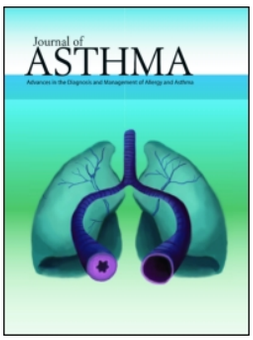

Journal of Asthma

ISSN: 0277-0903 (Print) 1532-4303 (Online) Journal homepage: http://www.tandfonline.com/loi/ijas20

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To cite this article: Sharon Davis B Pharm, Seeta Durvasula MBBS, MPH, MPaed, DCH, PhD, Diana Merhi MBBS, DCH, Paul Young B. Sci, PhD, Daniela Traini B. Sci(Hons), PhD & Sinthia Bosnic-Anticevich B. Pharm(Hons), PhD (2015): The ability of people with intellectual disability to use inhalers – an exploratory mixed methods study, Journal of Asthma

To link to this article: http://dx.doi.org/10.3109/02770903.2015.1065423

Published online: 12 Sep 2015.

http://informahealthcare.com/jas
ISSN: 0277-0903 (print), 1532-4303 (electronic)

Journal of ASTHMA

J Asthma, Early Online: 1–8
 DOI: 10.3109/02770903.2015.1065423

Taylor & Francis
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ORIGINAL ARTICLE

The ability of people with intellectual disability to use inhalers – an exploratory mixed methods study

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Abstract

Objective: This aim of this study was to assess inhaler technique of people with intellectual disability (ID), and evaluate the effectiveness of teaching with respect to their individual ability to adopt correct technique. *Methods*: Seventeen people with ID were recruited through existing networks of general practitioners and disability support organisations. Inhaler technique was assessed using validated checklists and placebo devices, followed by provision of individualised training. The educational interaction between participant and researcher was captured via video recording and analysed qualitatively. *Results*: Seventeen people with ID participated; females comprised 65%. At baseline, no participants correctly used any device. Pressurised metered dose inhalers, with or without accessory devices, were the most poorly used devices. Inhalation steps were poorly performed across all devices. Following training, the proportions of assessed participants that were able to master inhaler technique were 100% of Accuhaler users, 40% of Turbuhaler users, 25% of pressurised metered dose inhaler users and 0% of Handihaler users. Barriers identified included poor comprehension of breathing processes, the lack of attentiveness and poor dexterity. Facilitators for educator delivery of inhaler technique education included the use of analogies and being patient. *Conclusions*: This is the first study to examine inhaler technique mastery in people with ID. Results show that with education that addresses the unique patient barriers inherent in this group, some individuals can be trained to mastery. Structured modules of inhaler technique training tailored for people with ID, but which can be individualised, are recommended.

Keywords

Asthma, intellectual disability, inhaler technique, patient education, inhaler devices

History

Received 8 March 2015
Revised 17 June 2015
Accepted 20 June 2015
Published online 7 September 2015

Introduction

Asthma is a chronic inflammatory disorder of the airways associated with increased airway hyper-responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness and coughing. It affects 1–18% of the population in different countries [1]. The mainstay of treatment is medication delivered via the inhalational route of administration. Using an inhaler involves completing a series of device specific steps, which require dexterity, coordination of dexterity and timing and also cognitive skills [2]. Research over several decades indicates that up to 94% of adult patients are unable to use their inhalers correctly [3,4], and up to 40% of children make inhalation technique errors even with spacers [5]. Poor technique is also particularly common in older patients [6]. Correct inhaler technique (mastery) needs to be taught. Most patients rely on instruction from healthcare providers but only 15–69% of healthcare providers across all disciplines can demonstrate correct inhaler use [7]. Healthcare providers, once trained, can deliver brief yet effective interventions to patients in the general population resulting in significantly more patients using their inhalers correctly [8,9].

Approximately 15% of Australians with intellectual disability (ID) are reported to have asthma [10], and research shows that many of them use inhalers [11]. In addition, learning difficulties can contribute to an increased risk of fatality in people with severe asthma, and these are present in people with ID [12,13]. People with ID have deficits in cognitive function and adaptive functioning (relating to practical domains e.g. learning and self-management). Coexisting medical conditions or mental health disorders also influence adaptive functioning [14]. Therefore, people with ID may have unique challenges in being able to learn and execute correct inhaler technique. There is a lack of scientific studies relating to people with ID and their ability to use inhalers. Specifically we do not know whether people with ID can demonstrate inhaler technique mastery, or the feasibility

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of training them to correctly use inhalers. It is not known if current interventions are effective in people with intellectual disability, as cognitive impairment has been shown to be a barrier to acquisition of an effective inhaler technique [15].

The aim of this exploratory study was to assess inhaler technique, evaluate the effectiveness of standard training with respect to the individual ability of people with ID to achieve inhaler technique mastery, and identify specific strategies that may assist in the training process. This will help to inform future tailored educational support for inhaler use for people with ID and also recommendations for health professionals when providing care for people with ID.

Methods

Setting

The research was conducted in New South Wales, Australia at the location where the person accessed health care, the offices of the support organisation, or the participant's home.

Recruitment

Government and non-government organisations providing disability support were used to identify potential participants. The first author contacted nominated individuals to organise a study meeting and obtain consent. A specially designed consent form was used, and read aloud to participants by the educator. Participants were given the opportunity to ask questions, and sign the consent form when happy with the information provided.

Participants were eligible for inclusion if they were adults with ID (clinical judgment/receiving support from relevant organisations), had doctor diagnosed asthma, and self-administered their asthma medication.

Study design

Quantitative assessment of inhaler technique was combined with a qualitative analysis of the educational interaction.

A face-to-face interview was conducted to collect demographic and background information, followed by assessment of inhaler technique via validated checklists and provision of individualised training.

Participants' inhaler techniques were assessed before (baseline) and after one session of training. An expert in education delivery relating to inhaler technique conducted the assessment and training. The training was based on accepted principles of teaching inhaler technique in the general population [9]. These include verbal counselling and a physical demonstration [4,16–18] by the educator, and hands-on practice by participants, using placebo devices. Training in this study was individualised for participants as deemed necessary by the educator, based on their responsiveness.

No pre-determined time limit for training was imposed, allowing the educator to tailor training according to the needs of each participant. Training continued until participants achieved mastery of technique (all device steps performed correctly as per checklists), the educator judged that a participant's concentration was such that he/she was unlikely to absorb further information, or time intervened. Although no standardised maximum period of time for training was applied across this study, some interviews had to be curtailed due to encroaching on mealtimes or other routines that a participant was involved in.

Where multiple errors in technique were made, the educator chose to concentrate on teaching one or two of the required steps rather than attempt to train the participant to mastery. Turbuhaler training was modified from standard training in that two placebo devices were utilised – one containing no medication, but otherwise identical to the real device – and a second trainer whistle, which was used to demonstrate the inspiratory effort required for correct use (the device emits a whistle when inspiratory flow is at least 35 L/min).Inhaler technique was then reassessed.

Inhaler technique mastery was evaluated based on published inhaler technique checklists [19]. Baseline and post-training inhaler technique scores were calculated. Scoring was based on the fact that for each device type, there are a number of steps involved in correct use [19] (see Appendix for evidence-based device checklists). For each device assessed, each step correctly performed in the checklist was given a score of 1. For example, there are nine steps for the Turbuhaler therefore the total score would be out of nine. If all steps were performed correctly the person was said to have correct technique (mastery). To facilitate analysis of errors made technique steps were divided into device *preparation*, device *positioning* (if applicable) and *inhalation* manoeuvres (Appendix).

Data collection

Demographic and background data

Data collected included age, gender, cause of ID if known, living situation, previous inhaler education and prescribed respiratory medications.

Inhaler mastery

Data collected at baseline and after training were the proportions of participants demonstrating correct technique and the proportion of participants correctly demonstrating *preparation, positioning and inhalation* steps.

The time taken for each device assessment and education was recorded by the educator.

Video recordings

The iterative process of training provided by the educator was captured using video recordings to allow investigation of the educational interaction between educator and participant. The recordings were saved in electronic format.

Data analysis

Descriptive statistics were used for demographic information. McNemar's test was used to determine the proportions of participants with correct technique. Analysis was undertaken using SPSS version 22 (SPSS Inc., Chicago, IL).

The process of inhaler technique training was analysed qualitatively, considering such factors as consistency of delivery and responsiveness of the participants. A deductive approach was used based on the framework of established

models of inhaler technique training [9]. The purpose was to identify barriers to delivery of educational messages by health providers in people with ID, strategies that facilitated training in this population and any other subconscious modifications to training. Two researchers assessed the videos iteratively.

The first author, a trained educator, conducted all the assessments and training, between March and July 2014. On average the whole interaction took 30–40 min. Approximately one-third of participants had a caregiver accompany them at the interview. If necessary for clarification caregivers were asked to provide background information with participants' consent.

Ethics

The study was approved by the HREC University of Sydney in January 2014.

Results

Background participant information

Seventeen people with ID were nominated for participation. All except one provided their own consent; for that participant, guardian consent was sought and received. The median age of participants was 57 years and the proportion of females was 65%. The main aetiology for the intellectual disability was unknown (47%). Other causes included cerebral haemorrhage/hypoxia at birth (2), traumatic childhood brain injury (1), Aspergers (2), cerebral palsy (1), Klinefelters syndrome (1) and Down syndrome (1). The living situation of participants varied; seven lived independently, six lived in group homes, three with family and one in a large residential centre

Previous inhaler education

Eighty two percent of participants ($n = 14$) stated that they had been shown how to use an inhaler; nine by a health care professional and five by a paid caregiver. Only one participant indicated that written information was provided regarding how to use their inhaler.

Prescribed respiratory medications

Participants were prescribed a variety of devices: pressurised metered dose inhalers with or without spacers and facemasks (pMDI, pMDI + S) and the DPIs – Turbuhaler (TH), Accuhaler (ACC) and Handihaler (HH). A total of 31 therapeutic medications were prescribed in 24 devices for the 17 participants (Figure 1). Seven participants (41%) were prescribed more than one type of inhaler device.

Daily inhaler use was reported by 14 participants. The most commonly used device was the pMDI ($n = 14$). Of the participants using pMDI four demonstrated use of the device with a spacer without prompting. Thirteen participants were prescribed inhaled corticosteroids (ICS) either alone or in combination with a long acting beta agonist. Asthma severity may be estimated from the treatment dose of ICS needed for an individual patient to maintain good asthma control. In this study, two participants were on low dose ICS, five on medium dose ICS and six on high dose ICS (46%) based on the classification in the Australian Asthma Handbook 2014 [20].

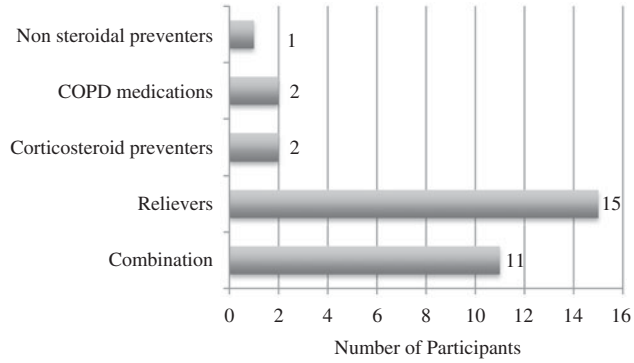

Figure 1. Prescribed respiratory medications by therapeutic class.

This suggests that the majority of participants were judged clinically to have moderate to severe asthma.

Inhaler technique mastery

At baseline no participant correctly used any device. Breaking down the steps (listed in Appendix), the proportions of participants mastering *preparation, positioning* (TH, ACC and HH only) and *inhalation* steps at baseline and following training are shown in Table 1. Not all participants were assessed after training for all devices. Omitted assessments were ACC (1), pMDI (2), MDIS (1) and HH (1). Following training the proportion of assessed participants correctly using devices was 100% of ACC users, 40% of TH users (2/5), 25% of pMDIs users with or without spacers (3/13) and 0% of HH users (0/1). McNemars test ($p < 0.05$) did not show a significant difference in the proportion of participants with correct technique at baseline and after training for any of the four devices.

Key errors were observed for all devices at baseline. Metered dose inhalers without accessory devices were the most poorly used device overall, with only 39% of eight participants correctly completing *preparation* or *inhalation* steps. In respect of *inhalation* steps, breath holding and exhalation before and after deep inhalation were often omitted. The inability to form a seal around the inhaler mouthpiece was also noted for several participants. Positioning of devices was incorrectly performed by all ACC users, 60% of HH users and 40% of TH users. *Preparation* steps were performed worst for pMDI – usually the participant did not shake the canister – followed by HH, and TH. All users completed *preparation* steps for the ACC correctly.

Video recording

All 17 participants were videoed using their inhalers and receiving inhaler technique training. The time required for assessment, education and reassessment, varied between devices, ranging from 2 min 40 s for a pMDI, to 8 min 30 s for one HH user. The median training times were 5.11 min (TH), 5.5 min (HH), 5 min (MDI with or without spacer) and 4 min (ACC).

Reviewing the video recordings allowed the researchers to identify characteristics of participants with ID that constituted barriers to adoption of correct technique; these included dexterity problems and cognitive deficits, e.g. attention span

Table 1. Proportions of participants with correct preparation, positioning and inhalation steps at baseline and post-training.

Device	Preparation (%)	Positioning (%)	Inhalation (%)
Turbuhaler			
Baseline	90	40	52
Post-training	100	80	88
Accuhaler			
Baseline	100	0	55
Post-training	100	100	100
Handihaler			
Baseline	60	50	66
Post-training	100	100	83
pMDI			
Baseline	38	Not applicable	38
Post-training	57		84
pMDI + spacer			
Baseline	66		58
Post-training	100		73

of clients. Problems observed with participants' dexterity particularly affected use of pMDI and HH. For example, a participant with carpal tunnel syndrome had difficulty in assembling the pMDI into the spacer and actuating it. Another participant had problems with opening the Spiriva capsule (tried to pop the capsule out when the seal needed to be peeled back) and then squashed the capsule whilst attempting to place it in the HH device mouthpiece.

A number of participants displayed problems with understanding and attentiveness. Initially during training several participants were unable to understand the educator's instruction to breathe in or breathe out, and therefore could not execute the required action at the request of the educator. Non-verbal cues from participants, including lack of eye contact for a period of 15 s or more, were also observed, suggesting an inability to maintain concentration.

As well as participant characteristics, another barrier was the interjection of caregivers in attendance. Although well meaning, some instructions put forward by caregivers were counterproductive, e.g. one caregiver gave her client an incorrect (and unsolicited) explanation of TH steps during the educational interaction with the educator. However, caregivers were found to be helpful in some instances, e.g. one suggested an instruction strategy that might be more effective with his client, i.e. ''get the person to practice *with* you, rather than *after* you''.

Strategies that facilitated delivery of inhaler technique training in the study were also identified. These included the temperament of the educator (exercising patience), positioning of the educator, the use of analogies and the presence of caregivers. During all assessments and training, the educator sat at eye level to the participants. The educator used similes during the training to describe the positioning of the device and the required inhalational steps. For positioning, these were: ''Hold upright – like a rocket'' (TH) and ''Hold flat – like a McDonald's burger'' (ACC). For the inhalational steps, similes used were ''like blowing out candles'' for exhalation, and ''like sucking through a straw'' for inhalation. In addition, to explain the length of time required for breath hold (up to 10 s), the educator instructed the participants to curl up each finger sequentially rather than ask them to count.

Discussion

The aim of this study was to examine the ability of people with ID to correctly use inhalers, and evaluate the effectiveness of teaching with respect to the participant's individual ability to adopt correct technique. Qualitative data were triangulated with established quantitative practices to collect preliminary data on the way people with ID use their inhalers. This was facilitated using video recording, which has previously been used for verification of inhaler technique in the mainstream population [21–25], but not for qualitative analysis of the training interaction between health professional and people with ID.

Key findings were that although training to mastery was achievable for some participants, overall results were poor, particularly for pMDIs and HH. The study also showed that standard inhaler technique training needed to be modified for several of the participants, as unique barriers exist in this population.

A high proportion of participants (82%) reported that they had previously been shown how to use an inhaler. While this is encouraging, around one third were shown by caregivers, who have not necessarily been trained in inhaler technique [26]. At baseline in this study, all participants demonstrated errors in technique with their devices, suggesting that the training previously received by people with ID was either not effective or not maintained. Research in the general community shows that regular repetition of technique instruction is an important step in ensuring it is maintained [27,28]; this is arguably even more essential in people with cognitive deficits, including intellectual disability, who may become confused or forget. Therefore, repeated assessment and instruction during visits with healthcare professionals is recommended for people with ID.

Errors in the current study occurred across all device types and checklist items, including *preparation*, *positioning* and *inhalational* steps. Most errors were with pMDIs, including the inability to form a seal, difficulty with coordinating actuation with inhalation, failure to hold the spacer with the inhaler upright and not sealing with lips; these types of errors have all been previously acknowledged in other population groups [7]. Interestingly, not all participants using pMDIs remembered to tell the educator about accessory devices when being assessed. This raises the question as to whether prescribed accessory devices are consistently being used, and is worthy of future investigation.

Errors with *inhalational* steps in this study, including failure to breath hold and failure to exhale prior to inhalation, are consistent with previous studies in cognitively impaired elderly persons [29–31]. Two participants manipulated their devices in unusual ways prior to inhalation; one TH user continuously twisted the grip, and a HH user constantly depressed the side button. The clinical consequences of these actions are likely to be different for the different devices. For example for the HH, consistently depressing the side lever may affect the integrity of the capsule and affect powder release.

Following training the ability to achieve inhaler technique mastery differed between devices with the ACC being the easiest (all three reassessed participants achieved mastery).

This may be because the TH is less forgiving in respect of loading and inhaling deeply than the ACC [32]. Anecdotally one participant stated that he was switched from Turbuhaler to Accuhaler for ease of use. The study results are supported by a study of elderly facility residents with dementia, which showed that 95% could successfully use the ACC when properly supervised [33]. In practice, the ACC device may therefore be easier for people with ID to master, but the results of the current study, which only scored three participants with ACC post-training, would need to be confirmed in a larger randomised trial with TH.

This study identified characteristics of participants that presented barriers to adoption of correct inhaler technique, and delivery of training. Poor dexterity and cognitive deficits affected participants' ability to perform correct technique. More than half the participants were aged over 55 years, and the lack of dexterity was observed by the researcher to be an issue for several, particularly in preparing the device for use (HH) and coordinating actuation and inhalation (pMDI). Problems with dexterity are already well known across both DPIs and pMDIs [2].

Participants in this study were observed to be heterogeneous in their ability to express themselves verbally and understand instructions. A novel observation related to the ability to understand instructions was that an act that usually would be perceived as simple for adults, i.e. intuitively distinguishing the difference between breathing in and breathing out, proved a challenge for a proportion of the participants. This phenomenon has previously been identified in children and managed in one inhaler study by using a modified inhaler canister, inserted with a horn, as a familiar sensory signal, to differentiate between the two actions [34]. The use of analogies to real world examples when describing desired technique steps proved successful in improving several participants' understanding of the differences between exhalation and inhalation in the current study.

Although not specifically tested in this study, short-term memory and attention have been previously proposed as being as influential as executive function in the process of inhaler training for people with cognitive impairment [15]. The median time to conduct inhaler assessment and training was between 4 and 5.5 minutes for the various devices. This duration was longer than online Australian inhaler technique demonstration videos [35], but similar to that in a study of pharmacist instruction in DPI technique (5.0 ± 2 min for TH and ACC) [36]. However that timing reflected training of all participants to mastery, which may require up to three attempts of technique education [37]. Training of all participants to mastery was not feasible in the current study due to limited focus and attentiveness in some participants (the training was preceded by collection of background information which also imposed cognitive demands). For five participants in the current study, the length of training was substantially increased – between 8 and 11 min.

The results of this study suggest that when training people with ID in inhaler technique additional time may be needed over and above standard practice to engage their attention, allow them to comprehend the educational messages and for participants to respond to the educator. The findings align with two studies of teaching methods for inhaler technique for elderly patients which noted that increased teaching time is needed for people with cognitive impairment [38,39].

In practice, general practitioners in Australia already report spending 19.5 min per consultation (range 5–60 min) for people with ID compared to an average of 13.5 min (range 5–60 min) spent with non-ID patients [40]. Therefore, reinforcement of training could conceivably be conducted during routine clinic visits. Also, in Australia, an annual health assessment for people with ID is reimbursed by the government, which may provide an additional opportunity to include reinforcement of inhaler technique training.

Correct inhaler technique involves a series of ordered and coordinated steps, not dissimilar to other tasks such as brushing teeth, which have been successfully taught to people with ID via behavioural modification interventions such as chaining [41]. With chaining a task is broken into several steps and the steps of the chain are cumulatively introduced over successive instructional trials until the task is completed independently to the required performance criteria [41]. This technique may be helpful with the teaching of inhaler technique steps for those people with ID with less functional ability. A behavioural modification approach might also be considered when a person with ID needs to be trained with multiple devices with different required techniques.

In consideration of information provision by healthcare providers to support inhaler use in people with ID, seven participants in this study resided in supported accommodation and although they self-managed their inhaled medication, they reported receiving support and encouragement for medication use from caregivers [26]. Therefore, it is desirable that both people with ID and their caregivers or support persons, are provided with information and trained in inhaler technique by health providers. Only one participant reported receiving information to keep regarding inhaler use. Current Australian guidelines suggest for inhaler technique training in the general population that patients are given a written record of steps incorrectly performed via a label or pictorial instruction sheet [20]. For the ID population, development of tailored patient leaflets in ''Easy English'', which is a style of writing which combines text and images to convey information simply and directly, could be considered.

Apart from education and training in inhaler device use, device selection also warrants attention in people with ID. In this study, seven participants were prescribed one or more DPIs as well as a pMDI, whereas Australian guidelines suggest choosing the same device type for each prescribed medicine if possible to avoid confusion [20]. This is likely to be even more pertinent in a cohort with cognitive impairment. In addition, in this study, reliever medication was usually prescribed as a pMDI when the preventer was a DPI. This could be ameliorated by employing the Symbicort Maintenance and Reliever Technology (SMART®) regimen for all TH users, or prescribing Bricanyl® TH when the person has their preventer delivered via a TH. Poor dexterity may have been improved with the use of a Haleraid® device with pMDI, or a breath-activated inhaler such as Airomir® or Qvar®. For patients who have cognitive deficits and self-administer inhaled medications device selection should preferentially be based on an assessment of cognitive

capacity for instruction and physical barriers to device manipulation [2,30].

Study limitations

In this exploratory study, the clients' level of ID was not assessed. Supporting organisations were asked to provide that information, but as clients generally come to services as adults, this information was not available in most clients' current records. The lack of descriptive data on the clients' level of ID is a possible limiting factor when interpreting the study findings. Future research should consider reporting such data, and potentially evaluating its association with outcomes. Health literacy, another potential barrier for people with ID in adopting correct inhaler technique, was not assessed in this study. Whilst the use of ''blinded observers'' and assessment of reliability in observation measurement of inhaler use skills, are acknowledged as desirable, they were not logistically feasible within the constraints of the current study and its support. However, they should be considered in the context of any future research.

The training time in this study was constrained for some participants by extraneous factors such as mealtimes, which may have influenced their ability to achieve technique mastery. However, it is likely that in the context of a clinic visit there would also be a finite amount of time available for technique education.

Finally, the study examined immediate acquisition and retention of inhaler technique, and did not consider longer-term retention of technique. As it is known in the general community that inhaler technique is not maintained over time it would be desirable to repeat training to determine if skills can be reinforced.

Recommendations

Structured modules of inhaler technique training tailored for people with ID which can be individualised are recommended. If the clinician educator deems that the person cannot be trained to mastery in one session it is recommended to concentrate on one or two steps and assess and reinforce technique regularly thereafter.

Potential future directions for research in the area include incorporation of a standardised behavioural-modification approach and a comparison of the ability of people with ID to master different inhaler types.

Conclusions

This is the first study to examine inhaler technique mastery in people with intellectual disability, as well as the educational interaction with a health professional. The research shows that standard modules of inhaler technique training require modification to address the unique cognitive barriers that exist in this population. Inhaler technique training should also be extended to caregivers or support persons.

Acknowledgements

The authors would like to thank the organisations and individuals that facilitated recruitment to this study, as well as the individual participants.

Declaration of interest

The authors declare that there are no conflicts of interest.

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Appendix

Inhaler checklists [19]

Table A1. Metered dose inhaler checklist.

Steps	Type of action
Step 1: Remove cap and shake well	Preparation
Step 2: Exhale all air out of lungs, away from inhaler	Inhalation
Step 3: Keep head upright, lift chin slightly	Inhalation
Step 4: Place mouthpiece between teeth and seal with lips	Inhalation
Step 5: Inhale slowly and deeply, pressing canister early	Inhalation
Step 6: Hold breath for as long as is comfortable (aim for 10 s)	Inhalation
Step 7: Breathe out normally, away from the inhaler	Inhalation
Step 8: Replace inhaler cap	Safe storage

Table A2. Turbuhaler® checklist.

Steps	Type of action
Step 1: Unscrew cap	Preparation
Step 2: Keep inhaler upright	Positioning
Step 3: Turn base until it clicks	Preparation
Step 4: Breathe out away from mouthpiece	Inhalation
Step 5: Keep head upright	Inhalation
Step 6: Place between teeth, close lips	Inhalation
Step 7: Breathe in forcefully and deeply	Inhalation
Step 8: Pause, then breathe out normally away from inhaler;	Inhalation
Step 9: Replace inhaler cap	Safe storage

Table A3. Accuhaler® checklist.

Steps	Type of action
Step 1: Open inhaler by sliding the thumb grip	Preparation
Step 2: Push level back completely to load dose	Preparation
Step 3: Exhale all air out of lungs, away from inhaler	Inhalation
Step 4: Keep head upright, lift chin slightly	Inhalation
Step 5: Hold inhaler horizontally; place mouthpiece between teeth; seal with lips	Positioning
Step 6: Inhale steadily and deeply	Inhalation
Step 7: Hold breath for as long as comfortable – aim for 10 s	Inhalation
Step 8: Breathe out normally away from inhaler	Inhalation
Step 9: Close inhaler	Safe storage

Table A4. Handihaler checklist.

Steps	Type of action
Step 1: Open the cap; lift the mouthpiece	Preparation
Step 2: Remove capsule from foil, place in the internal chamber	Preparation
Step 3: Close the mouthpiece firmly until you hear a click	Preparation
Step 4: Hold the inhaler upright and press the button firmly to pierce capsule	Positioning
Step 5: Exhale all air out of lungs, away from inhaler	Inhalation
Step 6: Keep head upright, lift chin slightly	Inhalation
Step 7: Place mouthpiece between teeth and seal with lips	Inhalation
Step 8: Inhale slowly and deeply so as to hear or feel the capsule vibrate	Inhalation
Step 9: Hold breath for as long as comfortable – aim for 10 s	Inhalation
Step 10: Breathe out normally away from inhaler	Inhalation
Step 11: Repeat steps 5–10, taking a second breath	

Table A5. Metered dose + spacer checklist.

Steps	Type of action
Step 1: Assemble the spacer if required	Preparation
Step 2: Remove inhaler cap, shake well and insert into spacer	Preparation
Step 3: Exhale all air out of lungs	Inhalation
Step 4: Keep head upright, lift chin slightly	Inhalation
Step 5: Place spacer mouthpiece between teeth and seal with lips	Inhalation
Step 6: Press canister and inhale slowly and deeply from spacer	Inhalation
Step 7: Hold breath for as long as comfortable (aim for 10 s)	Inhalation
Step 8: Breathe out normally, either	Inhalation
Step 9: Remove spacer from mouth	
Step 10: Replace inhaler cap and disassemble spacer if required	Safe storage