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Online Education Improves Pediatric Residents' Understanding of Atopic Dermatitis

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Abstract

Background/Objectives—Pediatricians manage skin conditions such as atopic dermatitis (AD) but report their dermatologic training is inadequate. Online modules may enhance medical education when sufficient didactic or clinical teaching experiences are lacking. We assessed if an online module about AD improved pediatric residents' knowledge and changed their clinical management of AD.

Methods—Target and control cohorts of pediatric residents from two institutions were recruited. Target subjects took a 30-question test about AD early in their residency, reviewed the online module, and repeated the test 6 months and 1 year later. The control subjects, who had 1 year of clinical experience but had not reviewed the online module, also took the test. The mean percentage of correct answers was calculated and compared using two-sided, two-sample independent t-tests and repeated measures ANOVA. For a subset of participants, clinical documentation from AD encounters was reviewed and 13 practice behaviors were compared using Fisher's Exact test.

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Conflicts of Interest: None

Results—25 subjects in the target cohort and 29 subjects in the control cohort completed the study. The target cohort improved from 18.0 ± 3.2 to 23.4 ± 3.4 correctly answered questions over 1 year ($p < .0001$). This final value was greater than that of the control cohort (20.7 ± 4.5 , $p=0.015$). Meaningful differences in practice behaviors were not seen.

Conclusion—Pediatric residents who reviewed an online module about AD demonstrated statistically significant improvement in disease-specific knowledge, both over time and compared to controls. Online dermatology education may effectively supplement traditional clinical teaching.

Keywords

Online education; dermatology; atopic dermatitis; pediatric residency

Introduction

Atopic dermatitis (AD, commonly called eczema) affects at least 10% of children in the United States.¹ It is characterized by a chronic and relapsing eczematous dermatitis associated with xerosis, pruritus, and increased risk for secondary skin infection.² Inadequately treated AD impairs quality of life for both the child and family due to uncontrolled itching, sleep disturbance, behavior disruptions, and emotional stress.^{3–5}

Pediatricians commonly manage skin conditions such as AD, but gaps in dermatology-specific knowledge may lead to inadequate treatment. Many pediatricians feel their residency training in the management of AD was “inadequate” or “enough to get by”.⁶ Compared to dermatologists, pediatricians are less likely to prescribe topical corticosteroids, more likely to emphasize the role of food allergy, and less likely to recognize bacterial superinfection when managing AD.^{6,7}

To address these gaps, two of the authors (MMT and ALB) created *Atopic Dermatitis 101: The essentials every pediatric primary care provider should know (AD101)*. AD101 was an online module available for pediatricians sponsored by Stanford Medicine CME from November 1, 2011 to October 31, 2013 (<http://cmead101.stanford.edu>). Its objectives were to improve knowledge about the pathogenesis, clinical signs, symptoms, and treatment of AD. It used a combination of text, images, and interactive patient vignettes to apply that knowledge to the care of AD.

Although AD101 was designed for practicing pediatricians, we postulated it would be valuable in the education of pediatric residents. The discomfort pediatricians have about AD may be rooted in a paucity of exposure to dermatology during residency. Online modules may enhance resident education in areas of curricular weakness, including specialties lacking sufficient didactic or clinical teaching experiences. Thus, our objectives were to assess if using AD101 as an adjunct to clinical training improved pediatric residents' knowledge and clinical management of AD.

Materials & Methods

We conducted a multicenter, prospective cohort study at the University of Colorado School of Medicine (Aurora, CO) and Mayo Clinic (Rochester, MN). Institutional review board approval was obtained at both institutions.

Participants

In the summer of 2012, we enrolled pediatric residents in this study. Participation was voluntary, and an IRB-approved consent form was signed. The target cohort comprised post-graduate year (PGY) 1 pediatric residents, and the control cohort comprised PGY2 pediatric residents.

Intervention and Outcome Assessments

AD knowledge, our primary outcome, was assessed using a 30-question, multiple-choice test written by ALB and MMT (see Supplemental Materials). The test was reviewed for readability by an educational expert (JH), and preliminary testing was performed by 4 pediatric dermatologists, 3 pediatricians, and 4 non-physician college graduates showing good stratification of scores (mean of 28.3, 25.0, and 14.0, correct answers respectively).

In order to determine the effect of *AD101* on knowledge versus clinical training alone, our primary comparison was the mean number of correct test questions for the target cohort 1 year after enrollment versus the control cohort at study enrollment. The target cohort was aware that a total of three tests would be administered at the beginning of residency, 6 months, and 1 year later. All tests were administered in person or via email depending upon resident location. After completion of test 1, the target cohort reviewed *AD101* and could re-access if desired. At each time point, the same questions were used, but their order and respective answers were randomly rearranged. Subjects in the control cohort took the same 30-question test at the beginning of their PGY2 year. Test answers were not revealed to either cohort. The control cohort did not have access to *AD101* during their PGY1 year. Thus, their knowledge about AD reflected what had been learned over the prior year of clinical training, while the target cohort's knowledge was to reflect both clinical training and use of *AD101*.

To study our secondary objective of whether using *AD101* changed clinical practice, clinical documentation from a subset of residents was performed. Inclusion criteria included: care provided by a participating resident at each institution's primary care clinic, coded encounter diagnosis of AD or eczema (ICD-9 codes 691.8 and 692.9, respectively), and patient age of 1 month to 12 years. One encounter per resident was reviewed at each institution. Two investigators at each institution (MFC and ALB at Colorado, MJY and MMT at Mayo Clinic) reviewed encounters from July to August, 2012 and June to August, 2013 for the target cohort and from April to October, 2012 for the control cohort. For each encounter, we determined if 13 practice behaviors relevant to AD were performed (see Table 1). A binary outcome (yes/no) was used for each behavior.

Statistical Analyses

A two-sided, two-sample independent t-test was performed to compare test scores between the target and control cohorts after 1 year of residency education. Repeated measures ANOVA was used to examine the change in test scores in the target group from baseline to 6 months and 1 year. Fisher's Exact test was used to compare practice behaviors in the target group from baseline to 1 year after starting clinical training and between the target and control cohorts. Due to variability in the number of encounters per resident, analysis of clinical documentation was restricted to the first encounter per resident at each time point. All statistical analyses were performed using SAS version 9.4 (Cary, NC).

Results

A flow diagram showing resident enrollment and dropout is shown in Figure 1. Twenty-five PGY1 residents in the target cohort completed the pretest, the *AD101* module, and the 1-year posttest. Twenty-nine PGY2 residents in the control cohort completed the test. The characteristics of our resident participants, based on those who completed the study, are presented in Table 2 and show similar gender and academic characteristics. Residents in the target cohort reported viewing *AD101* an average of 1.48 times. The timing of repeat viewing is not known.

Table 3 summarizes the results of the 30-question test. Only participants who completed both the baseline and 1-year follow up tests were included. Pediatric residents at the start of residency answered 18.0 ± 3.2 questions correctly. After 6 months of training, the number of correctly answered questions increased to 23.5 ± 2.9 . This gain was sustained but not improved upon through the end of the PGY1 year where the mean number of correct answers was 23.4 ± 3.4 . The change from baseline to 1-year was 5.4 more correctly answered questions (95% confidence interval 3.69, 7.11, $p < .0001$). A similar trend was seen if all participants who started the study were included in the analysis. Study site did not affect the results. The mean number of correct answers for the control cohort was 20.7 ± 4.5 . The difference between these groups was 2.7 (95% confidence interval 0.55, 4.94, $p = 0.015$).

10 encounters from July to August 2012 and 18 encounters from June to August 2013 were reviewed for the target cohort, and 21 encounters from April to October 2012 were reviewed for the control cohort. There were no statistically significant differences observed in practice behaviors within the target cohort or between the target and control cohorts for 12 of the parameters (see Table 4). In the target cohort, the degree of inflammation was documented in 5/10 encounters (50%) at baseline and in 3/18 encounters (16.7%) after 1 year ($p = 0.09$). In comparison, 12/21 encounters (57.1%) in the control cohort documented inflammation ($p=0.01$).

Discussion

This prospective cohort study demonstrates that using an online education module, *AD101*, as an adjunct to traditional clinical training improved pediatric residents' knowledge about the diagnosis and management of AD. This gain in knowledge was apparent 6 months after

the intervention and was sustained an additional 6 months later. After 1 year of clinical training, residents who used *AD101* were more knowledgeable about AD than those who had not.

Dermatologic complaints are the primary diagnosis for approximately 8% of pediatric primary care visits,⁸ highlighting the importance that pediatricians feel comfortable with skin conditions. A recent Delphi study of pediatricians, family practitioners, and pediatric dermatologists identified AD, acne, molluscum, warts, and newborn skin as common skin conditions that primary care providers need to understand.⁹ Children with AD may not need or may not be able to seek care with a specialist, necessitating that pediatricians have confidence with its diagnosis and management. A shortfall in the supply of pediatric dermatologists^{10,11} is another factor necessitating that pediatricians are able to manage common skin conditions effectively.

Novel educational experiences that do not rely on intensive interactions with faculty may bridge gaps in residency training. Online education has the advantages of being widely available and easy to access. Online content can be reviewed at leisure, as often as desired, and does not take time away from clinical demands in the era of duty hour restrictions. In a randomized, controlled study comparing web-based versus printed modules for internal medicine residents, investigators found that both modalities led to increased test scores, but residents preferred using web-based materials.¹² Baker and colleagues studied the effectiveness of an online pediatric primary care curriculum, finding that more residents accessed the online curriculum than attended noon conferences and that knowledge as assessed by a posttest improved over time versus a control group.¹³

To our knowledge, only one study regarding the use of online dermatology training for pediatric residents has been reported. Mathes and colleagues studied the effectiveness of spaced education to instruct pediatric residents about 5 common skin conditions and found the course did not have a statistically significant effect on posttest scores.¹⁴ However, the majority of residents indicated they would like to participate in additional courses. In contrast, we focused on a single skin condition and found an improvement in test scores. While this gain in knowledge is encouraging, we did not see an overall difference in the management of AD as assessed by reviewing clinical documentation.

One explanation for this negative finding is that changes in knowledge may not readily translate to changes in clinical practice. It is also possible that residents may have changed their clinical practice, but our study methods were not sensitive enough to discern a change. For instance, we had a limited number of encounters to review, and our sample size decreased further when we restricted our data to 1 encounter per resident at each time point in order to reduce bias. Encounters for the target cohort were drawn from the pool of residents assigned to the primary care clinic at the study time points. As resident schedules vary, the same residents may or may not have been in clinic at these times. Also, clinical documentation may not accurately reflect a resident's interaction with the patient, and management plans could have been modified by supervising attendings who were not asked to review *AD101*.

Traditional assessments of a resident's performance include standardized tests of knowledge (the annual in-service examination) and subjective attending evaluations. Appraising how medical education impacts clinical care is also important, but our study demonstrates that reviewing existing clinical documentation for this purpose has limitations. Alternatives, such as using standardized clinical vignettes or an objective structured clinical examination (OSCE), should be considered.

This study has additional limitations. Although the study was conducted at two medical centers, we had a modest number of resident participants. In addition, 40% of residents in our target cohort failed to complete the study. This high dropout rate could be a source of non-responder bias, but we did not find that our test results varied if all participants were included in the analysis. We solicited reasons for dropout, but no responses were received. Second, we evaluated the target cohort 1 year after the intervention, but we do not know if gains in AD-specific knowledge will be sustained over time. Last, the target cohort was aware of repeating testing at 6 months and 1 year, and the anticipation of future testing may have led to an increase in test scores at 6 months although the scores were only sustained at 1 year.

Conclusion

We have shown that an online education module improved pediatric residents' knowledge about the diagnosis and management of AD but did not change clinical practice. Online dermatology education may effectively supplement traditional clinical teaching.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Figure 1.
Resident Enrollment and Dropout

Table 1**Atopic Dermatitis Practice Behaviors**

1. Were affected areas of the body documented?
2. Was the degree of inflammation evaluated?
3. Was sleep disturbance evaluated?
4. Was itching evaluated?
5. Were unscheduled visits due to disease flare documented?
6. Were alterations in quality of life assessed?
7. Was the use of a moisturizer with frequency of daily or greater recommended?
8. Was a low potency (class VI, VII) topical steroid prescribed or refilled?
9. Was a moderate potency (class III, IV, V) topical steroid prescribed or refilled?
10. Was a high potency (class I, II) topical steroid prescribed or refilled?
11. Were antihistamines prescribed?
12. Was a follow-up appointment (for AD or a well-child check) recommended within 3 months?
13. Was the patient/family educated about the natural history, prognosis, and treatment of AD?

Table 2

Resident Characteristics

	Target Cohort (N=25)	Control Cohort (N=29)
Colorado	18	17
Mayo Clinic	7	12
Female	20 (80%)	22 (76%)
In-training exam [*] - % correct		
Colorado	65	69
Mayo Clinic	66	68
<i>AD10I</i> views	1.48 (1–3)	
Colorado	1.33 (1–3)	
Mayo Clinic	2.00 (1–3)	

* Obtained from the annual in-service examination taken at the beginning of the PGY2 year for each cohort.

Table 3

Number of correct answers on the standardized AD test

	Mean $\pm$ SD	Range		Mean $\pm$ SD	Range
Target Cohort			Control Cohort		
Baseline (N=25)	18.0 $\pm$ 3.2 *	12 – 26			
6 Month (N=23)	23.5 $\pm$ 2.9	18 – 28			
1 Year (N=25)	23.4 $\pm$ 3.4 *,**	17 – 30	Baseline (N=29)	20.7 $\pm$ 4.5 **	6 – 29

* The improvement in the number of correct test answers over 1 year was significant ($p < 0.001$).** The difference in the number of correct test answers between the target and control cohorts was significant ($p = 0.015$).

SD – Standard deviation

Table 4

Comparing Resident Practice Behaviors for Atopic Dermatitis

Practice Behavior	Target Cohort Baseline (N=10)	Target Cohort 1-Year (N=18)	p value	Control Cohort (N=21)	p value
Affected areas	(10) 100%	(16) 88.9%	0.52	(21) 100%	0.21
Inflammation	(5) 50.0%	(3) 16.7%	0.09	(12) 57.1%	0.01
Sleep Disturbance	(1) 10.0%	(2) 11.1%	1.00	(1) 4.8%	0.59
Itching	(3) 30.0%	(8) 44.4%	0.69	(7) 33.3%	0.48
Unscheduled visits	(1) 10.0%	(1) 5.6%	1.00	(1) 4.8%	1.00
Quality of life	0.0%	(2) 11.1%	0.52	(2) 9.5%	1.00
Moisturizer	(7) 70.0%	(13) 72.2%	1.00	(18) 85.7%	0.43
High potency topical steroid	0.0%	0.0%	–	0.0%	–
Moderate potency topical steroid	(5) 50.0%	(7) 38.9%	0.70	(8) 38.1%	0.96
Low potency topical steroid	(5) 50.0%	(8) 44.4%	1.00	(11) 52.4%	0.62
Antihistamines	(4) 40.0%	(5) 27.8%	0.68	(2) 9.5%	0.22
Follow up	(5) 50.0%	(13) 72.2%	0.41	(15) 71.4%	0.96
Education	(4) 40.0%	(4) 22.2%	0.40	(9) 42.9%	0.17