



# Exploring General Practitioners' Preferences and Experience with Respiratory Inhaler Devices

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## ABSTRACT

**Introduction:** Correct inhaler technique is essential for the optimal delivery of inhaled medicines and the successful management of respiratory conditions. The general practitioner (GP), the prescriber of inhaled medicines, plays a crucial role in educating patients on inhaler

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technique. However, in the real-world setting, there are barriers. For the GP, it is time and competence and for the patient, it is their ability to recognise inhaler technique as an issue and their ability to maintain correct inhaler technique over time. This study aimed to determine GPs' experience, skills and priority placed on inhaler technique and to identify factor(s) associated with inhaler technique competence.

**Methods:** This cross-sectional observational study design surveyed GPs' perspectives on inhaler use and preferences for inhaler prescribing within their practice setting. GP inhaler technique was assessed. GPs were recruited through an established network of GP practices. Data collected include (i) practice demographics, (ii) inhaler technique opinions and experience, (iii) inhaler prescribing preferences and (iv) inhaler education history data. Data were analysed descriptively and multivariate logistic regression modelling was used to explore the relationship between outcomes and GPs' ability to use devices correctly.

**Results:** A total of 227 GPs completed the inhaler survey. Sixty-three percent of GPs reported receiving previous inhaler education and 73.3% educated or checked their patients' inhaler technique; 64.5% felt they were somewhat competent in doing so. GPs who reported not demonstrating inhaler technique believed that a pharmacist or a practice nurse would do so. When prescribing new inhaler devices, GPs

considered the disease being treated first and then patient's experience with inhalers; they often already have an inhaler preference and this was related to familiarity and perceived ease of use. For GPs, inhaler competence was not associated with their previous inhaler education or the priority placed on inhaler technique.

**Conclusion:** GPs do recognise the importance of inhaler technique in respiratory management but their technique can be better supported with regular educational updates to inform them about new inhalers and management practices and to support appropriate inhaler choices for their patients.

**Keywords:** Asthma; COPD; Inhaler technique; General practitioners; Training

### Key Summary Points

Correct inhaler technique is essential for the optimal delivery of inhaled medicines and the successful management of respiratory conditions.

Patients' respiratory conditions are often poorly managed owing to their inability to recognise inhaler technique as an issue and GPs who prescribe inhaler medicines have the opportunity to intervene.

GPs' inhaler competence was not associated with their previous inhaler education or the priority placed on inhaler technique.

GPs need regular educational updates to inform them about new inhalers and management practices.

## INTRODUCTION

Efficient delivery of inhaled medicines is an essential component of successful therapy for respiratory conditions [1, 2], with incorrect inhaler technique being associated with poor asthma control and frequent emergency

department visits [3]. A simple educational intervention on inhaler technique from a health care professional (HCP) can improve patients' clinical outcomes [4–6]. However, the practicalities of providing this intervention have proved to be complicated, as most HCPs are unable to demonstrate correct inhaler technique [7]. With up to 94% of patients not being able to use their inhaler device correctly [8], it is of paramount importance that we look towards HCPs to ensure they are equipped to teach their patients correct inhaler technique so that they can improve their patients' inhaler technique [9, 10].

General practitioners (GP) (also known as family physicians) are often the first port of call for the prescription of inhaler therapy, which represents up to 20% of their prescription load [11]. GP encounters around inhalers are important and it has been shown that GPs who prescribe inhaler devices in collaboration with their patients while also demonstrating correct inhaler technique markedly improve the chances of the patient adhering to their prescribed therapy and being able to use their inhaler device correctly, leading to positive clinical outcomes [12, 13]. While a minority of physicians provide inhaler technique education on a regular basis, citing time as a barrier, very few HCPs are actually able to demonstrate correct inhaler technique [14]. Furthermore, training is not the only solution to improving inhaler technique, with factors such as the ability of the patient to learn, as well as selecting the most suitable inhaler for a particular patient, also being important [15].

Current guidelines recommend that inhaler selection should be made in collaboration with the patient [16]. Shared treatment decision-making results in improved adherence and clinical outcomes [17] whilst switching patients' inhalers without their consent can lead to errors in their use [18, 19]. Choosing an inhaler that a patient prefers and can use can improve adherence and inhaler technique and therefore respiratory outcomes [20–22], therefore it seems obvious that including patients in inhaler selection is essential; provided physicians have an understanding of the different inhaler devices themselves [23]. Whilst

physicians acknowledge the importance of patient satisfaction and preference for inhalers, [11] given the access restrictions affiliated with prescription medicine scheduling, the onus of inhaler device selection primarily falls back on the prescriber [24].

With so many inhaler device options available, prescribers have a complicated decision to make in choosing an inhaler for their patients [25], not only because of the number of different inhalers but also because of the complex array of factors which impact on patient use of/satisfaction with and preference for different products, including patient perceptions and beliefs [12, 23]. Reviews have been conducted to give prescribers guidance on the selection of inhalers [26–28]; however, there is little evidence of GPs using these guidelines in practice. One-third of the physicians are not able to articulate the basis for an inhaler preference, suggesting patient factors determine their inhaler choices [29, 30]. While two-thirds of physicians report inhaler device preference on the basis of underlying prescribing habits [29]. Research also demonstrates that a very high proportion of physicians who frequently prescribe inhaler devices lack adequate knowledge concerning inhaled therapy and related educational aspects [31]. With this in mind, we seek to better understand GPs' experiences and factors associated with their inhaler competencies.

This study aims to determine GPs' experience, skills and priority placed on inhaler technique and to identify factor(s) associated with inhaler technique competence.

## METHODS

This cross-sectional observational study surveyed practising GPs about their perspectives on inhaler use and preferences for inhaler prescribing within their practice setting.

### Ethics

This study was approved by the Human Ethics Committee of both The University of Sydney and The University of Notre Dame and was performed in accordance with the Helsinki

Declaration of 1964 and its later amendments. All subjects provided informed consent to participate in the study.

### Recruitment

GPs from general practices in metropolitan Sydney (Australia) and regional New South Wales (Australia) were recruited between August 2018 and May 2019.

### Inclusion Criteria

GPs who had completed visit 1 in the inhaler demonstration study (Dr. ELIOT) [32] were eligible for participation. The Dr. ELIOT study required GPs to demonstrate the use of two placebo dry powder inhalers, Turbuhaler and Spiromax, on two separate occasions (visit 1 and visit 2) 4 weeks apart. GPs were firstly required to demonstrate the use of these devices intuitively and in instances where they were not able to demonstrate correct technique with intuitive use, written, video and personal demonstrations were provided until device mastery was achieved. GPs were randomised to demonstrate either Turbuhaler or Spiromax mastery first and, once device mastery was achieved on the first device, they were required to demonstrate on the remaining device (visit 1). GPs were then required to repeat the same demonstrations 4 weeks later (visit 2).

### Exclusion Criteria

GPs who did not complete visit 1 of the Dr. ELIOT study were excluded.

### Data Collection

At the conclusion of visit 1 of the Dr. ELIOT study, GPs were invited to complete the inhaler survey. The inhaler survey was designed to gather information across four domains including: practice demographics, inhaler technique opinions and experience, inhaler prescribing preferences and inhaler education history. Survey responses were yes/no, open-

ended and multiple choice. The complete survey is available in Appendix 1.

GPs self-completed the survey on a tablet device pre-loaded with an electronic link to the survey questions via Research Electronic Data Capture (REDCap) system. Survey responses were anonymous and no incentive was provided to complete the survey.

## Data Analysis

Data were analysed using IBM Statistical Package for Social Sciences (SPSS) version 28.0 (IBM Corporation, Armonk, NY). Data across the whole dataset were analysed and then stratified for GPs who made at least one error on the inhaler devices tested and GPs who could demonstrate correct inhaler technique on all inhaler devices tested.

Descriptive statistics were used to analyse data and Chi-squared test was used to compare categorical outcomes between GPs who made at least one device error on the devices tested versus GPs who could demonstrate correct inhaler technique on all devices tested.

Multivariate logistic regression modelling using univariate logistic regression analysis was used to explore the relationship between outcomes and GPs' ability to use all devices correctly (dependent variable). The following independent variables were explored for correlations and the subsequent inclusion into the regression modelling: previous hands-on experience with devices, experience in delivering inhaler technique education, attitudes and decision-making with regard to prescribing of inhaler devices, confidence and competency in

optimising inhaler use. Multivariate logistic regression analysis was performed on the univariate predictors, with  $p < 0.05$  used as the threshold for entry into the model, which was a value sufficiently significant to ensure potential interactions were not disregarded [33]. A statistical approach to variable selection was chosen as this was an exploratory study and no prior assumptions of relationships between factors have been established [33]. The goodness-of-fit of the logistic regression model was confirmed by the Hosmer–Lemeshow test. The final logistic regression model was determined with significance levels set at  $p < 0.05$  [33].

Data for open-ended questions were categorised by the authors on the basis of the similarity of responses.

## RESULTS

A total of 227 GPs were eligible to participate and all 227 completed the inhaler survey. Table 1 presents the ability of GPs to use Spiromax and Turbuhaler.

Of the 227 GPs, 18.1% did not demonstrate correct inhaler technique on any device, 24.6% demonstrated correct inhaler technique on Spiromax only, 30% on Turbuhaler only and 27.3% on both devices (Table 1).

There was no statistically significant difference between the demonstration of correct technique for those with “Incorrect use of both devices” i.e. none of the devices and “Correct use of ONE device” and therefore these categories were combined for further analysis.

Table 2 presents GPs' practice demographics, inhaler technique education received and

**Table 1** GPs who intuitively demonstrated correct inhaler technique on the devices (pre-training) ( $n = 227$ )

	Intuitive inhaler technique (pre-training)			Total	
	Incorrect use of both devices	Correct use of ONE device			Correct use of BOTH devices Spiromax and Turbuhaler
		Spiromax only	Turbuhaler only		
Number of GPs	41 (18.1%)	56 (24.6%)	68 (30.0%)	62 (27.3%)	227

**Table 2** Outcomes relating to the inhaler survey on GP and practice demographics, the inhaler technique education received and delivered, for GPs who intuitively demonstrated correct inhaler technique on none/one of the devices ( $n = 165$ ) and both devices ( $n = 62$ )

	Intuitive inhaler technique (pre-training)		<i>p</i> value
	Incorrect use on both/one of the devices ( $N = 165$ ) $n$ (%)	Correct use on both devices ( $N = 62$ ) $n$ (%)	
Years of practice			
1–5 years	52 (31.5)	19 (30.6)	1.000
5–10 years	23 (13.9)	10 (16.1)	0.676
10–15 years	20 (12.1)	9 (14.5)	0.658
More than 15 years	70 (42.4)	24 (38.7)	0.652
Estimate of number of patients with asthma or chronic obstructive pulmonary disease (COPD) seen in one week			
0 patients	5 (3.0)	0 (0)	0.327
1–10 patients	124 (75.2)	49 (79)	0.603
11–20 patients	34 (20.6)	7 (11.3)	0.123
More than 20 patients	2 (1.2)	6 (9.7)	0.006
Prior to this study, have you received hands-on education about inhaler technique?			
Yes	104 (63.0)	34 (54.8)	0.287
Do you educate or check your own patient's ability or technique on how to use their inhaler device appropriately and effectively?			
Yes	121 (73.3)	47 (75.8)	0.738
How frequently do you believe a patient's inhaler technique should be checked?			
Upon initial prescription only	23 (13.9%)	8 (12.9%)	1.000
At every visit	52 (31.5%)	19 (30.6%)	1.000
Annually	62 (37.6%)	24 (38.7%)	0.879
Every few years	5 (3.0%)	1 (1.6%)	1.000
Other (Supplementary Fig. D)	52 (31.5%)	19 (30.6%)	1.000
Please indicate what you feel your level of competency is in educating your patients on how to use and care for their inhaler device			
Fully competent	47 (28.5%)	19 (30.6%)	0.748
Somewhat competent	106 (64.2%)	40 (64.5%)	1.000
Not competent	12 (7.3%)	3 (4.8%)	0.765
How do you learn of other devices?			
Pharmaceutical representative	134 (81.2%)	54 (87.1%)	0.331
Medical Journal	35 (21.2%)	14 (22.6%)	0.857
Pharmacists	10 (6.1%)	2 (3.2%)	0.520

**Table 2** continued

	Intuitive inhaler technique (pre-training)		<i>p</i> value
	Incorrect use on both/one of the devices ( <i>N</i> = 165) <i>n</i> (%)	Correct use on both devices ( <i>N</i> = 62) <i>n</i> (%)	
Patient request	15 (9.1%)	2 (3.2%)	0.166
Other ways of learning new devices (Supplementary Fig. G)	43 (26.1%)	14 (22.6%)	0.731
Have you had your inhaler technique evaluated outside of this project?			
Yes	25 (15.2%)	5 (8.1%)	0.191

delivered, opinions about inhaler assessments and perceived competence of GPs who demonstrated correct inhaler technique on none or just one of the devices versus GPs who demonstrated correct inhaler technique on both devices. More than half of the GPs surveyed had received inhaler technique education in the past and 73.3% said they educated or checked their own patients' ability in using their inhaler devices. More than 80% of GPs reported learning about devices from pharmaceutical representatives and 64.5% felt they were somewhat competent in being able to educate their patients about their devices. Few GPs had had their inhaler technique evaluated apart from during their participation in the Dr. ELIOT research study and for those that had, it was often associated with medical training (Supplementary Fig. A).

The source of past inhaler technique education was predominantly from a pharmaceutical representative (Supplementary Fig. B). In most cases where GPs reported that they did not demonstrate inhaler technique personally, they believed that a pharmacist or a practice nurse would do so (Fig. 1). Other reasons for not demonstrating inhaler technique included not feeling competent, lack of time or absence of placebos (Supplementary Fig. C). More than 94% of GPs believed that inhaler technique is very or extremely important (Fig. 2). GPs views about how frequently patient device technique should be checked varied across categories but there was no statistical significance in responses

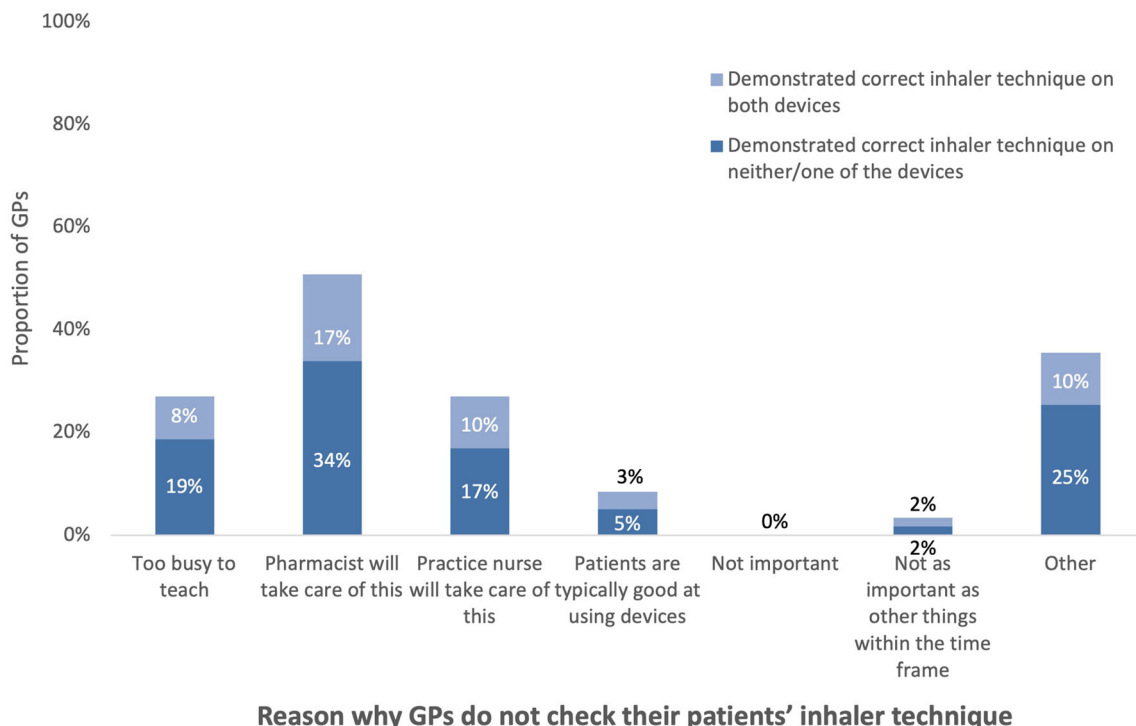
between the two GP groups (Fig. 3). Other frequencies for checking inhaler technique were also offered with the most common reason being 'when patients' asthma was not in control' (Supplementary Fig. D).

When GPs were asked if they had a preferred device(s) to prescribe (Fig. 4), pressurised metered-dose inhalers (pMDI) were most commonly nominated followed by the Turbuhaler and 'no device preference'. Reasons for preference included familiarity, ease of use and ability to be used with a spacer (Supplementary Fig. E). Although GPs most frequently reported that their device choice takes into consideration the patients' previous experience with devices, there was no significant difference in the nomination of other factors including patients' age, the disease being treated and patients' preference (Fig. 5).

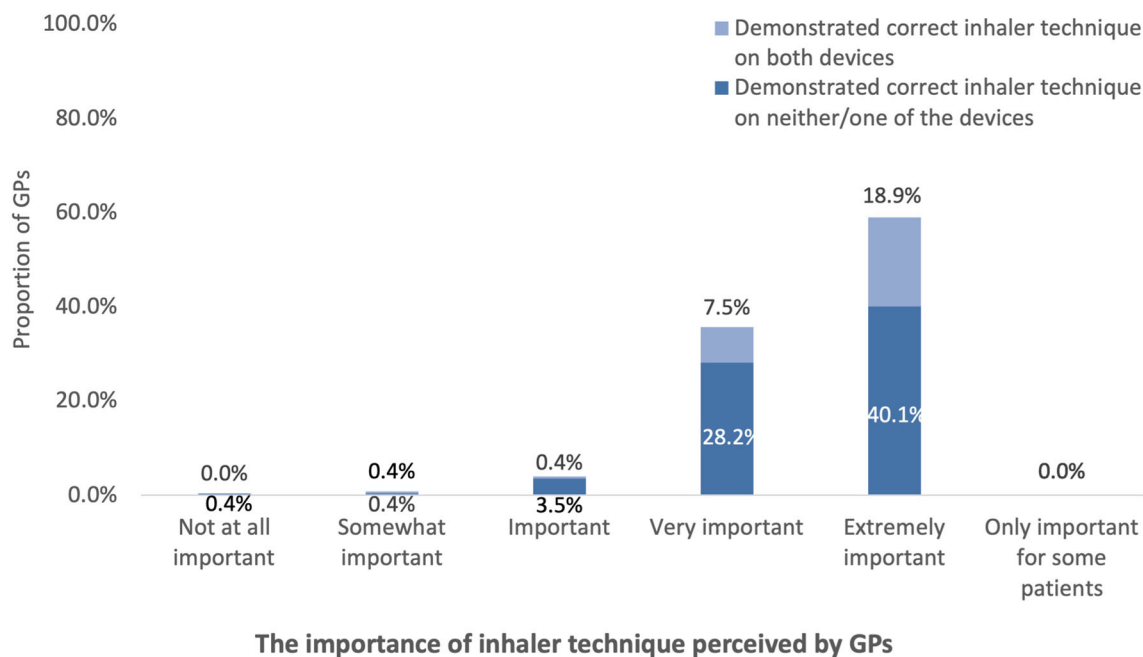
Following the logistic regression analysis, none of the outcomes was significantly correlated with GPs' ability to intuitively demonstrate correct inhaler technique on the devices (Table 3).

## DISCUSSION

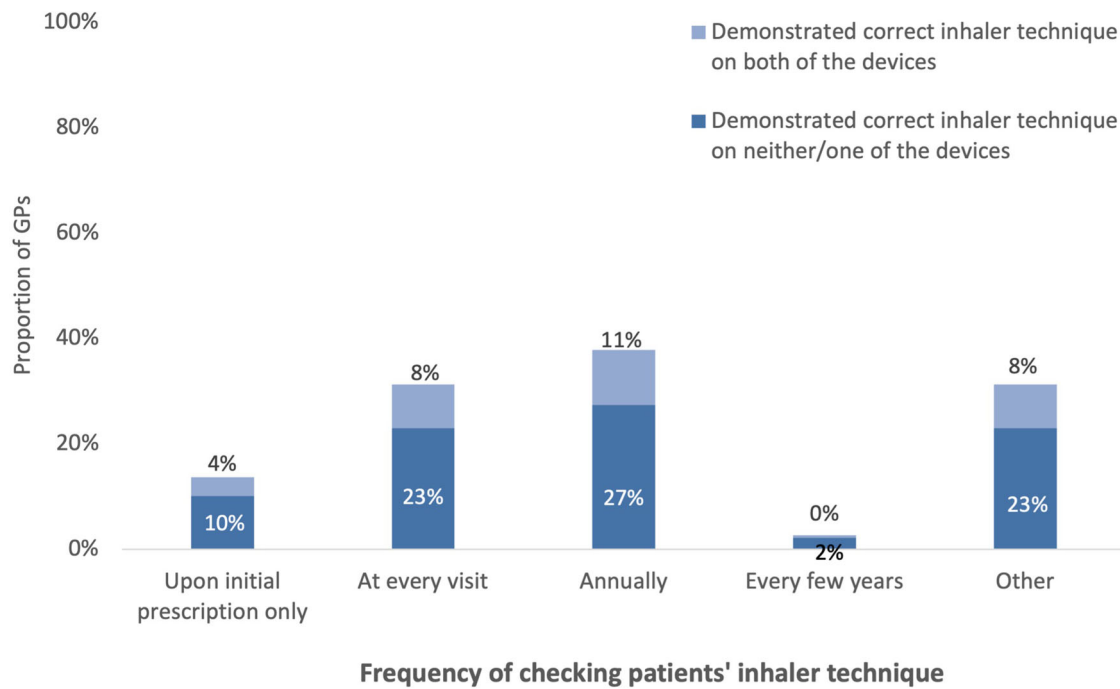
This study demonstrated that GPs' inhaler competence in the use of two dry powder inhalers was not associated with their prior inhaler education and experience or the priority they placed on inhaler technique in the management of respiratory diseases. GPs' inhaler



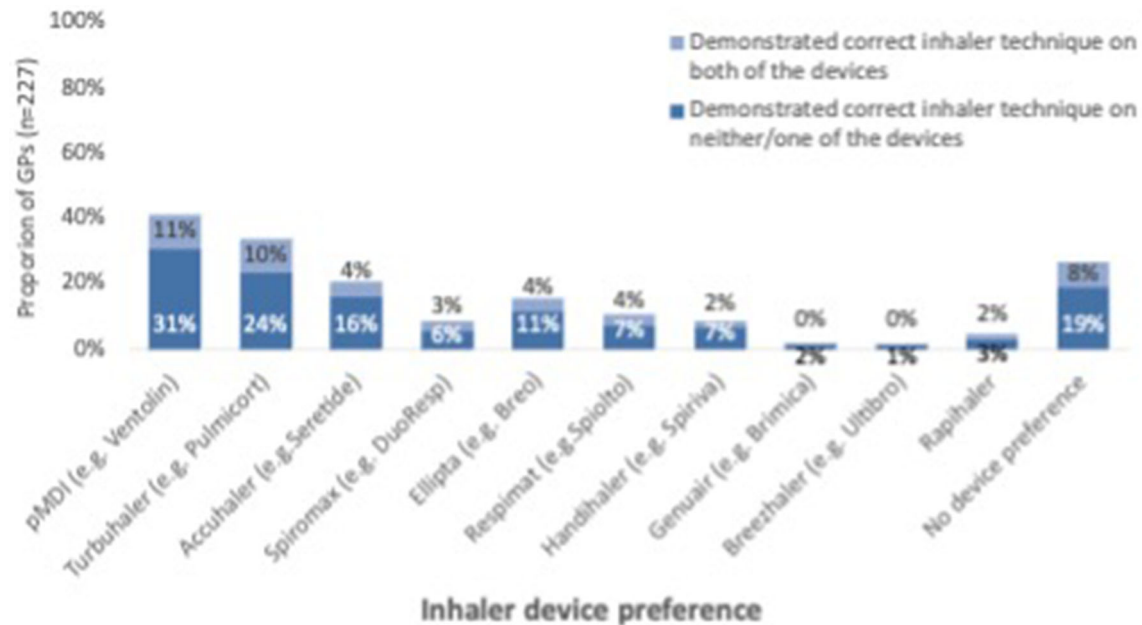
**Fig. 1** Reasons why GPs do not check their patients' ability or inhaler technique ( $n = 59$ ). Other reasons appear in Supplementary Fig. B



**Fig. 2** The importance of inhaler technique perceived by GPs ( $n = 227$ )



**Fig. 3** GP’s perceived frequency of checking patients’ inhaler technique ( $n = 227$ )



**Fig. 4** GP’s device preference ( $n = 227$ ) (GPs were allowed to select more than one option). Where reasons for preference were made available, they are reported in the supplementary material

competence was also not associated with the frequency of which they educate and check their patients’ inhaler technique or with their

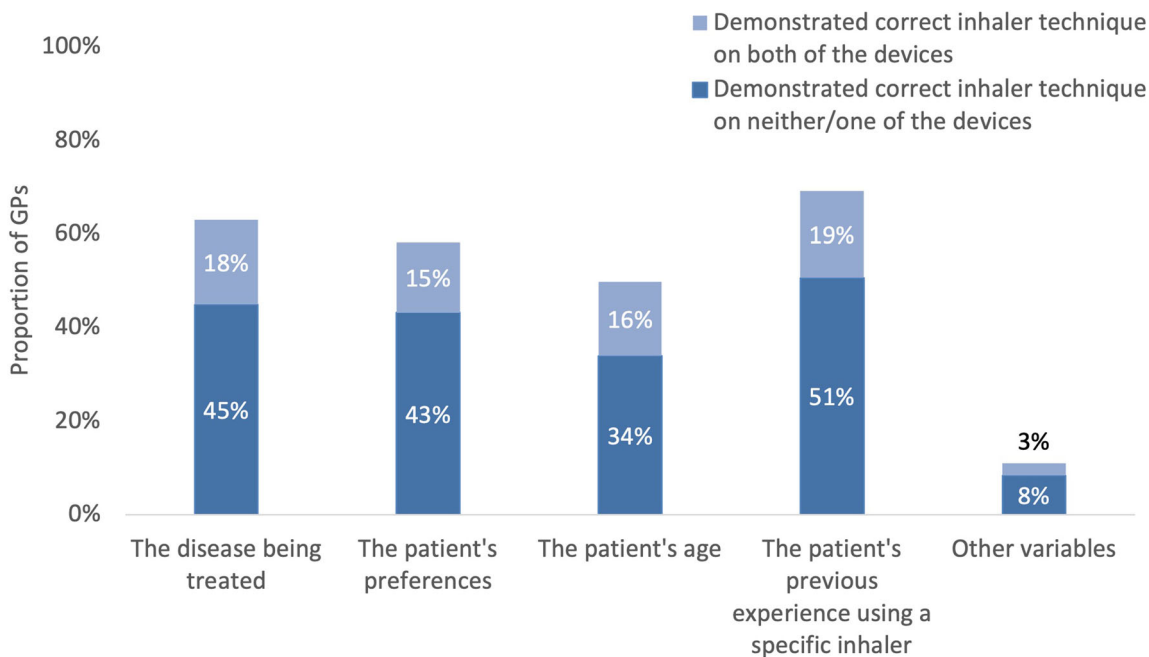
preferences for devices when prescribing inhaled medicines. Where GPs are not able to educate or check inhaler techniques



themselves, they reported being able to engage the assistance of a pharmacist or practice nurse to teach and assess inhaler technique. When prescribing new inhaler devices, GPs considered disease being treated, patients’ experience with inhalers, their age and their preferences and also considered the patient’s lung capacity and dexterity to try and match the patient to the inhaler. When it came to learning about devices themselves, most GPs reported having received some training at university or during fellowship training, but most education was received from pharmaceutical representatives. While GPs chose to prescribe inhaler devices that they felt best suited their patient and their circumstances, when asked if they had a preferred device/s, the pMDIs and Turbuhalers were most frequently mentioned. Their preference for a device/s was often owing to familiarity, ease of use and the ability to be used with a spacer (where applicable). Although GPs demonstrated that they were aware of the importance of

inhaler choice and technique in the overall management of respiratory disease, there is room for improvement with regard to ensuring they are well supported and resourced to ensure optimal inhaler use for their patients.

It appeared that the importance of inhaler technique is clearly understood by GPs, with more than 94% of participants rating inhaler technique very to extremely important. The significance of inhaler technique is further confirmed amongst this cohort with 74% reporting that they educate their patients or check inhaler technique, and those that are not able to do so personally, delegate them to a pharmacist or nurse colleague. Similar proportions of HCPs (72%) studied by Karle et al., reported teaching inhaler technique to their patients as a part of their clinical duties but also showed us that not all HCPs have a good understanding and good inhaler technique themselves, and there is a continued need to educate providers in inhaler technique,



**Factors influencing GP's decision in prescribing an inhaler**

**Fig. 5** Factors influencing GP’s decision in prescribing an inhaler for their patients (*n* = 227) (more than one answer was permitted). Descriptions of other variables are available in the supplementary materials

**Table 3** Analysis of factors associated with GPs ability to intuitively demonstrate correct inhaler technique on Spiromax and Turbuhaler

	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower bound	Upper bound
Intercept	1.825	0.554	10.859	1	0.001			
Do you educate or check your own patient's ability or technique on how to use their inhaler device appropriately and effectively?	0.208	0.353	0.346	1	0.556	1.231	0.616	2.461
How important do you think inhaler technique is?	-0.314	1.253	0.063	1	0.802	0.731	0.063	8.521
Preference for Spiromax and/or Turbuhaler	-0.269	0.359	0.564	1	0.453	0.764	0.378	1.543
No device preference	-0.371	0.395	0.886	1	0.347	0.690	0.318	1.495
Have you had your inhaler technique evaluated outside of this project?	-0.771	0.520	2.195	1	0.138	0.463	0.167	1.283

especially with the introduction of new inhaler devices [34]. With this in mind, very few GPs in our study had had their own inhaler technique assessed (23%) and only 27% were able to demonstrate correct technique on both dry powder inhalers. This raises the question about how or what they are teaching their patients if a vast majority are unable to demonstrate correct technique themselves. Further, there was uncertainty and a lack of consensus amongst GPs about how often patients' inhaler technique should be checked, with responses ranging anywhere from every prescription to every few years.

The education provided to GPs about inhalers and inhaler technique is mainly provided by the pharmaceutical industry once they have completed their university and fellowship training. Pharmaceutical industry representatives are an accessible wealth of knowledge and a valued source of therapeutic updates that many GPs have come to rely upon for education in their very busy working days. GPs reported the training received at university or during fellowship training to be the next most common source, which, depending on the number of years since they graduated, was not

something that they experienced recently. The GPs in this study ranged from having 1–5 years to more than 15 years of experience, yet the more experience they had was not correlated with being able to demonstrate correct inhaler technique, unlike to participants in Karle et al., where they demonstrated better inhaler technique knowledge the more experience they had post-graduation [34]. Karle et al. also argue that simulation workshops are necessary to improve inhaler technique knowledge, purely owing to the nature of pharmaceutical representative education. While we most certainly cannot expect pharmaceutical representatives to be responsible for providing a comprehensive inhaler technique education package for GPs, we should bear in mind the limitations GPs experience in accessing education beyond their university and fellowship training, why they have come to rely predominantly on this source of education and provide better opportunities with which they can learn about inhaler technique in future.

GPs primarily came to learn about new devices from pharmaceutical representatives, medical journals, continuing education seminars and their colleagues. Although few GPs

reported learning about new devices through requests from their patients, they placed the greatest importance on patient factors when prescribing a device. They considered the disease being treated, the patients' age, the patients' previous experience with a device and the patients' lung capacity and dexterity when choosing a device, confirming that GPs have a good understanding of the factors that should be considered when prescribing a device and role to play in matching a device to their patients [23, 35]. Given that patients are rarely involved in the decisions about which inhaler they use [36], it is encouraging to see that GPs place substantial consideration of patient factors when prescribing an inhaler. Although a quarter of GPs reported having no preferred device to prescribe, those that did have a preference nominated patient factors as reasons for their preference including ease of use and ability to use with a spacer. Given the challenges frequently faced by patients when using inhalers [37], ease of use is extremely important, perhaps more so than patient preference as using a patient's preferred device does not necessarily result in fewer errors, and it is still necessary to evaluate the appropriateness of inhalers independently of preference [38, 39].

One aspect of this research which raises further questions for both research and practice is the disconnect between GP responses on education behaviour, GP competence and what we continue to know about how patients use their inhalers in the real world setting, i.e. inhaler use remains poor [40]. While GPs' responses to the importance of inhaler technique as well as the considerations made for prescribing suggest a high level of awareness, their level of competence and responses relating to inhaler preference do not match. This is possibly reflective of the nature of the study design, i.e. the questions were close-ended and did not allow for in-depth exploration of factors such as gender, the disease itself, peak inspiratory flow, dexterity, device dynamics, numbers of steps to prepare the device, patient cognition, etc., which need to be explored [28]. This highlights the need to follow up this research with an in-depth qualitative study or a mixed methods approach that

also involves patient experiences relating to inhaler prescribing and device selection.

A strength of this research was its high response rate, where 100% of the GPs invited to complete the survey volunteered to do so, providing us with insight into the considerations they place on inhalers and inhaler technique in their prescribing as well as identifying opportunities to improve support and education for GPs in the future. A limitation of this research was the limited fields that were explored owing to the brevity of the questionnaire and the potential bias associated with participant responses. Given more time, more research into GPs' understanding and competence of different types of inhalers would ideally be explored [41].

## CONCLUSION

In conclusion, GPs have demonstrated that they have received the message about the importance of inhaler technique in respiratory management but can be better supported with educational updates to inform them about new inhalers and management practices to be well prepared to make the best choice of inhaler device together with their patients.

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**Compliance with Ethics Guidelines.** This study was approved by the Sydney University Human Ethics Committee and The University of Notre Dame Human Ethics Committee and was performed in accordance with the Helsinki Declaration of 1964, and its later amendments. All subjects provided informed consent to participate in the study.

**Data Availability.** Anonymous data are stored within a University of Sydney repository

and are available from the authors upon written request.

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## REFERENCES

1. Virchow JC, Crompton GK, Dal Negro R, Pedersen S, Magnan A, Seidenberg J, et al. Importance of inhaler devices in the management of airway disease. *Respir Med.* 2008;102(1):10–9.
2. Kocks JWH, Chrystyn H, van der Palen J, Thomas M, Yates L, Landis SH, et al. Systematic review of association between critical errors in inhalation and health outcomes in asthma and COPD. *NPJ Prim Care Respir Med.* 2018;28(1):43.
3. Al-Jahdali H, Ahmed A, Al-Harbi A, Khan M, Baharoon S, Bin Salih S, et al. Improper inhaler technique is associated with poor asthma control and frequent emergency department visits. *Allergy Asthma Clin Immunol.* 2013;9(1):8.
4. Basheti IA, Reddel HK, Armour CL, Bosnic-Anticevich SZ. Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists. *J Allergy Clin Immunol.* 2007;119(6):1537–8.
5. Armour CL, Reddel HK, LeMay KS, Saini B, Smith LD, Bosnic-Anticevich SZ, et al. Feasibility and effectiveness of an evidence-based asthma service in Australian community pharmacies: a pragmatic

- cluster randomized trial. *J Asthma*. 2013;50(3):302–9.
6. Bouwmeester C, Kraft J, Bungay KM. Optimizing inhaler use by pharmacist-provided education to community-dwelling elderly. *Respir Med*. 2015;109(10):1363–8.
  7. Plaza V, Giner J, Rodrigo GJ, Dolovich MB, Sanchis J. Errors in the use of inhalers by health care professionals: a systematic review. *J Allergy Clin Immunol*. 2018;6(3):987–95.
  8. Lavorini F, Magnan A, Dubus JC, Voshaar T, Corbetta L, Broeders M, et al. Effect of incorrect use of dry powder inhalers on management of patients with asthma and COPD. *Respir Med*. 2008;102(4):593–604.
  9. van der Palen J, Klein JJ, Kerkhoff AH, van Herwaarden CL, Seydel ER. Evaluation of the long-term effectiveness of three instruction modes for inhaling medicines. *Patient Educ Couns*. 1997;32(1 Suppl):S87–95.
  10. Leung J, Bhutani M, Leigh R, Pelletier D, Good C, Sin DD. Empowering family physicians to impart proper inhaler teaching to patients with chronic obstructive pulmonary disease and asthma. *Can Respir J*. 2015;22(5):266–70.
  11. Molimard M, Colthorpe P. Inhaler devices for chronic obstructive pulmonary disease: insights from patients and healthcare practitioners. *J Aerosol Med Pulm Drug Deliv*. 2015;28(3):219–28.
  12. Usmani OS. Choosing the right inhaler for your asthma or COPD patient. *Ther Clin Risk Manag*. 2019;15:461–72.
  13. Román-Rodríguez M, Metting E, Gacía-Pardo M, Kocks J, van der Molen T. Wrong inhalation technique is associated to poor asthma clinical outcomes. Is there room for improvement? *Curr Opin Pulm Med*. 2019;25(1):18–26.
  14. Basheti IA, Qunaibi EA, Hamadi SA, Reddel HK. Inhaler technique training and health-care professionals: effective long-term solution for a current problem. *Respir Care*. 2014;59(11):1716–25.
  15. Haughney J, Price D, Barnes NC, Virchow JC, Roche N, Chrystyn H. Choosing inhaler devices for people with asthma: current knowledge and outstanding research needs. *Respir Med CME*. 2010;3(3):125–31.
  16. Asthma GGif. Global strategy for asthma management and prevention. 2020.
  17. Wilson SR, Strub P, Buist AS, Knowles SB, Lavori PW, Lapidus J, et al. Shared treatment decision making improves adherence and outcomes in poorly controlled asthma. *Am J Respir Crit Care Med*. 2010;181(6):566–77.
  18. Bjermer L. The importance of continuity in inhaler device choice for asthma and chronic obstructive pulmonary disease. *Respiration*. 2014;88(4):346–52.
  19. Roggeri A, Micheletto C, Roggeri DP. Inhalation errors due to device switch in patients with chronic obstructive pulmonary disease and asthma: critical health and economic issues. *Int J Chron Obstruct Pulmon Dis*. 2016;11:597–602.
  20. 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 Prefer Adherence*. 2016;10:135–45.
  21. van Boven JFM, Chavannes NH, van der Molen T, Rutten-van Mólken MPMH, Postma MJ, Vegter S. Clinical and economic impact of non-adherence in COPD: a systematic review. *Respir Med*. 2014;108(1):103–13.
  22. Molimard M, Raheison C, Lignot S, Balestra A, Lamarque S, Chartier A, et al. Chronic obstructive pulmonary disease exacerbation and inhaler device handling: real-life assessment of 2935 patients. *Eur Respir J*. 2017;49(2):1601794.
  23. Kaplan A, Price D. Matching inhaler devices with patients: the role of the primary care physician. *Can Respir J*. 2018;2018:9473051.
  24. Administration AGDoHTG. 2021. <https://www.tga.gov.au/scheduling-basics>; <https://www.tga.gov.au/node/4439>.
  25. Broeders ME, Vincken W, Corbetta L. The ADMIT series—issues in inhalation therapy. 7. Ways to improve pharmacological management of COPD: the importance of inhaler choice and inhalation technique. *Prim Care Respir J*. 2011;20(3):338–43.
  26. Dolovich MB, Ahrens RC, Hess DR, Anderson P, Dhand R, Rau JL, et al. Device selection and outcomes of aerosol therapy: evidence-based guidelines. *Chest*. 2005. <https://doi.org/10.1378/chest.127.1.335>.
  27. Lavorini F, Fontana GA, Usmani OS. New inhaler devices—the good, the bad and the ugly. *Respiration*. 2014;88(1):3–15.
  28. Lavorini F, Janson C, Braido F, Stratelis G, Løkke A. What to consider before prescribing inhaled medications: a pragmatic approach for evaluating the current inhaler landscape. *Ther Adv Respir Dis*. 2019;13:1753466619884532.

29. Ding B, Small M, Scheffel G, Holmgren U. Maintenance inhaler preference, attribute importance, and satisfaction in prescribing physicians and patients with asthma, COPD, or asthma-COPD overlap syndrome consulting for routine care. *Int J Chron Obstruct Pulmon Dis*. 2018;13:927–36.
30. Booth A. Prescribing inhaled therapy in asthma: health professionals' habits and beliefs. *J Prescrib Pract*. 2020;2(4):181–6.
31. Plaza V, Sanchis J, Roura P, Molina J, Calle M, Quirce S, et al. Physicians' knowledge of inhaler devices and inhalation techniques remains poor in Spain. *J Aerosol Med Pulm Drug Deliv*. 2012;25(1):16–22.
32. Cvetkovski B, Hespe C, Tan R, Kritikos V, Azzi E, Bosnic-Anticevich S. General practitioner use of generically substitutable inhaler devices and the impact of training on device mastery and maintenance of correct inhaler technique. *Pulm Ther*. 2020;6(2):315–31.
33. Hosmer DW, Lemeshow S. Introduction to the logistic regression model. *Applied Logistic Regression*, Second Edition. 2000;1–30.
34. Karle E, Patel TP, Zweig J, Kravac A. Understanding the knowledge gap and assessing comfort level among healthcare professionals who provide inhaler education. *J Chronic Obstr Pulm Dis*. 2020;17(2):197–204.
35. Haughney J, Price D, Barnes NC, Virchow JC, Roche N, Chrystyn H. Choosing inhaler devices for people with asthma: current knowledge and outstanding research needs. *Respir Med*. 2010;104(9):1237–45.
36. Jahedi L, Downie SR, Saini B, Chan HK, Bosnic-Anticevich S. Inhaler technique in asthma: how does it relate to patients' preferences and attitudes toward their inhalers? *J Aerosol Med Pulm Drug Deliv*. 2017;30(1):42–52.
37. Harb HS, Laz NI, Rabea H, Abdelrahim MEA. First-time handling of different inhalers by chronic obstructive lung disease patients. *Exp Lung Res*. 2020;46(7):258–69.
38. Chorão P, Pereira AM, Fonseca JA. Inhaler devices in asthma and COPD—an assessment of inhaler technique and patient preferences. *Respir Med*. 2014;108(7):968–75.
39. Sadowski CA, Cor K, Cave A, Banh HL. Administration technique and acceptance of inhaler devices in patients with asthma or COPD. *Ann Pharmacother*. 2015;49(6):639–48.
40. Sanchis J, Gich I, Pedersen S, Team ADMI. Systematic review of errors in inhaler use: has patient technique improved over time? *Chest*. 2016;150(2):394–406.
41. Bosnic-Anticevich SZ. Continued innovation in respiratory care: the importance of inhaler devices. *Tuberc Respir Dis (Seoul)*. 2018;81(2):91–8.