

ENVIRONMENTAL DETERMINANTS

A Feasibility Study of Q-sort to Determine Recall of Skin Test Results and Environmental Remediation Education

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Objective. Allergic asthma is common in urban minority children and evidence suggests that remediation tailored to the child's allergic profile is the most effective management strategy. The purpose of this pilot study therefore was to examine the caregiver's recall of their child's skin test results and the accuracy of planned remediation ~4 months after testing. **Methods.** Caregivers were asked to recall their child's skin test results ~4 months after their skin testing but before any follow-up visit. A Q-sort was then used to determine the knowledge of the recommended remediation. In this Q-sort, caregivers placed 52 cards, each representing one intervention for an indoor allergen, on a response board that prioritized the interventions. At the conclusion of the Q-sort, caregivers received feedback on the accuracy of their recall and prioritization. **Results.** African American caregivers (5 females; mean age 33.6) of 5 children (4 males; mean age 7.8) were enrolled. No caregiver's recall of skin test results was concordant with the actual results for type or number of allergens. Caregiver's accuracy in prioritizing strategies was 33–100% for cat dander, 40–70% for molds, 70–87% for dust mite allergens, and 100% for the one dog allergic child. Subjects preferred Q-sort to traditional methods of receiving remediation education. **Conclusions.** Caregivers do not accurately recall skin test results and this may, in part, impede their ability to implement appropriate interventions. A low-literacy game-style approach is a novel strategy to provide complex teaching that warrants further investigation.

Keywords African American, allergies, asthma, Q-sort, self-management, triggers, urban

INTRODUCTION

According to the Expert Panel Report-3 (EPR-3) (1), control of environmental factors is one of the four critical components of asthma self-management. Environmental remediation is particularly important for children with poorly controlled allergic asthma. As many as 4 million children have an attack annually (2), contributing to over 10 million missed school days per year (3), making asthma the third ranking cause of hospitalization among children under 15 years of age (4).

Asthma prevalence is considerably higher in non-Hispanic black and Puerto Rican children, the poor and near-poor, and those residing in the northeast United States (3). Poor asthma control, as defined by excess asthma morbidity and mortality, is associated with poor outdoor and indoor air quality, inadequate asthma management training, and suboptimal medical care (1, 5). Unfortunately, underserved communities often have little to no control over outdoor air quality and have limited access to asthma care and education. While indoor remediation may be theoretically within a family's ability to

modify, many barriers to remediation exist and exposure can be much higher in older urban homes. For example, structural damage allows excess moisture and water to enter the home, which increases the concentration of dust mites, mold, and cockroach allergen. Structural damage also allows easy access for rodent and cockroach entry (6). Poor ventilation is also common which contributes to higher concentrations of indoor allergens (6). Not only are repairs costly but many of these homes are rental properties with landlords who choose not to invest in the repairs needed to remedy the problem. However, evidence suggests that even in the setting of private home ownership and expendable income, adherence to environmental remediation recommendations is disappointingly low (7).

Poorly controlled allergic asthma can be effectively managed using a combination of medications and environmental remediation or trigger avoidance. Interventions tailored to the individual's specific allergens are the most effective (8). It is less clear if accurate recall of specific allergens is necessary to implement appropriate remediation. The purpose of this study therefore was to examine the recall accuracy of caregivers of children with allergic asthma and to pilot a novel low-literacy approach to evaluate caregivers' knowledge of the recommended environmental interventions.

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(distribution) grid in rank order from highest to lowest priority (see Figure 2).

In this pilot, we created 52 cards. Of the 52 cards 23 were specific for dust mites, 10 for mold, 7 for rodents (pests), 6 for cockroaches, 4 for pets with fur or feathers, and 3 each for cat and dog. Ten cards were specific to indoor irritants. (Since several of these remediation strategies overlapped with other allergen categories, cards totaled only 52.) Unlike conventional Q-sorts, these cards included photographs to aid in the visualization of the word descriptors of the remediation activity. Words on the cards were written at a fifth grade reading level. After sorting was complete and the cards had been placed on the distribution grid, the caregivers were shown a copy of their child's skin test results and received feedback on the accuracy of their prioritization in the context of their child's skin test results. Tailored environmental remediation education was part of this feedback. The study visit concluded with a semi-structured interview to determine the subjects' opinion of the Q-card sort activity.

RESULTS

Sample

A convenience sample of 11 urban minority caregivers of children with allergic asthma was referred to the study from October 2010 to March 2011 by a pediatric allergist in an academic practice. As shown in Table 1, five African American women (mean age 33.6; 80% receiving public assistance) were enrolled. These caregivers were caring for 5 children with allergic asthma (4 males; mean age 7.8) (Table 2). No standard battery of tests was performed; skin testing was tailored to the child's history. Testing for cockroach allergen was rarely performed, except when the

TABLE 1.—Characteristics of the caregivers ($N = 5$).

Mean age (range)	33.6 (30–38)
Gender (%)	
Female	100
Racial/ethnicity (%)	
African American	100
Educational attainment (%)	
Some high school	1 (20)
High school or GED	1 (20)
Some college	1 (20)
College graduate	1 (20)
Post-graduate	1 (20)
Insurance (%)	
Medicaid	4 (80)
Health maintenance organization	1 (20)
Household income (%)	
Disability	1 (20)
<\$10,000	2 (40)
\$20,000–29,000	1 (20)
>\$100,000	1 (20)
Number of individuals in household (mean) ^a	3
Marital status (%)	
Single	4 (80)
Separated	1 (20)
Pack years (mean)	0.2

Note: ^aNumber of individuals in household data on $n = 3$.

TABLE 2.—Characteristics of children with allergic asthma ($N = 5$).

Mean age (range)	7.8 (6–10)
Gender (%)	
Female/male	1 (20)/4 (80)
Racial/ethnicity (%)	
African American	100
Asthma medication (%)	
SABA and ICS	3 (60)
SABA, ICS and LRTA	2 (40)
Daily antihistamine	2 (40)
Mean SABA puffs last 7 days	1 puff

Notes: SABA short acting β -2 agonist; ICS inhaled corticosteroid; LRTA leukotriene receptor antagonist.

allergist believed that the child had severe asthma and that their caregiver was motivated and capable of covering the cost of intensive pest management. Only one child in this pilot was tested for cockroach allergen and that child's test was negative. Skin test results confirmed four children had cat, tree, and/or grass allergies, three had dust mites and/or weed allergies, two were mold allergic and one was dog allergic.

Accuracy of Caregiver Recall of Skin Test Results

The study visit was conducted approximately 4 months after skin testing (mean 142.8 days; range 66–220 days). There was no intervening appointment with the allergist between the time of skin testing and the time of the study visit. Caregivers recalled more positive results (mean 4.6) than were actually found (mean 4.2). Most importantly, no caregiver's recall of skin test results was concordant with actual results. Table 3 compares the caregivers' recall to actual skin test results.

Three subjects reported specific allergies in their children to which they were actually negative. For example, subject 1 thought her child was mold allergic, subject 4 believed her child was dust mite allergic, and subject 5 reported a cockroach allergy; these were all incorrect. In addition, several caregivers knew their child was pet dander or pollen sensitive but could not specify the type, for example, subjects 1 and 5 could not specify cat allergy (described as "animal dander") and subjects 3 and 5 could not identify tree and weed allergies (described as "pollens"). In children with fewer positive skin tests, recall was not more accurate. For example, subject 2 was only allergic to dust mites but they believed their child was only allergic to molds. Conversely, others with multiple allergens inaccurately recalled which allergens their child was allergic to, for example, subject 4 was correct about three allergens (cat, dog, and mold), but incorrectly believed their child was allergic to dust mites. This same subject also denied any pollen allergies although their child was tree and grass allergic.

Accuracy of Caregiver Identification of Remediation Strategies: The Q-Card Sort

As seen in Table 4, the initial card sorting resulted in a mean of 35.8 cards (range 32–38) being classified as "very important for their child's allergic asthma control,"

TABLE 3.—Caregiver recall and skin test results.

Allergen	Type	Caregiver report	Chart report
Subject 1			
Animal dander	Unspecified	☑	
	Cat		☑
	Dog		
Cockroach			
Rodent pests			
Dust mites		☑	☑
Mold		☑	
Pollens			
	Unspecified	☑	
	Tree	☑	☑
	Weed		☑
	Grass	☑	☑
Subject 2			
Animal dander	Unspecified		
	Cat		
	Dog		
Cockroach			
Rodent pests			
Dust mites			☑
Mold		☑	N/T
Pollens			
	Unspecified		
	Tree		
	Weed		
	Grass		
Subject 3			
Animal dander	Unspecified		
	Cat	☑	☑
	Dog		
Cockroach		☑	N/T
Rodent pests		☑	N/T
Dust mites		☑	☑
Mold			☑
Pollens			
	Unspecified	☑	
	Tree		☑
	Weed		☑
	Grass	☑	☑
Subject 4			
Animal dander	Unspecified		
	Cat	☑	☑
	Dog	☑	☑
Cockroach			
Rodent pests			
Dust mites		☑	
Mold		☑	☑
Pollens			
	Unspecified		
	Tree		☑
	Weed		
	Grass		☑
Subject 5			
Animal dander	Unspecified	☑	
	Cat		☑
	Dog		
Cockroach		☑	
Rodent pests		☑	N/T
Dust mites		☑	

(Continued)

TABLE 3.—(Continued).

Allergen	Type	Caregiver report	Chart report
Mold			
Pollens	Unspecified	☑	
	Tree		☑
	Weed		☑
	Grass	☑	☑

Note: N/T, not tested.

TABLE 4.—Q-card sort summary.

	Not very important to controlling my child's allergic asthma	Unsure if important to controlling my child's allergic asthma	Very important to controlling my child's allergic asthma
Subject 1	17	3	32
Subject 2	9	5	38
Subject 3	12	3	37
Subject 4	8	9	35
Subject 5	13	2	37

11.8 cards (range 8–17) as being “not very important” and 4.4 cards (range 2–9) as “unsure of importance.” Since subjects categorized ~35 cards as important to their child's asthma, any cards placed in the first 35 spots were characterized as being correctly identified as a remediation intervention. As seen in Figure 2, the first 35 spots included the 8 columns of the response grid labeled –1 through +6.

Caregiver's accuracy in prioritizing strategies was 33–100% for cat dander, 40–70% for molds, 70–87% for dust mite allergens, and 100% for the one dog allergic child. Having a single positive test did not translate to having increased accuracy in identifying remediation strategies. For example, subjects with a single positive skin test demonstrated 66–70% overall accuracy in identifying remediation intervention whereas subjects with multiple allergens (subjects 1 and 5) had an overall accuracy of 77–90%.

Qualitative Interviews

The study visits concluded with qualitative interviews to determine the acceptability of the Q-card sort activity as a method to learn about environmental remediation and to gauge satisfaction with the previous remediation education they had received at the skin test visit. In addition, caregivers identified barriers to the implementation of the remediation strategies and were encouraged to ask questions about allergic asthma.

Q-sort was found to be an acceptable way to learn about remediation. All but one of the subjects enjoyed the activity; one stated that she would have preferred a formal PowerPoint presentation to the Q-sort. Most importantly, caregivers were uniformly dissatisfied with the conventional education they received. It is standard practice in this clinic to give caregivers three handouts

after their child's positive skin test: a 4-page handout on trigger remediation (written at a 6.5 grade level), a 4-page brochure on asthma (written at an 8.2 grade level), and a 6-page allergic rhinitis pamphlet (written at a 9.2 grade level). The caregivers described these materials as overwhelming in length and content. In fact, no subject read all the materials, including the two subjects with a college education. Moreover, subjects did not recall having received verbal instruction on these materials although this is standard of care for this practice.

Subjects identified many barriers to the implementation of the remediation strategies including cost, inability to implement interventions at relatives' homes, rodent infestation after cat removal, a preference for area rugs over hardwood floors, and a lack of responsiveness from landlords. One subject who lived in public housing complained of wall-to-wall carpeting that was never cleaned, chronic plumbing leaks, and indoor mold that was so severe that mushrooms sprouted from the carpeting in an unused bedroom. Her complaints to the landlord were addressed at annual inspections only and the tenants association denied her request for removal of the wall-to-wall carpeting.

Many subjects had specific questions about where to obtain allergen control products and how to determine their quality. Spontaneous questions about the safety of controller asthma medications were also raised by two subjects. Others asked for information on specific indoor and outdoor molds, eczema care, and grass allergies. Investigators identified additional sources of concern, including the *pro re nata* use of controller asthma medication, routine use of nebulized albuterol (twice daily) as prescribed by the primary care physician, delegation of responsibility of medication administration to the child with little or no parental supervision, refusal of schools to allow children to exercise their right to carry rescue inhalers, preference for the use of strong household chemicals for routine cleaning, failure to transition older children from nebulizers to inhalers with spacers, and remediation plans based on the caregiver's triggers rather than the child's allergies.

DISCUSSION

The burden of pediatric allergic asthma is highest in poor urban communities where there are many triggers and few resources for remediation. Therefore, it is critically important that caregivers accurately recall their child's skin test results so that limited resources can be directed to the most effective tailored interventions. However, in our pilot study, no caregiver accurately recalled their child's skin test results. In addition, caregivers had suboptimal knowledge of remediation interventions but were enthusiastic about using a gaming approach for knowledge acquisition.

This is not the first time that poor recall of health behaviors or diagnostic test results has been documented. In a study by Khavjou and colleagues (10), 66% of women did not recall a diagnosis of hypertension, 54% did not

recall being told they had elevated glucose, and 46% did not know they had elevated cholesterol levels 1 year after diagnoses. Similarly, Croyle et al. (11) found that only 31% of patients correctly recalled their cholesterol levels 6 months post-testing. Recognizing that recall accuracy decreases with time, the EPR-3 recommends no more than a 2- to 4-week recall period for asthma symptom evaluation (1). However, studies of 24 hour dietary recall (12, 13) have reported inaccuracies, which were not enhanced by assistive technology (14) or cash incentives (15).

Poor recall accuracy likely contributed, in part, to caregivers incorrectly identifying appropriate remediation strategies. For example, subjects were least likely to correctly identify cat and mold interventions. Of the two children who were mold allergic, their caregivers' inability to accurately identify a mold allergy was likely associated with their inability to identify mold reduction strategies. However, of the four cat-allergic children, the picture was less clear. Two caregivers accurately recalled their child's cat allergy: one could only identify a single cat-specific intervention while the other identified all three remediation interventions. Interestingly, the two caregivers who knew their children had a nonspecific "animal dander allergies" were able to identify two of three cat strategies. This suggests that having general knowledge of an allergy may be sufficient to implement appropriate interventions.

Dust mite allergens were correctly recalled in two of three children and accurate recall was associated with more precise identification of reduction strategies. However, the one caregiver who did not recall that her child was dust mite allergic correctly identified 70% of the allergen reduction interventions. This may have been due to an inherent limitation in this Q-sort. Twenty-three of the 52 cards addressed dust mite allergens, increasing the likelihood that many of these cards would be placed in the top 35 spots on the response board by chance alone. Taken together, these data suggest that accurate recall is a prerequisite for greater remediation knowledge. These data lend additional support to studies that have linked greater asthma control to environmental interventions tailored to the child's specific allergen profile (16, 17).

Subjects in this pilot described the print materials they received at the time of skin testing as overwhelming in length and complexity despite being only 3 handouts, totaling 14 pages, written at an eighth grade level (mean). No caregiver read all the handouts. This cannot be attributed to low literacy as one subject had a master's degree, one had a bachelor's degree, one was in college, one had a high school degree, and one had some high school education. Taken together, this would suggest that at least four of the five subjects should have been able to read, comprehend, and implement the content in the eighth grade materials. If caregivers do not complete the assigned self-learning, this may translate to less knowledge of health conditions and their associated management.

The Q-sort offers an interactive gaming style that most subjects preferred. Interactive games offer many

advantages over standard education (18) including the delivery of information orally in a social interaction with a greater emphasis on visual and hands-on learning. Games have been used previously to successfully teach healthcare professionals (18, 19) and patients (20, 21). For example, patients who engage in interactive learning gained more knowledge, retained that information over time (20), and had improved health behavior intentions (21). To our knowledge this is the first time that the Q-sort has been used to deliver an educational intervention. Traditionally Q-sort is used in research only to collect information from subjects. However, we believe that the use of Q-sort can be extended to deliver tailored education based on the knowledge collected. Caregivers in this study characterized this approach as a novel and enjoyable way to learn about environmental remediation.

Many barriers to implementing environmental remediation were identified by our subjects including cost, inability to impact allergens in other places where their child spent time, unresponsiveness of landlord and tenant associations, and preferences for cats to control rodents and for area rugs over bare floors. Similar obstacles have been reported previously in urban communities (22) but are not routinely addressed during the healthcare encounter.

Lastly, our subjects identified areas of inadequate asthma knowledge, including an underappreciation of controller therapy and little supervision of their young children's medication administration. Subjects also reported that their primary care providers failed to deliver care that conforms to asthma guidelines (routine daily use of albuterol) and met impediments to their child's access to rescue inhalers in the school. Together, inadequate knowledge and complex barriers create potent impediments to effective disease management in populations with the fewest resources to overcome such obstacles.

There are several limitations of this study. First, selection bias was introduced by having the provider identify potential subjects. Second, its generalizability is limited by the fact that it was a small pilot study using a convenience sample. Lastly, our low rate of successful enrollment (5 of 11 referrals) suggests that our study may have enrolled only the most motivated subjects.

CONCLUSIONS/KEY FINDINGS

Despite its limitations, critically important information about the care of children with allergic asthma was learned in this study. Caregivers do not recall skin test results. If caregivers do not recall what their child is allergic to, they cannot be expected to implement effective remediation strategies. To address poor recall, clinicians need to reassess how positive test results are communicated. In addition, if there is a shorter interval between skin testing and the follow-up visit, then the opportunity to review skin test results can occur sooner. This may facilitate earlier and more accurate implementation of remediation strategies.

Moreover, since caregivers may not read the self-learning materials they are given at diagnosis or testing, new methods of delivering tailored education must be developed to engage the learner and foster comprehension and retention. Earlier follow-up visits and more frequent visits would allow material that is characterized as "overwhelming" to be delivered in smaller digestible "doses." In so doing, tailored education increases the likelihood for success and improves the clinician's ability to deliver patient-centered care. Innovative approaches, such as using the information gained from the Q-sort to develop a tailored educational intervention, may offer a new way to bridge the disparity gap currently experienced by communities with high disease burden and limited resources. As such, this approach warrants further investigation in larger trials and in other populations.

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DECLARATION OF INTEREST

Kristen Townsend, James M. Corry, Beth Hogan Quigley, and Maureen George have no affiliation with any organization with a financial interest, direct or indirect, in the subject matter or materials discussed in this manuscript.

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