-41-6459).

mending the establishment of emergency departments [1]. In January 2012, Odense University Hospital established a new Department of Emergency Medicine (DEM) comprising an emergency and trauma centre and a bed unit/emergency ward (EW) with the aims of having highly qualified staff (specialists) present as well as access to accelerated diagnostic testing requiring continuous laboratory and radiology support around the clock.

Chronic obstructive pulmonary disease (COPD) is considered a global health issue [2]. In Denmark, an estimated 400,000 subjects have COPD [3], and COPD is responsible for more than 20,000 acute hospital admissions annually [4]. Non-invasive ventilation (NIV) is recommended as an add-on modality in the guidelines for patients acutely admitted with COPD exacerbation and hypercapnic respiratory failure [5]. This recommendation is based on randomised controlled trials showing decreased mortality rates in highly selected patients [6] and subsequent expert interpretation [7]. We have recently performed an internal audit on the use of NIV in patients admitted to the Medical Emergency Ward (MEW) in 2010. We found that NIV was initiated in 18.8% of the COPD admissions [8]. In 5.2%, the NIV criteria were met without initiation of treatment, and in 82.3% of the patients receiving NIV, a COPD diagnosis was present and the criteria for NIV treatment were met [8].

We performed an audit on all admissions with COPD in exacerbation to the DEM in the second half of 2012 to evaluate if the organisational change altered visitation, treatment, initiation of NIV and monitoring. We chose not to include the entire year to avoid data influenced by organisational start-up difficulties. The hypothesis was that NIV was initiated according to guidelines to at least the same extent as prior to the implementation of the DEM.

METHODS

All patients admitted to the DEM between 1 July and 31 December 2012 at Odense University Hospital with a discharge diagnosis of COPD were retrieved from the Patient Admission System using the International Classi-

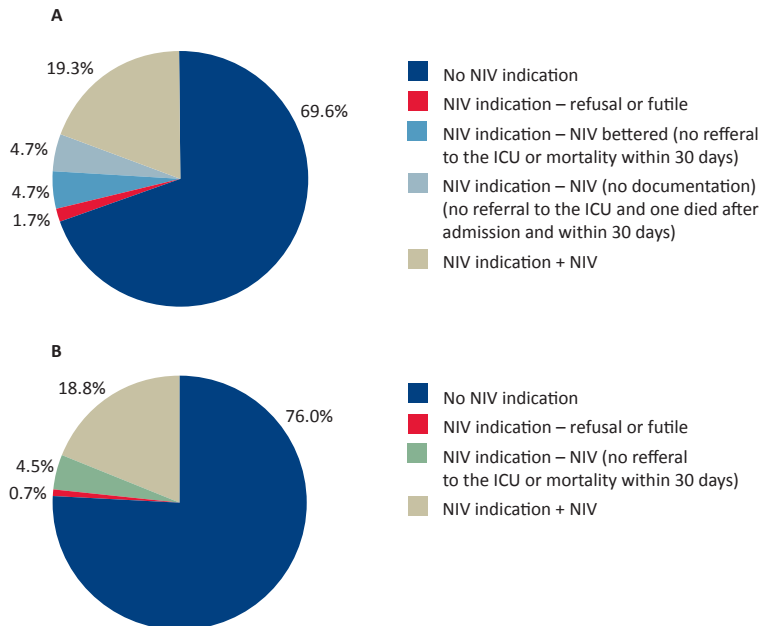
ORIGINAL ARTICLE

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Dan Med J
2014;61(11):A4958

 FIGURE 1

Illustration of admissions with chronic obstructive pulmonary disease in exacerbation and indication for non-invasive ventilation treatment in the second half of 2012 (A) and in 2010 with the former organisation at the same hospital (B).



ICU = Intensive Care Unit; NIV = non-invasive ventilation.

fication of Diseases (ICD)-10 codes: COPD (DJ44) as primary diagnosis, or respiratory failure (DJ96) or pneumonia (DJ13-DJ18) as primary diagnosis in combination with COPD (DJ44) as a secondary diagnosis.

Data were retrospectively retrieved from electronic medical records. The baseline data registered were age, gender and from spirometry: forced expiratory volume in the first second (FEV1), FEV1 in % of predicted value (FEV1%) and the FEV1/forced vital capacity (FVC) ratio. Diagnosis of COPD and use of long-term oxygen therapy were recorded, and co-morbidities were registered when reported in the electronic medical records or if medical treatment was provided. Listed co-morbidities included history of asthma, ischaemic heart disease, hypertension, heart failure, atherosclerosis, stroke, malignancy, diabetes, osteoporosis, liver disease, rheumatoid arthritis and chronic kidney failure. A “not-to-intubate” order was registered when listed. Patients were monitored with repeated arterial blood gas analyses and data were captured when reported in the records.

Organisation of the Department of Emergency Medicine

Patients referred either from their general practitioner or admitted as acute patients having called for an ambulance and been brought acutely to the DEM were initial-

ly evaluated by using triage in the Acute Trauma Centre. Patients suspected of having an acute exacerbation of COPD based on clinical presentation, prior records, arterial blood gas analyses and chest X-ray were assessed after initial standard treatment, administration of systemic steroids and, if needed, antibiotics. Patients were initially observed with an outpatient status until a decision on admission was made, at the latest after four hours. If intensive observation and care were required, the patient was referred to the Intensive Care Unit (ICU) earlier. Patients who presented with a mild exacerbation not requiring admission were not included in this study. Spirometry results obtained either prior to the admission, during admission (in patients without a prior COPD diagnosis) or at follow-up were recorded. Patients either continued standard medical treatment or were provided additional ventilatory support with NIV in the EW or they were referred to the respiratory ward (RW) with continuous NIV support. The criteria for NIV in COPD were: 1) arterial blood pH < 7.35; 2) PaCO₂ > 6.0 kPa and PaO₂ < 7.0 kPa, presenting with mono-organic symptoms of dyspnoea and a respiratory rate > 25. When possible, patients initiated on NIV were referred to the RW the next day. When NIV was initiated, standard NIV protocols were followed (an initial inspiratory positive airway pressure of 10 cm H₂O and an expiratory positive airway pressure of 4 cm H₂O), with an oxygen supplement aiming for a peripheral oxygen saturation measure of 90-92%. Changes in NIV pressure settings were made depending on the clinical situation and subsequent arterial blood gases in accordance with a National Danish NIV Guideline [4].

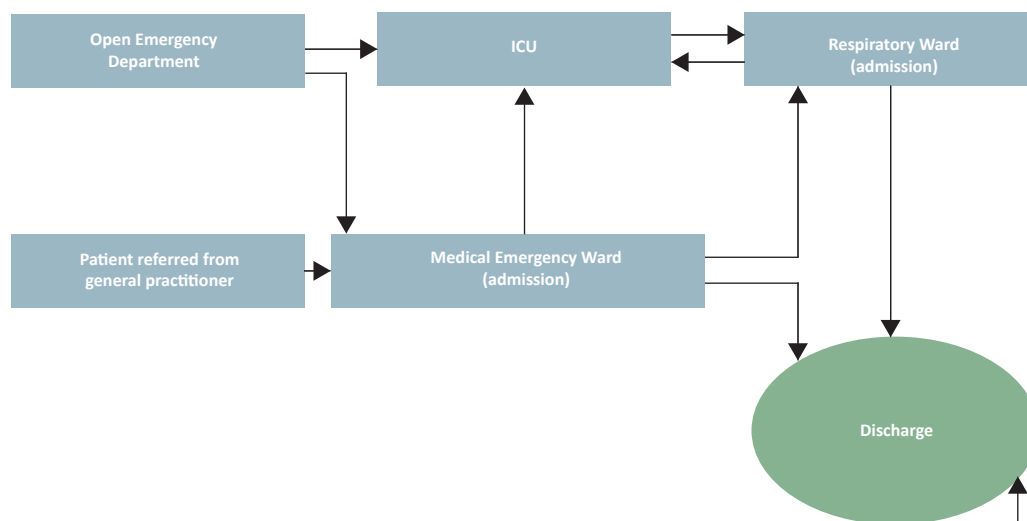
There were at least five medical doctors (in internal medicine) on duty in the DEM at all times with at least two consultants or senior registrars present at the department around the clock. A specialist in respiratory medicine was on call and available for consultation at all times.

Audit results were compared with data from the previous audit in 2010 including all admissions from 1 January to 31 December to the MEW with the same discharge diagnoses at the same hospital (Figure 1). A primary difference in organisation in 2010 compared with 2012 was that *all* patients were admitted to the MEW in 2010, unlike in the new organisation DEM where patients are initially considered outpatients, including patients referred from the general practitioner, until assessment (Figure 2). In addition, the former open Emergency Department had a single junior medical doctor in charge with the possibility of supervision from a consultant or senior registrar on call when required.

Trial registration: The study was approved by the Danish Data Protection Agency (record no. 2011-41-6459).

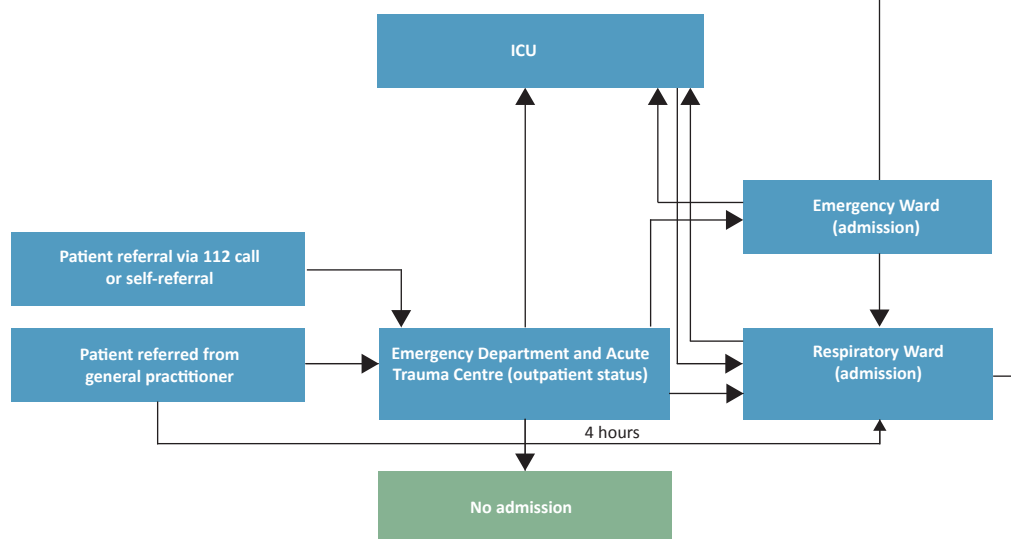
 FIGURE 2

Before 2012



Organisation and patient flow at the Medical Emergency Department prior to 2012 at Odense University Hospital and the new Emergency Department. The main difference in the new organisation is the status of patients as outpatients. Blood sample analyses and chest X-rays are available within four hours and stable patients without need of further observation (or admission) are sent home.

After 2012



ICU = Intensive Care Unit.

RESULTS

Initially, 353 admissions were registered with the diagnosis of COPD in the DEM during the second half of 2012, but 53 admissions were excluded either because the patient did not have verified COPD or did not present with an exacerbation. Thus, there were 300 admissions in the DEM in the second half of 2012 of patients presenting with an exacerbation of COPD compared with 393 admissions in MEW in the second half of 2010, a 24% reduction.

The demographic data of the 521 unique patients with 804 admissions in 2010 are presented in **Table 1**

and compared with the 236 unique patients with 300 admissions in the second half of 2012. In short, the patient cohorts were similar in gender and age range, but patients admitted in 2012 had higher registered co-morbidity rates (prior history of asthma, heart disease, kidney disease, hypertension and malignancies). However, there was no significant difference in registered FEV1 in 2012 compared with 2010 ($p = 0.3$).

Based on arterial blood gas analyses, NIV was indicated in 91 admissions (30.4%) to the DEM in 2012 compared with 193 admissions (24.0%) to the MEW two years earlier. In 2012, NIV treatment was initiated in 58

TABLE 1

Demography of verified COPD patients and of all admissions with a COPD exacerbation to the new Emergency Department in the second half of 2012 compared with the previous Medical Emergency Ward in Denmark in 2010 with ICD-10 codes COPD (DJ44) as primary diagnosis, or respiratory failure (DJ96) or pneumonia (DJ13-DJ18) as primary diagnosis in combination with COPD (DJ44) as a secondary diagnosis.

	2nd half of 2012		2010	
	all patients with verified COPD	all admissions of COPD exacerbation	all patients with verified COPD	all admissions of COPD exacerbation
Patients, n (male/female)	236 (90/146)	300 (121/179)	521 (205/316)	804 (304/500)
Age, yrs, average (range)	71.1 (38-92)	71.0 (38-92)	72.6 (38-94)	71.7 (38-94)
Documented spirometry, n (%)	181 (76.7)	241 (80.3)	383 (73.5)	635 (79.0)
FEV1%, average (range)	35.3 (11-115)	34.3 (11-115)	37.8 (12-101)	35.4 (12-101)
FEV1% ≤ 50%, n (%)	152 (84.0)	209 (86.7)	305 (79.6)	533 (83.4)
Long-term oxygen therapy, n (%)	38 (16.1)	56 (18.7)	59 (11.3)	150 (18.6)
<i>Co-morbidities, n (%)</i>				
History of asthma	26 (11.0)	35 (11.7)	39 (7.5)	56 (7.0)
Osteoporosis	90 (38.1)	125 (41.7)	141 (27.1)*	248 (30.8)
Heart disease	91 (38.6)	118 (39.3)	169 (32.4)	278 (34.6)
Chronic kidney Disease	17 (7.2)	20 (6.7)	24 (4.6)	35 (4.4)
Diabetes mellitus	35 (14.8)	38 (12.7)	79 (15.2)	122 (15.2)
Cerebral disease	41 (17.4)	58 (19.3)	88 (16.9)	132 (16.4)
Malignancy	49 (20.8)	56 (18.7)	62 (11.9)*	84 (10.4)
Rheumatoid arthritis	23 (9.7)	26 (8.7)	23 (4.4)	37 (4.6)
Hypertension	108 (45.8)	133 (44.3)	131 (25.1)*	219 (27.2)
Liver disease	12 (5.1)	13 (4.3)	23 (4.4)	56 (7.0)

COPD = chronic obstructive pulmonary disease; FEV1 = forced expiratory volume in 1. sec.; FEV1% = FEV1 in % of predicted value.
*) p < 0.05

TABLE 2

Comparison of non-invasive ventilation treatment in Department of Emergency Medicine (2nd half of 2012) compared with the previous organisation of the Medical Emergency Ward (2010) in admissions with chronic obstructive pulmonary disease in exacerbation at Odense University Hospital. The values are n (% [95% CI]).

	Department of Emergency Medicine (300 admissions)	Medical Emergency Ward (804 admissions)
No NIV indication,	209 (70 [64-75])	611 (76 [73-79])
NIV indication – refusal or futile	5 (1.7 [0.5-3.8])	6 (0.7 [0.3-1.6])
NIV indication and no NIV bettered ^a or no documentation ^b	28 (9.4 [6.3-13.2])	36 ^c (4.5 [3.2-6.1])*
NIV indication + NIV	58 (19.3 [15-24])	151 (18.8 [16-22])

CI = confidence interval; ICU = Intensive Care Unit; NIV = non-invasive ventilation.

*) p < 0.05.

a) 4.7% no referrals to the ICU or mortality within 30 days in 2012.

b) 4.7% no referrals to the ICU and one died after admission and within 30 days in 2012.

c) 4.5% no referrals to the ICU or mortality within 30 days in 2010.

admissions (19.3%), and in five cases NIV was not initiated due to refusal or because it was assessed that it would be futile (1.7%); all 63 patients therefore seem to have been correctly evaluated. In 28 admissions (9.3%), a NIV indication was present but treatment was not initiated. In the previous audit from 2010, NIV treatment was not initiated in 36 admissions (4.5%); and in six admissions treatment was not initiated due to refusal or because it was assessed that it would be futile (0.7%) (Table 2).

Outcome in terms of mortality rate within 30 days

in COPD patients who had initiated NIV treatment in the DEM in 2012 was 27% (95% confidence interval (CI): 16-41%); and in 2010 the mortality rate in NIV-treated patients was 21% (95% CI: 13-30%). In admissions where a NIV indication was present but treatment was not initiated, no referrals to the ICU or deaths were registered during the hospitalisation in either of the cohorts, but one patient died within 30 days after admission to the DEM.

DISCUSSION

Our results show that fewer COPD patients were admitted through the DEM in the second half of 2012 than in the second half of 2010, suggesting that observing patients in an outpatient setting prevented admissions. This was also supported by the fact that the rate of admissions where NIV was indicated increased from 24.0% in 2010 to 30.4% in 2012 assessed by arterial blood gas results. The patients in the two cohorts were comparable with regard to age range and gender, but COPD admissions to the DEM in 2012 more often had co-morbidities than was the case for admissions to the MEW in 2010. There was no change in the population size of the uptake area served by the hospital in the two-time periods.

We also found that the proportion of COPD patients fulfilling the NIV criteria, but not receiving treatment was significantly increased from 4.5% in 2010 to 9.4% in the second half of 2012 in the DEM. Two divergent explanations of the increase in "missed" initiation of NIV

seem likely: 1) the DEM's organisation has focused on logistics, patient flow and methods standardisation, primarily in the outpatient setting, and it therefore cannot be precluded that clinical evaluation of admitted patients had a lower priority than in the previous organisational set-up; or 2) in 4.7% of the admissions, it was documented that the patient bettered, and in the remaining 4.7% no documentation was noted, but none of the patients required referral to the ICU or died during the admission. This suggests that the more experienced clinicians present in the new organisation made valid decisions although documentation was lacking. The introduction and training of new staff (nurses, doctors) was not altered in these two settings and has been continuously performed by the same experienced medical staff.

A significant limitation in the evaluation of the organisations is the lack of review of the data on outpatients treated with symptoms of mild exacerbation of COPD without admissions in 2012 and patients evaluated in the Emergency Department in 2010 without requirement of admission. Future surveillance of outpatient contacts is needed to confirm the claim that admissions are prevented.

The mortality outcome of COPD patients receiving NIV in 2012 was not significantly different to that observed for 2010. The overall 30-day mortality rate for all COPD admissions at Odense University Hospital has only shown minor fluctuations since a nationwide COPD quality improvement programme was launched, with 30-day mortality rates of 10-12%; in 2012 and 2010 the 30-day mortality rates were both 10% [9].

In conclusion, we found a 24% reduction in admissions due to COPD exacerbations after a re-organisation of acute care with more focus on improved initial evaluation. The rate of NIV indication judged by arterial blood gas criteria increased from 24.0% in 2010 to 30.4% in 2012. Lack of NIV treatment increased and more data are needed to evaluate whether this is a beneficial result of closer monitoring or a lack of needed management due to an increased focus on logistics.

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ACCEPTED: 18 September 2014

CONFLICTS OF INTEREST: Disclosure forms provided by the authors are available with the full text of this article at www.danmedj.dk.

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