ABSTRACT

Title of Thesis: THE EDUCATIONAL EFFECTS FOR PEDIATRIC RESIDENTS OF A COMPUTER-BASED TRAINING ABOUT THE PART C EARLY INTERVENTION PROGRAM

Regina Anne Pettko, Master of Arts, 2011

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This study examined knowledge gains about early intervention programs using a computer-based training with pediatric residents. Fourteen pediatric residents at the University of Maryland School of Medicine were pre-tested, provided with training, and post-tested. Given in a computer lab, the training was part of the residency education program. Results showed a statistically significant increase in test scores post-intervention. The training was more effective in teaching about early intervention law, philosophy, and recommendations for physician screenings than it was in teaching best practices for making referrals to the early intervention program. Findings were consistent with past studies on computer trainings in other medical topics. Limitations included small sample size and lack of a control group or follow-up assessment to measure maintenance and generalization of knowledge gained. Further investigation should look into the kinds of learning for which a computer is suitable versus the kinds that require more personal teacher-student relationships.

THE EDUCATIONAL EFFECTS FOR PEDIATRIC RESIDENTS OF A COMPUTER-BASED TRAINING ABOUT THE PART C EARLY INTERVENTION PROGRAM

By

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DEDICATION

The years of work and prayer that went into this thesis are

dedicated to my godchildren, nieces and nephews.

I would not be the woman I am without them.

Together with the family, teachers and educators have a particular contribution to make.

Much will depend on them if young people, trained in true freedom, are to be able to

preserve for themselves and make known to others new, authentic ideals of life,

and if they are to grow in respect for and service to every other person,

in the family and society.

Blessed Pope John Paul II, *Evangelium Vitae*, no.97

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I am deeply grateful to my parents, family, and friends who have provided their love and encouragement all along. I am most grateful for the many people who kept me in their prayers. In a special way I thank all my friends who are priests or in religious life. The completion of this thesis is a witness to the power of their prayers.

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Introduction

Families seeking help for a young child with a developmental disability must navigate through an intricate and overwhelming new system. Before they are school-aged, infants and toddlers with a developmental delay or disability might still be able to receive educational or therapeutic services through a program called early intervention, but it is sometimes not easy for families to find out that this program is available. Research has shown that the earlier children receive help the better their outcome is likely to be than had services only started once the child began school (Bennett & Guralnick, 1991; Berlin, Brooks-Gunn, McCarton, & McCormick, 1998; Guralnick, 1997). If a child qualifies for early intervention, services are delivered very differently than traditional school-based services (which begin after a child turns three). Children receive services in their natural environment, and family-centered philosophies continue to influence the current approaches to early intervention (EI).

The 1990 amendments to the Individuals With Disabilities Education Act (IDEA) permitted states to provide an EI program to serve infants and toddlers with developmental delays and disabilities (Committee in Children With Disabilities, 2001a). All 50 states chose to provide these services. Under Part C of IDEA, acceptable service providers include physicians. Federal legislation allows each state some flexibility in developing its own EI program. Given the variety resulting from state-determined criteria and service fees, inconsistencies exist among the EI programs from state to state (Council on Children With Disabilities, 2005). School-based services (for school-aged children) are advantageously based out of a known central location, the local public school. Most families are familiar with this system. In contrast, EI programs are newer and less familiar, and they lack uniformity across jurisdictions.

Given the dynamic, ever-changing nature of EI (e.g., criteria for receiving services, funding and charging for services), families benefit from guidance through this often unfamiliar system (Council on Children With Disabilities, 2005). Frequently, families turn to their pediatrician for this guidance. Recent expectations set forth by the American Academy of Pediatrics (AAP) reinforce the idea that this seems the most appropriate starting point for families. The pediatrician's unique role in the family's life should incorporate developmental screenings, referrals for evaluations, and assistance in finding therapies and treatments.

In a policy statement, the American Academy of Pediatrics (AAP) recommended all pediatricians administer developmental screenings at ages 9-, 18-, and 30-months (Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee and Medical Home Initiatives for Children With Special Needs Project Advisory Committee, 2006). This increased emphasis on multiple, early screenings came out of the finding that developmental disorders are being detected at a rate lower than their current prevalence. Moreover, pediatricians who do screen have not necessarily been implementing best practices during their screenings.

The three specific age recommendations for screenings follow two previous AAP statements recommending that pediatricians provide early screenings and guidance towards early intervention (Committee in Children With Disabilities, 2001a; Committee in Children With Disabilities, 2001b). A 2007 AAP clinical report addressing pediatric care for children with autism spectrum disorders (ASDs) reaffirms the pediatrician's role in early detection, support for the family, and guidance towards valid treatments (Myers, Johnson, & Council on Children With Disabilities, 2007). In addition to routine screenings at 9-, 18-, and 30- (or 24) months, AAP recommends that pediatricians specifically screen for autism at the 18- and 24-month visits (Johnson et al., 2007). These recommendations are the most current and significant reports to date that address the pediatrician's role in early intervention.

Statement of Problem

As families begin their search for help for their child, seeking advice from a pediatrician is a sensible first step (Committee on Children With Disabilities, 2001a). Local EI programs may be able to provide services for these children from birth to 3. Unfortunately, pediatricians are not always knowledgeable about how their local program operates. Pediatricians may not be aware of how to screen for developmental delays or how to refer to the local EI program. A survey among AAP members found that only 23% of pediatricians reported using a standardized screening tool (Sand, Albers, & Rappaport, 2005).

Knowledge about early intervention programs is clearly important for pediatricians, and they need to learn about this program before beginning to practice medicine. A survey among pediatric residents reported that residents felt insufficiently educated in recognizing and referring patients for early intervention services (Sand et al., 2002). Training in proper screening practice is needed throughout medical and residency education. Insufficient physician guidance could end up causing the delay of proper diagnosis and necessary services (Committee on Children With Disabilities, 2001).

Limited instruction time along with a growing body of knowledge to learn presents a dilemma to the issue of residency education (Roche, Ciccarelli, Gupta, Hayes, & Molleston, 2007). The ever-increasing curriculum demands place a strain on the set number of hours for instruction. In response to these growing curriculum requirements, many graduate medical schools have increased computer and web-based teaching methods (Johnson et al., 2004).

To date, there is no available published research regarding a web-based pediatric resident training on EI. However, several studies have examined the use of computer-based modules to teacher other topics to medical and resident students (Cook et al., 2007; Isler, Basbakkal, Serdaroglu, Tosun, Polat, Gokben, et al., 2008; Johnson et al., 2004; Roche et al., 2007; Sisson, Rice, & Hughes, 2007). In a 2008 survey, medical students and interns indicated high satisfaction with an online module on treating burn victims (Cochran, Edelman, Morris, & Saffle, 2008). Moreover, respondents expressed interest in using similar online trainings for future instruction.

Given pediatricians' need for understanding EI and the potential for incorporating computerized instruction into residency education, in this study, I examined the effectiveness of an online training module about EI. This EI training was integrated within the pediatric residents' education program at the University of Maryland School of Medicine (UMSM). The training focuses on educating pediatricians about EI and their cooperating role. I administered a pre-test and post-test to assess knowledge gain as well as a survey evaluating student satisfaction with the online training.

Definition of Terms

For the purposes of this study, "early intervention" or "EI" refers to public services provided through Part C of IDEA for a child age 3 or younger. EI services can begin at birth or at any point before the child reaches his or her third birthday. These are services designed to meet physical, cognitive, communicative, social and emotional, or adaptive developmental needs. If a delay persists, services may continue until age 3, but if the delay resolves then services do not continue. According to federal law, these services may include family home visits, special instruction, speech therapy, occupational therapy, physical therapy, service coordination, psychological services, social work services, vision services, and early identification, screening, and assessment services. IDEA also lists the qualified professionals who can provide early intervention services. Pediatricians and other physicians are listed among possible providers. Their services to families include making referrals to EI, ordering other necessary medical assessments, and coordinating with the EI program (Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee and Medical Home Initiatives for Children With Special Needs Project Advisory Committee, 2006). Services are to be delivered in the child's natural environment which includes the home and/or childcare settings.

"Developmental delay" and "developmental disability" are used interchangeably throughout this thesis. These terms are applied when a child exhibits a delay in one or more areas of development and/or when a child is diagnosed with a condition that has a high probability of resulting in a developmental delay. It should be noted that each state's early intervention program makes their own definition for what they consider to be a developmental delay.

"Surveillance" and "screening" can be distinguished from one another. "Surveillance" refers to the ongoing process throughout all pediatric visits to identify children who are at-risk. This should involve physicians asking parents if there are concerns regarding their children's development (Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee and Medical Home Initiatives for Children With Special Needs Project Advisory Committee, 2006). Alternatively, "screening" requires a specific, standardized tool for designated ages that helps doctors identify children who should be referred for a formal and more in-depth evaluation by a specialist (e.g., developmental pediatrician, neurologist, physical therapist, speech therapist). Only after a complete evaluation will a specialist then be able to diagnose a developmental delay.

Research Questions

In this study I explore the feasibility and educational impact of a computer training module for teaching pediatric residents about EI. Specifically:

1. Will residents' overall knowledge about early intervention increase from pre-test to post-test?
2. After the training, will residents' knowledge differ among topic areas covered in the training (i.e., test questions specific to the EI program as outlined in IDEA, test questions specific to the physician's role in EI as stated by the AAP and IDEA)?

3. Looking at certain factors (i.e., the number of residents who attend the training, the average time it takes to complete it, the residents’ satisfaction with the training, any technical difficulties that arise), can a computer-based training for EI be successfully implemented within a residency program?

Literature Review

Part C of IDEA and recent AAP statements reaffirm the expectation that pediatric care includes attention to developmental growth (Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee and Medical Home Initiatives for Children With Special Needs Project Advisory Committee, 2006; Johnson, Myers, & the Council on Children With Disabilities, 2007). This understanding should be reflected in residency education where physicians can be encouraged to use best practices from the very beginning. Already dense with instructional material, medical education programs require a time-efficient intervention that is easy and flexible to administer. Other medical fields have started exploring internet and software-based computer interventions.

First, in this literature review I discuss the federal legislation for EI, the role of the pediatrician according to AAP, and the education requirements for residents regarding EI and their cooperating role. Second, I review research on computer teaching modules from other medical fields.

History of Early Intervention Legislation

Current special education law legislates early identification and intervention services for children who are age 3 and under. Yet, services for newborns, infants, and toddlers were not always part of state programs. Since 1986 and the Education for All Handicapped Children Act, special education legislation has increasingly sought to provide services to younger children with disabilities who are not school-age. The Education of the Handicapped Amendments of 1986 began federal support of early intervention (EI) for children age birth to 3. In 1990, the law's name changed to the

Individuals with Disabilities Education Act (or IDEA). IDEA continued to support state-run EI programs as laid out in Part H of this law.

Although states are not required to provide services to children younger than three, all 50 states have chosen to provide these services. In describing the services, the law clarifies that they are to be community-based, family-centered, and culturally sensitive. Moreover, services can be provided both to children with delayed or atypical development as well as children with a diagnosed condition highly correlated with developmental delays.

In the 1997 amendments of IDEA, Part H became Part C of the law, and in 2004, Part C of IDEA added a new requirement: children can be referred for EI in cases of neglect or abuse, family violence, substance abuse, and homelessness. States were also given the option of extending EI services until kindergarten age if the family so chooses.

The Role of the Pediatrician

After being born and going home with their family, children make numerous trips to the pediatrician before even turning two. The frequency of these early doctor visits is to ensure that the child's overall health and development continue normally and to detect and treat any atypical developments or illnesses as soon as possible. Developmental surveillance should be incorporated into *all* pediatric visits and a proper screening administered if ever a concern is identified.

Since 1930, the American Academy of Pediatrics (AAP) has worked to improve the health and well-being of children and adolescents (www.aap.org). To help support the professional needs of pediatricians and pediatric specialists, the AAP provides continuing medical education (CME) and publishes pediatric research in their journal, *Pediatrics* (American Academy of Pediatrics [AAP], 2004). Several recent AAP statements reinforced the pediatrician's professional and ethical obligation to identify and refer children with developmental disabilities to EI services.

In a 2005 policy statement, the AAP defined care coordination as "a process that facilitates the linkage of children and their families with appropriate services and resources" (Council on Children With Disabilities, 2005, p. 1238). This statement stresses that providing optimal care must include awareness of and facilitate access to subspecialty services as needed.

A 2001 statement required that regular health care incorporate ongoing developmental screenings (Committee in Children With Disabilities, 2001b). In 2006, the AAP readdressed pediatric developmental surveillance (Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee and Medical Home Initiatives for Children With Special Needs Project Advisory Committee, 2006). In this statement, AAP recommended routine developmental screenings to be given at every 9-, 18-, and 30-month appointment. One exception is given for the 30-month screening. The 30-month visit may not be covered by health insurance; moreover, pediatric visits significantly decrease after the 24-month visit. Therefore, doctors may perform the last screening at the 24-month visit if either of these are a concern. This ensures that the 18-month screening is not the last one before the child's visits become less frequent.

In this policy statement, AAP outlines nine specific recommendations for the pediatrician's role: (1) on-going developmental surveillance which includes attending to any concerns a parent may have, (2) following up on any surveillance concerns with a standardized screening tool as well as still administering regular screenings at 9-, 18-, and 30-months regardless of concern, (3) scheduling earlier return visits for a child who shows concerns but these concerns are not confirmed after screening, (4) when a developmental concern is noted, referring that child to EI, (5) when concerns are confirmed from a screening, coordinating the proper follow-up evaluations, (6) when a child is diagnosed with a developmental disorder, initiating a chronic-condition management program for that child, (7) keeping a thorough record of all surveillance, screening, referrals, and evaluations in the child's medical chart, (8) developing communication and a working relationship with both state and local resources, and (9) monitoring and evaluating the effectiveness of how these practices are being implemented. The statement also included a chart summarizing 20 screening tool options and reaffirmed the pediatrician's professional responsibility to identify developmental disorders early.

A year later, AAP established guidelines for pediatric practice regarding children with autism spectrum disorders (ASDs). This 2007 statement advised pediatricians to screen all patients for ASD at 18 and 24 months of age (Johnson et al., 2007). A second report educated physicians about empirically validated ASD interventions to share with families and emphasized the doctor's responsibility in helping families understand this diagnosis as well as specific treatments. Pediatricians can provide anticipatory guidance and emotional support while helping families find resources and advocating for their child's needs (Myers, Johnson, & the Council on Children With Disabilities, 2007).

Pediatric Education

Pediatric education is immensely time-consuming, and physicians have substantial education requirements. They devote years of study to learning their role as health care providers. After completing their formal education, pediatricians must continue to educate themselves on new, innovative approaches to providing patient care. In this section I explore residency education in general as well as specific to EI and relevant theory in assessing medical knowledge.

After completing four years of medical school, pediatric education requires three additional years of intense study and residency training. The Accreditation Council for Graduate Medical Education (ACGME), founded in 1972, provides accreditation for U.S. medical residency programs (www.acgme.org). The ACGME is responsible for establishing program requirements for pediatric residencies (Fulton, n.d.). In 2003, the ACGME updated their Program Requirements for Residency Education in Pediatrics. When outlining specialty training requirements in developmental/behavioral pediatrics, the ACGME required residents to be knowledgeable of typical and atypical behavior combined with an understanding of development from infancy through adulthood. Additionally, programs are required to train residents to "differentiate behavior that can and should be managed by the general pediatrician from behavior that warrants referral to other specialists" (Accreditation Council for Graduate Medical Education [ACGME], n.d., p. 27).

Miller's Triangle. One current way of understanding the assessment of medical students' clinical skills has been illustrated by Miller using a triangle-shaped hierarchy (1990). According to Miller, clinical skills assessment can be thought of occurring within four major categories. He presents these levels as a triangular hierarchy with the lowest level being the most basic skill level and the top point being the most advanced. Appendix A displays these levels in Miller's triangle.

At the base level, a learner first "knows" what is needed to accomplish certain task competently, and then the learner must "know how" to apply and use what he or she has learned. A written exam can suffice to show a student has reached these levels. At the third level, a student "shows how" he or she is able to use this information in a given simulated situation. The student finally reaches full competence at the "does" level. This top level is the ideal level of achievement, but this level cannot be attained without the grounding basis of its underlying levels. The transition up from "knows" and "knows how" to the skill of doing ("Does" level) requires time and learning to incorporate what one knows into everyday situations that will never exactly duplicate case scenarios of written exams. The physician must be able to reflect on his or her daily experience as a learning experience itself.

Summary. Residency requirements, as stipulated by the ACGME, require physician knowledge of child development, both typical and atypical. Additionally, pediatrician responsibilities, as reported by the AAP, include early identification and referrals for children with developmental disorders. Formal medical education includes physician knowledge of development, but this knowledge must then be incorporated into the resident's medical practice. This knowledge of development must include both the early identification of developmental disabilities and the corresponding guidance towards early intervention services. AAP's recent screening recommendations raise expectations concerning pediatric developmental monitoring. Research must begin exploring ways to help physicians meet this new level of expectation.

Computer-based Interventions in Medical Education

Search for studies. At present, there is no published research investigating computer-based training for physicians about early intervention for children with developmental disabilities. However, other medical communities have developed then investigated similar computer-based educational interventions. This research is useful to explore the possibilities of a web-based course on early intervention and its potential for improving pediatric residents' knowledge. In the following section I review research about computer-based instruction for the medical community. I compiled research through online searches using the University of Maryland Research Port. I used the databases Medline (CSA), Medline (EBSCO), Biological and Medical Sciences, Health Source: Nursing, MedlinePlus, National Center for Health Stats, and Science Citation Index (Web of Science). Search terms included "resident education," "online," and "computer." Additionally, I used the references from the studies I found. I included studies that had an intervention for medical professionals, and I looked exclusively at computer-based interventions with no other instructional elements. I only included studies published in peer-reviewed journals that used a post-intervention assessment of knowledge gain. I excluded one study because the computer-based intervention, a CD-ROM, was presented as a lecture (Levi, 2007). I identified six published studies that examined either a web-based or software-based intervention.

Web-based interventions. Of the studies that met my search criteria, four focused on a training delivered through the internet, and two studies used a software-administered training. The four trainings administered through the internet examined a variety of medical topics: ambulatory pediatrics, complementary and alternative medicine, cholesterol education, and care for burn victims.

In the first study, Johnson et al. (2004) investigated the impact of their web-based instruction on ambulatory pediatrics principles. Researchers at Columbus Children's Hospital in Ohio designed the curriculum to measure progress towards knowledge competency requirements of the ACGME. To overcome the division's obstacles of getting busy residents together at one time for instruction while still keeping information up-to-date and accessible, the course was distributed through the learning management system (LMS), Web Course Tools (WebCT).

Six faculty members developed the four separate training modules covering asthma, otitis media, gastroenteritis, and fever. They collaborated with an educational technology specialist. Beyond this, however, Johnson et al. (2004) did not specify whether they incorporated any learning theories or whether they researched computer module designs. Each module contained a pre-test of four to seven questions, a post-test of 8-14 questions, and an evaluation of the module using a seven-point scale. Johnson et al. developed a database of 120 questions and then a software package created the tests. Content validity for the training and the test questions were not addressed.

Johnson et al. (2004) offered an orientation to their training, and 61 residents attended. The online modules were incorporated into the pediatric residents' month-long ambulatory block rotation. Of the 80 Ohio State University College of Medicine/Public Health pediatric residents completing the rotation, 51 residents completed the asthma module, 44 participated in the fever module, 39 completed the gastroenteritis module, and 53 finished the otitis media module. Throughout the study, researchers added newly published articles and materials to address questions that residents appeared to be repeatedly answering incorrectly.

Using analysis of variance (ANOVA), Johnson et al. (2004) compared pre-test and post-test scores' means and differences in score gains within each residency year (i.e., year 1, year 2, or year 3 of the program). Each year showed gains from pre-test to post-test scores for each module with one exception. Second year residents did not show a statistically significant score increase after the asthma training. The average overall gain on score means from pre-test to post-test was 20.1%. The overall percentage of students who "somewhat agreed," "agreed," or "strongly agreed" that each module helped with patient care ranged from 87.1% to 94.4%. However, the small number of test and evaluation questions could have affected the reliability of residents' scores. Moreover, the post-intervention evaluation did not allow for qualitative feedback. Thus, participants could not provide feedback on topics beyond what the evaluation addressed.

Johnson et al. (2004) made a strong case for their study by citing 15 past studies of a curriculum incorporating a web-based component. They concluded that WebCT helped measure and document residents' progress toward ACGME competency requirements. They also concluded that WebCT was a successful way of delivering instruction. No resident year showed score gains that were significantly different from other resident years; therefore, all students made progress regardless of formal education level. However, not all residents completed the module trainings. The authors acknowledged this created potential for bias in learners' styles and motivations.

With an average score gain on a little over 20%, Johnson et al. (2004) concluded that a learning management system like WebCT, customized to an individual program's needs, can be an effective central location of information for students. They further noted that implementing a pre-test and post-test provides data to help instructors assess the effectiveness of this instruction for their students.

In another study, Cook et al. (2007) designed and piloted a web course on complementary and alternative medicine (CAM) consisting of three separate modules. Citing a recent survey showing most physicians as unprepared to advise patients in CAM, Cook et al. argued that physicians need better preparation because of the growing number of patients choosing to use some type of CAM.

The CAM course was divided into three topics for modules: Introduction, Dietary Therapies, and Nondietary Therapies and Systems. Content for the trainings included journal articles, the Natural Medicines Comprehensive Database, and local experts' input. Cook et al. (2007) utilized web-based learning principles when developing their course. Thus, the trainings included case scenarios, self-assessment questions, and a review activity. They also incorporated hyperlinks to websites with additional information.

Researchers invited participation from all 143 internal medicine residents and all 24 family medicine residents from the Mayo School of Graduate Medical Education located in Rochester, Minnesota. All 88 medical students in their third and fourth year at Mayo Medical School and approximately 350 medical students at the University of Illinois at Chicago School of Medicine also received the e-mail invitation to participate. The control group consisted of internal medicine residents and Mayo medical students in their third year. The authors noted that logistical considerations affected the composition of the control group. To address potential bias from the differing make-up of the control group, Cook et al. (2007) compared results from the control group with an intervention sub-group that matched similar participants according to demographics. The experimental group ended up including 89 residents and medical students, the control group, 34. The matched intervention sub-group included 57 of the 89 participants in the experimental group.

To evaluate resident attitudes and behaviors regarding CAM, participants completed a survey before and after the course administered through Blackboard's WebCT3.8. The authors developed the survey with the Mayo Survey Research Center. Residents also completed a 48-question knowledge post-test immediately following the training and a course evaluation. After piloting questions with local experts in CAM, questions were revised or omitted as needed. To measure maintenance, researchers asked participating residents to complete another knowledge test and survey after 3 months. The control group only participated in the pre-intervention attitude and demographics survey and the knowledge test.

Cook et al. (2007) used a t-test to compare the test scores for the control group and intervention sub-group. Within the experimental group, 79 of the 89 participants took the delayed knowledge test. Researchers compared these immediate and delayed knowledge test scores using a paired t-test. To achieve a power of 90%, researchers calculated that a meaningful score difference of 7.5% would be needed.

Between the pre-course and post-course surveys concerning opinions about CAM, researchers found a small though statistically significant difference between the intervention sub-group and the control group. The attitudes of the experimental group changed significantly from pre-course to post-course. The one exception was that the group felt strongly before and after the course that physicians should be knowledgeable in CAM. Physicians' reported behaviors were similar for the control and sub-group at baseline. On the 3-month post-survey, experimental group participants reported making more CAM recommendations or asking patients about CAM more than they had pre-intervention.

Even after adjusting for differences in attitudes about CAM, researchers found scores to be significantly higher for the intervention sub-group when compared to the control. Test scores declined after 3 months; however, the sub-group's scores continued to be significantly higher than the control. Scores were not significantly different between the overall experimental group and the sub-group matching the control. Authors noted that the increase in knowledge was much larger than Cohen's determined large effect size.

Over 93% of course evaluation questions came back positive. Concerning the quality of feedback, 26% of participants felt it was inadequate. Regarding technical problems, 35% of participants experienced problems at the beginning of the course, and 12% still felt they were experiencing significant problems by the end of the course. Test scores and overall course ratings were not significantly different between participants who reported having technical problems and those who did not.

Cook et al. (2007) demonstrated the potential for a web-based training to reach a larger audience, expanding beyond a single institution. However, the small sample size prevented the comparison of scores between the two medical schools. Voluntary participation in the study left the potential for bias from those who chose to participate.

Participants were not randomly assigned to instructional versus control group, and the knowledge tests were not monitored to prevent participants from accessing test answers elsewhere. Prior knowledge was not measured, and behavior changes were measured through self-report. The reliability of these types of measurements is questionable.

Cook et al. (2007) concluded that their web course successfully improved resident and student knowledge, behavior, and attitudes regarding CAM. Since technical problems did not impact scores significantly, the authors also noted that the training had been successfully implemented across four training programs and two institutions through its web-based format.

A third web-based intervention study examined a case-based interactive online curriculum to teach internal medicine residents and attending physicians about five cholesterol concepts (Sisson, Rice, & Hughes, 2007). Thirty-seven residency programs spanning 18 states and Washington, D.C. participated, providing a sample size of 877 physicians at varying levels of training. Incorporating the National Cholesterol Education Program (NCEP) III revised guidelines, Sisson et al. followed a previously studied 6-step approach to curriculum development and guidelines for constructing test questions. To establish content validity, six cardiologists reviewed and revised test questions. Seven cardiology experts answered the test questions and achieved an average score of 90%. Multiple choice questions were divided into a pre-test and a post-test. During both tests, the online program informed participants if an answer was incorrect and showed the correct response.

A chi-square test analyzed each training level's test score differences, and a *p* value less than 0.05 was considered statistically significant. Resident and attending physicians achieved similar baseline knowledge scores (though third-year residents outperformed the first-year residents). Baseline scores for residents on clinical case-based questions were lower than that of attending physicians'. For all participants, knowledge of NCEP III guidelines and clinical-based questions improved significantly from pre-test to post-test.

Sisson et al. (2007) noted that the higher baseline scores for third-year residents and attending physicians suggested the groups had more prior knowledge of cholesterol guidelines. However, the authors still rated these baseline levels as poor and noted that the online curriculum increased all physician groups' knowledge. The curriculum potentially improved clinical management as well; however, researchers only used post-test clinical-related questions without actually observing physicians' practice. Sisson et al. suggested there might be selection bias since the 877 participating physicians represented only 30% of the total residents and attending physicians across programs. Since attending physicians made up only 4% of the total participants, Sisson et al. indicated it would be difficult to generalize their results.

There were a number of strengths as well as limitations to this study. Sisson et al. (2007) developed an online educational training that incorporated a theoretical approach to curriculum development. They also assessed the content validity of test questions. Sisson et al. had a large sample size (N=877) and pioneered using the internet to reach a wider variety of institutions across the country. This unfortunately sacrifices having a consistent, controlled environment in which participants could take the course. Sisson et al. did not include a course evaluation for either qualitative or quantitative feedback on their curriculum.

In another study, Cochran, Edelman, Morris, and Saffle (2008) studied a web-based curriculum addressing the critical care of burn victims immediately following their injury. The course consisted of nine 20-minute modules each containing text material with audio-visual supplements, self-assessment questions, supportive links from the provider manual, three optional case studies, an online test, and a satisfaction evaluation of the modules. Participants were third-year medical students and surgical or emergency medicine interns completing a clinical rotation at The Burn Center at the University of Utah. Twenty-eight potential learners received a letter explaining the program and login information.

Cochran et al. (2008) collected data on login times and test scores. Using SPSS 13.0, they analyzed means and standard deviations for length of login time. Additionally, they calculated the correlation coefficient between time spent logged in and final test scores. A one-sample t-test analyzed the Likert scale responses regarding satisfaction with the curriculum. Student-written comments were evaluated and placed in one of four categories: general, exam-related, content-related, or web-site related.

Twenty learners logged in, but only 15 students and interns completed the course. Time spent on the course ranged from 19 to 402 minutes, and scores ranged from 72 to 96% with a mean score of 88%. With a Pearson correlation coefficient of .66, Cochran et al. (2008) concluded that time spent on the course highly correlated with post-test score. Course evaluations were largely positive with learners agreeing or strongly agreeing that they would recommend the curriculum and use similar web-based courses. Respondents indicated that the length of time was appropriate, but they perceived the level of difficulty to be “somewhat too easy.” Student-written comments were largely positive; only two comments described the modules as “redundant” and “dry,” and two comments reflected technical errors with the program. Learners also provided constructive ideas for enhancing the curriculum’s layout and design.

Based on post-test scores, Cochran et al. (2008) concluded that their study was consistent with past research in demonstrating the effective content-delivery of computer-based and web-based instruction. They noted that the average time for learners who completed the curriculum, approximately 3 hours, was similar to the amount of time utilized for the traditional didactic session. Cochran et al. further noted that their priority to create an attractive, easily navigated, and content relevant curriculum probably helped with learner satisfaction. Past studies have confirmed the impact of these qualities on learner satisfaction ratings. The authors also cited past studies findings that students prefer web-based learning to alternative styles.

Cochran et al. (2008) acknowledged that the small sample size compromised the generalizability of their findings, and data could not be stratified for demographic and education level factors. The lack of a pre-test prevented the investigators from being able to make any claims regarding knowledge gain. Future replication studies including a pre-test and maintenance test as well as addressing content validity would help to further evaluate the curriculum’s impact. Cochran et al. were unique in their analysis of time spent on the training compared to post-test scores.

Software-based interventions. The remaining studies used a computer-based intervention distributed as software (i.e., CD-ROM, Compact Disc). Both tutorials included a pre-test and post-test to measure knowledge of either seizure classifications (Isler et al., 2008) or nutrition topics (Roche et al., 2007). Since these interventions were not web-accessible, Isler et al. provided a reserved computer lab and Roche et al. loaned out their CD with a 6-week deadline. I included these studies given that technology advances could eventually support files on the internet that previously required software.

In Turkey, Isler et al. (2008) developed and piloted a CD-ROM modular education program on Semiologic Seizure Classification, or SSC. The decision to create such a tutorial arose from the need for health professionals to quickly define a type of seizure and provide better immediate care. Isler et al. noted that current literature has failed to investigate the practicality of this classification system with professionals other than neurologists and epileptologists.

The research team developed the CD-ROM tutorial to include five separate modules. The modules were composed of explanations of the seizure types with accompanying video examples. Pre-test and post-test CD-ROMs included video clips and case samples. A questionnaire evaluated participants' professional experiences as well as baseline knowledge of SSC.

Health professionals from three pediatric clinics in hospitals in Turkey took the training at a provided computer lab. Twenty residents, 20 nurses, and 10 EEG technicians were separated into three groups. Each group received two 3-hour sessions to complete the training. Isler et al. (2008) compared pre-test to post-test scores to analyze possible knowledge gains.

On their initial questionnaire, 85% of residents and 95% of nurses reported difficulties with defining and recognizing types of seizures. Pre-test scores were significantly higher for residents but the same for nurses and technicians. Isler et al. (2008) reported a significant increase in scores in subgroups and in general. Groups did not differ significantly in their number of correct answers. A significant percentage of participants (98%) earned a post-test score higher than their pre-test score.

Isler et al. (2008) concluded from their study that non-neurological health professionals better understood SSC and that overall the participants gained knowledge of SSC. Similar to other studies, this study was limited by its small sample size. Isler et al.'s research was the only study to include other health professionals in addition to physicians. The authors noted that their findings are consistent with previous research showing SSC to be a better understood classification system than the International League Against Epilepsy (ILAE) classifications. Incorporating web-based learning principles, evaluating content validity, and assessing maintenance of knowledge would have strengthened the study. Isler et al. speculated that similarly-appearing seizures were possibly confused on the tests.

Roche et al. (2007) created a compact disc (CD) program for pediatric residents covering three nutrition topics in 60-90 minutes: oral rehydration therapy, calcium, and vitamins. Despite efforts made at the federal level and by several nutrition-related organizations, survey data have revealed a lack of sufficient programming for nutrition content. Noting how medical education programs are already overwhelmed with so much content to teach in limited hours, Roche et al. decided to explore a computer-based instruction. Roche et al. attempted to address weaknesses of computer-based instruction from past research.

Faculty physicians and a clinical dietician at the Indiana University School of Medicine and James Whitcomb Riley Hospital for Children developed the modules' content. The University School of Informatics created a consistent interface utilized across modules. The CD's interactive features included case studies, self-tests, printable parent handouts, and hyperlinks to nutrition-related websites. Participants were given a 6-week deadline to complete the CD's trainings and advised not to share access to the CD.

Pediatric residents were randomly assigned to either the control group (n=19) or the study group (n=19). Groups were matched for demographics and education level. Roche et al. (2007) compared pre-test and post-test scores on 15 multiple-choice questions to assess knowledge gain. Likewise, they compared a pre-trial attitudinal survey and post-trial survey of attitudes toward content and evaluation of the module.

Statistical tests verified homogeneity between the control group and study group. A Pearson x^2 test revealed similar baseline attitudes toward computer-based learning between groups. A paired t-test showed a statistically significant decrease in the control group's scores from pre-test to post-test. When the oral rehydration therapy module was excluded from analysis because of overall poor performance, a dependent t-test demonstrated significant score increases for the study group. An independent t-test revealed significantly better post-test performance for the study group over the control. Post-trial surveys showed that all participants viewed the computer-based instruction as beneficial.

Roche et al. (2007) concluded that their modules were an effective means of teaching nutrition curriculum to pediatric residents. However, this conclusion is questionable with regards to the oral rehydration therapy module given its participants' poor performances. Limitations to this study include its small sample size and the absence of administering the trainings in a controlled environment. The authors encouraged future research in computer-based instruction that integrates human learning theories.

Summary of studies' designs and findings. These six studies covered a wide variety of content for physicians: ambulatory pediatrics, complementary and alternative medicine, cholesterol, critical care for burn victims, seizure classifications, and nutrition. The number of training modules per educational intervention ranged from three to five with one exception (Cochran et al., 2008) having nine modules. These studies varied greatly in how they distributed their computer-based interventions. Isler et al. (2008) had a reserved computer lab with a set day and time for their training session. Roche et al. (2007) loaned out CDs containing their curriculum and requested that participants complete and return the CD within six weeks. Johnson et al. (2004) incorporated their training into residents' ambulatory rotation. In contrast, Cook et al. (2007) invited participants to their training through an e-mail while Cochran et al. (2008) sent out invitation letters containing login information to access their online curriculum.

Both web-based and computer-based trainings were found to be effective in improving physician knowledge on varying topics. Cochran et al. (2008), Cook et al. (2006), and Sisson et al. (2007) were the only studies to specify what learning principles and theories guided the creation of their training modules. Cochran et al. applied theories on web course design derived from past studies, and Cook et al. consulted web-based learning principles. Sisson et al. followed a research-based six-step approach to curriculum development. Two studies were less specific about their modules' development. Johnson et al. (2004) collaborated with a technology education specialist, and Roche et al. (2007), with the University's School of Informatics. However, no details beyond these were noted regarding the actual types of theories these developers utilized. Isler at al. (2008), the only non-U.S. study, never addressed whether or not they followed any web-design or learning theories.

Only two studies, Cook et al. (2006) and Sisson et al. (2007), assessed the content validity of their module's test questions. Cook et al. revised their test questions based on local experts' feedback, and Sisson et al. had six cardiologists review their module's test questions. Johnson et al. (2004) and Roche et al. (2007) both had multiple creators for their trainings but did not specify how or if their groups of experts analyzed content validity. Additionally, Cochran et al. (2008) and Isler et al. (2008) did not discuss content validity in their articles.

Although all studies explored the impact of their interventions on knowledge gain, not all studies included a pre-test to control for participants' prior knowledge. Only four of the six studies, Johnson et al. (2004), Isler et al. (2008), Roche et al. (2007), and Sisson et al. (2007), utilized a pre-test. The only studies to include a non-instruction control group were Cook et al. (2006) and Roche et al. Cook et al. alone measured maintenance of knowledge over time. Cochran et al. (2008), Cook et al., Johnson et al., and Roche et al. included follow-up surveys for participants to provide feedback on the piloted modules. Of these four studies, only Cochran et al. included a qualitative opportunity for feedback where participants could freely write additional opinions.

All trainings demonstrated statistically significant gains in knowledge scores after their interventions. However, most of the studies had relatively small sample sizes. Only Sisson et al. (2007) had a large sample size of 877; additionally, their study included 37 programs. Cook et al. (2006) offered their intervention at two schools, and Isler et al.

(2008) used their intervention at three different clinics. The remaining studies' samples were drawn from single institutions.

Summary

To adequately prepare pediatric residents to meet the guidelines put forth by the ACGME and the AAP, residency programs need to incorporate direct training in early identification and intervention for children who have developmental delays. The AAP's 2006 and 2007 statements stipulating specific ages to screen for developmental delays and autism raise the standard expectation of physician involvement. The ACGME already specifies intense, extensive residency program requirements; therefore, innovative instructional delivery must be explored. Computer-based training offers the potential to provide consistent, direct instruction to residents with the added benefit of providing the means for assessing knowledge afterwards. Additionally, it can be cost and time efficient. Replication studies will add to this growing body of new research and will help programs better analyze the beneficial, or non-beneficial, aspects of computer-based instruction.

A training module in developmental delays and early intervention could potentially benefit residents' education given the knowledge gains demonstrated in online and computer-based modules for other medical fields. Following the lead of previous research, future interventions should be designed with adult learning theories and web-design principles in mind (Cochran et al., 2008; Cook et al., 2006; Sisson et al., 2007). Likewise, module development should include establishing content validity for the training's content and corresponding knowledge tests (Cook et al., 2006; Sisson et al., 2007). In addition to a post-test, a pre-test on knowledge will help control for participants’ understanding prior to intervention. Maintenance and generalization have not been sufficiently explored and should be a focus of future research. As residents begin to understand early intervention for children with developmental disabilities, this new knowledge must then be applied to their practices as physicians.

This new form of instruction may create some technical concerns. To revise technical and educational issues, participants should be provided a means to offer feedback on the training and technical logistics. Additional qualitative feedback can bring to attention issues that might otherwise go unreported. This is particularly important given how these interventions’ success depends on reliable technology. Moreover, as technology continues to evolve, computer trainings should continue adapting so as to benefit from pertinent innovations. Only through continued exploration of this ever-evolving technology can educational institutions benefit from what these studies have concluded to be helpful instructional techniques.

Methods

The purpose of this study was to examine whether a computer-based training on EI helped pediatric residents to learn more about EI itself as well as their own role within it. Past research looked at similar interventions within the medical field for other topics, but there has yet to be one developed and researched that is specifically about EI. Moreover, there is a growing need to teach doctors about EI and their role in early detection of developmental delays given recent documents published by the AAP as well as the IDEA federal legislation.

I designed this study to fit within the training schedule for pediatric residents at the University of Maryland School of Medicine (UMSM). This strategy seemed appropriate given that the computer training was intended to be part of an overall pediatric residency program and that past studies followed a similar format (Johnson et al., 2004). In this study, I evaluated residents' knowledge gains from pre-test to post-test. I also evaluated the feasibility of implementing such a training based on how much time it took to complete, resident satisfaction with the training, and participation.

Participants

Recruitment. All participants were pediatric residents at the University of Maryland School of Medicine. The participants were first year, second year, and third year residents in all pediatric residency programs (e.g., pediatrics, combined pediatric and emergency medicine, combined pediatrics and internal medicine). At the time of this study, there were 65 pediatric residents at UMSM. According to the director of the pediatric residency program, some residents would be unable to attend the training session because of their rotation schedule (E.L. Giudice, personal communication, May

12, 2009). Given her estimates of how many students would be unavailable on a given day, she anticipated that approximately 50 residents would be able to attend the session. We offered the session as part of the Fall 2009 training schedule for all residents.

Informed consent. The training began with a written explanation that the presentation was part of a research study at the University of Maryland, College Park (UMCP). A copy of this explanation can be found in appendix B. All residents participated in the module and knowledge tests as part of their standard educational training; however, disclosing their test scores for data analysis was optional. This study received IRB approval or exemption from both UMCP and UMSM. Residents who arrived to the training on time received a $1.00 gift card to a coffee shop regardless of study participation.

Procedure

Residents participated in the training in a reserved computer classroom in the Health Services and Human Services Library on their campus (www.hshsl.umaryland.edu). The three available classrooms contained 14, 18, and 25 Dell desktop computers respectively. The computer systems ran Windows XP, and all had access to the internet through the web browser Firefox 3.0. More information including the specific hardware and software features can be found on the library's website (http://www.hshsl.umaryland.edu/general/rooms/classrooms.html).

An assistant professor of pediatrics at UMMS developed the training module (Hussey-Gardner, 2009) and helped to proctor the tests. A computer technician uploaded this Microsoft PowerPoint © presentation onto all computers in the lab. In addition, CD-ROMs were available in case anyone had technical difficulties accessing the training.

We administered the tests on paper and in separate packets, the pre-test before the training began, and the post-test directly after. A copy of the pre-test and post-test are included in appendix B.

Training Module. Dr. Brenda Hussey-Gardner developed the computer training module that this study used. Her contact information can be found in appendix C for anyone who wants to obtain a copy of this training. The module consisted of a PowerPoint presentation, uploaded to all computers in a computer lab for students to access. It began with an overview of its objectives: (1) for the resident to become familiar with EI legislation and philosophy, and (2) for the resident to know what role the pediatrician has in developmental surveillance, screening, and EI programs. To acquaint students with EI, the training gave a rationale supporting the need for EI programs and the benefits of its family-focused interventions.

A summary and history of EI legislation under IDEA and the recent AAP recommendations for screening (for general development as well as for autism) followed. Students were introduced to the legal definition of an infant or toddler with a disability as given under Part C of IDEA. The presentation then contained more in-depth explanations of EI philosophy and practice (as more family-centered and provided within a child's everyday context, or "natural environment," while taking into account the family's specific learning style and cultural beliefs). It offered a rationale to help explain why family-centered services are of greater benefit for children.

After describing EI, the module presented slides that described more of the logistics (how this program looks from the federal level and what tasks are left to the states to accomplish). The PowerPoint presentation then displayed a map of the U.S.

allowing the student to click on any state to see a summary of what that state's EI program contains (e.g., its lead agency, program name, what is considered to be enough of a delay to receive services, whether babies born prematurely automatically qualify for EI under the "high probability" category, whether the state charges the family any fee for EI services).

Once finished searching the map, students saw slides explaining the EI process. For example, they were told how the process begins with a referral and what the timelines are for family contact, assessment, and service initiation under an IFSP. The presentation provided a non-comprehensive list of some example EI services, including medical services for the purposes of evaluating and diagnosing.

The final portion offered more information specific to the pediatrician's role in EI. This explained in further detail recent AAP recommendations and policy statements. It noted that a screening tool must be standardized as well as the fact that pediatricians are families' first connection to EI. The training included a universal referral form and list of recommended screening tools. It then ended with a slide containing contact information for further help in understanding EI.

Training administration. A prototype of the early intervention module (Hussey-Gardner, 2009) was used previously as a Microsoft PowerPoint presentation that was part of a lecture given to residents. It had not yet been used as an independent computer-based training module. Residents at the UMSM were the first group to participate in this early intervention module. The UMSM trains the majority of Maryland's doctors and health care professionals ("Just the Facts," n.d.; University of Maryland Medical Systems, 2007).

Similar to a previous study (Isler et al., 2008), we reserved a computer lab at the campus library to encourage attendance. We gave the training in place of the lecture on EI given in previous years, and this happened during the time frame regularly designated for the residents' core conference class (i.e., 7:45-8:45 a.m.). We estimated that residents would need approximately 45-60 minutes to complete the training.

Residents' received an email noting the location change for this class. The session began as soon as students arrived. As they walked in, we handed them an assigned number, a packet with their instructions for accessing the training, and a paper copy of the pre-test to take beforehand. They were asked to raise their hands as they finished the training so that we could collect their pre-test and give them their paper copy of the post-test. The two proctors observed as the residents completed the pre-test and training to be sure that no one completed their pre-test during or after the training. Students left their post-test in a marked bin as they exited the computer lab.

Data Analysis

Residents took a pre-test and post-test to assess their knowledge level from before to after the training. I developed 20 questions which the module's author and the members of this thesis committee reviewed. I consulted work by Dillman (2000a, 2000b) for additional guidance in writing and formatting the pre-test and post-test questions. Since this intervention has yet to be studied and it was likely that many students would be learning this material for the first time, the tests focused on the base level of Miller's triangle (see Appendix A). This basic level of competence evaluates if the student knows the material (before we can later see if this knowledge becomes part of medical practice). Two of the 20 test questions presented a hypothetical case scenario, thus also aiming to look at the next level of Miller's triangle ("Knows How"). This training module sought to introduce residents to the EI program and to their role so that they may first "know" this information and begin to "know how" to apply it in theory. The time it will take to incorporate this knowledge into skillful practice, as seen in the "shows how" and "does" levels, goes beyond the limits of a one-time PowerPoint presentation. Thus, a written exam was appropriate to assess these first basic levels of student knowledge.

Knowledge-based test questions are most frequently close-ended questions (i.e., true/false and multiple-choice). As Dillman points out, open-ended questions run the risk of yielding inadequate answers that lack enough specificity (2000b). Since I was not able to follow-up with individual participants to clarify any vague answers, I formed all knowledge-based questions as either true/false or multiple-choice. I included case scenario questions to see if participants would know how to apply what they had learned, and I grouped these questions together with the corresponding scenario (Dillman, 2000a).

Pre-test and post-test. At the beginning of the test there were a few survey questions (see Appendix B). I asked participants to rate their prior knowledge about EI on a scale from "A lot of information" to "No information." I also asked participants to mark their year of education, gender, and program of study within the pediatric residency program. The pre-test asked students to write their start time, while the post-test asked them to write their finish time, so that the average time span of the intervention could be analyzed.

I grouped survey questions and knowledge-based test questions separately for easier reading (Dillman, 2000a). The pre-test included true/false and multiple-choice knowledge-based questions. The questions covered two main topics: (1) early intervention itself and (2) the physician's role in EI. Within each of these categories there were sub-categories. Each topic area's sub-categories and questions are listed in appendix D along with their corresponding answers.

There were two to four questions per sub-category depending on how much information needed to be covered in that category. The test questions aimed at covering the most important concepts from the training and making sure residents at least learned the fundamental points.

The post-test included the same knowledge-based questions but in a different order. It ended with a few evaluation questions. Participants rated the helpfulness of the module on a scale of "not helpful" to "very helpful." They also rated their impression of their knowledge gained about EI from the training.

I printed the test questions vertically and on one side of the sheet. This was to avoid the possible error of participants missing questions printed on the backs of pages (Dillman, 2000a). I coded each test with the number assigned to the residents as they arrived so that no identifying information was collected from participants.

I entered data into an SPSS file and analyzed from pre-test to post-test using a two sample t-test for related groups. I also analyzed the average time spent on the module and recorded how many residents attended the training. I kept the data in a locked case within a securely locked office and building.

Since using computers and technology is a regular part of pediatric residency education, I anticipated no risk to participants. I anticipated that residents participating in the study would benefit from gaining knowledge about EI, and to provide a better service as health care providers. At the completion of the study, all residents in the University of

Maryland School of Medicine received, in their mailbox, an abstract of the study explaining the general results.

Results

In this study I investigated the educational impact of a computer-based training about EI designed for pediatric residents. Specifically, the training focused on teaching students about the philosophy of EI and its definitions according to federal law IDEA. It also focused on showing these students their role in EI as physicians based on the recommendations of AAP and IDEA. The main questions of this study were: (1) Did residents' overall knowledge about early intervention increase from pre-test to post-test, (2) After the training, did residents' knowledge differ among topic areas covered in the training, and (3) Was a computer-based training for EI successfully implemented within a residency program? I have presented the results of this study based on these three questions.

I assessed participants on these two major topics through a pre-test and post-test with 20 true/false or multiple-choice questions and asked participants to rate their knowledge level of EI before and after the training. I also evaluated the feasibility of implementing a computer-based training within a pediatric residency education program. I collected data on the number of residents who attended the training, the time they spent on the training, their satisfaction with the training, and technical errors that arose.

The training took place on September 28, 2009 at the University of Maryland School of Medicine. A total of 14 residents participated in the computer-based training on early intervention. Though there were approximately 60 residents total, the resident student coordinator reported that this was about the usual number of students who attend the morning conferences. Everyone who participated also agreed to share their test data for this study. The pre-test asked participants to report their year of residence, program of study, and gender. I have provided this demographic information in Table 1.

Table 1

Demographics Reported: Residency Year, Program of Study, Gender

Year of Residence (options given on pre-test)	*Frequency*
1^{st} year	4
2^{nd} year	4
3^{rd} year	1
Other	5

Program of Study (options given on pre-test)	*Frequency*
Pediatrics	9
Pediatrics/emergency medicine	1
Pediatrics/internal medicine	0
Other	3
No answer given	1

Gender	*Frequency*
Male	3
Female	11

Question 1: Overall Knowledge Gains

All 14 participants scored higher after the presentation with an average score gain of 4.86. In Table 2, I summarized the overall test scores per resident. Pre-test scores ranged from 11 to 16 while post-test scores ranged from 15 to 20. I calculated by hand a two sample t-test for related groups and then checked using SPSS 17.0. An alpha level of 0.01 was used for this statistical test, and degrees of freedom (df) equaled 13. The observed value of the calculated test statistic ($t_{observed}$ = 12.576) exceeded the critical value (t_{cv} = +2.650), and thus rejected the null hypothesis (H_O: $\mu_1 - \mu_2 = 0$). Therefore, the overall score gains from pre-test to post-test were statistically significant. Table 3 presents the data output from SPSS. A Pearson correlation test revealed a correlation of 0.508 between residents' test score gains and time spent on the training. Table 4 includes the SPSS output for the correlation test.

Table 2

Test Scores and Time per Participant

Subject (N=14)	*Test Scores*		***Score Gain***	*Time (minutes)*
	Pre-	*Post-*		
1	11	17	6	22
2	14	18	4	18
3	13	18	5	27
4	11	17	6	25
5	13	18	5	25
6	11	13	2	23
7	14	17	3	20
8	11	17	6	22
9	15	19	4	20
10	11	18	7	25
13	14	20	6	30
14	12	18	6	28
15	16	20	4	20
16	11	15	4	23
Mean:	12.64	17.5	4.86	23.43

Note. Scores were out of a possible 20 points, one point per question.

Table 3

SPSS Output: Dependent T-test for Matched Groups

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Posttest	17.5000	14	1.82925	.48889
	Pretest	12.7143	14	1.77281	.47380

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Posttest & Pretest	14	.688	.007

Paired Samples Test

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	4.78571	1.42389	.38055	3.96358	5.60785	12.576	13	.000

Table 4

SPSS Output: Pearson Correlation Test

Correlations

		Difference	Time
Difference	Pearson Correlation	1	.508*
	Sig. (1-tailed)		.032
	N	14	14
Time	Pearson Correlation	.508*	1
	Sig. (1-tailed)	.032	
	N	14	14

*. Correlation is significant at the 0.05 level (1-tailed).

Question 2: Knowledge Gains Within Main Topics

I considered each question individually, from within its overall topic (i.e., questions on early intervention topics versus questions on physician's role), to see which questions or topic areas showed the most improvement after the training. In Table 5, I summarized the total correct responses from pre-test to post-test per question. I outlined the changes in participants' responses after the presentation (e.g., whether a participant kept or changed an answer from pre-test to post-test) in Table 6. In both tables, I grouped questions together based on their broader topic area. Since the same questions appeared in a different order on the pre-test and post-test, I gave each question a letter from A through T (rather than using numbers 1 through 20).

For two sub-categories (EI: Timelines, Physician's Role: AAP Recommendations) the number of residents giving a correct answer increased from pre-test to post-test for all questions in those sub-categories. For one sub-category (EI: Philosophy) this was also the case except for question D which all participants already correctly answered on the pre-test.

For two EI sub-categories ("Federal Requirements of State Programs" and "Services") the number of residents who answered correctly increased from pre-test to post-test on only 3 out of the 4 questions in each of those sub-categories.

In two of the sub-categories concerning the role of the physician, the number of participants who gave the right answer increased from pre-test to post-test on only half the questions for those topics ("Referral Procedures" and "Best Practice for Referrals").

From pre-test to post-test, the number of correct respondents increased for 12 questions. For 3 questions (i.e., G, D, M), all participants answered correctly on the pre-test and post-test. These questions asked about what EI services could include (G), EI's family-centered philosophy (D), and best practice for referring a child to EI in a given case scenario (M).

For five questions (i.e., H, J, K, O, R), more participants actually gave incorrect answers after the training. Four of these five questions were true/false, and they pertained to whether or not states are required to charge for services on a sliding scale fee (O), whether medical services for diagnostic purposes are considered part of early intervention (H), referring for high probability conditions even if there is not yet a developmental delay (K), and referring for a suspected developmental delay (R).

Question J was multiple-choice with multiple answers and pertained to possible reasons for physician referral. I re-examined the post-test answers to see what answers participants gave instead of the correct one. The correct answer was to check all five answers offered (i.e., 1: Failing a developmental screening tool, 2: You suspect a developmental delay based on your observations, 3: The parent thinks there is a developmental delay, 4: The child has a high probability condition as defined in that state, and 5: Failing an autism screening tool). Four of the six incorrect responses missed answer 3 ("The parent thinks there is a developmental delay"). The remaining two incorrect responses missed answer 3 and answer 2 ("You suspect a developmental delay based on your observations").

Table 5

Total Correct Responses per Question on Early Intervention (N=14)

Early Intervention Topics	*Questions*	*Pre-Test*	*Post-Test*	*Test Score Difference*
Federal Requirements of State Programs	(A) What should you find out about your state's early intervention program to share with families?	7	11	+4
	(O) Every state must charge families on a sliding scale fee. (T/F)	12	11	-1
	(P) Every state determines its own eligibility criteria. (T/F)	13	14	+1
	(Q) All states are required to serve children with at-risk conditions. (T/F)	2	8	+6
Services	(F) Early intervention services could include services up to age 7 years. (T/F)	1	11	+10
	(G) Early intervention services could include family training and counseling. (T/F)	14	14	0
	(H) Early intervention services could include medical services, but only for diagnostic or evaluation purposes. (T/F)	10	9	-1
Timelines	(S) How long does an early intervention program have to write an Individualized Family Service Plan (IFSP) after the date of a referral?	0	13	+13
	(T) Services that are included in the IFSP must then begin within ___ days after the document has been signed by the parent.	9	13	+4

TABLE 5. (continued)

Early Intervention Topics	*Questions*	*Pre-Test*	*Post-Test*	*Test Score Difference*
Philosophy	(D) Early intervention services should focus specifically on the child's needs without regard to the family. (T/F)	14	14	0
	(E) Interventions should be universal with every child receiving the same exact services. (T/F)	12	14	+2
	(N) All children with Downs syndrome should receive the same type of services. (T/F)	11	14	+3

TABLE 5. (continued)

Total Correct Responses per Question on Physician's Role (N=14)

Physician's Role Topics	*Questions*	*Pre-Test*	*Post-Test*	*Test Score Difference*
AAP Recommen-dations	(B) At what ages does AAP recommend overall developmental screenings?	2	13	+11
	(C) At what ages does AAP recommend autism screenings?	0	13	+13
Referral Procedures	(I) A referral should include *(Check all that apply.)*:	10	13	+3
	(J) Reasons for a referral include (*Check all that apply.)*:	10	8	-2
Best Practice for Referrals	*(K) Refer Maria only if she fails a developmental screening (T/F)	14	13	-1
	*(L) Refer Maria based on the hearing loss alone (T/F)	9	12	+3
	*(M) Wait and only refer if Maria does not start talking on time (T/F)	14	14	0
	(R) If you suspect a developmental delay, it is best to wait until the next well-child visit to make sure the delay persists before referring. (T/F)	14	13	-1

Note. Questions K, L, and M are case study questions. They correspond to the following scenario which was printed with these questions in the pre-test and post-test: "Maria is a 6-month-old who failed her newborn hearing screening and subsequent BAER bilaterally. An audiologist diagnosed Maria with a severe hearing loss. Her mother and father bring her in for her well-baby visit and report that they are concerned but don't know what to do. You should…" True/False questions are indicated with the abbreviation "T/F," and the remaining questions are multiple choice/multiple answer questions. The answer choices for these questions can be seen in the copy of the pre-test/post-test questions provided in Appendix B.

Table 6

How Residents' Answers Changed per Question After the Computer Training

Early Intervention: Federal Requirements of State Programs

Question	*Answered Correctly:* Kept Answer	*Answered Correctly:* Changed Answer	*Answered Incorrectly:* Kept Answer	*Answered Incorrectly:* Changed Answer
(A) What should you find out about your state's early intervention program to share with families?	7	4	3	
(O) Every state must charge families on a sliding scale fee. (T/F)	10	1	1	2
(P) Every state determines its own eligibility criteria. (T/F)	13	1		
(Q) All states are required to serve children with at-risk conditions. (T/F)	2	6	6	

Early Intervention: Services

Question	*Answered Correctly:* Kept Answer	*Answered Correctly:* Changed Answer	*Answered Incorrectly:* Kept Answer	*Answered Incorrectly:* Changed Answer
(F) Early intervention services could include services up to age 7 years. (T/F)	1	10	3	
(G) Early intervention services could include family training and counseling. (T/F)	14			
(H) Early intervention services could include medical services, but only for diagnostic or evaluation purposes. (T/F)	7	2	2	3

TABLE 6. (continued)

Early Intervention: Timelines

Question	*Answered Correctly:* *Kept Answer*	*Answered Correctly:* *Changed Answer*	*Answered Incorrectly:* *Kept Answer*	*Answered Incorrectly:* *Changed Answer*
(S) How long does an early intervention program have to write an Individualized Family Service Plan (IFSP) after the date of a referral?		13	1	
(T) Services that are included in the IFSP must then begin within ___ days after the document has been signed by the parent.	8	5		1

Early Intervention: Philosophy

Question	*Answered Correctly:* *Kept Answer*	*Answered Correctly:* *Changed Answer*	*Answered Incorrectly:* *Kept Answer*	*Answered Incorrectly:* *Changed Answer*
(D) Early intervention services should focus specifically on the child's needs without regard to the family. (T/F)	14			
(E) Interventions should be universal with every child receiving the same exact services. (T/F)	12	2		
(N) All children with Downs syndrome should receive the same type of services. (T/F)	11	3		

Physician's Role: AAP Recommendations

Question	*Answered Correctly:* *Kept Answer*	*Answered Correctly:* *Changed Answer*	*Answered Incorrectly:* *Kept Answer*	*Answered Incorrectly:* *Changed Answer*
(B) At what ages does AAP recommend overall developmental screenings?	2	11	1	
(C) At what ages does AAP recommend autism screenings?		13	1	

TABLE 6. (continued)

Physician's Role: Referral Procedures

Question	*Answered Correctly:* *Kept Answer*	*Answered Correctly:* *Changed Answer*	*Answered Incorrectly:* *Kept Answer*	*Answered Incorrectly:* *Changed Answer*
(I) A referral should include *(Check all that apply.)*:	10	3	1	
(J) Reasons for a referral include (*Check all that apply.)*:	7	1	3	3

Physician's Role: Best Practice For Referrals

Question	*Answered Correctly:* *Kept Answer*	*Answered Correctly:* *Changed Answer*	*Answered Incorrectly:* *Kept Answer*	*Answered Incorrectly:* *Changed Answer*
*(K) Refer Maria only if she fails a developmental screening (T/F)	13			1
*(L) Refer Maria based on the hearing loss alone (T/F)	9	3	2	
*(M) Wait and only refer if Maria does not start talking on time (T/F)	14			
(R) If you suspect a developmental delay, it is best to wait until the next well-child visit to make sure the delay persists before referring. (T/F)	13			1

Note. Questions K, L, and M are case study questions. They correspond to the following scenario which was printed with these questions in the pre-test and post-test: "Maria is a 6-month-old who failed her newborn hearing screening and subsequent BAER bilaterally. An audiologist diagnosed Maria with a severe hearing loss. Her mother and father bring her in for her well-baby visit and report that they are concerned but don't know what to do. You should…" True/False questions are indicated with the abbreviation "T/F," and the remaining questions are multiple choice/multiple answer questions. The answer choices for these questions can be seen in the copy of the pre-test/post-test questions provided in Appendix B.

Question 3: Feasibility of Training

In Table 7, I listed the time each resident spent on the training. Participants spent an average of 23.43 minutes on the presentation and tests.

To address resident satisfaction with the training, I asked participants to rate how much knowledge they felt they had prior to the presentation. I then asked them to rate how much they learned from the presentation and how helpful they found it. I have summarized this information in Tables 8, 9, and 10. No resident reported having learned a lot of prior information about early intervention; reported answers included “some information,” “a little information,” and “no information” with approximately 57%, 28.5%, and 14% of participants reporting each answer respectively. All participants reported having learned either “a lot of information” (42.857%) or “some information” (57.143%) from the training. Nine of the 14 (64.286%) participants reported the training to be “very helpful” with the remaining five (35.714%) reporting it was “somewhat helpful.”

Table 7

Time Spent on Training

Subject (N=14)	*Time (minutes)*
1	22
2	18
3	27
4	25
5	25
6	23
7	20
8	22
9	20
10	25
13	30
14	28
15	20
16	23
Mean:	**23.43**

Note. Includes time spent on tests.

Table 8

Self-Reported Prior Knowledge and Corresponding Pre-Test Scores
(Q: How much information have you already been taught about early intervention services?)

Prior Amount of EI Information	*Frequency*	*Participant's Pre-test Score*	*Average Pre-test Score*
(1) A lot of information	0		
(2) Some information	8 (57.143%)	11, 11, 11, 13, 14, 14, 15, 16	13.125
(3) A little information	4 (28.571%)	11, 11, 14, 14	12.5
(4) No information	2 (14.286%)	11, 12	11.5

Note. The percentage recorded in parentheses indicates the percentage of participants who gave the corresponding rating.

Table 9

Self-Reported Knowledge Gain
(Q: How much new information do you feel you have learned about early intervention from this module?)

Amount of EI Information Learned	*Frequency*	*Participant's Score Gains*	*Average Score Gain*
(1) A lot of information	6 (42.857%)	2, 3, 4, 4, 6, 7	4.333
(2) Some information	8 (57.143%)	4, 4, 5, 5, 6, 6, 6, 6	5.25
(3) A little information	0		
(4) No information	0		

Note. The percentage recorded in parentheses indicates the percentage of participants who gave the corresponding rating.

Table 10

Self-Reported Satisfaction with Computer Training
(Q: How helpful was this module in helping you learn about early intervention services?)

Satisfaction Level	*Frequency*	*Score Gains*	*Average Score Gain*
(1) Very helpful	9 (64.286%)	2, 3, 4, 4, 4, 5, 6, 6, 7	4.555
(2) Somewhat helpful	5 (35.714%)	4, 5, 6, 6, 6	5.4
(3) A little helpful	0		
(4) Not helpful	0		

Note. *The percentage recorded in parentheses indicates the percentage of participants who gave the corresponding rating.*

Qualitative Feedback

Participants had the opportunity on their post-tests to provide written feedback for the researcher. I asked them to report any remaining questions about early intervention not answered by the training as well as any technical problems that arose. Four participants reported their remaining questions about early intervention, and three participants encountered a technical problem. I quoted and then summarized this feedback in Table 11.

Residents asked for more information specific to their state as well as information on what conditions are considered either high probability or high risk for early intervention. They also had questions about what screening tools there are for physicians and asked for more information on the types of early intervention services.

There were two technical problems reported. The presentation ended prematurely for one resident, and two residents reported problems using the magnifying glass icon to select certain state programs from a map of the U.S. Both participants still were able to complete the training despite these technical errors.

Table 11

Participants' Qualitative Feedback

Q: What questions do you still have about early intervention services that this training did not answer?	*Summary of Topic Areas*
▪ "I would like more specific info about what we have in Maryland for early intervention. Also what automatically qualifies for referral—what do they consider "high risk" in Maryland." ▪ "What high probability conditions are, what the screening tools look like but I learned where I can look this up" ▪ "I think I understand that each state's program is different but is there any federal mandate for HIGH RISK CONDITIONS?" ▪ "More information about the different types of services"	▪ State-specific information (e.g., automatic eligibility for high probability conditions, high risk conditions) ▪ High probability conditions ▪ Screening tools ▪ High risk conditions ▪ Types of services

Q: What, if any, technical problems arose as you were taking this training?	*Summary of Topic Areas*
▪ "Presentation exited before start of EI info. (eg. after slide #90)" ▪ "The magnifying glass screens repeated a couple of times" ▪ "Using the magnifying glass icon was confusing"	▪ Presentation ending prematurely ▪ Problems with magnifying glass for finding certain states on U.S. map

Discussion

The purpose of this study was to determine if pediatric residents who received an on-line training module improved their knowledge about EI for children who have developmental delays from pre-test to post-test. During an assigned training session, the residents received a self-guided PowerPoint presentation in a computer lab on campus. The presentation focused on the topics of the EI program itself (i.e., federal requirements, services, timelines, philosophy) and the physician's role in relation to it (i.e., AAP recommendations, how to make referrals, and best practice for referring). A total of 14 residents at the University of Maryland Medical School participated. Participants completed a 20-question pre-test and post-test to measure changes in their understanding of early intervention.

Knowledge Gains

Residents did gain in overall knowledge about early intervention based on improvements in scores from pre-test to post-test. The greatest gains were in the areas of IFSP timelines and AAP recommendations, two topics that they all seemed to be unfamiliar with prior to the training session. Residents showed improvement in their understanding of the timelines for writing an IFSP and for initiating services after IFSP completion. Residents gained knowledge on AAP recommendations for physician screening for developmental delays and autism, and the training did not appear to confuse any participants about this information.

The results of this study suggest that the computer training assisted residents in understanding IDEA's requirements for state EI programs. There were gains in understanding what physicians need to know about their local EI program and services for children who are considered to be at risk for delays. The one exception was that the presentation somehow was not clear about how state programs charge for services.

Other areas did not show as drastic of an improvement. Resident knowledge regarding EI services was not as drastically improved from this presentation when compared to other topic areas. Only one question showed marked improvement while the others did not. Given the relatively high pre-test scores in the area of EI philosophy, it is possible that there was already a high level of pre-existing knowledge. Nonetheless, the presentation did not appear to confuse any residents.

The knowledge areas regarding referral procedures and best practice for referring had the least knowledge gain when compared to other categories. It seems as though the presentation was unclear or confusing in this area.

Feasibility

In general, I found that this computer training is feasible to administer within the broader program of residency education. Overall, residents seemed satisfied with the module and reported that it was helpful. Some of the residents' comments indicated that they even desired to know more about certain topics of interest (e.g., what screening tools for pediatricians look like, wanting to know more about what EI services look like). The training itself did not take an unreasonable amount of time to administer. All residents finished before the end of the hour for which the computer lab had been reserved. The average time spent on the module (23.43 minutes) was similar in time length to a past study's training modules (Cochran et al., 2008). There was no correlation between how long residents spent on the training and their overall score gain. However, these statistics could be the result of having such a small sample size.

The technical difficulties that arose did not prevent participants from completing the training. Although only 14 of the 60 residents attended the training, the resident student coordinator reported that this was about the usual number of students who attend morning conferences, thus it is not necessarily the training itself that caused this low number of attendees.

Implications and Limitations

It is difficult to generalize these findings due to the small sample size (n=14); however, past studies with small sample sizes have drawn similar conclusions. For example, Cochran et al. (2008) had 15 students who chose to participate out of a potential 28. Isler at al. (2008) had group sizes that were as small as 10 and no bigger than 20, and Roche et al. (2007) had a study group of 19 participants. All three studies, despite sample size, concluded that their participants did gain knowledge from their training based on a pre-test and post-test assessment.

The discrepancies between pre-test answers for differing question topics indicated that for certain topics (e.g., state-determined criteria for EI, EI services including family training and counseling, EI philosophy) residents already had prior knowledge of the topic. However, this could also be due to the wording of the question and/or the question being too easy. It should be noted that the pre-test questions (which were the same questions in a different order for the post-test) could have created a carry-over effect, influencing what participants learned and attended to during the presentation. Since answers were true/false and multiple-choice, it is possible that high pre-test scores could have been due to residents making an educated guess rather than a high level of previous knowledge. Moreover, instead of learning from the presentation alone, it is possible that the questions themselves helped residents gain an understanding of EI. It is also possible that participants only focused on items that were on the pre-test and did not gain a more general understanding of the information presented in the training.

In this study, both pre-test and post-test (with 20 questions) had more questions than some past studies. Roche et al. (2007) used 15 questions, and Johnson et al. (2004) used a four to seven question pre-test and an 8-14 question post-test. However, the current study did not include a control group as some past studies did (Cook et al., 2006, Roche et al., 2007) which would have strengthened its conclusions.

Modifications to the training should be made based on these initial findings. One presentation changed should be to include more specific information explaining what services can include and clarify the ways in which states may charge for EI services. Reasons for referring also seemed to be unclear; however, the solution may not be revising the presentation. The lower knowledge gains for referral procedures and best referral practices could also be due to the topic itself. Making referrals involves more personal interactions and judgments that are always unique to each family and child. Unlike information such as timelines, federal laws, and screening recommendations, the personal judgments made in referring may not be taught well through an impersonal computer. Physician mentoring, on-site training, or traditional lectures might be better alternative teaching methods for this area.

The findings from this study should be replicated with a larger number of residents. A larger sample size would allow researchers to analyze any trends based on residency year, program of study, or other demographics. A study that follows residents after the training to see if this new knowledge is retained and incorporated into their everyday practice would be a good next step. Though the post-test indicates knowledge gains, the real question is whether or not this information will make a difference to how doctors practice medicine. Without knowing this it is difficult to conclude whether a computer-based training really has had the kind of impact we hope it has had.

Since the training was less helpful with knowledge topics that branched beyond the basic knowledge level of Miller's triangle (1990), the training should be paired with actual clinical training and experience. Professional, on-site training and mentoring could help expand the residents' knowledge gain to the upper levels of Miller's triangle (e.g., "shows how," "does"). Future research is needed to explore knowledge gains for residents when this computer training is coupled with clinical training.

Another consideration for future research is the education and training of the professionals who are involved in early intervention. Some of the communication struggles between pediatricians and EI are likely to not just be the fault of pediatricians. There is a question of how much EI professionals are aware of their responsibility to communicate with pediatricians. A similar training for early interventionists may be a beneficial contribution of future research.

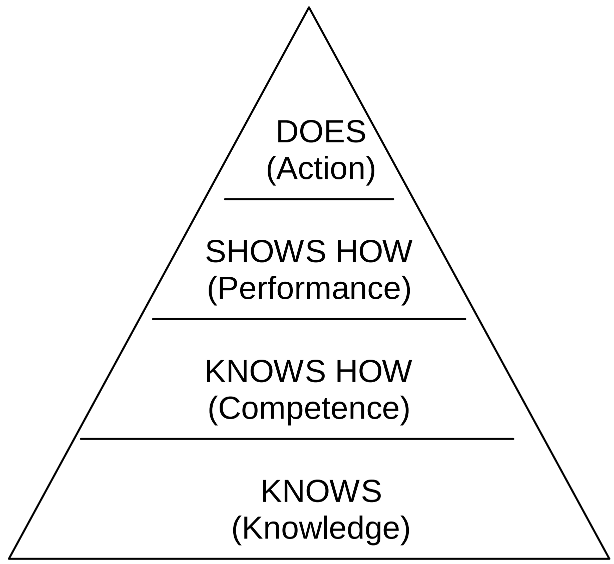
Future research should also investigate how this new type of training differs from traditional approaches. Although residents who participated in this computer training showed an overall knowledge gain, it is not clear what the gain would have been with a traditional teaching method since this was not examined. It is possible that an interactive lecture would have helped clarify those areas that appeared to be confusing to residents. Moreover, just because there seemed to be an overall gain in knowledge, this does not mean that all areas were taught equally well by this training. Future research, with a larger sample size, should look to see if any statistically significant differences exist between the different topics covered.

New technologies offer vast possibilities for medical education that have not been possible before. However, care must be taken not to replace traditional teaching methods too hastily. Further thought and research must be put into understanding the kinds of knowledge and teaching topics conducive to a computer-based training versus the kinds of knowledge and topics that should be taught through a more personal and traditional style. Philosophers such a George Grant (2000) have begun to think critically about what the computer is and the kind of knowledge and education towards which it is geared. Educators should consider these philosophical foundations when preparing information to be distributed through computerized means.

Though the computer training is logistically possible, there needs to be further consideration as to whether or not computers can educate in the same way as another person. Certain topics such as federal legislation and IFSP timelines require a different type of learning than the judgment calls that doctors must make when deciding whether or not to refer a patient to EI. Simply trying to revise the module to better educate in the areas where students seemed to be confused the most (e.g., best practice for referrals) may not be the proper response. Are there certain types of information that are better conveyed in person and other types that can be explained sufficiently by a computer? To better understand computer trainings, we need to ask the question of what kind of knowledge and learning a computer conveys. We should not presuppose that computers are suited to all types of knowledge. Current practice needs to keep this in mind, and educators should ask these questions as they consider the best ways to train our future pediatricians. The ease of using computers does not always make them the best solution where the training of future doctors is concerned.

APPENDIX A

MILLER'S TRIANGLE FOR CLINICAL ASSESSMENT[1]



This framework for the assessment of clinical knowledge begins with the most basic level of knowledge at the base of the triangle and builds up to the top level where knowledge has been thoroughly incorporated into clinical practice.

[1] Adapted from "The Assessment of Clinical Skills/Competence/Performance," by G.E. Miller, 1990, *Academic Medicine, 65* (Suppl. 9), p.S63.

APPENDIX B

PRE-TEST AND POST-TEST

Early Intervention Training

September 28, 2009

Directions

All residents will be participating in the following computer module as part of your training. It includes a pre-test and post-test along with a Microsoft PowerPoint presentation about early intervention services.

Please begin your pre-test as soon as you arrive.
Write your assigned number in the top corner box on each test packet.

When you have finished your pre-test, please place it in the assigned bin. You may then begin the training. Once you have completed the PowerPoint presentation, please take a copy of the post-test. Please place your post-test in the assigned bin before you leave.

This training is part of a research study at University of Maryland, College Park. Although all residents are required to participate in both tests and the training, you can choose to have your data withheld from the study.

May we use your pre- and post-test data for our research study?

- ☐ Yes
- ☐ No

What time are you beginning this pre-test?_________

Please write your number in this box

Pre-Test

Directions: Check the box next to the best answer(s).

Background Information

Year of residence:

- ☐ 1st year
- ☐ 2nd year
- ☐ 3rd year
- ☐ Other:____

Program of study:

- ☐ Pediatrics
- ☐ Pediatrics/emergency medicine
- ☐ Pediatrics/family medicine
- ☐ Other: _______

Gender:

- ☐ Male
- ☐ Female

How much information have you already been taught about early intervention services?

- ☐ A lot of information
- ☐ Some information
- ☐ A little information
- ☐ No information

Early Intervention Questions

1. What should you find out about your state's early intervention program to share with families? *Check all that apply*.
   - ❑ The percent delay required for eligibility
   - ❑ Diagnoses that automatically qualify as "high probability"
   - ❑ Costs to family (if any) for services
   - ❑ Name of program
   - ❑ None of the above, it's the early intervention program's responsibility to explain this information

2. At what ages does AAP recommend overall developmental screenings? *Check all that apply.*
   - ❑ 2 months
   - ❑ 6 months
   - ❑ 9 months
   - ❑ 18 months
   - ❑ 30 (or 24) months

3. At what ages does AAP recommend autism screenings? *Check all that apply*.
   - ❑ 6 months
   - ❑ 9 months
   - ❑ 18 months
   - ❑ 24 months
   - ❑ 36 months

4. Early intervention services should focus specifically on the child's needs without regard to the family.
   - ❑ True
   - ❑ False

5. Interventions should be universal with every child receiving the same exact services.
   - ❑ True
   - ❑ False

6. Early intervention services could include services up to age 7 years.
   - ❑ True
   - ❑ False

7. Early intervention services could include family training and counseling.

- ❑ True
- ❑ False

8. Early intervention services could include medical services, but only for diagnostic or evaluation purposes.

- ❑ True
- ❑ False

9. A referral should include *(Check all that apply.)*:

- ❑ Family income
- ❑ Areas of developmental concern
- ❑ Family's address and phone number
- ❑ Your contact information
- ❑ Child's date of birth

10. Reasons for a referral include (*Check all that apply.)*:

- ❑ Failing a developmental screening tool
- ❑ You suspect a developmental delay based on your observations
- ❑ The parent thinks there is a developmental delay
- ❑ The child has a high probability condition as defined in that State
- ❑ Failing an autism screening tool

11-13. Maria is a 6-month-old who failed her newborn hearing screening and subsequent BAER bilaterally. An audiologist diagnosed Maria with a severe hearing loss. Her mother and father bring her in for her well-baby visit and report that they are concerned but don't know what to do. You should:

11. Refer Maria only if she fails a developmental screening

- ❑ True
- ❑ False

12. Refer Maria based on the hearing loss alone

- ❑ True
- ❑ False

13. Wait and only refer if Maria does not start talking on time

- ❑ True
- ❑ False

14. All children with Downs syndrome should receive the same type of services.
    - ❑ True
    - ❑ False

15. Every state must charge families on a sliding scale fee.
    - ❑ True
    - ❑ False

16. Every state determines its own eligibility criteria.
    - ❑ True
    - ❑ False

17. All states are required to serve children with at-risk conditions.
    - ❑ True
    - ❑ False

18. If you suspect a developmental delay, it is best to wait until the next well-child visit to make sure the delay persists before referring.
    - ❑ True
    - ❑ False

19. How long does an early intervention program have to write an Individualized Family Service Plan (IFSP) after the date of a referral?
    - ❑ 10 days
    - ❑ 30 days
    - ❑ 45 days
    - ❑ 60 days
    - ❑ 90 days

20. Services that are included in the IFSP must then begin within ___ days after the document has been signed by the parent.
    - ❑ 10 days
    - ❑ 30 days
    - ❑ 45 days
    - ❑ 60 days
    - ❑ 90 days

Please write
your number
in this box

Post-Test

Directions: Check the box next to the best answer(s).

Early Intervention Questions

1. A referral should include *(Check all that apply.)*:
   - ❑ Family income
   - ❑ Areas of developmental concern
   - ❑ Family's address and phone number
   - ❑ Your contact information
   - ❑ Child's date of birth

2. Reasons for a referral include (*Check all that apply.)*:
   - ❑ Failing a developmental screening tool
   - ❑ You suspect a developmental delay based on your observations
   - ❑ The parent thinks there is a developmental delay
   - ❑ The child has a high probability condition as defined in that State
   - ❑ Failing an autism screening tool

3. All children with Downs syndrome should receive the same type of services.
   - ❑ True
   - ❑ False

4. Every state must charge families on a sliding scale fee.
   - ❑ True
   - ❑ False

5. Every state determines its own eligibility criteria.
   - ❑ True
   - ❑ False

6. All states are required to serve children with at-risk conditions.
   - ❑ True
   - ❑ False

7. If you suspect a developmental delay, it is best to wait until the next well-child visit to make sure the delay persists before referring.

    ❑ True
    ❑ False

8. What should you find out about your state's early intervention program to share with families? *Check all that apply*.

    ❑ The percent delay required for eligibility
    ❑ Diagnoses that automatically qualify as "high probability"
    ❑ Costs to family (if any) for services
    ❑ Name of program
    ❑ None of the above, it's the early intervention program's responsibility to explain this information

9. How long does an early intervention program have to write an Individualized Family Service Plan (IFSP) after the date of a referral?

    ❑ 10 days
    ❑ 30 days
    ❑ 45 days
    ❑ 60 days
    ❑ 90 days

10. Services that are included in the IFSP must then begin within ___ days after the document has been signed by the parent.

    ❑ 10 days
    ❑ 30 days
    ❑ 45 days
    ❑ 60 days
    ❑ 90 days

11. Early intervention services should focus specifically on the child's needs without regard to the family.

    ❑ True
    ❑ False

12. Interventions should be universal with every child receiving the same exact services.

    ❑ True
    ❑ False

13. Early intervention services could include services up to age 7 years.

    ❑ True
    ❑ False

14. Early intervention services could include family training and counseling.

- ❑ True
- ❑ False

15. Early intervention services could include medical services, but only for diagnostic or evaluation purposes.

- ❑ True
- ❑ False

16. At what ages does AAP recommend overall developmental screenings? *Check all that apply.*

- ❑ 2 months
- ❑ 6 months
- ❑ 9 months
- ❑ 18 months
- ❑ 30 (or 24) months

17. At what ages does AAP recommend autism screenings? *Check all that apply*.

- ❑ 6 months
- ❑ 9 months
- ❑ 18 months
- ❑ 24 months
- ❑ 36 months

18-20. Maria is a 6-month-old who failed her newborn hearing screening and subsequent BAER bilaterally. An audiologist diagnosed Maria with a severe hearing loss. Her mother and father bring her in for her well-baby visit and report that they are concerned but don't know what to do. You should:

18. Refer Maria only if she fails a developmental screening

- ❑ True
- ❑ False

19. Refer Maria based on the hearing loss alone

- ❑ True
- ❑ False

20. Wait and only refer if Maria does not start talking on time

- ❑ True
- ❑ False

Other

How much new information do you feel you have learned about early intervention from this module?

- ❑ A lot of information
- ❑ Some information
- ❑ A little information
- ❑ No information

How helpful was this module in helping you learn about early intervention services?

- ❑ Very helpful
- ❑ Somewhat helpful
- ❑ A little helpful
- ❑ Not helpful

What questions do you still have about early intervention services that this training did not answer?

____

____

____

What, if any, technical problems arose as you were taking this training?

____

____

____

What time did you finish this post-test? ______________

Thank You!

APPENDIX C

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APPENDIX D

QUESTION TOPICS AND ANSWERS

Question Topics for Pre-test/Post-test

EI: Federal Requirements of State Programs

Question	*Answer*
(A) What should you find out about your state's early intervention program to share with families? *Check all the apply*.	The percent delay required for eligibility, Diagnoses that automatically qualify as "high probability," Costs to family (if any) for services, Name of program
(O) Every state must charge families on a sliding scale fee. (T/F)	False
(P) Every state determines its own eligibility criteria. (T/F)	True
(Q) All states are required to serve children with at-risk conditions. (T/F)	False

EI: Services

Question	*Answer*
(F) Early intervention services could include services up to age 7 years. (T/F)	False
(G) Early intervention services could include family training and counseling. (T/F)	True
(H) Early intervention services could include medical services, but only for diagnostic or evaluation purposes. (T/F)	True

EI: Timelines

Question	*Answer*
(S) How long does an early intervention program have to write an Individualized Family Service Plan (IFSP) after the date of a referral?	45 days
(T) Services that are included in the IFSP must then begin within ___ days after the document has been signed by the parent.	30 days

EI: Philosophy

Question	*Answer*
(D) Early intervention services should focus specifically on the child's needs without regard to the family. (T/F)	False
(E) Interventions should be universal with every child receiving the same exact services. (T/F)	False
(N) All children with Downs syndrome should receive the same type of services. (T/F)	False

Physician's Role: AAP Recommendations

Question	*Answer*
(B) At what ages does AAP recommend overall developmental screenings? *Check all that apply.*	9 months, 18 months, 30 (or 24) months
(C) At what ages does AAP recommend autism screenings? *Check all that apply.*	18 months, 24 months

Physician's Role: Referral Procedures

Question	*Answer*
(I) A referral should include *(Check all that apply.)*:	Areas of developmental concern, Family's address and phone number, Your contact information, Child's date of birth
(J) Reasons for a referral include (*Check all that apply.)*:	Failing a developmental screening tool, You suspect a developmental delay based on your observations, The parent thinks there is a developmental delay, The child has a high probability condition as defined in that State, Failing an autism screening tool

Physician's Role: Best Practice For Referrals

Question	*Answer*
*(K) Refer Maria only if she fails a developmental screening (T/F)	False
*(L) Refer Maria based on the hearing loss alone (T/F)	True
*(M) Wait and only refer if Maria does not start talking on time (T/F)	False
(R) If you suspect a developmental delay, it is best to wait until the next well-child visit to make sure the delay persists before referring. (T/F)	False

**Note.* Questions K, L, and M are case study questions. They correspond to the following scenario which was printed with these questions in the pre-test and post-test: "Maria is a 6-month-old who failed her newborn hearing screening and subsequent BAER bilaterally. An audiologist diagnosed Maria with a severe hearing loss. Her mother and father bring her in for her well-baby visit and report that they are concerned but don't know what to do. You should…" True/False questions are indicated with the abbreviation "T/F," and the remaining questions are multiple choice/multiple answer questions. The answer choices for these questions can be seen in the copy of the pre-test/post-test provided in Appendix B.

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