Impact of a Quality Improvement Initiative on Increasing Height Measurement Among Children with Medical Complexity

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ABSTRACT

BACKGROUND: This quality improvement project aimed to increase the rate of height measurement among children with medical complexity (CMC) seen for well-child visits.

METHODS: Three interventions were implemented over 17 months. Retrospective chart review of well-child visits for patients 35 months through 18.5 years was conducted for children with medical complexity. Height measurement rates were analyzed across intervention phases.

RESULTS: Overall rate of height measurement was 81.1% for children with medical complexity. From start to finish, rate of height measurement for CMC increased – 63.6% to 100.0% (P=0.006).

CONCLUSION: Quality improvement methodology increased height measurement rates at well-child visits amongst children with medical complexity. This approach can be utilized to address health care inequities among individuals with medical complexity.

KEYWORDS: children with medical complexity; quality improvement; height measurement

INTRODUCTION

Background

Height measurement is a standard method for tracking the growth, development, and nutritional status of children.[1-3] The American Academy of Pediatrics (AAP) recommends annual height measurement of children over the age of three at preventative health appointments known as well-child checks or visits (WCC).[4] Height is typically measured by a medical assistant, certified nursing assistant, or nurse using a stadiometer (a measuring stick with a blade that adjusts to rest atop a patient's head) which requires a patient be able to assume a straight-legged standing posture.

Among children with medical complexity (CMC) this posture is often unattainable. Children with medical complexity are individuals under the age of 18 who have chronic health conditions and/or disabilities leading to medical fragility, significant health care use, and functional limitations.[5-7] They are at increased risk of malnutrition and stunting, and require close surveillance of growth and development.[8-10] Alternative validated methods of growth measurement for CMC include upper-arm length, tibial length, and knee height.[11,12] Measurement of knee height – the distance from a patient's anterior thigh to their heel – with a knee height caliper (KHC) is the most reliable method and measurements can be converted to standing heights using validated calculations.[11-13]

Specific Aims

Approximately 100 children with medical complexity receive primary care and complex care coordination through the complex care center at the Hasbro Primary Care Clinic (Primary Care Clinic) – an academic medical center based clinic. This program has a dedicated physician and nurse case manager but operates out of the Primary Care Clinic and utilizes their space, equipment, medical assistants, and nursing staff. Children with and without medical complexity receive height measurement from Primary Care Clinic-based medical assistants or nurses at the start of their well-child visits. Children with medical complexity were noted to be receiving height measurement at approximately 40% fewer well-child visits than their peers without medical complexity. This quality improvement (QI) project sought to improve adherence to AAP guidelines and equity in care of children with medical complexity, by increasing the rate at which CMC receive height measurement during well-child visits. The Specific, Measurable, Applicable, Realistic, and Timely aim (SMART aim) was to achieve 100% height measurement amongst CMC within 12 months of the first intervention.

METHODS

A two-person team – the complex care center physician and a medical student – conducted this Institutional Review Board-approved project. Specific interventions were decided upon following informal conversations with Primary Care Clinic staff, as well as a nurse practitioner and two medical assistants at the interdisciplinary Spina Bifida Clinic where KHC use had been previously integrated. Key challenges to height measurement amongst CMC were identified as access to a knee height caliper (which was shared with the Gastrointestinal Clinic down the hall), uncertainty regarding use of the KHC and corresponding standing height

conversion calculations, and time needed to calculate standing heights from knee heights. Three phases of targeted interventions were implemented to address these challenges. Intervention success was measured by retrospectively reviewing electronic medical records from the WCCs of children with medical complexity over 17 months spanning from four months prior to the first intervention through the two months following the third and final intervention. Up to 10 well-child visits of children ages 35 months through 18.5 years were included from each month. Data was grouped into four phases; pre-Intervention – the four months prior to implementing any intervention, post 1st Intervention – the four months following implementation of Intervention 1, post 2nd Intervention – the four months following implementation of Intervention 2, and post 3rd Intervention – the two months following implementation of Intervention 3. Data included patient demographic variables, ambulatory status, technology dependence, height, and mechanism of height measurement. Data were stored in REDCap.[14]

Table 1. Participant demographics by intervention period

Characteristics of the study sample of 90 well-child visit patients seen at the Complex Care Clinic compared by intervention phase.

	Pre-Intervention (n=33)	Post 1st Intervention (n=15)	Post 2nd Intervention (n=31)	Post 3rd Intervention (n=11)	P-value	Full Study Period (n=90)
Age: Mean (standard deviation)	9.6 (4.5)	8.8 (5.1)	9.8 (4.7)	10.1 (5.5)	0.90	9.6 (4.7)
Male sex: Number (%)	17 (51.5)	8 (53.3)	15 (48.4)	3 (27.3)	0.54	43 (47.8)
Preferred language: Number (%) English	24 (72.7)	11 (73.3)	24 (77.4)	5 (45.5)	0.28	64 (71.1)
Spanish	8 (24.2)	2 (13.3)	6 (19.4)	5 (45.5)		21 (23.3)
Other	1 (3.0)	2 (13.3)	1 (3.2)	1 (9.1)		5 (5.6)
Ambulates with an assistive device: Number (%)	23 (69.7)	10 (66.7)	19 (61.3)	8 (72.7)	0.89	60 (66.7)
Dependent on medical technology: Number (%)	12 (36.4)	6 (40.0)	15 (48.4)	5 (45.5)	0.82	38 (42.2)

* $P<0.05$

Intervention 1

A KHC was purchased for complex care center patients and placed in the Primary Care Clinic. Staff were shown the KHC's location.

Intervention 2

The study team held a 20-minute training session during a Primary Care Clinic Friday morning huddle. Approximately seven staff members attended including nurses, medical assistants, the complex care nurse case manager, and the Primary Care Clinic manager. The session reviewed proper KHC use and calculation of standing heights from knee heights. A flyer detailing KHC use and height conversion calculation was distributed. The complex care physician additionally began noting requests for KHC measurements on the daily clinic schedule.

Intervention 3

An automatic knee height to standing height conversion tool was added to the clinic's electronic health record-based vitals flowsheet. This eliminated the need for staff to independently calculate standing height in order to use patient growth charts and measure body mass index.

Data Analysis

Patient demographics were analyzed using analysis of variance and Fisher's exact test. Height measurement rates were compared across all four intervention phases. Months during which an intervention took place (3 months total) were omitted from analysis. Stata SE version 17.0 (College Station, TX) was used for statistical analyses; $P<0.05$ was considered statistically significant.[15]

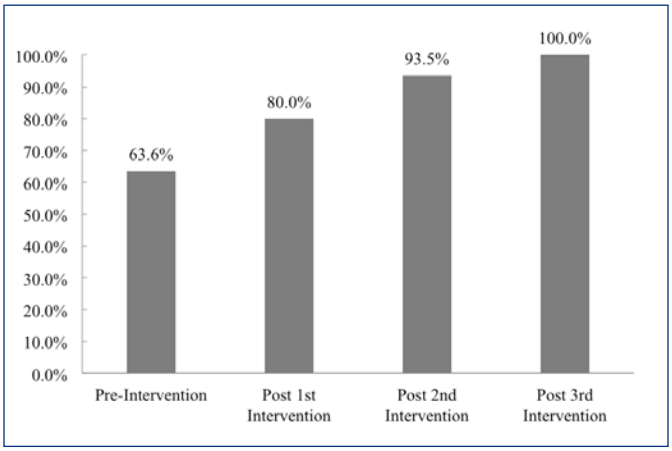
RESULTS

This study included 90 patient visits – 33 pre-Intervention, 15 post 1st Intervention, 31 post 2nd Intervention, and 11 post 3rd Intervention. The mean age of patients was 9.6 years (SD=4.7), 47.8% were male, 71.1% had a preferred language of English, 66.7% ambulated with an assistive device (walker, cane, wheelchair, and/or braces), and 42.2% were dependent on medical technology (tracheostomy tube, ventilator, gastrostomy tube, and/or jejunostomy tube) (**Table 1**). Patient demographics varied across the intervention phases, however there were no statistically significant differences (**Table 1**).

Over the study duration, CMC received height measurements at 81.1% of WCCs. Rate of height measurement increased over the four intervention phases from 63.6% pre-Intervention to 100.0% post 3rd Intervention ($P=0.006$) (**Figure 1**). The largest improvement in height measurement occurred from the pre-Intervention phase to the post 1st Intervention phase – a 16.4% increase.

Figure 1. Percent of patients receiving height measurement over four intervention phases

Chart of the percent of children who received a height measurement at their well-child visit by intervention phase. A statistically significant difference across the four intervention phases was found using Fisher's exact test (P=0.006).



DISCUSSION

This QI project sought to achieve 100% height measurement at well-child visits amongst children with medical complexity. Over 17 months and three interventions, children with medical complexity received height measurements at increased rates, reaching 100% height measurement following the final intervention. This finding supports implementation of a QI process to improve rates of task completion within primary care clinics. This finding furthermore underscores the value of modifying typical clinic work flows to ensure equal and appropriate health care is provided to individuals with medical complexity.

Past research has consistently found that individuals with disabilities and chronic medical conditions, such as complex care center patients, encounter barriers to accessing health care services and are subsequently less likely to receive appropriate exams, screenings, and treatments.[7,16,17] According to systematic reviews by Manikandan et al and Mitchell et al inaccessible environments, as well as lack of knowledge and experience regarding the needs of individuals with disabilities are significant barriers to accessing appropriate health care for this population.[17,18] This literature indicates that the standard design of health care settings and training of health care providers excludes individuals with medical complexities, and supports our findings that interventions such as purchase of accessible equipment and staff training, can significantly improve access to appropriate health care for this population.

The success of this project was driven by a combination of mechanisms including improved equipment access, reduction in time to complete height measurement for CMC, and increased knowledge of and ability to meet the unique needs of CMC. The acquisition of a dedicated clinic-based KHC ensured KHC availability. This played the largest role in improving height measurement amongst CMC, underscoring the importance of timely access to appropriate equipment. However, 100% height measurement was not achieved with purchase of the KHC alone. Formal training in KHC use along with reminders on when to use it and automatization of a particularly time-consuming component of KHC use – knee height to standing height calculation – likely all played a role in integration of the KHC into clinic workflow and the subsequent improvement in rates of height measurement.

Limitations

Among limitations of this project was the impact of the COVID-19 pandemic on well-child visit attendance. Complex care center well-child visits were frequently made virtual or postponed to avoid potential exposure of CMC to COVID-19 during periods of heightened infection. This led to a smaller study population at certain time points. Additionally, there was likely variation in the accuracy of KHC measurements amongst patients with severe contractures, or limb malformations. However, assessing accuracy of KHC measurements is outside the scope of this project. Furthermore, this project's success relied on institutional resources to purchase the KHC and provide staff training which may limit its applicability among community-based clinics with fewer resources. A community-based clinic would need to replicate this project to fully understand its applicability outside of an academic medical center.

CONCLUSIONS

Studies continue to document deficits in health care access and quality among individuals with disabilities and chronic medical conditions.[17,18] The results of this project demonstrate that by addressing needs for adaptive equipment and staff training, clinics can improve the quality and consistency of health care provided to this population. Further research in both academic and community-based settings is needed to improve equity in health care accessibility for individuals with medical complexity.

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