Taking Well-Child Care Into the 21st Century

A Novel, Effective Method for Improving Parent Knowledge Using Computerized Tutorials

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Background: Despite expert panel recommendations, few pediatric providers administer sufficient anticipatory guidance and educational counseling during well-child visits, largely owing to lack of time.

Objectives: To design a waiting room educational kiosk that uses interactive, self-guided, computerized tutorials to give anticipatory guidance to parents at the 6-week and 4-month well-child visits, and assess impact on parent knowledge. The intervention required no additional provider time, and automatically printed a summary for the medical record.

Setting: A government-funded hospital serving Navajo patients in New Mexico.

Methods: After a well-child visit, knowledge regarding issues such as fever management, dental care, sleep position, nutrition, and car seat use was tested in a group of parents receiving standard care (control), and a group using the computerized tutorials in addition to standard care (intervention).

Results: Fifty-two parents in the control group and 49 parents in the intervention group completed the knowledge assessment. Ninety-five percent of intervention subjects completed the computerized tutorial without clinic staff involvement. Compared with the control group, the intervention group had superior knowledge in all tested areas. The percentage of correct responses to all questions was higher for the intervention group in the following categories: car seat use (49% vs 31%, *P* < .01), dental care (80% vs 27%, *P* < .001), and nutrition (43% vs 21%, *P* < .001). Among parents of 6-week-old infants, a greater number of parents in the intervention group identified fever as 100.4°F or higher (86% vs 50%, *P* < .001), and fewer replied that they would give antipyretics to a febrile child younger than 3 months old without consulting a provider (52% vs 100%, *P* < .001). The percentage of parents with a perfect score or only one question wrong on the 21-item test was 17-fold higher in the intervention group (*P* < .001).

Conclusion: Computerized anticipatory guidance at well-child visits increases knowledge over printed materials alone and is usable by the majority of parents.

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Anticipatory Guidance during well-child visits, defined as education and counseling to influence a parent's behavior and thus improve a child's health, is simultaneously recommended by authorities and neglected by practitioners. The federal Early and Periodic Screening, Diagnostic and Treatment Services program was created for healthy children in 1967. Twelve years later, Surgeon General Julius Richmond published Healthy People: The Surgeon General’s Report on Health Promotion and Disease Prevention, which addressed the importance of preventive health services. These efforts to improve children's health culminated in the 1994 publication of Bright Futures by the Maternal and Child Health Bureau of the Health Resources and Services Administration.

Bright Futures prescribed a curriculum for parents at well-child visits, including accident avoidance, nutrition, proper dental care, sleep position, and a host of other basic topics. In general, the impact of such teaching has been poorly studied. The US Office of Technology Assessment reported that “sample sizes have been uniformly too small and follow-up too brief to identify mortality changes; the available measures of childhood morbidity have been inadequate, and most investigators have not even looked at children's developmental outcomes.” Nonetheless, one study showed a correlation between teaching effort and maternal knowledge. Another study showed that intensive anticipatory guidance with home visits improved certain scores of maternal-infant interaction. Few pediatricians dispute the common-sense notion...
that, in an ideal practice setting, anticipatory guidance, as described in Bright Futures, is a key component of well-child care.

However, for many reasons, most pediatricians do not administer adequate anticipatory guidance. It is impractical to spend large amounts of time on guidance. On average, revenue from 10 patient visits per day covers overhead costs, which necessitates short visits. Pediatricians spend only 8% of the time of a well-child visit (less than a minute) providing anticipatory guidance, an amount that diminishes with increasing patient age.

A solution to this divergence between guidelines and practice requires an efficient, interactive method of delivering education that demands no additional provider time. To address the need for more practical methods of delivering anticipatory guidance, we developed and assessed the impact of a waiting room education kiosk with computerized tutorials for parents of infants at the 6 week and 4 month well-child visits in a community health clinic.

METHODS

The project was approved by the hospital health board and the Navajo Nation Human Research Review Board.

PROJECT POPULATION AND PARTICIPANTS

The study population consisted of parents of children receiving healthy well-child visits at 6 weeks and 4 months of age at the Gallup Indian Medical Center in Gallup, NM. As part of the US Indian Health Service, the Gallup Indian Medical Center serves a population of 40,000 almost exclusively Navajo patients in one of the most impoverished counties of New Mexico. In the pediatric clinic, 11 full- and part-time staff pediatricians and 3 mid-level providers see about 30,000 outpatients and attend to about 800 newborns delivered at the hospital each year.

For the first 2 months of the 4-month study period, all parents of healthy 6-week-old and 4-month-old infants (the control group) received standard well-child care. Prior to the face-to-face visit, patients were handed a packet of reading materials about well-child care to be reviewed in the waiting room, as was routine practice before the study. After the provider visit, parents were asked to complete a written questionnaire assessing well-child knowledge. Participants received additional counseling from the study coordinator regarding any erroneous responses after completing the questionnaire.

For the second 2 months of the 4-month study period, all parents of 6-week-old and 4-month-old infants (the intervention group) completed the computerized tutorial before a visit with the provider, in addition to receiving the packet of written materials. After the visit, the same written questionnaire was completed and recorded, as with the control group. To avoid confusion, parents of 4-month-old infants who had previously completed the questionnaire at the 6-week visit during the control period were excluded from analysis.

INTERVENTION DESIGN AND IMPLEMENTATION

Content for tutorials was abstracted from Bright Futures “Promotion of Health Habits” guidelines for 2 month and 4 month visits, with minor modifications. The tutorials are interactive and provide positive feedback or corrections based on responses. Responses are used to generate a complete encounter note for the provider before the face-to-face visit.

The Internet-based tutorials were programmed using JavaScript and Active Server Pages (Microsoft Corp, Redmond, Wash). Software design was completed with Dreamweaver UltraDev 4.0 (Macromedia Inc, San Francisco, Calif), graphic design with Microsoft PhotoDraw 2.0, database functions with Microsoft Access 2000 queried by the Microsoft ActiveX Data Objects library, and Internet serving with a remote Microsoft Windows NT server.

Because mouse and touch screen input requires the least amount of instruction for effective teaching, a Dell desktop computer (DELL Inc, Round Rock, Tex) equipped with a touch-screen (MagicTouch, Keytec Inc, Richardson, Tex), running Microsoft Windows NT 4.0 and Internet Explorer 5.5 was set up in a waiting room. Preliminary testing showed that the average patient took 10 to 20 minutes to complete the tutorial program. The complexity of the process was similar to using an automated teller machine.

Participants were first checked in by a clerk, who registered the child via a password-protected Internet form. The parent was then directed to the education kiosk, where he or she logged on to a touch-enabled computer using their registration information, completed the instructional tutorial, and then returned to the waiting room. The clerk then printed the report of the visit, which the provider reviewed during his or her visit with the parent and child, and then inserted into the medical record.

Sample educational modules can be viewed and completed at http://www.prevista.net, using registration number 1234. Full access to register patients and view patient summary notes can be obtained by contacting the study author. The tutorials are noncommercial.

SURVEY INSTRUMENT

Involving both multiple choice and fill-in-the-blank questions, a 21-item questionnaire testing knowledge about car seat use, fever management, sleep position, infant nutrition, dental care, and basic demographics was developed and administered. Sample questions included, “Where in a vehicle should you put the baby’s car seat?” and “By what age should your baby stop drinking from a bottle?” Questions regarding fever were omitted from the 4-month visit questionnaire; otherwise the 6-week and 4-month questionnaires were identical. Blank responses were considered incorrect.

STATISTICAL ANALYSIS

Using Microsoft Excel, we compared mean values of continuous variables using the Student t test and proportions using \( \chi^2 \) analysis.

RESULTS

DEMOGRAPHICS AND FEASIBILITY

During 4 months, a total of 101 parents participated in the project: 52 in the control group and 49 in the intervention group (Table 1). Demographic characteristics of the control and intervention groups were similar for mean age, rate of high school graduation, number of other children, and average number of parenting books owned.

Of the parents registered for the computer tutorial by a clerk, 95% were able to operate the computer screen...
unassisted and complete the program without any guidance from a clinic staff member.

**KNOWLEDGE**

Superiority in knowledge in the intervention group compared with the standard education group was found in all tested areas, and was substantial and significant in the majority of areas (Table 2). Parents in the intervention group scored higher on questions testing their knowledge of car seat use, fever management, sleep position, dental care, and nutrition.

Overall, the percentage of total correct responses to the questions was 61% in the control and 81% in the intervention group ($P<.001$). The percentage of parents with a perfect score or only one question wrong was 2% in the control and 35% in the intervention group ($P<.001$).

**PROVIDER FEEDBACK**

Providers reported no additional time or involvement required on their part for the intervention. Providers read the printout prior to the visit and tailored anticipatory guidance to areas of knowledge deficiency. Because the reports could be inserted directly into the medical record, a decrease in charting time was reported by several providers, although the amount was not quantified.

**COMMENT**

Computer-based training (CBT) offers significant potential for patient education. In a review of randomized trials involving computer-based education, 21 (95%) of the 22 CBT interventions produced positive results, including clinical effect, patient satisfaction, and patient knowledge.$^{11}$ For example, in a hospital-wide study using CBT to increase universal precaution compliance, the intervention group was more likely to use universal precautions.$^{12}$ Computer-based training offers advantages of interactivity and tracking, compared with information delivered via video and paper.$^{13,14}$

Although comprehensive anticipatory guidance is recommended in *Bright Futures*, a substantial gap between theory and practice remains. Perhaps the greatest barrier to effective anticipatory guidance is a lack of time from providers. We uncovered substantial knowledge deficits regarding car seat use, fever management, infant feeding, and dental care following routine well-child visits. However, this does not mean that populations are not teachable; for example, an intensive “back to sleep” campaign at the project hospital has led to almost complete adoption of proper sleep positioning, as reflected in the project questionnaire. This campaign consisted of the following: a mandatory video on the postpartum unit for new mothers, reinforcement and written confirmation of information given to the mother by the discharging pediatrician, nursing policy mandating that the “back to sleep” position be discussed by the mother’s nurse, and handouts given to mothers at prenatal visits. Unfortunately, this level of scrutiny cannot be applied to every single item recommended by *Bright Futures*, especially since the well-child visits are outpatient.

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**Table 1. Participant Demographics**

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n = 52)</th>
<th>Intervention Group (n = 49)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y</td>
<td>27.5</td>
<td>27.1</td>
<td>.78</td>
</tr>
<tr>
<td>Have high school diploma, %</td>
<td>79</td>
<td>83</td>
<td>.29</td>
</tr>
<tr>
<td>Mean No. of other children</td>
<td>2.2</td>
<td>1.8</td>
<td>.17</td>
</tr>
<tr>
<td>Mean No. of parenting books at home</td>
<td>1.3</td>
<td>1.4</td>
<td>.40</td>
</tr>
</tbody>
</table>

**Table 2. Percentage of Correct Answers on Postvisit Questionnaire**

<table>
<thead>
<tr>
<th>Question</th>
<th>Control Group (n = 52)</th>
<th>Intervention Group (n = 49)</th>
<th>Relative Improvement Attributed to Intervention</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use rear-facing car seat in rear seat</td>
<td>71</td>
<td>92</td>
<td>29</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Know to forward face car seat at 12 mo/20 lb</td>
<td>46</td>
<td>53</td>
<td>15</td>
<td>.30</td>
</tr>
<tr>
<td>Optimal car seat knowledge</td>
<td>31</td>
<td>49</td>
<td>59</td>
<td>.01</td>
</tr>
<tr>
<td>Can define fever ($\geq 0.5 ^\circ F^*$)</td>
<td>50</td>
<td>86</td>
<td>71</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Use antipyretics in fever &lt;3 mo without visit*</td>
<td>100</td>
<td>72</td>
<td>48</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Optimal fever knowledge*</td>
<td>0</td>
<td>43</td>
<td>9</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Knows “back to sleep” positioning</td>
<td>98</td>
<td>100</td>
<td>2</td>
<td>.30</td>
</tr>
<tr>
<td>Begin toothpaste when tooth erupts†</td>
<td>46</td>
<td>88</td>
<td>90</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>OK to sleep with bottle of formula or breast milk</td>
<td>35</td>
<td>8</td>
<td>76</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Will wean bottle by 12 mo</td>
<td>67</td>
<td>98</td>
<td>46</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Optimal dental knowledge</td>
<td>27</td>
<td>80</td>
<td>196</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Avoid honey until 12 mo</td>
<td>50</td>
<td>61</td>
<td>22</td>
<td>.11</td>
</tr>
<tr>
<td>Avoid cow’s milk until 12 mo</td>
<td>71</td>
<td>76</td>
<td>6</td>
<td>.44</td>
</tr>
<tr>
<td>Begin solid foods at 4-6 mo</td>
<td>46</td>
<td>71</td>
<td>55</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Avoid eggs until 12 mo</td>
<td>46</td>
<td>71</td>
<td>55</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Optimal food knowledge</td>
<td>21</td>
<td>43</td>
<td>103</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Perfect score or only 1 question wrong</td>
<td>2</td>
<td>35</td>
<td>1704</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Average percentage of questions correct</td>
<td>61</td>
<td>81</td>
<td>33</td>
<td>.01</td>
</tr>
</tbody>
</table>

*Fever questions performed only for 6 week visit (n = 29 for control group and n = 21 for intervention group).
†Recommendation of US Indian Health Service Dental Program.
The requirements of anticipatory guidance make it an ideal candidate for CBT. In this project, CBT effectively increased knowledge without an increased provider time commitment. Providers will save time because CBT generates automated charting notes. Since many patients spend time in waiting rooms before visits, they would benefit from CBT intervention and use existing “down time” more efficiently.

In the area served by the project hospital, almost 80% of all children have dental caries. In addition, car seat observation studies in public areas show epidemic numbers of incorrectly secured infants. In such areas, parents may have limited resources to purchase instructional books and videos for their reference, and a well-child visit may be one of few opportunities to improve the knowledge and health practices of families.

Overall, the addition of CBT increased questionnaire performance regarding well-child issues from 61% to 81%. In particular, 35% of CBT participants had perfect or near-perfect scores, compared with 2% of those getting standard well-child care. This suggests that in addition to the overall benefit achieved with CBT, a subgroup of parents benefit to an unusually high degree from computer-based education in addition to standard printed documentation. The level of improvement by these parents indicates both an unfulfilled need for CBT and a missed teaching opportunity for providers.

The cost of implementing an education kiosk was relatively small. The computer and touch-screen monitor cost $700, and the monthly Internet access fee was $25.

Although this pilot study suggests that CBT may improve parent knowledge, future studies may assess the retention of this information at later visits, and also whether the tutorials positively influence actual behavior and improve patient outcomes. Also, specific pictorial contents and layouts can be selectively analyzed to determine the most educationally potent designs for future tutorials.

Patients are becoming increasingly familiar with computers and their operation; in this study, 95% of participants had no difficulty using CBT. Waiting room education or screening may be expanded in the future to cover all infant well-child visits. Time-consuming screening and counseling for depression, substance abuse, and other issues for older pediatric patients at routine physical visits may be automated, tracked, and scored by such instruments. Additionally, histories and initial documentation for common pediatric outpatient complaints may be automated by this method.

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REFERENCES