Assessing the Efficacy of the Pediatric Growth Curve:
An Analysis of one Children's Hospital's Procedure

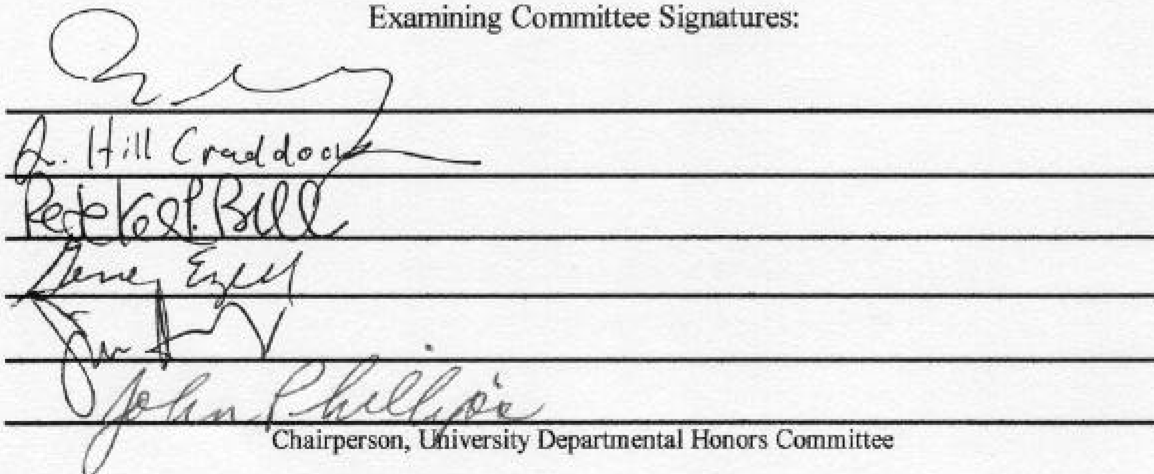
by
Whitney L. Sanders

Departmental Honors Thesis
The University of Tennessee at Chattanooga
Department of Biological and Environmental Sciences

Project Director: Dr. Henry Spratt
Examination Date: March 27, 2002

Dr. J. Hill Craddock
Rebekah P. Bell
Dr. Gene Ezell
Dr. Jim Henry

Examining Committee Signatures:



Chairperson, University Departmental Honors Committee

Introduction

Obesity is an increasingly prevalent problem in the United States. The Centers for Disease Control, through the National Center for Health Statistics, now indicates that approximately 13% of children ages 6-11 and 14% of adolescents ages 13-19 in the United States are considered clinically obese, as compared with 5% of children and 7% of adolescents in 1976.[1]

Obesity in children and adolescents, if left untreated, can pose potentially serious health risks in many organ systems. Orthopedic complications include slipped capital femoral epiphysis, which may manifest as hip or knee pain and limited hip range of motion.[2] Obesity can cause breathing difficulties such as sleep apnea and obesity hypoventilation syndrome, which can both be potentially fatal if left untreated.[3] Endocrinologic disorders related to obesity include polycystic ovary disease, which results in delayed menstruation and hirsutism,[4]and noninsulin-dependent diabetes mellitus (NIDDM), an increasingly common condition in children.[5] Tobacco use may compound the long-term negative effects of childhood obesity[6], adding to the risk of cardiovascular disease and high blood pressure. All of these risks are potentially serious and can eventually contribute to lowered life expectancy if left untreated.[7]

In treating childhood obesity, early detection and prevention are key. The earlier a child is identified as at risk for obesity, the earlier a treatment program can begin. The National Committee on Pediatric Obesity was established in 1997 as a joint effort of the Maternal and Child Health Bureau, Health Resources and Services

Administration, and the Department of Health and Human Services in order address the issue of childhood obesity and make recommendations for physicians, nurse practitioners, and nutritionists to guide the evaluation and treatment of overweight children and adolescents.[8] The Committee recommends that obesity intervention begin as early as possible, acknowledging that the risk of persistent obesity increases with the age of the child and becomes progressively more difficult to treat in adolescence.[9]

Along with the recommendations of increasing activity level and reducing calorie intake for currently obese children, the Committee emphasizes the careful monitoring of weight and height proportionality in all children.[10] It has been shown that the most effective way to examine weight and height proportionality is through the use of body mass index calculations, or BMI.[11]

Body mass index is calculated by dividing body weight in kilograms by the square of height in meters (kg/m^2), resulting in a single number. Height, weight, and BMI can all be plotted on a series of pediatric growth curves.

Pediatric growth curves, first developed by the National Center for Health Statistics (NCHS) in 1977, are used to monitor the progress of a child's height, weight, and BMI over time, by comparing the individual child's measurements to standardized, national averages.[12] The pediatric growth curves are designed so that a child's height, weight, and BMI are actually plotted on the curve, resulting in a percentile for comparison. NCHS released a new and updated set of growth curves in 2000.

Concerns about the 1977 NCHS charts along with the availability of recent, comprehensive data, and improved statistical smoothing procedures, led to a revision of the charts and the release of the new charts in 2000. The main concerns about the 1977 NCHS charts centered on the use of Fels Research Institute[13] data for the infant charts. Although not ideal, the Fels data were considered the best available data at the time and some of the limitations of incorporating them were clearly stated with the initial release.[14]

Nevertheless, three main issues related to using the Fels data led to criticisms of the 1977 growth charts. First, the data were not representative of the entire country; data from the Fels Institute were derived from white, middle-class infants living in southwestern Ohio between 1929 and 1975. Second, the infants in the Fels sample, similar to what was happening nationally during those years, were primarily formula fed. Pediatricians now recommend that mothers breastfeed their infants, which results in increased infant weight gain. Third, birth weights in the Fels sample did not match the national distribution of birth weights.[15]

National data collected in a series of 5 surveys between 1963 and 1994 were used to develop the 2000 CDC growth charts.[16] The most recent was the NCHS/CDC Third National Health and Nutrition Examination Survey (NHANES III, 1988–1994). This survey was designed as a stratified, multistage probability sample based on the selection of counties, blocks, households, and persons within households.[17] Preschool-age children were oversampled for the specific purpose of revising the 1977 NCHS growth charts. Similar to the previous health examination surveys, NHANES III

consisted of a home interview and a standardized physical examination conducted in a mobile examination center. The physical examination included measurements of stature, recumbent length, weight, and head circumference. Head circumference and recumbent length were measured in children younger than 4 years, and stature was measured in children 2 years and older.[18]

Two substantial data exclusions were made before specific charts were created. First, all very low birth weight infants (<1500 grams) were excluded from the infant growth charts. These infants have substantially different growth patterns than normal birth weight infants, and specialized growth charts for infants with birth weight <1500 g are available.[19] Second, all charts with weight and BMI exclude data from NHANES III for children ages 6 years and older. This exclusion was made because of the higher prevalence of overweight in this sample as compared with data from previous surveys.[20] NHANES III had a disproportionately high influence on the curves compared with the other surveys. The NHANES III data alone shifted the upper percentiles of the weight and BMI curves, resulting in higher values for the 85th and 95th percentiles. Because the 85th percentile of BMI has been recommended as a cutoff to identify children and adolescents who are at risk for becoming overweight,[21] the inclusion of NHANES III would lead to misclassification of overweight children as not overweight.

In 1997, the National Committee on Pediatric Obesity recognized the pediatric growth curve as a valuable tool in childhood obesity detection and prevention,[22] with a follow-up recommendation for the revised 2000 growth charts.

Although pediatric growth curves and body measurements such as height, weight, and BMI have been shown to aid in childhood obesity detection and prevention, they remain to be utilized on many children. Some possible reasons that growth charts are not employed may include time constraints and lack of knowledge in general about growth charts.

Specific Aims and Hypotheses:

This study will focus on the incidence of childhood obesity and use of growth charts at one hospital, the Children's Hospital of The King's Daughters (CHKD) in Norfolk, Virginia. CHKD is the only freestanding hospital in the state of Virginia serving children from birth to age 21 and was ranked as a Top 20 children's hospital in 2001 by *Child* magazine.

This project has two main parts: (1) a retrospective chart review in which randomly selected charts were assessed for the presence of growth data such as height, weight, and head circumference and presence and completion of growth charts; (2) a physician survey in which physicians at CHKD were asked to complete a survey regarding growth chart efficacy and limiting and enhancing factors of growth chart use.

The specific aims of this project are as follows:

1. To evaluate the presence of growth data and growth curve presence and completion at the time of admission to CHKD
2. To assess limiting and enhancing factors of growth chart use by physician perception, and to assess physician use patterns of growth charts

The hypotheses for each of these specific aims are as follows:

1a. At least one growth data variable (height, weight, BMI, or head circumference) is present in more than 75% of the charts examined.

1b. Growth charts are present in less than 20% of the charts examined.

1c. Growth charts are completed (plotted) in less than 15% of the charts examined.

2a. Physicians feel that growth charts are a valuable assessment tool.

2b. Physicians feel that time is a limiting factor in growth chart use.

Through a retrospective chart review and physician survey, these hypotheses were tested and evaluated.

Methods for Part 1: Chart Review

Patient charts were randomly selected in CHKD's Record Department. The only criterion for chart selection was that the charts be from October 2000 through December 2000. This time period was selected because pediatric residents start their rotations in July, and we did not want the data in the charts to be influenced by new residents who may not have adjusted to the standardized procedure of taking a patient's history and physical information. Patient age, weight, height, length of stay, and admitting physician were not selection factors in the chart review because of the need to get a totally random sampling of patient growth data and growth chart use.

Once the charts were pulled from the Records department, they were examined for a number of factors. In order to comply with International Review Board standard, a patient identification number was assigned to each patient's chart reviewed in place of the hospital record number. A number was also assigned to each physician at CHKD for the purpose of determining admitting service received by the patient.

A chart review data sheet with all of the above variables was completed for each chart reviewed (Fig. 1). Once the chart review was complete, the information was entered into a Microsoft Access database. The database was examined by a CHKD biostatistician, Bonnie Burke, and the data were statistically analyzed using STATA, a program for statistical analysis. Statistically significant was defined as a p-value of less than 0.05.

For weight category placement, definitions used by the National Center for Health Statistics in defining weight categories were employed. Underweight was defined as having a body mass index (BMI) less than the 5th percentile. Appropriate weight was defined as having a BMI = 5th percentile and < the 85th percentile. At risk for obesity was defined as having a BMI = 85th percentile and < the 95th percentile. Obese was defined as having a BMI = 95th percentile.

Figure 1. Chart Review Data Sheet

Identification Number		
Date of Birth		
Patient's Age (Months/Years)		
Date of Admission		
Admitting Physician ID Number		
Patient's Weight (kg)		
Patient's Height (cm)		
Patient's FOC (Age < 2 years)		
Patient's BMI (Age > 2 years)		
Weight Recorded on Nursing Intake Sheet?	Yes	No
Height Recorded on Nursing Intake Sheet?	Yes	No
Growth Curve Present?	Yes	No
Height Plotted?	Yes	No
Weight Plotted?	Yes	No
FOC Plotted (Age < 2 years)	Yes	No
BMI Plotted (Age > 2 years)	Yes	No
Height Recorded on Physical Exam Sheet?	Yes	No
Weight Recorded on Physical Exam Sheet?	Yes	No
Height Percentile Recorded?	Yes	No

Weight Percentile Recorded?	Yes	No
FOC Percentile Recorded (Age < 2 years)?	Yes	No
BMI Percentile Recorded (Age > 2 years)?	Yes	No

Methods for Part 2: Physician Survey

The second part of the project, the physician survey (Fig. 2), was begun after the chart review was completed. The survey design was supervised by CHKD's Clinical Outcomes, Research, and Epidemiology department (CORE) so the results could be easily tested for statistical significance. The survey consisted of six parts. Question 1 of the survey asks for job description (general pediatrician, pediatric subspecialist, pediatric surgeon, pediatric surgical subspecialist, pediatric resident with level, or other) for demographics. Question 2 utilizes a Likert scale with the responses Strongly Agree, Agree, Disagree, Strongly Disagree. A neutral response was eliminated to encourage more honest responses. Question 3 is a yes/no question. Question 3a asks who should plot the growth curve with the choices Doctors, Nurses, Residents, and Other.

Question 4 asks the participant to circle a range of percentages for the amount of time he/she does certain things regarding growth charts. It was felt by the CORE team that allowing the participant to circle pre-fabricated percentages would facilitate ease of use for the survey. Question 5 asks the participant to rank limiting factors of growth chart use. Once again, it was felt that by listing limiting factors for the participants to rank instead of requiring handwritten responses, the survey would be easier to complete, resulting in a better rate of return. Question 6 asks the participants to rank factors that would enhance growth chart use.

The surveys were distributed at two separate Grand Rounds meetings at CHKD, on July 12 and July 19, 2001. The surveys were also distributed at a pediatric

residents' noon conference meeting on June 28, 2001. In order to increase rate of return, Blow-Pops™ were offered to those completing and returning the surveys. A total of 95 surveys were completed and returned on the three dates.

Figure 2. Physician Survey

Growth Curve Questionnaire

Date Completed: ___________________

1. Which of the following best describes you:

ð General Pediatrician
ð Pediatric Subspecialist
ð Pediatric Surgeon
ð Pediatric Surgical Subspecialist
ð Pediatric Resident (circle level) PL1 PL2 PL3 PL4
Other: ________________________

Please circle only one response.

2. I feel that pediatric growth curves are a useful tool for helping assess my patients.
Strongly Agree Agree Disagree Strongly Disagree

3. Do you feel that growth curve data should be completed on the patients you admit?
Yes No

3a. If YES: Who should plot the growth curve data upon patient admission?
Doctors Nurses Residents Other:__________

Please circle only one percentage.

4. What percent of the time…

…do you use the data collected from the pediatric growth curve when seeing your patients?
<20% 21-40% 41-60% 61-80% >81%

…do you plot the patient's data on the growth curve at the time of admission?
<20% 21-40% 41-60% 61-80% >81%

…do you plot past patient data on the growth curve at the time of admission?
<20% 21-40% 41-60% 61-80% >81%

…are you able to find blank growth curves in the charts at the time of patient admission?
<20% 21-40% 41-60% 61-80% >81%

…are patient height, weight, and head circumference measurements easily located at the time of patient admission?
<20% 21-40% 41-60% 61-80% >81%

5. **Which of the following limits your use of growth charts at the time of patient admission? Please rank each choice from 1-7, with 1 being the most limiting, and 7 being the least limiting. If you do not have a suggestion for "Other," mark it as #7. (You will end up ranking six items.)**

Do not know where growth curves are kept on the units
(a)____ Growth curves are not on the charts
(b)____ Takes too much time to plot the curves
(c)____ Do not know how to use a growth curve
(d)____ The patient's height, weight and head circumference data are not easily found.
(e)____ Use of growth curves is not important in my management of children.
(f)_____ Other: ____

6. **Which of the following would enhance your use of growth curves for patients at the time of admission? Please rank each choice from 1-7, with 1 being the most helpful, and 7 being the least helpful. If you do not have a suggestion for "Other," mark it as #7. (You will end up ranking six items.)**

(a)____ Have growth curves kept in the same location for all units of the hospital (i.e., with the unit secretary).
(b)____ Have growth curves put on the chart at the time of admission
(c)____ Offer CME discussion on use of growth curves
(d)____ Have nursing plot the patient's height, weight and head circumference at the time of admission.
(e)____ Patients' height, weight, and head circumference being uniformly placed in the same location for all admissions (i.e., on the patient's door).
(f)____ Use of growth curves is not important in my management of children.
(g)____ Other: ____

Thank you!

Results: Chart review

A total of 359 charts were reviewed in the chart review portion of the project.

Demographics

The mean age was found to be 7 years, with a range from birth to 20 years of age. The sex distribution was 56% male and 44% female. The categories for the service the patient received at admission were general pediatrician, general surgeon, medical subspecialist, and surgical subspecialist. (Demographic information, see Appendix A.)

Chart Review Results

Table 1. Nursing Intake Sheet: Growth Data Recorded

Nursing Intake Sheet: Growth Data Recorded?		
Growth Data Variable Recorded	No. of Charts with Variable Recorded on Nursing Sheet/Total Charts	Percentage of Charts With Variable Recorded on Nursing Sheet/Total Charts
Height	273/359	76%
Weight	326/359	91%

From the 359 charts reviewed, it was determined by the nursing intake sheet that nurses recorded height for 76% of patients, and weight was recorded by nurses for 91% of patients (Table 1).

Table 2. Physician Examination Sheet: Growth Data Recorded

Physician Examination Sheet: Growth Data Recorded?		
Growth Data Variable Recorded	No. of Charts with Variable Recorded on Physician Sheet/Total Charts	Percentage of Charts With Variable Recorded on Physician Sheet/Total Charts
Height	240/359	67%
Weight	292/359	81%

From the 359 charts reviewed, it was determined that physicians recorded height for 67% of patients and weight was recorded for 81% of patients (Table 2).

Table 3. Growth Curve Presence Within Patient Chart

Growth Curve Presence Within Patient Chart		
Growth Curve Present?	No. of Charts Containing Growth Curves/Total Charts	Percentage of Charts Containing Growth Curves/Total Charts
Present	32/359	9%

It was found that growth curves were present in 32 of the 359 charts examined, or 9% of the charts (Table 3).

Table 4. Variables Plotted for Charts Containing Growth Curves

Variables Plotted For Charts Containing Growth Curves?		
Variable Plotted	No. of Charts Plotting Variable/Total Charts Containing Growth Curves	Percentage of Charts Plotting Variable/Total Charts Containing Growth Curves
Height	21/32	66%
Weight	21/32	66%
BMI (Age > 2 years)	0/6	0%
FOC (Age < 2 years)	15/26	58%

Of the 32 charts containing growth curves, height and weight were plotted in 66% of the charts. Of the 6 charts for children over two years containing growth curves, BMI was not plotted in any of the charts. Of the 26 charts for children under two years containing growth curves, FOC was plotted in 15 of the charts, or 58% of the time (Table 4).

Table 5. Growth Data Percentiles Recorded

Growth Data Percentiles Recorded		
Variable Percentile Recorded	No. of Charts With Percentile Recorded/Total Charts	Percentage of Charts With Percentile Recorded/Total Charts
Height Percentile	28/359	8%
Weight Percentile	43/359	12%
BMI (Age > 2 years)	0/229	0%
FOC (Age < 2 years)	11/130	8%

Of the 359 charts reviewed, weight and height were the most frequently recorded percentiles, at 12% and 8%, respectively. Of the 229 charts for children over two years, BMI percentile was recorded in none of the charts. Of the 130 charts for children under two years, FOC percentile was recorded in 11 of the charts (Table 5).

Table 6. Distribution of Weight Proportion for Children Admitted

Distribution of Weight Proportion for Children Admitted		
Weight Category	No. of Children in Category/Total Children Calculable	Percentage of Children in Category/Total Children Calculable
Underweight	32/179	18%
Appropriate Weight	100/179	56%
At Risk for Obesity	17/179	9%
Obese	30/179	17%

Of the 359 children admitted, BMI was calculable for 179. 180 were discarded because of missing height or weight measurements, or because they were under 2 years of age. The majority (56 %) of children admitted were appropriate weight. The next largest category was underweight, at 18%. Obese was the third largest category at 17%, and at risk for obesity was the smallest percentage, at 9% (Table 6).

For the following data, the physician admitting the patient was classified into one of four categories depending on specialty: general pediatrician, general surgeon, medical subspecialist, or surgical subspecialist. The p-values listed in the tables are those calculated from the difference between all four specialties listed unless otherwise noted. The p-value for specific differences between categories is listed under the appropriate table, and is only listed when statistically significant.

Table 7. Category of Service: Underweight Patients

Category of Service: Underweight Patients		p-value: 0.8123
Category of Service Received	No. of Underweight Patients/Total for Category	Percent of Underweight Patients/Total for Category
General Pediatrician	12/70	17%
General Surgeon	2/17	12%
Medical Subspecialist	13/71	18%
Surgical Subspecialist	5/21	24%

The number of underweight children was 32 for all categories of service combined, out of a total of 179 patients whose BMI could be calculated. Of the 359 charts reviewed, 180 patients were discarded because of missing height or weight measurements or because they were under two years of age. Surgical subspecialists had the largest proportion of underweight patients admitted, followed by medical subspecialists, general pediatricians, and general surgeons (Table 7). In a comparison among the different categories of service, this was not found to be statistically significant.

Table 8. Category of Service: Appropriate Weight Patients

Category of Service: Appropriate Weight Patients		p-value: 0.2018
Category of Service Received	No. of Appropriate Weight Patients/Total for Category	Percent of Appropriate Weight Patients/Total for Category
General Pediatrician	36/70	46%
General Surgeon	12/17	71%
Medical Subspecialist	44/71	62%
Surgical Subspecialist	8/21	38%

The percentages were out of 179 children as before. General surgeons had the largest proportion of appropriate weight patients admitted, followed by medical subspecialists, general pediatricians, and surgical subspecialists (Table 8). In a comparison among the different categories of service, this was not found to be statistically significant.

Table 9. Category of Service: At Risk Patients

Category of Service: At Risk Patients		p-value: 0.7190
Category of Service Received	No. of At Risk Patients/Total for Category	Percent of At Risk Patients/Total for Category
General Pediatrician	9/70	13%
General Surgeon	1/17	7%
Medical Subspecialist	6/71	8%
Surgical Subspecialist	1/21	5%

Out of the 179 total patients for whom BMI was calculable, general pediatricians admitted the largest proportion of at risk patients, followed by medical subspecialists, general surgeons, and surgical subspecialsists (Table 9). In a comparison among the different categories of service, this was not found to be statistically significant.

Table 10. Category of Service: Obese Patients

Category of Service: Obese Patients		p-value: 0.0619
Category of Service Received	No. of Obese Patients/Total for Category	Percent of Obese Patients/Total for Category
General Pediatrician	13/70	19%
General Surgeon	2/17	12%
Medical Subspecialist	8/71	11%
Surgical Subspecialist	7/21	33%

Of the 179 patients admitted, surgical subspecialists had the largest proportion of obese patients, followed by general pediatricians, general surgeons, and medical subspecialists (Table 10). This was not found to be statistically significant in a comparison among the categories.

Table 11. Category of Service: Growth Curve Presence Within Chart

Category of Service: Growth Curve Presence		**p-value: 0.005**
Category of Service Received	No. of Charts Containing Growth Curve/Total Charts for Category	Percent of Charts Containing Growth Curves/Total Charts for Category
General Pediatrician	8/128	6%
General Surgeon	0/35	0%
Medical Subspecialist	23/141	16%
Surgical Subspecialist	1/55	2%

Out of the 359 total charts reviewed, medical subspecialists had the highest percentage of growth curve presence, with 16%. General surgeons had the lowest, with 0% (Table 11). The difference between categories was found to be statistically significant, with the breakdown as follows. The difference between general pediatricians and medical subspecialists was found to be statistically significant, with a p-value of 0.020. The difference between general surgeons and medical subspecialists was found to be statistically significant, with a p-value of 0.013. The

difference between general surgeons and surgical subspecialists was found to be statistically significant, with a p-value of 0.070.

Table 12. Height Plotted if Growth Curve Present

Height Plotted If Growth Curve Present		**p-value: 0.1569**
Category of Service Received	No. of Charts With Height Plotted/Total Charts Containing Growth Curves for Category	Percent of Charts With Height Plotted/Total Charts Containing Growth Curves for Category
General Pediatrician	7/8	88%
Medical Subspecialist	14/23	61%
Surgical Subspecialist	0/1	0%

Since this table only examines height plotted if a growth curve is present, the "general surgeon" category was removed since no general surgeon charts contained a growth curve. There were a total of 32 charts containing growth curves, and out of those, general pediatricians had the highest proportion of heights plotted, followed by medical subspecialists and surgical subspecialists (Table 12). The difference in these categories was not found to be statistically significant.

Table 13. Weight Plotted if Growth Curve Present

Weight Plotted If Growth Curve Present		**p-value: 0.1569**
Category of Service Received	No. of Charts With Weight Plotted/Total Charts Containing Growth Curves for Category	Percent of Charts With Weight Plotted/Total Charts Containing Growth Curves for Category
General Pediatrician	7/8	88%
Medical Subspecialist	14/23	61%
Surgical Subspecialist	0/1	0%

Once again, general surgeons were removed from the table because no growth curves were found in general surgeon charts. Of the 32 charts containing growth curves, general pediatricians had the highest proportion of weights plotted, followed by medical subspecialists and surgical subspecialists (Table 13). This was not found to be statistically significant.

Table 14. Height Recorded on Physician Exam Sheet

Height Recorded on Physician Exam Sheet		**p-value: 0.000**
Category of Service Received	No. of Charts With Height Recorded/Total Charts for Category	Percent of Charts With Height Recorded/Total Charts for Category
General Pediatrician	83/128	65%
General Surgeon	26/35	74%
Medical Subspecialist	77/141	55%
Surgical Subspecialist	54/55	98%

Out of 359 total charts reviewed, surgical subspecialists recorded height on physician exam sheet the largest percentage of the time, followed by general surgeons, general pediatricians, and medical subspecialists (Table 14). Among categories, there was a statistically significant difference. The difference between general pediatricians and surgical subspecialists was found to be statistically significant, with a p-value of 0.000. The difference between medical subspecialists and surgical subspecialists was found to be statistically significant, with a p-value of 0.000.

Table 15. Weight Recorded on Physician Exam Sheet

Weight Recorded on Physician Exam Sheet		**p-value: 0.000**
Category of Service Received	No. of Charts With Weight Recorded/Total Charts for Category	Percent of Charts With Weight Recorded/Total Charts for Category
General Pediatrician	120/128	94%
General Surgeon	27/35	77%
Medical Subspecialist	122/141	87%
Surgical Subspecialist	23/55	42%

Of the 359 total charts reviewed, general pediatricians recorded weight on physician exam sheets the largest percentage of the time, followed by medical subspecialists, general surgeons, and surgical subspecialists (Table 15). There was a statistically significant difference between categories. The difference between surgical subspecialists and all other categories was found to be statistically significant, with a p-value of 0.000 for all.

Table 16. Height Percentile Recorded

Height Percentile Recorded		p-value: 0.0137
Category of Service Received	No. of Charts With Height Percentile Recorded/Total Charts for Category	Percent of Charts With Height Percentile Recorded/Total Charts for Category
General Pediatrician	17/128	13%
General Surgeon	2/35	6%
Medical Subspecialist	9/141	6%
Surgical Subspecialist	0/55	0%

Of the 359 charts reviewed, height percentile was recorded the largest proportion of the time by general pediatricians, followed by medical subspecialists, general surgeons, and surgical subspecialists (Table 16). The difference between general pediatricians and surgical subspecialists was found to be statistically significant, with a p-value of 0.013.

Table 17. Weight Percentile Recorded

Weight Percentile Recorded		p-value: 0.0005
Category of Service Received	No. of Charts With Weight Percentile Recorded/Total Charts for Category	Percent of Charts With Weight Percentile Recorded/Total Charts for Category
General Pediatrician	26/128	20%
General Surgeon	2/35	6%
Medical Subspecialist	15/141	11%
Surgical Subspecialist	0/55	0%

Of 359 charts, weight percentile was recorded the largest proportion of the time by general pediatricians, followed by medical subspecialists, general surgeons, and surgical subspecialists (Table 17). There was a statistically significant difference between categories. Specifically, the difference between general pediatricians and surgical subspecialists was found to be statistically significant, with a p-value of 0.001.

Table 18. FOC Percentile Recorded (Age < 2 years)

FOC Percentile Recorded (Age <2 years)		**p-value: 0.4395**
Category of Service Received	No. of Charts With FOC Percentile Recorded/Total Charts for Category	Percent of Charts With FOC Percentile Recorded/Total Charts for Category
General Pediatrician	6/50	12%
General Surgeon	0/10	0%
Medical Subspecialist	5/59	8%
Surgical Subspecialist	0/11	0%

FOC, or head circumference, is only measured in children under two years of age. There were a total of 130 children under two years of age out of the 359 charts reviewed. General pediatricians recorded FOC percentile the largest proportion of the time, followed by medical subspecialists (Table 18). None of the surgical subspecialists or general surgeons recorded FOC percentile.

Table 19. BMI Percentile Recorded (Age > 2 years)

BMI Percentile Recorded (Age >2 years)		**p-value: none**
Category of Service Received	No. of Charts With BMI Percentile Recorded/Total Charts for Category	Percent of Charts With BMI Percentile Recorded/Total Charts for Category
General Pediatrician	0/78	0%
General Surgeon	0/25	0%
Medical Subspecialist	0/82	0%
Surgical Subspecialist	0/44	0%

BMI is only calculated for children over age two. Of the 229 children that were over two years of age, none of the categories of admitting services recorded BMI percentile (Table 19).

Results: Physician Survey: Demographics

Table 20. Categories of Survey Respondent

Categories of Survey Respondents		
Job Description	No. in Category/Total Respondents	Percentage in Category/Total Respondents
General Pediatricians	31/95	37%
Pediatric Subspecialists	21/95	22%
General Surgeons	0/95	0%
Surgical Subspecialists	0/95	0%
Pediatric Residents	35/95	37%
Other (med students, nurses, fellows)	8/95	8%

The largest percentage of respondents were residents, followed by general pediatricians, subspecialists, and Other (Table 20).

Results: Physician Survey: Growth Curve Efficacy

Table 21. Responses to Question 2**:** I feel that pediatric growth curves are a useful tool for helping assess my patients.

Question 2 Responses: Pediatric Growth Curves Are Useful.		
Strongly Agree	74/95	78%
Agree	17/95	18%
Disagree	1/95	1%
Strongly Disagree	3/95	3%

The values to the responses to this question were assigned as follows:

Strongly Agree = 4

Agree = 3

Disagree = 2

Strongly Disagree = 3

The average response to this question was a 3.7 ± 0.6, meaning most respondents strongly agreed with the statement (Table 21).

Table 22. Responses to Question 3: Do you feel that growth curve data should be completed on the patients you admit?

Question 3 Responses: Should growth curve data be completed?		
Yes	90/95	95%
No	5/95	5%

The majority (95%) of respondents felt that growth curve data should be completed for the patients they admit (Table 22).

Table 23. Question 3A Responses: If growth curve data should be completed, who should plot the curve?

Question 3A Responses: Who should plot the curve?		
Doctors	3/90	3%
Nurses	41/90	46%
Residents	23/90	26%
All of these	10/90	11%
Nurses and Residents	11/30	12%
Other	1/90	1%

These responses were taken from 90 respondents. Five of the original 95 respondents did not answer this question because they answered “No” to Question 3. Of the 90 respondents, the majority felt that nurses should be responsible for plotting growth curves for patients, followed by residents (Table 23).

Table 24. Responses to Question 4: What percentage of the time do you…

What percentage of the time…			
	Mean	IQR	p-value
Do you use data from growth curves when seeing your patients?	70%	50-90%	0.2998
Do you plot the patient’s data on the growth curve at admission time?	50%	10-70%	0.3473
Do you plot past patient data on the growth curve at admission time?	10%	10-30%	0.9080
Are you able to find blank growth curves in the patient’s chart?	10%	10-50%	0.4483
Are height, weight, and FOC measurements easily found?	70%	30-70%	0.8316

For this table, the results are presented as a mean value of the percentage of the time reported. IQR, or Inter Quartile Range, is a value that represents the range of the middle 50% of respondents. The p-value was calculated as a difference between the following three groups: general pediatricians, pediatric subspecialists, and residents. None of the results were statistically significant between those three groups. On average, respondents reported that they use growth curves 70% of the time when seeing patients, plotted growth curves 50% of the time, plotted past data on the curves 10% of the time, were able to locate blank growth curves within the charts 10% of the

time, and were able to easily locate growth measurements such as height, weight, and FOC 70% of the time (Table 24).

Table 25. Responses to Question 5: Which of the following limits your use of growth curves at the time of patient admission?

Growth Curve Use: Limiting Factors	
1	Growth curves are not present in the patient charts.
2	Do not know where blank curves are kept.
3	Growth data (height, weight, FOC) not easily located.
4	Takes too much time.
5	Growth curve use not important in my management of patients.
6	Do not know how to use growth curves.
7	Other

The number one limiting factor was reported to be that blank growth curves are not present in the patient charts at admission time (Table 25). For a comparison among groups for this ranking, please see Appendix B.

Table 26. Responses to Question 6: Which of the following would enhance your use of growth curves at time of patient admission?

Growth Curve Use: Factors To Enhance Use	
1	Have blank curves put in patient charts at admission time.
2	Have nurses plot growth curves.
3	Place all growth data (height, weight, FOC) in uniform location for all admissions.
4	Have blank growth charts placed in same location on every floor.
5	Offer Continuing Medical Education classes of growth curve use.
6	Growth curve use not important in my management of patients.
7	Other

It was reported by respondents that the factor that would most enhance growth curve use would be to place a black growth curve inside every patient's chart at admission time, followed by having nurses plot each patient's growth curve (Table 26). For a comparison among groups for this ranking, please see Appendix B.

Discussion: Hypotheses Review

Generally, the results of this project fit the hypotheses quite well.

To review:

1a. Height and weight measurements will be present in more than 75% of the charts examined.

Nurses recorded height 76% of the time and weight 91% of the time (Table 1). Therefore, height and weight were both recorded at least 75% of the time.

1b. Growth charts are present in less than 20% of the charts examined.

Growth curves were found in 32 out of 359 charts, or 9% of the time (Table 3), which is less than 20%. Thus, this hypothesis was supported.

1c. Growth charts are completed (plotted) for height and weight in less than 15% of the charts examined.

Growth curves were plotted for weight and height in 21 of the 359 charts reviewed, or 6% of the time (Table 4), which is less than 15%. This hypothesis was supported by the results.

2a. Physicians feel that growth curves are a valuable assessment tool.

With 78% of physicians responding that they strongly agreed that growth curves were a useful assessment tool, and 18% stating that they agreed,

physicians do indeed feel that growth curves are useful (Table 21). This hypothesis was very strongly supported by the survey results.

2b. Physicians feel that time is a limiting factor in growth curve use.

Although physicians responded that time was a limiting factor in growth curve use, it was not the most limiting factor. Absence of blank growth curves within patient charts was ranked as the most limiting factor (Table 25). However, the results show that time is, indeed, a limiting factor in growth curve use.

Discussion: Chart review in general

In general, the chart review and results were what was expected. Nurses record growth measurements more frequently than physicians (Tables 1, 2). This was expected because of the time limitations of admitting physicians. On average, weight was recorded more frequently than height (Tables 1,2). This can probably be explained by the fact that a child's weight is needed in order to calculate how much medication he/she needs. Therefore, weight is usually a more urgent concern than height when admitting a patient. Due to lack of studies about this subject, it is unknown as to whether these results are typical or not.

Although growth curve presence was expected to be less than 20% within patient charts, it was not expected to be as low as 9% (Table 3). However, it was found that if a chart actually contained a growth curve, there was a relatively good

chance that it would be plotted, excepting BMI (Table 4). There was a large difference between instance of recording BMI and other growth data (Table 4,5). This disparity between BMI and other growth variables can possibly be explained by the fact that BMI, developed in the late 1980s, is a relatively new measurement. The new 2000 CDC growth curves are the first growth curves to have an individual chart devoted to BMI. Therefore, physicians and nurses may not be familiar with the new curves, and may, as a result, plot them less.

The distribution of weight categories for patients was also somewhat unexpected. While it was felt that there would be a large proportion of obese children due to the socioeconomic conditions of the surrounding area of the hospital, it was unexpected that 17% of children admitted would be obese (Table 6). A computer-generated readout of BMIs for patients at CHKD between July 1999 and July 2000 done by Pasquinelli, et al (2000) indicated that approximately 11% of patients were obese at that time.[23] The increase in the number of obese patients for this study can possibly be accounted for by the smaller sample size. However, the National Center for Health Statistics reports that obesity among children is increasing in the United States,[24] so it may simply be that patients as a whole are increasing in weight. The number of underweight patients (18%) was also higher than initially expected (Table 6). However, after taking into account that this project was done with children admitted to a hospital for some illness or another, the number of underweight patients is perhaps not so high after all.

As far as breaking the results down into different categories of admitting physician (general pediatrician, general surgeon, subspecialist, surgical subspecialist), no remarkably significant findings were found. Although there were some results that were statistically significant (p-value of less than 0.05), such as growth curve presence within charts (Table 11), there was a large difference in sample size of surgeons and non-surgeons. For example, there were only 35 general surgeons out of 359 charts reviewed. Therefore, the difference between physician categories was not thought to be very significant. Also, it is less likely that a surgeon, who is quite possibly seeing a patient for the first and last time, would plot a growth curve than a general pediatrician, who is likely to see a child several times. There have been no studies that examine incidence of growth curve plotting as broken down by subspeciality, so it is not known whether these results are typical or not.

Although medical subspecialists had the highest incidence of growth curve presence within patient charts at 16% (Table 11), general pediatricians had the highest incidence of growth curve plotting (Tables 12,13) and weight measurement (Table 15). Also, generalists had the highest incidence of height and weight percentile calculation (Tables 16, 17). This could possibly suggest that general pediatricians are more likely to plot growth curves since it is more likely that they will see a patient more than once, and that they are more aware of obesity than other specialties. However, this evidence is far from concrete since general pediatricians did not have the highest incidence of growth curve presence or height measurement (Tables 11, 14).

It was rather unexpected that not a single chart reviewed had BMI percentile recorded (Table 19). However, reasons discussed above regarding the novelty of BMI can possibly account for this.

Discussion: Physician Survey

Generally speaking, the physician survey results were what was expected. An interesting aspect of the demographics was that none of the respondents identified themselves as surgeons, general or specialty (Table 20). This was felt to be slightly unusual, but since the total respondent pool was 95 and surgeons make up a much smaller proportion of CHKD's staff than other physicians, the nonexistent number of surgeon respondents was not that unusual. For this reason, the respondents could be divided into three main groups: general pediatricians, pediatric subspecialists, and residents.

It was not surprising that the large majority of respondents felt that growth curves were a useful tool in treating their patients (Table 21), and that almost all of the respondents felt that growth curves should be completed for their patients (Table 22). When asked who should plot the curve, it was not surprising that the number one response was nurses, followed by residents (Table 23). It should be noted that there was only one nurse respondent in the survey. It is felt that if a separate survey were conducted asking nurses the same question, the response would be quite different.

Responses to Question 4 of the physician survey were quite interesting. For the first part, respondents indicated that they used information from the growth curve when seeing patients approximately 70% of the time (Table 24). However, it would seem almost impossible for this to be so, since growth curves were only found in 9% of charts (Table 3) and plotted in only a few of those (Tables 12, 13). This indicates good intentions from the physicians, but little action on these intentions. Even more

interesting is the response to the next part of Question 4. Respondents indicated that they plotted growth data an average of 50% of the time for patients they admitted (Table 24), but once again, this was not shown in the chart review. While indicating that growth measurements were easily found at admission time (70%), respondents admitted that they rarely plotted past data (10%) and that they could rarely find black growth curves in the patient charts (10%). Once again, there have been no previous studies regarding physician perception of growth curve use, so it is unclear as to whether these findings are typical.

The most limiting factor in growth chart use was indicated to be that blank curves are not placed in patient charts at admission time (Table 25). This is supported by responses to Question 4 indicating that respondents could find blank curves in patient charts only 10% of the time (Table 24). The next most limiting factor was that respondents did not know where blank curves were kept, followed by the fact that growth data was not easily located. This was surprising since Question 4 indicated that growth data was easily located 70% of the time. Time limitations were fourth on the list, indicating that time is not as large a limitation as once thought. Respondents listed not knowing how to use growth curves as sixth on the list of limitations, indicating that lack of knowledge is not as issue (Table 25).

For factors that would enhance use of growth curves, the number one response was to have blank curves inserted in patient charts at admission time (Table 25). This is consistent with the findings of this survey thus far. The second most helpful factor was for nurses to plot the growth curves, which is consistent with the responses to

Question 3A (Table 23). The third most helpful factor was for all growth data to be placed in a uniform location for all patients, such as on the patient's door. The fourth most helpful factor was to have growth curves placed in a uniform location on each floor, such as with the unit secretary. These responses were consistent with the other responses to the survey.

The data included in Appendix B was not felt to be critical to the study as a whole, therefore it was not included in the body of the report. The data in Appendix B deals with limiting and enhancing factors of growth curve use as broken down into the categories general pediatricians, pediatric subspecialists, and residents.

In response to the data listed in Appendix B, there are only a few significant pieces of data. General pediatricians listed inability to locate growth curves as a more significant limitation than residents, indicating that residents may be more informed as to a perhaps new location for growth curves (Table B2). Residents indicated that time was a more of a limiting factor in growth curve use than general pediatricians, which makes sense considering that residents often work up to twice as many hours as regular physicians (Table B4). Residents ranked having growth curves kept in a uniform location as significantly less helpful than general pediatricians or subspecialists, indicating once again that residents are more likely to know where the curves are kept than regular physicians (Table B10). Residents also ranked having nurses plot the curves as significantly more helpful than physicians did, which indicates that residents probably have less time and therefore need help in plotting the curve (Table B13). It is generally well-known that many residents work long hours,[25]

so this could possibly be an effect of the large work load that residents are expected to undertake.

What does these results mean for CHKD?

Overall, the results of this project indicate that while physicians feel that growth curves are important, they are rarely plotted for children admitted. With an average 16% of the patient population classified as obese and 10% classified as at risk for obesity, there appears to be a significant problem. As there are no other studies similar to this one that have been done, it is unknown as to whether this is typical for most children's hospitals.

There are some considerations to be made regarding these results. First, CHKD is a children's hospital located in a large metropolitan area. Most of the patients are from a lower socioeconomic background, which puts them at a higher risk for obesity. A 1998 study by Strauss and Knight investigated home environment as a predictor for childhood obesity. It was found that low-income homes, homes with single mothers, African-American households, and households in which the parent(s) received less than a high school education were all factors for increased incidence of childhood obesity.[26] These factors are typical of patients admitted to CHKD, therefore CHKD may have a higher incidence of childhood obesity than other hospitals not serving the same type of client base.

It should also be noted that all the charts reviewed were for patients being admitted to CHKD, not patients being seen for office visits or well-child checkups. Therefore, the charts reviewed were for patients who had potentially more serious problems than those simply seen in a doctor's office. This certainly has an effect on growth charts plotted; if a child is admitted, for example, with a severe asthma attack,

it is unlikely that the first thing on the admitting physician's mind will be to plot a growth chart.

Also to be considered is that admission to a hospital is usually an isolated event. Therefore, there will most likely not be any past growth data for the child, resulting in only one plot on the growth curve. Growth curves are certainly more effective when seen as a measure of a child's progress over time, and not as helpful when seen as one isolated point. However, many patients at CHKD do not have pediatricians as primary care providers and may simply use hospital visits as primary care. Therefore, many children do not have adequate records of growth curve data. In this case, a single point is certainly more helpful than none at all.

In the event that accurate patient data is being recorded by a primary care physician, this information needs to be accessible to physicians who admit these patients to CHKD. Currently, the only way to link these two groups is through a telephone call to the primary care physician's office in order to retrieve information, or a faxed growth curve from the primary care physician's office. Both of these methods are time-consuming, which makes physicians less likely to utilize them. It would be helpful if all this information could be compiled in some sort of database through a network of physicians' offices and CHKD. However, such a system could be costly to implement and take a long time to be fully realized.

However, having considered the facts that CHKD may be atypical as far as proportion of obese children and that physicians admitting children to a hospital are probably less likely to plot growth curves than in office visits, the fact remains that

16% of patients admitted are obese. This must be addressed. Even if a patient is admitted for a life-threatening condition, weight-for-height ratios cannot be ignored. It is possible, as in the case of asthma, that obesity is an underlying cause of the illness for which the child is admitted. Therefore, although the more serious conditions must be treated first, growth data and growth curves must be taken into account when admitting patients.

Future Direction: Recommendations to CHKD

Future direction must be aimed at plotting more growth curves for patients admitted to CHKD. As stated before, a single isolated plot is more helpful than no plot at all. Therefore, these are the recommendations for CHKD:

- Blank growth curves should be placed in each patient's chart at admission time.
- There should be an assigned person who puts the blank curves in the charts at admission time. This person can be a nurse, resident, or physician.
- There should be an assigned person to plot the growth curve at admission time, preferably a nurse or resident, according to survey results.
- The importance of plotting growth curves should be stressed to all physicians, nurses, and residents.
- The linking of information taken by primary care physicians with information taken by physicians who admit patients to CHKD is integral and should be examined to see if there is any way to integrate these two procedures.

Future Direction: Research

Although this project provides useful information about obesity and growth curve use at CHKD, there are many other relevant issues that can be examined. Some suggestions for future research:

- *An examination of growth curve completion for in-office visits rather than hospital admissions*. It would be very helpful to know whether or not patients admitted to CHKD are being assessed for height and weight at a primary care physician's office, rather than simply at a hospital. It is possible that some of the patients admitted to CHKD are being accurately and consistently assessed at a general pediatrics office. However, that is unclear from this study.
- *An assessment of obesity counseling at CHKD.* Are the children who are recognized as obese or at risk for obesity getting the counseling they need to make positive changes in their lifestyles and eating habits? In the event that a child is recognized as obese, it would be useful to know if there are resources that are being utilized at CHKD in order to address the problem of obesity.
- *A survey similar to the one in this project examining how nurses feel about growth curve use.* Although this project deals mainly with physicians, the role that nurses play in pediatric care cannot be ignored. A project examining how nurses feel about pediatric growth curves and how often they are utilized would be helpful in future procedure for CHKD.
- *An analysis childhood obesity and growth curve use at other large children's hospitals.* This is perhaps the most valuable direction in which future studies

could be conducted. As stated before, there are virtually no studies that have ever been performed prior to this one that deal with the issues of pediatric growth curve use and how physicians perceive growth curves. A similar study done in another large children's hospital would be most valuable in determining whether or not the results of this study are typical or atypical.

Appendix A: Demographic Information

Table A1. Sex of Patients

Sex of Patients		
Male	201/359	56%
Female	158/359	44%

Of the 359 charts reviewed, 201 were male patients and 158 were female patients (Table A1).

Table A2. Demographics of Admitting Physicians

Demographics of Admitting Physicians		
General Pediatrician	128/359	36%
General Surgeon	35/359	10%
Medical Subspecialist	141/359	39%
Surgical Subspecialist	55/359	15%

The service of the admitting physician was broken down into four categories: general pediatrician, general surgeon, medical subspecialist, and surgical subspecialist (Table A2).

Appendix B. Additional Physician Survey Results

Table B1. Determination of limiting factor rankings.

Determination of Limiting Factor Rankings		
	Mean Rank of Respondents	Overall Rank
Growth curves are not present in the patient charts.	2.05 ± 1.47	1
Do not know where blank curves are kept.	2.84 ± 1.42	2
Growth data (height, weight, FOC) not easily located.	3.24 ± 1.51	3
Takes too much time.	3.82 ± 1.68	4
Growth curve use not important in my management of patients.	4.95 ± 1.42	5
Do not know how to use growth curves.	5.51 ± 1.29	6
Other	6.26 ± 1.92	7

The limiting factors were ranked from most limiting (1) to least limiting (7) according to respondent rank. For example, the average respondent ranking of "Other" was 6.26 ± 1.92, making the least limiting factor (7) (Table B1).

For the following data, respondents were placed into one of the following categories: general pediatricians, pediatric subspecialists, or pediatric residents. The 8 "Other" category respondents were discarded, so n = 87. The rankings among these three categories were compared. The p-value listed at the top of the table is for difference among all three categories. If this value is significant, specific differences

between categories are listed under the table.

Table B2. Comparison of response to Question 5a.

Question 5a: Do not know where blank curves are kept.	p-value = 0.0187
	Mean rank of group
General Pediatricians	2.54 ± 1.48
Pediatric Subspecialists	2.85 ± 1.53
Pediatric Residents	3.29 ± 1.18

The difference between groups was found to be statistically significant, with a p-value of 0.0187 (Table B2). Specifically, there was a significant difference between general pediatricians and residents with a p-value of 0.0047. This indicates that not knowing where blank curves are kept is a more limiting factor for general pediatricians than for residents.

Table B3. Comparison of response to Question 5b

Question 5b: Blank growth curves not present in charts.	p = 0.9776
	Mean rank of group
General Pediatricians	1.97 ± 1.52
Pediatric Subspecialists	2.19 ± 1.89
Pediatric Residents	1.82 ± 0.95

The difference between these groups was not found to be significant in the ranking of Question 5b.

Table B4. Comparison of response to Question 5c

Question 5c: Takes too much time	**p = 0.0248**
	Mean rank of group
General Pediatricians	4.48 ± 1.79
Pediatric Subspecialists	3.86 ± 1.68
Pediatric Residents	3.25 ± 1.44

The difference between groups was found to be statistically significant, with a p-value of 0.0248 (Table B2). Specifically, there was a significant difference between general pediatricians and residents with a p-value of 0.0055. Since residents ranked this factors at 3.25, and general pediatricians ranked it at 4.48, this indicates that time is a more limiting factor for residents than for general pediatricians.

Table B5. Comparison of response to Question 5d

Question 5d: Do not know how to use a growth curve.	**p = 0.1087**
	Mean rank of group
General Pediatricians	5.61± 1.17
Pediatric Subspecialists	5.48 ± 1.44
Pediatric Residents	5.82 ± 0.82

The difference between these groups was not found to be significant in the ranking of Question 5d.

Table B6. Comparison of response to Question 5e

Question 5e: Patient growth data not easily found.	**p = 0.1087**
	Mean rank of group
General Pediatricians	3.68 ± 1.64
Pediatric Subspecialists	3.23 ± 1.55
Pediatric Residents	2.80 ± 1.30

The difference between these groups was not found to be significant in the ranking of Question 5e.

Table B7. Comparison of response to Question 5f

Question 5f: Growth curves not important.	p = 0.6336
	Mean rank of group
General Pediatricians	4.77 ± 1.48
Pediatric Subspecialists	5.09 ± 1.37
Pediatric Residents	4.89 ± 1.45

The difference between these groups was not found to be significant in the ranking of Question 5f.

Table B8. Comparison of response to Question 5g

Question 5g: Other	p = 0.9687
	Mean rank of group
General Pediatricians	6.23 ± 1.99
Pediatric Subspecialists	6.10 ± 2.19
Pediatric Residents	6.37 ± 1.80

The difference between these groups was not found to be significant in the ranking of Question 5g.

Table B9. Determination of enhancing factor rankings.

Determination of Enhancing Factor Rankings		
	Mean Rank of Respondents	Overall Rank
Have blank curves put in patient charts at admission time.	1.77 ± 1.17	1
Have nurses plot growth curves.	2.25 ± 1.04	2
Place all growth data (height, weight, FOC) in uniform location for all admissions.	2.76 ± 1.24	3
Have blank growth charts placed in same location on every floor.	3.33 ± 1.36	4
Offer Continuing Medical Education classes of growth curve use.	4.86 ± 1.01	5
Growth curve use not important in my management of patients.	5.74 ± 1.02	6
Other	6.86 ± 0.42	7

The limiting factors were ranked from helpful (1) to least helpful (7) according to respondent rank. For example, the average respondent ranking of "Other" was 6.86 ± 0.42, making the least limiting factor (7) (Table B9).

Table B10. Comparison of response to Question 6a

Question 6a: Keep growth curves in same location	**p = 0.0017**
	Mean rank of group
General Pediatricians	2.80 ± 1.22
Pediatric Subspecialists	3.24 ± 1.37
Pediatric Residents	3.97 ± 0.92

There is a significant difference between these three groups for their response to question 6a. Specifically, there is a difference between residents and general pediatricians with a p-value of 0.0002 and a difference between residents and subspecialists with a p-value of 0.0337. Because the residents ranked this factor lower than general pediatricians or subspecialists, this indicates that having blank growth curves kept in the same location would not be as helpful to residents as it would be to general pediatricians or subspecialists.

Table B11. Comparison of response to Question 6b

Question 6b: Have blank growth curves put in charts.	**p = 0.1130**
	Mean rank of group
General Pediatricians	1.54 ± 0.96
Pediatric Subspecialists	1.81 ± 1.21
Pediatric Residents	2.00 ± 0.94

There was no significant difference in the way these three groups responded to Question 6b (Table B11).

Table B12. Comparison of response to Question 6c

Question 6c: Offer CME discussion about growth curve use.	**p = 0.9484**
	Mean rank of group
General Pediatricians	4.93 ± 1.43
Pediatric Subspecialists	5.00 ± 1.30
Pediatric Residents	4.97 ± 0.98

There was no significant difference in the way these three groups responded to Question 6c (Table B12).

Table B13. Comparison of response to Question 6d

Question 6d: Have nurses plot growth curves.	**p = 0.0289**
	Mean rank of group
General Pediatricians	2.52 ± 1.48
Pediatric Subspecialists	2.57 ± 1.72
Pediatric Residents	1.63 ± 0.88

There is a significant difference between these three groups in their response to question 6d. Specifically, there is a difference between residents and general pediatricians with a p-value of 0.0106 and a difference between residents and subspecialists with a p-value of 0.0275. Because the residents ranked this factor

higher than general pediatricians or subspecialists, this indicates that having nurses plot the growth curves would be more helpful to residents as it would be to general pediatricians or subspecialists.

Table B14. Comparison of response to Question 6e

Question 6e: Place patient growth data in uniform location.	**p = 0.5340**
	Mean rank of group
General Pediatricians	2.81 ± 1.11
Pediatric Subspecialists	2.95 ± 1.12
Pediatric Residents	2.60 ± 0.81

There was no significant difference in the way these three groups responded to Question 6e (Table B14).

Table B15. Comparison of response to Question 6f

Question 6f: Growth curves not important.	**p = 0.6890**
	Mean rank of group
General Pediatricians	5.68 ± 1.08
Pediatric Subspecialists	5.52 ± 1.66
Pediatric Residents	5.97 ± 0.38

There was no significant difference in the way these three groups responded to Question 6f (Table B15).

Table B16. Comparison of response to Question 6g

Question 6g: Other	**p = 0.8444**
	Mean rank of group
General Pediatricians	7.00 ± 0.00
Pediatric Subspecialists	6.67 ± 1.32
Pediatric Residents	6.83 ± 1.01

There was no significant difference in the way these three groups responded to Question 6g (Table B16).

Literature Cited

[1] National Center for Health Statistics. Prevalence of overweight among children and adolescents: United States, 1999. Available from: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm. Accessed 2001 August.

[2] Loder RT, Aronson DD, Greenfield ML The epidemiology of bilateral slipped capital femoral epiphysis. A study of children in Michigan. *J Bone Joint Surg.* 1993; 75:1141-1147

[3] Boxer GH, Bauer AM, Miller BD Obesity-hypoventilation syndrome in childhood. *J Am Acad Child Psychiatry.* 1988; 27:552-558

[4] Bringer J, Lefebvre P, Boulet F, Body composition and regional fat distribution in polycystic ovarian syndrome. Relationship to hormonal and metabolic profiles. *Ann NY Acad Sci.* 1993; 687:115-123

[5] Pinhas-Hamiel O, Dolan LM, Daniels SR, Standford D, Khoury PR, Zeitler P Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. *J Pediatr.* 1996; 128:608-615

[6] Nilsson PM, Lind L, Pollare T, Berne C, Lithell HO Increased level of hemoglobin A1c, but not impaired insulin sensitivity, found in hypertensive and normotensive smokers. *Metabolism.* 1995; 44:557-561

[7] Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics*. 1998; 101:518-525

[8] Barlow SE, Dietz WH. Obesity evaluation and treatment: expert committee recommendations. The Maternal and Child Health Bureau, Health Resources and Services Administration, and the Department of Health and Human Services. *Pediatrics.* 1998; 102: E29

[9] Barlow SE, Dietz WH. Obesity evaluation and treatment: expert committee recommendations. The Maternal and Child Health Bureau, Health Resources and Services Administration, and the Department of Health and Human Services. *Pediatrics.* 1998; 102: E29

[10] *Ibid.*

[11] Roche AF, Siervogel FM, Chumlea WC, Webb P. Grading body fatness from limited anthropometric data. *Am J Clinical Nutrition.* 1981; 34: 2831-2839

[12]National Center for Health Statistics. CDC Growth Charts: United States. National Health and Nutrition Examination Survey. Available from: http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/background.htm. Accessed 2001 July.

[13] Roche AF. *Executive Summary of the Growth Chart Workshop, December 1992.* Hyattsville, MD: National Center for Health Statistics; 1994

[14] Hamill PV, Drizd TA, Johnson CL, Reed RB, Roche AF. NCHS growth curves for children birth-18 years United States. *Vital Health Stat 11.* 1977; 165 :1 –74

[15] Ogden CL, Kuczmarski RJ, Flegal KM, et al. Centers for Disease Control and Prevention 2000 Growth Charts for the United States: Improvements to the 1977 National Center for Health Statistics Version. *Pediatrics.* 2002; 109: 45-60.

[16] Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. *Adv Data.* 2000; 314 :1 –27

[17] Plan and operation of the Third National Health and Nutrition Examination Survey, 1988–94. *Vital Health Stat 1.* 1994; 32 :1 - 407

[18] Ogden CL, Kuczmarski RJ, Flegal KM, et al. Centers for Disease Control and Prevention 2000 Growth Charts for the United States: Improvements to the 1977 National Center for Health Statistics Version. *Pediatrics.* 2002; 109: 45-60.

[19] Guo SS, Roche AF, Chumlea WC, Casey PH, Moore WM. Growth in weight, recumbent length, and head circumference for preterm low-birthweight infants during the first three years of life using gestation-adjusted ages. *Early Hum Dev.* 1997; 47 :305 –325

[20] Troiano RP, Flegal KM, Kuczmarski RJ, Campbell SM, Johnson CL. Overweight prevalence and trends for children and adolescents: the National Health and Nutrition Examination Surveys, 1963 to 1991. *Arch Pediatr Adolesc Med.* 1995; 149 :1085 – 1091

[21] Himes JH, Dietz WH. Guidelines for overweight in adolescent preventive services: recommendations from an expert committee. *Am J Clin Nutr.* 1994; 59 :307 –316

[22] *Ibid.*

[23] Pasquinelli L. 2000 July 28. Results of obesity study 2000. [personal communication]

[24] National Center for Health Statistics. Prevalence of overweight among children and adolescents: United States, 1999. Available from: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm. Accessed 2001 August.

[25] Laine C, Goldman L, Soukup JR, Hayes JG. The impact of a regulation restricting medical house staff working hours on the quality of patient care. *JAMA*. 1993; 20: 269(3):374-8.

[26] Strauss RS, Knight J. The role of the home environment and socioeconomic factors in the development of childhood obesity. *Pediatrics.* 1999;103: e85