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**Educating Adolescents about Acne Vulgaris: A Comparison of Written Handouts  
with Audio-Visual Computerized Presentations**

A Thesis Submitted to the Yale University  
School of Medicine in Partial Fulfillment of the  
Requirements for the Degree of Doctor of  
Medicine

By

Phoebe Este Koch

2007

## Abstract

### **Educating Adolescents about Acne Vulgaris: A Comparison of Written Handouts with Audio-Visual Computerized Presentations**

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Acquisition of data: PEK

Analysis and interpretation of data: RJA, PEK

Drafting of thesis: PEK

Critical revision of thesis for important intellectual content: RJA, VN

Statistical expertise: VN, JD

Disclosure: The authors have no relevant financial interest in this research.

This randomized clinical study aimed to compare the efficacy of written handouts with that of audio-visual computerized presentations in educating adolescents about acne vulgaris. The study included 101 adolescent patients, aged 13 to 17 years, presenting to a private dermatology practice or one of three pediatric clinics in New Haven, CT. All participants completed a brief enrollment questionnaire to gauge baseline knowledge about acne vulgaris. Subjects were then randomized to receive either a written handout or an audio-visual computerized presentation. Immediately following the intervention, and again at one month, patients were asked to complete identical questionnaires to assess change in knowledge about acne. The main outcome measure was change in knowledge about acne vulgaris, as indicated by performance on pre-intervention, post-intervention, and one-month follow-up questionnaires. Baseline questionnaires were completed by 21 patients in the pilot study and 80 subjects in the revised study; 17 (80.95%) and 77 (96.25%) completed the respective studies. In both the pilot and revised studies, there was no significant difference *between* intervention groups in terms of baseline knowledge or gain-in-knowledge. Immediately post- intervention, both groups showed significant improvement from baseline ( $P<.0001$  revised study,  $P<.01$  pilot study). At the one-month follow-up, patients in the pilot study randomized to receive the computerized presentation still showed significant gain in knowledge from baseline ( $p<.05$ ), while those in the handout group did not. Meanwhile, both intervention groups in the revised study continued to show significant gain in knowledge from baseline at one month ( $p<.0001$ ). From the above results it appears that both written handouts and audio-visual computerized presentations about acne vulgaris confer significant and equivalent benefits in terms of short- and long-term knowledge gains among adolescent patients with acne.

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## INTRODUCTION:

Acne vulgaris is the most common skin disorder in the United States, affecting more than 17 million Americans<sup>1</sup> and accounting for over 5.1 million patient visits per year.<sup>2</sup>

Adolescents are particularly affected, with approximately 85% experiencing some degree of acne.<sup>3</sup> Although rarely life-threatening, acne can cause substantial psychological morbidity<sup>4-6</sup>. Indeed, studies have shown acne can significantly impair self-image<sup>7, 8</sup> and the ability to form relationships,<sup>9</sup> and may even contribute to suicidality.<sup>10</sup>

### *Need for dissemination of accurate information*

Despite its prevalence and its potential to significantly impair emotional health and well-being, substantial misunderstanding persists regarding the causes and treatment of acne.<sup>11,12,13</sup> Surveys of acne patients in academic and community settings have revealed widespread misconceptions regarding acne's pathogenesis, natural course, and response to therapy. In a 2003 study, McEvoy et al. surveyed 144 consecutive patients presenting to a private dermatologist's office for acne treatment, as well as 182 middle and high school students who served as a control group. Both the patients and student controls filled out identical questionnaires. These questionnaires addressed subjects' beliefs regarding the cause of acne and the effect on acne of diet, stress, topical treatments, menses, hair length, and lack of sleep. Participants were also asked their opinion about the effect of "popping zits" and the effect of applying pressure to the face by leaning on the hand. With regard to the causes of acne, 10 (7%) patients identified diet as a factor, while 26 (18%) patients said that they did not know the cause and 61 (42%) gave no

answer. In particular, patients believed the following foods worsened acne: chocolate, fast food, nuts, potato chips, iodized salt, soft drinks, beer, and alcohol.

In addition to beliefs about the causes of acne, the study questionnaires highlighted factors believed to improve acne. Thirty-one percent of male patients and 22% of females reported that "popping zits" improved their acne, while only 1% believed "popping zits" worsened their acne. Most patients said applying pressure to the face by leaning on the hand improved their acne. The students in the control group possessed beliefs similar to those of the patients with regard to the effect of diet on acne, the effect of "popping zits," and the effect of applying pressure to the face by leaning on the hand.

Previous studies have found patients to be confused regarding the expected time course of acne therapy. When questioned about the time needed to see improvement in acne with treatment, the patients in McEvoy et al's study<sup>13</sup> expected to see significant improvement at 4–6 weeks (depending on severity). These findings correlate with those of Rasmussen and Smith,<sup>11</sup> who found improvement was expected by 35% at 6 weeks. Likewise, in a study by Tan, patients expected treatment to take less than 4 weeks.<sup>12</sup> In fact, most patients receiving appropriate treatment for acne are likely to see 30-40% improvement in 2 months, 60% improvement in 4 months and 80% or even greater improvement in 6 months<sup>14</sup> Thus the majority of patients in the above-mentioned studies have unrealistic expectations for therapy.

While patients continue to be misinformed about acne, it is not because they are disinterested. Community-based surveys indicate patients receive most of their information about acne from television (74%), parents (61%) friends (47%) and

magazines (39%); meanwhile, the majority of patients surveyed felt the information they had received from these sources was inadequate.<sup>15, 16</sup> When education is left to the media and lay public, the information conveyed may not always be accurate, thereby leading to the propagation of acne myths and misconceptions.

### *Misconceptions among caregivers*

The need for improved dissemination of acne information extends beyond the lay public; recent studies of medical students and clinicians found knowledge about acne to be extremely poor among these groups.<sup>17, 18</sup> Green and Sinclair<sup>17</sup> analyzed examination answers of final year medical students at Melbourne University and found that 10% identified smoking and alcohol, and 25% identified poor facial hygiene, as exacerbating factors in acne. Forty-one percent of students further identified dietary factors (especially chocolate, oily or fatty foods and high sugar-content foods) as exacerbating acne. The treatment recommendations of the final year students were in keeping with their beliefs about acne pathogenesis—in particular, they recommended the use of cleaners and washes, antiseptics and medicated soaps, and improved facial hygiene and diet. The Melbourne University medical student responses are consistent with popular beliefs about acne, but are at odds with current dermatological opinion that diet and hygiene are likely unrelated to acne pathogenesis and that skin cleansing and dietary changes are ineffective acne treatments.

Brajac et al.'s study<sup>18</sup> of 100 patients and 120 family physicians lends further credence to the notion that acne knowledge is poor among patients and caregivers alike. Acne was



considered a trivial and transitory condition by 52% of patients and 44% of family physicians. The overall score of correct answers regarding the causes of acne among family physicians was 15% while that pertaining to the natural course of the disease was 6%. Just over half of family physicians were knowledgeable about isotretinoin teratogenicity (55% correct answers), but knowledge of other side effects was lower (9%). The overall score of correct answers regarding antibiotic therapy among family physicians was only 21%. In general, the impact of acne was underestimated by family physicians and also by acne patients. These findings led Brajac et al. to conclude that overall knowledge pertaining to acne causes, natural course and therapy was extremely low among these groups.

#### *Compliance and health education*

While effective therapeutic options exist for the treatment of acne, treatment compliance with acne medications has been shown to be as low as 12.5%.<sup>25</sup> In fact, poor patient compliance has been identified as the main reason for acne treatment failure.<sup>26</sup> Accurate diagnosis, appropriate therapy and good compliance with directions for therapy are all important components in the treatment of disease. Previous studies have suggested that noncompliance with treatment is the result of the patient not understanding the nature of acne, not understanding the nature of the treatment, or having unrealistic expectations of treatment.<sup>13, 26</sup> Meanwhile, health education, especially knowledge of disease-therapy interactions, has been shown to increase compliance in adolescents with other chronic diseases.<sup>27,28</sup> In a disease such as acne, where compliance with treatment is of paramount importance, patient education may play a critical therapeutic role.

### *Conveying information efficiently and effectively*

Many clinics and, in fact, many non-medical organizations struggle to find a way to educate patients about their diseases. Traditional methods of patient education have included physician-patient conversations and printed handouts and pamphlets. While these methods may be moderately effective, conversations in a busy clinic are often hurried and printed handouts left unread.<sup>29</sup> Meanwhile, analysis of patient educational materials has found that such materials are often written at a reading level above that of the average patient.<sup>24</sup>

Even when efforts are undertaken to educate patients, much of what is conveyed may be quickly forgotten. Indeed, studies have found patients often forget much of what they have been told during an office visit. Using a large (n= 2,670) sample of patients visiting family physicians in community practice, and verifying patient report by direct observation, a study by Flocke and Stange showed that less than 50% of family physicians' discussions about diet, smoking and exercise were recalled by patients.<sup>30</sup> Clearly, patient education suffers from lack of time available to practitioners, inadequacy of educational materials, and the tendency of patients to forget what has been taught. In short, there is vast room for improvement in the both vehicles and delivery of patient education.

Audio-visual presentations have been found to be significantly more effective than traditional methods of patient education in improving patient knowledge as measured by scoring on pre- and post-test questionnaires.<sup>31</sup> In a technologically savvy cohort such as teen-aged patients, digitized, computer-based information may be seen as 'cooler' and

more accessible than traditional vehicles of information. While studies in other areas of medicine have shown internet-enabled multimedia interventions<sup>32</sup> and ‘sound and slide shows’<sup>33</sup> to be more effective than written presentation of information, to date, no such studies have been conducted on adolescents in dermatology.

*Specific aims of the study:*

We aimed to evaluate the effectiveness of two educational methods, both of which are applicable to everyday clinical practice. We hypothesized that subjects randomized to receive audio-visual, computerized presentations about acne vulgaris would demonstrate a greater increase in knowledge about acne, as measured by scoring on post-intervention and one-month follow-up questionnaires, when compared to subjects receiving written handouts. We felt information from this study could potentially influence the methods by which information is conveyed to an adolescent patient population—thus building upon previous research into the specific educational methods most likely to maximize adolescents’ acquisition and retention of material.

**METHODS:**

A clinical and questionnaire-based study was conducted with approval granted by the Human Investigation Committee at the Yale University School of Medicine. The study involved eighty adolescents, aged 13-17 years, who presented to a private dermatology office or one of three pediatric clinics in New Haven, CT. Participants received a brief questionnaire upon enrollment to assess baseline knowledge about acne vulgaris, and were then randomized via coin toss to receive either a written informational handout or an audio-visual computerized presentation (see educational materials for more detail). All

enrolled subjects then immediately completed an identical questionnaire to assess the effectiveness of the intervention. At one month, the questionnaire was again administered via telephone interview to determine the degree of retention of the information.

The questionnaires and educational materials were designed specifically for this study and pilot-tested on a group of 21 patients at the end of their visit to a private dermatology practice.

### *Educational Materials*

Both the audiovisual and written presentations were designed to maximize the acquisition of material with strategies that have proven effective: writing at the sixth to eighth grade reading level, limiting the number of take-home messages, and focusing on the most prevalent misconceptions about acne vulgaris.<sup>33</sup> The computer presentation and written hand-out presented the same information, focused specifically on issues shown to be misunderstood by adolescents in previous studies.<sup>11, 13, 26, 33</sup> In particular, our intervention addressed the causes of acne, factors that may exacerbate acne, the duration and proper use of acne treatments, and suggestions to increase compliance.

In designing our educational materials, we adhered to principles of education theory and psychiatric theory of compliance.<sup>34</sup> According to Ames et al., high-quality educational materials meet the following criteria: they contain accurate, current and appropriate information, adopt an appropriate learning philosophical point of view, are interesting and attractive to children, and are free of cultural, ethnic, age, race, disability, and sexual biases.<sup>34</sup> Both the computerized and written formats contained identical information, and

the information presented was sufficient to answer all questions posed by the questionnaires. The computerized presentation was 6 minutes 36 seconds in duration; the pamphlet was read in less than five minutes by the majority of participants. During the revised study, most patients were able to provide informed consent, complete the questionnaires, and read or view the written or audiovisual materials while waiting to be seen by their physician. Changes to the educational materials following the pilot study included minor changes in wording and layout. Attempts were also made to ensure that the content of each question on the questionnaire was addressed in a similar manner by both the computerized and written interventions.

#### *Assessment of knowledge questionnaire*

In order to allow comparison of our data with previously published data, we modeled our assessment questionnaires after those distributed by Rasmussen and Smith<sup>11</sup> and Tan et al.<sup>12</sup> In creating the questionnaires, we sought to adhere to standard areas of questioning in patient conceptions of acne. In particular, we attempted to focus on misconceptions we felt were most likely to interfere with patient compliance. For example, the erroneous notion that dirt causes acne may lead some patients to use harsh soaps or wash too frequently or vigorously. The dry skin resulting from such washing may then be blamed on acne therapies, leading to poor compliance. Therefore the misconception that dirt causes acne may have direct implications for patient compliance with acne medications and skin-care-regimens. Our questionnaires accordingly addressed issues such as whether or not blackheads are caused by dirt, and whether or not frequent face-washing is likely to improve acne.

Another issue addressed by our interventions and questionnaires was the tendency of certain acne medications to initially worsen acne. We hypothesized that if patients were unaware of this fact, compliance with these medications might suffer as a result. A true-false question on our questionnaire asked patients whether or not certain acne medications could initially make acne worse.

A third focus of our intervention was the expected duration of acne therapy—also shown to be widely misunderstood by the lay public and physicians alike.<sup>18</sup> We postulated that if patients expected to see results in a matter of days, they might be less likely to continue treatment for the length of time required to see improvement in the majority of cases.

The baseline assessment included demographic information as well as information regarding subjects' current acne severity by self-report, sources of acne information, and desire for additional information about acne. The pre-, post- and one-month follow-up questionnaires all contained an identical set of eighteen questions to assess knowledge of acne and its treatments. The revised study questionnaires consisted of 18 questions, 15 of which remained unchanged from those of the pilot study. Those questions that were changed included three we deemed unclear, or irrelevant to participants' baseline knowledge about acne. Following the pilot study, three additional questions were incorporated in an effort to address additional misconceptions we felt were pertinent to patient compliance and understanding of acne vulgaris.

### *Statistical considerations*

All data collected for this study was entered into a Microsoft Access database and analyzed with SAS version 9.1.<sup>35</sup> The pilot study was conducted *following* the patient visit and included only patients visiting a private dermatology practice. The subjects in the pilot study had already received minimal acne education prior to enrollment. The revised study was, in most instances, conducted *before* and during the patient visit, and took place at either a private dermatology practice or one of three pediatric clinics.

The primary outcome variable in this study is “knowledge about acne,” measured on a scale from 0-18 (0-15 for the pooled data), representing the number of questions answered correctly. To assess the change from baseline *within* groups (audiovisual vs. hand-out) we used paired student t-tests. The difference *between* groups was analyzed using a two-sample student *t*-test. In all analyses, a p-value of less than .05 was considered statistically significant. Intention-to-treat analysis was employed, such that patients who failed to complete the study were considered to show no improvement from baseline.

### RESULTS:

Twenty-one patients were recruited to the pilot study and then randomized into a hand-out group (n = 7) and a computerized presentation group (n = 14). Of the original 21 subjects, 4 were lost to follow-up after completing the post-intervention questionnaire, leaving 17 (80.95%) to complete the study.

Eighty-two patients were approached to participate in the revised study, two of whom refused: one cited lack of time while the other “didn’t feel like it.” The eighty remaining subjects were randomized into a hand-out group (n = 45) and a computerized presentation group (n = 35). Of the original 80 subjects, 3 were lost to follow-up, thereby resulting in a 96.25% completion rate. Of the 3 subjects who did not complete the revised study, one was Latino and discovered to lack the requisite fluency in English only after enrollment, one was unable to complete the study due to time constraints, and a third could not be reached within the four- to five-week window allotted for the one-month follow-up.

## **Pilot Study**

### *Demographic data and baseline values*

The demographic data for the pilot study participants is summarized in Table 1. Eleven (78.57%) patients in the computerized group and 6 (85.71%) patients in the hand-out group had previously seen a doctor for their acne. When asked to rate their current acne severity, 10 (47.62%) reported no acne, 8 (38.10%) reported mild acne, and 3 (14.28%) reported moderate-to-severe acne. In response to the question, “How much does your acne bother you?” 2 (9.52%) patients answered “never,” while 5 (23.81%) were “sometimes” bothered, 13 (61.90%) were bothered “most of the time,” and 1 (4.76%) was bothered “almost all of the time.” In rating their pre-intervention knowledge of acne, 10 (71.43%) patients in the computerized presentation group reported knowing “nothing” or “a little” about acne, with the rest reporting “some” or “a lot” of knowledge. Of those in the hand-out group, 6 (85.71%) knew “nothing” or “a little” about acne. Participants reported receiving acne information from a variety of sources, including friends, family members and the media. However, only 5 (35.71%) patients in the computerized group



and 2 (28.57%) in the hand-out group felt they had “enough information” from those sources.

The baseline knowledge scores, as determined by the performance on the pre-intervention questionnaire, were similar between intervention groups; the mean score for those receiving the computerized presentation was 50.95% with a standard deviation of  $\pm 14.70$ , while the mean for the hand-out group was  $47.62\% \pm 15.60$ . There was no significant difference between intervention groups in any of the above categories (See Table 1).

#### *Change in knowledge*

The post-intervention change-in-knowledge scores, as determined by comparing the results of the pre- and post-test questionnaires, were as follows: In the computerized group, the mean score improved from baseline by  $16.67\% \pm 12.19$ ; the hand-out group improved by  $25.71\% \pm 18.23$ . Although there was no significant difference *between* intervention groups, the within-group improvement was significant ( $p < .01$ ) for both groups (See Table 2).

At the one-month follow-up, significant improvement from baseline was again noted in the computerized group ( $p < .05$ ), but not in the hand-out group. The mean score on the final questionnaire showed a change from baseline of  $15.15\% \pm 16.35$  in the computerized group, and  $13.33\% \pm 15.20$  in the handout group. Again, no significant difference was noted between groups (See Table 3).

## **Revised Study**

### *Demographic data and baseline values*

The demographic data pertaining to participants in the revised study is summarized in Table 4. As in the pilot study, patients reported whether they had ever seen a doctor for their acne, and were asked to rate their current knowledge about acne. They were also queried regarding current acne severity and the degree to which they were bothered by their acne.

Respondents had the following acne severity by self-report: of the 80 patients, 19 (23.75%) reported no acne, 43 (53.75%) reported mild acne, and 18 (22.50%) reported moderate-to-severe acne. In response to the question, “How much does your acne bother you?” 20 (25%) patients answered “never,” while 34 (42.50%) were “sometimes” bothered, 20 (25%) were bothered “most of the time,” and 6 (7.50%) were bothered “almost all of the time.” Twenty (57.14%) patients in the audio-visual computerized group and 24 (53.33%) patients in the hand-out group had previously seen a doctor for their acne.

In rating their own knowledge of acne, 23 (65.71%) patients in the computerized group reported knowing “nothing” or “a little” about acne, with the rest reporting “some” or “a lot” of knowledge. Of those in the hand-out group, 22 (48.89%) knew “nothing” or “a little” about acne, with the remaining 23 (51.11%) claiming to know “some” or “a lot.” None of the above measures differed significantly between the two intervention groups.

A large percentage of patients in the revised study felt that additional information about acne would be helpful; this included 28 (80.00%) patients in the computerized group and 32 (71.11%) patients in the hand-out group. The baseline knowledge scores, as determined by the initial pre-intervention questionnaires, were similar between intervention groups; the mean score for those receiving the computerized presentation was  $55.08\% \pm 17.79$ , while the mean for the hand-out group was  $53.33\% \pm 14.53$ . Neither the differences in baseline knowledge nor the desire for more information about acne were significant between groups (See Table 4).

#### *Change in knowledge*

The post-intervention change-in-knowledge scores, as determined by comparing the results of the pre- and post-test questionnaires, were as follows: in the computerized group, the mean score improved from baseline by  $22.06\% \pm 18.05$ ; the hand-out group improved by  $26.91\% \pm 15.93$ . Although there was no significant difference *between* intervention groups, the within-group improvement was significant ( $p < .0001$ ) for both groups (See Table 5).

At the one-month follow-up, significant improvement from baseline was again noted within both intervention groups ( $p < .0001$ ). The mean score on the final questionnaire was improved by  $17.14\% \pm 16.74$  in the computerized group, and by  $12.84\% \pm 19.27$  in the hand-out group. Again, no significant difference was noted between groups (See Table 6).

## **Pooled Data**

As discussed previously, changes were made to the questionnaires as well as the computerized and written educational interventions following analysis of the pilot data. Despite these changes, curiosity led us to pool the data from the pilot and revised studies in an attempt to explore any patterns that might emerge. In doing so, we incorporated only the 15 questionnaire items that remained identical from the pilot to the revised study. The results of the pooled data are discussed here, with the acknowledgment that they are invalid due to the limitations discussed above, and are thus purely conjecture. However, these results seem to merit discussion as they provide interesting questions for future research and, potentially, warrant the enrollment of additional subjects to our study. It is possible that our sample of 80 participants was not large enough to capture the difference between the two intervention methods.

In pooling the data from both the pilot and revised studies we found that, contrary to our expectations, the change in knowledge scores immediately after the intervention were significantly greater ( $p < .05$ ) for the hand-out group as compared to the computerized group. Whereas the average improvement for the computerized group was  $21.90\% \pm 17.59$  from baseline, the hand-out group improved by an average of  $29.23\% \pm 17.77$  (See Table 7). However at the one-month follow-up, the reverse was true: subjects in the computerized group showed a greater change from baseline ( $18.12\% \pm 17.14$ ) than did those in the hand-out group ( $14.93\% \pm 16.74$ ). The improvement of the subjects in the computerized group was statistically significant ( $p < .0001$ ), while that of students in the hand-out group was not (See Table 8).

## COMMENT:

To our knowledge, this is the first study comparing written pamphlets with audiovisual computerized presentations as a means of educating adolescent patients about acne vulgaris. Previously collected data suggest that despite acne's prevalence,<sup>1</sup> knowledge about acne pathogenesis and treatment remains poor among adolescents and practitioners alike.<sup>11-13, 17, 18</sup> Meanwhile, studies in other areas of medicine have shown computerized health interventions to improve health status and serve as valuable supplements to one-on-one interaction between patients and clinicians.<sup>3,6,31, 32, 37</sup> With the results of such studies in mind, we hypothesized that a population of adolescent acne patients would find colorful, computer-based information more accessible than traditional vehicles of information and that this would translate into superior knowledge gains as determined by performance on pre- and post-intervention questionnaires.

The results of our study support the notion that computerized, audiovisual presentations serve as effective teaching tools in the clinic, and may relieve the burden upon busy health-care providers. Our findings also raise interesting questions regarding the potential role of testing, or quiz-taking, in patient education. Contrary to expectations, our data suggest that written handouts and computerized presentations impart *equal* gains in acne knowledge. Although the pilot data raised the possibility that audiovisual computerized interventions yield greater long-term retention of knowledge gained, this trend was not borne out in the revised study. Analysis of these results sheds light upon the limitations of our study and also generates questions for future research.

### *Baseline knowledge about acne vulgaris*

While dermatologists still receive nearly 80% of all visits for acne, the number of acne visits to non-dermatologists has increased by more than four-fold since 1980.<sup>2</sup> Previous studies evaluating acne knowledge among general practitioners suggest they may not be adequately equipped to meet the educational needs of this increasing acne patient population.<sup>17, 18</sup> It is noteworthy that our study interventions yielded significant improvement in knowledge scores in a cohort of patients of whom the majority had previously seen a doctor for acne. This gain in knowledge among patients with previous exposure to acne education underscores the need, on the part of clinicians in dermatology and general practice, for more consistent and effective means of educating patients.

The enthusiastic response of adolescents to our study is evidenced by the fact that of 82 patients asked to participate, only two refused: one citing lack of interest and the other lack of time. The resulting 97.6% enrollment rate may have been influenced by the fact that most patients were approached while waiting to be seen by their pediatrician or dermatologist, and had little aside from magazines with which to occupy their time. A second, related factor in the high enrollment rate may have been that patients were assured participation in the study was unlikely to add substantial time to their clinic visit. That these assurances were born out in the execution of the study—despite the time-consuming process of obtaining informed consent and filling out questionnaires—suggests similar educational interventions could be adopted in clinical practice without extending patient visit times. As mentioned previously, the majority of patients were able to complete the study while waiting to be seen by their physician.

Yet another factor influencing our high study enrollment rate may have been the desire on the part of patients to learn more about acne. This possibility is consistent with findings from previous studies indicating that patients are unsatisfied with the information about acne they currently receive from friends, family and the lay press.<sup>15, 16</sup>

### *Obtaining informed consent*

The demographics of our study sample were influenced, in part, by the need to obtain informed consent. Because the study involved minors, both the adolescent and his or her parent had to be willing to participate. This was problematic in terms of recruiting patients from Yale's primary care adolescent clinic. Although equally eager to participate, the majority of adolescents presenting to the primary care clinic did so in the absence of a parent or guardian (in fact, many came with younger siblings in tow). Unfortunately, the need to obtain informed consent and parental permission thus prevented many adolescents from joining our study. The patient population at the Yale Primary Care adolescent clinic consists largely of African-American and Latino adolescents, many of whom were excluded for the reasons outlined above.

There was a second, unmeasured way in which parental involvement influenced our study. It was noted during the execution of the study that the majority of parents watched the computerized presentation alongside their child. However, similar participation was not observed among parents whose children had received the written handout. Rather, parents of participants randomized to the handout group usually continued to read office magazines or engage in other, unrelated activities. Therefore, a potential, unmeasured

benefit of the computerized presentation may be the inclusion of parents in the educational intervention.

### *Desire for more information*

The desire for more information about acne vulgaris was evident among the majority of pilot and revised study participants, and in keeping with their low self-assessment of baseline acne knowledge. When asked to assess their pre-intervention knowledge about acne vulgaris, more than 75% of patients in the pilot study reported knowing “nothing” or “a little” about acne. Study participants were asked to indicate their sources for information about acne, and listed among them magazines and newspapers, family members, friends, and physicians. Pilot study participants were subsequently asked if they felt they had enough information from their listed sources; only a third of patients answered in the affirmative. The wording of this question was changed in the revised study questionnaire, as we felt the phrase “enough information” was unclear. Revised study participants were instead asked if they felt more information would be *helpful*.

Results of both questions—with two thirds of pilot study participants feeling that the information they were receiving was inadequate, and 75% of revised study participants asserting that more information about acne would be helpful—support the notion that patients are eager for information about acne.

The majority of pilot study participants reported knowing “nothing,” or “a little” about acne, despite the fact that these participants were enrolled immediately following their visit to a dermatologist. We did not request participants’ self-report of acne knowledge



*following* the study intervention, but it might have been interesting to record differences in perceived learning depending on whether patients had watched the computerized presentation or read the pamphlet.

#### *Change in knowledge about acne*

The main outcome measure in our study was *change in knowledge about acne* as determined by performance on the pre-intervention, post-intervention and one-month follow-up questionnaires. We had postulated that the audio-visual computerized intervention would lead to greater improvement in scores when compared to that of the written handout. However, results from the individual pilot and revised studies did not support our hypothesis. Although there was significant improvement *from baseline* in both groups and in both studies, there was no significant difference *between groups*.

Previous reports in the literature have spoken to the efficacy of audio-visual mediums via which to educate patients. One such report, a systematic review of randomized clinical trials conducted by Krishna et al<sup>36</sup> aimed to evaluate the utility of computerized patient education. Of 22 studies meeting the inclusion criteria, only one failed to show positive results for the interactive educational intervention. The authors conclude:

*The results of some of the studies, such as those involving diabetes, asthma, and arthritis, indicate that computers may be the preferred educational method for patients with chronic diseases that require a high degree of self-management and involvement. Computers help patients take better care of their conditions by providing access to the necessary information. Increased understanding of the clinical disease, a benefit that was frequently noted, may have contributed to patients' positive attitudes by eliciting in the patients feelings of greater control and increased confidence in their ability to effect positive changes in their health status.*<sup>36</sup>

Differences exist between our computerized intervention and those evaluated in Krishna et al's review. For example, the average duration of computer-assisted intervention in their study sample was 30 minutes, while our intervention took less than 7 minutes. Furthermore, some of the interventions in Krishna et al's sample were self-paced, whereas the pace of our intervention was pre-determined. Lastly, the term "interactive," when used to describe the various computerized interventions, is subject to variation. For example, our study and some of those described by Krishna et al. use the term "interactive" to describe interventions involving sound and slide presentations. Other studies in Krishna et al's sample describe more extensive patient interaction with the computer—such as those that featured self-paced learning, use of the keyboard or mouse, and others that incorporated patient quiz-taking.

A subsequent randomized, controlled clinical trial conducted by Krishna et al<sup>32</sup> concluded that supplementing conventional asthma care with interactive multimedia education led to improved asthma knowledge as well as decreased morbidity and use of emergency services among 228 pediatric asthma patients. Krishna et al's studies, among others, have found these educational methods to be particularly effective in patient populations suffering from chronic diseases such as diabetes mellitus and asthma.

A study by Sly<sup>38</sup> compared two methods of allergy patient education. Asthmatic children presenting to a clinic in New Orleans were randomized into one of two experimental groups: the first received a sound-slide show on the etiology and control of the particular allergy suffered by the children, while the second group received the same information via lecture. The effectiveness of the two interventions was judged equivalent. However,

an important distinction was perceived in that the slide show “[freed] the doctors for counseling on different aspects of the allergy program and more specific problems.”

#### *Limitations of the study*

Our study did not measure patient satisfaction with intervention/ perceived learning during office visit/ time spent with physician. This would be an interesting metric to capture in future studies, especially in light of Marshall et al’s study;<sup>31</sup> they found patients who had received information directly from their physician rated their learning as very high compared to those who had received identical information from another source— such as a written pamphlet, audio-tape, or sound-slide presentation—and yet these patients’ test scores suggested otherwise.

Our study of acne patients did not address whether the educational interventions impacted upon patient visit time, nor whether they eased the burden upon physicians. However, this possibility is supported by other reports in the literature. A randomized, controlled clinical trial conducted by Marshall et al<sup>31</sup> revealed that physicians spent less time with patients who had previously received audiovisual education materials (mean, 7.0 minutes) than with patients who had not received such information (9.5 minutes), despite the fact that physicians were blinded to patient grouping. Furthermore, a recent study by Schaffer and Tian<sup>39</sup> showed that providing patients with written and audio educational materials—*with no further intervention by the healthcare provider*—conferred a lasting, beneficial effect on asthma medication adherence.

Contrary to expectations, our data suggest the written handout was equally as effective as compared to the audio-visual presentation. This was not the case in the study by Marshall et al described above,<sup>31</sup> which found that patient knowledge gain was greater among patients receiving audio-visual education than among those receiving a pamphlet or a lecture. One explanation for the efficacy of our handouts may be that patients receiving the written handout could control the pace at which they received information. Furthermore, patients received the handout immediately upon completing a pre-intervention questionnaire—it is therefore possible that their reading of the material was more focused than would normally be the case. Familiarity with the testing material may also have led participants to exercise the option of re-reading relevant sections of the handout. The advantages of this re-reading may have been less significant at the one-month follow-up—thus factoring into the temporal differences in efficacy between the two interventional methods noted in the pilot study (as well as in the pooled data). In other words, at the one-month follow-up, the initial advantage conferred by re-reading of the handout was lost.

Yet another complicating factor in our comparison of the two interventional methods was the fact that the information presented in the computerized intervention was more detailed than that in the handout. This may have conferred an advantage to patients receiving the latter, as they were given information in a less cluttered, bullet-type form. For example, while the handout simply reports that acne forms in sebaceous follicles, the computerized presentation delves into a description of such follicles. It is possible these additional details distracted from the essential take-home messages of the power-point presentation. A better comparison could have been made were the two interventions, both

written and computerized, exactly the same in terms of content, with the only difference being the addition of visual and audio accompaniment.

The above discussion illuminates some of the limitations of our study. In formulating our hypothesis we postulated that written pamphlets were inferior to computerized presentations in that the former were likely to be left unread in daily practice. In contrast, we assumed that information conveyed via an audio-visual medium would more likely hold the attention of an adolescent audience. Yet this perceived shortcoming of the handout was effectively cancelled by the fact that participants in our study enrolled with the understanding that they would not only *read* the material, but also be *tested* on its content. Hence the process of obtaining informed consent may have influenced our study results.

On the other hand, a benefit inherent to written handouts is that they can be brought home and read at a patient's leisure. Audio-visual materials are less portable (although this distinction is fast losing its significance along with ever-expanding access to the internet and home computing). However, the design of our study required that participants relinquish their written handouts before receiving the post-intervention questionnaire. Therefore, one theoretical advantage of the written handout—its portability and the opportunity for patients to re-read it after discharge from the clinic— was negated by the false restrictions imposed by our study.

While we recognize the above limitations, we do not feel they cancel the important findings of our study. If applied to clinical practice, it is likely that an audio-visual aid

would serve to augment, rather than replace, written pamphlets. Our study did not contain a third arm in which participants received both a written handout and an audiovisual presentation, but we can only assume that the combination would be comparable to, if not more effective than, either intervention alone.

#### *The utility of patient test-taking*

The possibility that our study participants paid special attention to the materials because they knew they would be tested on the content can likewise be viewed either as a limitation of the study or as a springboard for further research. Other evaluations of audio-visual aids in patient education have successfully incorporated patient testing/feedback into their educational strategies.<sup>37, 40</sup> Testing may serve a dual purpose: that of increasing the attention paid to educational media, and that of alerting healthcare providers and/or patients about gaps in patient knowledge.

#### *Questions for future research*

Future studies could help to elucidate the effects of an interactive, multimedia presentation on patients' perceptions of their clinic visits. Our study did not evaluate this aspect of the educational interventions, but anecdotally it was noted during the coin toss that many patients expressed a desire to be randomized into the audio-visual group, despite the greater time commitment entailed. Future research could examine the impact of an audiovisual presentation upon patient satisfaction with the education offered, as well as the office visit in general.

Future studies could also evaluate whether enhanced patient education translates into improved compliance with acne medications. Previous research has suggested noncompliance to be the result of a patient not understanding the nature of acne, or the mechanism and natural time course of acne therapies.<sup>13, 26</sup> A recent study by So et al<sup>41</sup> evaluated the effects of enhanced patient education on compliance with treatment for hypertrophic burn scars. Their intervention, which involved a 5-page printed pamphlet and a 26-minute video tape, resulted in significant improvement in medication compliance and better scar outcomes as compared to patients receiving only a 1-page pamphlet and in-visit counseling. Aforementioned studies of children with diseases such as asthma and diabetes have also shown education to translate into behavior change. Future research could address whether this holds true in the case of adolescent acne patients.

The findings from our study raise intriguing questions about patient education in general and the education of adolescents in particular. The improvement in knowledge scores achieved by the majority of participants, including those who had previously seen a doctor for their acne, are consistent with previous research suggesting there is room for improvement in acne education. Future studies could provide further clarification regarding the specific combination of educational interventions which may be most effective and feasible in the setting of an outpatient clinic. In addition, future research could evaluate the effect increased knowledge about acne might have on an adolescent population in terms of self-confidence, compliance with skin-care regimen and, most notably, improved clinical outcomes.

Table I. Demographics/Baseline Values (**Pilot Data**)

| Variable   | PP (n=14)    | H (n=7)      | p-value |
|--|--------------|--------------|---------|
| Age (years)*   | 14.29 ± 1.27 | 13.71 ± 0.76 | 0.2885  |
| Ethnicity, n (%)                                       |              |              |         |
| White  | 13 (92.86)   | 3 (42.86)    | 0.0241‡ |
| Other  | 1 (7.14)     | 4 (57.14)    |         |
| Sex, n (%)   |              |              |         |
| Male   | 9 (64.29)    | 4 (57.14)    | 0.3443‡ |
| Female   | 5 (35.71)    | 3 (42.86)    |         |
| Doctor for Acne, n (%)                                 |              |              |         |
| Yes  | 11 (78.57)   | 6 (85.71)    | 0.4257‡ |
| No   | 3 (21.43)    | 1 (14.29)    |         |
| Current Acne Severity, n (%)                           |              |              |         |
| No acne  | 8 (57.14)    | 2 (28.57)    | 0.4066  |
| Mild   | 4 (28.57)    | 4 (57.14)    |         |
| Moderate/Severe  | 2 (14.29)    | 1 (14.29)    |         |
| How much does acne bother you?,<br>n (%)               |              |              |         |
| Never  | 2 (14.29)    | 0 (0.00)     | 0.6250  |
| Sometime   | 3 (14.29)    | 2 (28.57)    |         |
| Most of the time                                       | 8 (57.14)    | 5 (71.43)    |         |
| Almost all the time                                    | 1 (7.14)     | 0 (0.00)     |         |
| Information from current sources is<br>adequate, n (%) |              |              |         |
| Yes  | 5 (35.71)    | 2 (28.57)    | 0.3616‡ |
| No   | 9 (64.29)    | 5 (71.43)    |         |
| Knowledge of Acne, n (%)                               |              |              |         |
| Nothing/ A little                                      | 10 (71.43)   | 6 (85.71)    | 0.3443‡ |



|                      |               |               |        |
|----------------------|---------------|---------------|--------|
| Some/ A lot          | 4 (28.57)     | 1 (14.29)     |        |
| Knowledge Score (%)* | 50.95 ± 14.70 | 47.62 ± 15.60 | 0.6365 |

\*Values are mean ± SD; ‡obtained from Fisher's exact test

Table 2. Change in knowledge score after intervention (**Pilot Data**)

| Variable             | PP (n=14)      | H (n=7)        | p-value |
|----------------------|----------------|----------------|---------|
| Knowledge Score (%)* | 16.67 ± 12.19† | 25.71 ± 18.23† | 0.1899  |

† significant (p<0.01) improvement from baseline (paired ttest); \*Values are mean ± SD

Table 3. Change in knowledge score, one month follow-up (**Pilot Data**)

| Variable             | PP (n=11)      | H (n=6)       | p-value |
|----------------------|----------------|---------------|---------|
| Knowledge Score (%)* | 15.15 ± 16.35† | 13.33 ± 15.20 | 0.8256  |

† significant (p<0.05) improvement from baseline (paired ttest); \*Values are mean ± SD

Table 4. Demographics/Baseline Values (**Revised Study Data**)

| Variable                                 | PP (n=35)    | H (n=45)     | p-value |
|--|--------------|--------------|---------|
| Age (years)*                             | 14.71 ± 1.25 | 15.04 ± 1.28 | 0.2508  |
| Ethnicity, n (%)                         |              |              |         |
| White                                    | 25 (71.43)   | 35 (77.78)   | 0.5153  |
| Other                                    | 10 (28.57)   | 10 (22.22)   |         |
| Sex, n (%)                               |              |              |         |
| Male                                     | 14 (40.00)   | 17 (37.78)   | 0.8396  |
| Female                                   | 21 (60.00)   | 28 (62.22)   |         |
| Doctor for Acne, n (%)                   |              |              |         |
| Yes                                      | 20 (57.14)   | 24 (53.33)   | 0.7340  |
| No                                       | 15 (42.86)   | 21 (46.67)   |         |
| Current Acne Severity, n (%)             |              |              |         |
| No acne                                  | 9 (25.71)    | 10 (22.22)   | 0.5981  |
| Mild                                     | 20 (57.14)   | 23 (51.11)   |         |
| Moderate/Severe                          | 6 (17.14)    | 12 (26.67)   |         |
| How much does acne bother you?,<br>n (%) |              |              |         |
| Never                                    | 9 (25.71)    | 11 (24.44)   | 0.9736  |
| Sometime                                 | 15 (42.86)   | 19 (42.22)   |         |
| Most of the time                         | 8 (22.86)    | 12 (26.67)   |         |
| Almost all the time                      | 3 (8.57)     | 3 (6.67)     |         |
| More info helpful, n (%)                 |              |              |         |
| Yes                                      | 28 (80.00)   | 32 (71.11)   | 0.3624  |
| No                                       | 7 (20.00)    | 13 (28.89)   |         |
| Knowledge of Acne, n (%)                 |              |              |         |
| Nothing/ A little                        | 23 (65.71)   | 22 (48.89)   | 0.1323  |

|                      |               |               |        |
|----------------------|---------------|---------------|--------|
| Some/ A lot          | 12 (34.29)    | 23 (51.11)    |        |
| Knowledge Score (%)* | 55.08 ± 17.79 | 53.33 ± 14.53 | 0.6303 |

\*Values are mean ± SD

Table 5. Change in knowledge score after intervention (**Revised Study Data**)

| Variable             | PP (n=35)      | H (n=45)       | p-value |
|----------------------|----------------|----------------|---------|
| Knowledge Score (%)* | 22.06 ± 18.05† | 26.91 ± 15.93† | 0.2064  |

† significant (p<0.0001) improvement from baseline (paired ttest); \*Values are mean ± SD

Table 6. Change in knowledge score, one month follow-up (**Revised Study Data**)

| Variable             | PP (n=35)      | H (n=45)       | p-value |
|----------------------|----------------|----------------|---------|
| Knowledge Score (%)* | 17.14 ± 16.74† | 12.84 ± 19.27† | 0.2977  |

† significant (p<0.0001) improvement from baseline (paired ttest); \*Values are mean ± SD

Table 7. Change in knowledge score after intervention (**Pooled Data**)

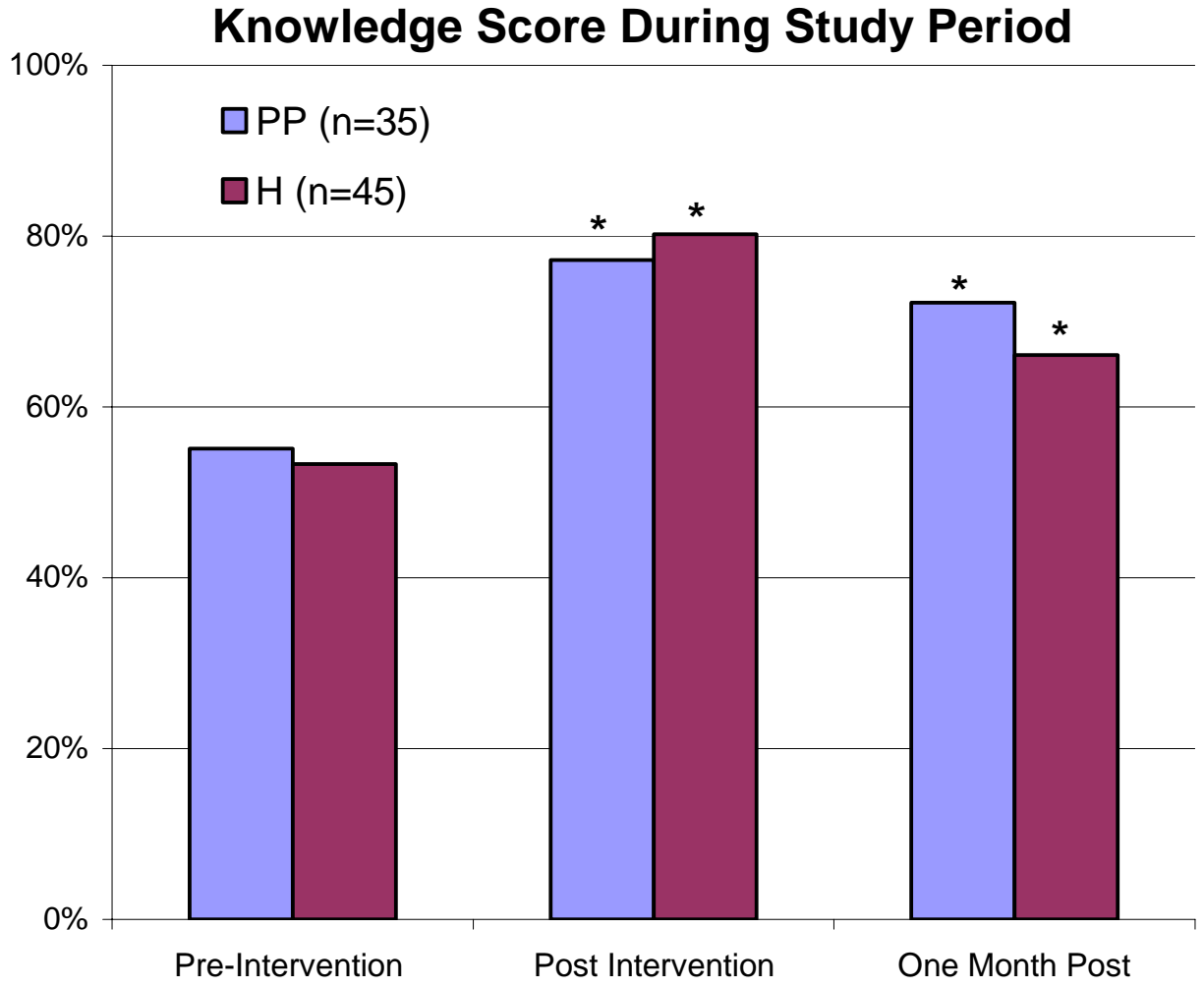
| Variable             | PP (n=49)      | H (n=52)       | p-value |
|----------------------|----------------|----------------|---------|
| Knowledge Score (%)* | 21.90 ± 17.59† | 29.23 ± 17.77† | 0.0400  |

† significant (p<0.0001) improvement from baseline (paired ttest); \*Values are mean ± SD

Table 8. Change in knowledge score, one month follow-up (**Pooled Data**)

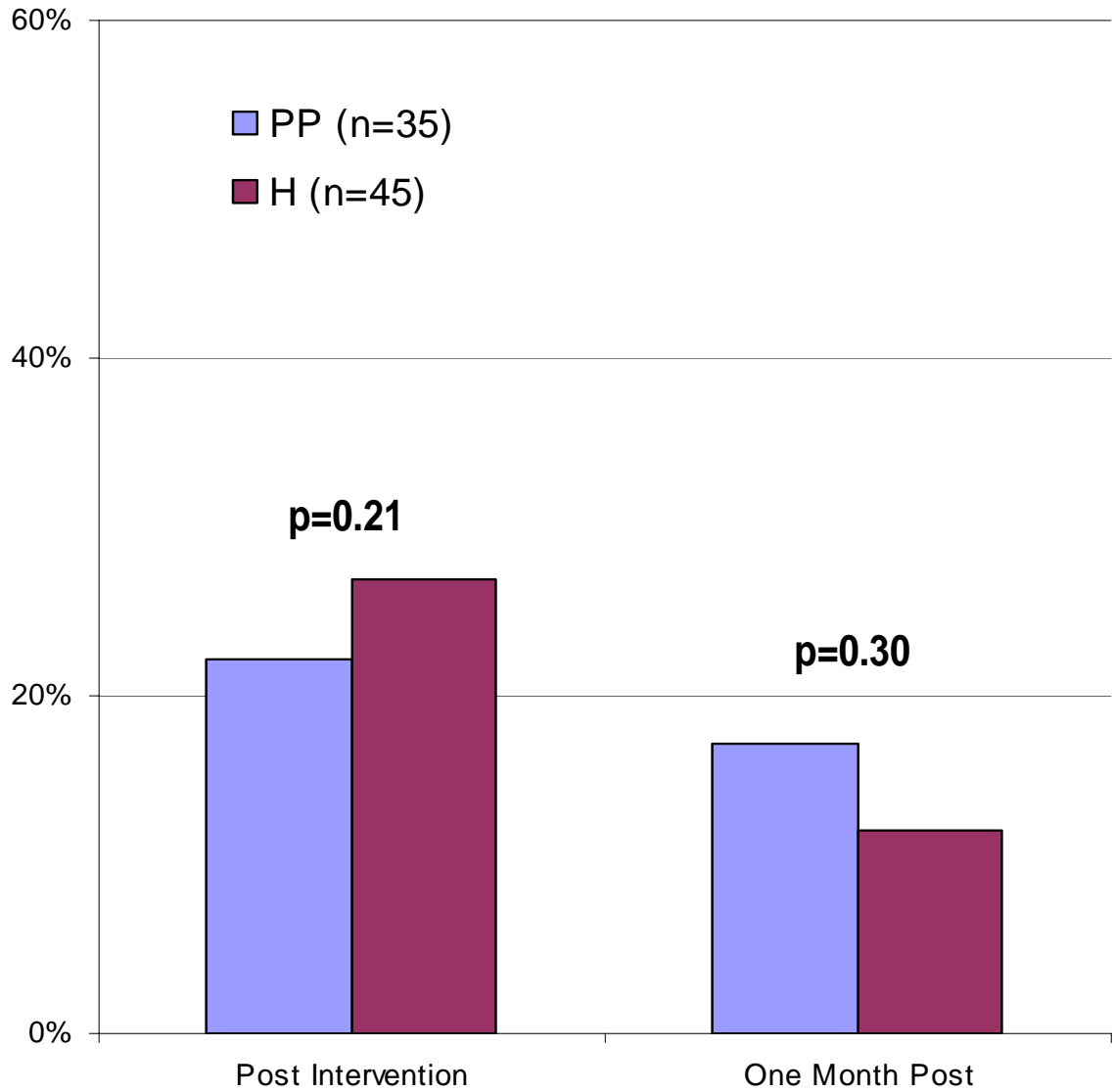
| Variable             | PP (n=46)      | H (n=50)      | p-value |
|----------------------|----------------|---------------|---------|
| Knowledge Score (%)* | 18.12 ± 17.14† | 14.93 ± 16.74 | 0.3599  |

† significant (p<0.0001) improvement from baseline (paired ttest); \*Values are mean ± SD

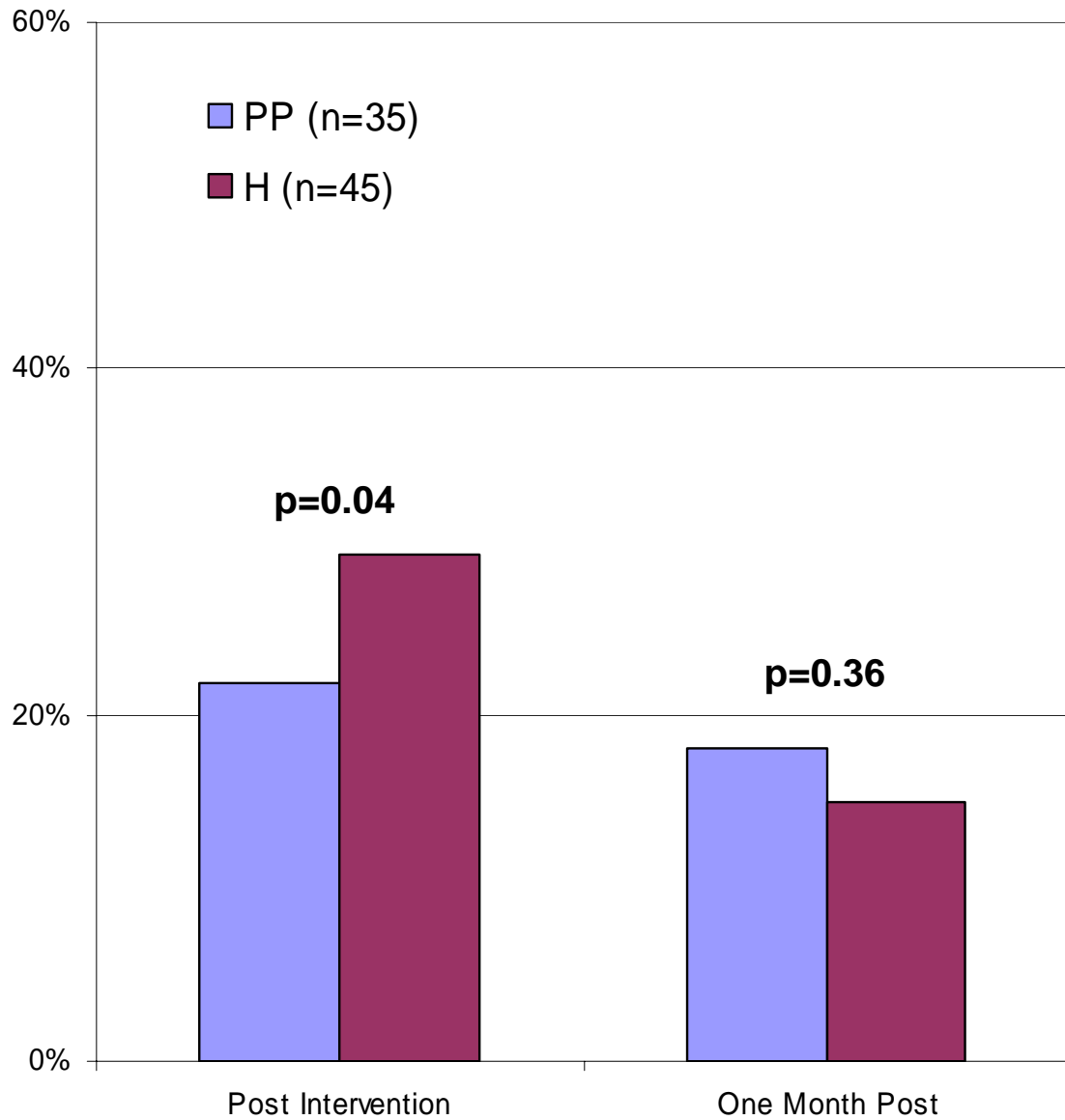


*\*p<0.001 in paired t-test comparing to pre-intervention baseline*

## Knowledge Score Change From Baseline



## Knowledge Score Change: Pooled Data



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