

**Original article:**

**Commencement of systemic corticosteroids in emergency Department versus in ward in management of acute adult asthma requiring hospitalization: a retrospective cohort study**

*Suen PY*

**Abstract**

**Introduction:** Systemic corticosteroids are commonly used in management of acute asthma, sometimes started before admission in emergency department, sometimes in ward after admission. This study is to determine whether commencing systemic corticosteroids in emergency department compared to in ward for managing acute adult asthma requiring hospitalization can improve the outcome: shorter length of hospital stay. **Methods:** A retrospective cohort study was conducted in an emergency department in Hong Kong. Adults aged 18 to 65 years-old who presented to the emergency department with acute asthma and subsequently hospitalized with use of systemic corticosteroids were recruited and divided into two groups: a group with commencement of systemic corticosteroids in emergency department (Group A, n=139) and the other group with commencement of systemic corticosteroids in ward (Group B, n=209). The outcome measurement was length of hospital stay. **Results:** A total of 348 subjects were recruited in final analyses. We used Mann-Whitney *U* test to test the difference in ranking of length of hospital stay (days) between these two groups. The mean rank of length of hospital stay in Group A was 159, and that in Group B was 185 ( $p=0.014$ ). The difference was statistically significant with commencement of systemic corticosteroids in emergency department resulting in higher ranking-shorter length of hospital stay. **Conclusion:** It may be possible to result in earlier discharge in acute adult asthma requiring hospitalization when systemic corticosteroids is started before admission in emergency department, instead of in ward after admission.

**Keywords:** Glucocorticoids; respiratory hypersensitivity; bronchial spasm; emergency service; Hospital

*Bangladesh Journal of Medical Science Vol. 15 No. 04 October '16*

**Introduction**

In the world, there are 300 million people with asthma<sup>1</sup>. In 2005, 255000 people died from asthma<sup>2</sup>. In Hong Kong, the prevalence of asthma among different age groups has different prevalence rates from 5% to 10%; and there were more than 330,000 people suffering from asthma<sup>3-5</sup>.

Acute asthma is a common emergency condition in adult, especially healthy young adult; thus, its management is very important in emergency department<sup>6-9</sup>. The pathophysiology of asthma involves airway inflammation, airway obstruction and bronchial hyper-responsiveness; hence, there are increased airway secretions, inflammatory cellular infiltrate and smooth muscle hypertrophy<sup>10-14</sup>. Systemic corticosteroids (including oral, intravenous or intramuscular route) can be used to control and suppress the inflammatory process in the airway

in acute setting, and their use in treatment of acute asthma were established<sup>15,16</sup>. Moreover, a Cochrane review showed that use of systemic corticosteroids within 1 hour of presentation to an emergency department can significantly reduce the need for hospital admission in patients with acute asthma<sup>17</sup>. Also, systemic corticosteroids can help to reduce the rate of relapse; and thus, it should be administered to patients with severe asthma<sup>18-21</sup>.

However, in management of acute asthma requiring hospitalization, some emergency medicine (EM) physicians would like to commence systemic corticosteroids in emergency department because they think that this would benefit these hospitalized patients. On the other hand, some EM physicians would not like to do so because they think there would be no significant difference to commence systemic corticosteroids in emergency department

**Corresponds to:** Suen Pao Yim, Resident, Accident and Emergency Department, Yan Chai Hospital, Accident and Emergency Department, Yan Chai Hospital, 7-11 Yan Chai Street, Tsuen Wan, New Territories, Hong Kong, Email: [suenpaoyim@yahoo.com.hk](mailto:suenpaoyim@yahoo.com.hk)

or in ward. However, there is no study to address this difference of beliefs. Therefore, this study was to determine, for managing acute adult asthma requiring hospitalization, whether commencement of systemic corticosteroids in emergency department before admission, compared to in ward after admission, can improve the outcome-shorter length of hospital stay.

## Methods

### Study Design

It was a retrospective cohort study to test the difference in ranking of length of hospital stay (days) between 2 groups of acute adult asthma: a group with commencement of systemic corticosteroids in emergency department before admission (Group A, n=139) and the other group with commencement of systemic corticosteroids in ward (Group B, n=209). Ethical approval was obtained from the Research Ethics Committee of Kowloon West Cluster of Hospital Authority in Hong Kong. Clinical Data Analysis and Report System (CDARS) was used to search all patients, attending the Accident and Emergency Department of Yan Chai Hospital, between 18 to 65 years-old, with acute asthma requiring hospitalization and administration of systemic corticosteroids from 1 January 2013 to 31 December 2014. Exclusion criteria were chronic lung diseases, other than asthma, (including chronic obstructive pulmonary disease and bronchiectasis), major medical illness (including pneumonia, ischemic heart disease, congestive heart failure, stroke, renal failure and liver failure, etc.), acute asthma within 4 weeks, use of systemic corticosteroids within 4 weeks and life-threatening acute asthma, shown in table 1.

**Table 1. Inclusion and exclusion criteria**

Inclusion criteria	Exclusion criteria
Acute asthma	Chronic lung disease other than asthma
18 to 65 years old	Major medical illness
hospitalization	Acute asthma within 4 weeks
Use of systemic corticosteroids during hospitalization	Use of systemic corticosteroids within 4 weeks
	Life-threatening acute asthma

### Data collection

Data of patients' characteristics including age, gender, smoking status and co-morbidity status were collected. Data of patients' clinical findings on arrival in our emergency department including respiratory rate, heart rate, completion of a sentence in one breath and oxygen saturation were also collected, these clinical findings were used to stratify the level of severity of acute asthma exacerbation according to BTS/SIGN Asthma Guideline 2014<sup>22</sup>. Data of during hospitalization with use of salbutamol (Ventolin) puff, ipratropium (Atrovent) puff and antibiotics, and data of before hospitalization with regular use of inhaled steroid, long-acting beta-agonist and oral theophylline were collected, too. Admission to Emergency Medicine ward (EMW) or medical ward might be a possible confounding

factor because of different strategies in term of frequency of ward round and threshold of discharge from different specialities. The outcome measurement was the length of hospital stay in term of days.

### Statistical analysis

Chi-Square test and t-test were used to test the statistical difference between Group A and Group B in term of age, sex, smoking status, co-morbidity status, severity of acute asthma, use of salbutamol puff, ipratropium puff and antibiotics during hospitalization and use of regular inhaled steroid, long-acting inhaled beta-agonist and oral theophylline before hospitalization. Mean, median and mode of length of hospital stay (days) of these 2 groups were calculated by descriptive statistics. The non-parametric test - Mann Whitney *U* test was used to test the significance of difference between these 2 groups in term of length of hospital stay, instead of t-test, because the length of hospital stay was unlikely to follow a normal distribution pattern. Mann Whitney *U* test, calculated the mean rank of length of hospital stay of these 2 groups, then calculated the p value of the difference of the mean rank, to determine whether the difference was statistically significant or not. SPSS version 16 was used.

### Results

There were 411 subjects identified from CDARS, 352 subjects met the inclusion and exclusion criteria. There were 4 cases of discharge with acknowledge of medical advice (DAMA) during hospitalization, thus, these 4 cases were excluded from the study. A total of 348 subjects were in the final analysis, showed in figure 1. There were 139 out of 348 subjects (39.9%) given systemic corticosteroids in emergency department (Group A), whereas, 209 out of 348 subjects (60.1%) given systemic corticosteroids in ward (Group B).

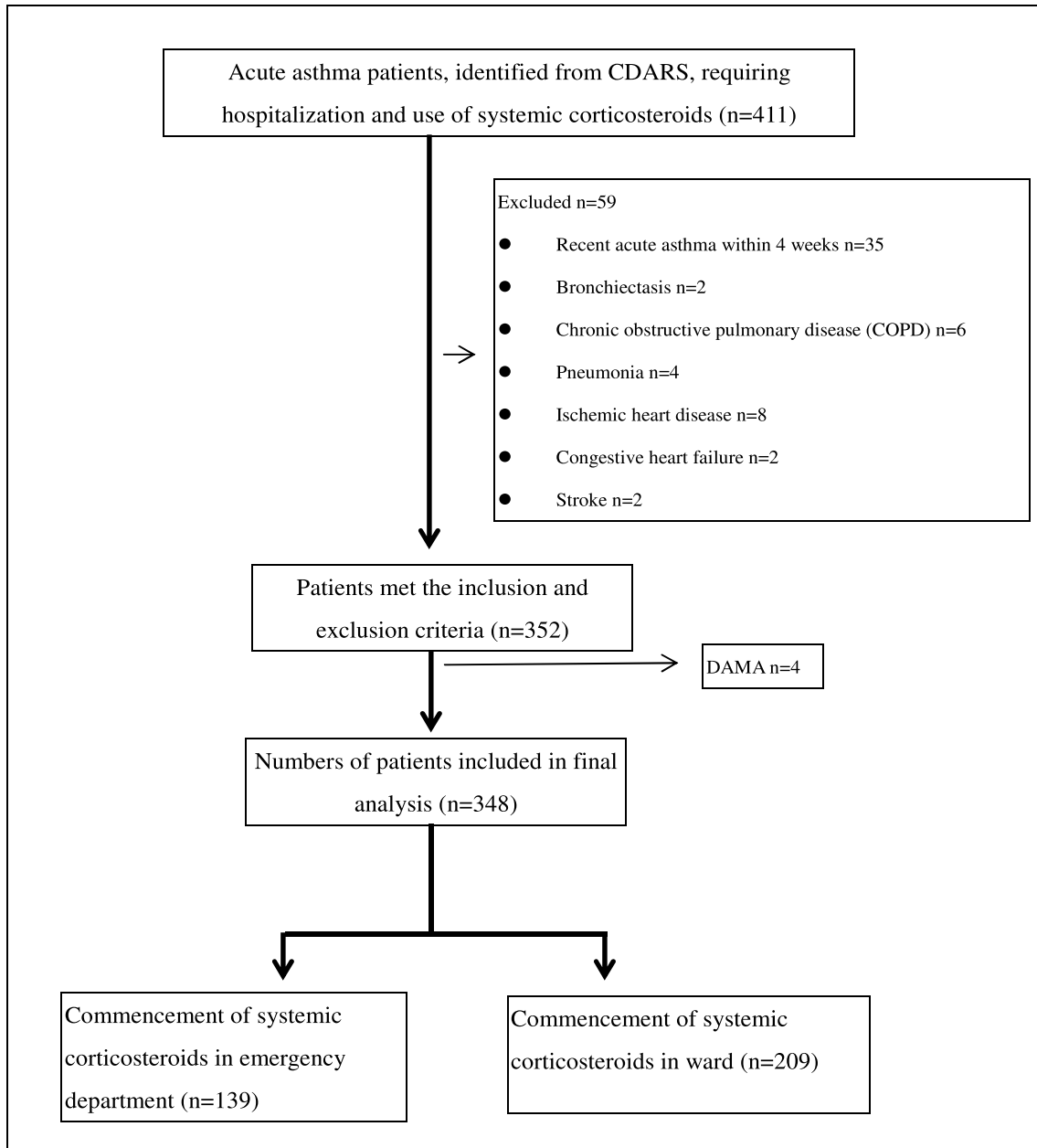
**Table 2.** Characteristics of patients (n=348)

Figure 1: Flowchart of selection of subjects

The characteristics of patients, including gender, age, smoking status, co-morbidity status, severity of acute asthma, admission proportion to EMW and medical ward, use of salbutamol puff, ipratropium puff and antibiotics during hospitalization, use of inhaled steroid, long-acting inhaled beta-agonist and oral theophylline before hospitalization and admission proportion to EMW and medical

ward, were shown in table 2. The proportion and p-value of these factors between Group A and Group B were calculated. The results showed that these factors were not statistically significant different between these 2 groups because all the p-value were greater than 0.05. Also, the lists and proportion of co-morbidity were shown in table 3.

**Table 2.** Characteristics of patients (n=348)

Characteristics		commencement of systemic corticosteroids in ED, Group A (n=139)	commencement of systemic corticosteroids in ward, Group B (n=209)	p-value
<b>Gender</b>	Male, n=176	65(46.8%)	111(53.1%)	0.33*
	Female, n=172	74(53.2%)	98(46.9%)	
<b>Age (18-65)(years), mean+/-SD</b>		41.4+/-12.3	43.6+/-14.1	0.14‡
<b>Smoking</b>	Smokers	21(15.1%)	46(22.0%)	0.86*
	Non-smokers	103(74.1%)	151(72.2%)	
	Unknown	15(10.8%)	12(5.8%)	
<b>Co-morbidity</b>	Nil	111(79.9%)	154(73.7%)	0.35*
	With co-morbidity	28(20.1%)	55(26.3%)	
<b>Clinical findings</b>	Respiratory rate (n/min), mean+/-SD	23.3+/-3.1	22.8+/-2.9	0.20‡
	Pulse (beats/min), mean+/-SD	105+/-11	103+/-12	0.15‡
	SpO2 (%), mean+/-SD	95.8+/-1.5	96.1+/-1.4	0.11‡
	Comp. of a sent. §			
	Yes	72(51.8%)	55(26.3%)	0.08*
	No	4(2.9%)	0	
Unknown	63(45.3%)	154(73.7%)		
<b>Severity of acute asthma †</b>	Moderate	88(63.3%)	142(67.9%)	0.37*
	Severe	51(36.7%)	67(32.1%)	
<b>During Hospitalization</b>	Salbutamol puff	139(100%)	208(99.5%)	0.42*
	Ipratropium puff	18(12.9%)	16(7.7%)	0.06*
	Antibiotics	105(75.5%)	166(79.4%)	0.24*
<b>Before Hospitalization</b>	Inhaled steroid	64(46.0%)	79(37.8%)	0.21*
	Long-acting inhaled beta-agonist	22(15.8%)	29(13.9%)	0.26*
	Oral theophylline	8(5.8%)	4(1.9%)	0.35*
<b>Admission Ward</b>	EMW	35(25.2%)	58(27.8%)	0.59*
	Medical ward	104(74.8%)	151(72.2%)	
SD=standard deviation; ED=emergency department; Comp. of a sent. §= completion of a sentence in one breath; * Chi-Square test; ‡ t-test; † based on BTS/SIGN asthma guideline 2014				

**Table 3.**Co-morbidity of patients

No co-morbidity	259 (74.4%)	Two co-morbidities	16 (4.6%)
<b>One co-morbidity</b>	<b>64 (18.3%)</b>	Hypertension and diabetes	11
Hypertension	19	Hypertension and hyperlipidemia	2
Allergic rhinitis	7	Diabetes and hyperlipidemia	2
Diabetes	6	Hypertension and hepatitis B carrier	1
Hypothyroidism	6		
Schizophrenia	5		
Depression	4		
Hyperlipidemia	4		
Hepatitis B carrier	3	<b>Three co-morbidities</b>	<b>3 (0.9%)</b>
Hyperthyroidism	3	Hypertension, diabetes and hyperlipidemia	2
Epilepsy	2	Hypertension, diabetes and gout	1
Ankylosing spondylitis	1		
HIV	1		
Irritable bowel syndrome	1		
Neurofibromatosis	1		
Uveitis	1		

The mean, median and mode of the length of hospital stay between 2 groups were showed in table 4. The mean length of hospital stay for Group A was 1.83 days and for Group B was 2.12 days. The median lengths of hospital stay in two groups were same—2 days and the mode of lengths of hospital stay in two groups were also the same—1 day. The range of length of hospital stay in Group A was from 1 to 7 days and that in Group B was from 1 to 10 days.

**Table 4.** Length of hospital stay (days) in commencement of systemic corticosteroids in emergency department (Group A) and in ward (Group B)

	Length of hospital stay			
	Median	Mean	Range	Mode
Group A, n=139	2	1.83	1 to 7	1
Group B, n=209	2	2.12	1 to 10	1

By Mann Whitney test, the mean rank of length of hospital stay in Group A was 159.2 and that in Group B was 184.6. The difference of their mean rank was statistically significant with p value of 0.014, shown in table 5. Therefore, it was statistically significant that Group A had higher mean rank of length of hospital stay; this implied that Group A with commencement of systemic corticosteroids in emergency department was likely to have shorter length of hospital stay, and thus, earlier discharge.

**Table 5.** Mean rank of length of hospital stay with commencement of systemic corticosteroids in emergency department (Group A) versus in ward (Group B)

Outcome	Mean rank in Group A (n=139)	Mean rank in Group B (n=209)	Difference (p-value)
Length of Hospital Stay (in rank)	159.2	184.6	25.4(0.014)*
* Mann-Whitney <i>U</i> test			

## **Discussion**

This study was designed as retrospective cohort study to determine whether commencing systemic corticosteroids in emergency department before admission compared to in ward for managing acute asthma requiring hospitalization can improve the outcome: shorter length of hospital stay. Shorter length of hospital stay was chosen as the outcome measurement; it implies earlier discharge. Shorter length of hospital stay or earlier discharge is very important for patients, clinicians, departments and administrators because this save resources for all of them.

We found the mean rank of length of hospital stay among the acute asthma adult with commencement of systemic corticosteroids in emergency department (159.2) was higher than the group with commencement of systemic corticosteroids in ward (184.6). This difference was statistically significant. The higher rank implied the shorter length of hospital stay. The higher mean rank implied overall shorter length of hospital stay on average. Therefore, the group with commencement of systemic corticosteroids in emergency department had overall shorter length of hospital stay in average compared with the group with commencement of systemic corticosteroids in ward. It is likely related to the fact that earlier commencement of systemic corticosteroids helps to control and reduce the inflammatory process of acute asthma earlier<sup>15,16</sup>, and thus, resulting in shorter length of hospital stay and earlier discharge.

There were quite a lot of possible confounding factors in our study. These were age, sex, smoking status, co-morbidity status, severity of acute asthma, admission to EMW or medical ward, during hospitalization with use of salbutamol, ipratropium and antibiotics and before hospitalization with use of inhaled steroid, long-acting inhaled beta-agonist and oral theophylline. These possible confounding factors were identified and their p-value of statistical difference between Group A and Group B were calculated to see whether these factors were statistically significant different or not. The results showed that these factors were not statistically significant different.

Co-morbidity was one of important confounding factor to affect the length of hospital stay. To minimize its effect, patients with significant co-morbidity including chronic lung diseases and major medical illness were excluded from this study. As a result, there were more than 70% of patients had no co-morbidity and more than 90% of patients had no or

only one co-morbidity, shown in table 3. Therefore, the effect of co-morbidity in this study was markedly reduced.

Another important confounding factor was the severity of acute asthma. For stratification of the severity of acute asthma, we tried to stratify the severity as accurate as possible. We used BTS/SIGN Asthma Guideline 2014, which was based on clinical findings of respiratory rate, heart rate and completion of sentence in one breath and peak expiratory flow (PEF) percentage of the best or predicted. However, the stratification in our study was not very accurate because most of our cases (n=336, 97%) did not measure PEF, even with PEF measured, there were no best PEF mentioned nor patients' height for calculating the predicted PEF, thus, no PEF percentage could be calculated. And, there were missing data (n=217, 62%) for the completion of a sentence in one breath, this also affected the accuracy in assessing the severity of acute asthma. Since this study was a retrospective study, the missing data could not be retrieved; this was an important drawback in this study. GINA guidelines 2014 were not used for stratification of the severity of acute asthma in our study because there were even more missing data regarding agitation status, sitting position and use of accessory muscles.

Subgroup analysis of patients with oral or intravenous corticosteroids was not done because it was shown that corticosteroids administered orally and intravenously had similar efficacy in the treatment of adult with acute asthma<sup>23,24</sup>. Moreover, the subgroup analysis of different dosages was also not done because it was shown that higher doses do not appear to be more effective for acute asthma<sup>21</sup>.

It is important to note that commencement of systemic corticosteroids in emergency department before admission instead of in ward will not pose extra harm to patients because systemic corticosteroids are just given earlier.

For patients already with frequent use of systemic corticosteroids, to commence systemic corticosteroid in emergency department may increase the exposure to systemic corticosteroid and related cumulative adverse effects like osteoporosis<sup>24</sup> and adrenal insufficiency. Therefore, for this group of patients, it may be beneficial to them if we hesitate to commence systemic corticosteroids in emergency department.

## **Conclusion**

The mean rank of length of hospital stay was higher among patients with commencement of systemic

corticosteroids in emergency department before admission than those in ward in our study. This implies to commence systemic corticosteroids in acute adult asthma in emergency department before admission instead of in ward, may result in shorter length of hospital stay or earlier discharge. Further prospective and randomized controlled trial will be useful to confirm our results and guide clinical

practice.

**Conflict of interest:** None declared

**Acknowledgements:**

Dr. Ngan Hung Kwok  
 Dr. Wong Kwok Leung  
 Dr. Mok Yin To  
 Dr. Cheung Chi Kin

### **References:**

- Bronchial asthma, WHO Factsheet No.307 Geneva: World Health Organization; 2008
- 10 facts on asthma. World Health Organization 2007
- Leung R, Wong G, Lau J, et al. Prevalence of asthma and allergy in Hong Kong school children: an ISAAC study. *European Respiratory Journal* 1997; **10**(2): 354-360
- Proper monitoring brings improved care to childhood asthma. Press Release (13/1/2004). Hong Kong SAR. The Chinese University of Hong Kong. 2004
- <http://www.census2011.gov.hk/tc/main-table/A103.html>, Census and Statistics Department
- Kwong T, Town I, Holst PE, et al. A study of the management of asthma in a hospital emergency department. *NZ Med J* 1989; **102**(878):547-9
- Ebden P, Carey OJ, Quinton D, et al. A study of acute asthma in accident and emergency department. *Br J Dis Chest* 1988; **82**(2):162-7
- National Asthma Education and Prevention Program (2007) Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma Summary Report 2007. *J Allergy Clin Immunol.* 120:S94-138
- Global Initiative for Asthma (2014) Global strategy for asthma management and prevention
- Lipworth BJ. Clinical pharmacology of corticosteroids in bronchial asthma. *Pharmacol Ther.* 1993; **58**(2):173-209
- Grainje CL, Lau LC, Ward JA, Dulay V, Lahiff G, Wilson S, et al. Effect of bronchoconstriction on airway remodelling in asthma. *N Eng J Med.* 2011; **364**:2006-15
- Holgate ST. Pathogenesis of asthma. *Clin Exp Allergy.* 2008; **38**:872-97
- Busse WW, Calhoun WF, Sedgwick JD. Mechanism of airway inflammation in asthma. *An Rev Respir Dis.* 1993 Jan. 147 (supplement):S20-S24
- Horwitz RJ, Busse WW. Inflammation and asthma. *Clin Chest Med.* 1995 Dec.16(4):583-602
- Fanta CH, Rossing TH, Mc Fadden ER. Glucocorticoids in acute asthma. *A critical controlled trial. Am J Med.* 1983; **74**:845-51
- Littenberg B, Gluck EH. A controlled trial of methylprednisolone in the emergency treatment of acute asthma. *N Engl J Med.* 1986; **314**:150-2
- Rowe BH, Spooner C, Ducharme FM, Bretzlaff JA, Bota GW. Early emergency department treatment of acute asthma with systemic corticosteroids. *Cochrane Database Syst Rev.* 2001:CD002178
- Chapman KR, Verbeek PR, White JG, Rebeck AS. Effect of a short course of prednisolone in the prevention of early relapse after the emergency room treatment of acute asthma. *N Engl J Med* 1991; **324**:788-94
- Rowe BH, Spooner CH, Ducharme FM, Bretzlaff JA, Bota GW. Corticosteroids for preventing relapse following acute exacerbations of asthma. *Cochrane Database Syst Rev* 2002; **4**:CD000195
- Rodrigo G, Rodrigo C. Corticosteroids in the emergency department therapy of acute adult asthma—an evidence-based evaluation. *Chest* 1999; **116**:285-95
- Manser R, Reid D, Alnamson M. Corticosteroids for acute severe asthma in hospitalized patients. *Cochrane Database Syst Rev.* 2001; (1): CD001740
- BTS/SIGN guideline on the management of asthma (2014)
- Cunning D, Smith N, Steed K, Rosengarten P, Kelly A.M, Teichtahl H. Oral versus intravenous corticosteroids in adults hospitalized with acute asthma. *Pulm Pharmacol Ther.* 2005; **18**(3): 207-12. Epub 2005 Jan 24.
- Dembla G, Mundle RP, Salkar HR, Dolfoide DV. Oral versus intravenous steroids in acute exacerbation of asthma-randomized controlled study. *J Assoc Physicians India.* 2011 ; **59**: 621-3
- Smith N. Corticosteroids and osteoporosis. *Thorax* 1990; **45**:573-8