

Implementation of a Policy Change: Replacement of Nebulizers by Spacers for the Treatment of Asthma in Children

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ABSTRACT: **Background:** Treatment using inhaled bronchodilators for asthma with a metered dose inhaler attached to a spacer device (MDI+S) was shown to be as efficient as nebulizers. Nevertheless, nebulizers remain the treatment of choice in most hospitals.

Objectives: To implement a policy change to improve asthma treatment in pediatric wards and the pediatric emergency department.

Methods: The study was performed in the emergency department and pediatric wards of a university medical center. The study group comprised all children admitted with a diagnosis of asthma necessitating treatment. The medical and nursing staff of both the pediatric emergency department and the pediatric wards was trained how to use metered dose inhalers attached to spacers on a regular basis in asthmatic pediatric patients. At a preset date nebulizers were replaced by spacers and their use was monitored by the supervising physician. Salbutamol was administered by a metered dose inhaler (100 µg/puff) attached to a spacer device. The number of puffs was determined by severity of disease according to GINA recommendations. After 2 years the outcome and cost analysis were examined.

Results: During 3 years since the initial policy change 92.5% patients were treated with spacers throughout their hospital stay (emergency department and pediatric ward). Costs were reduced by an estimated 63%.

Conclusions: In view of its many advantages, replacing nebulizers by MDI+S for the treatment of acute asthma is feasible, if performed in collaboration with the staff, hospital authority and patients.

IMAJ 2015; 17: 421–424

KEY WORDS: acute asthma, policy change, spacers, nebulization, metered dose inhaler attached to spacer device (MDI+S)

Published evidence favoring treatment with inhaled bronchodilators for asthma with a metered dose inhaler attached to a spacer device (MDI+S) has been available for over two decades. Administration of bronchodilators via MDI+S is as efficient as

nebulization with compressed air to treat acute mild and moderate asthma [1-5]. Additional advantages are ease of use and shorter administration time, fewer side effects, decreased costs, and higher parent and child satisfaction [2,4-6]. Therefore, most established policies recommend the use of MDI+S over nebulizers for the treatment of acute asthma [7,8]. Yet surprisingly, nebulizer treatment remains the mainstay of therapy for asthma in most medical centers. The majority of pediatric wards and pediatric emergency departments in Canada and the United States as well as all pediatric wards in Israel do not employ the MDI+S technique as standard treatment [9-11].

Many potential barriers are encountered when implementing new techniques and promoting policy change in medical practice and/or within a medical organization [12]. Education is helpful but improving knowledge and providing specific policies do not necessarily guarantee change [13]. Obstacles to policy implementation have been classified into two groups: internal factors (problems with the validity of the policy) and external factors (behavioral, social, organizational barriers) [13,14]. The most prevalent obstacles are lack of leadership to guide the change, concerns about increased costs and workload, as well as belief of both staff and patients that established methods are often more efficient than new techniques [10,11,15].

Until 2009 all pediatric patients with asthma at the Hadassah Medical Center, Mount Scopus, were treated with inhaled salbutamol respiratory solution (5 mg/ml) via nebulizers (disposable masks attached to flow from available oxygen outputs). Administration of inhaled salbutamol by nebulizers for pediatric patients with asthma exacerbation was assessed by a staff nurse in the pediatric ward and the entire treatment session was recorded. In the study by Boe et al. [16] the criteria for correct use of nebulizers were fulfilled by fewer than 40% of assessed children (unpublished results).

In 2009 it was acknowledged that salbutamol administration for treating acute asthma in the pediatric wards and emergency department needed to be improved. A pilot study was performed to assess the feasibility of treatment with MDI+S devices. Five MDI+S devices were purchased. Over 2 months a randomized group of pediatric patients received treatment with MDI+S instead of nebulizers. Results were discussed

with staff members to analyze the efficiency and effectiveness of a putative policy change. A policy change from nebulizers to spacers (MDI+S) was introduced in 2009 in the pediatric wards and in 2011 in the pediatric emergency department. The process of this policy change is assessed.

PATIENTS AND METHODS

According to the policy regarding research at the Hadassah-Hebrew University Medical Center, this was considered policy change and its analysis was therefore exempt from institutional review board approval. The study was performed in the emergency department and pediatric wards in the Hadassah-Hebrew University Medical Center. The hospital staff had no prior experience with spacer devices.

MDI+S DEVICES

Spacers (standard units including masks) that can be sterilized, designated for hospital use, and standard unit salbutamol MDI (100 µg/puff) were purchased (RespiChamber[®] Hospital, Trudell Medical Int., Canada). The number of spacers was calculated to supply the needs of an estimated 250 admissions/year of patients with asthma. A turnover of 48 hours for sterilization was taken into account. The hospital's infection and control unit was notified and consulted.

On admission the patient was provided with an individual spacer device for personal use during the hospital stay or until providing his/her own device. The device was marked with the patient's name. On discharge the hospital device was sent for sterilization according to the manufacturer's instructions.

TRAINING

The medical and nursing staff attended a 3 hour educational session on the MDI+S device. Pediatric residents were instructed in small groups or individually. After introduction of the spacers into the wards all newly admitted patients and their parents received oral and written instructions on the correct use of the device. Under the nurses' supervision the parents were encouraged to be the main MDI+S inhalation providers.

Ongoing interactive educational sessions were held by the physician in charge of the new policy, routinely assessing implementation in the wards, discussing potential objections by the staff, and providing additional advice on daily rounds if needed.

FIRST STEP: PEDIATRIC WARDS

On the date set for implementing the policy change, MDI+S devices were introduced in the wards. On admission, patients were supplied with a hospital device and given a prescription for MDI+S to replace the one provided by the hospital.

During the first 6 weeks after the policy change, daily rounds were led by the physician in charge to ensure implementation. Thereafter, less frequent evaluations were required, and by 4

months post-initiation the MDI+S technique was the mainstay of therapy for acute asthma in the pediatric wards.

SECOND STEP: PEDIATRIC EMERGENCY DEPARTMENT

The policy was implemented 2 years after its initial introduction into the wards. Because the treating physicians in the pediatric emergency department (PED) are the same as in the wards but the nursing staff is different, education was targeted at the nurses only. Ensuring the implementation of the changed policy was not required as the MDI+S technique had already been introduced into the wards and for the physicians was the mainstay of treatment.

COST ESTIMATION

MDI+S cost and use were evaluated after initiation of the policy change. Cost estimation for the two salbutamol administration methods (MDI+S and nebulization) was obtained by calculating the price of medication (100 µg/puff salbutamol given by MDI, or 5 mg/ml respiratory solution), the device (spacer or nebulizer mask), and the administration time by a nurse (2 minutes and 10 minutes for the MDI+S and nebulizer techniques, respectively). Estimates of nurse time spent administering each treatment either by her and/or supervising the parent was based on observations performed during the pilot study. The nurse's cost was calculated using the institution's median hourly wage of \$11.10. Equipment and drug costs were calculated based on spacer device cost (\$25), sterilization cost (\$0.41), salbutamol MDI cost (\$3.33), nebulizer mask cost (\$0.96), and salbutamol respiratory solution cost (\$0.53) including syringe, needle and sterile saline solution per inhalation.

IMPLEMENTATION ANALYSIS

One year after complete implementation of the MDI+S technique a retrospective analysis evaluated the change in policy. The analysis covered all admissions in 2012 to the pediatric wards with an ICD-9 diagnosis of asthma, asthma exacerbation or status asthmaticus, and treatments in the PED and pediatric wards were reviewed. Administration of salbutamol via nebulization at any point during hospitalization was considered non-adherent to the policy change and the reason was investigated.

RESULTS

At the end of the implementation process we performed an analysis of the treatment given to children admitted to the pediatric wards with the diagnosis of asthma to assess adherence to the policy change by the medical staff and the patient/family. Of 236 hospitalized children, 134 (57%) were male, and 115 (49%) were under 2 years of age, 72 (30.5%) were 2–5 years old and the remaining 49 (20.7%) were between 5 and 16.

All 236 were initially seen in the PED. Of those, 205 (87%) were treated with MDI+S. After transfer to the pediatric

Table 1. Cost estimation in US\$ for inhalations, calculated for 250 annual asthma admissions

| | MDI+S | Nebulizer |
|-------------------|-------|-----------|
| Device | 1,250 | 240 |
| Drug | 833 | 2122 |
| Sterilization | 102 | N/A* |
| Nursing time | 1481 | 7407 |
| Total | 3666 | 9769 |
| Total per patient | 14.67 | 39.07 |

MDI+S = metered dose inhaler attached to a spacer device with mask
 *Not applicable as nebulizer masks are disposable

wards, the number of patients receiving salbutamol by spacers increased to 230 (97.5%). For 27 of the 31 patients treated with nebulizers in the PED, inhalers were changed to MDI+S on arrival to the wards. Four patients (1.7%) continued nebulizer treatment in the pediatric ward following the parents' request. Two patients (0.8%) on the pediatric wards who were not satisfied with the MDI+S treatment were switched to nebulizers.

Today, more than 3 years after initial policy implementation, MDI+S has become the standard inhalation technique in the treatment of asthma for both hospitalized children and pediatric patients in the PED.

Cost analysis showed that expenses for inhaled salbutamol treatment were significantly reduced after introduction of the MDI+S technique [Table 1], as also described by Bowton et al. [17] and Goh et al. [18]. Calculations were based on the estimated number of asthma admissions per year (250), hospital stay per asthma admission (3 days), and a mean of 16 doses salbutamol per admission. The cost estimation included the purchase of 50 spacer devices. Implementation of the new policy reduced treatment price per patient by 63%, from \$39.07 to \$14.67 in the first year of implementation. In the following years, treatment price was further reduced since there was no need to purchase additional spacer devices. The only expenses still to be covered were sterilization costs and purchasing salbutamol (MDI). An official change in policy regarding salbutamol administration for hospitalized children was subsequently implemented by the hospital, based on cost reduction and time saving.

DISCUSSION

Accomplishing a policy change is challenging and relies on anticipating and understanding objections to the process from within (staff, administration) and from without (patients, families). According to Haines et al. [19], overcoming these difficulties and promoting the uptake of clinical findings requires an orderly set of actions. We used this approach in planning and executing our policy change. New policies require the

change from established habits to different habits for medical staff, and may cause a feeling of unease for patients used to a known routine. Thus, to successfully implement the MDI+S technique, the “nebulizer culture” had to be overcome by hospital staff as well as patients and their families [12].

The first step according to Haines and co-researchers [19] is identifying a significant gap between research findings and practice. The well-established evidence regarding the benefit of MDI+S in asthma [1] was the major incentive for implementing this technique in our medical center, especially as the nebulizer technique was not used correctly for > 60% of our pediatric patients (unpublished results). An additional motivation was the anticipated ease of use, cost-effectiveness, and reduction in nursing time.

The next set of steps is to involve key players in a position to influence change, identify barriers to change, recognize levers to help accomplish change, and decide on specific interventions to help promote the change [19]. It is well known that educational activities alone are unlikely to promote behavioral changes among health professionals [20]. Thus, three main elements essential for successful implementation were chosen: a senior physician to lead the change, provide ongoing education to address problems that might arise, and provide continuous monitoring to overcome prescribing and treating habits.

The MDI+S is a portable, time-saving, easy-to-use and efficient device, which helped convince most patients and personnel to switch to the new technique. However, given the general “nebulizer culture” and our concern that after discharge both patients and primary care physicians will switch back to their familiar habits (i.e., nebulizers), we published our policy change in local newspapers and presented the technique at regional primary care conferences.

No statistical data are yet available on outpatient treatment in asthmatic patients discharged from our hospital; however, based on follow-up data from our respiratory clinics and readmissions, adherence to the MDI+S technique was maintained by most parents.

Cost assessment was performed for administrative purposes. A full change of practice is cost effective and may significantly reduce hospital expenses for treating asthma. This cost reduction is helpful for receiving administrative assistance to promote change in practice.

The retrospective analysis of the policy change showed that the vast majority of patients were treated according to the new policy throughout their hospital stay, namely, 87% in the PED and 97.5% in pediatric wards. Although we did not review the treatment given to asthmatic patients in the PED who were subsequently not admitted, a trend was observed showing that the implementation was less successful in the PED. This could be explained by the fact that response to different treatments is assessed as part of the diagnosis, e.g., adrenalin + hypertonic saline administered by nebulizers for bronchiolitis. After trans-

fer of the patient to the ward the final diagnosis of asthma was established and the treatment adapted. In addition, since the same nursing staff sometimes works in both the regular ED and the PED and not all nurses in the adult ED are familiar with the new technique, pediatric patients may initially be treated with nebulizers.

In summary, a policy change can be implemented successfully – even when habits are firmly established. In the case presented here, the “nebulizer culture” was considered to be the main obstacle for changing to the MDI+S device, a method proven for over two decades to be as effective if not better than the nebulizer technique. With a systematic approach, education and perseverance, medical staff and patients can accept changes. Our experience as described here may help other pediatric departments to initiate policy changes in general and change to spacers in particular.

Acknowledgments

Thea Pugatsch, PhD, Dept. of Pediatrics, Hadassah Medical Center, Mount Scopus, contributed to the writing and editing of the manuscript.

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