

**Study to Evaluate the Knowledge and Skills of COPD and Bronchial Asthma (BA) Patients Regarding the Inhaling Technique of Dry Powder**Vijay Gadhia<sup>1</sup>, Darshankumar Parmar<sup>2</sup>, Sanket G. Makwana<sup>3</sup><sup>1</sup>Consultant, Department of General Medicine, Jeevandeep Hospital, Morbi, Gujarat, India<sup>2</sup>Consultant, Department of General Medicine, Aayush Multi-speciality Hospital, Morbi, Gujarat, India<sup>3</sup>Associate Professor, Department of General Medicine, C U Shah Medical College and Hospital, Surendranagar, Gujarat, India

Received: 11-04-2023 / Revised 15-05-2023 / Accepted 05-07-2023

Corresponding author: Dr. Sanket G. Makwana

Conflict of interest: Nil

**Abstract:****Aim:** The aim of the present study was to evaluate the knowledge and skills of COPD and bronchial asthma (BA) patients regarding the inhaling technique OF Dry powder.**Methods:** A cross-sectional study including 200 patients who were those diagnosed with COPD (post-bronchodilator forced expiratory volume in 1 second [FEV1] <80% and the ratio of FEV1 to forced vital capacity <.070 on spirometry after the inhalation of bronchodilator) by physicians whose medical examination card notes the final diagnosis as COPD and attending medical outpatient department (OPD) in Department of General medicine for 18 months a aged ≥20, and who had been taking dry powder inhalation with a rotahaler as the treatment prior to the date of data collection.**Results:** The study showed that nearly half (49%) of the rotahaler users belonged to the 61–70 years age group. The overall mean and SD of the age of those users was 66.24±8.92. More than half of the COPD patients using rotahalers were females (55%) and from rural areas (58%). More than two-thirds of them were illiterate (68.6%) and unemployed (66.2%). Among the literates, the maximum number (41.66%) of DPI users had basic education. The majority (46%) of the respondents had used the rotahaler for less than a year. Regarding instruction, nearly all (99%) of the rotahaler users got verbal instruction regarding the use of the rotahaler. However, only 15% of the respondents had observed a demonstration of dry powder inhalation from health care providers. The majority of the DPI users (90%) had correct knowledge about the storage of rotacaps. They were aware that rotacaps should be kept in a cool place away from moisture, and four- fifths of them (80%) were aware that they should take a slow deep breath while inhaling the drug.**Conclusion:** The study concluded that patients with respiratory conditions do not always know how to use inhalation devices properly. To improve patient outcomes, medical professionals should instruct patients on how to use inhalation devices on dry powder inhalation with demonstration and re-demonstration from the patients to improve the knowledge and practice of dry powder inhalation for COPD patients.**Keywords:** Asthma, COPD, Knowledge, Inhalation Techniques

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

**Introduction**

COPD is a life-threatening disease. It is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. Chronic bronchitis and emphysema fall under COPD. [1] It is an increasing cause of morbidity and mortality and an economic burden on the health care system. [2,3] An estimated annual death rate of 3 million people (5%) occurs due to COPD, which makes it the fourth leading cause of death in the world.4 Approximately 90% of these deaths occur in low- and middle-income countries. [4] Patients with pulmonary diseases like cystic fibrosis, chronic obstructive pulmonary disease (COPD), and asthma

are managed primarily through inhalation therapy. [5] It involves administering medication directly into the lungs using inhalation tools like nebulizers, dry powder inhalers, and metered-dose inhalers. [6] Studies have shown that various factors affect the inhalation technique of patients. These include their age, sex, educational status, occupation, area of residence, duration of disease, associated comorbid conditions, poor inhalation instruction, and poor monitoring of the inhalation technique of the patients. [7,8,9,10]

Inhalation devices must be used correctly for inhalation therapy to be effective, which necessitates that patients have a working

knowledge of inhalation techniques. [11] Monitoring patients and their lung function frequently, limiting environmental factors, and using medications are the cornerstones of effective pulmonary disease management. [12] In general, inhaler medications (IDs) can be divided into four groups: nebulizers (NBs), dry powder inhalers (DPIs), breath actuated inhalers (BAIs), and metered dose inhalers (MDIs). [13] An effective medication is delivered right to the lungs through inhalation therapy. Inhalation therapy offers faster and more effective treatment at lower doses than systemic therapy and has fewer systemic side effects. [14]

Inhaled aerosoled drug is the mainstay of treatment in patients with Chronic Obstructive Pulmonary Disease (COPD) as it allows the delivery of drugs directly to the lungs with minimal side effects. Effectiveness of the treatment by those drugs depends on how correctly a patient inhales the drug through the prescribed inhaler. It has been reported that incorrect inhalation technique results in recurrent exacerbations of COPD increasing the health care costs and socio economic burden to the patient and the family. Despite this serious result, very little consideration is given to the inhalation technique used by the patient. Among the various devices, rotahaler is a commonly used aerosol device to deliver drug in the form of dry powder for the treatment of COPD. [5] The improper use of inhaler devices is a significant contributing factor to this situation. Correct inhaler use helps to achieve desired drug levels in the lung, reduces disease symptoms, prevents exacerbations, and improves respiratory function and quality of life. [15] Noncompliance and improper inhaler handling can affect drug delivery and lessen its therapeutic benefits. [16]

Understanding those advantages and limitations helps clinicians in choosing the proper device for the individual patient's clinical needs and preferences. However, with the wide range of permutations of drug combinations now possible, inhaler selection remains challenging. For all inhaler devices, adequate training for patients on how to use their device is required to achieve optimal therapeutic benefits. [17] Hence the aim was to evaluate the knowledge and skills of COPD and bronchial asthma (BA) patients at Department of General medicine, Jeevandeep Hospital, Morbi, Gujarat, India regarding the inhaling technique of Dry powder.

### Material & Methods

A cross-sectional study including 200 patients who were those diagnosed with COPD (post-bronchodilator forced expiratory volume in 1 second [FEV1] <80% and the ratio of FEV1 to forced vital capacity <.070 on spirometry after the

inhalation of bronchodilator) by physicians whose medical examination card notes the final diagnosis as COPD and attending medical outpatient department (OPD) in Department of General Medicine, Jeevandeep Hospital, Morbi, Gujarat, India for 18 months aged  $\geq 20$ , and who had been taking dry powder inhalation with a rotahaler as the treatment prior to the date of data collection.

### Inclusion Criteria

Adult patients diagnosed COPD, who had been using a rotahaler since the last 1 month were identified using the examination card and the laboratory and radiological findings of the patients.

### Exclusion Criteria

From these patients, those who did not consent to participate in the study and/or who had other obstructive diseases (asthma, bronchiectasis, and cystic fibrosis) were excluded from the study.

### Methodology

The patients who exited from the OPD and who were COPD patients who had been using a rotahaler were identified through the examination card and diagnostic tests carried out. The purpose of the study was explained, and informed verbal and written consent was collected with information about the nature of the study and the participants' role in the research. Finger prints were taken from the illiterate respondents after the verbal consent. The questionnaire was administered by the interviewer in a separate room in the OPD (between the OPD time of 9 am and 2 pm). Regarding knowledge, the frequency of correct answer on each question was given the score of 1. Then, assessment of the dry powder inhalation technique was conducted using the rotahaler with placebo rotacaps in the same room.

A similar assessment was carried out in the ward at the bedside of the patients (before 9 am and after 2 pm). Practice was examined using the rotahaler checklist developed by the Dutch Asthma Foundation. The performance of each of the steps of rotahaler use was labeled a correct inhalation technique if the respondent correctly performed each of the steps of the checklist. The performance was labeled incorrect if the patient could not perform the steps correctly and/or missed some of the steps. After examination of the inhalation technique, the incorrect method adopted by the patient was explained to the patient. After that, the patients were shown a video of the correct inhalation technique.

### Statistical Analysis

The collected data were organized, coded, and entered in SPSS software, version 16. The data were analyzed by using descriptive statistics, such

as frequency, percentage, mean, and SD to assess the socio-demographic information, knowledge, and practice of rotahaler. Inferential analysis was conducted using a chi-square test to assess the association of practice of rotahaler with socio-

demographic characteristics and health care provider-related aspects. The level of significance was considered at 5% with  $p < 0.05$  and a 95% CI.

## Results

**Table 1: Background characteristics of patients using rotahaler**

Background characteristics	Number	Percentage
<b>Age (years)</b>		
Up to 60	42	21
61–70	89	49
71–80	40	20
81 years and above	20	10
<b>Sex</b>		
Male	90	45
Female	110	55
<b>Place of Residence</b>		
Rural	116	58
Urban	84	42
<b>Education Status</b>		
Illiterate	140	70
Literate	60	30
If literate		
Can read and write only	20	33.34
Basic education (grade 1–8)	25	41.66
Secondary education (grade 9–12)	9	15
Higher education (above grade 12)	6	10
<b>Employment status</b>		
Unemployed	130	65
Employed	70	35
<b>Years of use of rotahaler</b>		
Less than 1 year	92	46
1–5 years	72	36
More than 5 years	36	18

The study showed that nearly half (49%) of the rotahaler users belonged to the 61–70 years age group. The overall mean and SD of the age of those users was  $66.24 \pm 8.92$ . More than half of the COPD patients using rotahalers were females (55%) and from rural areas (58%). More than two-thirds of

them were illiterate (68.6%) and unemployed (66.2%). Among the literates, the maximum number (41.66%) of DPI users had basic education. The majority (46%) of the respondents had used the rotahaler for less than a year.

**Table 2: Health care provider-related factors affecting knowledge and practice of dry powder inhalation among COPD patients**

Health care provider related factors	Number	Percentage
<b>Verbal instruction on dry powder inhalation use</b>		
Received verbal instruction	198	99
Not received verbal instruction	2	1
<b>Observed demonstration of rotahaler use</b>		
Observed demonstration	30	15
Not observed demonstration	170	85
<b>Performed re-demonstration</b>		
Performed	2	1
Not performed	198	99
<b>Re-demonstration of rotahaler use by patient on each visit</b>		
Performed	–	–
Not performed	200	100

Regarding instruction, nearly all (99%) of the rotahaler users got verbal instruction regarding the use of the rotahaler. However, only 15% of the respondents had observed a demonstration of dry powder inhalation from health care providers. 1% of the respondents were given an opportunity for

re-demonstration and were observed doing re-demonstration by the care providers at their first use of the rotahaler; however, none of them were rechecked on their inhalation technique during their follow-up visits.

**Table 3: Knowledge about dry powder inhalation among COPD patients**

Aspects of knowledge	Correct item score	Correct item percentage
Site of storage of rotacaps	180	90
Nature of breathing during inhalation	160	80
Percentage of drug that reaches the lung	36	18
Position of head during inhalation of drug	50	25
Holding of breath after inhalation	26	13
Cleaning of rotahaler	90	45

The majority of the DPI users (90%) had correct knowledge about the storage of rotacaps. They were aware that rotacaps should be kept in a cool place away from moisture, and four-fifths of them (80%) were aware that they should take a slow deep breath while inhaling the drug. However, only 13% of them possessed the correct knowledge on holding breath for 10 seconds after deep inhalation of the drug.

**Table 4: Stepwise practice of dry powder inhalation through the rotahaler among COPD patients**

Steps	No. of correct responses	Percentage
Keep rotahaler upright	198	99
Insert rotacap with transparent end down	184	92
Keep rotacap horizontal	198	99
Rotate both ends to open the capsulet	190	95
Exhale to residual volume	50	25
Keep rotahaler vertical	192	96
Keep mouthpiece between the teeth and lips	168	84
Slightly extend the head	90	45
Inhale forcefully and deeply	160	80
Hold breath for 10 seconds	72	36
Exhale away from the mouthpiece	170	85
If powder still remains inside rotahaler, breathe in again and hold breath for 10 seconds	10	5
Open the rotahaler and discard the empty capsule	196	98

Regarding practice, the item most correctly performed by the rotahaler users was keeping the Rotacap horizontal (99%) followed by keeping the rotahaler upright (99%) and opening the rotahaler and discarding the empty capsule (96%). In contrast, the least correctly performed step was

breathing in again and holding the breathe for 10 seconds (5%), which is also a combination of steps. Regarding the essential steps, the majority of the COPD patients correctly performed the step "Keep rotahaler upright" (99%) followed by "Rotate both ends to open the capsulet" (95%).

**Table 5: Association between health care provider-related factors and the practice of dry powder inhalation among COPD patients**

Care provider related factors	Practice		p-value
	Correct	Incorrect	
<b>Obtained verbal instruction</b>			—
Obtained	6	192	
Not obtained	0	2	
<b>Practical classes/demonstration</b>			<0.001
Obtained	8	22	
Not obtained	1	169	

There was statistically significant association of practice of dry powder inhalation with a demonstration of dry powder inhalation by health care providers ( $p < 0.001$ ). Those who received a demonstration on the use of the rotahaler from

healthcare providers performed the inhalation more accurately than those who did not.

## Discussion

Asthma and chronic obstructive pulmonary disease (COPD) are chronic inflammatory pulmonary diseases affecting millions of people worldwide. [18] Inhaled therapy can be delivered via nebulizers, pressurized metered-dose inhalers (MDIs), dry powder inhalers (DPIs), and soft mist inhalers (SMIs). Studies consistently report that many patients with asthma and COPD do not use their inhaler devices correctly. [19,20] Indeed, medications cannot be effective if they do not reach the sites they are intended to target. [21,22] Poor inhaler technique stems from the fact that patients often poorly understand the purpose of and how to use their inhalation device. [23] Poor adherence is common, with 50% or more of patients with asthma and COPD not taking their inhaled therapy as prescribed or instructed. [24,25]

The study showed that nearly half (49%) of the rotahaler users belonged to the 61–70 years age group. The overall mean and SD of the age of those users was 66.24±8.92. More than half of the COPD patients using rotahalers were females (55%) and from rural areas (58%). More than two-thirds of them were illiterate (68.6%) and unemployed (66.2%). Among the literates, the maximum number (41.66%) of DPI users had basic education. The majority (46%) of the respondents had used the rotahaler for less than a year. Regarding instruction, nearly all (99%) of the rotahaler users got verbal instruction regarding the use of the rotahaler. However, only 15% of the respondents had observed a demonstration of dry powder inhalation from health care providers. The majority of the DPI users (90%) had correct knowledge about the storage of rotacaps. They were aware that rotacaps should be kept in a cool place away from moisture, and four-fifths of them (80%) were aware that they should take a slow deep breath while inhaling the drug. Regarding practice, the item most correctly performed by the rotahaler users was keeping the Rotacap horizontal (99%) followed by keeping the rotahaler upright (99%) and opening the rotahaler and discarding the empty capsule (96%). In contrast, the least correctly performed step was breathing in again and holding the breathe for 10 seconds (5%), which is also a combination of steps. Regarding the essential steps, the majority of the COPD patients correctly performed the step “Keep rotahaler upright” (99%) followed by “Rotate both ends to open the capsulet” (95%). Regarding the single step, most commonly committed error was not being able to exhale to residual volume. Similar results have been reported in other studies. [26-29]

There was statistically significant association of practice of dry powder inhalation with a demonstration of dry powder inhalation by health care providers ( $p < 0.001$ ). Those who received a

demonstration on the use of the rotahaler from health care providers performed the inhalation more accurately than those who did not. Numerous studies have shown that it is very typical for inhaler devices to be used incorrectly. [30,31] Because they demand more patient coordination and cognitive abilities, metered dose inhaler (MDI) devices have been linked to higher rates of misuse. The incorrect use of MDI devices was discovered in seven large-scale studies to range from 71% to 89%. Inability to hold one's breath and failure to coordinate inhalation and device actuation were the most frequent mistakes. [32,33] In regard to the essential items, the most frequently committed error was in the step, inhale forcefully and deeply. [33,34] This error halts the deposition of inhaled drug into the lungs, resulting in poor treatment outcome. However, this result contrasts with the study by van der Palen et al, which showed that the most frequent error was keeping the rotahaler upright. [35] This inconsistency may be associated with the quality of instruction from the health care providers and their emphasis on item skills.

## Conclusion

It was concluded that COPD patients using the rotahaler possessed a satisfactory level of knowledge and poor practice of dry powder inhalation. Regarding practice, the most commonly performed error among rotahaler users is not exhaling prior to inhalation followed by the inability to hold one's breath for 10 seconds. However, practice of essential items of the inhalation procedure is better compared with the practice of all of total items.

## References

1. World Health Organization. Chronic Respiratory Diseases. Geneva: Switzerland; 2017.
2. Guarascio AJ, Ray SM, Finch CK, Self TH. The clinical and economic burden of chronic obstructive pulmonary disease in the USA. *Clinicoecon Outcomes Res.* 2013; 5:235–245.
3. Blasi F, Cesana G, Conti S, et al. The clinical and economic impact of exacerbations of chronic obstructive pulmonary disease: a cohort of hospitalized patients. *PLoS One.* 2014; 9(6):e101228.
4. World Health Organization. Chronic obstructive pulmonary disease (COPD). Fact sheet N°315. Geneva: Switzerland; 2015.
5. Baral, M. A. Knowledge and practice of dry powder inhalation among patients with chronic obstructive pulmonary disease in a regional hospital, Nepal. *International Journal of General Medicine,* 2018; 31-37
6. Hanania, N. A., Wittman, R., Kesten, S., & Chapman, K. R. (1994). Medical personnel's knowledge of and ability to use inhaling devices: metered-dose inhalers, spacing chambers,

- and breath-actuated dry powder inhalers. *Chest*, 1994;105(1): 111-116.
7. Hesselink AE, Penninx BW, Wijnhoven HA, Kriegsman DM, van Eijk JT. Determinants of an incorrect inhalation technique in patients with asthma or COPD. *Scand J Prim Health Care*. 2001;19(4):255–260.
  8. Pun S, Prasad GK, Bharati L. Assessment of inhalation techniques in copd patients using metered-dose inhaler and rotahaler at a tertiary care hospital in Nepal. *Int Res J Pharm*. 2015; 6(5):288–293.
  9. Shrestha S, Sapkota B, Ghimirey A, Shakya R. Impact of counseling in inhalation technique (rotahaler) in chronic obstructive pulmonary disease patients. *Int Res J Pharm*. 2013; 3(3):442–449.
  10. Aydemir Y. Assessment of the factors affecting the failure to use inhaler devices before and after training. *Respir Med*. 2015;109(4):451–458.
  11. Price D, Thomas M, Mitchell G, Niziol C, Featherstone R. Improvement of asthma control with a breath-actuated pressurised metered dose inhaler (BAI): a prescribing claims study of 5556 patients using a traditional pressurised metered dose inhaler (MDI) or a breath-actuated device—respiratory medicine. 2003 Jan 1;97(1):12-9.
  12. Vogelmeier CF, Criner GJ, Martinez FJ, Anzueto A, Barnes PJ, Bourbeau J, Celli BR, Chen R, Decramer M, Fabbri LM, Frith P. Global strategy for the diagnosis, management, and prevention of chronic obstructive lung disease 2017 report. GOLD executive summary. *American journal of respiratory and critical care medicine*. 2017 Mar 1;195(5):557-82.
  13. Kozma CM, Slaton TL, Monz BU, Hodder R, Reese PR. Development and validation of a patient satisfaction and preference questionnaire for inhalation devices. *Treatments in respiratory medicine*. 2005 Feb; 4:41-52.
  14. Rootmensen GN, Van Keimpema AR, Jansen HM, de Haan RJ. Predictors of incorrect inhalation technique in patients with asthma or COPD: a study using a validated videotaped scoring method. *Journal of aerosol medicine and pulmonary drug delivery*. 2010 Oct 1;23(5):323-8.
  15. Kaya A, Erkocoglu M, Akan A, Vezir E, Azkur D, Ozcan C, Civelek E, Toyran M, Giniş T, Misirlioglu ED, Kocabas CN. TRACK as a complementary tool to GINA and NAEPP guidelines for assessing asthma control in pre-school children. *Journal of Asthma*. 2014 Jun 1;51(5):530-5.
  16. Giraud, V., & Roche, N. Misuse of corticosteroid metered-dose inhaler is associated with decreased asthma stability. *European Respiratory Journal*, 2002;19(2): 246-251.
  17. Global Initiative for Chronic Obstructive Lung Disease. GOLD 2017 Global Strategy for the Diagnosis, Management and Prevention of COPD.
  18. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the global burden of Disease Study 2016. *Lancet*. 2017; 390:1151-210.
  19. Chrystyn H, van der Palen J, Sharma R, Barnes N, Delafont B, Mahajan A, Thomas M. Device errors in asthma and COPD: systematic literature review and meta-analysis. *NPJ primary care respiratory medicine*. 2017 Apr 3;27(1):22.
  20. Price DB, Román-Rodríguez M, McQueen RB, Bosnic-Anticevich S, Carter V, Gruffydd-Jones K, Haughney J, Henrichsen S, Hutton C, Infantino A, Lavorini F. Inhaler errors in the CRITIKAL study: type, frequency, and association with asthma outcomes. *The Journal of Allergy and Clinical Immunology: In Practice*. 2017 Jul 1;5(4):1071-81.
  21. Levy ML, Hardwell A, McKnight E, Holmes J. Asthma patients' inability to use a pressurised metered-dose inhaler (pMDI) correctly correlates with poor asthma control as defined by the global initiative for asthma (GINA) strategy: a retrospective analysis. *Primary care respiratory journal*. 2013 Dec;22(4):406-11.
  22. Lavorini F, Magnan A, Dubus JC, Voshaar T, Corbetta L, Broeders M, Dekhuijzen R, Sanchis J, Viejo JL, Barnes P, Corrigan C. Effect of incorrect use of dry powder inhalers on management of patients with asthma and COPD. *Respiratory medicine*. 2008 Apr 1;102(4):593-604.
  23. Darbà J, Ramírez G, Sicras A, García-Bujalance L, Torvinen S, Sánchez-de la Rosa R. Identification of factors involved in medication compliance: incorrect inhaler technique of asthma treatment leads to poor compliance. *Patient preference and Adherence*. 2016 Feb 9: 135-45.
  24. van Boven JF, Chavannes NH, van der Molen T, Rutten-van Mólken MP, Postma MJ, Vegter S. Clinical and economic impact of non-adherence in COPD: a systematic review. *Respiratory medicine*. 2014 Jan 1;108(1):103-13.
  25. Molimard M, Raheison C, Lignot S, Balestra A, Lamarque S, Chartier A, Droz-Perroteau C, Lassalle R, Moore N, Girodet PO. Chronic obstructive pulmonary disease exacerbation and inhaler device handling: real-life assessment of 2935 patients. *European Respiratory Journal*. 2017 Feb 1;49(2).
  26. Pun S, Prasad GK, Bharati L. Assessment of inhalation techniques in copd patients using metered-dose inhaler and rotahaler at a tertiary

- care hospital in Nepal. *Int Res J Pharm.* 2015;6(5):288–293.
27. Shrestha S, Sapkota B, Ghimirey A, Shakya R. Impact of counseling in inhalation technique (rotahaler) in chronic obstructive pulmonary disease patients. *Int Res J Pharm.* 2013;3(3): 442–449.
  28. van der Palen J, Klein JJ, Kerkhoff AH, van Herwaarden CL. Evaluation of the effectiveness of four different inhalers in patients with chronic obstructive pulmonary disease. *Thorax.* 1995;50(11):1183–1187.
  29. van Beerendonk I, Mesters I, Mudde AN, Tan TD. Assessment of the inhalation technique in outpatients with asthma or chronic obstructive pulmonary disease using a metered-dose inhaler or dry powder device. *J Asthma.* 1998; 35 (3):273–279.
  30. Rau JL. Practical problems with aerosol therapy in COPD. *Respiratory care.* 2006 Feb 1;51 (2):158-72.
  31. Molimard M, Raheison C, Lignot S, Depont F, Abouelfath A, Moore N. Assessment of handling of inhaler devices in real life: an observational study in 3811 patients in primary care. *Journal of aerosol medicine.* 2003 Sep 1;16(3):249-54.
  32. Giraud V, Roche N. Misuse of corticosteroid metered-dose inhaler is associated with decreased asthma stability. *European Respiratory Journal.* 2002 Feb 1;19(2):246-51.
  33. van Beerendonk I, Mesters I, Mudde AN, Tan TD. Assessment of the inhalation technique in outpatients with asthma or chronic obstructive pulmonary disease using a metered-dose inhaler or dry powder device. *Journal of Asthma.* 1998 Jan 1;35(3):273-9.
  34. Sapkota D, Amatya YR. Assessment of rotahaler inhalation technique among patients with chronic obstructive pulmonary disease in a teaching hospital of Nepal. *Kathmandu Univ Med J.* 2017;5(1):11–17.
  35. van der Palen J, Klein JJ, Kerkhoff AH, van Herwaarden CL. Evaluation of the effectiveness of four different inhalers in patients with chronic obstructive pulmonary disease. *Thorax.* 1995;50(11):1183–1187.