

# MySmileBuddy: An iPad-Based Interactive Program to Assess Dietary Risk for Early Childhood Caries

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## ARTICLE INFORMATION

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**E**ARLY CHILDHOOD CARIES (ECC), DEFINED AS THE occurrence of tooth decay in children younger than age 6 years, is a chronic, highly prevalent,<sup>1</sup> and consequential<sup>2</sup> disease of US children that is overwhelmingly diet-dependent.<sup>3</sup> Although ECC is a multifactorial disease that is only partially explained by sugar intake,<sup>4</sup> the importance of diet has long been established through laboratory, clinical, and epidemiologic studies.<sup>5</sup> This knowledge has been translated into dietary recommendations for the prevention or suppression of caries activity in young children,<sup>3</sup> often with only limited success.<sup>6</sup>

In an effort to reduce ECC prevalence and its consequences in a high-risk, economically stressed Latino population in Northern Manhattan, NY, a multidisciplinary team of Columbia University researchers—including experts from behavioral nutrition, pediatric medicine and dentistry, community health, social work, and information technology—has developed MySmileBuddy, a prototype Internet-based application for the iPad (Apple, Inc) that facilitates community health workers' (CHWs) engagement of parents in dental caries prevention, with funding support from the National Institute on Minority Health and Health Disparities. The prototype was designed for the iPad but can be used by CHWs with parents on any laptop, desktop, tablet, or Internet-enabled telephone because this program operates in common Internet browsers. Central to its utility is its diet recall function (Figure 1), a sub-program designed to engage families in a modified 24-hour recall that contributes to a risk score for individual children. Here we describe the challenges confronted and approaches adopted in designing this diet recall function for initial dietary screening by nonprofessional peer counselors.

## ENGAGEMENT OF CHWs

ECC disproportionately affects families that are disadvantaged by low income, low literacy, cultural barriers, and minority status. Lay health workers, including CHWs and Head

Start Health Workers, are often on the front lines counseling such families. Therefore, an approach that engages such lay personnel in completing an initial dietary screening assessment that is not intended to be a thorough recall assessment, but sufficient to inform MySmileBuddy's underlying caries risk algorithm, is needed. Twenty-four-hour recalls have been identified as a useful interviewer-administered tool to assess diet for caries risk in adults<sup>7,8</sup> and children.<sup>9</sup> The automated diet recall function in MySmileBuddy guides CHWs through such an assessment.

## DIETARY CARIES RISK ASSESSMENT

The current American Academy of Pediatric Dentistry Guideline on caries risk assessment identifies dietary risk for caries through only two factors: the number of reported between-meal sugar-containing snacks or beverages, and sugar-containing bottle exposures.<sup>10</sup> The challenge was to develop a recall methodology that reflected knowledge of dietary cariogenicity while also being suitable for use by lay health workers.

Dietary cariogenicity is predicated on the frequency, duration, and timing of simple carbohydrate exposure rather than the quantity of sugar consumed because these factors contribute to the total time that acidogenic bacteria in the dental plaque have substrate available to them for acid production. Foods consumed in combination may also be less cariogenic than sugar-containing foods consumed in isolation.<sup>11</sup> To account for these complexities, a food grouping system was used and a scoring method developed at the Tufts University School of Dental Medicine that incorporates timing, physical form, and retention characteristics.<sup>9</sup>

Each of several food and beverage categories developed for MySmileBuddy were assigned weights from zero to four based on progressive degrees of assumed cariogenicity.<sup>9</sup> For each eating and drinking occurrence (meal or snack), weights for each consumed item or items are averaged. If the weighted value for an eating occurrence is scored as three or greater, it is considered a cariogenic occasion. The number of "risky" occasions are then summed for the day and given a total weight (Figure 2) that contributes to a child's dietary risk score. In addition to the dietary risk score, additional elements contribute to the algorithm to produce an overall caries risk score that includes fluoride exposures (eg, type of toothpaste used), family history (eg, parental experience with tooth decay), feeding practices (eg, sippy cup use), and thoughts and feelings about oral health (eg, confidence in reducing tooth decay).

**Figure 1.** MySmileBuddy dietary recall function tool. The images of brand-name products have been blurred.

Time	Diet Recall	Food/Beverage Category	Type	Weight	Time	Diet Recall	Food/Beverage Category	Type	Weight
7:30 AM	Nesquik chocolate milk <sup>a</sup>	Flavored milk	Cariogenic liquid	3	12:30 PM	Sweetened iced tea	Juice and juice drinks	Cariogenic liquids	3
			Total	3				Total	3
8:30 AM	Nesquik chocolate milk	Flavored milk	Cariogenic liquid	3	5:00 PM	Rice	Unsweetened grain product	Low cariogenic	1
	Cheerios <sup>b</sup>	Unsweetened grain products	Low cariogenic	1		Beans	Starchy vegetables	Low cariogenic	1
	Plain milk	Milk	Low cariogenic	1		Steak	Meats	Non-cariogenic	1
	Apple juice	Juice and juice drinks	Cariogenic liquid	3		Water	Water/seltzer	Non-cariogenic	0
	Peanut butter and jelly	Peanut butter and jelly sandwich	Solid/retentive cariogenic food	4					Total
			Total/average	2.4	7:00 PM	Crackers	Unsweetened grain products	Low cariogenic	4
11 AM	Wheat bread	Unsweetened grain products	Low cariogenic	1		Sweetened iced tea	Juice and juice drinks	Cariogenic liquids	3
	Oatmeal	Unsweetened grain products	Low cariogenic	1		Water	Water/seltzer	Non-cariogenic	0
	Sugar	Sweeteners	Cariogenic liquid	3		Average 2.3			
	Plain milk	Milk	Low cariogenic	1		9:00 PM	Nesquik chocolate milk	Flavored milk	Cariogenic liquid
			Total/average	1.5				Total	3
12 PM	Sweetened corn flakes	Sweetened cereals	Solid/retentive cariogenic food	4	Total "risky" occurrences for the day				4
			Total	4					

**Figure 2.** Example of a MySmileBuddy dietary recall function using the weighting method from a 4-year-old Hispanic girl. Circled weights indicate a "risky" eating occurrence, with an average weight  $\geq 3$  for that eating occasion. There are four total "risky" occurrences for this sample day. <sup>a</sup>Nestlé S.A. <sup>b</sup>General Mills.

## ADAPTATION TO THE TARGET POPULATION

Food and beverage categories were developed in collaboration with mothers of young children in the local target community through focus groups. Pictures of foods from proposed categories (eg, beverages, snack items, and desserts) were shown to participants who were asked to assess whether the photos captured their children's feeding practices. This exercise resulted in 25 food and seven beverage categories that represent typical diets of this population.

Foods and beverages from neighborhood bodegas were photographed to represent items in each of the categories. To conduct the recall, a CHW asks parents whether the prior day was a typical eating day and, if so, what their child ate and drank. As a parent recalls each food occurrence for their child, the appropriate category is selected on the iPad (Figure 1). A detailed listing of specific foods within each category is available for reference to assist in identifying the appropriate category (eg, the cake-like dessert category includes cakes, cookies, pies, doughnuts, muffins, and sweetened bread products). As a parent recalls the items consumed, a CHW presses the picture/pictures of the food/drink consumed during that eating occurrence and drags the photo(s) onto the timeline, which is divided into 30-minute intervals. Unlike a more classic recall, information on portion sizes is not collected because it would substantially increase respondent burden while not adding to the caries risk calculation.<sup>12</sup>

## DELIVERY AND TESTING OF RESEARCH

The purpose of the diet recall function is to inform caries risk rather than to assess overall diet quality. Once a child's caries risk level is determined by combining information on diet with other factors, the software offers parents a list of behavior goals from which to choose and the opportunity to develop an individualized action plan that can meet the selected goal. When deployed in the community, CHWs will revisit parents to assess progress in meeting the selected goal and to offer assistance in achieving caries control.

A small pilot test was conducted within the CHW program at the Northern Manhattan Perinatal Partnership Program, a case management program that provides health and family support to pregnant women and parents. This study was overseen by the Columbia University Medical Center Institutional Review Board (human subjects protocol no. AAAE5799). Members of the project development team engaged six Northern Manhattan Perinatal Partnership CHWs (four CHWs and two CHW interns) in two training sessions, 2 weeks apart, lasting 2 hours each. During the first session, CHWs were provided with an overview of ECC, viewed a demonstration of MySmileBuddy, and were given an instructional guide along with two project-funded iPads. They were encouraged to gain familiarity through practice with the iPads and the program. Following this 2-week experiential learning period, a second training session was convened for them to discuss their expe-

rience and role-play with the trainers. After facilitating MySmileBuddy with 35 mothers, most of whom were Latina and had children under 6 years of age, CHWs were asked to complete an anonymous survey reporting on usability and usefulness of the program. Using 5-point Likert scales, CHWs provided high scores for “ease of navigation” and “usefulness in educating families” with mean responses of 1.75 (1=very easy and very useful; 5=not easy at all and not useful at all). They also commented that the technology was “fun and easy for families” and “enjoyable in a visual way.” The development of the MySmileBuddy program will continue, including validation of the diet recall function’s contribution to caries risk along with expanding the planning and follow-up component of the program.

## CONCLUSIONS

Current research shows that capturing food intakes from one typical day identifies significant associations between diet and presence of severe caries developed in early childhood.<sup>9</sup> By creating a mobile application that features an interactive diet recall function, the task of assessing diet for caries risk is assisted by the technology and delivered by lay personnel. With further research, the use of mobile technology for dietary assessment identified in this project may be applicable for widespread use in a variety of sites and programs that address the health needs of young children.

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## STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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