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Qualitative and quantitative analysis of a new educational implement for the newborn nursery

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ABSTRACT

In this era of duty hour restrictions time is premium. Many programs are utilizing new and innovative ways to meet the educational demands of training with less direct time to do so. The authors wanted to develop an online educational supplement, and test its effectiveness in learners in the newborn nursery. Six educational modules were created for the learners (Pediatric and Family Medicine residents, and Senior Medical students) to augment their nursery education. Two tests were created to assess learner's acquisition of the modules content. One test was given prior to the start of the modules, and the second test given after completion of both the modules and rotation. Residents who completed the rotation prior to the start of the study were tested for comparison purposes. Seventy-six learners participated. Test level statistics, (KR-20, point biserial, Cohen D) were utilized to assess the tests' reliability, performance between all users, and effect size between groups. Participants rated the modules 9 of 10 on educational value. Time to completion averaged from 1 to 3 hours. Learners showed improvement from 0.8 to 3.5 standard deviations. KR-20 is 0.73 and 0.58, and average point biserial was 0.3 and 0.2 for Test A and Test B. Two-tailed t-test analysis showed that the tests were equally challenging. The modules were easily integrated, and participants enjoyed the use of the modules. All learners showed improvement, and the AI's acquired a knowledge base in newborn care equal to that of senior residents who completed the old educational model. The online educational supplement was easy to implement, and showed benefit to the learners. The use of the modules will continue with future groups, and given their success in the newborn nursery will be expanded into the Neonatal Intensive Care Unit, and the Pediatric Inpatient Unit.

INTRODUCTION

Developing didactic curricula is becoming more challenging with the advent of duty-hour restrictions for Resident trainees. Night shifts, post-call departures, continuity clinic, and patient care obligations can limit the ability of trainees to attend structured lecture times. The educational experience in this new era of house-staff duty hours must be multifaceted, and flexible.

Acting Interns (AIs) also present an educational challenge simply because there are so few of them on a rotation at any time. Acting Interns are third or fourth year medical students completing a required medical school rotation, usually in the area they plan to practice in the future. The role of AIs has been significantly reduced by restrictions on their use of the electronic medical record, especially the electronic physician order entry system, and at times it is challenging to create responsibilities for them that are unique and above those of their junior medical student colleagues on the rotation.

Given the difficulty presented by both sets of trainees, residents and students, it is necessary for educators to create new models to train future physicians. Although no studies to date have shown that the new duty hours or altered responsibilities affect resident and senior medical student education, program directors and medical educators are concerned, and are considering

alternate learning models or extending training time to appropriately prepare trainees [1-3]. Online or e-education is emerging in multiple formats and proving to be effective in providing education which can be tailored to the learners' needs, and a great deal of information exists to guide faculty in developing online educational tools [4-7]. Online and distance education have demonstrated efficacy and efficiency when used alone as well as in conjunction with traditional teaching methods in medical education. Face to face learning and online education alone are effective tools, but used together enhance the learners' and educators ability to achieve educational goals [5,8-11]. Currently the literature is limited on quantitatively assessing the effectiveness of these newer learning models. Online teaching has been shown to increase knowledge retention as well as predict clinical performance (9). More so it can shape practice attitudes, change physician practice in the long term, and increase the clinical confidence in practitioners [9,12-15]. Online education is also easy to adapt into existing medical curricula [13].

To address educational objectives in the midst of increasing challenges in getting learners together, we created six online educational modules for our student and resident trainees on our Newborn Nursery rotation. The goals of our online curriculum were to create an effective learning model that was flexible and easy to use for both educators and learners. It was also important to demonstrate the effectiveness of this new model quantitatively with test level statistics, and qualitatively with surveys of learners and educators alike. With these data points, if successful, would allow the educators to determine the effectiveness of the new approach and consider expanding this model to more areas of training in the Department of Pediatrics.

METHODS

Module Development

The purpose of the cases and questions in the modules were designed to convey defined educational objectives. The educational objectives for the modules were developed from the guidelines or educational expectations for newborn care set by the American Academy of Pediatrics (AAP), Accreditation Council for Graduate Medical Education (ACGME), Council on Medical Student Education in Pediatrics (COMSEP), and the neonatal nursery topics for newborn education at our institution [16-18]. There are a total of 6 modules with 62 patient-based cases. The educational modules were designed to mirror a day and night in the newborn nursery (NBN). During a day in the newborn nursery an intern or AI would be expected to admit new patients, discharge patients, manage common newborn problems, and visit with families. In the evenings, the expectations revolve around attending deliveries, admitting patients and managing issues that arise, particularly jaundice during what we refer to as evening 'bilirubin rounds'. Cases for the modules were designed to fit into these routine activities, and arranged in a fashion to emulate a routine day in the newborn nursery. Each module contained 10 cases. Each case contained 3 to 5 open ended questions directly related to each case. The patient-based case stems resembled patients the learners routinely encounter in the newborn nursery. The modules were displayed in Design a Case (www.designacase.org). Design a Case is a UT system product for the development and display of online educational modules. This program provides progressive information related to a clinical case, with prompts for the learner to provide free text responses to focused questions [19]. A case example with exemplar question would be: *A 39 week AGA female develops respiratory distress, grunting and flaring, 3 hours after delivery. What is the differential diagnosis of respiratory distress in the transitional newborn period?* Once all of the questions related to the case are completed by the participants they are able to see the faculty response to those same prompts. Content for the faculty responses was derived from common resources utilized by the housestaff in the neonatal nurseries. The modules were peer reviewed by the Neonatologists at our institution for content errors, and beta tested on AIs prior to their implementation. When the modules were finalized and implemented they were made mandatory as part of the completion of the newborn nursery rotation for student and resident trainees. Participation in the study, completion of pre and post testing, was not mandatory as part of completing the newborn nursery rotation. Learners were able to complete the modules anywhere they could access the internet, and the program allows learners to stop a module at any point with their answers saved for later completion. Learners had the option to work on modules during the rotation when clinical care was complete, or at home after hours. The modules were administered to the AIs and Interns at the start of their 4 week long newborn nursery month after completion of their pre-test.

Testing

Tests before and after the completion of the modules was utilized to assess the modules' effectiveness at conveying the educational goals. A total of 80 multiple choice, board-style questions were written based on the educational objectives of the individual cases. The questions were reviewed by faculty with extensive question writing experience. These questions were then divided into two 40-question tests, Test A and Test B. Group 1 was given Test A followed by Test B. Group 2 was given Test B followed by Test A. This

was done in order to compare the difficulty of Test A to Test B after the first year. The tests were not administered to a preliminary group prior to implementation in the study. Test performance results are all from the testing group, and no adjustments to the tests were made during the study.

Participants

The research group includes AIs, Pediatric and Family Medicine interns recruited during the 2010-2011, and 2011-2012 academic years. Participants recruited in the 2010-2011 academic year are represented in Group 1, and those recruited in the 2011-2012 academic year are represented in Group 2. All the acting interns in this study were fourth year medical students. The AIs rotation entails completing 2 weeks in the Neonatal Intensive Care Unit and 2 weeks in the Newborn Nursery. The Newborn Nursery portion is divided into 1 week of day shifts and 1 week of night shifts. Twenty-six total AIs participated, 17 in the first year and 9 in the second year.

Family Medicine housestaff complete one month of Newborn Nursery during their intern or second year. Three participated in the study, and all of them were interns.

Pediatric interns in our program complete 6 weeks of Newborn Nursery during their first year. Initially they complete 4 weeks of day shifts followed later by 2 weeks of night shifts. Pediatric residents in their second year complete another two weeks of night shifts. Pediatric residents included rising 2nd year, rising 3rd year, and graduating 3rd year housestaff completing their training from 2010 to 2012. This group of residents represented the old academic model, receiving only standard bedside teaching with daily didactic lectures. They were given Test A and B for comparison purposes with the research group.

Module Evaluations

The Design a Case program has a built in function to query the learners in regards to the educational modules. It also tracks the length of time it takes individuals to complete modules including the number of times they logged into the module before completion. Learners evaluate the educational value of the modules with a 1-10 Likert scale, with 10 being the best. The learners are also asked yes or no questions as to whether or not the level of information or cases seemed appropriate, if they had difficulty accessing any of the links or content, or if they felt that any of the information was incorrect. The learners also had access to free text boxes to explain difficulties, and to put in any comments they felt were useful for the case authors. Learner comments were reviewed, and content modified when corrections or clarifications were suggested. Module content was updated as new guidelines were made available.

Data Analysis

Data analysis was completed with CITAS, Classical Item and Test Analysis Spreadsheet. CITAS is a Microsoft Excel spreadsheet that provides test level statistics such as reliability, and item level statistics such as difficulty (*P)* and discrimination (*rpbis*) [20]. Test reliability was indexed using the Kuder-Richardson Formula 20 (KR-20). The Cohen D statistic was utilized to test the effect size between the groups taking Test A and Test B [21]. A two-tailed t-test was performed to assess whether the tests performed equally.

RESULTS

Seventy-six participants were enrolled in the study. Table 1 represents the total number of participants in the study broken down by level and area of training, and whether they completed the modules or were used for comparison purposes. Table 2 outlines the learners' concerns with the ability to utilize the modules, content concerns, educational value, and time to completion. There were no participants who had any difficulty accessing the cases or links, and the few content concerns listed revolved around clarity of case stems and their subsequent questions. The modules were rated highly by the participants, averaging 9 out of 10 for each module. The amount of time it took the participants to complete the modules varied greatly, but most were completed in 1-3 hours. The feedback was 100% positive in 4 of the 6 modules, and more than 90% for the other 2. There were many positive comments listed by participants mainly in regards to the overall usability and application of the information directly to their rotation. There were only 2 negative comments for all of the participants. The learner stated that some of the case stems were confusing, and that several of the short answer questions required too much information. Table 3 represents the test performance of all users listed in number of questions answered correctly with standard error of the mean divided by group, and level of training. Cohen D statistics are listed when tests and effect size could be determined, and the KR-20 values are for all users, Group 1 and 2 for each test. When comparing Test A to Test B in equivalently experienced learners, they performed equally with one exception. When utilized as a posttest learners performed better on Test A compared to Test B, (28.9 ± 3.1 vs 24.6 ± 3.5 correct with a p value <0.003). Test A and B performed equally as pretests, (20.8 ± 4 vs. 19.4 ± 2.5 with a p value of 0.19). Both tests showed a similar magnitude of improvement from pretest to posttest (Test A, 20.8 ± 4 vs 28.9 ± 3.1 correct, $p<0.001$, and Test B 19.4 ± 2.5 vs 24.6 ± 3.5, $p<0.001$). The KR-20 values for Test A and B can be seen in Table 3. The average point biserial for Test A was 0.3 (-.05 to 0.6), and Test B was 0.24 (-.07 to 0.6).

Table 1. Demographics of participants completing modules

Demographics	Total	Subgroup
Total N	76 (25% Male, 74% Female)	51 - completed the modules 25 - did not complete the modules and were used for comparison
Categorical Pediatrics	n=47 (62%)	22 - completed the modules 25 - did not complete the modules and were used for comparison
Family Medicine	n=3 (4%)	All completed the modules
Acting Interns	n=26 (34%)	All completed the modules

Table 2. Survey results of individual module evaluations by participants including percentage of problems related to content or ease of use of the computer program, educational value, and time to completion of individual models when completed in 1 sitting.

Module#	% Content Concerns	% Navigation Concerns	Educational Value (0-10) –Likert Scale	Time to Completion
1 – 10 cases	0	0	9.1 ± 0.13	2h, 49min ± 1h, 49min
2 – 10 cases	3	0	8.9 ± 0.17	1h, 16min ± 55min
3 – 10 cases	11	0	8.8 ± 0.17	1h, 4min ± 32min
4 – 10 cases	25	0	9 ± 0.14	1h, 47min ± 1h, 5min
5 – 11 cases	0	0	9 ± 0.15	2h, 22min ± 1h, 31min
6 – 11 cases	10	0	8.8 ± 0.19	1h, 45min ± 1h, 7min

Table 3. Test scores of participants by educational level listed as number of questions correct with standard error of the mean, effect size between groups (Cohen D), and test reliability (KR-20)

Group 1				
Learner Type (Graduation Year)	**N**	**Test A Pre-Module**	**Test B Post-Module**	**Cohen D**
Acting Interns	17	22.3 ± 3.8	25.4 ± 3.7	0.83
July Pediatric Interns (2013)	11	18.6 ± 4	23.1 ± 2.9	1.3
Family Medicine Interns (2013)	3	21.3 ± 0.6	23.3 ± 3.1	0.9
Group 2				
Learner Type (Graduation Year)	N	Test B **Pre-Module**	Test A **Post-Module**	Cohen D
Acting Interns	9	19.6 ± 2.2	28.6 ± 3.2	3.5
July Pediatric Interns (2014)	11	19.3 ± 2.7		
June Pediatric PGY1 (2012	9	21.5 ± 2.9	29 ± 2.6	2.7
June Pediatric PGY2 (2011	9	25 ± 2.4	28 ± 1	1.6
June Pediatric PGY3 (2010)	7	24.9 ± 2.7		
KR-20 – All Groups		0.73	0.58	

DISCUSSION

In this new era of housestaff duty hour restrictions time is the premium, and the opportunity to educate future physicians is a challenge. While no research to date has shown that duty hour restrictions have affected learning, and thus patient care, it is easy to see that the less time housestaff are available for clinical care, the less time they are available for direct face to face education. Many residencies and medical schools are utilizing new and innovative ways to meet the educational demands of training with less direct time to do so. To meet this demand at our institution we augmented the educational experience in the NBN with

6 online educational modules designed to enhance the clinical experience of the resident and student trainees. Effectiveness of this new intervention was defined by quantitative improvement in tests administered before and after the rotation, and a qualitative survey of participants after completing the modules. Determination of the effectiveness of this intervention was important for several reasons. First it was important to show that the new modules added to the overall learning and educational experience for trainees. Second the data would help support the expansion of this educational program to other areas of the Pediatric training program.

This new educational model met and exceeded the authors' expectations. The modules were easy to create, and implement into the existing training program. The participant response was overwhelmingly positive in regards to both content and ease of use. Each of the groups that participated in the new curriculum showed improvement from their first to second test. The improvement was demonstrated in the short term, over 1 month, and the long term over the course of 1 year. After the completion of the modules the AI's performed equally on tests with the senior Pediatric residents who did not complete the modules. These findings are similar to those of Shaw et al, and Taradi et al who utilized a blended learning model and showed an effect size of 0.7, and a "moderate" effect size respectively [10,11].

The study has several limitations. The primary limitation is the number of participants so far. To assess pass or fail on a high-stakes standardized exam, the KR-20 value should be 0.8 or more, and individual questions should have a point biserial of 0.2 at a minimum or 0.3 to be considered good. The KR-20 of Test A and Test B here reach 0.72 and 0.58 respectively, and the average biserial of the questions are 0.3 and 0.24. For the purposes of this study these numbers are more than adequate. The next limitation is that the improvement we see can't be completely attributed to the modules. Learning is dependent on the learner and their improvement in part is related to the modules, but also to their individual approach to learning. Some participants may relate well to this format of education, but others will continue to prefer bedside teaching or reading from review texts. These differences will affect how much the modules impacted the individual learner. This can be seen in the wide range of time spent on the modules by the participants. Those interested in this educational format will spend more time engaging the modules and the questions thus gaining more from the modules than someone who quickly goes through the modules.

The modules have made a positive impact on the learning in our newborn nursery, and they have given the educators a tool to convey information in the care of the newborn in this era of limited face to face educational time. Given the success of these modules, and the positive comments from both faculty and learners we will continue to utilize this tool to aid in the educational endeavors in the newborn nursery. The plan is to expand and create similar modules for our Neonatal Intensive Care Unit as well as the Inpatient Pediatric unit.

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REFERENCES

1. Antiel RM, Thompson SM, Hafferty FW, James KM, Tilburt JC, Bannon MP, Fischer PR, Farley DR, Reed DA. Duty hour recommendations and implications for meeting the ACGME core competencies: views of residency directors. Mayo Clin. Proc. 2011 Mar;86(3):185-91.
2. McCoy CP, Halvorsen AJ, Loftus CG, McDonald FS, Oxentenko AS. Effect of 16-hour duty periods on patient care and resident education. Mayo Clin. Proc. 2011 Mar;86(3):192-96.
3. Rockey PH. Duty hours: where do we go from here? Mayo Clin. Proc. 2011 Mar;86(3):176-78.
4. D'Alessandro DM, Lewis TE, D'Alessandro MP. A pediatric digital storytelling system for third year medical students: the virtual pediatric patients. BMC Med Educ 2004 Jul;4:10.
5. Cook DA, Dupras DM. A practical guide to developing effective web-based learning. J Gen Intern Med 2004 Jun;19(6):698–707.
6. Sisson SD, Hill-Briggs F, Levine D. How to improve medical education website design. BMC Med Educ 2010;10:30.
7. Wong G, Greenhalgh T, Russell J, Boynton P, Toon P. Putting your course on the Web: lessons from a case study and systematic literature review. Med Educ 2003 Nov;37(11):1020-23.
8. Lewin LO, Singh M, Bateman BL, Glover PB. Improving education in primary care: development of an online curriculum using the blended learning model. BMC Med Educ 2009;9:33.
9. Weston CM, Sciamanna CN, Nash DB. Evaluating online continuing medical education seminars: evidence for improving clinical practices. Am J Med Qual 2008 Dec;23(6):475-83.

10. Shaw T, Long A, Chopra S, Kerfoot BP. Impact on clinical behavior of face-to-face continuing medical education blended with online spaced education: a randomized controlled trial. J Contin Educ Health Prof 2011 Mar;31(2):103–08.
11. Taradi SK, Taradi M, Radic K, Pokrajac N. Blending problem-based learning with Web technology positively impacts student learning outcomes in acid-base physiology. Adv Physiol Educ 2005 Mar;29(1):35–39.
12. Casebeer L, Allison J, Spettell CM. Designing tailored Web-based instruction to improve practicing physicians' chlamydial screening rates. Acad Med 2002 Sep;77(9):929.
13. Metcalf MP, Tanner TB, Buchanan A. Effectiveness of an online curriculum for medical students on genetics, genetic testing and counseling. Med Educ Online. 2010; Jan 29:15.
14. Ruiz JG, Mintzer MJ, Leipzig RM. The impact of E-learning in medical education. Acad Med 2006 Mar;81(3):207-12.
15. Alexander EK, Bloom N, Falchuk KH, Parker M. Using a web-based, iterative education model to enhance clinical clerkships. Acad Med 2006 Oct;81(10):925-31.
16. ACGME Program Requirements for Graduate Medical Education In Pediatrics. Chicago, IL: Accredidation Council for Graduate Medical Education; 2007. Available via http://www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/320_pediatrics_07012007.pdf (Accessed 18 September 2011).
17. Committee on Fetus and Newborn. Available via http://www.aap.org/visit/cmte17.htm (Accessed 18 September 2011).
18. Welcome to COMSEP : Curriculum : Curriculum Competencies and Objectives. Available via http://www.comsep.org/Curriculum/CurriculumCompetencies/index.htm (Accessed 10 November 2011).
19. Bulik R, Shokar G. The Design a Case Story 2000. Available via http://www.designacase.org/AboutUs.aspx (Accessed 18 September 2011).
20. Thompson N. Classical Item and Test Analysis with CITAS White Paper. Assessment Systems Corporation; 2009.
21. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed, Lawrence Earlbaum Associates, Hillsdale, NJ, 1988.