PROCEEDINGS ARTICLE

The Center for Healthy Weight: an academic medical center response to childhood obesity

TN Robinson^{1,2} and KM Kemby²

Childhood obesity represents a worldwide medical and public health challenge. Academic medical centers cannot avoid the effects of the obesity epidemic, and must adopt strategies for their academic, clinical and public policy responses to childhood obesity. The Center for Healthy Weight at Stanford University and Lucile Packard Children's Hospital at Stanford provides an example and model of one such strategy. The design provides both breadth and depth through six cores: Research, Patient Care, Community Programs, Advocating for Public Policy Change, Training and Professional Education, and the Healthy Hospital Initiative. The Center and its cores are designed to facilitate interdisciplinary collaboration across the university, medical school, children's hospital and surrounding community. The foci of these cores are likely to be relevant to almost any academic medical center's mission and functions.

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INTRODUCTION

Childhood obesity represents a worldwide medical and public health challenge. In the United States, the rates of obesity among children and adolescents have more than tripled since 1980—with about 17% of 2- to 19-year-olds classified as obese in 2007–2008.¹ The projected health, psychological, social and economic consequences of the obesity epidemic are staggering. For example, the US Centers for Disease Control and Prevention projects that about one in three of all children born this past decade will have diabetes in their lifetime, and one-half of Latina and African American females.² Rising rates of diabetes are only one of the consequences of the epidemic of childhood obesity. Obesity is associated with dyslipidemias, hyperinsulinemia and hypertension, increasing risks for premature heart disease and stroke, many cancers, bone and joint problems, sleep apnea, asthma and other breathing problems, gall bladder disease, liver disease leading to cirrhosis, depression and eating disorders, genitourinary problems, pregnancy complications, central nervous system problems and more, many of which are now starting to be seen in children and adolescents.³ These trends are already showing up as increased medical care costs for children and adolescents.⁴ The overall medical care costs of obesity in the United States already exceed \$140 billion per year.⁵ As a result, the obesity epidemic may be one of the most challenging and serious medical and public health problems of the twenty-first century.

Academic medical centers cannot avoid the effects of the obesity epidemic. But how can they respond to meet the needs of patients, families and their communities, and to address the broader challenges this epidemic presents? This is a question all academic medical centers must face. To complicate things, obesity is not the typical type of acute medical condition for which our current medical care systems evolved to manage. Obesity is particularly complex to understand and address, because it involves nearly every aspect of our lives, from basic biology to global society.⁶ Very few, if any, other health problems involve so

many levels of influence, from genomics to global trade policies, from the US constitutional protections of free speech to cognitive neuroscience, from social and economic discrimination to selecting sites for supermarkets and schools, from airline regulations and commercial building codes to mental health care and the microorganisms inhabiting the gastrointestinal tract, and so on. Most believe that there is no single cause, or even a small number of causes, and there is no single or small number of solutions.⁷ Instead, it is believed obesity will only be solved by understanding and altering interactions among biological, psychological, behavioral, cultural, political, economical and environmental processes.

THE CENTER FOR HEALTHY WEIGHT AT STANFORD AND LUCILE PACKARD CHILDREN'S HOSPITAL

Awareness of these issues led to the development of the Center for Healthy Weight at Stanford University and Lucile Packard Children's Hospital at Stanford. In the early 2000s, recognizing the growing impact and importance of childhood obesity, leaders at the Hospital and the Department of Pediatrics asked for a broad-based and forward-thinking, clinical and academic plan to address this epidemic. As a result, the Center for Healthy Weight was designed *de novo* through a strategic planning effort rather than in a piecemeal and reactive manner. It was organized based on specific strengths of our institutions, with a children's hospital, medical school and university all sharing the same campus. However, it is a model that may be replicated and/or adapted to many different settings, as many academic medical centers will have similar resources to draw upon.

At the foundation of the design of the Center for Healthy Weight is the acknowledgment of the multilevel complexity of the causes, consequences, and potential treatment and prevention strategies. Figure 1 illustrates the multiple, nested levels of influence on a child's energy balance, growth, health and disease. The upper concentric ovals include extra-individual or societal

¹Division of General Pediatrics, Department of Pediatrics, Stanford Prevention Research Center, Department of Medicine, and Center for Healthy Weight, Stanford University School of Medicine, Palo Alto, CA, USA and ²Lucile Packard Children's Hospital at Stanford, Palo Alto, CA, USA. Correspondence: Dr TN Robinson, Division of General Pediatrics, Center for Healthy Weight and Stanford Prevention Research Center, Stanford University School of Medicine, 1070 Arastradero Road, Suite 300, Palo Alto, CA 94304, USA. E-mail: tom.robinson@stanford.edu

Figure 1. Schematic of the multilevel complexity of the causes, consequences, and potential treatment and prevention strategies. The central rectangles represent child and adolescent eating and activity behaviors that influence energy balance, growth, health and disease. These are influenced at multiple levels of organization. The lower concentric ovals represent examples of organizational levels within the individual child. The upper concentric ovals represent examples of organizational levels outside the individual child. The vertical list on the right includes examples of departments, institutes and schools of the University with relevance to the academic mission of the Center for Healthy Weight.

levels of influence, and the lower concentric ovals include intra-individual biological and psychological levels of influence. Children's eating and activity behaviors, and thus energy balance, are influenced by societal, biological and psychological factors, independently and interactively, to determine a child's phenotype, his or her growth, health and disease. The vertical box along the right side of Figure 1 includes a non-exhaustive list of Stanford University academic departments and university-wide initiatives that can contribute to our understandings of the etiologies, consequences, treatment and prevention of childhood obesity. The large number and variety of relevant fields reflects the complexity of the problem. The Center for Healthy Weight is designed to bring these disciplines together, along with the clinical and community programs related to childhood obesity, to solve the problem of childhood obesity.

Consistent with the nested levels of influence and the very large number of relevant disciplines and University departments and institutes, the Center for Healthy Weight was not designed to become a monolithic, self-contained 'institute' or 'department' of its own. Instead, the Center is designed to nimbly help broker the many faculty, departments, and hospital and community resources available to markedly move childhood obesity research, clinical care and policy forward, to identify practical solutions that may be implemented and promoted through patient care, training and education, community programs and public policy. Although the main work of a university and academic medical center is often focused on research and discovery, linking research with the hospital's clinical programs and allied community programs is designed to help stimulate discovery and innovation with greater direct applicability and promise for improving children's health in a much shorter time frame.⁸

This understanding led to a particularly key design feature of the Center, to cross institutional barriers, to include resources from the children's hospital, the rest of the medical center, the medical school, the broader university, as well as the local community. Academic medical centers and their affiliated medical schools and universities are somewhat unique in their potential to respond to childhood obesity simultaneously across the entire spectrum of levels of influence and organization. This partly arises from the breadth and depth of disciplines available in an academic environment that may all contribute to understanding causes and developing and testing solutions. Bringing multiple perspectives together can create exciting new synergies and collaborations that may be more likely to produce scientific breakthroughs and meaningful advances in patient care and public health. Reflecting this multilevel view of the problem and the desire to promote collaboration at all levels, the Center for Healthy Weight is organized to include six, cross-cutting core programs or pillars: Research, Patient Care, Community Programs, Advocating for Public Policy Change, Training and Professional Education, and a Healthy Hospital Initiative. The organization of the Center is illustrated in Figure 2.

The six cores represent a substantial breadth of perspectives, approaches and goals. However, we make an important distinction between breadth and comprehensiveness. The Center for Healthy Weight is designed to emphasize breadth, but not to be comprehensive in its aims. Stanford University, Stanford School of Medicine and Lucile Packard Children's Hospital at Stanford are relatively small institutions, regardless of whether measured by the number of faculty members, numbers of students or numbers of beds. As a result, we know that Stanford and Packard Children's

Figure 2. Organization of the Center for Healthy Weight at Stanford University and Lucile Packard Children's Hospital at Stanford. The Center Director reports to the Children's Hospital CEO and the Chair of the Department of Pediatrics. Major Cores are shown, as well as distinct programs within each Core. Each Core has its own Director, except the Advocating for Public Policy Change Core, which has two Co-directors, one representing the medical school advocacy programs and the other the hospital's Director of Government Relations. Each distinct program shown within the cores also has its own leadership. Other related programs, for example, the hospital's Department of Clinical Nutrition, participate in Center programs, but have their own leadership within the hospital's organizational framework. In this way, the Center for Healthy Weight is able to pull together researchers, clinicians, other professionals and programs from across the hospitals, the school of medicine, the greater university and the local community, without creating new organizational reporting relationships.

Hospital will not grow to have the largest research programs studying every biological pathway relating to energy balance, nor provide all possible treatment modalities. Instead, the Center's vision is for the highest quality programs—to achieve or sustain pre-eminence, both within and across each of the six core areas, fueled by interactions and collaborations across multiple disciplines and perspectives. This vision is uniquely suited to the culture and environment at Stanford and Packard Children's Hospital.

Research

As part of an academic institution, research is a foundation of the Center. Research findings can drive the other five core areas. Center for Healthy Weight laboratory scientists, clinical researchers, and public health and policy scientists join forces with medical and public health professionals to generate new research ideas and bring discoveries to the bedside, clinic and into the community—from 'bench to backyard,' and from 'biology to society.' This interdisciplinary exchange maximizes innovation and accelerates the translation from initial discovery to practical applications in patient care, public health and public policy.

There are two unique aspects of the research programs of the Center for Healthy Weight. First, we link researchers with clinicians and other professionals in the other five cores; and second, our goal is to stimulate greater breadth of involvement from throughout the University and community. Another important objective is to develop programs without duplicating the personnel and resources of other existing programs at Stanford and Packard Children's Hospital, but to integrate them to benefit the broader research enterprise and Center-affiliated faculty.

The research vision is to help sustain the existing pre-eminent research programs, to promote a focus on childhood obesity as a research topic, and to strategically develop new research directions that will provide opportunities for collaborating across disciplines. Some of these programs will be found among existing

faculty in the University, whereas others may require collaborations with investigators at other institutions and/or new faculty recruitments. The following represent some of the current interdisciplinary directions across four broad areas of research:

Basic and translational science. Genomics and proteomics studies examine genes and proteins that contribute to variations in appetite and energy regulation, risk for diabetes and other obesity-related complications. Animal and human physiological studies look at the many different factors regulating energy intake, energy expenditure, and carbohydrate, fat and protein metabolism. The research at Stanford also includes laboratory metabolic studies of obesity and conditions associated with obesity; behavioral studies of factors influencing the nervous system, and metabolic control of eating, physical activity and sedentary behaviors; and informatics research using powerful computing resources to tie the basic biology together with clinical syndromes, patient characteristics and environmental exposures, to identify novel etiologic hypotheses, and treatment and prevention approaches.

Clinical research and clinical trials. Clinical studies are designed to discover the causes of child and adolescent obesity, as well as its medical, social and economic consequences. Clinical researchers explore the factors that put individuals or groups at increased risk or protect them from obesity and its complications. Other studies identify new targets for prevention or treatment. Collaborating physicians, nutritionists, exercise physiologists, psychologists, epidemiologists, economists and statisticians use data collected from our own patients, as well as from local, regional, national and international data sets.

Clinical trials test whether particular treatments are effective, which individuals respond to one treatment over another and why. The Center for Healthy Weight helps organize clinical trials to find the most effective pharmacological, behavioral, nutritional and surgical treatments for obesity and obesity-related complications in children and adolescents. Some of the ongoing trials combine these different approaches. By performing clinical trials,

academic medical centers provide access to state-of-the-art obesity treatment programs in a monitored setting.

Prevention science. Stanford University School of Medicine boasts a long history as a leader in prevention research, including child and adolescent obesity prevention. Over the past two decades, tens of thousands of children and their families along with scores of preschools, elementary, middle and high schools in the neighboring counties have participated in these child and adolescent obesity prevention trials. These studies apply behavioral theories to family-based, school-based and community-based interventions to increase physical activity, reduce sedentary behaviors, improve eating habits and reduce weight gain in children and adolescents. A majority of this research is conducted with low-income and/or ethnic minority populations, the groups that have been most severely affected by the obesity epidemic and the accompanying ill effects to health and well-being.

Public policy research. The public policy research programs focus on the effects of policy and economic factors on child and adolescent obesity. These studies generally use large data sets to examine variations and/or inequalities in access to care, patient outcomes, and the economic and social consequences of policies, and structural and environmental factors. The results of this research help inform rational policy-making to reduce disparities between different groups or geographical areas, and to improve the quality of medical care and public health programs and their effects on child, adolescent, and family health and well-being. Local, state, national and international government, and other policy-makers rely upon this research.

Patient care

The Patient Care Core is designed to provide needed primary and specialty care for obese children in the local community, as a referral center for northern California and, for bariatric surgery for adolescents, throughout the western United States. Resources are available to address obesity across a broad spectrum of needs, as illustrated in Figure 3. Inherent in this model, we do not provide all possible treatment approaches. Instead, we offer strategically selected clinical services that we have decided we are capable of delivering with the highest quality to best meet the needs of our patients and community.

Primary care clinics. Primary care clinics at the Lucile Packard Children's Hospital serve as the medical center's front line for clinical evaluation and management of overweight and obese children. These clinics also serve as a major site for training medical students, Pediatrics house staff and General Pediatrics and Adolescent Medicine postdoctoral fellows.

The pediatric weight clinic. The Pediatric Weight Clinic receives referrals from primary care providers and other specialty providers. Every patient referred to the Pediatric Weight Clinic is given a complete evaluation by a pediatrician or adolescent medicine specialist who examines potential causes and complications, and establishes a baseline for treatment.^{3,9} In addition, the Pediatric Weight Clinic performs the medical evaluations for adolescent bariatric surgery candidates and follow-up care after bariatric surgery. The Pediatric Weight Clinic is currently accommodating a volume of about 700–850 total patient visits per year, including 100–150 new patient evaluations. However, this still leaves a long waiting list, as demand outstrips the available capacity.

Each new evaluation includes a detailed review of the patient's medical history, a complete physical exam, diagnostic testing as needed and consultation with a registered dietitian to develop dietary and activity goals. By using the patient's baseline evaluation, the physicians and dietitians at the Pediatric Weight Clinic create a program tailored to the patient's and family's individual situation and goals. For most patients, this involves periodic visits for family behavioral counseling and medical approaches to weight loss, in which the Pediatric Weight Clinic's physicians and dietitians help each patient and their family understand the causes of their weight problem and develop a family-centered plan to achieve their weight reduction goals. The Pediatric Weight Clinic also coordinates further evaluations for specific causes of obesity. Some complications may require referral to other sub-specialists, more aggressive nutritional treatments and/or bariatric surgery. A major goal of the Pediatric Weight Clinic is to support the treatment of patients by their own primary care providers in their own communities.

Packard Pediatric Weight Control Program. A family-based, group behavioral program, the Packard Pediatric Weight Control Program, helps overweight children, adolescents and their families adopt and maintain healthy eating and physical activity habits

Figure 3. Clinical programs of the Center for Healthy Weight. The inverted pyramid illustrates the full spectrum of clinical programs ranging from primary care evaluation and management, serving the greatest volume of patients at the lowest cost per patient, to bariatric surgery for adolescents, treating the fewest number and most severe patients at the highest cost per patient. Descriptions of specific programs are included in the text.

lifelong.^{3,10} Since 1999, the 6-month program has achieved more than 85% retention and helped more than 85% of participating children and teens successfully reduce their percent overweight. Groups for 8- to 12-year-old children and 13- to 15-year-old teenagers include up to 12 families, who meet every week for 6 months and help support each other's efforts throughout the program. A culturally tailored Spanish language version of the program makes up about half of the groups. Children and parents go through the program together and, although the focus of treatment is only on the child, more than 75% of overweight parents have also lost weight while participating.

Drug and behavioral clinical trials. The clinical trial research described above expands the options available to our patients. To improve treatment success as quickly as possible, our goal is to model the extremely successful Pediatric cancer model. In Pediatric cancer treatment, almost all patients are enrolled in experimental protocols, mostly randomized clinical trials to formally test the efficacy of the most promising available treatments at the time of treatment. The outcomes of this approach have been marked improvements in survival and well-being for many pediatric cancers. To help make this a reality, the Center for Healthy Weight is attempting to expand obesity-related clinical trials at Stanford and Packard Children's Hospital, and also to help start multi-institutional clinical research networks.

Intensive medical therapies. Intensive nutritional and/or behavioral treatment is available to individual patients through multiple clinical subspecialty divisions and departments. These may include supervised very low-calorie diets, pharmacological treatments and/or intensive psychotherapy.

Bariatric surgery. Severely obese adolescents who have not had success with other means of weight loss and are suffering from serious complications related to their weight may be candidates for bariatric surgery. Lucile Packard Children's Hospital was the first hospital in California to offer bariatric surgery to adolescents, building upon an existing strength in minimally invasive pediatric surgery and a vigorous program in adult bariatric surgery. Operations performed laparoscopically include the Roux-en-Y gastric bypass, gastric banding and the sleeve gastrectomy. The program includes intensive medical, psychological and surgical follow-up care to address the needs of adolescents, experiencing the major changes experienced as a result of their surgery.

Community programs

A major challenge to combating the obesity epidemic is moving effective prevention and treatment programs into communities. A goal of the Community Programs core of the Center for Healthy Weight is to make effective programs developed by Packard Children's Hospital and Stanford researchers available to all children and families in the San Francisco Bay Area. The Center for Healthy Weight actively reaches beyond the walls of the medical center to partner with other community-based organizations, businesses, government agencies and individual community leaders, to improve the health of children and their families in our local communities. The physicians and staff at the Packard Children's Hospital are actively involved in community initiatives that promote healthy nutrition choices and more active lifestyles, including the major citywide, countywide and regional coalitions formed to improve children's health and well-being, and reduce the burden of childhood and adolescent obesity. These initiatives are a priority for Lucile Packard Children's Hospital's Community Partnerships program.

Advocating for Public Policy Change

The Lucile Packard Children's Hospital is active in advocating for public policies that benefit children and families, locally, regionally, statewide and nationally. Consistent with its strategy in other cores, the Advocating for Public Policy Change core is

integrated into the broader advocacy and government relations resources of the hospital and medical school. Therefore, this core is codirected by the director of the medical school and Department of Pediatrics advocacy training programs and the hospital's Director of Government Relations. The Center for Healthy Weight's advocacy and public policy programs support and promote changes that will make it easier for children and families to eat a healthy diet, stay physically active, and achieve and maintain a healthy weight. This may include everything from endorsing proposed legislation to working with school wellness committees. Major initiatives have supported making healthy lunches and snacks available in schools, ensuring access to healthy foods in all communities, providing opportunities for safe and supervised physical activity at school, after school, weekends and summers, and ensuring access to appropriate medical and nutritional preventive care and treatment.

In addition to advocating for specific policy initiatives, our Center for Healthy Weight faculty and staff frequently serve as officers, committee members or consultants for local coalitions and community organizations (such as collaboratives in the surrounding counties), national scientific or professional organizations, and government panels and committees, where they contribute their expertise to developing and implementing policy initiatives related to child and adolescent obesity.

Training and professional education

As part of a teaching hospital and medical school, the Center for Healthy Weight is a key provider of essential professional education in childhood and adolescent obesity. Many medical and public health professionals are underprepared to address the needs of the growing number of overweight children and adolescents. Major training and educational programs include the following: the Pediatric Weight Control Training Institute, to train and certify other providers and organizations to deliver the family-based, behavioral Pediatric Weight Control Program; the Community Action for Children's Health Program, to provide technical assistance to build capacity in community organizations to help them deliver more effective prevention programs; and national Continuing Medical Education courses for practicing medical professionals. In addition, Center for Healthy Weight faculty and staff participate in many other educational programs, from grand rounds to national and international scientific conferences, and provide direct training and education through undergraduate and graduate courses, clinical medical student, house staff and fellow training, as well as research mentorship.

Healthy hospital initiative

The Center for Healthy Weight initiated a Healthy Hospital Initiative to improve the hospital environment, to provide more opportunities for healthful nutrition and physical activity for hospitalized patients, their families and visitors, hospital employees and medical staff, and to set an example for the community. Early successes with this effort grew into a broader initiative including four foci: providing a healthful food and physical activity environment, green environmental sustainability practices, expanding employee wellness programs to include physical, emotional and financial wellness, and workplace safety, as well as designing a built environment that promotes health and wellness. Key to this initiative is strong support from the leadership of the hospital along with substantial and enthusiastic grassroots participation. Some of the successes to date include improving the healthfulness of cafeteria and vending machine offerings, increasing availability of locally grown, seasonal produce, stair-use promotions, walking trails and maps for patients and their families and visitors, and subsidization of employee health promotion classes, for example. The Healthy Hospital Initiative also provides a laboratory for researchers to

study the effects of hospital/workplace policies and practices on behavioral, health and economic outcomes.

SUMMARY AND CONCLUSION

As the obesity epidemic demands greater medical and public health resource needs, academic medical centers must adopt strategies for their academic, clinical and public policy responses to childhood obesity. The Center for Healthy Weight at Stanford University and Lucile Packard Children's Hospital at Stanford provides an example and model of one such strategy. In our experience, it is unique in both its breadth and depth. This arose, in large part, because of its design *de novo*, from the ground up. Although it clearly highlights existing strengths in our academic environment, it was first conceptualized as a whole before integrating individual research, clinical, service and educational programs. As a result, it started with a conceptual infrastructure into which programs could be integrated, rather than a disparate set of programs upon which a unifying structure was imposed. This led to a Center that draws its strengths from its openness to participation from across the university, the medical school, the hospital and the local community.

All academic institutions have their unique strengths. Stanford and Lucile Packard Children's Hospital at Stanford are known for their strengths in scholarship, clinical care and education, and benefit from an environment in which the hospital, medical school and university all share the same campus. The medical center and university are also smaller, in size of faculty, students and trainees, than many other academic medical centers. The Center for Healthy Weight at Stanford and Packard Children's model, however, is likely to be relevant for academic medical centers with a great variety of different characteristics. The six cores—Research, Patient Care, Community Programs, Advocating for Public Policy Change, Training and Professional Education and the Healthy Hospital Initiative—are likely to be relevant to almost any academic medical center's mission and functions. Different institutions may have different strengths to populate these areas with different levels of emphasis. Some institutions may leave out one or more of these cores as well. Therefore, the Center for Healthy Weight serves as a potential model for an academic medical center response to childhood obesity.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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