LEVEL OF INHALER TECHNIQUE KNOWLEDGE AND ITS ASSOCIATION WITH DURATION OF SERVICE IN PRIMARY CARE AMONG MEDICAL OFFICERS IN PENINSULAR MALAYSIA

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Abbreviations

BA : Bronchial Asthma

COPD : Chronic Obstructive Airway Disease

DPI : Dry Powder Inhaler

EPR-3 : Expert Panel Report 3 (EPR—3)

GINA : Global Strategy for Asthma Management and Prevention

GOLD : Global Initiative for Chronic Obstructive Lung Disease

pMDI : pressurized Metered Dose Inhaler

Abstrak

Tahap Pengetahuan Teknik *Inhale*r dan Kaitan dengan Tempoh Perkhidmatan dalam Penjagaan Primer di kalangan Pegawai Perubatan di Semenanjung Malaysia

Latar belakang: Rawatan aerosol (inhaler) yang digunakan dalam merawat penyakit saluran pernafasan kronik (iaitu Penyakit Paru-paru Obstruktif Kronik-COPD dan asma) datang dalam bentuk kabus / semburan atau serbuk kering, yang disampaikan kepada paru-paru melalui pelbagai reka bentuk peranti. Ubat pernafasan memerlukan teknik yang kompleks yang mungkin berbeza berdasarkan peranti untuk membolehkan ubat untuk sampai ke dalam paru-paru. Teknik yang tidak berkesan boleh menjejaskan penghantaran ubat ke paru-paru, dan pesakit selalu mempunyai teknik yang tidak tepat seperti yang terbukti dalam banyak kajian. Oleh itu, adalah penting bagi pegawai perubatan untuk mempunyai pengetahuan teknik *inhaler* yang mencukupi, kerana mereka adalah bertanggungjawab untuk penilaian pesakit dan pendidikan penggunaan *inhaler*. Kajian semasa ini dijalankan untuk memastikan kedalaman pengetahuan inhaler teknik pegawai perubatan di pusat penjagaan primer.

Objektif: Untuk mengkaji tahap pengetahuan *inhaler* teknik dalam kalangan pegawai perubatan dan kaitan dengan tempoh perkhidmatan dalam penjagaan primer.

Metodologi: Kajian keratan rentas dilakukan pada tahun 2017 dalam pegawai perubatan di penjagaan primer Di Semenanjung Malaysia yang melibatkan tiga negeri (iaitu Selangor, Kedah dan Kelantan). Soal selidik telah diedarkan kepada responden. Soal selidik meneliti data sosiodemografi, latar belakang pengalaman klinikal, pengetahuan mengenai teknik inhaler dan praktik dalam mengkaji teknik inhaler pesakit. Kemasukan dan analisis data dilakukan dengan menggunakan SPSS versi 24.

Keputusan: Kaji selidik telah melibatkan 122 pegawai perubatan. Purata umur responden adalah 33 tahun dengan kebanyakan responden adalah doktor wanita (n = 107, 87.7%). Mengenai pengalaman klinikal, tempoh perkhidmatan dalam penjagaan primer adalah purata 7 tahun dengan kekerapan memprikripsi ubatan menyedut inhaler sebanyak 5 kali dalam sebulan. Skor min pada teknik inhaler soalan pengetahuan dalam kalangan responden adalah 12 markah daripada 22. Analisis lanjut menggunakan ANCOVA menunjukkan bahawa tidak ada kesan yang signifikan tempoh perkhidmatan dalam penjagaan primer pada teknik pengetahuan teknik inhaler selepas mengawal kesan purata memberikan prekripsi inhaler dengan perbezaan min dilaraskan -0.727 (1.693,0.240), F (1,120) = 2.21, P = 0.132.

Kesimpulan: Dalam kajian ini, pengetahuan teknik inhaler dalam kalangan pegawai perubatan dalam penjagaan primer tidak berada pada tahap yang diharapkan. Selain itu, tidak terdapat perkaitan antara tempoh perkhidmatan dalam penjagaan primer dan tahap pengetahuan teknik inhaler. Intervensi yang mungkin seperti latihan dalam perkhidmatan mengenai peranti sedut mengikut garis panduan boleh menyebabkan peningkatan pengetahuan di kalangan pegawai perubatan penjagaan primer.

Kata kunci: teknik inhaler, pengetahuan, penjagaan primer

Abstract

Level of Inhaler Technique Knowledge and Its Association with Duration of Service in Primary Care Among Medical Officers in Peninsular Malaysia

Background: Aerosol medicine (inhaler) used in treatment of chronic airway diseases (i.e. Chronic Obstructive Pulmonary Disease and asthma) comes either in the form of mist/spray or dry powder, which are delivered to the lungs via various design of devices. Inhaler medicine requires a complex technique which may differ based on the devices to enable the drugs to reach the lungs. Ineffective technique may affect the delivery of drugs to the lungs, and patients are always having poor technique as proven in many studies. Thus, it is important for medical officers to have adequate inhaler technique knowledge, as they are the responsible for patient's assessment and education of inhaler use. The current study was thus conducted to ascertain the depth of inhaler technique knowledge of medical officers in primary care centres.

Objective: To study the level of inhaler technique knowledge among medical officers and its association with duration of service in primary care.

Methodology: A cross-sectional study was done in 2017 among medical officers at primary care in Peninsular malaysia involving three states (Selangor, Kedah and Kelantan). Self -administered questionnaires were distributed to the respondents. The questionnaire enquires on sociodemographic data, background on clinical experience, knowledge on inhaler technique and practice on reviewing patient's inhaler technique. Data entry and analysis was performed using SPSS version 24.

Result: The questionnaire was completed by 122 medical officers. The mean age of respondent was 33 years with most respondents was female doctors (n=107, 87.7%). Regarding clinical experience, the duration of service in primary care was on average 7 years with frequency of prescribing inhaler of 5 times in a month. The mean score on inhaler technique knowledge questions among the respondents only was 12 marks out of 22. Further analysis using ANCOVA showed that there was no significant effect of duration of service in primary care on inhaler technique knowledge score after controlling the effect of inhaler prescribing frequency with adjusted mean difference -0.727(1.693,0.240), $F(1,120)=2.21$, $P= 0.132$.

Conclusion: In the present study, the inhaler technique knowledge among medical officers in primary care was not at the expected level. Furthermore, there was no association between the duration of service in primary care and the level of inhaler technique knowledge. Possible intervention like in-service training regarding inhaler devices according to the guidelines may lead to improvement in the knowledge among the primary care medical officer.

Keywords: inhaler technique, knowledge, primary care

CHAPTER 1

INTRODUCTION

1.1 Background of inhalation devices and factors affecting inhalation techniques

For patient with obstructive lung diseases (i.e. asthma and chronic obstructive pulmonary disease (COPD) the mainstay of treatment is inhaled medications. Aerosol medications are prepared in the form of mist/spray or dry powder, which is delivered directly to the lung parenchyma via various design of devices (GINA, 2015; Anderson, 2005). There have been many advances in the technology of devices and formulations for inhaled drugs since 1950's, starting from pressurised metered dose inhaler (pMDI) followed by invention of breath actuated MDI-1971, and dry powder inhalers (DPI) such as Diskhaler in 1980, Turbuhaler in 1988, Autohaler in 1989, Diskus in 1995, and Novolizer in 2001 (Levy et al., 2016).

The use of different inhaler devices requires an appropriate and specific technique. Inhaled drug delivery systems can be divided into 3 types including pMDIs, DPI, and nebulizers. Each class has its unique strengths and weaknesses. A pMDI is made of a metal canister that consists of propellants, surfactants, preservative and drug. The metal canister is fitted into an actuator where the actuator nozzle function as a spray formation when used by the patient (Newman, 2005).

A problem with the technique in using the pMDI is well known. Since the delivery of drug is closely related to the technique, it can cause zero drug deposition into the lungs if the technique is incorrect. And if correct technique is not being used, most of the drug will mostly be deposited at the oropharynx area which can cause side effects such as hoarseness of voice or candidiasis especially for pMDI that contains corticosteroid.

Nevertheless, MDI can be considered as the "senior" device that has been used by many patients for 50 years in many countries. MDI remains as the leading choice for inhaler as it has several practical benefits of small size, portability, convenience and affordable. Nonetheless, MDI requires patient coordination during inhalation to ensure complete drug delivery to the lung.

A DPI is a device which the drug is combined with the carrier. Examples of DPI include Diskus inhaler, Turbuhaler, Easyhaler and HandiHaler. When a DPI is actuated, the formulation is fluidised and entered the patient's airways. Under the influence of inspiratory airflow, the drug particles separate from the carrier particles and are carried deep into the lungs, while the larger carrier particles deposit on the oropharyngeal surfaces and are cleared (Telko and Hickey, 2005). The advantages of DPI are it requires less patient coordination during inhalation and it is environmentally friendly since no propellant is needed in the formulation. There are several limitations for DPI such as it requires correct inhalation technique where it needs a deep and rapid inspiratory flow to achieve the deposition in the lung. In addition, compared to MDI, the DPI is more expensive.

The main principle when using both devices is correct technique. Literatures reveal a strong link between the technique and its lung deposition, where errors in inhalation technique lead to reduce drug deposition by approximately 30% for both inhalers (Longest, 2012). The poor inhaler technique will lead to impairment in its therapeutic effect and it is associated with an increase risk of hospitalisation, emergency room visits, and poor disease control (Melani et al., 2011).

Sociodemographic and disease factors among the patients play important roles in influencing the correct usage of inhaler devices. Among all the factors are educational status, gender, living in rural areas, duration of disease, and being diagnosed and

followed-up by a chest diseases specialist (Aydemir, 2015). According to Hamdan et al. (2013), lack of education and lack of follow-up contribute significantly to improper use of inhaler.

The magnitude of the problems or contributing factors may vary in different populations, thus it is important for healthcare professionals to review the inhaler technique of their patients at every clinic visit, especially if the disease control is still partly achieved or when changing to a new device. The review includes observing, checking, re-educating of the patient's inhaler technique as well as assessing their adherence to medication and its side-effect, and it should be done at every opportunity (GINA, 2015; GOLD, 2015). As suggested by Bosnic-Anticevich et al. (2010), patients have the tendency to decline in their technique after some time due to several reasons therefore continuous review by the doctors is necessary to avoid decline in their inhaler technique. In addition, to achieve an effective consultation during inhaler technique review, the doctors need to be fully equipped with adequate knowledge on the correct inhaler technique. Despite having educational resources available including practical guidelines, training, courses and continuous medical education (CME) programs, they have not yet been adequately utilised by many doctors (Roghmann and Sexton, 1999). A recent study by Cloutier et al. (2018) to evaluate adherence on asthma guidelines specifically on inhaler technique review, found only 16.8% of primary care physicians adhere to it.

1.2 Good practice in inhaler medicine review

Inhaler medicine review is one of the components in the management of Asthma or COPD (GINA, 2015; GOLD, 2015). The importance of reviewing the inhalation medicine is to make sure an effective use of inhalers. According to GINA (2015), 50% of patients misuse the medication such as either in the way of incompliance or misuse between controller or reliever medications. All medical officers should do the review at every opportunity by using the simple strategies recommended by the guideline which involves choosing the inhaler, checking the technique, correcting the patient, and confirming the inhaler (GINA, 2015).

Inhalation technique is an important aspect when using the inhaler. It is closely related with the delivery of the drug to the target organ. It is common that patients have problem in this aspect, yet this problem can be avoided through constant checking of the patient technique and re-demonstrating it correctly (Bosnic-Anticevich et al., 2010; GINA, 2015). Prior to inhaler medicine review, it is pertinent for the medical officers to know the essential steps for inhalation technique, so that complete patients' inhalation assessment can be done. Nevertheless, an adequate knowledge on the correct techniques even though easily can be learned from online guidelines, attending training/courses and CME are also important to ensure proper techniques are being exercised.

1.3 Justification of study

The prevalence of asthma among adults (18 years and above) in Malaysia was 4.5% based on the National Health and Morbidity Survey in 2006. It is widely known that patients commonly face problem in handling the asthma devices. A study found incorrect inhaler technique is still frequent, and has not improved for more than four decades (Sanchis et al., 2016). There are many factors associated with inhaler misuse among patients such as age, education level, type of inhaler device and poor instructions from healthcare personnel (Melani et al., 2011). Error in handling asthma medications lead to increase of hospitalisations, emergency room visits and medication usage including steroid and antibiotics. Nonetheless, education or training by health caregivers is the modifiable factor useful for reducing inhaler mishandling among patients (Aydemir, 2015; Melani et al., 2011b).

There are many available guidelines that can be retrieved from the website such as GINA for asthma and GOLD for COPD, as well as local guideline such as Malaysia Clinical Practice Guidelines on Asthma. All the guidelines emphasised on review on patient's inhaler technique as part of routine check when meeting with patient with chronic respiratory disease. However, in other countries, the practice is still not being actively performed (Plaza et al., 2012; Leung et al., 2015). Similarly, in Malaysia, patient's inhaler technique review may not actively being practiced by the medical officers. But, the important question is, how is our medical officer knowledege on inhaler technique since it is needed prior to patient assessment.

The study on the practice related to knowledge inhaler technique among medical officer is still scarce, especially in Malaysia therefore, the present study can serve as among the pioneer reports to provide the best care to chronic respiratory diseases in Malaysia. Finally, it is hoped that the study will provide valuable information regarding

current knowledge of medical officers in primary care regarding patient's inhaler technique. Hence, proper training and evaluation should be stressed at any levels, because this is the one of the modifying factors that can help to control patients' disease and complications. Furthermore, the findings of this study can assist in the patient management, where if patients have adequate knowledge and understanding about their own treatment as being learned from the medical officer, it helps in improving the efficacy of the treatment. Subsequently, it helps in controlling the disease, and brings the patient into a better quality of life.

CHAPTER 2

LITERATURE REVIEW

2.1 Chronic respiratory disease

Chronic respiratory diseases (CRDs) are diseases of the airways and other structures of the lung. Some of the most common diseases are COPD, asthma, occupational lung diseases and pulmonary hypertension. CRDs are not curable, however, various forms of treatment that help to dilate major air passages and improve shortness of breath can help to control the symptoms and increase the quality of life for people with the diseases.

Asthma can be defined as a disease with many variations (heterogeneous) usually characterised by chronic airway inflammation. It has two defining conditions which are respiratory symptoms characterised by wheeze, shortness of breath, chest tightness and cough with variable airflow limitation (GINA, 2015). Asthma is a common and treatable respiratory disease. It is a chronic disease that may burden the patient, family and the community. The condition leads to respiratory symptoms that have stable course or flare up (exacerbations) which sometimes requires urgent treatment. The most serious complication is, it can lead to fatality if not manage appropriately and adequately.

COPD is a spectrum of disorders used to describe chronic lung disease. It is characterised by airflow limitation which is progressive with incompletely reversible airflow obstruction (GOLD, 2015). The chronic airflow limitation is a mixture of small airway diseases. In other words, COPD is not a single entity, but it comprises of small airway disease (obstructive bronchiolitis) and lung parenchymal destruction (emphysema). However, both terms are no longer being used (GOLD, 2015).

Asthma and COPD patients are commonly followed up at primary care. The management of both diseases holds almost the same principle in terms of medication aspect (GOLD, 2015; GINA, 2015). Both diseases need medication that act and function directly to the lungs. To get the medication to the lung parenchyma, it must be delivered through inhalation process, which can be achieved by medical devices called 'inhaler'.

After the treatment has started, on-going process to evaluate the response and control of the asthma or COPD should be made to make sure the diseases are under controlled. The evaluation of the disease involves monitoring of the patient's symptom, the daily activities, any exacerbation or hospitalisation. This can be done in several ways, such as using asthma control questionnaire (ACQ) and asthma control test (ACT) that has been created based on GINA guidelines (GINA, 2015). While for COPD, monitoring of the symptoms can be done by Modified Medical Research Council (MMRC), Dyspnea Scale, COPD assessment test (CAT) or St. George's Respiratory Questionnaire (SGRCQ) (GOLD, 2015).

Other than the symptoms of the diseases, evaluation of the medication should also be done by the medical personnel (GOLD, 2015; GINA, 2015). Evaluation of medication will be on the adherence aspect and the medicine itself. The medical personnel need to make sure the patient is prescribed with the correct inhalation agent which suits the patient disease. Additionally, the review must include checking the correct agent (reliever or controller), the dose and frequency, as well as the practical aspect in which patient should be able to demonstrate the right technique in using the devices.

2.2 Inhaled medication

Main management of COPD and Asthma is using aerosol (inhaler) (GINA (2015), GOLD, 2015). Usually the medication consists of two types of inhalation agent, an anti-inflammatory which is inhaled corticosteroid e:g beclomethasone, budesonide, fluticasone and a bronchodilator known as inhaled beta-agonist e.g salbutamol, formoterol, salmeterol or anticholinergic e:g ipratropium bromide, tiotropium bromide (GOLD, 2015, GINA, 2015). The medication preparation may come as either single inhalation agent or combination of two types of inhalation agents depends on the types of inhaler device.

Even though there is another mode of delivery for asthma and COPD medication, studies clearly demonstrate, that inhaled therapy provides advantages compare to oral or parenteral. Delivery of the medication by inhalation, place the drug directly into the lungs as the target organ. Eventually, this will need a lower dose of the drug with a greater efficacy and resulting with less adverse effect (Rau, 2005). Apart from that inhalation therapy provide a fast onset compare to oral route painless and convenient (Kemp and Meltzer, 1990).

Inhaled medications for asthma and COPD are available in the form as pressurized Metered Dose Inhaler (pMDI), breath-actuated MDIs, dry powder inhalers (DPIs) and Nebulizers (GOLD, 2015, GINA, 2015). Inhaler devices have different efficiency in the action which depends on the type of the device, the formulation, the particle size, dose during each delivery, and patient factor. Pressurized metered dose inhaler (pMDI), is an aerosol and currently one of the most common types of inhaler. The medication comes out of the inhaler as a mist or spray (GINA 2015, GOLD, 2015, National Asthma Council Ausralia, 2016). Breath-actuated MDI will function as automatically release a spray of medication when the person begins to inhale (GOLD 2015, GINA, 2015, National

Asthma Council Ausralia, 2016). Dry powder inhalers (DPIs) are inhalers, which delivers the drugs in dry powder form. The medication delivered by many kinds of different device designs like Accuhaler/Diskuss, Easyhaler, Handihaler or Turbuhaler (GINA, 2015, GOLD, 2015, National Asthma Council Ausralia, 2016). A nebulizer (or JET inhaler) is an electric or battery-powered compressor to which tubing is attached. The nebulizer tubing consists of a hollow tube connected to a nebulizer cup, which holds the liquid medication. When the compressor is turned on, air flows through the tubing to the cup, causing a mist (aerosol) of the medication. The medicated mist is inhaled through a mouthpiece or mask attached to the medication cup (GINA, 2015, GOLD, 2015, National Asthma Council Ausralia, 2016). However, even though there are many types of inhaler devices, when it comes to usage of the inhaler (pMDI /DPI /nebulizer) there were no differences in terms of drug efficacy (Dolovich et al., 2005, Srichana et al., 2016).

All inhalers have specific steps to be followed which may differ in between the device which essential to be familiar among the patient and as well as the healthcare provider, because they will do the assessment during the patient follow up. The steps for each device are listed in appendix (GINA 2015, EPR-3, 2007, National Asthma Council Ausralia, 2016). Within all the steps in each device, there are optimal steps needs to be done perfectly when use the device, because if it is not done or poorly done it will result with minimal or no drug delivery to the lungs. All the optimal steps also included in the appendix 2,3,4 (GINA 2015, EPR-3, 2007, National Asthma Council Ausralia, 2016). At the primary care level in Malaysia, especially at the government health clinics there are lists of inhaler medications which can be prescribed to the patients. According to the Malaysia Drug Formulary, the list of inhalers that available in health clinic are presurrised Metered Dose Inhaler (pMDI) (e:g MDI Salbutamol, MDI Ipratopium Bromide, MDI Budesonide, MDI Beclomethasone, MDI Fluticasone), while Dry Powder Inhaler (DPI)

(e:g *Symbicort* Turbuhaler, *Seretide* Accuhaler, and *Spiriva* Handihaler So, all the medical officer at primary care level should be able to know and familiar with all these types of inhaler, especially the technique.

2.3 Patient and Inhaler technique

The relationship to successful treatment needs patient cooperation. Patient will play a key role because the frequency of meeting the medical personnel only by appointment which can be weeks or months. Factor such as compliance, understanding the rules or direction of medicine intake can affect the efficacy of the treatment. For inhaler medicine, one of the important issues is the technique to take the medicine (GINA 2015, GOLD, 2015). To be noted inhaled medication does not reach to lungs 100% during each inhalation as proven by studies where a study done by De Backer and colleagues found average lung deposition was $34.08 \pm 9.30\%$ among healthy subjects (De Backer et al., 2010). Another study, found under best circumstances around 15-20% of the inhlaed medication reaches the lungs. However, with correct inhalation techniques, it shows the drug amount deposition can increase to 22.8% from 7.2 % (Erk, 2002).

Studies among the patient found that, the majority of them have a poor technique in execution to use the inhaler (Melani et al., 2011, Shrestha et al., 1996, Hamdan et al., 2013). Bonavia and collegues, in the year of 2011 had conducted a study on prevalence and associated factors for inhaler mishandling among 1664 adults with chronic obstructive pulmonary disease-COPD or asthma in Italy, found that the issue under study is still common. The failure rate of using inhaler correctly ranging from 12% for Metered Dose Inhalers, and even higher, 35% for Diskuss® and HandiHaler® and 44% for Turbuhaler (Melani et al., 2011). A study in the United States among asthma patient who presented at an urban Emergency Department found only 21% from 125 subjects able to

perform all steps in using the metered dose inhaler(MDI) (Shrestha et al., 1996). While a study in Saudi Arabia, revealed almost 45% of the 414 subjects use MDI unable to perform the technique correctly (Hamdan et al., 2013).

From the literature review, a large study conducted involving 3811 primary care outpatient, common mistakes made by the subjects when using any inhaler devices were failure to exhale before inhalation and not holding breath for a few seconds. And in more specific technique errors in the same study, subject who was using a presurrised metered dose inhaler (pMDI) did not perform "slow and deep inhalation" after actuation", and did not "pressing the canister once only for each inhalation". While subject with dry powder inhaler (pMDI) eg *Turbuhaler* made mistakes like not holding up right and wrong way to activate the inhaler (Molimard et al., 2003).

Poor inhaler technique among patient is a common issue related to inhaler device for many years (Sanchis et al., 2016) and it is associated with poorly controlled of the disease, exacerbation and multiple visits to A&E (Melani et al., 2011, Hamdan et al., 2013)**.** All the adverse effect of this can affect the quality of the patient's life and burden to the caregivers. So it is very clear that appropriate use of inhaler device should be incorporated each time during discussion of treatment with the patient where this aspect is emphasised in the guidelines (GOLD, 2015, GINA, 2015)

There are many factors associated with poor usage of inhaler device. A few studies showed physician related factor can lead into error in the inhaler use. One of the study found that lack of instruction received for the use of inhaler by the healthcare personnel was significantly lead to inhaler mishandling among patient (Melani et al., 2011). This was supported by a study, which revealed that a lack of education about the disease or a lack of regular follow-up was more likely to lead to the improper use of an inhaler device (Hamdan et al., 2013). Another factor was the type of inhaler, in which it was appeared

as a determinant of incorrect inhalation technique. Studies found in comparing the patients using different types of devices, patients using the pressurised metered dose inhaler (pMDI) were at significantly higher risk of making inhalation mistakes (Aydemir, 2015, E. Hesselink, 2001).

Apart from personal understanding about the techniques, patients' socio-demographic factors play an important role in determining how patients handling the inhaler. In 2011, Melani and colleagues found association between inhaler mishandling misuse and older age and lower schooling status. The findings from the Melani and colleagues was further supported by the study Aydemir on 2015, where they found low level in education was a significant factor on failure use of inhaler but the significant was disappear after training and education to the patient. However, duration of disease (longer duration) and frequent hospitalisation associated with a better inhalation technique (Aydemir, 2015). Factor such as type of the disease either bronchial asthma or chronic obstructive pulmonary disease-COPD was not reported as having any significant association with poor inhalation technique (Aydemir, 2015). Because of multiple factors that can lead to poor inhaler technique among patient, it is wisely for physician to always check the technique on every visit.

Even though there many associated factors on poor inhaler use, there is room of improvement to tackle this problem. Guidelines already implemented strategies to ensure effective inhaler use to be practiced by the health care provider during review patient (GINA, 2015, EPR-3, 2007). Education is very important aspect to the patient, because, there is no such term "a perfect inhaler", because patient may or may not face problem with inhaler technique. A study by Jolly and Mohan et al., (2015) proved inhalation techniques improved after imparting systemic educational intervention.

2.4 Healthcare professionals' knowledge on inhaler device inhalation technique

Healthcare providers play a pivotal role in imparting a correct knowledge and the accurate use of presurrised metered dose inhaler (pMDI) or dry powder inhaler (DPI) technique among asthmatic and chronic obstructive pulmonary disease-COPD patients. As opposed to other diseases, treating asthma and chronic obstructive pulmonary disease-COPD requires the proper use of inhalers and not just by merely swallowing pills to treat most other diseases. As the head of clinic, the doctors are required to not only be competent clinicians but also good managers to various staffs under their care, including nurses, medical assistants, and pharmacists in managing the patients. As a team, they are responsible in providing appropriate services to patients depending on their roles. Among the key role is to ensure that patients get the maximum benefits from the inhaled therapy provided at the healthcare facilities. Although there are health personnel who assist in evaluating and educating patients on correct inhaler technique, doctors are required to ensure that patients use the inhaler properly.

At certain stage during treatment, there is a clinical requirement to step-up the inhaler types to a higher efficacy level due to uncontrolled of the disease. Nonetheless, prior to change of any inhaler to a higher level, prescriber needs to perform inhaler technique assessment to ensure the reason of uncontrolled of the disease is not caused by improper inhaler technique (GINA, 2015, GOLD, 2015). Correct inhaler techniques will affect the effectiveness of treatment received by the patient (Melani et al., 2011) where inabilities to properly use inhalers among patients lead to prevalence of disease. While there are many patient education sources available such as mini talks, brochure or internet on the correct use of inhalers, most patients do not participate in such formal programs and instead rely on instruction or education received from doctors in the clinic. Takemura (2011) found that repeated education by the doctor on inhalation techniques may

contribute to adherence to therapeutic regimens, which relates to better health status to the patients (Takemura et al., 2011).

Therefore, it is very important for medical officers to have sufficient knowledge on the correct and proper techniques involving the use of inhaler. Medical officers are required to know the technique in the use of inhalation devices as it is important to carry out the assessment and thereby correct the patient's technique on the use of the inhaler. Several studies are available which identify the factors associated with the use of inhalation devices and the efficacy of the treatment. Although several studies have shown factors involving patients such as poor knowledge on the proper technique lead to poor clinical outcome, similar trend is also observed among medical officers who lack knowledge on the correct use of the inhalation device (Plaza et al., 2018)

In 2013, Caliskaner surprisingly found only 18.5% of 685 doctors self-reportedly claimed to have had adequate knowledge of inhaler devices and proper administration techniques including the respiratory specialists, internal medicine specialists, paediatricians, family physicians and general practitioners (Calışkaner et al., 2013). Another cross-sectional study in Nigeria around 2018 found only 9 out of the 75 (12%) doctors knew at least 3 essential steps of the techniques of using the metered-dose inhaler (MDI) correctly (Adeniyi et al., 2018). Nonetheless, the data on the mentioned study are based solely on the results of a survey on self-perceived knowledge and may not reflect subject's behaviour in actual clinical practice.

However, a greater understanding on the doctors' knowledge on inhaler technique is observed in a study by Kim where the authors determined the doctors' knowledge objectively. The assessment was conducted by asking doctors to demonstrate the inhaler technique, in which their performances were graded as either good, adequate or inadequate based on the checklist for each device. Almost half of them (142 doctors)

unable to perform the technique well, where the performance grade was inadequate for 50.7% of them while using metered dose inhaler (MDI), 43.0% for Diskuss, and 51.4% for Turbuhaler (Kim et al., 2009). Indeed, all reported studies, either through theoretical or demonstration approach, show the knowledge on inhaler technique among doctors was not adequate for quite some period despite being the main person in educating, assessing and prescribing the inhalers to their patients (Plaza et al., 2018). The poor understanding of the correct use of these devices may prevent these healthcare professionals especially the doctors from being able to adequately assess and teach proper inhalation techniques to their patients (Plaza et al., 2018).

2.5 Factors associated with doctors' knowledge on inhaler technique

Despite having a plethora of studies on the factors involving patients and the inhaler techniques, limited studies are available which asses the associated factors for doctors' knowledge on inhaler techniques. In a literature review by Basheti and the colleagues in 2014 assess the ability of a range of healthcare professionals (HCPs) (e.g. specialists physicians specializing in management of airways disease, general practitioners, pharmacists, pharmacist assistants, nurses, and respiratory therapists). The study found that the background of the healthcare can determine their knowledge on the inhaler, where the specialists group had better inhaler technique knowledge and higher confidence levels in demonstrating technique at baseline than other HCPs (Basheti et al., 2014). The finding also was supported by Fattah et al. (2017), where specialty background may also influence the knowledge on inhaler. In the study, chest physicians scored higher marks compared to other groups regarding inhaler technique knowledge (66.7%), followed by internist, primary-care physician and paediatricians who scored the lowest. It is suggested that the better knowledge on proper inhaler technique among the specialist

group could be due to their experience, as most of them have duration of working longer compared to the other groups. However, no statistical analysis was performed to support the assumption.

However, in a cross-sectional study by Khan and Azhar (2013) among 150 community pharmacists, the authors found that the respondents have moderate knowledge on the proper use of inhalers. In addition, the authors found that pharmacists have increased level of knowledge in the correct technique involving inhalation devices due to their job experience in describing health prescription. Pharmacists aged 30 – 35 years have significantly higher knowledge on the correct use of inhalers. Surprisingly, job experience of 3-4 years was significantly correlated with better knowledge on the appropriate use of inhalers compared to pharmacists with more experience. The data is in contradictory to the aforementioned studies where duration of profession is highly associated with better knowledge on inhaler technique.

On the contrary, in another recent study which also involved pharmacist community, Belachew et al. (2017) found that other than history attendance in inhaler training, other factors such as educational status, work experience, working sector had no significant association with competency of delivering sufficient inhalational techniques (Belachew, 2017)

Apart from the duration of working, inhaler prescription habit among the doctors also was found to be a significant factor on inhaler knowledge. This statement was supported by a study done in 2017 among 443 Egyptian doctors. The study was comparing between those who usually prescribe the inhalers compare to sometimes/never prescribe any inhaler. Analysis of the data found a significant association ($p=0.001$) between good inhaler knowledge and the group who usually prescribe inhalers (Fattah et al., 2017).

In terms of sociodemographic factors such as age or gender of doctors, several studies found there was no association with the knowledge on inhaler technique. In a study involving 50 family physicians who work in primary health care, the subjects were assessed on their inhaler knowledge and the associated factors (Tanrıverdi et al., 2015). The assessment was performed using a questionnaire and demonstration on the inhaler technique of several inhalation devices inclduing metered dosi inhaler (MDI), Turbuhaler, Diskuss, and HandiHaler. There was no association between the inhaler devices usage scores and the sociodemographic factors such as sex and age of the doctors. The findings of this study were also supported by Fattah (2017) and Basheti (2016) where sociodemographic characteristics (age and gender) were not significantly associated with the knowledge on inhaler techniques.

2.6 Medical personnel and inhaler technique review

Medical personnel are the most important contact person for any patient with an underlying medical disease. The role of them, not only limited to taking history, physical examination, making the diagnosis, but also involved in the management and follow-up, especially in chronic diseases such as diabetes, hypertension, asthma, chronic obstructive pulmonary disease-COPD and many more. In asthma and chronic obstructive pulmonary disease-COPD patient, the vital role of medical personnel is to make sure the disease is under control. To achieve this aim, one of the responsibilities is to review the treatment given to the patients. The recommended practice on review of the inhaled medication is, it should be done at every clinic visit, as recommended by many major guidelines (GINA, 2015, GOLD, 2015, EPR-3, 2007). This is because there will be tendency of the patient technique to fall off by the time. During reviewing the medication, especially the inhaled medications, all medical officer should check the type of inhalation devices either it is a

pressurized metered dose inhaler(pMDI), breath actuated MDI or a dry powder inhaler (DPI). Then, the medical officer must confirm the drugs that consist in the devices either it is reliever agent like inhaled beta-agonist (salbutamol/formoterol/salmeterol) or anticholinergic (ipratropium bromide/tiotropium bromide) or controller agent (inhaled corticosteroid e:g beclomethasone/budesonide/fluticasone etc.). The medication can come as a single or combination of reliever and controller (GINA, 2015, GOLD, 2015).

Medical personnel should educate the patient the purpose of medication given to the patient so that they can have a better understanding and compliance (GOLD, 2015, GINA, 2015). Once the device is confirmed, then the dosage and frequency should be correct. And lastly the important step is to check the patient's technique depending on the types of the device (GINA, 2015, GOLD, 2015, EPR-3, 2007).

To check either patient's inhaler technique is correct, it is utmost the medical personnel know how to use the inhaler devices. However, studies show medical personnel had inadequate knowledge and poor technique on inhalation device as discussed on earlier section on healthcare professionals' knowledge on inhaler device inhalation technique. As mentioned in the paragraph, it utmost of medical officer to review patient's inhaler technique during follow-up, because most patient still have problem with the use inhaler device. Important component on inhaler review is it must be done on every follow-up, checking the technique by patient to perform the inhaler use, and lastly correction or education of inhaler technique by physical demonstration using placebo inhaler (GINA, 2015).

Literature review on the first component of assessing patient's inhaler technique found many studies showed the recommendation to check inhaler at every follow-up still below expectation. This can be seen from a study found only 24% out of 307 general practitioners always assess the inhaler technique (Plaza et al., 2012). A latest study in

2017, only 58% from 67 general practitioners who always assess the patient skill using the inhaler during clinic visit (Fattah et al., 2017). The next component when review the inhaler technique is to assess the capability of the patient to use the inhaler. Assessment of the technique cannot be done by verbal answer only. It is important for patient to demonstrate the technique in front of the medical officers, because a study found prevalence of patient with asthma and chronic obstructive pulmonary disease-COPD unable to demonstrate the use of dry powder inhaler correctly was between 4% to 94% (Lavorini et al., 2008). This is further supported by another study where they found 94.2% of patients who claimed to know how to use inhalation devices (by verbal answer), in fact committed error in at least one inhaler step. This showed that their technique was inappropriate and reveals a discrepancy between understanding and practice (Souza et al., 2009).

Although, it is important to see demonstration of inhaler use by the patient, this recommendation was not being practice it should be. A study among healthcare providers in New York revealed only 5.3% of them asked the patients to demonstrate the technique (Reznik et al., 2014). Education or correction of inhaler technique must be done to improve any faulty steps detected after earlier assessment done. This has been recommended by the guideline in which doctors or physicians should predominantly correct patients' technique. (GINA, 2015). The need of physician to demonstrate the technique was further reinforced by Price et al. (2018) where in their study, they found that patients preferred their physicians to train them by: demonstrating inhaler use (83%), followed by showing educational videos (58%), giving further instructions for it uses (51%), and providing leaflet (34%).

Despite that, looking at the previous studies, diverse results were found in-terms of practice of general practitioners on this recommendation. Plaza et al. (2012) reported

only 33.8 % of doctors provided inhaler technique education to their patients , while in another study, around 50% (Fattah et al., 2017). Correcting technique by physicians' demonstration is well accepted by guideline (GINA, 2015, GOLD, 2015) and this was highlighted by one study in Turkey, where it showed patients' technique improved greatly after being educated by physical demonstration of their doctors during clinic sessions. This was observed in 44 out of 108 patients (40.7%) who used one or more inhalers inappropriately where after correction by the physician demonstration on initial visit, re-evaluation of the technique on subsequent visit found significant decrease to 8.3% ($p < 0.001$). A similar study also found practical demonstration can achieved success as high as 80.4% (Aksu et al., 2016) .

However some centres may use the pharmacist or staff nurse as the educator. A study done to see effectiveness inhaler education by the pharmacist found the percentage of patients with optimal inhaler technique rose from 24% before to 79% after training ($p<0.001$), the researchers concluded that inhaler training by pharmacists is feasible and seems to improve inhaler technique (Giraud et al., 2011). While among staff nurse, a study proven that they also can be appointed as educator for inhaler technique education, where a study conducted to assess the impact of nurse-driven inhaler education on the compliance and proficiency of using inhalers among inhaler users yielded positive outcomes in both patient's inhaler proficiency and compliance (Al-Kalaldeh et al., 2016)

The advantages of checking the inhaler technique, not only to identify and correct any errors, but the physician can assess if any difficulties using any specific inhaler which needs consideration changing to other types that suits for a particular patient. Finally, following recommendation by the guidelines in the review of inhaler technique not only able to improve the technique over the time, but in term of psychological effect, it also found that patients who were checked for inhaler technique felt more confident that they

received the full dose compared to those who were unchecked (Price et al., 2018). And among patients who were the technique was checked were significantly more adherent to the treatment (p=0.020) (Price et al., 2018).

Finally, patient's inhaler technique review practice was carried out below than the recommended guidelines especially on the frequency and approach used in technique assessment, where inhaler review should always been done and the technique must be check by patient demonstration at every opportunity (GOLD, 2015, GINA, 2015, EPR-3, 2007) . Factors related to the under practice were no access to device (66%), lack of time (50%), lack of knowledge (28%), lack of patient interest 19%) (Reznik et al., 2014). A summary on recommended strategies to ensure effective use of inhaler device is listed below based on the GINA *Global Strategy for Asthma Management and Prevention.*

Table 2.1 Summary on recommended strategies to ensure effective use of inhaler GINA (2015)

Choose	Most appropriate device for patient, taking account on comorbid, patient skill, availability, cost Avoid use of multiple different inhaler types where possible, to avoid confusion
Check	Check inhaler every opportunity Ask patient to demonstrate how they use inhaler Identify any errors using a device-specific checklist
Correct	Show the patient how to use the device correctly with a physical demonstration, e.g. using a placebo inhaler Check technique again, paying attention to problematic steps. Only consider an alternative device if the patient cannot use the inhaler correctly after several repeats of training
Confirm	Clinicians should be able to demonstrate correct technique for each of the inhalers they prescribe

2.7 CONCEPTUAL FRAMEWORK