



Health e-Technologies

I N I T I A T I V E

Building the Science of eHealth

***Childhood Obesity Prevention and Reduction:
Role of eHealth***

**Exploring the role that technology can play in reducing
the incidence and prevalence of childhood obesity**

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Executive Summary

Childhood overweight and obesity are epidemic in the United States and throughout the world. This report addresses the potential role that evidence-based eHealth can play in reducing the incidence and prevalence of childhood obesity for at-risk children and families, especially those from low socio-economic status (SES) and culturally diverse neighborhoods and communities.

For the purposes of this project, eHealth is defined as the use of emerging interactive technologies (i.e., Internet, interactive TV, interactive voice response systems, kiosks, internet-enabled cell phones and personal digital assistants [PDAs], CD-ROMs, DVDs) to enable health improvement and health care services.⁽¹⁾ These technologies, through the programs they enable, offer individuals and families the ability to obtain and utilize health information at relatively low cost, including people with limited access to health care professionals or services, and historically underserved populations. They can also improve the reach and effectiveness of self-management programs and enable enhanced communication between patients/consumers and their providers. eHealth applications have emerged not only as potential vehicles for facilitating delivery of evidence-based care, but also as unique conduits to provide tailoring and customization that would otherwise be unachievable.

To date, though, there is limited research on or consensus about how eHealth can be leveraged to contribute to the prevention of childhood obesity. Further, knowledge is lacking about how young people can be supported with eHealth tools in safely attenuating weight increases through diet modification, increased physical activity, and ultimately a more adaptive and sustainable energy balance. With regards to traditionally underserved populations, even less systematic information exists. Moreover, there is a concern, often expressed in public discourse, that the omnipresent role of technology in the lives of our youth promotes a sedentary lifestyle and may be a causal factor in the rise of overweight and obesity in our society.

Hence, at the core of this project was the desire to address the following questions:

- What are the potential benefits and opportunities that eHealth holds for childhood obesity prevention and reduction, especially for those from low SES and culturally diverse neighborhoods and communities?
- What are the unintended consequences, if any, in the use of eHealth for childhood obesity prevention and reduction?

This project adopted a two-pronged approach to gathering data and conducting a formative evaluation: 1) a systematic review of the published literature, including peer-reviewed articles, opinion pieces and commentaries, and articles from the lay press, and 2) employing a modified Delphi consensus method with an interdisciplinary panel of experts to explore perspectives by (a) eliciting written responses to a standardized set of questions and synthesizing the results, and (b) convening a face-to-face meeting of the panel members. These activities will be described in more detail in this report.

Key findings and implications include:

- The ubiquity of technology in the lives of today's youth requires new pedagogical methods and paradigms for interventions to prevent and treat childhood obesity that are adapted to the learning and information-seeking styles preferred by these frequent technology users.
- More research is necessary, both qualitative and quantitative, to better understand the feasibility, acceptability, patterns of use, and potential effectiveness of eHealth applications targeting the prevention and reduction of obesity and overweight in children and teens. This is especially true for traditionally underserved populations.

- Researchers and developers must be culturally competent and consider cultural issues and challenges when creating eHealth interventions.
- Interventions that do not integrate seamlessly into the daily ecology of children’s lives are not likely to succeed.
- Public health interventions were seen as a priority, with the potential to affect long-term, population-based improvements. At the same time, maintaining focus on the immediate, pressing needs of children and families currently in crisis is also imperative.
- “Screen time” is often identified as a primary causal factor in childhood overweight and obesity in the academic literature and by health professionals and the lay press. Further differentiation between passive TV, computer, and video game use, as well as delineating other confounding factors, is needed to clarify which components have the greatest magnitude of effect for specific populations.
- eHealth interventions can require substantial up front costs, both in the development of computing hardware and sophisticated software applications. However, the cost of technologies used for eHealth inevitably decrease over time, posing less of a barrier to scalability and access for traditionally underserved populations.
- eHealth can be used to mobilize and engage citizens and communities to advocate for environmental changes in their neighborhoods, including increased access to healthy, inexpensive foods and safe recreational spaces.
- Opportunity exists for multi-disciplinary collaboration with the entertainment industry, which possesses the expertise to create fun applications that target the youth demographic, in creating eHealth applications for children (specifically with companies committed to the prevention and reduction of obesity in this population).
- Childhood obesity prevention and reduction is a tremendously difficult problem, and development of novel partnerships is critical to effective intervention. Developers of eHealth-based interventions should consider how they fit into existing and emerging initiatives when collaborating to avoid duplication of efforts.

After delineating and considering a multitude of pressing issues, the following three areas were prioritized for further inquiry and potential for near term benefit by researchers, evaluators, governmental agencies, developers, funders, and others in the eHealth arena:

- **Stimulate development of eHealth applications to assist families with food choices/options and improving nutrition.**
- **Foster the creation of various “middleware” technologies and platforms** (e.g., creation of a structured and searchable database of food items and their nutritional contents and values) that other developers could then access to build a myriad of eHealth programs for obesity prevention and reduction.
- **Support systematic evaluation of and applied research for video games** (e.g., Dance Dance Revolution®, Guitar Hero II®) and the application of video game platforms (e.g., Nintendo Wii®, Sony PlayStation II®) to determine their potential for increasing physical activity amongst youth.

Literature Review

I. The Epidemic of Childhood Obesity

The crisis of childhood and adult overweight and obesity in the United States and throughout the world is well documented by such leading organizations such as the Institute of Medicine⁽²⁾ and the World Health Organization.⁽³⁾ While corroborating this data is not the primary focus of our literature review, it is important to note that at least 16% of children and teens between the ages of 6 – 19 in the United States are considered to be overweight (defined by the U.S. Centers for Disease Control as a body mass index [BMI] > 95th percentile; the Institute of Medicine classifies this as “obese”),^(4, 5) tripling over the past 20 years.⁽⁴⁾ Children of ethnic minority groups fare significantly worse than their white counterparts on a variety of measures, including BMI⁽⁵⁻⁷⁾ and reduced physical activity (PA) amongst girls who attend schools with lower median incomes.⁽⁶⁾ Overweight and obese children and teens are at increased risk for experiencing musculoskeletal problems⁽⁸⁾ and dysfunction of the heart,⁽⁹⁾ and one study found a doubling over a period of four years in the number of children ages 5 – 19 who were prescribed medication to prevent or treat diabetes.⁽¹⁰⁾ Overweight children and teens often extend their excess weight into adulthood,⁽¹¹⁾ where they are subject to increased risk of developing diabetes,⁽¹²⁾ cardiovascular disease⁽¹³⁾ and depression.⁽¹⁴⁾ Elevated blood lipids, blood pressure, and glucose levels are found in overweight youth, potentially placing them at risk for earlier development of chronic disease.⁽¹⁵⁾ On a financial scale, the estimated medical costs in the United States associated with being overweight and obese are almost \$100 billion annually.⁽¹⁶⁾

II. Digital Natives: Technology Use amongst Youth

Given the rapid changes in communication technologies, children and teens today are growing up in a remarkably different world than their parents. They are more connected than in any preceding generation of human beings, using technologies – the Internet, cell phones, global social networking websites (MySpace[®], Facebook[®], etc.), massive multiplayer online role-playing games – that scarcely, if at all, existed a mere ten years ago. One report found that today’s youth spend nearly 6.5 hours a day engaged with a variety of media channels such as TV, computers, MP3 players and the like.⁽¹⁷⁾

A 2005 Pew Internet and American Life Project report, *Teens and Technology*,⁽¹⁸⁾ noted that amongst U.S. teens aged 12 – 17:

- 87% use the Internet, up from 73% in 2000;
- 51% of those that use the Internet go online on a daily basis, up from 42% in 2000;
- 45% have cell phones, with 33% using them to send text messages;
- 89% of those online use e-mail; and
- 65% use Instant Messaging (IM).

In addition, another Pew report found that 55% of online teens use social networking sites, with nearly half visiting them at least once a day.⁽¹⁹⁾

To be sure, there is a mixed picture with regards to the use of and access to technology based upon demographic characteristics, which have implications when employing eHealth platforms to engage traditionally underserved populations. For example, there is no difference in the percent of whites, African-Americans and Hispanics who have ever gone online.⁽¹⁷⁾ However, white (87%)

and Hispanic (89%) teens are more likely to be online than their African-American counterparts (77%).⁽¹⁸⁾ It is interesting to note that all three groups of teens are more likely to be online than the U.S. adult population (66%), including their parents.⁽¹⁸⁾

Whites are significantly more likely than both African-Americans and Hispanics to have Internet access at home; the same holds true, regardless of race, for those with more education.⁽¹⁷⁾ When there is home Internet access, 50% of white teens have a high-speed connection as compared to 39% of African-American and 42% of Hispanic teens. And, while only 73% of teens with household incomes under \$30,000 report Internet use, this increases to 93% in households with incomes over \$75,000. Paradoxically, there were no statistically significant differences by race/ethnicity or household income with regards to teens who create profiles on social networking sites.⁽¹⁹⁾

Exposure to and the explosion in the use of these technologies by young people lead Prensky to coin the phrase *digital native* (attributed to those born beginning in 1985) in describing this generation.⁽²⁰⁾ Prensky posits that children not only live in a much richer and distinctly different informational environment than their parents, but that this digital environment has helped to shape them into fundamentally different types of thinkers, potentially on a biological/neural level,⁽²¹⁻²³⁾ requiring a change in messaging methodologies to successfully engage and educate them. According to Rainie, the tools used to access media and other forms of communication are ubiquitous for digital natives and multi-tasking is a way of life for this generation.⁽²⁴⁾ Rainie also noted some interesting information about technology ownership and use for adults and teens:

	Adults	Teens
Own Cell Phone	73%	67%
Own Digital Camera	55%	43%
Own Video Camera	43%	37%
Play Video Games	40%	83%
Own Laptop	30%	32%
Own MP3 Player	20%	45%
Own PDA or Blackberry	11%	7%

It's clear that technology has been and will continue to become an ever-increasing part of children's lives. Therefore, intervention programs aimed at changing young people's health behaviors may have far greater reach and be much more effective if delivered via the channels that children and teens prefer and in the forms that they recognize and will use. Indeed, the previously cited *Teens and Technology* report found that close to one-third of teens who use the Internet have sought information about health, dieting or physical fitness online.⁽¹⁸⁾ These data indicate that eHealth interventions are not only appropriate but perhaps even requisite for this population.

III. Evidence Base for eHealth Programs

eHealth is often employed to assist patients and consumers with the management of chronic conditions or to change health behaviors. The vast majority of eHealth programs are designed for adults, employing a wide variety of technological strategies. Interventions to assist patients with diabetes management have successfully utilized automated telephone calls with a diverse, low income population⁽²⁵⁾ and Internet websites to report and track glucose levels.⁽²⁶⁾ Online programs have significantly improved the health status of chronically ill patients through changes in health-related behavior,⁽²⁷⁾ as well as assisted in smoking cessation.⁽²⁸⁾ Using multimedia video presentations, breast cancer knowledge and screening intentions increased amongst low education Latinas,⁽²⁹⁾ while other researchers found evidence that tailored, interactive Internet

interventions effectively increased healthy perceptions about skin cancer prevention.⁽³⁰⁾ Computer-based, interactive programs have also effectively delivered behavioral interventions for prevention of adverse drug interactions in the elderly.⁽³¹⁾

A. eHealth Applications for Weight Management in Adults

eHealth weight reduction interventions, typically Internet-based, generally employ comprehensive tools that simultaneously integrate diet education, exercise advice, and behavioral change techniques. Online programs are an attractive option to support effective, long-term weight maintenance because they can be offered at lower cost than traditional, labor-intensive counseling and increase personal convenience.^(32, 33)

However, these applications are often difficult to compare due to heterogeneous methods, definitions, and measurements. Some studies found no difference between intervention and control groups, while others have resulted in modest, but statistically significant levels of weight loss.⁽³⁴⁻³⁸⁾ When long term weight maintenance was not designed into the intervention, subjects often regained the lost weight post-intervention.⁽³⁸⁻⁴⁰⁾ Subsequent applications showed increased maintenance of healthy weight once long term weight goals were included in intervention design.^(32, 33, 41)

Some commercially available weight reduction programs like eDiets[®] show modest weight loss even a year after the initial intervention, although they do not produce as large an effect as traditional, face-to-face weight loss programs.⁽³⁶⁾ Self-directed weight loss interventions paired with different forms of behavioral e-counseling via e-mail, text messages, and web discussion perform much better.^(34, 35) The use of e-mail contact with licensed professionals significantly increased weight loss by an average of 7.3 kilograms in one study, surpassing both the computerized, tailored messages and no counseling treatments.^(34, 35) Another study found that behavioral e-counseling paired with Internet weight loss programs significantly improved weight loss outcomes over a one year period, with the experimental group losing twice as much weight as the control group.^(34, 35) Physician-centered interventions employing telemedicine to deliver care to overweight and obese adults at home observed significant, short-term reductions in all parameters compared to the control group.⁽⁴²⁾ One study found no difference in average weight loss, overall attrition rates, and number of peer support contacts formed between an in-person, therapist-led weight maintenance program and an Internet-based, therapist-led program.⁽³²⁾ A different study group found that the use of tailored feedback helped maintain significantly greater weight loss than with an information-only system, and that the users of the tailored feedback system felt the information was more personally relevant.⁽⁴³⁾

B. eHealth Applications for Nutrition and Physical Activity in Adults

With regards to nutrition, tailored education over the Internet has produced significant decreases in consumption of saturated fats and improved awareness of good nutrition.^(44, 45) Multimedia computer interventions also significantly improved nutritional knowledge, advanced stages of behavior change, and healthy eating behavior.⁽⁴⁶⁻⁴⁸⁾ Two computerized applications successfully reduced fat intake and increased the consumption of fruits and vegetables.⁽⁴⁶⁻⁴⁸⁾

Physical activity eHealth applications employed similar strategies, such as using Internet-based behavioral counseling and multimedia computer interventions to significantly increase PA and decrease fat intake in the experimental group.^(49, 50) Automated telephone messages also succeeded in significantly increasing moderate intensity PA, reducing daily kilocalorie consumption, and advancing participants' motivational readiness.^(51, 52) Marcus et al.

compared tailored messages delivered in print and via the Internet vs. non-tailored Internet information, with an increase in PA amongst all three groups, highlighting the capacity for both scalability and cost-effectiveness of web-based programs.⁽⁵³⁾ Finally, researchers have investigated the efficacy of pairing virtual reality with indoor exercise, finding that it increased energy expenditure and simultaneously decreased psychological tension.⁽⁵⁴⁾

C. eHealth Applications for Children

In contrast to the emerging research with adult populations, evidence-based, interactive eHealth applications for children are scarce. Currently, there are effective programs designed to prevent drug and tobacco use,^(55, 56) enhance asthma management,⁽⁵⁷⁾ and reduce pediatric encopresis.⁽⁵⁸⁾ However, only a few published studies to date focus on physical activity, sedentary, and nutrition behaviors as a method for weight management in children. What does exist addressing these topics, however, is promising. Baranowski et al. evaluated a computer game that was successful in increasing the consumption of fruits and vegetables by children in the experimental group.⁽⁵⁹⁾ Casazza and Ciccazzo found that students who utilized a computer-based nutrition and PA program increased their knowledge base and PA, as well as reduced their meal skipping, when compared to both the control group and students who received traditionally-based education.⁽⁶⁰⁾ Among of group of overweight adolescents, Saelens et al. found that computer-based behavioral assessment coupled with a single session of weight counseling by a physician and follow-up telephone and mail contacts created improved BMI z-scores compared to controls at 4-months.⁽⁶¹⁾ Patrick et al. found that some improvements in diet, PA, and, sedentary behaviors can be obtained through the use of a 1-year intervention that combined computer-assisted behavioral assessment and action planning with health provider counseling, mail, and telephone contact.⁽⁶²⁾ A two-year web-based weight loss program for African-American girls and their parents showed significant weight loss during the first six months of study, but the effect disappeared at the end of two years due to decreased use of the website.⁽⁶³⁾ Sustaining use of websites to deliver an effective “dose” of an intervention is problematic for many eHealth applications, and for behavioral change interventions as a whole, though Thompson et al. used incentives to achieve a log-on rate exceeding 75% for a web-based, obesity prevention program for African-American girls at risk for obesity.⁽⁶⁴⁾

Several studies have targeted the reduction of sedentary behaviors in an attempt to increase PA and reduce BMI. Robinson used a TV restriction device, often called “the Robinson box,” to limit screen time for young children, which resulted in a decrease of BMI for the intervention group.⁽⁶⁵⁾ Saelens and Epstein successfully increased PA in obese children while lowering BMI by linking PA to highly-prized behaviors like watching television or playing video games.⁽⁶⁶⁾ Two other studies made television access contingent upon increased PA, with both noting increases in PA.^(67, 68) One also found reduced BMI⁽⁶⁷⁾ and the second found a decrease in TV viewing.⁽⁶⁸⁾

More recently, research is being conducted to measure the capacity of commercially available active video games – games where the user must stand up and move around versus being seated – to increase metabolic activity and energy expenditure. A recent paper that compared the energy expenditure of active video games to seated video game play and television watching found that active video games and watching TV while using a treadmill expended more than twice the amount of energy in comparison to seated video game activities.⁽⁶⁹⁾ While the study is limited by the lack of long term, home-based analysis of weight loss, the intervention shows promise for creative application of commercial technologies. In a second study, the West Virginia Games for Health group partnered with Konami® to analyze the efficacy of using Dance Dance Revolution® (DDR), an active video game, for improving the health of children. Although the study is pending publication, the researchers report

preliminary results showing the capacity of DDR to maintain weight loss and increase general fitness, aerobic capacity, and blood vessel function.⁽⁷⁰⁾

IV. Impact of “Screen Time”

Screen time is variably defined as the amount of time in which individuals are engaged in the use of electronic media (TV, videos/DVDs, computers, video games, etc.). It warrants special attention here, as there is concern, whether fact-based or perceived, not only about unintended negative consequences with increased screen time by children and teens (e.g., sedentary behavior), but also in leveraging electronic media (e.g., incentivising children and teens with video game or, especially, TV time) to combat childhood obesity when it may potentially exacerbate the problem of overweight and obesity amongst youth.

Two major hypotheses are currently offered to explain the relationship between media screen time and weight gain. One theorizes a causal mechanism that links increased screen time to decreased energy expenditure through reduction of PA. The second posits that increased media use is associated with simultaneous, increased snack food consumption and therefore caloric intake.

A. Physical Activity, Screen Time, and BMI

A significant number of studies have documented associations between time watching TV/videos/DVDs and increased risk of overweight or obesity amongst children and adolescents.⁽⁷¹⁻⁷⁷⁾ Others have noted similar findings, but with inconsistent results. Santos et al. and McMurray et al. found that the links between increased TV use and decreased PA only held up on weekends or non-school days.^(7, 78) Another study uncovered some associations between TV/video/DVD viewing and overweight in adolescents, but their results varied amongst ethnic/racial and gender lines, and not all were significant.⁽⁷⁹⁾ When McMurray et al. adjusted for SES and ethnicity in their study, the link between TV viewing and BMI was not observed, suggesting that these two demographic factors had a greater impact on being overweight than watching TV. Kautiainen et al. found increased TV use was associated with prevalence of overweight in girls, but not boys.⁽⁸⁰⁾ Another two analyses noted relationships between TV use and decreased PA, but the overall impact on overweight and obesity was deemed small, especially as compared to other variables.^(81, 82) In a prospective study, Salbe et al. found a link between obesity in Native American children and increased TV viewing at both 5 and 10 years of age, but decreased PA levels were associated with obesity only for the 10-year-olds.⁽⁸³⁾ The researchers suggest that decreased PA happened after the children became obese, not before.

With regards to PA and computer and video game use, the associations are tenuous⁽⁸²⁾ or sometimes positively correlated. Stettler et al. observed a positive correlation between the use of electronic games and obesity.⁽⁷²⁾ However, another study found an increase in PA as computer time increased,⁽⁷⁸⁾ with a Kaiser Family Foundation report observing the same trend with frequent media users.⁽¹⁷⁾ Amongst Asian-American teens, increased video and computer gaming was associated with decreased risk of overweight.⁽⁷⁹⁾ Kautiainen et al. discovered increased overweight in girls as their computer use increased,⁽⁸⁰⁾ with two other investigations reporting no impact of video game or computer use on adolescent weight or BMI for either gender.^(80, 81) Segal and Dietz measured energy expenditure during various activities and found that video game play consumed more energy than during complete inactivity,⁽⁸⁴⁾ and researchers at the Mayo Clinic discovered significant differences in energy expenditure between sedentary vs. active video game use.⁽⁶⁹⁾

How can these ostensible contradictions in results be reconciled? Biddle et al. note that analyses on overweight/obesity and youth must attend to both the absence of PA as well as determining what young people are doing when they are sedentary.⁽⁸⁵⁾ They suggest that inactivity is actually a more complex behavior than previously thought, and should not be defined as merely the absence of activity. In their research, Saelens and Epstein confirmed that sedentary behaviors (watching TV, reading, drawing/coloring) are not interchangeable, and that children can actually be motivated to engage in PA over sedentary behaviors with the promise of gaining access to screen time.⁽⁶⁶⁾ Similarly, Zabinski et al. performed a cluster analysis of six sedentary behaviors (watching television, talking on the telephone, using a computer, listening to music, doing homework, reading) among a diverse set of adolescent boys and girls and four clusters emerged: low sedentary, medium sedentary, selective high sedentary, and high sedentary, with significant cluster differences for gender, age, body mass index, and physical activity.⁽⁸⁶⁾ A longitudinal study by Taveras et al.⁽⁸⁷⁾ proposes that PA and watching TV are separate constructs, independent of each other, which is echoed by Ekelund et al.,⁽⁸⁸⁾ suggesting the need for distinct interventions to address both. Robinson's findings support this recommendation, in that efforts to reduce TV, video and game time decreased BMI amongst his study sample as compared to controls, but there were no differences in moderate-to-vigorous PA between groups.⁽⁷⁷⁾

B. Food Consumption and Screen Time

A second hypothesis posits that the immediate media environment shapes children's energy balance through food intake. A recent article shows that children in grade school consume a significant amount of their total daily energy intake while watching television, approximately 17-18% on weekdays and 25% on weekends.⁽⁸⁹⁾ To date, several studies have found a positive association between television viewing and energy intake, which may be due to the increased opportunity to consume unhealthy snacks.⁽⁹⁰⁻⁹²⁾ French et al. found that adolescents who watched more television were more likely to eat fast food, drink soda, and consume fewer fruits and vegetables.⁽⁹¹⁾ Blass et al. quantified the amount of high-density food consumed while viewing television and found that under conditions of television viewing, undergraduate students consumed more food than under non-television viewing conditions.⁽⁹³⁾ This study lends support to the food intake-vector hypothesis, but not all cross-sectional studies have found an association between television viewing and increased food and/or calorie consumption.⁽⁷²⁾ Gaming and computer use have not been studied, but these activities occupy the hands and, with more recent video games and mobile devices, the whole body, potentially reducing the opportunities to snack. In the Zabinski et al. study, the low sedentary cluster was found to consume significantly more grams of dietary fiber/100 kilocalories compared with the selective high sedentary and high sedentary clusters.⁽⁸⁶⁾ The clusters, however, did not differ on the percentage of calories from fat or reported daily servings of fruits and vegetables.

Van den Bulck and Eggermont offer an alternative hypothesis on how media shapes dietary choices. In their recent study, they found that high levels of media use are associated with higher frequencies of meal skipping and/or accelerated food intake.⁽⁹⁴⁾ Adolescents who watched four or more hours of television a day were seven times as likely to skip meals, while children who played computer games at least four times a week were at nine times the risk of meal skipping. Evidence of a link between irregular food consumption and weight gain is lacking, but the study evokes another possible dimension of media usage on eating patterns.

Finally, limited research has examined whether the mere act of excessive television viewing directly depresses metabolic rate. Kleges and his colleagues initially reported this finding,⁽⁹⁵⁾ but in a more recent study, found no metabolic difference in resting energy expenditure between pre-pubertal obese and non-obese adolescent girls.⁽⁹⁶⁾

V. Marketing in Children's Media

An issue of major concern in childhood obesity is the marketing of unhealthy foods to children through television, computer games, internet sites, and commercial tie-ins.⁽⁹⁷⁾ Children spend an average of three hours a day watching television, exposing them to a great deal of advertising that is aired during children's programming⁽⁹⁸⁾ and marketing that affects the food requests children make.^(99, 100) 40% of children in a research sample asked their parents to purchase foods seen in television advertisements and 9% of these children resorted to crying or arguing with their parents to obtain this food.⁽¹⁰¹⁾ Increased television viewing, and thus more frequent exposure to commercials, raised the likelihood of children drinking soft drinks and eating fast food, such as hamburgers and French fries.⁽¹⁰²⁾ Lobstein and Dobb found a significant association between the frequency of food advertisements per hour and the proportion of overweight children.⁽¹⁰³⁾ Moreover, Wiecha et al. conducted a longitudinal study showing that each hour of television viewed was significantly associated with an additional 167 kilo-calories consumed.⁽¹⁰⁴⁾ Their analysis suggests that high calorie, low nutrient foods are a likely mediator of obesity, given that the food consumed while watching television was predominantly composed of the unhealthy foods advertised on TV. The Institute of Medicine study, *Food Marketing to Children and Youth: Threat or Opportunity*, reviewed the evidence and also found a compelling link between food marketing and obesity.⁽¹⁰⁰⁾

While the link between junk food consumption and product placements in television has been examined, little is known about the impact of food advertising in gaming and other newer forms of media. "Advergaming" is a growing trend where companies pay for product placements in popular video games, or make and distribute games with their products.⁽¹⁰⁵⁾ This new sector of advertising promises greater reach for corporate campaigns and requires further research as to its impact on overweight and obesity.

Some health professionals strongly advocate either banning or somehow curtailing the effects of advertising to children as one of the solutions to the obesity problem.^(106, 107) Caraher, Landon, and Dalmeny examined the policies of 20 countries and found that bans were a highly unusual policy decision.⁽¹⁰⁸⁾ Government organizations generally preferred voluntary agreements and self-regulation, with partial regulation on the type and content of advertisements. Given the borderless nature of the Internet, satellite TV/radio, and the like, advertisement bans in one region or country would not guarantee a reduction in children's exposure to food marketing campaigns. Ultimately, the fight over advertising to children is highly contentious, with the food industry still denying direct links to obesity from data gathered through their own funded research studies.⁽¹⁰⁹⁾

VI. Key Issues

The current literature indicates that use of electronic media per se is not a central, direct cause of childhood overweight and obesity (passive TV use being the exception). Moreover, given the increasingly ubiquitous nature of these technologies in the lives of children, and given the promising results of early-stage eHealth interventions for overweight and its related behaviors, technology-based interventions have considerable potential to support health promotion messaging and behavior improvement. On balance, the present evidence suggests that their use for this purpose is appropriate as long as particular attention is paid to issues such as cultural relevance and access.

Several caveats must be noted with regards to the current eHealth research for childhood obesity prevention and reduction:

- Future investigations should be longitudinal in design so as to account for the order of effects and establish grounds for causality, as well as adjusting comprehensively for

confounders. With regards to the impact of passive TV viewing and overweight/obesity, research needs to tease out the components of this connection – in what manner do sedentariness, food marketing, increased consumption of junk food, and other factors mediate this problem?

- Additional research and development is required to explore the feasibility of using eHealth applications for obesity prevention and reduction with children, especially those from traditionally underserved populations, to clarify different preferences for intervention style and delivery, as well as to increase reach, adoption, and efficacy.
- As a term, “screen time” has no accepted, standard definition and, as it has been used in the literature, implies inactivity. As a concept, it needs differentiation and refinement to encompass active vs. passive media use.
- It has been generally assumed that eliminating or reducing the use of technology by children will automatically be replaced by more active, as opposed to sedentary, behaviors. The research evidence to support this notion is lacking.
- While the correlation between passive TV use and overweight/obesity exists and should not be ignored, other compelling influences (SES, race/ethnicity, family patterns of exercise and food consumption) mediate children’s BMI and weight. Therefore, eHealth interventions addressing obesity in children should not be discounted simply because they are technology-based.

On the whole, the opportunities that lie ahead to leverage evidence-based eHealth programs for obesity prevention and reduction are promising. The data show that these programs often have a documented effect, and even if the outcomes are smaller than traditional, face-to-face interventions (which many are not), this limitation may be greatly offset by the potential scalability, cost-effectiveness, and reach of these programs.

Expert Panel Perspectives: Written Responses to Standardized Questions

The first component of the formative evaluation research for this project consisted of eliciting written responses from an interdisciplinary panel of experts (see Appendix A) to a standardized set of questions (see Appendix B – question numbers are referenced in the headings below). These were distributed to panel members in the late summer and early fall of 2006. A synthesis of their responses is below.

VII. Influences on Children’s Diet and Physical Activity (question 1)

Panelists view parents and parental modeling of good nutritional choices as the major influence on children’s decisions concerning diet and nutrition. The difficulties of positive parental modeling were acknowledged, including misinformation, lack of time, the relative inconvenience of cooking, and the uneven availability of fresh, nutritious foods in different neighborhoods. As one member noted:

“I see the parent-child dyad is ‘where the action is.’ The negotiating, the limits or lack thereof, the back and forth is very important to me in examining the outcomes in pediatric overweight. I worry about these family dynamics because I believe this is where we often forget we need to help families. I think that the overweight epidemic is attributable to the erosion in the parent-child relationships and limit setting and guidance.”

Children are also heavily influenced by peer opinions and the social norms of their communities, ethnic enclaves, and friends. One panel member pointed out that peer opinions are themselves influenced by the media. The panelists largely agreed on the importance of media advertising and its impact on children’s behavior and food choices, especially product placements in music videos, sporting events, and during afternoon television programming.

Environmental factors constitute the major category of influences on children’s food choices. These factors encompass the food that is available in children’s physical environment (beyond the home), such as in-school vending machines and lunches, shops and delis surrounding the school or a child’s home or the food choices available around a teenager’s after school job.

Environmental factors that affect PA center on issues of the built environment. This includes the availability of parks, the distance of schools and stores that prohibits walking, and the physical safety of neighborhoods where children could play outdoors. Organized sports and other avenues of PA may also not be available in the community.

Other factors affecting PA are childcare responsibilities and after school constraints such as studying and club duties. Also, genetics and biology, personal predisposition, age, gender, and ethnicity can help determine levels of PA in addition to time and physical constraints. A question was raised regarding the difference in absolute energy expenditure between organized sports, where children may spend a lot of time standing or sitting (like in baseball), and free play in the backyard. One panelist pointed out that recommendations for PA can be confusing to both parents and children, making it difficult for parents to model healthy behaviors in the home.

VIII. Engaging Youth with Technology (question 2)

Several panel members, in listing the types of technology currently used by children, saw great potential in mobile computing. Mobile devices most often mentioned were cell phones and handheld video games. The panelists discussed these technologies in conjunction with “just-in-time” software that provides tailored feedback at the place and time that it is immediately needed. These devices appealed to panelists because children are not “tethered” to a media console that enforces a certain level of sedentary behavior.

Nevertheless, panelists cautioned that careful study of usage patterns must be conducted before making decisions about intervention design, because different demographic groups practice very different media use patterns depending on the technology.

IX. Pros and Cons of Technology and eHealth (questions 3 and 4)

Technology was characterized as “ubiquitous” and “powerful.” The panelists all agreed that it should be leveraged for positive messaging and intervention. The primary pros listed by panelists were that technology is easily disseminated, kids enjoy using it, and technology is pervasive even in lower SES homes. The appeal of technological applications is that it allows health messages to reach more people faster and more efficiently, and children are already using technology in their everyday lives.

While acknowledging the great potential of technology, several of the panel members expressed concern towards the dual nature of technology – its perceived role in causing childhood obesity, as well as its potential role in preventing or reducing obesity. They raised the possibility that eHealth programs will increase children’s screen time and other sedentary behaviors as an unintended negative consequence. These panelists expressed ambivalence towards screen time’s displacement of PA and contributions to increased BMI, but also recognized technology’s power as a behavioral modeling tool:

“One of the major obstacles that will need to be addressed is the argument that technology is ‘part of the problem’ and that using it to promote obesity prevention behaviors is both irresponsible and sends the ‘wrong’ message. I believe the response is that we need to meet youth halfway – it’s obvious they enjoy technology and use it. Therefore, it would be shortsighted not to learn to harness its power and potential to promote healthy behaviors to youth.”

Other cons of technology use included the current high cost of some equipment, the high cost of initial development, personal safety and privacy issues for social networking technology, technological literacy gaps, and the difficulty in ensuring that the intervention technology is sufficiently engaging for kids. Panelists also raised concerns over designing an intervention to appeal to different ethnic, age, and gender groups, and that it overcome the disparity in both socio-economic access to technology and the wide array of available hardware platforms. Several members cautioned that technology should not be a stand-alone strategy. eHealth is seen as being a key component in a larger campaign against childhood obesity that spans school, policy, and family interventions.

In response to some of the concerns put forth, panel members had a variety of insights. For example, one panelist noted that adults may perceive a greater usage of cell phones amongst youth than is actually the case. The availability or access to a technology does not necessarily

determine its consistent use, such as with video games. Another panelist noted that health leaders need to temper their concerns about the cost of technology to underserved youth with the knowledge that prices on hardware will drop over time. By leveraging the ubiquity of existing consumer hardware systems in American households, development and dissemination of intervention software would be economical.

X. Requirements for Funding (question 5)

Panelists listed a variety of specific requirements they would need to see before providing funding to develop an eHealth application for obesity prevention or reduction. All the requirements fell under the category of formal research and include:

- Data on use patterns, acceptability by youth, great potential to measurably change behavior and knowledge, and feasibility, as well as positive and negative experiences in using technology for this purpose.
- Theory-based, employing robust research designs and statistical analysis/power.
- Developed with formative research and in collaboration with youth and community/cultural advisors.
- Research team with a track record of recruiting youth, doing obesity prevention and technological research, and that includes investigators/staff from the target population.
- Cost for development and maintenance, cost effectiveness going into the future.
- Means of integration with other methods of reaching target groups.
- Dissemination plan.

XI. Potential Partnerships (question 6)

Panelists were overwhelmingly positive about the wide variety of possibilities for partnership with non-health-related organizations. Some panelists framed these collaborations in terms of increasing competitiveness for potential partners by “demonstrating corporate responsiveness and responsibility and providing overall civic value”:

- entertainment companies
- video game developers
- kids’ television channels
- community organizations and stakeholder groups
- fast food and beverage companies
- eHealth and other software companies
- suppliers of food to schools
- social marketers
- policy analysts
- organizations funding research
- local businesses

There were, however, several caveats cited by panelists. There was concern that developing software for use in schools may be exploitive of schools, given all the other programs and

activities that they are mandated to do. Another issue discussed by several panelists was a concern about working with the food industry, especially the manufacturers of low-nutrition food.

One panelist expressed:

“In my opinion, the food industry’s insistence on the messages of ‘moderation and balance’ has created a huge obstacle to presenting clear and consistent messages to children and parents about how to eat. The concepts of moderation and balance are so ill-defined that they essentially say absolutely nothing. I would be interested in hearing the industry defines what moderation is. How often should children eat fast food? Candy? How much exercise do they need to do to stay balanced? Saying that it varies from child to child is not helpful either. Parents need to know what to do, and that is why any public education effort done must be stronger and give clearer messages about how to set limits, how to say ‘no,’ how to go to the grocery store and not end up with a cart full of foods that are marketed to your children.”

XII. Key Issues

There was considerable convergence with regards to responses both amongst panel members, as well as between panel members and the current research evidence on eHealth programs and technology use by youth:

- A significant point of intervention is the family.
- Environmental factors and peers also have a major influence on nutrition and physical activity, especially as children get older.
- Technology is ubiquitous in the lives of today’s youth.

One glaring difference has to do with the “common knowledge” view of screen time as a major contributor to obesity, which was pervasive amongst the panelists. This could certainly be due to the issues cited in the literature review section above – lack of agreement regarding definition of the term, effect size relative to other variables or the confounding of factors such as food consumption during media use.

Expert Panel Perspectives: Face-to-Face Panel Meeting

The second component of this project's formative evaluation research was the modified Delphi consensus panel which met for a one-day, face-to-face meeting. This occurred in Boston, Massachusetts on December 13, 2006.

During the course of the meeting, a variety of issues wove their way into the discussion. For the purposes of this report, we have categorized them into two major theme areas: process and content. Process themes primarily include topics that are specific to childhood obesity from the "big-picture" view. While they do not necessarily address the role that technology may play in the prevention or reduction of obesity, they must be deliberated when exploring how technology may be engaged to fight the epidemic. Content themes attend principally to the various facets that were contemplated when employing technology for childhood obesity prevention and reduction. Both theme areas interact with each other (indeed, they are not necessarily mutually exclusive and may parallel each other) and will be important to consider when decisions are made about the focus of potential technology-based initiatives.

XIII. Process Themes

A. Individual vs. Environmental/Public Health Interventions

Panel members acknowledged that technology-based opportunities for intervention in this realm run along a spectrum from individual to environmental/public health. While individually-based programs were seen as important, the panel embraced the need for more population-based perspectives and interventions that would change the milieu in which people make their choices around diet, nutrition and physical activity:

"People behave essentially the way that the environment facilitates."

Despite the fact that panelists recognized difficulties with acting at the public health/environmental level due to an "individualistic" American culture, one panelist summed up the need for:

"...a move to shift the focus away from individual behavior and decision making, in other words, individual responsibility, to a more multi-level, multi-dimensional approach to deal with this problem."

This was echoed by another:

“One of my reactions to this question was the word ‘choice.’ In psychology, there has actually been quite a lot of research to show that people’s behavior is often affected by things that are beyond their awareness Sometimes the decisions need to be made not at the individual level, but a step up.....In the town where I live, they completely removed all of the snack foods from the elementary school and I remember thinking that September, ‘All the kids in my town are eating fewer cookies than they were last spring.’ I did collect data and, in fact, that was the case. I could have spent ten years of my life doing nutrition education with those kids, and I feel like instead the work I did to try to get the policy changed paid off a lot more.”

Health disparities were presented as a population-based phenomenon, with obesity-related issues such as lack of access to inexpensive, healthy foods at local grocery stores; safe, outdoor exercise venues; and health care-related resources. In this context, attending to the barriers facing traditionally underserved communities demands, in part, a consideration of environmental interventions.

B. Setting Priorities: Balancing the Most Immediate Need with the Greatest Long-Term Impact

An offshoot of the individual/public health issue above is the challenge that supporting initiatives which may have the highest potential impact and success (often public health/environmental) may be at odds with where the most pressing, immediate needs lie (often at the individual level). Public health interventions take a significant period of time, money, and coordination to implement and achieve adoption (the experience of tobacco is a case in point). This does not mean that they should not be undertaken. However, the key role that parents play in influencing what their children eat based upon what foods are purchased, household rules, and parental role modeling was highlighted. Families are overwhelmed and stretched for time, and parents feel guilty about not being able to manage this issue more effectively. One panelist’s comment, that “desperate situation(s) need to be tackled first,” highlights the fact that families with overweight or obese children at this moment cannot wait 10 years for population-based strategies to gain hold.

As priorities are being assessed, they must juggle the interplay between helping those in the most immediate need while holding a long-term vision of environmental changes that may hold the greatest promise for population-based transformation.

C. Defining an Organizational Model and Partnerships: Who “Owns” the Pieces of the Pie

Due to the enormity of obesity epidemic, panelists agreed that an organizing framework was required not only for their meeting, but also at the national/international level, around which discussions about obesity prevention and reduction could be tackled. Several models were presented, including the Sociobiologic Integrative Model⁽¹¹⁰⁾ and the Social Ecological Model,^(111, 112) as well as a conceptual framework used by UNICEF for childhood survival in the 1980s. Essentially, these models acknowledge that actions, processes, and interventions that impact obesity occur on a continuum:

Global ←-----Macro-----Mezzo-----Micro-----Individual-----→ Cellular

Across this continuum, there are a variety of stakeholders including developers, purchasers, evaluators, consumers, governments, and policy makers. Panel members emphasized the need to build partnerships amongst these stakeholders. These collaborations should address gaps where they exist, considering not only the opportunities to develop and invest in programs and policies that are likely to have high impact and potential for success, but also probable barriers, implementation timeframes, the evidence-base for proposed solutions, and who will confront which pieces of the problem. Looking to experiences outside of the U.S. (in Europe, Canada and Asia, for example) was encouraged.

D. *Framing the Issue with Target Populations*

Panel members stressed the power of the term “obesity” in that it may hold clinical relevance amongst doctors and other healthcare workers, but was perceived in a negative light by lay people:

“We find the word obesity stigmatizing. One of our programs, even though it was basically obesity prevention, we positioned as healthy eating and physical activity. Parents told us, ‘Thank you for not calling it obesity prevention!’ I think there’s just a different mindset when you think about healthy eating and physical activity. It’s something positive.”

Eliminating the negative associations of the term “obesity” from obesity interventions could lead to greater parental and youth buy-in. One panelist suggested that this word leads some parents to assume failure on their part or the part of their children. By framing an intervention in terms of healthier living, the focus is on positive change rather than blame.

Another panelist described interactions with patients/consumers:

“Do they talk about obesity? No, they don’t talk about obesity. We’ve got a large community of online households that we do surveys with all the time. We ask them how they think about diet and health, and it comes down to feeling good, looking good.....the ‘feel good, look good’ website, not the ‘let’s eliminate child obesity’ website.”

Given current disapproving societal pressures already felt by overweight and obese individuals, interventions and the marketing for them should take care to focus on enhancing lifestyle choices in a positive light, making sure not to alienate and add to an unwarranted stigma that can be especially difficult to endure by children and teens.

A separate, but related, idea was put forth:

“.....obesity interventions don’t have to be obesity-specific. There are lots of social interventions that have occurred throughout history where the state of reduction of the chronic disease of prevalence is simply a by-product of whatever the intervention is.....Tom Robinson has been so successful with some of his interventions like the reduction of TV viewing time. The delivery of the intervention has nothing to do with obesity. Obesity, that word, doesn’t even come up when the interface is with its target population. He basically tried to tap into what was important to the parents. What would the reasons be for the parents to adhere to his prescription of reducing children’s television viewing time? It wasn’t obesity; it was screen violence, maybe sexual content and that sort of thing.”

Several examples of this notion would include things like competitions or fundraisers linked to exercise (e.g., *Jump Rope for Heart*, sponsored by the American Heart Association) or engaging children in urban planning processes to create outdoor green spaces which could ultimately be used for physical activity.

Finally, stress in the lives of children and teens was mentioned as a potential mitigating factor of healthier eating and PA. Children have expressed that they are not eating properly or exercising enough because of the amount of stress that they experience in their daily lives. Interventions that assist youth in managing their stress may have the secondary and unexpected outcome of reducing overweight and obesity.

E. To Tell or to Teach

There was some discussion about the difference between the medical establishment telling you to do something and individuals engaging in a behavior because they want to and it fits in with their lifestyles:

“What he (*one panelist*) is talking about is he wants a strategy that helps him do what he wants to do, but better, and what he (*another panelist*) is talking about is the medical establishment telling him what’s good and what’s not good.”

And:

“.....not telling me what to do but teaching me about what I’m doing.....I think sometimes it’s subtle difference between creating an application that tells somebody what to do and somebody else creating an application that teaches somebody what to do.”

Not to discount the formidable role which physicians and other healthcare providers can and do play in the obesity epidemic every day, one panelist summarized:

“We have to fundamentally understand behaviorism, how people make decisions, why they make decisions about what they do and what they don’t do, and then integrate that knowledge into the technologies that we are building. Otherwise, we will have nice technologies that sit on the shelf right there.”

F. Consumer Engagement

The importance of and need to engage consumers, including children, in the reduction of the obesity epidemic was noted by several panelists from different perspectives:

“We had this obesity meeting where we brought in the food industry, helping the food industry fight obesity. Basically, it was really eye opening. I think there are a number of issues, but if we could get consumers to purchase healthier foods, they would sell them, they told us. The only thing they’re doing is they are making a lot of changes because consumers are demanding them.”

And:

“We thought about trying to do some things like that (*taking a PDA out into the world and playing a game where you are trying to track and find things*).....a game where kids go out and map the ecological diversity so that we can then take that data to places, but tying it to a political aspect of the macro or the global. Kids actually coming up and saying, ‘We’re the 599th worst district for places to exercise in our community,’ that sort of thing so that data can actually see a cause and effect in a real world basis. I think that would get certain kids, really, I mean just doing it for the sake of doing it is not much fun. The fun part might come in knowing that you made the mayor change her mind.”

XIV. Content Themes

A. Building the Evidence Base: Understanding Youth Technology Use for Health Behaviors

There is a relevant difference in both technology use and information-seeking behavior between adults and children brought up in a technology-rich environment that necessitates further exploration. This cultural gap must be understood and bridged if developers and scientists are to successfully tailor health interventions to youth.

In order to better comprehend how children and teens are using technology, we must construct an evidence base in both in qualitative inquiry (e.g., discovering the practices that arise out of the interplay between the constraints and opportunities unique to a given technology; the role of competition, prizes, and, incentives as motivators) and quantitative analysis (e.g., health outcomes of eHealth obesity reduction interventions). Additionally, how these technologies fit within the existing social and technological infrastructures is also extremely important. For example:

“.....the use of cell phones with kids, which is a very complicated thing, because you give a kid a cell phone and they’re downloading ring tones and there doing this and a lot of other things. We really didn’t know what they would do when we gave them these phones. It’s really a qualitative experience as much as a quantitative experience to see what effect it’s having on this arm of research.”

Not only is there a dearth of outcome research on nutrition, PA, and diet eHealth interventions targeting children, technology use amongst traditionally underserved communities is even studied less often:

“I do think we need to know more about this formative research, particularly when it comes to African-Americans and maybe minorities in general, about technology and implications in their lives.....before we can decide something that we can know will have a much bigger, better sense will be successful at getting them. We need to know more about their uses or how it may differ from mainstream or some of the larger populations, and build on that.”

And, where research results suggest an effect, the magnitude of this effect must be weighed. As one panelist put it:

“Might be a big effect but not very many people are doing that. Of course, with TV, maybe it’s a small effect but a lot of people are doing it, a lot of kids are doing it, everybody’s doing it. Small change but could make a big difference because it’s a large etiologic fraction.”

Ultimately, the need to translate evidence-based research findings into applicable real-world settings, as well as the dissemination of successful applications to broader audiences, was seen as critical.

B. *If You Build It, They Might Not Come: Merging Theory with Day-to-Day Living*

Panelists stressed the need for behavioral science and other theories as drivers of technology development for obesity prevention and reduction. Goal setting, readiness to change, and related principles of behavior change were seen as important. However, the potential success of eHealth was deemed superior if its functions are “naturally integrated into people’s lives”:

“It cannot be something extra that people have to do. That’s not going to work outside of laboratory or Internet-controlled interventions studies.”

And:

“I think a lot of the interventions I see, sometimes they’re beautifully designed websites and they have all the theory built into the background, but the reality is there is no reason a person would go to it in the first place.”

Additionally:

“If you could create an intervention where you didn’t have to start using the intervention, you just started doing something you were already doing and the intervention rolls itself into your natural life, I think you would be much more successful.”

C. Manufacturing “Fun”

Throughout the meeting, panelists periodically returned to the concept of needing to make any technology-based program for use by children and teens captivating and “fun.” Otherwise, the application would be ineffective, no matter how sophisticated or interactive the programming:

“I think part of the reason that you don’t see some of the interventions that have been proposed being successful is not because of different operating systems or other things like that, or even challenges with PDAs and things like that, being different models. I think the problem is, frankly, that most of the interventions are not very good. They’re not fun and they don’t have a pull.”

And:

“I think a study should be created for children so that they could read about nutrition and fun games that they could play with so they could learn more about nutrition and about the (food) pyramid.”

The difficulty of trying to determine exactly what makes something fun was expressed by another panelist:

“People look for the silver bullet especially when it comes to fun, right? They think that there’s somehow, what we are going to end up doing is this recipe. Here’s how you make stuff fun. Believe me, these people exist. They exist searching for it. I cannot tell you how incredibly impossible it is to define how you make something fun on that basis, as if it’s a recipe where you just throw the fun at something and it sticks. I think this is really important, but it has to be done extremely right or it’s going to be another waste of money.”

While difficult to capture, “fun” as a development issue in the creation of eHealth applications needs further examination.

D. Cost and Cost-Effectiveness

An oft-cited concern about the use of technology from the perspective of the end user is the expenses associated with hardware, software, connectivity (e.g., Internet access fees), and maintenance. This is of special concern for traditionally underserved populations, where costs could serve to exacerbate the digital divide.

In addition, development and implementation of eHealth interventions can require a significant amount of financial resources, without guarantee that applications being created will realize or have the ability to determine a return on investment. While it may be difficult to establish the monetary costs of delivering “usual care” for obesity education or treatment (often face-to-face individual or group programs), many are wary to employ eHealth applications, even when shown to be effective, due to the perception that their costs are higher. However, because of eHealth’s capacity for tailoring and customization, these programs hold the promise of scalability:

“I feel like, if you compare the cost of the technology and the scalability versus the cost of the vast majority of interventions that have currently been proposed, there is going to be, and in some cases already is, with Internet-based stuff and in the future will be more complicated technologies, no comparison. The cost of physical hardware that would run most of these interventions is going to drop to next to nothing. If you can figure out a way to get an intervention on those devices that is really compelling and works well, maybe not as well as the face-to-face interaction, but it’s going to be dramatically less expensive, and somebody could define a very large scale that would be next to impossible with most of the interventions that have been proposed.”

One panelist’s poignant comment also helped to put “cost” into perspective:

“States that bother to look at how much obesity is costing them, or sedentariness..... California did the study and Maine has just done the study. Once you have that number in front of you, of how painful it is, then Blue Cross Blue Shield takes direct action. Maine - \$2.13 billion [was spent on] our insured customers [who] were overweight every year. That spoke pretty loudly and people wanted to move very quickly.”

Additionally, noting that costs are not just financial, one panelist posited:

“(I see) economics as the science of choice. How can we create technologies that lower personal costs towards achieving any one of these goals that we think is useful?”

Finally, panel members stressed the need for sophisticated promotion and business plans as eHealth developers go forward to enhance the speed to market, scalability and distribution,

and sustainability of applications beyond Small Business Innovation Research (SBIR) grants from the National Institutes of Health or other start-up funding.

E. Standards and Interoperability

As with technology-based programs in other business sectors (e.g., banking), the capacity for systems to interact with one another relies heavily on agreed sets of interoperability standards. eHealth currently lacks these standards. As a result, technology and its platforms are highly fragmented in nature and may pose a threat to interoperability and thus, scalability:

“Everything is actually shattering into a million of little shards, even with open source software. Actually, open source is making it more possible to have a million little shards.”

And:

“There are a lot of “me too” things out there and there’s a lot of funding that is duplicated, so there is actually a market to be marginal. There is a market in being walled. To try and find ways to shatter those markets even through sheer will.....for instance, in the e-learning field.....(there is) a group of people who are saying, ‘Uh-oh, we can’t allow this to constantly keep happening.’ That very well could be an issue especially with something as pandemic or epidemic as obesity is said to be.”

The technology-neutral platform (“net neutrality”) offered by the Internet was seen as extremely positive, the preservation of which is critical. In addition, the panel believed that major players in the obesity epidemic may have the potential capacity to encourage “policy cross-cuts” that would effectively cut through walled markets that make the creation of platform operating standards difficult.

F. Opportunities and Challenges in the Use of eHealth

As mentioned earlier, panelists found it helpful to have an organizing structure around which discussions could take place regarding the role that technology might play in obesity prevention and reduction. Key issues and/or areas for further exploration that were put forth by panel members are categorized below.

1. Individual Level

- Mobile/wearable/portal technologies were seen as those most likely to engage youth. However, allowances should be made for different technological options (e.g., computers) to access the same information. Additionally, opportunities exist for the use of Radio Frequency Identification (RFID).
- More information is needed to determine the potential for active video and computer gaming to increase PA, especially in youth who are typically sedentary.
- Applications must be interactive and provide feedback, where appropriate.

- Tailoring and personalization of content (by gender, race, ethnicity, age, etc.) is crucial.
- “Just-in-Time” interventions, those which provide immediate feedback, information and/or alternative options at the point of decision-making, warrant further attention.
- Technologies that assist individuals in culling away at habits little by little (i.e., food substitutions – sodas to sports drinks to water) were seen to have potential.
- Privacy and security concerns of technology use must be considered when weighing the potential benefits of eHealth applications.

2. Micro Level

- As mentioned earlier, families are key points of influence and decision-making, and need assistance on a variety of different levels. Technology-based applications that use cell phones, RFID, Global Positioning Systems (GPS)/Global Information Systems (GIS) and the like could be used to target issues as diverse as the location of and access to less expensive, nutritional foods and PA options; stress management; nutrition education; cultural concepts of weight in children (e.g., “overweight babies are healthier”); and nutritious, quick, and easy meals:

“I wish I could come home and put on this little machine, and say, ‘Well, I want something with chicken. Tell me what’s healthy so I can cook it.’”

- Further opportunities exist to enlist doctors and other health care professionals in the prevention and reduction of overweight and obesity through the use of eHealth. Rothman et al.⁽¹¹³⁾ highlight the importance of primary care physicians in managing chronic illness, while also noting the sheer magnitude of services needed. Given the time crunch that most primary care providers experience,⁽¹¹⁴⁾ eHealth’s capacity for efficiency and scalability may serve to enhance service provision options.

3. Mezzo Level

- Schools were seen as gatekeepers, data collectors, centers for access to nutrition education and PA, and often, as sources of unhealthy foods (be it through vending machines with candy to high-fat entrees in the cafeteria). Panelists conceded the multiple, sometimes conflicting, and extremely overburdened roles that schools currently occupy, and do not want to add to that burden. However, technology-based systems that gather BMI data from school-aged children are currently in use in Arkansas and Pennsylvania, reporting information back to parents. Panelists believed that further school-based eHealth programs are possible, linking information gathered there with public health departments, doctors’ offices and so on. Whether or not the recording and monitoring of BMI of youth in schools will have a positive impact is unknown at present.
- Technology can facilitate important linkages and data sharing between groups of stakeholders (consumers, schools, local health departments, employers, local government, etc.) to enhance knowledge and increase activism.

- There are opportunities for novel technology use at this level, such as developing “scores” or rankings to assess a community’s overall nutrition and PA health – based upon supermarket content and costs, fast food access, safe playgrounds – or online/virtual grocery stores that allow for more thoughtful, less spontaneous shopping.

4. Macro Level

- Data-driven, system-level (e.g., school boards, governmental agencies, health care organizations) policies and laws supporting the investigation, use, and dissemination of evidence-based eHealth tools are required to successfully implement this agenda:

“We need to figure out what that software needs to be as soon as possible so that.....the cell phone providers and manufactures build that in. Rather than with the (*Nintendo*) Wii, where the health community is reacting, the health community should be proactive in saying this is what we need for the good of the country to be embedded in all these devices that everyone is going to be carrying anyway. Make it happen.”

- Middleware as a technological platform (e.g., the development of an RFID food database) on which a multitude of other eHealth applications could be built is essential:

“Traditionally, with middleware and platforms, these tend to be very hard businesses to get off the ground because the customer is another software developer. It’s usually a software developer under start up.....they don’t have a lot of money so one of the things that has actually been missed is the fact that sometimes these platforms have immense value, but no apparent immense value, so there’s no return. There’s a huge social return but there’s not a lot of financial return, at least obviously.”

- It is important to determine the potential role that technology can play in both making healthier foods less expensive and healthier meals that are quick, cheap, and easy to prepare.

5. Global Level

- Technology to track food distribution and transit on an international level could be used to keep locally grown foods in the communities where they were harvested, potentially enhancing freshness and reducing costs.
- Given the porous nature of our media and society, technology could be applied in “reverse marketing” to advertise healthy messages to youth regarding nutrition and PA.

XV. Key Issues

While many topics were covered over the course of the day, panelists did reach consensus on a variety of different issues, which are outlined below.

- Technology is ubiquitous in the lives of children and teens, and current and future projected access to it is an opportunity for intervention:

“More and more kids are carrying these things around for a variety of reasons, parents purchasing them for them and what not, so it’s just a matter of trying to capture the infrastructure in some way.”

- The scalability of an effective intervention could potentially be enormous, reaching even traditionally underserved youth. eHealth applications could give Americans unprecedented access to medical/health assistance and interventions, and support efforts at self-management:

“You already have a computer in the kitchen, because you have your mobile phone, and you can bring it wherever you want. When I think about the problem, I don’t think, ‘Do they have a computer in this area of the home?’ or ‘Can I apply the technology?’ I think, ‘What do I need to apply?’ and then, ‘How am I going to take advantage of the technology I might have?’”

- Over time, technology will become quicker and cheaper, making interventions more user-friendly and reducing cost-related barriers to access for traditionally underserved populations.
- Currently successful, evidence-based eHealth applications need better dissemination channels.

Cross-Cutting Key Findings and Implications

The formative evaluation approach employed in this project, including the focused literature and two-phase, modified Delphi consensus conference generated a rich information source from which to draw cross-cutting key findings and their implications. These findings include the following:

- The ubiquity of technology in the lives of today's youth requires new pedagogical methods and paradigms for interventions to prevent and treat childhood obesity that are adapted to the learning and information-seeking styles preferred by these frequent technology users.
- More research is necessary, both qualitative and quantitative, to better understand the feasibility, acceptability, patterns of use, and potential effectiveness of eHealth applications targeting the prevention and reduction of obesity and overweight in children and teens. This is especially true for traditionally underserved populations.
- Researchers and developers must be culturally competent and consider cultural issues and challenges when creating eHealth interventions.
- Interventions that do not integrate seamlessly into the daily ecology of children's lives are not likely to succeed.
- Public health interventions were seen as a priority, with the potential to affect long-term, population-based improvements. At the same time, maintaining focus on the immediate, pressing needs of children and families currently in crisis is also imperative.
- "Screen time" is often identified as a primary causal factor in childhood overweight and obesity in the academic literature and by health professionals and the lay press. Further differentiation between passive TV, computer, and video game use, as well as delineating other confounding factors, is needed to clarify which components have the greatest magnitude of effect for specific populations.
- eHealth interventions can require substantial up front costs, both in the development of computing hardware and sophisticated software applications. However, the cost of technologies used for eHealth inevitably decrease over time, posing less of a barrier to scalability and access for traditionally underserved populations.
- eHealth can be used to mobilize and engage citizens and communities to advocate for environmental changes in their neighborhoods, including increased access to healthy, inexpensive foods and safe recreational spaces.
- Opportunity exists for multi-disciplinary collaboration with the entertainment industry, which possesses the expertise to create fun applications that target the youth demographic, in creating eHealth applications for children (specifically with companies committed to the prevention and reduction of obesity in this population).
- Childhood obesity prevention and reduction is a tremendously difficult problem, and development of novel partnerships is critical to effective intervention. Developers of eHealth-based interventions should consider how they fit into existing and emerging initiatives when collaborating to avoid duplication of efforts.

Priority Recommendations

Integrating the findings from the literature review, synthesized responses from panelists, and the Delphi Conference leads us to recommend that the following specific areas be considered for further inquiry by researchers, evaluators, governmental agencies, developers, funders, and others in the eHealth arena:

- Stimulate development of eHealth applications to assist families with food choices/options and improving nutrition.
- Foster the creation of various “middleware” technologies and platforms (e.g., creation of a structured and searchable database of food items and their nutritional contents and values) that other developers could then access to build a myriad of eHealth programs for obesity prevention and reduction.
- Support systematic evaluation of and applied research for video games (e.g., Dance Dance Revolution[®], Guitar Hero II[®]) and the application of video game platforms (e.g., Nintendo Wii[®], Sony PlayStation II[®]) to determine their potential for increasing physical activity amongst youth.

These recommendations represent recognition of the current pressing needs felt by children and families dealing with obesity, as well as a desire to push the envelope about future potential opportunities that eHealth may hold.

Appendix A

Panel Members

Lilian Cheung, DSc, RD	Lecturer, Department of Nutrition Harvard School of Public Health
M. Christopher Gibbons, MD, MPH	Associate Director, Johns Hopkins Urban Health Institute (UHI) Director, Center for Community HEALTH (CCH) Assistant Professor of Public Health and Medicine Johns Hopkins Medical Institutions
Terry T-K Huang, PhD, MPH	Health Scientist Administrator Program Director, Pediatric Obesity & Metabolic Syndrome Endocrinology, Nutrition and Growth Branch Center for Research for Mothers and Children National Institute of Child Health and Human Development
Stephen Intille, PhD	Research Scientist Massachusetts Institute of Technology
Ann Maloney, MD	Clinical Assistant Professor University of Vermont College of Medicine Department of Psychiatry Maine Medical Center Research Institute
Kevin Patrick, MD, MS	Professor, Department of Family and Preventive Medicine University of California, San Diego Editor-in-Chief, American Journal of Preventive Medicine
Erika Sanchez	Junior, Northeast Metropolitan Regional Vocational School Member, Boys and Girls Club of Chelsea, MA
Ben Sawyer	Co-Founder, Games for Health Project Digitalmill, Inc.
Dirk G. Schroeder, ScD, MPH	Executive Vice-President DrTango Inc. and HispaniCare Associate Professor of Global Health Emory University
Marlene Schwartz, PhD	Director of Research and School Programs Rudd Center for Food Policy and Obesity at Yale Department of Psychology Yale University
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Harvard Medical School and Harvard Pilgrim Health Care

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Assistant Professor of Pediatrics
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Appendix B

Childhood Obesity Panel Questionnaire

Using your professional and/or personal experience, please answer the following questions from your own perspective.

Keep in mind that we are especially interested in traditionally underserved populations. For the purposes of this project, this is defined as lower income children and teenagers (ages 5 – 18) and their families from ethnically/racially and/or linguistically diverse groups.

We recognize that there are some questions that you may have more to say about than others, which is fine. Remember, there are no right or wrong answers! Our goal here is to have you share your knowledge, opinions, thoughts and insights regarding these issues.

1. How do children and teenagers get information and make choices about what they eat and the types of physical activity that they participate in?
2. What kinds of technologies are children and teenagers currently using in their daily lives or may be using in the future (here we're talking about entertainment, communication, etc.)? How might these technologies be used to engage children and teenagers, especially those from traditionally underserved populations, in activities that help to prevent obesity?
3. What are the pros and cons of trying to use technology-based programs for obesity prevention with children and teenagers from traditionally underserved populations?
4. Do you have any concerns about encouraging additional technology use to prevent obesity among children and teenagers? Please discuss.
5. If you had money to invest in preventing childhood obesity, especially among traditionally underserved children and teenagers, what information would you need to convince you that spending it on technological programs was a good use of your funds?
6. Are there ways that we can partner with non-health-related organizations (for example, the food industry, schools, Boys and Girls Clubs, entertainment companies including video game developers) to help prevent childhood/teenage obesity?

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