To Teach Is to Learn Twice

Resident Teachers Learn More

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Objectives: To describe the formal teaching activities of pediatric residents and to assess how the act of formal teaching affects residents' acquisition and retention of knowledge.

Design and Methods: Randomized controlled trial. Forty-three pediatric residents in a university-based program were surveyed about their teaching activities, given a pretest on a predetermined topic (oral rehydration), then randomly assigned to either teach (n=18) or listen to (n=25) a 30-minute lecture on that topic; 6 to 8 weeks later they completed a posttest. The difference between pretest and posttest scores was calculated for each resident as an index of knowledge acquisition.

Results: The mean number of resident teaching events per year was 3.5 for interns (n=16), 2.9 for junior residents (n=11), and 6.9 for senior residents (n=16). Self-reported comfort with the teaching role, ability to hold a group's attention, and desire to teach were similar across year of training. Prior to randomization, teachers (experimental group) reported less interest in oral rehydration than did listeners (control group) (P<.03). However, knowledge acquisition was significantly greater for teachers than for listeners (posttest score minus pretest score [mean±SD], 6.1±4.2 vs 3.2±2.5; P<.01).

Implications: Among pediatric residents, formal teaching enhances knowledge acquisition relative to self-study and lecture attendance.

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Editor's Note: I never cease to be amazed that residents, not to mention “faculty,” consider themselves to be teachers by self-proclamation despite no formal training. This study shows that the preparation needed to present a formal lecture is an effective means of study, not an effective way to learn how to teach. Or, as one reviewer commented, when it comes to resident lectures, it's better to give than to receive. The authors or other investigators need to do the next study, ie, first teach the residents how to teach and then repeat what was done in this study.

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J ohn Dewey championed “learning by doing” a century ago. This principle was echoed in the 1920s when the study of adult learning began. In the 1970s, Knowles coined the term andragogy for “the art and science of helping adults learn.” A major principle of andragogy is that adults must be actively engaged in their own learning. A common form of active engagement is teaching itself.

Pediatric residents participate in informal teaching on a daily basis, at the bedside and in the clinic. In recent years, the contribution of this activity toward residents' own education has begun to be examined. On a less frequent basis, residents also actively participate in formal teaching, preparing and delivering lectures to their colleagues. Andragological principles suggest that formal as well as informal teaching would be of significant educational benefit, but to date, no studies have examined critically this proposition. If giving lectures were to prove a particularly effective method of learning, residency programs might seek to expand residents' opportunities to teach.

The purposes of this study were (1) to characterize the frequency of formal teaching by pediatric residents and describe their attitudes toward this activity, and (2) to assess how the act of formal teaching impacts the residents' own learning. To this end, we conducted a randomized controlled trial of an educational intervention in which residents were assigned to present a lecture on a preselected medical topic. The topic of oral rehydration therapy was chosen, because we thought that residents were likely to be interested but not already expert in it, and because the topic had been used in a previous study of resident learning. Based on the principles of andragogy, we hypothesized that the act of formal teaching would enhance knowledge acquisition and retention by residents.
PARTICIPANTS AND METHODS

Eligible subjects included all residents in a large, university-based academic pediatric residency program.

The study was conducted between February and April 1996. At baseline (time 0), residents completed a survey describing their teaching activities during the past 8 months. "Teaching" in this context was defined as presenting information on a specific topic for 10 or more minutes to more than 1 person. Residents reported the number of times they taught and their attitudes toward teaching (eg, their levels of comfort and enjoyment), rated on a scale of 0 to 5, with higher numbers representing a greater degree of the stated quality. To put this activity in context, residents were asked to estimate how many hours a week, on average, they spent at home studying pediatrics. Residents also reported their degree of interest in the preselected topic of the teaching intervention (ie, oral rehydration therapy), using a scale of 0 to 5. They then completed a 37-question pretest to measure baseline knowledge about the topic.

After the pretest, residents were given 2 review articles on oral rehydration therapy, containing a total of 23 pages. The test questions related to information in the articles. Residents were then randomly assigned to 1 of 2 groups: "teachers" (the experimental group) were instructed to prepare and present a 30-minute talk on oral rehydration therapy; "listeners" (the control group) were asked to read the articles and attend the talks given by the teachers. Randomization was designed to generate approximately 1.5 times as many listeners as teachers. Two weeks after randomization (time 1), the teachers gave their talks, as part of a series of daily preclinical conferences. Six to 8 weeks later (time 2), all study participants were retested, using the same questions as in the pretest.

The intervention (teacher) and control (listener) groups were compared on baseline measures of interest and knowledge, to ascertain inequalities in group assignment. The amount of new knowledge acquired and retained was estimated by subtracting the pretest score from the posttest score for each subject, and calculating the group means. The data were analyzed using SAS computer software (SAS Institute, Cary, NC). $\chi^2$ and $t$ tests were used for discrete and continuous variables, respectively. Results are presented as mean (±SD).

RESULTS

Of the 62 residents in the program, 55 (89%) completed the baseline survey and knowledge test. Forty-three residents (78% of those enrolled) completed the protocol. The respondents included 16 interns, 11 junior residents, and 16 senior residents. Reasons for nonenrollment and noncompletion included vacation and assignment to night shifts or particularly demanding rotations (eg, the intensive care unit). Residents who completed the protocol did not differ significantly from those who did not in the following measures: self-reported comfort in the teaching role, ability to communicate, enjoyment of teaching, or ability to hold an audience’s interest.

In the baseline survey, the average frequency of teaching events per 12 months was 3.5 for interns, 2.9 for junior residents, and 6.9 for senior residents. Most residents reported teaching between 1 and 3 times per year. Residents reported a range of attitudes toward teaching and self-assessed teaching competence. There were no statistically significant associations between year of training and any of these factors. However, there was a trend for residents who taught more frequently to report greater comfort teaching (Pearson $r^2 = 0.05, P = .07$). Average study hours per week for residents at each level of training are shown in the Figure. The majority of residents estimated that they spent fewer than 5 hours per week studying at home. Typically, residents were on call every fourth night.

After randomization, there were no significant differences between the teacher and listener groups in year of training, attitudes, or pretest scores (Table). However, the listener group reported a significantly higher baseline interest in oral rehydration therapy (mean interest score 2.6±1.6 vs 1.3±1.2; $P < .02$). Consistent with our hypothesis, knowledge acquisition (posttest score minus pretest score) was significantly greater in the teacher group (6.1±4.2 vs 3.2±2.5; $P < .01$).
On average, residents in the teacher group spent 2.9±1.0 hours preparing for their talks. Nearly all of the teachers (17 of 18) reported having completely read the 2 standard articles, compared with only 3 of the listeners. Among these 3, however, the average posttest-minus-pretest score was 3.7, closer to the listener group as a whole (mean, 3.2) than to the teacher group (mean, 6.1); the sample size was too small for statistical comparison.

In this prospective randomized trial, residents assigned to present brief lectures on oral rehydration therapy retained nearly 2 times more new information about the topic than did residents assigned to read the same material and listen to the same talks. This finding could not be accounted for by a difference in level of interest. Residents assigned to the listener (control) group reported significantly greater baseline interest in oral rehydration therapy, a difference which if anything should have driven the results counter to our hypothesis. Nor can a difference in baseline knowledge explain the finding that a greater degree of improvement might be expected among residents who initially scored lower. However, there was a nonsignificant trend for residents assigned to the teacher group to score higher at baseline, again working counter to our hypothesis.

Why did teachers learn more? Being a teacher appeared to increase the residents’ motivation to read. Far more of the teachers reported that they read all of the assigned articles. They also spent a considerable amount of time, relative to their typical study time, working on their talks. However, the 3 residents in the listener group who read all of the supplied material scored no better than the other listeners, suggesting that the quantity of reading alone may not be a sufficient explanation. Residents faced with the prospect of standing up in front of their peers may well have read the material more thoroughly. Also, they interacted with the material actively, not only reading and listening to it, but writing and speaking it as well. Thus, formal teaching stimulates “active learning” in the andragogical sense. Future studies are needed to evaluate these possible explanations.

Our study bears a superficial similarity to a recent study by First et al, who studied the value of informal, bedside teaching. In their study, pediatric residents who taught parents about oral rehydration subsequently tested better than did residents who merely attended a lecture on the subject. Our choice of the same medical topic increases the comparability between the studies. Taking the 2 studies together, it appears that active engagement in teaching by residents benefits their learning, whether the teaching is informal (ie, bedside) or formal (ie, lecture), at least with respect to the topic of oral rehydration therapy.

Although further comparison between these studies is obviously problematic, one cannot help but note one intriguing point. The control subjects in our study, who listened to a lecture given by one of their peers, gained an average of 3.2 points in the posttest-minus-pretest analysis. By contrast, the control subjects in the first study, who listened to a lecture by a member of the faculty, actually lost an average of 0.34 points. From the standpoint of the residents being lectured to, the relative value of resident vs faculty teaching invites further investigation.

Our study is limited in that it examined a relatively small number of residents from a single program, teaching a single topic. Our measure of knowledge acquisition—posttest minus pretest scores—may not accurately reflect true learning, ie, the ability to apply knowledge in the real world. However, although not meaningful in any absolute sense, the posttest-minus-pretest score difference is useful for between-group comparisons.

Lectures continue to hold a prominent place in resident education, despite the current trend toward more small-group, “active,” and individual instruction. Our data suggest that one important benefit of lectures is in enhancing the learning of the lecturers. Residents in our institution currently have relatively few opportunities to present formal lectures during their training, although many report that they enjoy teaching. Future studies to investigate the effect of active participation in formal teaching on residents’ level of comfort and skill as teachers, and to assess the effectiveness of residents as lecturers could help establish the role of formal teaching by residents in resident education.

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REFERENCES


Educational Interventions

Purpose: This section is intended to share information concerning educational efforts in the broad field of pediatrics. We welcome studies on the following topics: undergraduate and graduate education in medicine and allied health occupations; continuing education of health professionals; education of patients and families; and health education for the general public, the community, and organizations that contribute to the promotion and improvement of the health of children and adolescents.