Management of acute exacerbation of COPD in rural Alberta emergency departments

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This article has been peer reviewed.

Introduction: Acute exacerbation of chronic obstructive pulmonary disease (COPD) is a common presentation to emergency departments (EDs); however, limited information exists about the management of this condition in nonurban locations. We sought to examine the diagnostic and treatment approaches for acute exacerbation of COPD in 3 rural EDs, and to determine levels of adherence to recommendations from the Canadian Thoracic Society (CTS) clinical practice guideline.
Methods: We conducted retrospective chart reviews to explore the management of patients who presented to 3 rural EDs for acute exacerbation of COPD in 2011. Data are reported as medians and interquartile ranges (IQRs) and proportions.
Results: Over a 1-year period, 192 patients presented a total of 266 times with acute exacerbation of COPD. The median age was 68 (IQR 58–77) years, and 54.9% of the patients were women. Diagnostic testing included chest radiography in 65.0%, blood tests in 45.1%, electrocardiography in 33.5%, and arterial blood gas tests in 6.4%; only a few patients received pulmonary function testing. In the ED, 58.7% of patients were given a short-acting β-agonist, 48.9% a short-acting anticholinergic, 27.4% corticosteroids and 19.9% antibiotics. Overall, short-acting β-agonists (63.5%), anticholinergic agents (53.4%), corticosteroids (54.5%) and antibiotics (71.1%) were prescribed more commonly to discharged patients (*p* < 0.05 for all).
Conclusion: We found a low to moderate level of adherence to the CTS clinical practice guideline for the management of acute exacerbation of COPD in these rural EDs. Moreover, we identified gaps in both diagnostic and therapeutic care.

Introduction : Les cas d'exacerbation aiguë de la maladie pulmonaire obstructive chronique (MPOC) sont fréquents à l'urgence. Pourtant, il existe peu d'information sur la prise en charge de cette maladie en dehors des centres urbains. Nous voulions examiner les méthodes de diagnostic et de traitement de la MPOC utilisées dans 3 services d'urgence en milieu rural et savoir dans quelle mesure les lignes directrices de la Société canadienne de thoracologie (SCT) sont respectées.
Méthodes : Nous avons effectué une analyse rétrospective des dossiers pour examiner la prise en charge des patients s'étant présentés dans 3 services d'urgence en milieu rural en raison d'une exacerbation aiguë de la MPOC en 2011. Les données sont présentées en valeurs médianes et en intervalles interquartiles (II) et proportions.
Résultats : Sur une période d'un an, 192 patients se sont présentés au total 266 fois pour exacerbation aiguë de la MPOC. L'âge médian était de 68 ans (II 58–77); 54,9% des patients étaient des femmes. Les tests diagnostiques comprenaient des radiographies pulmonaires dans 65% des cas, des analyses sanguines dans 45,1% des cas, un électrocardiogramme dans 33,5% des cas et une analyse des gaz artériels dans 6,4% des cas; seuls quelques patients ont subi un test de la fonction pulmonaire. À l'urgence, 58,7% des patients ont reçu un β-2 agoniste à action rapide, 48,9%, un anticholinergique à action rapide, 27,4%, un corticostéroïde et 19,9%, un antibiotique. Dans l'ensemble, les β-2 agonistes à action rapide (63,5%), les anticholinergiques (53,4%), les corticostéroïdes (54,5%) et les antibiotiques (71,1%) étaient les agents prescrits le plus souvent aux patients recevant leur congé de l'hôpital (*p* < 0,05 pour tous).

Conclusion : Nous avons observé que le degré d'observance des lignes directrices de la SCT variait de faible à moyen dans les services d'urgence en milieu rural. De plus, nous avons observé des lacunes autant en ce qui concerne les tests diagnostiques que les soins thérapeutiques.

Chronic obstructive pulmonary disease (COPD) is one of the most common respiratory conditions in the developed world. Acute exacerbations of COPD can lead to use of health care, emergency department (ED) visits, hospital admissions and death.[1] Acute exacerbation of COPD is defined by the Canadian Thoracic Society (CTS) as "a sustained worsening of dyspnea, cough or sputum production leading to an increase in the use of maintenance medications and/or supplementation with additional medications."[2] In Alberta, patients with acute exacerbation of COPD who are 55 years of age or older present to one of more than 100 EDs in the province about every 37 minutes.[3]

To assist emergency and family physicians with effective management of this condition, several clinical practice guidelines have been developed and disseminated. The CTS produced the most commonly available and referenced guideline in Canada.[2] The development of this guideline involved a multidisciplinary team, clear search strategies, a risk-of-bias assessment, grading of evidence and iterative feedback with the goal of providing accurate, timely and relevant information for clinicians dealing with acute exacerbation of COPD. Although physicians consider clinical practice guidelines to be useful tools, data are lacking on the impact of clinical practice guidelines on patient outcomes in rural settings.

In this study, we sought to explore the diagnosis and management of acute exacerbation of COPD in 3 rural EDs, and to assess adherence to recommendations from the CTS clinical practice guideline.

METHODS

Study settings

We conducted this study in 3 rural teaching hospitals in the towns of Edson (2011 population: 8365), Hinton (2011 population: 9825) and Whitecourt (2011 population: 9202) in Alberta. Throughout the study, site data are anonymous. These communities are medically staffed by family physicians and other health care professionals, and periodically receive visiting medical specialists. All 3 communities maintain acute care hospitals, which are managed by Alberta Health Services.

Staff at these health care units accept medical students and family medicine residents for elective and selective training periods. The local family physicians provide 24-hour coverage of the ED and are occasionally relieved by short-term locum physicians.

Case selection

We conducted retrospective chart reviews to explore the diagnosis and ED management of consecutive patients who presented for acute exacerbation of COPD during the 2011 calendar year (Jan. 1–Dec. 31). We then described the management and compared it to diagnostic and treatment recommendations from the CTS guideline (Table 1).

Charts coded for COPD (J41–44) based on the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) were selected for review. Charts were not excluded based on patient age, sex, smoking history or severity of disease. Each presentation during the study period was documented as a separate case. Repeat presentations within 7 days were not included, because these events were felt to be the continuation of the same event.

Data collection

Research assistants collected data from the full-paper charts directly onto standardized collection forms at the site of the hospital visit. The completed data collection forms were collected centrally at the Department of Emergency Medicine at the University of Alberta, for entry by experienced research data personnel into a Microsoft Access database. The data were checked for inconsistencies, which were resolved by checking the data collection forms.

The data collected included the following: 1) patient demographics; 2) patient flow times (e.g., time of triage, bed assignment, doctor assessment, either discharge from ED or inpatient admission times, and time of discharge after inpatient admission, if applicable); 3) vital signs (e.g., respiration rate, pulse rate, temperature, oxygen saturation by oximetry); 4) diagnostic tests (e.g., peak expiratory flow [PEF] or forced expiratory volume in 1 second

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[FEV$_1$], chest radiography, electrocardiography [ECG], and blood tests, including complete blood count, electrolytes, cardiac enzymes and blood gas panel); 5) mode of arrival and interventions/treatments by emergency medical services (EMS) and/or in the ED; and 6) patient disposition and repeat visit to the ED within 14 days of discharge from the ED or, where the patient was admitted to hospital, after discharge from hospital admission. We also checked ED records for spirometry taken before and after administration of a bronchodilator on the day of the visit.

Statistical analysis

Descriptive data are presented as proportions for categorical variables and means with standard deviations (SDs), or medians with interquartile ranges (IQRs), as appropriate for continuous variables. Statistical analysis was done using the Student t test, with significance indicated by $p < 0.05$. Data were analyzed using Stata 11 software.

Sample size

Given the limited funding for this study, there was a need to balance the work for the research team with the ideal sample size. We endeavoured to examine all charts for 1 year and anticipated about 100 charts at each site. This sample provided reasonable estimates around midrange (e.g., at 50%, the 95% confidence interval (CI) was ± 9%) as well as low (e.g., at 10%, the 95% CI for 100 observations was 6%) incidence observations. Assuming homogeneity, the goal was to obtain 300 total charts to provide narrower 95% CIs for midrange (± 6%) and low (± 3%) incidence observations. To obtain 95% CIs approximating ± 1%, more than 1000 charts for each location would be required, which was untenable.

The study was approved by the University of Alberta's Health Research Ethics Board. Patient charts were accessed and data were collected in accordance with the guidelines set out by the board. Patients were not contacted during this study.

RESULTS

Patients and transport

A total of 266 cases were reviewed from 192 unique patients who presented 1 or more times to one of the 3 EDs for treatment of acute exacerbation of COPD. The sex ratio of patients slightly favoured women, and the median age was 68 (IQR 58–77) years. Significantly more female patients presented to Site 3 than to the other sites; patients at Site 3 were also younger (Table 2). In 40 cases, patients were transported by

Table 1. Recommendations for the diagnosis and treatment of acute exacerbation of chronic obstructive pulmonary disease from the Canadian Thoracic Society guideline (2007 update)[2]

Recommendation	In the ED	At ED discharge
Diagnosis		
Chest radiograph	Recommended for all patients presenting to the ED	NA
Peak flow measurement	Not clearly addressed	NA
Pulse oximetry	Not clearly addressed	NA
Arterial blood gas test	Recommended for patients with low oxygen saturation on oximetry	NA
Sputum sample	Consider for patients with very poor lung function, with frequent exacerbations or who have been taking antibiotics in the preceding 3 mo	NA
Treatment		
Inhaled β-agonists	• Short-acting recommended • Long-acting not recommended	• As needed • Combined with inhaled corticosteroid as second-line chronic therapy
Inhaled anticholinergics	• Short-acting recommended • Long-acting not recommended	• As needed • First-line chronic therapy
Systemic corticosteroids	Recommended for moderate to severe exacerbations in ED and at discharge	For patients with Anthonisen type-1 and -2 exacerbations*
Antibiotics	Consider for patients with purulent exacerbations	For patients with Anthonisen type-1 and -2 exacerbations*
Supplemental oxygen	Not addressed	For chronic hypoxemia
Noninvasive ventilation	As required for respiratory failure before intubation	NA

ED = emergency department; NA = not applicable.
*The Anthonisen criteria are based on a self-reported history of dyspnea, increased sputum volume and/or increased sputum purulence. Patients with type 1 exacerbations report all 3 criteria, and those with type 2 exacerbations report 2 of 3 criteria.

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ambulance. Overall, most (97.5%) transported patients received some EMS treatment; the most common EMS treatments are presented in Table 2. Of note, intravenous magnesium and corticosteroids were infrequently used (0 and 1 [2.5%], respectively).

ED assessment and management

Patients who presented to the ED at Site 1 had lower scores on the Canadian Triage and Acuity Scale (CTAS) than those who presented to the other 2 sites (Table 3). The frequency of common assessments for COPD in the ED varied among sites. A summary of vital signs and ED assessments is presented in Table 3. Testing for PEFs was not reported frequently overall, and not at all in patients from Site 2. Most patients (58.7%) received salbutamol, an inhaled short-acting β-agonist (SABA) in the ED; however, the method of administration differed significantly among sites (Table 4). Oral prednisone was used most commonly (72.6%); the use of intravenous (IV) corticosteroids was low at all 3 sites. Overall, 19.9% of patients received guideline-approved antibiotics (i.e., macrolides, fluoroquinolones and doxycycline). Administration of inhaled corticosteroid medication and oxygen in the ED varied among sites (Table 4).

Disposition decisions

Most patients (205, 77%) were discharged from the hospital, and the majority of those were discharged home (189, 92%) (Table 5). Other patients were discharged elsewhere, such as to a nursing home. Six patients were transferred for immediate hospital admission to the nearest major centre, in Edmonton. Overall, 61 admissions occurred, but 2 patients were later transferred to Edmonton. Most admitted patients (59, 97%) were assigned to a medical floor in the

hospital to which they initially presented. Median length of stay (LOS) for admitted patients was 4 (IQR 2–6) days. Patients who were admitted to hospital were more likely to receive antibiotics (odds ratio [OR] 2.96, 95% confidence interval [CI] 1.45–6.05), corticosteroids (OR 3.14, 95% CI 1.59–6.25) or both (OR 2.48, 95% CI 1.11–5.53) in the ED (Figs. 1 and 2).

Post-ED treatment

Medications that were commonly prescribed to treat acute exacerbation of COPD at discharge from the ED or admission are summarized in Table 5. Briefly, antibiotics (71.1%) were the most frequently prescribed medication at ED discharge, followed by SABA agents (63.5%). Patients who were admitted to the hospital were more likely to receive antibiotics (OR 2.16, 95% CI 1.01–4.72) in hospital than patients who were discharged from the ED; however, there was no difference in corticosteroid prescriptions (OR 1.54, 95% CI 0.83–2.89) or both (OR 1.79, 95% CI 0.97–3.32) at discharge (Figs. 1 and 2).

The likelihood of a return visit within 14 days correlated to the percentage of patients at each site who were sent home with antibiotics, corticosteroids or both; however, it is unclear whether this correlation is due to treatment or other factors such as disease severity.

The results shown in Tables 1–5 indicate that there was low to moderate adherence to the recommendations in the CTS clinical practice guideline for the management of acute exacerbation of COPD.

DISCUSSION

High-quality care in EDs for acute exacerbation of COPD is timely, equitable, effective, efficient, patient-centred and safe.[4] Although it is difficult to

Table 2. Characteristics of 266 cases of acute exacerbation of chronic obstructive pulmonary disease at 3 rural emergency departments

Characteristic	No. (%) of cases*			
	Site 1 $n = 76$	Site 2 $n = 94$	Site 3 $n = 96$	Total $n = 266$
Sex, female	36 (47.4)	50 (53.2)	60 (62.5)	146 (54.9)
Age, median (IQR), yr	71 (62–77)	69 (61–80)	65 (53–71)	68 (58–77)
EMS treatment	20 (26.3)	10 (10.6)	10 (10.4)	40 (15.0)
Oxygen	17/20 (85.0)	9/10 (90.0)	9/10 (90.0)	35/40 (87.5)
SABA	7/20 (35.0)	4/10 (40.0)	5/10 (50.0)	16/40 (40.0)
SAAC	6/20 (30.0)	1/10 (10.0)	3/10 (30.0)	10/40 (25.0)
Other	2/20 (10.0)	0	0	2/40 (5.0)

EMS = emergency medical services; IQR = interquartile range; SAAC = short-acting anticholinergics; SABA = short-acting β-agonists.
*Unless stated otherwise.

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Table 3. Assessment and investigation of 266 cases of acute exacerbation of chronic obstructive pulmonary disease at 3 rural emergency departments

Variable	Site 1 n = 76		Site 2 n = 94		Site 3 n = 96		Total n = 266	
CTAS score								
2	6	(7.9)	10	(10.6)	9	(9.4)	25	(9.4)
3	26	(34.2)	43	(45.7)	42	(43.8)	111	(41.7)
4–5	36	(47.4)	40	(42.6)	38	(39.6)	114	(42.9)
Not recorded	8	(10.5)	1	(1.1)	7	(7.3)	16	(6.0)
Vital signs, median (IQR)*								
Respiratory rate, breaths/min	22	(18–24)	20	(18–24)	20	(18–22)	20	(18–24)
Pulse rate, beats/min	92	(78–106)	87	(72–97)	91	(80–105)	89	(77–103)
Temperature, °C	36.5	(36.2–36.9)	36.5	(36.2–37.4)	36.7	(36.3–37.1)	36.5	(36.2–37.0)
Temperature ≥ 38°C, no. (%)	13	(17.1)	7	(7.4)	9	(9.4)	29	(10.9)
Oxygen saturation on room air, %	92	(84–95)	93	(87–95)	93	(90–95)	93	(89–95)
PEF obtained, no. (%)	8	(10.5)	0		5	(5.2)	13	(4.9)
Earliest PEF, L/min	170	(100–340)		—	150	(150–275)	170	(140–293)
ED investigations								
Chest radiography	42	(55.3)	67	(71.3)	64	(66.7)	173	(65.0)
Electrocardiography	29	(38.2)	33	(35.1)	69	(71.9)	89	(33.5)
Sputum sample	1	(1.3)	1	(1.1)	6	(6.3)	8	(3.0)
Blood cultures	6	(7.9)	5	(5.3)	1	(1.0)	12	(4.5)
Blood tests	33	(43.4)	42	(44.7)	45	(46.9)	120	(45.1)
CBC	33/33	(100.0)	40/42	(95.2)	44/45	(97.8)	117/120	(97.5)
Electrolytes	27/33	(81.8)	41/42	(97.6)	35/45	(77.8)	103/120	(85.8)
Cardiac enzymes	21/33	(63.6)	24/42	(57.1)	18/45	(40.0)	63/120	(52.5)
ABG	6	(7.9)	10	(10.6)	1	(1.0)	17	(6.4)
pH, median (IQR)	7.4	(7.3–7.5)	7.4	(7.3–7.4)	7.4		7.4	(7.3–7.4)
PaCO$_2$, median (IQR), mm Hg	46.9	(42.2–63.0)	43.4	(33.7–100.7)	63.0		44.1	(38.4–63)
PaO$_2$, median (IQR), mm Hg	86	(53–160)	58	(52–76)	55.0		58	(52.5–123)

ABG = arterial blood gas; CBC = complete blood count; CTAS = Canadian Triage and Acuity Scale; ECG = electrocardiography; ED = emergency department; IQR = interquartile range; PaO$_2$ = partial pressure of oxygen in arterial blood; PaCO$_2$ = partial pressure of carbon dioxide in arterial blood; PEF = peak expiratory flow.
*Unless stated otherwise.

Table 4. Management of 266 cases of acute exacerbation of chronic obstructive pulmonary disease at 3 rural emergency departments

Variable	Site 1 n = 76		Site 2 n = 94		Site 3 n = 96		Total n = 266	
Inhaled SABA	42	(55.3)	64	(68.1)	50	(52.1)	156	(58.7)
ED dose, median (IQR), mg	2.5	(2.5–5.0)	5.0	(2.5–8.8)	5	(5–10)	5	(2.5–7.5)
Inhaled SAAC	31	(40.8)	53	(56.4)	46	(47.9)	130	(48.9)
ED dose, median (IQR), mg	0.5	(0.5–1.0)	0.5	(0.5–1.5)	0.4	(0.3–0.7)	0.5	(0.3–1.0)
Inhaled SAAC and SABA	31	(40.8)	53	(56.4)	46	(47.9)	130	(48.9)
Corticosteroids	18	(23.7)	32	(34.0)	23	(23.9)	73	(27.4)
Prednisone	7/18	(38.9)	29/32	(90.6)	17/23	(73.9)	53	(72.6)
Antibiotics	10	(13.2)	30	(31.9)	13	(13.5)	53	(19.9)
Most common	Fluoroquinolone		Doxycycline		Cephalosporin		Cephalosporin	
	4/10	(40.0)	11/30	(36.7)	6/13	(46.2)	14/49	(28.6)
Assisted ventilation	2	(2.6)	3	(3.2)	1	(1.0)	6	(2.3)
Other COPD treatments	20	(26.3)	40	(42.6)	34	(35.4)	94	(35.3)
Oxygen	8/20	(40.0)	30/40	(75.0)	23/34	(67.7)	61/93	(65.6)
Inhaled corticosteroids	12/20	(60.0)	10/40	(25.0)	18/34	(52.9)	40/93	(43.0)

COPD = chronic obstructive pulmonary disease; ED = emergency department; IQR = interquartile range; SAAC = short-acting anticholinergics; SABA = short-acting β-agonists.
*Unless stated otherwise.

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retrospectively "grade" the true quality of a clinical interaction, adoption of management recommendations from COPD guidelines would represent markers, albeit incomplete, of high-quality care. This study employed standard guideline and quality markers to examine the overall quality of care delivered in 3 EDs in rural Alberta.

The CTAS scores and outcomes of these patients suggest a lower acuity than seen in larger urban centres.[5] In a rural setting, patients who would otherwise see their family physician might be told that their physician is working in the ED and be sent there for treatment, thus resulting in an ED population with lower-acuity conditions. Whereas only 4.9% of patients received PEF testing and 6.4% had ABG test results recorded, all patients had oxygen saturation recorded during measurement of vital signs. These data indicate that concordance with recommended diagnostic testing is not optimal in these 3 rural EDs. Many urban hospitals in Canada have respiratory therapists dedicated to their ED; howev-

er, this is not the case for these 3 hospitals and many other rural EDs. This may contribute to the lower proportion of patients receiving measurements of airway obstruction in these and other rural EDs.

It was encouraging that 65% of patients received chest radiography as part of their workup. The CTS guidelines recommend chest radiography for all patients presenting to the ED with symptoms consistent with an acute exacerbation of COPD because the test has been shown to change management in 16%–21% of patients.[6,7] Many urban hospitals in Canada have dedicated ED radiology services and 24-hour in-house coverage; however, this is not the case for these 3 hospitals (i.e., call backs are required) and many other rural EDs. This may contribute to the lower proportion of patients receiving chest radiography in these and other rural EDs. For patients whose management did not adhere to recommendations, we were unable to examine whether this was because of lower acuity or some other factor.

Table 5. Outcomes and post–emergency department treatment in 266 cases of acute exacerbation of chronic obstructive pulmonary disease at 3 rural emergency departments

	No. (%) of cases*			
Variable	Site 1 n = 76	Site 2 n = 94	Site 3 n = 96	Total n = 266
Discharged	54 (71.1)	71 (75.5)	80 (83.3)	205 (77.1)
Home	50/54 (92.6)	64/71 (90.1)	75/80 (93.8)	189/205 (92.2)
Transferred	1/54 (1.8)	5/71 (7.0)	0	6/205 (2.9)
Treatment				
Antibiotics	34/54 (62.9)	41/71 (57.7)	64/80 (80.0)	139 (67.8)
Corticosteroids	20/54 (37.0)	33/71 (46.5)	53/80 (66.2)	106 (51.7)
Corticosteroids and antibiotics	12/54 (22.2)	27/71 (38.0)	49/80 (61.2)	88/205 (42.9)
Post-ED outcome				
ED LOS, median (IQR), h	1.7 (1.3–2.4)	2.2 (1.1–2.8)	1.6 (1.2–2.5)	1.7 (1.2–2.6)
Returned to the ED < 14 d	7/54 (12.9)	10/71 (14.1)	17/80 (21.3)	34/205 (16.6)
Hospital admission < 14 d	1/54 (1.8)	0	3/80 (3.8)	4/205 (1.9)
Admitted	22 (28.9)	23 (24.5)	16	61 (22.9)
Transferred	2/22 (9.1)	0	0	2/61 (3.3)
ED LOS, median (IQR), h	1.9 (1.3–3.8)	3.1 (2.5–6.6)	2.2 (1.3–3.6)	2.5 (1.7–3.8)
Hospital LOS, median (IQR), d	4 (3–7)	3 (1–5)	4 (3–11)	4 (2–6)
Post-ED treatment				
Inhaled corticosteroids	15 (19.7)	8 (8.5)	26 (27.1)	49 (18.4)
SABA	54 (71.1)	48 (51.1)	67 (69.8)	169 (63.5)
Inhaled anticholinergics	40 (52.6)	30 (31.9)	72 (75.0)	142 (53.4)
SABA and SAAC	10 (13.2)	3 (3.2)	1 (1.0)	14 (5.3)
Inhaled corticosteroids and LABA	29 (38.2)	29 (30.8)	51 (53.1)	109 (40.9)
Antibiotics	51 (67.1)	62 (65.9)	76 (79.2)	189 (71.1)
Theophylline	7 (9.2)	0	5 (5.2)	12 (4.5)
Corticosteroids	34 (44.7)	48 (51.1)	63 (65.6)	145 (54.5)
Other medication	7 (9.2)	1 (1.1)	13 (13.5)	21 (7.9)

ED = emergency department; IQR = interquartile range; LABA = long-acting β-adrenoceptor; LOS = length of stay; SAAC = short-acting anticholinergics; SABA = short-acting β-agonists.
*Unless stated otherwise.

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Overall, the low rate of quantitative assessment of severity for patients with acute exacerbation of COPD, including PEF and ABG measurement, suggests that physicians might rely more heavily on triage scores, vital signs, subjective reporting of symptoms, and/or clinical gestalt in determining severity. Moreover, more sophisticated measurement techniques and personalized medicine appear to be an unlikely solution for these centres.[8] Further research into the reliability and validity of practical tools for severity assessment is warranted.

We found that 65.6% of patients received supplemental oxygen, 58.7% received inhaled SABAs and 48.9% received inhaled SAACs in the ED. Systemic corticosteroids were administered to only 27.4% of patients in the ED and prescribed to 54.5% of patients on discharge. Antibiotics were administered to only 19.9% of patients in the ED and prescribed to 71.1% of patients on discharge. Consistency with guideline recommendations was improved in the outpatient setting.

Corticosteroids are effective for the treatment of COPD to prevent treatment failure after hospital admission[9] and to reduce relapse after discharge.[10] The only metric related to COPD listed in the 2010 report of the Institute for Clinical Evaluative Sciences[11] that relates to ED quality of care in Canada is the percentage of patients with COPD who receive corticosteroid therapy in the ED and at discharge. Our results indicate that only slightly more than one-quarter of patients (27.4%) received corticosteroids in the ED and slightly more than half (54.5%) were taking corticosteroids as post-ED treatment. Overall, management adherence to clinical practice guidelines was only moderate; however, medical management adhered to guideline recommendations better than diagnostic assessment.

Comparable literature pertaining to rural medicine is scarce. However, Tsai and colleagues[12] conducted a similar study in 2 academic urban EDs in Boston and found overall higher levels of concordance with established clinical practice guidelines than we found in our study. In addition, multicentre Canadian data pertaining to acute exacerbation of COPD suggest more ED admissions,[5] more common investigations and higher adherence to ED and post-ED management recommendations from clinical practice guidelines in urban centres than in the rural centres examined here.[3] In addition, both US[13] and Canadian[5,14] data demonstrate higher use of antibiotics and corticosteroids at discharge from hospital. A recent study of patients with acute exacerbation of COPD in a Canadian tertiary care centre identified similar gaps in management (e.g., 58% received corticosteroids and 84% antibiotics); however, the study was restricted to admitted patients.[14]

Limitations

Our study had several limitations that require discussion. Our data from these rural hospitals could have several different implications. The overall average severity of disease seen in this study may have been low, thus warranting the limited diagnostic assessment and treatment strategies observed. Alternatively, there may be gaps in the knowledge translation between research and practice at several different levels. The most feasible gap might be the dissemination and point-of-care use of clinical practice guidelines in the ED setting.

With the relatively low number of physicians working in these communities, the practices of 1 or 2 physicians could affect the results to a large degree. Also, these 3 EDs in Alberta likely do not represent all rural sites, either provincially or nationally.

This study's methods were retrospective, and issues such as missing data and unrecorded measures would reduce the confidence in the data. For example, determining the appropriateness of antibiotic therapy based on the Anthonisen criteria was not always possible owing to the lack of detailed charting of symptoms.[15] Despite this, recording of medications by nurses is mandatory, giving credence to the collected data, and we completed training using medical students
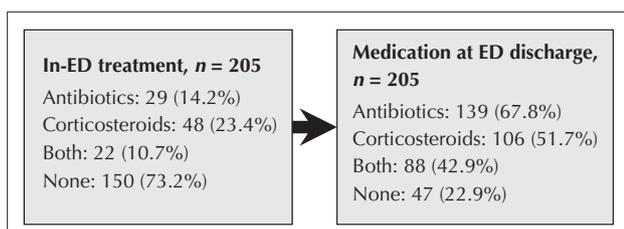

Fig. 1. Emergency department (ED) treatment and medication at discharge in 205 patients with acute exacerbation of chronic obstructive pulmonary disease.

In-ED treatment, *n* = 205
Antibiotics: 29 (14.2%)
Corticosteroids: 48 (23.4%)
Both: 22 (10.7%)
None: 150 (73.2%)

Medication at ED discharge, *n* = 205
Antibiotics: 139 (67.8%)
Corticosteroids: 106 (51.7%)
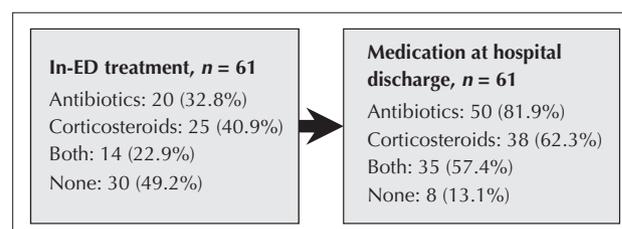Both: 88 (42.9%)
None: 47 (22.9%)

Fig. 2. Emergency department (ED) treatment and medication at hospital admission in 61 patients with acute exacerbation of chronic obstructive pulmonary disease.

In-ED treatment, *n* = 61
Antibiotics: 20 (32.8%)
Corticosteroids: 25 (40.9%)
Both: 14 (22.9%)
None: 30 (49.2%)

Medication at hospital discharge, *n* = 61
Antibiotics: 50 (81.9%)
Corticosteroids: 38 (62.3%)
Both: 35 (57.4%)
None: 8 (13.1%)

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practising in these rural locations who had no pre-existing biases.

It was difficult to comment on appropriateness of care for patients who were not given management consistent with guidelines, because quantitative measures of severity of acute exacerbation of COPD (e.g., vital signs, PEF, ABG) were often not documented. Also, patients were not assessed in follow-up so the effectiveness of therapy could not be determined. Finally, sampling bias may have influenced the results, because the medical record coding of COPD was not validated.

Future research

Research could be undertaken to compare our results from rural EDs with similar presentations in an urban or academic ED. Differences in diagnosis and management may be found due to setting, population, availability of reliable follow-up or physician scope of practice (e.g., rural family physician v. full-time emergency physician). Alberta has developed urban computer-based electronic clinical practice guidelines; availability to physicians working in rural EDs is planned and should be evaluated.[16,17] Adherence to recommendations within respiratory and other electronic clinical practice guidelines may improve with higher usage of these guidelines,[18] even at community and rural sites.[19] Further research might re-examine guideline adherence with easier and less cumbersome access to electronic clinical practice guidelines or more encouragement from administration to use these guidelines.

CONCLUSION

We found a low to moderate level of adherence to the CTS clinical practice guideline in management of acute exacerbation of COPD in these rural EDs. Moreover, we identified gaps in both diagnostic and therapeutic care in these EDs. We identified low adherence associated with diagnostic testing and moderate adherence associated with medical management. The causes of these findings require further research.

REFERENCES

1. Akinbami LJ, Liu X. Chronic obstructive pulmonary disease among adults aged 18 and over in the United States, 1998–2009. *NCHS Data Brief* 2011;(63):1-8.
2. O'Donnell DE, Aaron S, Bourbeau J, et al. Canadian Thoracic Society recommendations for management of chronic obstructive pulmonary disease — 2007 update. *Can Respir J* 2007;14:5B-32B.
3. Rowe BH, Voaklander DC, Marrie TJ, et al. Outcomes following chronic obstructive pulmonary disease presentations to emergency departments in Alberta: a population-based study. *Can Respir J* 2010; 17:295-300.
4. Institute of Medicine Committee on the Future of Emergency Care in the U.S. Health System. *Hospital based emergency care: at the breaking point.* Washington (DC): The National Academies Press; 2006.
5. Rowe BH, Villa Roel C, Guttman A, et al. Predictors of hospital admissions for chronic obstructive pulmonary disease exacerbations in to Canadian emergency departments. *Acad Emerg Med* 2009;16:316-24.
6. Emerman CL, Cydulka RK. Evaluation of high-yield criteria for chest radiography in acute exacerbation of chronic obstructive pulmonary disease. *Ann Emerg Med* 1993;22:680-4.
7. Tsai TW, Gallagher EJ, Lombardi G, et al. Guidelines for the selective ordering of admission chest radiography in adult obstructive airway disease. *Ann Emerg Med* 1993;22:1854-8.
8. Adamko DJ, Sykes BD, Rowe BH. The metabolomics of asthma: novel diagnostic potential. *Chest* 2012;141:1295-302.
9. Walters JA, Gibson PG, Wood-Baker RR, et al. Systemic corticosteroids for acute exacerbations of chronic obstructive pulmonary disease. *Cochrane Database Syst Rev* 2009;1:CD001288.
10. Aaron S, Vandemheen K, Hebert P, et al. Outpatient oral prednisone after emergency treatment of chronic obstructive pulmonary disease. *N Engl J Med* 2003;348:2618-25.
11. Schull MJ, Guttmann A, Leaver CA, et al. Prioritizing performance measurement for emergency department care: consensus on evidence-based quality of care indicators. *CJEM* 2011;13:300-9.
12. Tsai CL, Ginde AA, Blanc PG, et al. Improved care of acute exacerbation of chronic obstructive pulmonary disease in two academic emergency departments. *Int J Emerg Med* 2009;2:111-6.
13. Kim S, Emerman CL, Cydulka RK, et al. Prospective multicenter study of relapse following emergency department treatment of COPD exacerbation. *Chest* 2004;125:473-81.
14. Sandhu SK, Chu J, Yurkovich M, et al. Variations in the management of acute exacerbations of chronic obstructive pulmonary disease. *Can Respir J* 2013;20:175-9.
15. Anthonisen N, Manfreda J, Warren P, et al. Antibiotic therapy in exacerbation of chronic obstructive pulmonary disease. *Ann Intern Med* 1987;106:196-204.
16. Lim C, Bawden JL, Wing A, et al. Febrile neutropenia in the emergency department: the role of an electronic clinical practice guideline. *Am J Emerg Med* 2012;30:5-11.
17. Bond CM, Djogovic D, Villa-Roel C, et al. Pilot study comparing sepsis management with and without electronic clinical practice guidelines in an academic emergency department. *J Emerg Med* 2013;44:698-708.
18. Rowe BH, Chahal AM, Spooner CH, et al. Increasing the use of anti-inflammatory agents in acute asthma in the emergency department: experience with an asthma care map. *Can Respir J* 2008;15:20-6.
19. Mackey D, Myles M, Spooner CH, et al. The use of an asthma care map in a community hospital emergency department. *CJEM* 2007;9:353-65.

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