

**Improving Pediatric Acne Management and “Filling in Practice Gaps”: a
Prospective Multicenter Study of Case-Based Education**

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Short Title: Prospective Multicenter Study of Case-Based Acne Education

Abbreviations: American Acne and Rosacea Society – AARS; American Academy of Pediatrics – AAP; Continuing Medical Education – CME

Key Words: Acne, Practice Gaps, Education, Retinoid

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What’s known on this subject: Studies have documented practice gaps in acne management between pediatricians and dermatologists. The American Acne and Rosacea Society and the American Academy of Pediatrics recently published acne treatment recommendations in *Pediatrics*. The impact of these recommendations, and whether they have helped ‘fill in’ practice gaps, is unknown.

What this study adds: Knowledge of the recommendations was ‘poor’ in over one-quarter of pediatric providers. Common treatment mistakes included failure to use retinoids and failure to combine benzoyl peroxide with antibiotic therapy. An interactive, case-based educational intervention significantly increased compliance with recommendations as evaluated by a case-based questionnaire.

Abstract

Background/Objectives: Studies have documented practice gaps in acne management between pediatricians and dermatologists. Evidence-based recommendations for acne management were published by the American Acne and Rosacea Society and the American Academy of Pediatrics in *Pediatrics* in 2013. We assess the impact of a case-based learning intervention on pediatrician knowledge of and treatment of acne in accordance with published recommendations.

Methods: Participants were recruited at 4 conferences for pediatric providers. Knowledge of the recommendations and confidence in utilizing these recommendations were assessed. Five case-based questions were presented, with providers choosing acne treatments before, immediately after, and three months after a 40 minute case-based educational presentation. Responses with selections consistent with the recommendations were scored as correct, and all responses evaluated for patterns of medication selection.

Results: 150 individuals participated, most pediatricians with over 10 years of experience. Knowledge of the recommendations and confidence in prescribing acne therapy was poor. The average pre-intervention management selections were 70% correct, increasing significantly to 86% at 3 months post-intervention ($p < 0.01$). The most significant improvements were demonstrated in provider ability to choose regimens for moderate facial and truncal acne consistent with published recommendations, and in recommendation-consistent usage of retinoids and benzoyl peroxide ($p < 0.05$). Persisting practice gaps included a reluctance to use topical retinoids in pre-adolescents, and lack of initiating oral combination therapies in patients with severe acne.

Conclusions: The 2013 AARS/AAP recommendations have been disseminated with mixed impact. A case-based educational intervention significantly increased providers choosing acne treatments in accordance with evidence-based recommendations. Persisting practice gaps represent important avenues for further study and education.

Contributors' Statement Page

Stephanie Feldstein, BA, conceptualized and designed the study, carried out initial data analysis, drafted the initial manuscript, and approved the final manuscript as submitted.

Maryam Afshar, MD, assisted in designing the study, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Andrew C. Krakowski, MD, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Lawrence F. Eichenfield, MD, conceptualized and designed the study, gave the lectures to pediatric providers, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Introduction:

In the article, “Big Med,” Dr. Atul Gawande describes how medicine and the restaurant ‘The Cheesecake Factory’ share a similar goal: to deliver a wide range of services to millions of people at a reasonable price with a consistent level of quality (1). In order to meet this goal, ‘The Cheesecake Factory’ has developed a system of best practices that all employees in their restaurants follow to optimize the dining experience and decrease costs. Healthcare, he writes, could benefit significantly from adopting a similar model – studying what works best, and then standardizing it to ensure a consistently high level of service between hospitals and providers (1).

One method in which we can work towards standardizing best practices is by identifying and ‘filling in’ practice gaps. Practice gaps are “the gap between what the medical professional is doing or accomplishing in clinical practice (current reality) compared with what is or should be achieved in practice based on the best available evidence or professional knowledge” (2). Practice gaps are a particularly significant problem in acne management. Though acne is one of the most common skin conditions in children and adolescents, there is tremendous variation in its treatment among healthcare professionals. For example, while topical retinoids are extremely beneficial in the treatment of mild-to-moderate acne and are important maintenance therapy for all types of acne, they are inconsistently prescribed, especially by non-dermatologists (3). In preadolescents, pediatricians are more likely to prescribe antibiotics, such as minocycline or oral clindamycin, than topical retinoids (4). Other studies have shown frequent use of topical antibiotics without benzoyl peroxide among general practitioners (5). Even among dermatologists, overtreatment with oral antibiotics is common (6).

In order to narrow these practice gaps and better optimize patient care, continuing medical education (CME) is shifting towards ‘action-oriented’ activities that highlight how to correctly identify or manage a condition in which a practice gap exists. Journals are also adopting this model. Since 2011, the *Journal of the American Medical Association – Dermatology* has published a dedicated “Practice Gaps” section, highlighting the differences between how the average dermatologist is performing and how they should be performing, with the ultimate goal of changing beliefs and habits of practice (7). A recent study found this section has had a significant impact on physician practice, residency curricula, and even on the initiation of quality improvement projects (2).

In this study, we employed a case-based educational intervention targeting pediatric providers’ knowledge of the newest pediatric acne recommendations from the American Acne and Rosacea Society (AARS), endorsed by the American Academy of Pediatrics (AAP), and published in *Pediatrics*, in May of 2013 (8). While the purpose of these recommendations was to better standardize acne management, it is not known whether pediatric providers are utilizing these recommendations or if they are even aware of them. Our intervention surveyed both baseline knowledge and knowledge after a 40-minute, case-based interactive learning session with follow-up one and three months after the initial intervention. We hypothesized that after the intervention, providers would demonstrate increased ability to choose acne treatments in accordance with the evidence-based recommendations. If successful, we hoped this intervention would become a model for the implementation of other pediatric guidelines in the future, helping to bridge practice gaps and create more standardization of patient care.

Methods:*Subjects and setting*

This study was approved by the Institutional Review Board of the University of California, San Diego. Participants were recruited at four different educational events for pediatricians and pediatric residents across the country. Providers had the option of participating in the study and listening to a 40-minute case-based lecture on the AARS/AAP recommendations for the management of pediatric acne, as well as the option of listening to the lecture without being in the study. Individuals were eligible for the study if they were board-certified pediatricians, family practitioners, pediatric physician assistants, pediatric nurse practitioners, or ACMGE-certified pediatric residents. The lecture was also certified as 1 unit of Continuing Medical Education (CME) credit in some instances.

Evaluation:

Participants completed a baseline questionnaire (Q1) before the lecture. This questionnaire inquired about the participants' demographics and their knowledge of and confidence in implementing the AARS/AAP pediatric acne recommendations in their practice. The questionnaire also contained five case-based questions asking them to choose the "next best step" for treating a variety of different pediatric patients with acne (Appendix 1). The cases were designed by the pediatric dermatology team at Rady Children's Hospital, two members of whom also authored the AARS/AAP recommendations. Each case underwent a series of modifications to ensure that it was easy to understand and relevant. Immediately after the intervention, the questionnaire was

re-administered (Q2) to gauge immediate learning. Participants were then emailed the same questionnaires via SurveyMonkey one month (Q3) and three months (Q4) later to assess long-term retention.

Analysis:

The analysis focuses on before-and-after changes between the pre-intervention questionnaire (Q1), the post-intervention questionnaire (Q2), the 1-month post-intervention questionnaire (Q3), and the 3-month post-intervention questionnaire (Q4). Data from the questionnaires were entered into Microsoft Excel. Change in responses among variables of interest, from baseline to follow up, were determined using the McNemar test for matched categorical variables ($p < 0.05$), with a continuity correction. Comparisons between respondents and nonrespondents were calculated using a chi-squared test. Comparisons between self-rated recommendation knowledge and confidence were calculated using a t-test.

Results:

Part I: Demographics

One hundred and fifty pediatric providers participated in the educational intervention, the majority of whom were pediatricians working in suburban settings (Table 1). Forty-five providers (30%) completed Q3 (1-month follow-up), and 62 providers (41%) completed Q4 (3-month follow-up). There was no statistically significant difference between the individuals who completed Q4 (respondents) and those who did not complete Q4 (nonrespondents) with respect to profession, gender, geographic location, or years in practice. There was a significant difference ($p = .0009$)

between respondents and non-respondents at Q4 with respect to practice setting (Table 1).

Part II: Self-Reported Knowledge of and Confidence in Using the AARS/AAP

Recommendations

Figures 1 and 2 and Table 2 illustrate participants' self-reported awareness of and confidence in using the AARS/AAP recommendations. Average pre-intervention knowledge of the recommendations was rated 2.4 (on a 5-point Likert scale, where 1 is poor and 5 is excellent), and average pre-intervention confidence in using the recommendations was 2.5. Notably, pre-intervention, 27% of individuals rated their knowledge of the AARS/AAP recommendations as 'poor,' and 26% rated their confidence in using the recommendations as 'poor.' Only 3% of individuals rated their knowledge of or their confidence in using the recommendations as 'excellent' pre-intervention. Three months after the intervention, average awareness of the recommendations was rated as 3.5, and average confidence in using the recommendations was rated 3.7. At this time point, less than 2% of participants rated their knowledge as 'poor,' and no participants rated their confidence in using the recommendations as 'poor.'

Part III: Case-Based Exam Results and Errors in Acne Management

Figure 3 describes the results from the case-based exam developed for this study. There was a significant increase in overall test scores three months after the intervention; test scores rose from an average of 70% correct, pre-intervention, to an average of 86%

correct three months after the intervention ($p < 0.0001$). Answers were graded as ‘correct’ if they were congruent with the AARS/AAP recommendations.

Before the intervention, over 90% of providers correctly identified treatment plans for mild acne in both teenagers and preadolescents that were congruent with AARS/AAP recommendations. Uncommon pre-intervention errors in treating mild acne in a teenager (case 1) included choosing a regimen with an oral antibiotic (3% of providers) or choosing a regimen consisting of topical antibiotic monotherapy (1%) (Table 3). Similar errors were made in treating a preadolescent with mild acne (case 2) before the intervention: 1% of providers utilized topical antibiotic monotherapy, 1% utilized an oral antibiotic, and 1% incorrectly chose to refer the preadolescent to endocrinology (Table 3). Three months after the intervention, 100% of providers chose a correct treatment regimen for mild acne in both teenagers and preadolescents.

Providers had more difficulty selecting recommendation-consistent treatment regimens moderate acne. Before the educational intervention, 60% of providers chose a correct treatment regimen for moderate facial acne (case 3), and 44% chose a correct treatment regimen for moderate face and truncal acne (case 4). Immediately after the intervention, the percentage of correct answers to these cases increased significantly, with 93% of providers choosing a correct regimen for case 3 and 79% for case 4 ($p < 0.0001$ for both). These knowledge gains were retained upon retesting three months after the intervention, with 82% of providers choosing a correct regimen for case 3 ($p = 0.0021$) and 71% for case 4 ($p = 0.0046$).

The most common errors in management of moderate acne pre-intervention were failure to use a retinoid (17% of providers in case 3, 13% in case 4) and failure to use

benzoyl peroxide with a topical or oral antibiotic (15% of providers in case 3, 17% in case 4). An increase in the appropriate selection of topical retinoids for moderate facial acne and moderate facial and truncal acne was significant at the three-month time-point ($p=0.0455$ and $p=0.0269$, respectively). Similarly, there was a significant increase at three months in the inclusion of benzoyl peroxide into regimens of care for moderate facial ($p=0.0455$), and facial and truncal acne ($p=0.0026$) with topical or oral antibiotics, which is recommended to decrease the emergence of bacterial resistance. Other pre-intervention errors included use of oral contraceptive pills or isotretinoin as first-line therapy prior to initiation of oral antibiotics and/or referral to dermatology. These errors appeared to decrease 3 months after the intervention; however, they did not reach statistical significance (Table 3).

For the treatment of severe acne, 56% of providers initially chose a treatment regimen in accordance with the AARS/AAP recommendations. Immediately after the intervention, there was a significant increase in the number of providers (84%) choosing a treatment aligned with recommendations ($p < 0.001$) (Table 3). At retesting three months later, 74% of respondents identified a correct treatment regimen, which was statistically nonsignificant ($p=0.2482$). The most common error in the treatment of severe acne was failure to initiate combination therapy (oral antibiotic + benzoyl peroxide + retinoid +/- topical antibiotic) before referral to dermatology for isotretinoin treatment. Thirty-four percent of providers failed to initiate this combination therapy before the intervention, and 29% failed to initiate combination therapy three months after the intervention ($p=0.8445$). Less common errors before the intervention were failing to include some component of combination therapy, such as a retinoid (5% of providers),

benzoyl peroxide (3%), or an oral antibiotic (1%). After the intervention, all providers that chose a non-isotretinoin answer choice included all three components of combination therapy, though this result did not reach statistical significance.

Part IV: Use of Retinoids

Figure 4 describes the percentage of providers including a retinoid in their treatment regimen for each case. The educational intervention increased the willingness to utilize topical retinoids in management of mild acne in a teenager (increasing from 52% to 71% of providers) and in preadolescents (21% to 35%); this increase persisted and actually increased at three months.

Similarly, the percentage of providers using a retinoid in the treatment of moderate facial acne, and moderate facial and truncal acne, increased significantly from 81% to 97% ($p=0.0033$) and 85% to 97% ($p=0.0269$) respectively. The number of providers using a retinoid to treat severe acne was 93% pre-intervention, and did not significantly increase after the intervention (Fig 4).

Discussion:

The rate of guideline integration into clinical practice is often very slow, which means patients may not be receiving the most up-to-date evidence-based care (9). This can be especially troubling in diseases with a significant psychological burden, such as acne. Adolescents with acne, in particular with severe acne, are at increased risk of depression and suicidal ideation (10), necessitating the need for timely and effective treatment in order to prevent the development of these comorbidities.

One effective way in which to increase the implementation of best-practice clinical recommendations is through targeted educational interventions (11). These interventions have helped increase provider knowledge of both chronic obstructive pulmonary disease guidelines (12) and genetic testing guidelines (13) in other studies. In our study, we found that an interactive case-based educational intervention was effective in increasing provider knowledge of the AARS/AAP recommendations as demonstrated by a case-based exam. The most significant knowledge gains were seen in the treatment of moderate acne and in the use of topical retinoids in adolescents.

Further analysis of the pre-intervention answer selections demonstrated several important differences in baseline practice amongst those participating in the study and the AARS/AAP recommendations. One such practice gap was a reluctance among providers to use topical retinoids in preadolescents, which continued to persist (though to a lesser degree) even after the intervention. This gap is consistent with prior literature demonstrating underutilization of retinoids by all providers, but especially by non-dermatologists in treating the preadolescent population (3). A retrospective review of the National Ambulatory Medical Care Survey (NAMCAS) found that amongst teenagers topical retinoids were prescribed at 36.3% of dermatology visits but only at 15.7% of primary care visits (4). In preadolescents, topical retinoids were prescribed at 52% of dermatology visits but only 10.5% of primary care visits (4). One possible reason for this difference might be concern over the irritating side effects of first generation retinoids, which may lead to dissatisfaction and poor patient adherence (14). However, the availability of newer generation retinoids such as adapalene that have fewer side effects than first generation retinoids has not appeared to ameliorate this unease. This hesitancy

towards using retinoids in this population is concerning given that the most acne in preadolescents is comedonal, and thus responds especially well to retinoid therapy (4). Since early comedonal acne may be one of the best predictors of later, more severe disease, effective early intervention may prevent unwanted psychological and physical sequelae (14). This discrepancy in retinoid usage between adolescents and preadolescents represents an enduring practice gap that should be addressed through further study and education.

Another difference between baseline practice amongst those participating in the study and the AARS/AAP recommendations was with regard to benzoyl peroxide use. While experts recommend using oral and topical antibiotics with benzoyl peroxide to decrease the development of microbial resistance (8), a significant minority of participants selected regimens containing antibiotics without benzoyl peroxide. Similar trends have previously been reported in studies of general practitioners (5) and in a NAMCAS review of acne prescriptions from dermatologists and non-dermatologists (15). Further education on antibiotic stewardship, perhaps by utilizing educational interventions such as ours, may be warranted for providers at all levels in order to ‘fill in’ this practice gap.

The initiation of therapy for severe disease is another area of discrepancy between the AARS/AAP recommendations and baseline knowledge of the participations. Most participants did not initiate combination therapy for severe acne (oral antibiotic, benzoyl peroxide, a retinoid, and possibly a topical antibiotic) prior to referral to dermatology for isotretinoin treatment. This enduring practice gap may be a limitation of a case-based study rather than management in real practice, where a provider would likely optimize

current medication use while simultaneously referring to dermatology for initiation of isotretinoin.

Other limitations of this study include a relatively small sample size (150 providers) and a lack of long-term follow-up (beyond three months) to evaluate retention of knowledge gained from the intervention. Despite the limitations, we were able to successfully identify and ‘fill in’ several of the practice gaps in the treatment of pediatric acne, demonstrating that educational interventions such as ours can be an effective means of increasing guideline dissemination and narrowing practice gaps. It would be interesting to see how this targeted intervention could be ‘scaled-up’ to include more providers, perhaps by utilizing a web-based methodology.

Conclusion

This study illustrates how case-based continuing education focused on practice gaps can lead to gains in guideline knowledge and in increased willingness to apply expert recommendations to a case-based scenario, even months after the educational intervention. In this report, the intervention increased the number of providers choosing simulated treatment regimens aligned with the AARS recommendations and greatly increased the number of providers utilizing retinoids in their answer choices for mild and moderate acne. Enduring practice gaps included a reluctance to use retinoids in the preadolescent population and a failure to utilize oral and topical combination therapy in individuals with severe acne prior to initiation of isotretinoin. These represent important areas for continued and focused education. In the future, more studies on different

methods of closing practice gaps and longer-term studies of educational interventions will be vital in finding ways to increase evidence-based care.

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Table 1. Demographic characteristics of all participants, and comparison between respondents and nonrespondents at Q4 (3 month follow-up)

Characteristics	Q1 - All participants. (N=150) (%)	Q4 Respondents (N=62) (%)	Q4 Non-respondents (N=88) (%)	P-value
Profession				<i>0.2416</i>
Pediatrician	119 (79.3%)	47 (76%)	72 (82%)	
Pediatric Resident	14 (9.3%)	8 (13%)	6 (7%)	
Pediatric Nurse Practitioner	7 (5%)	3 (5%)	4 (5%)	
Pediatric Physician Assistant	5 (3%)	2 (3%)	3 (3%)	
Family Practitioner	3 (2%)	0 (0%)	3 (3%)	
Other	2 (1.4%)	2 (3%)	0 (0%)	
Gender				<i>0.3949</i>
Female	98 (65%)	39 (63%)	59 (67%)	
Male	52 (35%)	23 (37%)	29 (33%)	
Geographic Location				<i>0.4120</i>
Suburban	87 (58%)	37 (60%)	50 (57%)	
Urban	53 (35%)	21 (34%)	32 (36%)	
Rural	10 (7%)	4 (6%)	6 (7%)	
Setting				<i>0.0009*</i>
Group Pediatric Practice	63 (42%)	23 (37%)	40 (45%)	
Academic Center	29 (19%)	13 (21%)	16 (18%)	
Solo Pediatric Practice	23 (15%)	10 (16%)	13 (15%)	
Multispecialty Group Practice	18 (12%)	7 (11%)	11 (13%)	
Other	10 (7%)	4 (7%)	6 (7%)	
Hospital	7 (5%)	5 (8%)	2 (2%)	
Years in Practice				<i>0.0627</i>
20 years or more	70 (46.7%)	28 (45%)	42 (48%)	
10 to 19 years	34 (22.7%)	11 (18%)	23 (26%)	
5 to 9 years	19 (12.6%)	8 (13%)	8 (9%)	
Less than 5 years	27 (18%)	15 (24%)	15 (17%)	

Figure 1. Self-rated recommendation knowledge, before and three months after the educational intervention

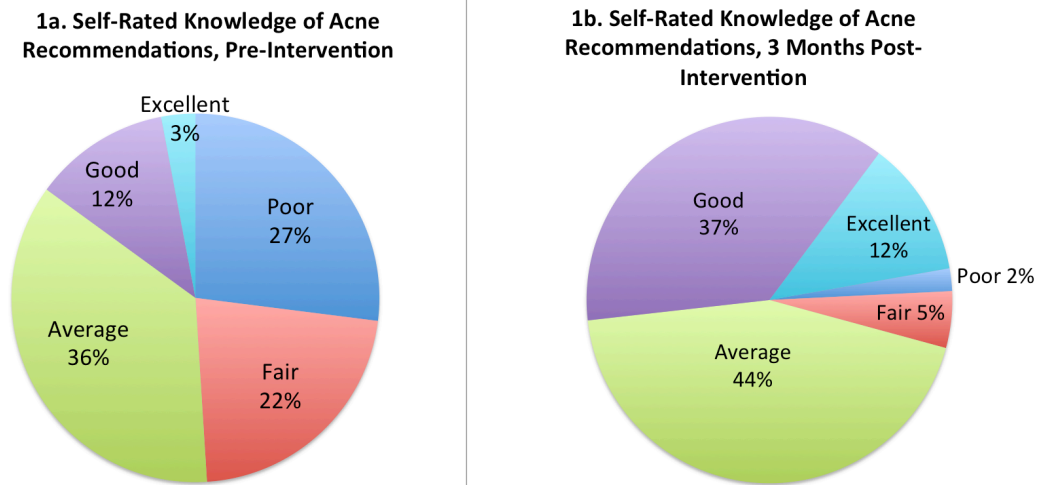


Figure 2. Self-rated confidence in using AARS acne recommendations, before and 3 months after the educational intervention

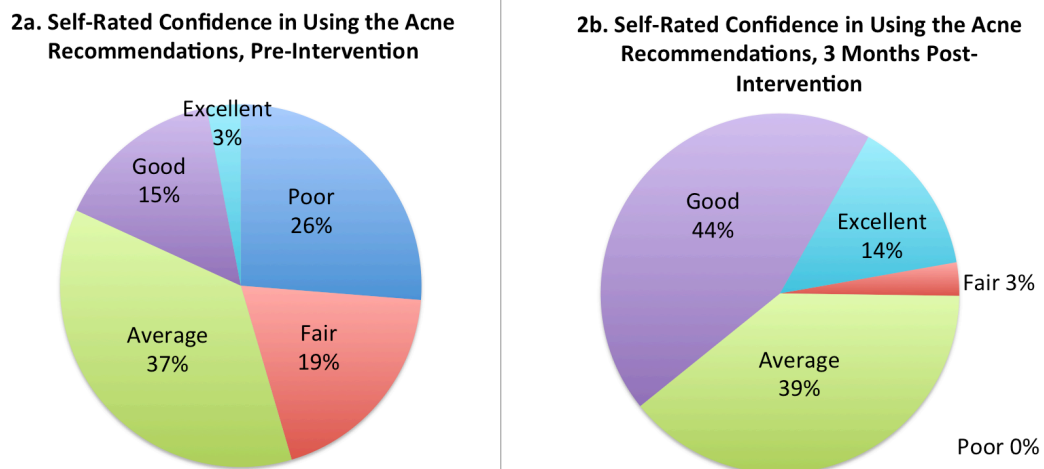


Table 2: Average participant self-reported knowledge of and confidence in using the AARS/AAP recommendations, pre-intervention and at 3-month follow-up, rated on a 5-pointed Likert Scale, where 1 is poor and 5 is excellent

	Pre-Intervention (N=150)	3 Months Post- Intervention (N=62)	<i>P</i> -value
Knowledge of Acne Recommendation	2.4	3.5	<0.0001*
Confidence in Using Acne Recommendations	2.5	3.7	<0.0001*

Fig 3. Percentage of Correct Answers to Case-Based Exam, Before, Immediately After, and 3 Months After an Educational Intervention

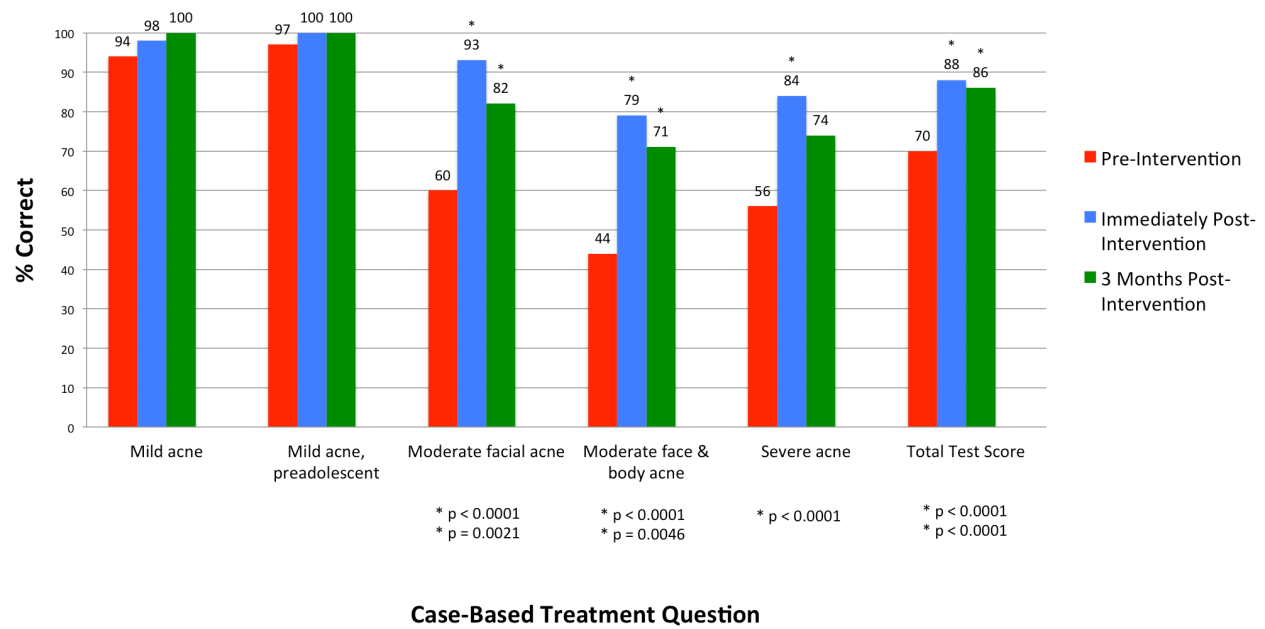


Table 3. Errors in management of pediatric acne on the case-based exam

Case 1: Mild Acne in a Teenager			
Management Error (corresponding answer choice)	Number of Providers (%)		P-value
	Pre-Intervention (N=149)	3 Months Post-Intervention (N=62)	
Use of oral antibiotic (J, K)	4 (3)	0 (0)	<i>1</i>
Use of topical antibiotic monotherapy (D)	1 (1)	0 (0)	<i>1</i>
Case 2: Mild Acne in a Preadolescent			
Use of oral antibiotic (J, K)	1 (1)	0 (0)	<i>1</i>
Use of topical antibiotic monotherapy (D)	1 (1)	0 (0)	<i>1</i>
Referral to Endocrinology (P)	1 (1)	0 (0)	<i>1</i>
Case 3: Moderate Facial Acne			
Failure to include a retinoid (E, J, A)	26 (17)	2 (3)	0.0455*
Use of a topical or oral antibiotic without benzoyl peroxide (F, D, H, I)	23 (15)	4 (6)	0.0455*
Use of oral contraceptive pills as first-line therapy (N)	1 (1)	0 (0)	<i>1</i>
Use of topical retinoid alone (B)	2 (1)	0 (0)	<i>1</i>
Case 4: Moderate Face and Body Acne			
Failure to include a retinoid (E, J, A)	19 (13)	1 (2)	0.0269*
Use of a topical or oral antibiotic without benzoyl peroxide (F, D, H, I)	26 (17)	2 (3)	0.0026*
Use of isotretinoin as first-line therapy (O)	1 (1)	0 (0)	<i>1</i>
Case 5: Severe Acne			
Failure to initiate combination therapy before starting isotretinoin (O)	50 (34)	18 (29)	<i>0.8445</i>
Failure to include a topical retinoid as part of combination therapy (E, J)	7 (5)	0 (0)	<i>0.2482</i>
Failure to include an oral antibiotic as part of combination therapy (G, C)	4 (3)	0 (0)	<i>1</i>
Failure to include benzoyl peroxide as part of combination therapy (I)	2 (1)	0 (0)	<i>1</i>

Fig 4. Percentage of Providers Including a Retinoid in the Treatment Regimen, Before, Immediately After, and 3 Months After an Educational Intervention

