

Appendix 1

Inhaler technique and self-reported adherence to medications among hospitalised patients with asthma and COPD

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Checklist – Autohaler (Airomir, Aerobec)*

1. *Remove the protective cap.*
2. Shake the inhaler lightly.
3. *Hold the inhaler upright and pull the red lever straight upwards to load a dose.*
4. Exhale and empty the lungs of air, (but not into the inhaler).
5. *Place the mouthpiece between the teeth and lips and enclose tightly.*
6. *Take a deep and slow breath through the inhaler. Do not stop when the click is heard.*
7. Hold your breath for about 5-10 seconds (or as long as possible).

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 9.
3. Dénes J. Inhalatorer – Läkemedel för behandling av astma och KOL. FAKTA lungor och allergi; 04-2017. s. 35.
4. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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Checklist – Breezhaler (Onbrez, Seebri och Ultibro)*

1. *Remove the breezhaler (BH) cap and remove one capsule from the blister.*
2. *Grasp the mouthpiece and tilt it backwards, place the capsule in the capsule chamber and tilt back the mouthpiece until a click is heard.*
3. *Hold the BH between your thumb and forefinger and push from both sides to pierce the capsule.*
4. Exhale and empty the lungs of air (but not into the inhaler).
5. *Place the mouthpiece between the teeth and mouth, enclose tightly.*
6. *Inhale vigorously, deeply and for a long time through the BH so that a whirring sound is heard.*
7. After inhaling, try to hold your breath for about 5-10 seconds (or as long as possible).
8. *Grasp the mouthpiece and tilt it back to check that the capsule is empty. If it is not empty, repeat steps 4-7.*
9. When the capsule is empty, remove the capsule and discard it.
10. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 10.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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Checklist – Diskus (Ventoline, Serevent, Flutide, Seretide)*

1. Make sure there are doses left.
2. Hold the discus horizontally.
3. *Open the diskus.*
4. *Load a dose by pulling the "lever" as far as it will go until a click is heard.*
5. Exhale and empty the lungs of air (but not into the inhaler).
6. *Place the mouthpiece between the teeth and mouth, enclose tightly.*
7. *Inhale vigorously and deeply through the discus.*
8. Hold your breath for about 5-10 seconds (or as long as possible).
9. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 7.
3. Basheti IA, Bosnic-Anticevich SZ, Armour CL, Reddel HK. Checklists for Powder Inhaler Technique: A Review and Recommendations. *Respir Care*. 2014 Jul 1;59(7):1140-54.
4. Price D, Bosnic-Anticevich S, Briggs A, Chrystyn H, Rand C, Scheuch G, et al. Inhaler competence in asthma: Common errors, barriers to use and recommended solutions. *Respir Med*. 2013 Jan;107(1):37-46.
5. Price DB, Román-Rodríguez M, McQueen RB, Bosnic-Anticevich S, Carter V, Gruffydd-Jones K, Haughney J, Henrichsen S, Hutton C, Infantino A, Lavorini F, Law LM, Lisspers K, Papi A, Ryan D, Stållberg B, van der Molen T, Chrystyn H. Inhaler Errors in the CRITIKAL Study: Type, Frequency, and Association with Asthma Outcomes. *J Allergy Clin Immunol Pract*. 2017 Jul - Aug;5(4):1071-1081.e9.

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Checklist – Easyhaler (Buventol, Giona, Beclomet, Bufomix)*

1. Check how many doses there are left in the easyhaler (EH).
2. *Remove the protective cap from the EH.*
3. Shake the EH vigorously a few times (3-5 times).
4. *Hold the EH upright and click on the "button" once, a click should be heard.*
5. Exhale normally to empty the lungs of air (but not into the inhaler).
6. *Place the mouthpiece between teeth and lips, be sure to enclose tightly.*
7. *Inhale vigorously and deeply through the EH.*
8. After inhalation, try to hold your breath for at least 5 seconds (or as long as possible).
9. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 13.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev. 2005 Dec 1;14(96):102-108.

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Checklist – Ellipta (Anoro, Incruse, Relvar, Trelegy)*

1. Make sure there are doses left.
2. *Slide the protective cover aside until a click is heard (the dose is charged).*
3. Exhale and empty the lungs of air (but not into the inhaler).
4. *Place the lips and teeth around the mouthpiece.*
5. *Inhale with a deep, long, even breath through the inhaler.*
6. Hold your breath for 5-10 seconds (or as long as possible).
7. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 14.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev. 2005 Dec 1;14(96):102-108.

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Checklist – Evohaler (Ventoline, Serevent, Flutide, Seretide)*

1. *Remove the protective cap.*
2. Shake the inhaler well, about 4-5 times.
3. Exhale and empty the lungs of air, (but not into the inhaler).
4. *Place the mouthpiece between the teeth and lips and enclose tightly.*
5. *Take a deep and slow breath through the inhaler, right at the beginning of the breath, press the top of the inhaler so that the aerosol is sprayed out. Keep breathing in after you have pressed.*
6. Hold your breath for 5-10 seconds (or as long as possible).
7. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 20.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.
4. Price DB, Román-Rodríguez M, McQueen RB, Bosnic-Anticevich S, Carter V, Gruffydd-Jones K, Haughney J, Henrichsen S, Hutton C, Infantino A, Lavorini F, Law LM, Lisspers K, Papi A, Ryan D, Stållberg B, van der Molen T, Chrystyn H. Inhaler Errors in the CRITIKAL Study: Type, Frequency, and Association with Asthma Outcomes. J Allergy Clin Immunol Pract. 2017 Jul - Aug;5(4):1071-1081.e9.

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Checklist – Forspiro (AirFluSal)*

1. Check that there are doses left and *open the cover so that the mouthpiece is visible. Then lift the mouthpiece as far as it will go until a click is heard, fold back the mouthpiece until another click is heard.*
2. Exhale and empty the lungs of air, (but not into the inhaler).
3. *Place the lips and teeth around the mouthpiece, the protective cap should be down.*
4. *Inhale deeply and evenly through the inhaler.*
5. Hold your breath for 5-10 seconds (or as long as possible).
6. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 15.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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Checklist – HandiHaler (spiriva)*

1. *Open the grey protective cover by pressing the green button.*
2. *Tilt the white mouthpiece backwards and place a capsule from the blister strip in the capsule holder.*
3. *Fold back the white mouthpiece until you hear a click.*
4. *Pierce the capsule by clicking on the green button all the way down to the bottom*
5. *Exhale and empty the lungs of air (but not into the inhaler).*
6. *Place the lips and teeth around the mouthpiece.*
7. *Inhale deeply but evenly through the inhaler (hear the capsule vibrate).*
8. *Hold your breath for 5-10 seconds (or as long as possible).*
9. *Repeat steps 5-8 to make sure that all contents of the capsule have been emptied.*

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 17.
3. Melani AS, Bonavia M, Cilenti V, Cinti C, Lodi M, Martucci P, et al. Inhaler mishandling remains common in real life and is associated with reduced disease control. *Respir Med.* 2011 Jun;105(6):930-938.

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Checklist – Novolizer (Ventilastin, Formatris och Novopulmon) samt Genuair (Eklira och Duaklir)*

1. Check that there are doses left.
2. *Remove the protective cap.*
3. *Charge the inhaler by clicking the button.* The red window should then turn green, indicating that a dose has been loaded.
4. Exhale and empty the lungs of air, (but not into the inhaler).
5. *Place the lips and teeth around the mouthpiece.*
6. *Inhale vigorously and deeply through the mouthpiece. A click will be heard, continue to inhale after the click.*
7. Hold your breath for about 5-10 seconds (or as long as possible).
8. Check that the window has turned red again, confirming a correct inhalation.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 16, 19.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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Checklist – Respimat (Striverdi, Spiriva, Spiolto)*

1. Make sure there are doses left...
2. *..while the transparent cover is still close.*
3. *Charge the dose by turning the lower part of the inhaler until a click is heard (in the direction shown by the arrow).*
4. *Open the transparent cover.*
5. Exhale and empty the lungs of air.
6. *Place the mouthpiece between the teeth and lips and enclose tightly.*
7. *Take a deep and slow breath through the inhaler, pressing the grey button to release the aerosol at the start of the inhalation. Continue to inhale after pressing.*
8. Hold your breath for about 5-10 seconds (or as long as possible).
9. For one dose, two inhalations are required → Repeat steps 1-6.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 25.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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Checklist – Spacer (till MDI, evohaler, respimat)*

1. *Attach the MDI/evohaler/respimat to the spacer and shake the MDI/evohaler or prepare the respimat by loading a dose as usual.*
2. *Place the mouthpiece or mask to the mouth.*
3. *Press the MDI evohaler/respimat once.*
4. *Breathe 5 breaths completely normally to inhale the whole dose.* If the optichamber diamond is used, you can see how many breaths have been taken. It also emits a sound if the patient inhales too rapidly.
5. Remove the spacer from the mouth and try to hold the breath for 5-10 seconds (or as long as possible).
6. If more dosages have been prescribed or if the respimat is used, the procedure should be repeated.

References:

1. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 22.
2. Dénes J. Inhalatorer – Läkemedel för behandling av astma och KOL. FAKTA lungor och allergi; 04-2017. s. 37.

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Checklist – Spiromax (Duoresp och aerivio)*

1. Make sure there are doses left and hold the inhaler with the lid down. *Fold down the cover completely until a click is heard. A dose is then charged.*
2. Exhale and empty the lungs of air.
3. *Place the lips and teeth around the mouthpiece, do not hold your fingers on the air valve which will block it.*
4. *Inhale vigorously and deeply through the inhaler.*
5. Hold your breath for 5-10 seconds (or as long as possible).
6. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 26.
3. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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Checklist – Spray/MDI (Airomir, Airsalb, AeroBec, Alvesco, Flutiform, Innovair, Atrovent, Symbicort)*

1. *Remove the protective cap.*
2. Shake the inhaler well, about 4-5 times.
3. Exhale and empty the lungs of air, (but not into the inhaler).
4. *Place the mouthpiece between the teeth and lips and enclose tightly.*
5. *Take a deep and slow breath through the inhaler, pressing the top of the inhaler to release the aerosol at the start of the inhalation. Continue to inhale after pressing.*
6. Hold your breath for about 5-10 seconds (or as long as possible).
7. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. FASS. Airomir. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=19960403000015>. [uppdaterad 2016-06-22, citerad 2018-06-15].
2. FASS. Airsalb. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20061206000076>. [uppdaterad 2017-10-20, citerad 2018-06-15].
3. FASS. AeroBec. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20021115000154>. [uppdaterad 2017-06-16, citerad 2018-06-15].
4. FASS. Alvesco. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20040916001894>. [uppdaterad 2017-07-06, citerad 2018-06-15].
5. FASS. Flutiform. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20100330000139>. [uppdaterad 2017-12-13, citerad 2018-06-15].
6. FASS. Innovair. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20071108000050>. [uppdaterad 2018-04-18, citerad 2018-06-15].
7. FASS. Atrovent. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=19781215000037>. [uppdaterad 2016-05-20, citerad 2018-06-15].
8. FASS. Symbicort. [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20141001000010>. [uppdaterad 2017-11-20, citerad 2018-06-15].
9. Melani AS, Bonavia M, Cilenti V, Cinti C, Lodi M, Martucci P, et al. Inhaler mishandling remains common in real life and is associated with reduced disease control. *Respir Med*. 2011 Jun;105(6):930-938.
10. Price DB, Román-Rodríguez M, McQueen RB, Bosnic-Anticevich S, Carter V, Gruffydd-Jones K, Haughney J, Henrichsen S, Hutton C, Infantino A, Lavorini F, Law LM, Lisspers K, Papi A, Ryan D, Stållberg B, van der Molen T, Chrystyn H. Inhaler Errors in the CRITIKAL Study: Type, Frequency, and Association with Asthma Outcomes. *J Allergy Clin Immunol Pract*. 2017 Jul - Aug;5(4):1071-1081.e9.

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Checklist – Turbuhaler (Bricanyl, Oxis, Pulmicort, Symbicort)*

1. Make sure there are doses left in the turbuhaler (TBH).
2. *Remove the cap from the TBH.*
3. *Turn the bottom of the inhaler in one direction (it does not matter which) and then back so that a click is heard while the TBH is upright (an inclination of 45 degrees is ok).*
4. Exhale completely and empty the lungs of air (but not into the inhaler).
5. *Insert the mouthpiece between teeth and lips sitting or standing (free airway).*
6. *Inhale deeply and vigorously through the inhaler.*
7. Hold your breath for max 10 seconds (or as long as possible).
8. Rinse your mouth with water afterwards if the inhaler contains corticosteroids.

References:

1. Hagedoorn P, Klemmeier-Boekhout T, redaktörer. Patientutbildningsatlas. Nederländerna: Escuulaap Media; 2017.
2. Capstick T, Attack K. The Leeds Inhaler Device Guide: inhaler technique instructions for healthcare professionals and patients. 1st ed. Leeds: The Leeds Teaching Hospitals; 12-2015. p. 27.
3. Dénes J. Inhalatorer – Läkemedel för behandling av astma och KOL. FAKTA lungor och allergi; 04-2017. s. 21.
4. Salaneck A. Assessment of Inhaler Handling in Elderly Hospitalized Patients with Asthma or COPD. 2016. p. 7.
5. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96):102-108.
6. Price DB, Román-Rodríguez M, McQueen RB, Bosnic-Anticevich S, Carter V, Gruffydd-Jones K, Haughney J, Henrichsen S, Hutton C, Infantino A, Lavorini F, Law LM, Lisspers K, Papi A, Ryan D, Stållberg B, van der Molen T, Chrystyn H. Inhaler Errors in the CRITIKAL Study: Type, Frequency, and Association with Asthma Outcomes. J Allergy Clin Immunol Pract. 2017 Jul - Aug;5(4):1071-1081.e9.

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Checklist – Twisthaler (Asmanex)*

1. Check that there are doses left and *check that the counter and arrow on the protective cap are lined up.*
2. *Hold the inhaler upright (pink/reddish brown bottom down) and open the inhaler by removing the protective cap.* When the protective cap is removed, the counter will decrease one step (the dose loads when the protective cap is removed).
3. Exhale and empty the lungs of air, (but not into the inhaler).
4. *Place the lips and teeth around the mouthpiece.*
5. *Take a deep and rapid breath through the inhaler.*
6. Hold your breath for 5-10 seconds (or as long as possible).
7. Rinse mouth with water afterwards.
8. *Replace the protective cap correctly after the inhalation to reload the dose for the next inhalation.*

References:

1. FASS. Asmanex, Twisthaler. . [Internet]. Läkemedelsföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20020208000286&docType=7&scrollPosition=493>. [uppdaterad 2017-12-14, citerad 2018-06-15].
2. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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Checklist – Zonda (braltus)

1. *Open the protective cover and open the mouthpiece by lifting it backwards.*
2. *Place a capsule from the bottle/container into the capsule holder.*
3. *Close mouthpiece until a click is heard.*
4. *Make a hole in the capsule by clicking on the white button all the way down to the bottom. Then release the button.*
5. *Exhale and empty the lungs of air, (but not into the inhaler).*
6. *Place the lips and teeth around the mouthpiece.*
7. *Inhale deeply but evenly through the inhaler (hear the capsule vibrate).*
8. *Hold your breath for 5-10 seconds (or as long as possible).*
9. *Repeat steps 5-8 to make sure that all contents of the capsule have been emptied.*

References:

1. FASS. Braltus. [Internet]. Läkemedelsindustriföreningen, LIF. Hämtat från: <http://www.fass.se/LIF/product?userType=2&nplId=20141028000031>. [uppdaterad 2016-07-20, citerad 2018-06-15].
2. Newman SP. Inhaler treatment options in COPD. Eur Respir Rev 2005 Dec 1;14(96): 102-108.

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