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Addressing pediatric obesity in ambulatory care: where are we and where are we going?

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Abstract

Since the "2007 summary report of child and adolescent overweight and obesity treatment" published by Barlow, many obesity intervention studies have been conducted in pediatric ambulatory care. Although several meta-analyses have been published in the interim, many studies were excluded because of the focus and criteria of these meta-analyses. Therefore, the primary goal of this article was to identify randomized case-control trials conducted in the primary care setting and to report on treatment approaches, challenges, and successes. We have developed four themes for our discussion and provide a brief summary of our findings. Finally, we identified major gaps and potential solutions, and describe several urgent key action items.

Keywords

Obesity; pediatrics; adolescents; weight management; review; randomized case-control studies

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Conflict of interest

The authors do not report any conflict of interest.

Introduction

Obesity remains a major public health threat in the United States (US), with about one in five youth (2–18 years) and one in ten children under age 2 being obese [1]. Early onset and duration of obesity have been identified as major contributors to complications related to obesity in adulthood [2]. In fact, obesity is associated with all causes mortality [3] and the top causes of mortality are lifestyle-related and preventable [4]. Therefore, strategies that affect the delivery of care from prevention to treatment and focus on early years of life may be critical.

Despite the urgency for interventions, physicians and nurses have been slow to tackle this problem and have described their lack of knowledge and skills to assess and counsel pediatric patients with obesity [5, 6]. Although certifications in pediatric nutrition are available for registered dietitians (RDs) [7, 8], few train in pediatrics and reimbursement is limited [9, 10]. In the face of these barriers, recommendations for prevention and treatment of pediatric obesity were developed for healthcare settings [11] and more recently a call of action was made for inter-professional education, training, and research [12].

The review of interventions in childhood obesity since the publication of the Expert Committee “2007 summary report of child and adolescent overweight and obesity treatment” provide an opportunity to re-evaluate these recommendations in order to identify approaches that may be effective and also to highlight current gaps. The focus of this review is on the primary care setting and we have developed four critical themes around which this review is based.

Review process

This a descriptive review of obesity treatment models for ambulatory care published since the Expert Committee “2007 summary report of child and adolescent overweight and obesity treatment” [11]. Key words in five different permutations were used to search articles on pediatric obesity interventions in the ambulatory care setting. “Randomized controlled trial obesity pediatrics” yielded 233 matches; “randomized controlled trial obesity primary care pediatrics,” yielded 46 matches; “randomized controlled trial obesity primary care adolescents,” yielded 89 matches; “randomized controlled trial obesity primary care children,” yielded 200 matches; and “randomized controlled trial weight management primary care pediatrics,” yielded 34 matches. We identified a total of 599 articles and narrowed the search to 108 relevant abstracts of obesity interventions that were implemented in the primary care setting since 2007.

Our primary goal was to identify randomized case-control trials conducted in the ambulatory care setting and report on treatment approaches, challenges, and success. Therefore, we excluded studies that had no outpatient clinic component, for example studies that solely took place in the community. Likewise, our focus was on comprehensive interventions and therefore we excluded studies that lacked an educational or behavioral component (e.g. compared two types of diet only) or focused on weight loss medication or weight loss surgery. Other exclusion criteria were not used to allow for exploration of novel methods and

identification of research gaps and priorities. We also conducted a manual review of the abstracts' references to identify additional relevant articles and "PubMed" articles to highlight findings from these reviews in our discussion.

We classified the studies according to the treatment stages defined by Expert Committee where possible. (Figure 1) Study characteristics examined included child demographics, study period, treatment and control arm data including contact hours, inclusion and exclusion data, recruitment and drop out data, as well as anthropometric outcomes measures including BMI and BMI z-scores. At least two authors reviewed all RCTs. Discrepancies were resolved using a consultation and consensus approach. Of the 108 abstracts and their references, 45 randomized case-control trials were identified as meeting our criteria. (Appendix) We identified several themes for further discussion using a question format.

Question 1: Whom do the studies target and in what settings?

This section provides a summary of the state of the evidence based on the populations targeted in each study, including age group, weight classification, socioeconomic background, the focus of the treatment (parent, child, or both) and whether the allocated treatment was individual or group-based. Other methodologies, such as location and support of the intervention, are also discussed in this section.

Age group—The majority of interventions reviewed were conducted among school-age children (6–10 year old) and adolescent (11–21 years old) patients. Fewer were conducted in the preschool-age population (3–5 years old). Only a handful of studies were dedicated to interventions among infants and toddlers (0–2 years old) but more than in a previous USPTF meta-analysis [13]. This is especially important since the first 1000 days, from pregnancy to a child's second birthday, have been identified as a critical period for nutritional interventions' impact on health outcomes [14, 15].

More intensive multidisciplinary studies [16, 17] demonstrated significant reductions in weight measures compared to standard of care. Although system-based treatment interventions in early childhood that used motivational interviewing without a multidisciplinary approach did not show significant reductions in weight measures, [18] one study showed significantly less increase in weight measures. [18] As a result, Foster (2015) stated in their systematic review of treatment interventions for early childhood obesity that there is evidence supporting "Stage 3" interventions for obesity treatment in early childhood but little evidence to support other stages in this age group [19].

Weight classification—Most of the programs sought participants who met criteria for overweight and obesity based on BMI or weight-for-length using national or international references. A total of twenty one initiatives targeted both overweight and obese patients in primary care settings [16, 18, 20–38]. A total of thirteen initiatives targeted only obese patients [39–51]. One program focused on children with BMI z-score 0–3 [52] and another two targeted more severely obese individuals defined using BMI $\geq 97^{th}$ percentile [53, 54] or z-score >=3 [55]. Finally, five studies focused on pregnant women and their offspring regardless of BMI [56–60].

Socio-economic status—Few studies that included minority participants existed when the 2010 USPTF meta-analysis was performed [13]. However, that meta-analysis included one major study that focused on a diverse population conducted among obese children and adolescents (8–16 years old) in an urban specialty clinic setting in the US [51]. Although the intervention showed benefit for anthropometric outcomes at 12-months, including BMI, BMI z-score, body fat, plasma lipids, and insulin sensitivity, the data were not examined according to ethnicity.

Since then, other studies including diverse populations have also been conducted in the ambulatory care setting [18, 20, 21, 24, 25, 29–31, 39, 43, 50, 51,]. Hofsteenge [28] conducted an RCT of 122 adolescents aged 11–18 years after a brief evaluation in a tertiary weight management program. Using post hoc analysis, these authors found that change in BMI z-score, blood pressure, and HDL were significant only in a population of western descent but not that of non-western descent. The authors postulated that the difference among ethnic groups might be due to differing cultural norms of physical appearance and healthy body weight.

More studies provide data on either income or insurance status of the families [18, 23, 24–26, 30, 32, 35, 37, 40, 46, 47, 53, 55–58, 61]. For example, Taveras et al. (2011) [18] studied 471 children age 2–6.9 years old. In post hoc analyses, they found that BMI was significantly improved among girls and children living in lower-income households (< $50,000). More studies are being conducted in diverse or underserved populations, an important advancement given their vulnerability. However, an analysis of differential effects of the interventions are rarely presented.

Parental and child involvement—Parental involvement and parent-tailored approaches were a large component of the design and implementation of the programs reviewed, as would be expected given the importance of addressing the parent-child dyad in the pediatric ambulatory care setting. Most of the studies incorporated strategies aimed at the parent-child dyad but also at each one separately. One study explicitly examined the impact of parent involvement vs. no involvement [46]. Using a sample of 357 Iranian adolescents aged 14–18 years followed for one-year, there was a significant decrease in BMI z-score, but not in BMI, for adolescents who received MI with parental involvement versus MI alone or passive assessments [46]. Although parental involvement for pre-adolescents has been standard of care based on former research studies conducted outside of outpatient clinic by Epstein [62], the Iranian study points toward the benefit of parental involvement in adolescents [46]. Such a study would need to be replicated in other populations, which likely have very different norms for family behavior and parenting.

Individual and group treatment—We observed eleven studies that included interventions delivered in individual counseling sessions without supplemental group education sessions [22, 32, 35, 38, 40, 42, 49, 54, 57, 58, 61]. Of these, six [22, 32, 35, 38, 58, 61] used phone calls, written educational materials and/or home visits to supplement the counseling sessions. Five [35, 42, 54, 58, 61] were successful in improving weight status compared to the control group; however half of the group interventions used supplemented face-to-face clinical visits and the studies varied in intensity and design. From these

findings, clinical counseling sessions may be an effective alternative to group sessions, but the differences in design limit our ability to draw conclusions as to the efficacy of individual counseling sessions compared to group sessions.

Location of Intervention—The studies reviewed were predominantly conducted in the US and Australia with a few conducted throughout North America, Europe, and the Middle East. The interventions were predominantly conducted in urban settings, although some focused on rural populations.

The interventions were mostly located in outpatient pediatric primary care clinics [18, 22, 25, 26, 32, 35–39, 41, 45–49, 52, 60, 61], outpatient weight management clinics [21, 28, 50, 51], hospital-based outpatient obesity clinics [54], and community health centers [20]. One arm of an intervention took place in a high school [33] and one arm of an intervention took place in a school health center [43, 44]. Another intervention had one arm that included an inpatient component [55]. For some approaches, interventions extended beyond clinic walls and involved phone coaching [30–32, 37, 48], text messaging [48], telemedicine [24], home visits [17,47, 48, 57, 58] and communication with families via newsletters, manuals, automated phone, and educational audio tapes [22, 25, 30, 32, 35, 37, 40, 44, 61].

Studies in primary care settings that include multidisciplinary specialty protocols, home visits, and telemedicine looked especially promising (Appendix). Additional support from technology may increase contact time with families and play a role in family satisfaction [24, 63]. Given the paucity of pediatric obesity studies using supportive technologies, it is currently difficult to draw conclusions on the best method to support primary care providers.

Question 2: What are the program characteristics associated with reduction in weight status?

Since 2007, study findings have suggested that multiple treatment options may be effective in improving weight status and metabolic measures in the pediatric population. Although interventions differed in their delivery and locations, those that were of greater intensity and included supporting providers (e.g. RD) tended to be more successful.

Intensity and duration of Intervention—To the best of our knowledge, there is no randomized clinical trial specifically comparing different intensities of a behavioral intervention on anthropometric outcomes. Former reviews have summarized the anthropometric outcomes of various behavioral studies by pooling data from studies with similar level of intensities [13]. In the USPTF meta-analysis [13], authors used hours of contact as a proxy for treatment intensity. Categories of intensity were defined subjectively as very low (<10 hours), low (10–25 hours), moderate (26–75 hours), or high (>75 hours). The pooled interventions that included a medium- to high-intensity behavioral component for obese children and adolescents (≥6 y old) with BMI above the 95–97th percentile [64] were associated with modest average short term weight improvements in mean BMI change (range: 1.9–3.3 kg/m^2) and were typically conducted in specialty clinics or similar settings [13]. These authors suggested that lower-intensity interventions that could be implemented in primary care had more modest and less consistent improvements in BMI.

We further classified the outpatient clinical interventions identified since 2007 based on the stages of obesity treatment defined in Barlow et al. (2007) [11]. The majority of approaches reviewed typically fit best the “stage two” treatment (“structured weight management”), which is based in ambulatory care clinics but includes support from specialists such as dietitians or outpatient physical activity programs [16, 20, 21, 24–26, 32–36, 38, 39, 40, 42, 45–47, 49, 52, 53, 56, 61]. Less intense interventions focused on dietary and physical activity education and/or behavior modification. However, as the approaches intensified, they notably involved more follow-up, multidisciplinary teamwork, and behavioral interventions, including cognitive behavioral therapy (CBT), and parenting skills training and counseling.

Several studies showed that lower intensity interventions were less effective [20, 35, 41, 49]. Mean change in BMI z-score were not significantly better in the intervention compared to the control arm of these studies (−0.20 to 0.0 s.d) [20, 41, 49]. Resnicow (2015) [35] was able to find some changes in lower intensity intervention groups: mean change BMI percentile from baseline was −1.8 for usual care, −3.8 for PCPs care, and −4.9 for PCP and RD care. However, a greater effect was found in a few studies. Looney (2014) [30] demonstrated that less than 2.5 contact hours, which included growth monitoring and behavioral change coupled with newsletters, could improve mean BMI z-score (average −0.16 s.d.) compared to standard of care in a predominately Caucasian and higher-income population (household income >$50,000/year). Pakpour (2015) [46] was also able to achieve a reduction in weight status using 4–5 hours of motivational interviewing in an Iranian population (mean BMI z-score 2.58±0.61 s.d. vs. 2.76±0.70, p=.02). These authors’ findings suggest that particular interventions may vary in effectiveness depending on the target population.

In addition to intensity of treatment, duration of treatment varied according to studies.. In Whitlock’s review [13] short-term weight outcomes were defined based on a study period lasting 6–12 months while weight maintenance was defined as a study period lasting 1–5 years after the beginning treatment. Overall, the average duration of the interventions we have identified since 2007 was 9.5 months and the average follow-up time was 15 months. The shortest intervention was a 5-month pilot study in adolescents [21] and the longest were 24-month [35, 47, 48]. Although, long term programs showed a lack of sustainability but no study included a long term maintenance program [58].

Primary care intervention with and without support—The intervention in most studies included another healthcare provider in addition to the primary care provider. Only two studies [22, 48] solely examined the efficacy of a PCP treating obesity without supportive staff. Despite support from technology, neither Taveras (2015) [48] nor McCallum (2007) [22] PCP-only interventions were found to be successful in reducing weight status. These interventions can be viewed as low-intensity, which may be an important factor in the lack of those studies efficacy. Interventions reliant solely on PCPs would not likely be sustainable given the PCPs time and cost constraints compared to allied health care professionals.

The variety of healthcare specialists used in the multidisciplinary interventions examined was broad. RDs and nutritionists played key roles in dietary counseling and education, while nurses and nurse practitioners delivered education and met with patients and families to track progress in hospital-based clinics [54]. Other supportive staff included exercise specialists and physical therapists, clinical psychologists, counselors, and social workers. To the best of our knowledge, there is no study comparing PCP and PCP with supportive staff using equal contact hours.

In summary, successful interventions used additional health care providers. Uniformly, supporting providers were used to increase the number of contact hours available to subjects. They were used to conduct group and individual visits, home visits, telemedicine visits, and follow up by phone. However, real-world implementation of web-based shared care software appeared to be challenging [65].

Question 3: Where are the research problems and gaps?

Prior to the expert committee recommendations in 2007, weight studies predominantly focused on elementary school-aged children, Caucasians, and urban areas. Nevertheless, several investigators called for studies in minorities and underserved populations [66, 67]. Recent RCTs in US primary care settings have started to enlarge their focus. Future study designs should include stratification of data by race/ethnicity and by income or insurance status.

As illustrated in the Healthy Hawks study (2013), program attrition rates are especially common in pediatric lifestyle interventions targeting minorities and populations from underserved areas [68]. Dhaliwal et al. [69] recently examined the reasons for program attrition using data from twenty three pediatric obesity programs. A few consistent predictors of attrition included pediatric patients from families who were recipients of public health insurance and children were older. Given the levels of program attrition, identifying patients and families who are more likely to adhere to their treatment goals is critical. Recently, pretreatment readiness scales and behaviors such as exercise have been used to predict program adherence [70], however more studies are needed. Better definitions and characterization of attendance and adherence rates are needed.

Another concern is the generalizability of outpatient clinic RCTs: one example is the study of Berkowitz (2013) where 43% (133/306) of patients recruited from two clinics electronic medical records and public announcement were excluded during evaluation [22]. Another example is that of Stark (2014) [47], where 84% (235/277) of the population of preschoolers in three practices met age and BMI percentile criteria but were either excluded, unable to contact, or declined. More consistent definitions for treatment program eligibility, inclusion and exclusion criteria in outpatient clinics are needed.

The field would also benefit from agreement on a uniform clinical outcome measure for weight status. Since 2007, the most frequently used outcomes were absolute values and z-scores of BMI for children aged 2–18 years old and weight-for-length in children younger than 2 years of age. Improvement in anthropometric parameters is difficult to interpret in children because they continue to growth. Greater decreases in weight are required to

achieve good health in adolescents compared to toddlers. In addition, because of a paucity of empiric data above the 97th percentile, categorization of children with BMI above that percentile is not accurate [71–74]. For individuals with severe obesity, large changes in BMI is required to see a change in unit of percentile or standard deviation. Therefore, other weight measures may be required to estimate changes in weight measures (average and rates) [71–75].

As reported in other conditions [76], behavioral interventions and system-based strategies require clinical trials to evaluate their efficacy but also a real-world situation to evaluate their effectiveness. Real-world weight clinics are characterized by referral of patients who are less healthy than those who participate in trials [77] in addition to low enrollment [78] and high degree of attrition [79]. Therefore, observational studies in a real-world setting need to be better defined.

Question four: Are the interventions applicable to and sustainable in clinical practice?—Our review of the literature suggests that effective interventions depend on intervention intensity and staff availability; the more successful programs provide frequent visits and employ non-physician clinical staff such as RDs, RNs, and mental health professionals. This section explores whether these two elements can be disseminated to clinics outside of research protocols and whether these practices are sustainable.

Families' logistical challenges—Attendance at programs requiring frequent visits may pose a challenge to some families. Attrition rates in weight management programs tend to be high (27–73%) [80]. With few exceptions, the RCTs in our review showed high attrition rates. Risk factors for attrition do include not only family insurance and older age [69], but also missing school, distance from home, scheduling conflicts, transportation and parking, clinic environment, child not ready to change, frequency of visits (too low or too high), program content (tools, individual rather than family focus, exercise interventions) [79]. Families have recommended programs that focus more on "physical activity within appointments, a family-centered approach, interactive learning environments, age-appropriate information for children and parenting support" [80]. In addition, lack of program satisfaction is a major contributor to attrition rates [63].

Family perception of treatment need—One recent study investigated why parents do not initiate enrollment in pediatric obesity programs after being referred by their primary care provider [78] and found five main themes: no perceived need for care, no perceived need for further actions, no intention to initiate the recommended care, initiation barriers, and situational factors. For those who had barriers to initiating enrollment, the main reasons included lack of time/schedule conflicts, distance/transportation problems, and misperception about the program. In that study [78], parents also listed associated costs (psychological, educational and financial), perceived lack of effectiveness (diet and lifestyle changes won't work), perceived lack of control ("I can't change my child's behavior"), and preference for an alternative source of management ("doing it on their own"). Parents likely need to feel that enrollment in a program is worthwhile and is producing the expected results to remain enrolled, especially if there are costs associated with enrollment. Further studies

are needed that address logistical barriers in order to improve program enrollment, adherence, satisfaction, and attrition.

Program costs—Wright et al (2014) [81] looked at the cost of a primary care-based childhood obesity intervention. Their intervention included four in-person visits and two phone calls, and estimated an average $30 of parent-incurred cost per child for participation. These costs would be expected to be prohibitive for low income families as the number of visits and travel time increase.

Using “Cost Per Quality-Adjusted Life-Year (QALY) Saved”, Cawley (2010) [82] notes that two of the most cost effective ways to prevent obesity in children are programs promoting healthy eating and physical activity in elementary schools (Coordinated Approach to Child Health [CATCH]) and middle schools (Planet Health). While treatment options that meet the needs of busy families need to be further studied, efforts toward community-based prevention may be the key to addressing the obesity epidemic on the whole.

The healthcare perspective—Increasing the frequency of visits to manage pediatric obesity could face several barriers to implementation in clinical practice. Primary care providers are ill-equipped to provide nutrition and dietary counseling given their limited education in medical school [83–85] and training during residency [86]. Therefore there is a need for intra- and inter-professional medical nutrition education and training of clinicians in primary care settings [12, 87]. Given the PCP’s demands, their limited training in pediatric obesity, and the need for high intensity treatment, support from allied health professionals is critical.

The more successful interventions reviewed in this article often used allied health care professionals to conduct visits, which increased the number of contact hours and improved weight measure outcomes. While studies did not compare which type of allied health care professional would be most effective, one could argue that RDs would be best equipped to promote healthy eating. While RDs have been proven effective for treating patients with a variety of medical nutrition conditions, they are rarely integrated into primary care teams [88]. In addition, low reimbursement of obesity interventions and high overhead costs are of concern to hospitals administrators [89, 90]. Lee et al. (2010) [91] showed that Medicaid in ten states addressed childhood nutritional and behavioral therapy reimbursement and billing codes for obesity, Medicaid in ten states did not address it, and Medicaid in the remaining 30 states had unclear guidelines. Another reason for infrequent use of allied health care professionals could be the lack of team exposure during training, however the movement toward “patient centered medical home” and more innovative payment models [88] as well as inter-professional training in medical nutrition [12;87–89] may provide the opportunity to overcome this barrier.

With the Affordable Care Act allowing for a change in the delivery care and opportunities to focus on prevention, an integration of clinical and community care to prevent and manage obesity has been proposed [92]. Such Integration of services would likely allow for more involvement of allied health care professional and community liaisons to affect the current obesity epidemic. As our health care system evolves, new opportunities to prevent and treat

pediatric obesity are arising. Systems that rely on frequent visits to PCPs may not be feasible or the most effective. Increasing contact using a variety of health care professionals with support from new technologies may become a more sustainable model for the prevention and treatment of childhood obesity that isn't burdensome on families.

Conclusions and recommendations

In summary, this review showed that weight reduction in primary care clinics improves with the level of intensity of the intervention, which often requires additional staff and technologies. During this review, we have identified multiple gaps and we are proposing several solutions. (Table 1) There is an urgent need for uniform definitions of outcomes such as weight, adherence, compliance, and attrition measures. Future studies should include strategies to improve program enrollment and attrition rates as well as use new technologies, which may also improve satisfaction. In addition, inter-professional education and training as well inter-professional approaches to the prevention and treatment of obesity is critical. Long term studies including weight maintenance strategies are needed. Finally, special attention must be given to underserved populations including non-English speaking populations and multidisciplinary interventions in early childhood obesity. This review points at multiple areas including:

1. Standardization of outcome measures to allow for better comparisons between studies and population groups (minorities, poverty status, etc.)
2. Use of innovative study approaches to improve weight and adherence measures using a combinations of settings and staff to assure intensity and continuity of care, as well as new methodologies to increase family satisfaction and decrease attrition rates
3. Develop an inter-professional approach to education and training in medical nutrition and lifestyle behaviors

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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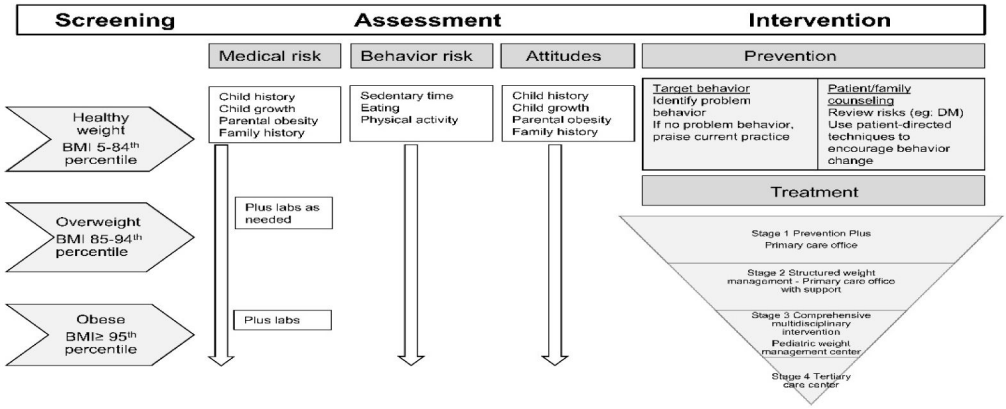

Figure 1. Stages of prevention and treatment approaches in pediatric obesity
Source: Adapted from [11]

Table 1

Gap areas that are limiting study comparisons and proposed solutions

Gap areas	Proposed solutions
Lack of standardization of outcome measures across studies	• Create a set of standard outcome measures that are clinically relevant for target populations • Create an international outcome measures of program success
Lack of population characterization and adjustment for potential confounding factors	• Create stage of change, motivation, and adherence measures • Define adherence measures (rate of attendance, compliance with goals, attrition and retention) • Define intervention groups based on age of the subject targeted (e.g.: pregnancy, < 2 years old) • Define categories of intervention (e.g. parent, electronic) • Define insurance type • Define social support (e.g. access to food pantry, activities, family/friend) • Define economic status
Lack of a clear definition of a real-world study	• Define characteristics required for a “real world” RCT • Define characteristics required for a “real world” observational study
Lack of studies targeting groups with special needs	• Underserved populations • Minorities – families of Hispanic ethnicity will account for the majority of population in 2030 • Patient with disabilities
Limited use of new technologies to facilitate weight management	• Electronic medical record, I-Phone, telemedicine
Lack of dedicated supporting staff	• Define the role of supportive staff • Develop guidelines to refer patients to supporting staff • Reimbursement of supporting staff (e.g. RDs, community workers)
Lack of inter-professional education/training and research	• Update and improve Standards for education and training of health professionals (MD, MS, RD, RN, PhD, SW, Psy D, EP, PT, dentist, Pharm D, etc.) in obesity prevention and treatment • Conduct outcome research in nutrition and obesity education for health care professionals
Need to define a chronic care model	• Develop cost effective models with prevention and treatment of obesity in a continuum of care • Include supportive staff (e.g. RD, SW, RN) in the medical home • Use of home visits

Gap areas	Proposed solutions
	• Use current community structures as supportive methods