

## ORIGINAL ARTICLE

## Spacer compliance after discharge following a mild to moderate asthma attack

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**Aim:** To assess MDIS usage in patients discharged from a children's hospital emergency department following a mild to moderate asthma attack.

**Methods:** Prospective observational study of 73 consecutive patients presenting to a children's hospital emergency department with a mild to moderate asthma attack. Demographic data, whether asthma literature/written MDIS instructions were provided, and who provided MDIS instructions (either a discharge coordinator or other emergency department staff) were noted. Parents of patients were telephoned after the first week following discharge and questioned about patient improvement, MDIS use/reasons for not using MDIS, and unscheduled presentations to their local doctor or hospital.

**Results:** Following discharge, 50/73 (68.5%) patients used MDIS exclusively (compliers), while 23/73 used nebulisers some or all of the time (non-compliers). There was no difference in patient improvement or unscheduled presentations between compliers and non-compliers. Most non-compliers 14/23 (60.9%) changed because of parental preference; ease of nocturnal nebuliser use was a possible factor. Compliance was associated with the age of the patient, spacer usage at hospital, the size of device used at hospital, and whether an information fact sheet was given.

**Conclusions:** Most children discharged from the emergency department following a mild to moderate asthma attack continue MDIS use exclusively in the first week. MDIS compliance may be associated with knowledge, experience, and ease of spacer usage. The study shows that education for parents is crucial for MDIS compliance.

A recent Cochrane Systematic Review has established that in mild to moderate asthma attacks, MDIS are as effective as nebulisers.<sup>1</sup> Recently one tertiary paediatric hospital has reported success in introducing MDIS along evidence based guidelines.<sup>2</sup> This model has been subsequently implemented in other emergency departments. However no paediatric studies to date have assessed the rate of MDIS use following discharge home. A prospective observational study was therefore conducted with the aim of exploring factors that may be associated with MDIS use in patients who are discharged from a children's hospital emergency department following a mild to moderate asthma attack.

## METHODS

### Setting

This study was performed in the emergency department of the Children's Hospital at Westmead (CHW), one of the two tertiary paediatric hospitals in Sydney, Australia. The emergency department serves the entire Greater Western metropolitan region of Sydney and as such sees a wide ethnicity and social stratification of patients. The total attendance to the emergency department for the calendar year 2000 was 42 060 patients. The total number of asthma presentations in the calendar year 2000 was 1583, of whom 657 (41.5%) were admitted to the ward. Of those who were discharged directly from the emergency department, 260 stayed in the department more than four hours.

This project was performed as a quality control project. As such, the ethics committee of the hospital deferred the decision for ethics approval to the Service Improvement Unit, which duly granted ethics approval for this work.

### Inclusion and exclusion criteria

Discharge coordinators enrolled consecutive patients to the study during the last quarter of the year 2000. Patients were

included if they were diagnosed with either asthma (defined as repeated episodes of wheeze and/or dyspnoea responsive to bronchodilators) or a bronchodilator responsive wheezing illness. Illness severity was determined according to National Asthma Campaign guidelines for asthma attacks,<sup>3</sup> modified for in-house use. Patients presenting with severe asthma attacks and those with moderate asthma attacks who required admission were excluded. Patients were also excluded if they had a history of other pulmonary disease, or were aged less than 12 months or over 16 years.

### Procedures

All asthmatic patients were treated with oral prednisolone (1 mg/kg/dose daily for two days) on presentation to the emergency department. As this study took place during a transition period (when evidence based MDIS use was being introduced into the emergency department), patients were permitted to use MDIS with metered dose inhalers and/or nebulisers during their stay in the emergency department.

Where nebulisers were used, children less than 6 years of age were given 2.5 mg of salbutamol per dose, while children 6 years old or more were given 5 mg of salbutamol per dose. Where MDIS were used, children less than 6 years old were given 600 µg salbutamol per dose, while children 6 years old or more were given 1200 µg per dose. Children less than 4 years old used small MDIS (Space Chamber, Medical Developments Australia Pty Ltd) with masks, while children over 4 years old used large MDIS (either Volumatic, Glaxo Wellcome Australia Ltd or Space Chamber, Medical Developments Australia Pty Ltd) with mouthpieces.

In children who presented with a moderate attack of asthma, ipratropium bromide was added to the initial three doses of salbutamol and thereafter used every 3–4 hourly. Ipratropium bromide was administered using the same mode of delivery as the salbutamol. Where nebulisers were used, children less than 6 years old were given 125 µg ipratropium

per dose, while children 6 years old or more were given 250 µg ipratropium per dose. Where MDIS were used, children less than 6 years old were given 80 µg ipratropium per dose, while children 6 years old or more were given 160 µg of ipratropium per dose. Patient response determined the interval between subsequent doses. Patients were discharged home once they tolerated at least three hours between bronchodilator doses.<sup>4</sup>

During their stay all parents (and where age appropriate, patients) were given asthma education and introduced to MDIS by an instructor, who was either a discharge coordinator or another staff member (asthma educator, doctor, or nurse). Correct MDIS technique was ensured prior to discharge. At discharge all patients were prescribed salbutamol metered dose inhalers to be delivered via MDIS. All patients were advised to schedule an appointment with their local doctor within the first week of discharge.

### Data collection and analyses

The parents of patients were contacted by telephone 1–8 weeks after discharge (such that no calls were made during the first week). During this phone call, parents were asked a set of standard questions. They were asked whether the patient had complied with MDIS use or, if they had not complied (that is, changed to a combination of MDIS and nebuliser or nebuliser exclusively), the reason why they changed (parent preference, child preference, local doctor advice, or miscellaneous reasons). Parents were also asked whether the patient had continued to improve and if any unscheduled visits to the local doctor or hospital within 48 hours of discharge had occurred. The provision of or lack of asthma literature and written instructions on MDIS use to parents on discharge by each instructor was also assessed.

Demographics and information on hospital treatment were also recorded for each patient. The outcome of the study was defined as compliance to spacer use one week after hospital treatment. Data were collated into a Microsoft Access 97 database (Microsoft Corporation, Seattle, USA). Statistics were derived using SPSS for Windows, version 9.0.1 (SPSS Corporation, Chicago, USA). Associations between categorical variables were analysed by  $\chi^2$  tests. Fisher's exact tests were also employed when the expected cell size was smaller than 5. Student's *t* tests were used to compare mean ages and presenting  $S_{aO_2}$  between compliers and non-compliers.

### RESULTS

In the study period, 84 patients were identified who met the study criteria. Seventy three (86.9%) were contactable within the specified time. One patient, who had a very mild asthma attack, did not take any salbutamol after discharge. This patient was retained in the study (intention to treat), hence all 73 patients were included.

The mean age of the 73 patients was 3 years 10 months (range 14 months to 10 years 11 months). There were 58 (79.5%) male patients and 15 (20.5%) female patients. Forty nine patients (67.1%) presented with a mild asthma attack, and 24 (32.9%) with a moderate asthma attack. The mean oxygen saturation on presentation was 95.8% (SD 2.1%). Comparisons on all variables between mild and moderate asthmatic patients indicated no significant differences.

We found that 39 of the 73 patients (53.4%) had previously used MDIS. During their emergency department visit, 37 patients (50.6%) used MDIS exclusively while 36 patients (49.4%) used a combination of MDIS and nebulisers or nebulisers exclusively.

In the first week after discharge, 50 of the 73 patients (68.5%) used MDIS exclusively (compliers), while 23 patients (31.5%) used nebulisers some or all of the time (non-compliers). Of the 23 non-compliers, 14 (60.9%) cited parental preference, two parents (8.7%) cited child preference, one

parent (4.3%) cited local doctor advice, and three parents (13.0%) cited miscellaneous reasons for their non-compliance.

Table 1 summarises the results obtained on comparison of patient characteristics, hospital treatments, and outcomes between compliers and non-compliers. As shown, patients who complied with spacer use at home after discharge were significantly younger than the non-compliers, with mean ages of 2.95 and 5.76 respectively (table 1). No other patient characteristics were significantly associated with compliance status. In terms of hospital treatments, three variables were found to be associated with compliance. There were significant relations between spacer use at hospital, whether parents were given fact sheets about spacer use, and a smaller size of device used at hospital and compliance with spacer use at home (table 1). Higher proportions of compliance were found with MDIS use in hospital (59.2%), fact sheets given (94.0%), and smaller size of device used in hospital (84.0%) when compared with other devices used, fact sheets not given, and larger device size.

None of the disease outcomes were associated with compliance status, and minimal complication rates were noted across all patient groups. Three of 50 compliers (6.0%) failed to improve compared with one of 23 non-compliers (4.3%). Six of the 50 compliers (12%) made unscheduled visits to their local doctor or to hospital compared with four of 23 non-compliers (17.4%). There was no statistical difference between compliers and non-compliers in either case.

### DISCUSSION

Our study suggests that most children who present to and are discharged from a children's hospital emergency department following a mild to moderate asthma attack continue to use MDIS exclusively (that is, are compliers) in the first week. A number of factors may promote compliance, including the age of the patient, spacer usage during the patient's emergency department stay, the size of the device used at hospital, and whether an information fact sheet was given to the parent during their emergency department education. In this study no differences were found between mild and moderate asthmatics in terms of asthma condition, MDIS compliance, likelihood of representation, and exacerbation.

All our patients agreed to try MDIS after discharge. In their study, Powell and colleagues<sup>2</sup> implemented MDIS treatment in the emergency department in 92.5% of the 200 children who took part in their trial. However, the number of patients who continued MDIS use after discharge was not known. We note that their study included patients who had severe asthma attacks and who were admitted. Our study considered patients who had mild to moderate asthma attacks and who were not admitted.

In our study there was a low failure rate (that is, failure to improve in the first week) with both compliers and non-compliers. Similarly low rates for unscheduled local doctor and hospital presentation were noted both compliers and non-compliers. There was no significant difference between compliers and non-compliers in either case. These data are in agreement with current literature. Cates and Rowe<sup>1</sup> performed a Cochrane Systematic Review of the literature. In part of their review they examined data from 686 paediatric patients with acute asthma attacks. They found that MDIS produced equivalent peak flow and forced expiratory volume improvements compared with nebulisers. They highlighted advantages with MDIS delivery among paediatric patients in terms of fewer side effects (such as tachycardia) and shorter length of stay in the emergency department.

Compliance was defined in this study as continuation of MDIS use exclusively in the first week after discharge. However, treatment adherence in general is an important factor in achieving effective asthma treatment in children.<sup>5</sup> A major factor in MDIS non-compliance in our study was

**Table 1** Patient characteristics, treatment variables, and outcomes by compliance status (n=73)

	Compliance status		Significance
	Yes (n=50)	No (n=23)	
<i>Patient characteristics</i>			
Mean age (SD)	2.95 (1.67)	5.76 (2.87)	t=5.21, df=69, p<0.001
Sex			
Male	39 (78.0)*	19 (82.6)	NS
Female	11 (22.0)	4 (17.4)	
Asthma severity			
Mild	31 (62.0)	18 (78.3)	NS
Moderate	19 (38.0)	5 (21.7)	
Used spacer before			
Yes	23 (46.0)	16 (69.6)	NS
No	27 (54.0)	7 (30.4)	
Mean SaO <sub>2</sub> (SD)	95.70% (2.04)	95.95% (2.38)	NS
<i>Hospital treatment</i>			
Spacer used in hospital			
Yes	29 (59.2)	8 (34.8)	χ <sup>2</sup> <sub>1</sub> =3.73, p=0.05
No	20 (40.8)	15 (65.2)	
Instructions given			
Yes	21 (42.0)	14 (60.9)	NS
No	29 (58.0)	9 (39.1)	
Instructor			
Discharge coordinator	31 (62.0)	7 (36.8)	NS
ED staff	9 (18.0)	7 (36.8)	
Educator	10 (20.0)	5 (26.3)	
Fact sheet given			
Yes	47 (94.0)	15 (65.2)	Fisher's exact p=0.003
No	3 (6.0)	8 (34.8)	
Size of device used			
Small	42 (84.0)	6 (31.6)	χ <sup>2</sup> <sub>1</sub> =17.87, p<0.001
Large	8 (16.0)	13 (68.4)	
Written instruction given			
Yes	38 (76.0)	14 (60.9)	NS
No	12 (24.0)	9 (39.1)	
<i>Disease outcome</i>			
Asthma condition			
Improved	47 (94.0)	21 (91.3)	NS
Same/no response	3 (6.0)	2 (8.7)	
Visit to LMO			
Yes	4 (8.0)	2 (8.7)	NS
No	46 (92.0)	21 (91.3)	
Readmission to hospital			
Yes	2 (4.0)	2 (8.7)	NS
No	48 (96.0)	21 (91.3)	
Exacerbation			
Yes	0 (0.0)	0 (0.0)	-
No	50 (100.0)	23 (100.0)	

\*Column percentage.

parental preference. The age of the child was important in determining MDIS compliance, with non-compliance higher in those older than 5.6 years of age. Furthermore, compliance to MDIS treatment depended on the size of the spacer; children using small sized spacers were more compliant than children using large sized spacers. This may explain why MDIS treatment in some children may be less than convenient to administer at home, resulting in parental preference biased to nebuliser usage. Two parents commented at follow up that nebulisers did not disturb sleeping children as MDIS did. Two other parents commented that their children appeared to find nebulisers easier to use compared to MDIS when sick. Both these reasons are recognised limitations of MDIS.

Many parents of children who did not comply indicated indirectly that they had used nebulisers previously. In this study, compliance was higher in children whose parents had received hands-on experience in the use of MDIS treatment during their emergency department stay. This, together with practical asthma education during their emergency department visit, had a significant impact on improving compliance after discharge from the emergency department for MDIS

treatment. The rate of previous nebuliser use was not formally documented in this study, although there has been a culture of nebuliser use for asthma treatment in our area for many decades. Further studies are needed to determine specifically what reasons for non-compliance are the most important.

Our study reaffirms the role of asthma education in achieving treatment adherence. In particular, it suggests that the provision of written information may have an important role. In our study compliance was greatest among patients undergoing education in the use of an information fact sheet in addition to receiving hands-on practical use of the MDI spacer while in the emergency department. In combination with behavioural strategies, written instructions help promote compliance to asthma treatment.<sup>6-8</sup> To ensure that the parents'/patients' understanding of their asthma treatment is adequate, the discharge coordinators generally attended each patient on more than one occasion (R Yeoh, discharge coordinator, personal communication). Repetition is an important technique for retention of medical knowledge,<sup>9</sup> but requires additional time spent with each patient.

We recognise several potential sources of bias in our study. We note that the discharge planners made almost all of the follow up telephone calls, and information bias may be weighted favourably towards the discharge coordinators in those patients instructed by them. However, the questionnaire was standardised, and the discharge coordinators offered the same standard of care on their follow up calls for all patients, regardless of the MDIS instructor at discharge. We also note that the sample size was too small to appreciate the role of the asthma educator fully or allow comparison between patients using different MDIS sizes. The study was not designed to analyse the relative importance of factors that could promote treatment adherence/compliance. Finally, we did not record whether patients had used nebulisers prior to the study.

This study could not show any statistical difference between the different types of instructor involved in the education of the patients. In the majority of cases in this study, the instructor was the discharge nurse. We believe that the most important aspect of asthma education is to ensure that reliable and uniform information is given to all parents. A key role of the discharge nurse in our emergency department is to educate staff, ensuring that asthma education given to parents is both consistent and reliable in every case. Hence the discharge nurses have a significant role in ensuring compliance with MDI spacer and patients after discharge from the emergency department.

To address the shortcomings in this study, it may be useful to perform a randomised control trial in which patients are randomised to receive or not receive written MDIS instructions, asthma literature, and additional time from instructors. The person providing MDIS instruction (discharge planner or other staff) should also be randomised. Pre-existing nebuliser or spacer use should be documented. Patients should then be followed up over a longer period of time. A much larger sample size than in this study would be needed to appreciate the differences between each arm of the study.

## Conclusion

Our study suggests that most children who present to and are discharged from a children's hospital emergency department following a mild to moderate asthma attack continue to use MDIS exclusively in the first week. They have low failure rates, in agreement with current literature. Ease of nebuliser use, particularly at night, may be one factor against compliance. Written information and time/repetition of education sessions were identified as factors that may promote compliance.

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