

Beyond BMI: Building an EMR-based  
Childhood Healthy Weights  
Surveillance System to Include  
Nutritional Risk and Protective Factors  
Through the Collection and EMR-  
integration of NutriSTEP®

Final Report: Phase 3



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## Executive Summary

One-third of Canadian children and youth are overweight or obese. Estimating rates of overweight and obesity in children has been identified as a critical information gap. Ontario's Food and Nutrition Strategy recommends screening using NutriSTEP® to identify children at risk of poor nutrition, physical inactivity, sedentary behaviours and other related health problems. NutriSTEP® is a valid and reliable tool used to assess nutritional risk in toddlers (18 to 35 months) and preschool aged children (3 to 5 years). NutriSTEP® implementation supports an ecological approach to obesity prevention, recognizing that family factors, peer influences, environmental factors and public policy all play a role in determining a child's weight.

The Beyond BMI research team envisions an electronic medical record (EMR)-based healthy growth surveillance system that includes risk and protective factors for overweight and obesity in Ontario children. Through a systems approach to healthy growth surveillance, comprehensive information on childhood healthy weights and nutritional risk and protective factors would be available to primary care practices to monitor and improve their delivery of care. In addition, public health units in Ontario could accurately and reliably monitor the prevalence of overweight and obesity, and the factors that influence healthy weights.

Previous research from the Beyond BMI research team found that NutriSTEP® was being used effectively in primary care practices. Incorporating NutriSTEP® into the well-baby or well-child visit was a common practice. All participants were interested in a system that would bring NutriSTEP® screening results automatically into the EMR.

In this study, the Beyond BMI team worked with five primary care practices to test the feasibility of an electronic version of NutriSTEP® in the Accuro® EMR as a step toward a surveillance system for childhood healthy weights including risk and protective factors, using primary health care EMR data. The research questions were:

1. Can primary care practices implement and integrate an electronic version of NutriSTEP®?
2. Can NutriSTEP® data be combined with height and weight data from EMRs of primary care practices and used for childhood healthy weight surveillance?

The research had three objectives:

1. Supports for implementation: explore processes to support the implementation, integration and extraction of NutriSTEP® data from the EMRs of children 18-months up to 5 years of age in primary care practices in Ontario;
2. Data quality: assess the quality of NutriSTEP® data, linked with height and weight data within the EMR of children 18-months up to 5 years of age in primary care practices in Ontario; and
3. Evaluation of process in primary care: assess the process for successful implementation, integration and extraction of data from primary care practices in Ontario.

The ongoing support from BORN Ontario facilitated the successful implementation of this study. QHR Technologies created the NutriSTEP® questionnaires as standardized forms, including scoring calculation, within their Accuro® EMR, as well as a purpose-built query to facilitate extraction.

The results provide some important implementation successes. This pilot study has shown that NutriSTEP® data, along with heights and weights, can be incorporated into, and extracted from, EMRs. NutriSTEP® is acceptable to and valued by practitioners, patients and families, and thus, is a viable way to capture nutritional risk and protective factors for healthy weights.

Almost 5% of children were at nutritional risk, supporting the growing body of evidence that nutritional risk starts early in life. Measuring nutritional risk and protective factors in primary care provides an opportunity for early identification, management and referral. While the study sample was small and non-representative, and links between nutritional risk and growth status could not be examined, 17.5% of children in this study were at risk of being overweight and a further 12.9% were overweight or obese. This underscores the need for a childhood healthy growth surveillance system that includes nutritional risk and protective factors. Such a system could improve care and management in primary care and provide an opportunity to measure and monitor key population health outcomes. To move forward with such a surveillance system, supports for increased routinization of NutriSTEP® would be needed within primary care.

Further implementation of NutriSTEP® in primary care practices would benefit from a checklist of options that could be presented to individual practices to adapt to their workflow.

Further development of a system to measure and monitor healthy growth and nutritional risk would need to ensure the timing of the clinical measurements occur at the same visit. Education and training could support this practice change.

This research supports previous work of the Beyond BMI research team; it is feasible to build a high quality EMR-based healthy growth surveillance system including nutritional risk and protective factors that could support clinical decision-making as well as improve population health outcomes.

## Introduction

### Healthy Growth and Development

One-third of Canadian children and youth are overweight or obese (1, 2). Health consequences of excess weight in childhood include increased risk of type 2 diabetes, hypertension and poor emotional health (3, 4, 5). The significance of childhood obesity on long-term population health rivals that of smoking in potential impact (6, 7).

The Canadian Task Force on Preventive Health Care (CTFPHC) recommends growth monitoring in children and youth at all appropriate primary care visits (8). Measuring height and weight and calculating body mass index (BMI) creates an opportunity for primary care and for public health, given that estimating rates of overweight and obesity in children has been identified as a critical information gap (9, 10, 11).

As stated in Ontario's Healthy Kids Strategy, "to have the greatest impact on weight, we must focus on healthy eating" (10, pg. 24). It is essential to intervene early in life, as the behaviours established in early childhood will last into adolescence and set the stage for adulthood (12, 13). Ontario's Food and Nutrition Strategy (14) recommends screening using NutriSTEP® to identify children at risk of poor nutrition, physical inactivity, sedentary behaviours and other related health problems.

#### NutriSTEP®

NutriSTEP® is a valid and reliable tool used to assess nutritional risk in toddlers (18 to 35 months) and preschool aged children (3 to 5 years) (15; see [www.nutristep.ca](http://www.nutristep.ca)). These questionnaires have been developed to consider determinants of nutritional health in young children, including: food and nutrient intake; factors affecting dietary intake and eating behaviours; physical growth and development and weight concerns; development and physical abilities; and physical activity and sedentary behaviour (including screen time) (15).

Once administered, an overall nutritional risk level (low, moderate, or high) is assigned based on the total score. The NutriSTEP® questionnaire can be re-administered on an annual basis to monitor behaviour change and reduction in nutritional risk. NutriSTEP® implementation supports an ecological approach to obesity prevention, recognizing that family factors, peer influences, environmental factors and public policy all play a role in determining a child's weight (10, 12, 15).

### Landscape for Promoting Healthy Growth and Development

#### Primary Care

There are now over 200 Family Health Teams in Ontario (16), and while the focus remains disease-related care, team-based care with a focus on prevention is expanding (11). Collaboration between public health and primary care provides an opportunity to combine efforts related to promoting healthy growth and development.

#### Electronic Medical Records (EMRs)

The use of EMRs in primary care practices is growing (17) and provides an opportunity to use health data beyond the patient's circle of care for other purposes such as population health measures and health system quality improvements.

## Better Outcomes Registry and Network (BORN) Ontario

BORN Ontario is a prescribed registry and has the authority under Ontario's Personal Health Information Protection Act to collect and disclose personal health information to facilitate and improve the provision of health care. The BORN Information System (BIS) enables the collection of, and access to, data on every birth in Ontario. Recognizing that primary care is the only place where all children are routinely seen in the first years of life, BORN Ontario has data partnerships with primary care sites across the province and collects data from their EMRs in support of reporting on key paediatric health indicators. The phase 1 Beyond BMI study demonstrated that the EMR data transmitted to BORN Ontario and extracted from the BIS are of good quality. This result highlighted the key role of BORN Ontario in the centralized collection of and access to data from multiple sources, demonstrating an expanded use of EMR data for improving quality of care and management in primary care practices as well as population health assessment and monitoring (18).

In addition to paediatric growth parameters, BORN Ontario also collects the Rourke Baby Record and Nipissing District Developmental Screen from all primary care visits from birth to 5 years of age, including 18-month enhanced well-baby visits (WBV) into the BIS (19).

## Collaborating on a Vision of a Childhood Healthy Growth and Development System including Nutritional Risk and Protective Factors

The Ontario Public Health Standards: Requirements for Programs, Services, and Accountability, Healthy Growth and Development Program Standard (20) specifies that local public health units must conduct surveillance and monitor trends over time in healthy growth and development. From 2011 to 2017, local public health units in Ontario were mandated to assess the implementation status of NutriSTEP® as per the Accountability Agreement Indicator Protocol, with an ultimate goal of mobilizing and supporting NutriSTEP® use by community partners, including primary care providers.

The Beyond BMI research team envisions an EMR-based healthy growth surveillance system that includes risk and protective factors for overweight and obesity in Ontario children – a secure system capable of population health measurement and supporting the care and management of children and their families in primary care practices.

Through a systems approach to healthy growth surveillance, comprehensive information on childhood healthy weights and the risk and protective factors would be available to primary care practices to monitor and improve their delivery of care. In addition, public health units in Ontario could accurately and reliably monitor the prevalence of overweight and obesity, and the factors that influence healthy weights. This information would guide planning, implementation and evaluation of local public health programs and services, and inform and evaluate healthy public policies. In addition, the monitoring of childhood healthy weights and the risk and protective factors could be used to detect changes in public health practices and the effects of these changes, assist with prioritizing the allocation of public health resources, and provide a basis for epidemiological research.

## Implications of Previous Beyond BMI Research

Previous research from the Beyond BMI research team (18) highlighted that NutriSTEP® was being used effectively in primary care practices. Incorporating NutriSTEP® into the well-baby or well-child visit was a common practice. Practices had made efforts, in various creative ways, to bring NutriSTEP® into their

EMRs, but all were interested in a system that would bring NutriSTEP® screening results automatically into the EMR.

With the potential to have NutriSTEP® integrated into EMRs comes the potential for expanded uses of the data, both at the level of the practice and at the provincial level. All participants interviewed were supportive of the idea of provincial-level data pooled across practices. Practices recognized that provincial direction would be needed to achieve a scaled-up version of what they had been doing independently and in different ways.

## The Present Study

Although the NutriSTEP® screening tool is being used in some primary care settings to identify nutritional risk among children, little is known about exactly how the screening tool is being used in these settings. It seems that primary care offices would be the ideal place to conduct this screen; however, there are still a number of unknowns, including, for example, how the NutriSTEP® screen is currently administered in primary care offices; how regularly the screen is used; how primary care providers support parents of toddlers and preschoolers with healthy lifestyle behaviour recommendations; and whether a tablet or another e-version of the NutriSTEP® screen would be effective in administering the NutriSTEP® screen.

The potential for incorporating nutritional status data as standardized forms into EMRs is also not well understood. If nutritional status data were available in EMRs, this would have implications for combining height and weight data available in EMRs with risk and protective factors to provide a more comprehensive picture of childhood healthy weights: a picture that goes *beyond BMI*.

In this study, the Beyond BMI research team worked with five primary care practices to test the feasibility of an electronic version of NutriSTEP® in the Accuro® EMR. The research questions were:

1. Can primary care practices implement and integrate an electronic version of NutriSTEP®?
2. Can NutriSTEP® data be combined with height and weight data from EMRs of primary care practices and used for childhood healthy weight surveillance?

The research had three objectives:

1. Supports for implementation: explore processes to support the implementation, integration and extraction of NutriSTEP® data from the EMRs of children 18-months up to 5 years of age in primary care practices in Ontario;
2. Data quality: assess the quality of NutriSTEP® data, linked with height and weight data within the EMR of children 18-months up to 5 years of age in primary care practices in Ontario; and
3. Evaluation of process in primary care: assess the process for successful implementation, integration and extraction of data from primary care practices in Ontario.

This research adds to a growing body of knowledge exploring the feasibility of establishing a surveillance system for childhood healthy weights, and risk and protective factors by using primary health care EMR data. Our hypothesis is that by linking the NutriSTEP® screening tool with EMR data, primary care practices could improve care and management of childhood overweight and obesity, and public health

units would be able to understand local risk and protective factors for child obesity and leverage this information to target local prevention programs and services to children.

### Framework: Implementation of Innovations

Durlak and DuPre (21) reviewed the literature on implementation of new prevention or health promotion programs for children and adolescents. They developed a framework based on their findings, describing contextual variables related to the innovation itself, the providers, the organization, the support system and the broader community (see Figure 1). Given that this study focused on the implementation of NutriSTEP® as an innovation in primary care practices, this framework was considered to be helpful in structuring the investigation.

**Figure 1:** Factors affecting the Implementation Process, Durlak and DuPre (21) (Re-ordered and Condensed for Application to the Present Study)

- |   |
|---|
| <ul style="list-style-type: none"><li>I. PROVIDER CHARACTERISTICS<ul style="list-style-type: none"><li>A. <i>Perceived need for innovation</i></li><li>B. <i>Perceived benefits [and drawbacks] of innovation</i></li><li>C. <i>Self-efficacy</i></li><li>D. <i>Skill proficiency</i></li></ul></li><li>II. CHARACTERISTICS OF THE INNOVATION<ul style="list-style-type: none"><li>A. <i>Compatibility</i></li><li>B. <i>Adaptability</i></li></ul></li><li>III. FACTORS RELATED TO THE PREVENTION DELIVERY SYSTEM: ORGANIZATIONAL CAPACITY and COMMUNITY LEVEL FACTORS<ul style="list-style-type: none"><li>A. <i>General organizational factors</i></li><li>B. <i>Specific practices and processes</i></li><li>C. <i>Specific staffing considerations</i></li></ul></li><li>IV. FACTORS RELATED TO THE PREVENTION SUPPORT SYSTEM<ul style="list-style-type: none"><li>A. <i>Training and technical assistance</i></li></ul></li></ul> |
|---|

As in the Phase 1 study (18), the ongoing support from BORN Ontario facilitated the successful implementation of this study, as BORN Ontario is a key link between public health, EMR vendor(s) and primary care practices. BORN Ontario advocated on behalf of the Beyond BMI research team to add the NutriSTEP® screening tool into the EMR platform of vendors across Ontario. One of these vendors, QHR Technologies, led the way with the creation of the NutriSTEP® questionnaires as standardized forms, including scoring calculation, within their Accuro® EMR, and a purpose-built query to facilitate extraction. A licensing agreement between the EMR vendor and the University of Guelph enabled all questions on the NutriSTEP® screening tool to be added as discrete data elements to the EMR platform. The research team partnered with BORN Ontario to broker the recruitment of primary care practices who use Accuro®.

## Recruitment

Between May and August 2016, the Beyond BMI research team used a variety of channels to identify and recruit practices for this pilot study. A one-page poster was circulated, describing the research and inviting practices to contact the team for more information. Communication was sent using the following approaches:

- Email blast to all Accuro® users in Ontario
- Post to Nutrition Resource Centre listserv
- Post to Ontario Society of Nutrition Professionals in Public Health listserv
- Email blast to all Public Health Unit Registered Dietitians in Ontario
- Post to Association of Public Health Epidemiologists in Ontario listserv
- Email to Registered Dietitians interest group of the Association of Family Health Teams of Ontario

Five practices were recruited via these methods. Practices began using NutriSTEP® when they had completed their training, if applicable, and when it was convenient for them to begin (see Table 1). The first NutriSTEP® screen date by practices new to NutriSTEP® ranged from July to December 2016.

**Table 1:** Participating Site Characteristics

<b>Primary Care Practice</b>	<b>Current NutriSTEP® Implementation Status</b>	<b>Participation in Beyond BMI Training</b>
<b>A</b>	Started November 2016	Yes
<b>B</b>	Already using	No
<b>C</b>	Already using	No
<b>D</b>	Started July 2016	Yes
<b>E</b>	Started December 2016	Yes

We did receive expressions of interest from practices that did not use Accuro®, but were unable to include them as participants because our research required data extraction from Accuro®.

## Objective 1: Supports for Implementation

Our first objective was to explore processes to support the implementation, integration and extraction of NutriSTEP® data from the EMRs of children 18-months up to 5 years of age in primary care practices in Ontario. This was largely a procedural objective, although there were learnings about implementation from this step in the research.

### Method

Durlak and Dupre (21) note that training and technical assistance is one factor that is important for successful implementation of an innovation. With this in mind, and knowing from the Phase 2 study that it was important for practitioners to feel comfortable with the NutriSTEP® tool and key messages to deliver when discussing nutrition with patients (18), a one-hour webinar training on NutriSTEP® and key messages related to its content was offered to participating sites. The value of the webinar training was assessed through a brief survey.

Each participating site received a *Key Message Reference Guide for Primary Care Providers Implementing NutriSTEP®* (one for toddlers and one for preschoolers) that covered key messages for each NutriSTEP®

question as well as other core nutrition messaging. In addition, sites were provided with multiple child nutrition handouts for patients that could be provided during an appointment or left in the waiting room. These resources were available in English and French. Local public health units assisted with the distribution of materials to the sites. See Appendix A for a list of all materials supplied.

Through our work with Accuro® EMR, NutriSTEP® was available as a form in the EMR, which had the potential to reduce the need for data entry of paper copies. Accuro® also had a built-in query that allowed sites to extract the data required for this project as well as for their own use within the practice.

## Results

Participants found the training helpful and reported that it improved their confidence slightly. Two sites were already using NutriSTEP® and did not participate in training because they were already experienced with the tool. At the sites that did participate in the training, between three and eight practitioners attended the training session, which included those providers most involved in administering NutriSTEP® for this project, but did not include all practitioners at their sites.

Resources were welcomed by practices, and the liaison with local public health units was an effective way of distributing materials.

Practices reported no difficulty in extracting the data and transferring it securely to the Beyond BMI research team.

## Discussion

The Beyond BMI research team offered assistance with processes to support the implementation, integration and extraction of NutriSTEP® data. In general, the supports offered were considered helpful; however, the training webinar was not taken up by all practices, and some participating sites had already implemented NutriSTEP® prior to participating in this pilot study. In addition, although our training did reach people who already intended to use NutriSTEP® and some others who were interested, this was not a practice-wide training, which may have limited the extent to which NutriSTEP® was implemented across the practice.

The data extraction process was streamlined substantially through the use of a built-in data query, and was transferred easily for analysis.

## Objective 2: Data Quality

Our second objective was to assess the quality of NutriSTEP® data, linked with height and weight data within the EMR of children 18-months up to 5 years of age, in primary care practices in Ontario.

## Method

### Extraction

Practices extracted data using a purpose-built query in the Accuro® EMR, pulling from the following fields: patient identifier (specific number assigned to each patient at each clinic); gender; date of birth; patient postal code; screen date; screen location/ organization (as entered on the questionnaire); form name; score per NutriSTEP® question; total NutriSTEP® score; most recent height/length; most recent height/length date; most recent weight; most recent weight date. Data were extracted from the EMRs

of five primary care practices between June 20 and July 7, 2017 and transferred using a secure file transfer site to Toronto Public Health. Some sites had already been using NutriSTEP® on paper or as a self-constructed form in their EMR. Although the use of the query went smoothly, one practice was using their pre-existing form for part of the study period, and as a result had to implement a parallel query to extract those data for our study.

## Analysis

Data were analyzed in SAS version 9.3.

The NutriSTEP® screen was deemed to be invalid if:

1. The child's age at time of screening was not within the appropriate age for NutriSTEP®;
2. The date of birth was not valid and an appropriate age could not be determined;
3. The incorrect tool was used for the age of the child; or
4. The sum of the sub-scores (questions 1 to 17) did not equal the total score.

The growth status for each record was calculated where possible. Growth status could not be calculated where:

1. Height and/or weight were missing;
2. Where height and/or weight were out-of-range; or
3. Height and weight were measured more than 30 days apart.

For the data from the NutriSTEP® screen and growth status to be combined, there was an additional requirement for the age at time of height/weight measurements to be within the appropriate range for the NutriSTEP® screen that was used.

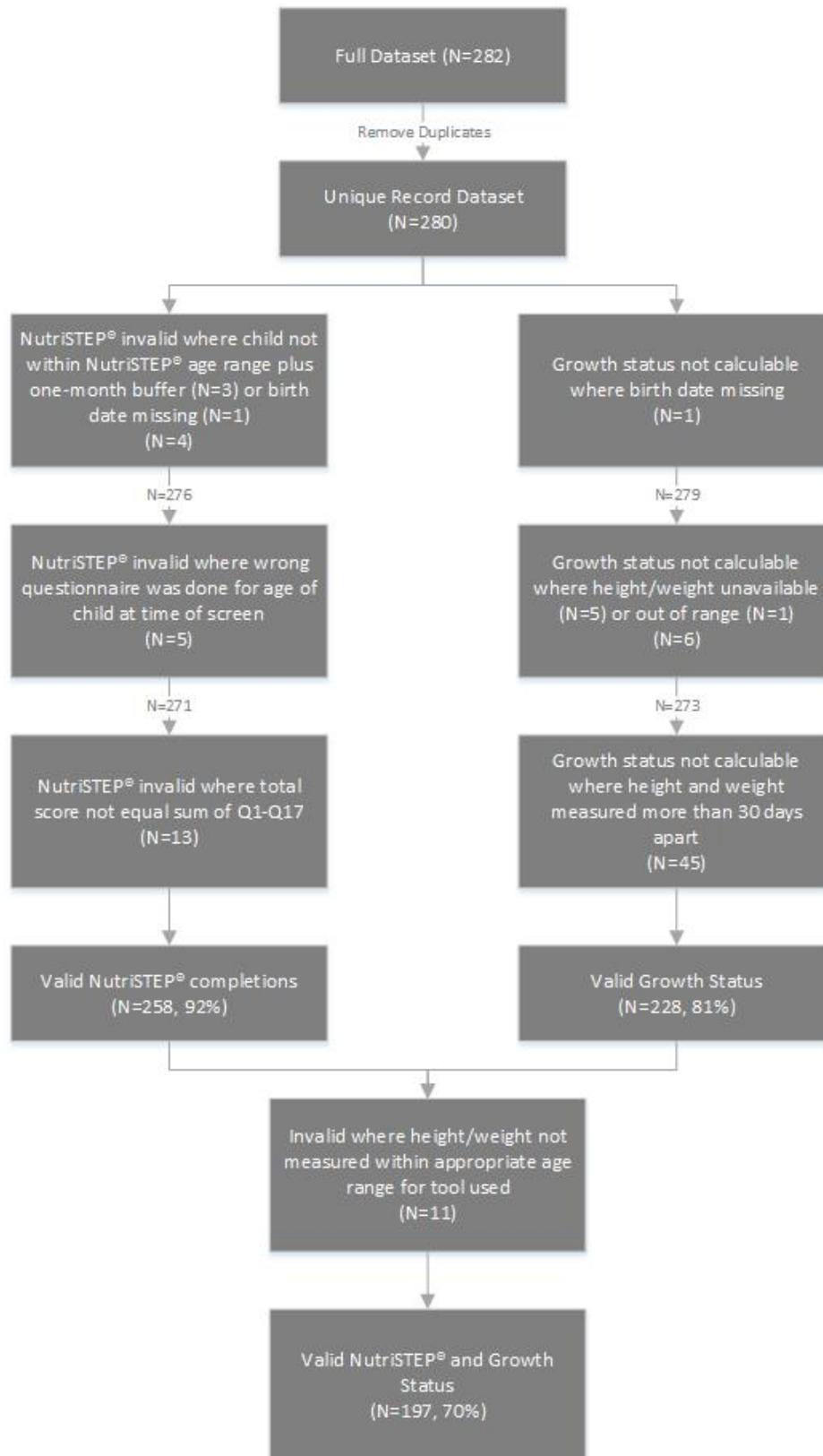
A one-month age buffer was allowed on either end of the designated age range for the completion of the NutriSTEP® screen. The toddler NutriSTEP® was considered to be valid if the child was 17 to 36 months old and the preschooler NutriSTEP® was considered to be valid if the child was 35 to 72 months old. A similar age buffer was used when calculating growth status.

The World Health Organization's (WHO) *Child Growth Standards* (22) and associated SAS macros were used to define z-scores for weight-for-age, weight-for-length, and BMI-for age for records up to 60 months of age. The WHO's *Growth Reference Data for 5-19 Years* and associated SAS macros were used to define z-scores for weight-for-age and BMI-for-age for records 61 to 72 months of age (23). Z-scores were converted into percentiles and growth status was defined based on percentile cut-off points available from the Dietitians of Canada (24). Appendices B and C show the percentile cut-off points used to define growth status.

## Results

A total of 282 records were extracted from the EMRs of the five participating primary care practices. Two of these records were duplicates and were removed from the dataset; all results are presented using the unique record dataset (n=280). Figure 2 presents a visual representation of the data processing flow.

**Figure 2: Flow Chart of Data Processing**



The majority (258/280; 92.1%) of the records were valid NutriSTEP® completions. The other 22 (7.9%) of records were invalid for the following reasons: 3 records were younger than 17 months of age at time of screening; 1 record had a date of birth in 1900; 5 records had the wrong NutriSTEP® done based on the age at the time of screening; and 13 records had a total score that did not equal the sum of the sub-scores.

One primary care practice used a pre-existing form for data entry into their EMR for approximately half of the study period and the individual scores for questions 1 to 17 were not imported into their EMR. Only the total NutriSTEP® score for these records was available. As a result, risk level for individual questions was not available for 94 of 258 (33.6%) NutriSTEP® completions.

The growth status could be calculated for 228/280 (81.4%) of the records. For the other 52 (18.6%) of records, growth status could not be calculated for the following reasons: 1 record had a date of birth in 1900; 5 records were missing height or weight measurements; 1 record had an out-of-range height; and 45 records had height or weight in the dataset measured more than 30 days apart.

There were 197/280 (70.4%) records that had both a valid NutriSTEP® completion and growth status measurements. In 11 records, the age of the child when the height or weight measurements were taken was not within appropriate range for the NutriSTEP® screen. Eight of these records were younger than 17 months at time of the NutriSTEP® measurement, while three of the records had a valid preschooler NutriSTEP® screen but were toddler age at time of measurement.

Table 2 shows the number of records by primary care practice. The majority (74%) of the unique records were from practice B. Practice E had only three records, all of which were invalid for NutriSTEP® because the children were younger than 17 months.

**Table 2:** Number of Records by Primary Care Practice and Record Outcome

Primary Care Practice	Unique Record Dataset	Valid NutriSTEP® Completions	Valid NutriSTEP® and Growth Status
A	21	15	13
B	206	200	146
C	31	28	25
D	19	15	13
E	3	0	0
<b>Total</b>	280	258	197

Tables 3, 4, and 5 show the distribution of records by sex, age at the time of the NutriSTEP® screen, and screen used. There were more females (53.2%) than males in the data. Toddlers in the 17 to 23-month age category were screened most frequently (63.2%), followed by preschoolers in the 36 to 47-month age category (23.9%). Specifically, the majority of records were either 18 months (n=140, 50.0%) or 36 months (n=52, 18.6%) of age at time of NutriSTEP® screening. Most (67.9%) of the records in this pilot study were toddler questionnaires.

**Table 3:** Sex Distribution of Records in the Unique Record Dataset (N=280)

Sex	Frequency	Percent (%)
Female	149	53.2
Male	131	46.8

**Table 4.** Age Distribution of Records in the Unique Record Dataset (N=280)

Age at time of NutriSTEP® Screen (months)	Frequency	Percent (%)
<17	3	1.1
17-23	177	63.2
24-35	10	3.6
36-47	67	23.9
48-59	17	6.1
60-72	5	1.8
Missing	1	0.4

**Note:** Total will not sum to 100% due to rounding

**Table 5:** Distribution of Screen Used in the Unique Record Dataset (N=280)

Screen	Frequency	Percent (%)
Toddler	190	67.9
Preschooler	90	32.1

Table 6 shows the percentages of records by nutritional risk. The majority of records had low nutritional risk (87.5%). The risk category is indeterminate in 7.8% of the records.

**Table 6:** NutriSTEP® Risk Category in the Unique Record Dataset (N=280)

NutriSTEP® Risk Category	Frequency	Percent (%)
Low Risk ( $\leq 20$ )	245	87.5
Moderate Risk (21-25)	9	3.2
High Risk ( $\geq 26$ )	4	1.4
Indeterminate	22	7.9

The results from the analysis of individual scores for questions 1 to 17 of NutriSTEP® completions (n=164) showed that low frequency of grain product consumption (48.1%), high frequency of drinking from baby bottles (48.1%), and high frequency of sedentary behaviours (42.5%) were the most frequently identified risk factors in toddlers (n=106), while low grain product consumption (56.9%), sedentary behaviours (46.6%) and low fruit consumption (44.8%) were the most frequently reported risk factors in preschoolers (n=58).

Table 7 shows the percentage of records by growth status: 17.5% were at risk of overweight while 12.9% were overweight or obese. In 18.6% of the records, growth status was missing.

**Table 7.** Growth Status in the Unique Record Dataset (N=280)

Growth Status	Frequency	Percent (%)
Underweight/Healthy Weight	143	51.1
Risk of Overweight	49	17.5
Overweight/Obese/Severely Obese	36	12.9
Missing	52	18.6

In 197 of the records, there was a valid NutriSTEP® screen as well as a valid growth status measurement. This number was too small for any additional analysis.

## Discussion

Data were found to be of good quality. Certain implementation, measurement and technical issues were identified, that, if addressed, could improve the completeness of data in EMRs and contribute to a comprehensive system of surveillance for healthy growth and development.

### Implementation Issues

The small number of records extracted could have been influenced by the short study period or the small numbers of paediatric patients at some practices. Further information on the number of paediatric patients in each participating site would be needed to explore this further. Limited uptake of the NutriSTEP® form across the practices could also explain the small sample size and is explored further in objective #3. Compliance with NutriSTEP® is further discussed in the conclusions.

### Measurement Issues

The purpose-built query extracted a record if a screening tool had been completed, and then extracted the most recent height and weight within the EMR for that individual patient. This resulted in some records that had height and weight measured on different days, and on different days than the day the screen was administered. As shown in Table 8, fewer than 50% of the records had the same date for height, weight, and nutritional screen.

**Table 8:** Differences between Height, Weight, and Screen Dates

<b>Date Comparison</b>	<b>Frequency</b>	<b>Percent (%)</b>
<b>All dates are the same</b>	135	48.2
<b>Weight and height have same date; screen date different</b>	87	31.1
<b>Screen and height have same date; weight date different</b>	29	10.4
<b>Weight and screen have same date; height date different</b>	7	2.5
<b>All dates are different</b>	22	7.9

Literature was reviewed for recommendations on appropriate time lags between height and weight measurements when calculating growth status in children. Although many systems collect growth measurements at the same time (e.g., self-reported height and weight in the Canadian Community Health Survey, record-level data from one visit from BORN Ontario, or studies that specifically enroll participants, rather than using data for secondary purposes), there was no methodological guidance found in the literature for appropriate time lags between measurements. A decision was made to use 30 days as an appropriate time gap, following consultation with a researcher at St. Michael's Hospital (25).

In the future, data completeness could be improved with a change in practice, and modification to the query, that supports growth measurement and nutritional screening on a single, or proximal, visit date(s).

### Technical Issues

Individual scores for questions 1 to 17 did not always correctly calculate the risk score. In 11 of 13 records, the risk score was zero when at least one of the individual questions was non-zero. Further

refinement and testing of the purpose-built query would be needed in the future to clearly identify item non-response from an individual question score, or total risk score, of zero.

While we are confident that there were no duplicate records across participating sites based on an analysis of date of birth, postal code, and sex, a unique identifier should be considered in the future.

### Prevalence of Nutritional Risk and Prevalence of Overweight and Obesity

The number of records was smaller than anticipated, and thus, analysis of NutriSTEP® and growth status data must be interpreted with caution.

Approximately 5% of children were at moderate or high nutritional risk. This is not unexpected for a population-level screening: previous studies using NutriSTEP® have reported between 4 to 27% of children as being at risk (15, 26, 27). Approximately 18% of children were at risk of overweight, and 13% were overweight or obese. These data are consistent with our previous findings in Phase 1 of Beyond BMI (18), and speak to the need to promote systematic growth monitoring (consistent with CTFPHC recommendations (8)) to identify those at risk.

We did not examine associations between nutritional status and growth status due to the small number of records. However, previous research has shown that NutriSTEP® risk scores correspond to growth status (28). The prevalence of nutritional risk, overweight and obesity begins early in life and signals an opportunity for early intervention in primary care (29), and supports the need for a comprehensive healthy growth surveillance system that includes nutritional risk and protective factors.

## Objective 3: Evaluation of Process in Primary Care

Our third objective was to assess the process for successful implementation, integration and extraction of data from primary care practices in Ontario.

### Method

A key informant from each of the five participating primary care practices who was considered ‘most knowledgeable’ about the process was selected for an interview. Interviews were conducted by telephone and audio-recorded. The interview recordings were transcribed verbatim by a transcriber who signed a confidentiality agreement. One of the transcripts was reviewed by the Research Associate to ensure accurate reflection of the recorded interview content in the transcriptions. The number of errors was negligible, and, thus, the remainder of transcripts were considered accurate for analysis. Key informants were given the opportunity to review their transcribed audio-recorded interviews, if they wished.

NVivo 10 software was used to support the qualitative analysis of interview transcripts. A coding frame (see Appendix D) was established based on the key research questions, aligning with the interview guide and the Durlak and Dupre (21) framework for implementation of innovations.

Each transcript was reviewed once and coded for the coding frame categories. During the first pass, additional learnings of interest with respect to implementation were identified and new codes were created. A second review of each transcript was completed to identify comprehensively any additional data with respect to the newly created coding categories.

## Results and Discussion

Findings with respect to each main area of investigation are provided, along with quotations from the interviews added to provide illustrative examples of the content. The implications of the findings are discussed together with the results in order to provide a contextualized discussion.

Table 9 summarizes the implementation context for each practice setting. Practices implemented to suit their workflows, and the process varied by practice. Two practices had parents complete NutriSTEP® on paper in the waiting room, with a flag in the EMR reminding front office staff to distribute the tool for completion. Of these practices, one discussed the completed NutriSTEP® tool in the appointment, with data entered into the EMR later by front office staff, and one had the dietitian review and follow up by telephone after the appointment, with data entered into the EMR by the dietitian. Two other sites had parents complete NutriSTEP® directly in the EMR, with the parent and practitioner viewing the questions on the screen during the appointment and discussing as needed during that time. One site completed only three NutriSTEP® forms, when they felt there was a nutrition concern.

**Table 9:** Practice Implementation Characteristics

Primary Care Practice	Tools Used	Context of Use	Practitioner	Administration
<b>A</b>	Toddler	18-month WBV	Registered nurse	During appointment, both look at screen
<b>B</b>	Toddler and preschooler	18-month WBV and 36 months	Registered nurse	Patient does it on paper in waiting room; registered nurse reviews paper version with them; registered nurse enters data after visit
<b>C</b>	Toddler and preschooler	18-month WBV and 36 months	Dietitian	Patient does it in waiting room (EMR flags the age range); front office staff enter data after visit; dietitian follows up by phone afterwards; will book appointment if high risk
<b>D</b>	Preschooler	4-year immunization	Registered nurse	During appointment, both look at screen
<b>E</b>	Very few completed	If problems identified in appointment	Nurse practitioner	Very few completed

The most common context for completion of the screen was the 18-month enhanced WBV. Three practices completed NutriSTEP® routinely for all patients attending these visits. In addition, two of these practices completed the NutriSTEP® screen at 36-month visits as well. One practice completed the screen only at a 4-year immunization visit. As noted in the analysis of the data quality described earlier, most of the records in this pilot study were toddler questionnaires, reflecting the fact that most of the practices chose to implement NutriSTEP® at the 18-month WBV.

The screening was completed with registered nurses at three sites. At one site, the parent completed the screen in the waiting room and follow up was completed by a dietitian.

## Provider Characteristics

Durlak and Dupre (21) identify provider characteristics such as perceived need for the innovation; perceived benefits and drawbacks of the innovation; self-efficacy; and skill proficiency as factors in implementation of an innovation.

Our main purpose in the interviews was to understand the experience of the providers who had used NutriSTEP® in their practices, in terms of the value of the tool and its benefits and drawbacks. In general, providers felt that NutriSTEP® added something valuable that was not already part of their appointment. They felt confident in using the tool, talking about it with their patients and families, and using it as the basis for follow up and referral.

*It was super easy and convenient, and it was already loaded into the patient's chart.*

*I think it's a huge value. I'm a big EMR user, [using] pathways and reminders. I think the Rourke and the well-baby visits are good, but they're very generalized. We don't look at how people eat, you know, we look at what they eat sometimes, but not how they eat, and promoting healthy habits. We have lots of obese children here, so I think it's a good tool to actually get the conversation started about better nutrition and healthy eating habits. It's nice to have. I like objective data.... it's nice to have the scores, and say oh, hey, maybe this patient should go to a paediatrician, or whatever.*

In general, the majority of children had a low level of nutritional risk, as would be expected from population-level screenings, and as suggested by previous studies using NutriSTEP® (15, 26, 27). Nonetheless, practitioners reported that parents generally valued the opportunity to discuss nutrition-related issues, regardless of their child's level of risk. When a concern or level of risk was identified, providers responded by sharing resources (including those provided by the Beyond BMI team for this purpose), providing advice and recommendations, and in some cases referring to a dietitian on staff, or to another provider or community resource.

These key informants identified some challenges when implementing NutriSTEP®. In general, the informants (the 'most knowledgeable person' about NutriSTEP® who had been most involved in the implementation) valued NutriSTEP® screening and acted as champions for the use of the tool. However, there was not always equal engagement across the practice. Some other providers in the practices were less interested in using NutriSTEP®, often because it was not required and they only felt they could make time for processes that were not optional.

*I would've like to have seen it as part of the ... mandatory portion of the visit, but because provincially it's not, it just kind of got left behind.*

*For the other two physicians [who complete the well-baby visits but did not implement NutriSTEP®], they have a nurse to assist, so they go through the Rourke, and the Nipissing, and all of those sort of things, and they didn't really push or promote the NutriSTEP® portion of it.*

Even for those providers who were supportive and dedicated to completing NutriSTEP®, there were challenges associated with trying to fit anything else into existing visits (especially the 18-month WBV, which was described as 'jam-packed').

*I find the form really generates a lot of questions from parents too, right, so you just don't have time to do that in that well-baby visit.*

They experienced the greatest success when the usual WBV time was extended, which was done in two practices.

Another important feature of successful implementation was that completion was part of the routine in the appointment or in the waiting room ahead of the appointment, so there was no need to decide in each appointment whether or not to complete the screen. One key informant suggested that NutriSTEP® implementation could become even more routinized and prescriptive as part of visits (as opposed to the open implementation that we had offered for this pilot study because we did not know what would work best).

*Maybe being a little bit more ...concrete, ... saying to providers or offices, you really should do it at 18 months, or you really should do it at 2 years old, or that sort of thing, as opposed to leaving it open between, what is it, 18 to 30 month. I think in our heads, as providers, we're so, you know, "everybody age 50 has a mammogram".*

The one site where very few screens were completed had not made the use of NutriSTEP® as part of their routine. Even for this site, they continued to express interest in using the screen, and could articulate the process they would need to take to be ready to use NutriSTEP®, although in the timeframe of our study they had not moved to implementation:

*I think if we could figure out exactly when we would use it, at what age, at what well-baby visit, ...and they would have [front office staff] print a paper copy out for them, because it's very easy to transfer that into the EMR, it's just click, click, click, you know.*

**Interviewer: It wouldn't take long at all.**

*Which is nice, and we could definitely revisit it, I mean, I think it just kind of got put on the backburner.*

One provider reflected in depth on her decision-making about when and how to implement NutriSTEP®. In this quotation, she reflects both on the value of the screening and on the challenges of adding an additional step to an already full appointment. There are other options she considers, such as bringing in nursing help, or having the patient complete the form ahead of time, but each of these options brings its own challenges.

*I thought, let me do this with all kids, because we do ask questions, but they're very general, we don't really get a sense of how they're eating at home, are they sitting in front of a TV, are they picky eaters, or whatever. So that was just kind of a general idea, 'let's do it for everybody'. It took me a lot of time [to implement NutriSTEP® in the appointment], so maybe if I had nursing help, that would be good, or if that form was given to the patient prior... but then it's a paper form that I have to input, right, so how does that data get transferred over?*

Although some practices thought about whether a separate visit would be a good opportunity for completion of NutriSTEP®, to allow more time, in general this option did not seem feasible because families would not be likely to come in just for nutrition screening.

*I think it's hard for parents, even though most of them aren't working at first, but by the time [the child is] a toddler or 18 months, people are working, so to come back just for a routine screen, and then come back again for a well-baby [visit], it's not realistic for people.*

## Characteristics of the Innovation

Durlak and Dupre (21) point out that there are features of the innovation itself, such as compatibility with and adaptability to existing workflows and systems that contribute to successful implementation.

We had heard from providers in the Beyond BMI Phase 2 study that having NutriSTEP® in the EMR would align with their workflows and would make the use of NutriSTEP® easier (18). In the present pilot study, having the NutriSTEP® screening tool in the EMR was efficient as a way of *storing* the data in the patient's record. It was not as important to have the screen *completed* electronically as we had previously thought: two practices did complete electronically, but two others chose to have patients complete on paper, only transferring the data to the EMR after the appointment. Having the data in the EMR was helpful for data extraction; this process went smoothly for all sites. For possible future applications of these data for surveillance purposes, integration into the EMR would be critical. However, from this pilot study, we can conclude that the method of completion of NutriSTEP® by the parent may be effectively done on paper or electronically. The following quotation speaks to the value of having the form in the EMR:

*It's easy to use. It even does the math for you, which I love, it's kind of cool, it's already in there, so nobody had to scan it and make text boxes, which might not sound like a big deal, but when the medical secretaries have to load a PDF that way, they hate it, and put 400 little text boxes, so it really, it made it easy to put it into play. The metrics were already set up, which is also equally as awesome, we didn't have to figure out how to do that, again, it took some of that workload off everybody here. And it coincides nicely with the times that we are seeing people, so I think it works out well.*

Providers who discussed the NutriSTEP® in the appointment found it easy to adapt into their appointment and in the context of existing relationships with patients. They used it to start a conversation about nutrition and to provide some information as part of the interaction. They used the NutriSTEP® questions as a way to introduce recommendations. They emphasized the importance of reinforcing the parent's confidence and not imparting so many recommendations that the information becomes overwhelming.

*I think that the NutriSTEP®, in how it has been developed in the conversation style that you have it set as, is an easy approach for parents, and it's a neutral approach. You're getting them to just rate on average what they think from a day-to-day, and it opens up that conversation.*

*Yeah, I sort of pause on it [asking each question]. You know, you're trying to find that point between sort of providing some of the information, because the rules for mothers are a bit daunting and it's impossible to follow them all. So I sort of say, ... for example, the reason that we ask this, is that there is a recommendation to not include juice, and the reason behind it is this, so that's why we're interested.*

## Characteristics of the Prevention Delivery System

As Durlak and Dupre's (21) model suggests, implementing an innovation relies on organizational capacity and community level factors (such as front office staff and referral supports), a finding which is supported in our research.

The important role of front office staff was evident in these pilot sites, either in responding to the EMR flags and handing out the NutriSTEP® on paper for completion (two sites) or in entering the data after the appointment (one site).

*The workflow, or the front staff, really is one of the biggest challenges of how to actually get the screen into the parent's hands. [At our] site, it works very seamlessly, just because of the great champions in the front office.*

Some sites in our previous and current research were interested in, or had explored, the possibility of using tablets for electronic completion of the screen in the waiting room, with direct linking to the EMR. This solution was considered by some to be ideal because it addressed two main challenges: how to save time in the appointment and how to get data entered into the EMR. Although our pilot study did not prescribe or support the use of tablets for this purpose, one informant reflected on their prior experience with using tablets to complete NutriSTEP® (this site was already using NutriSTEP® before our pilot study).

*We recently went into a new EMR system, and so we had iPads out in the waiting room, for patients to be able to use, and the medical office assistant or receptionist would give the iPad with the screen all set up, to complete the NutriSTEP® under the child's chart, and it was submitted, and so it was coming in completed that way to me. However, I found that there were a lot of barriers with that method. One, the child sees an iPad and wants to play, and so [laughing] it didn't always work, and then, with our program, there was a time lapse for privacy reasons, so if you didn't use it for 30 seconds or a minute, or whatever, it shut down and nothing saved. So a parent could be at the very end and have to run after their child, and then nothing saved. So I just went back to the old-fashioned paper form for that reason, and then once the visit is completed, I would manually input it onto our EMR system.*

The use of tablets to complete NutriSTEP®, although addressing several challenges, was not a preferred method and in the end, this provider preferred completion on paper.

One benefit for clinical management was in terms of more helpful referrals, such that if follow-up is required, the reason for the referral is documented thoroughly in the NutriSTEP® results.

*The good part of it was it addressed some of the feeding issues that some people have, and so then I was able to refer to a dietitian with that. The dietitian loved getting NutriSTEP®. They really like it, because otherwise they just get a script with your few notes, right...so [with NutriSTEP®] they have something to go by.*

Another aspect of clinical management and decision-making is that NutriSTEP® is a screening tool with a score, but the score is only part of what is useful. The understanding of the issues in context, and the conversation with the patient/parent is critical to getting the full value from the screening tool.

*Definitely there's children that I've identified in conversation that are less than the 26, that for sure, I would be referring on to other resources based on the situation and those kind of things, whereas there's some children who I've seen have over 26 that I don't, based on parent confidence, or how they've answered or interpreted it, and as we go through, it doesn't always indicate a referral. So I find it can go case by case, but definitely, there are trends. If you're 26 or more, for the majority, we're most likely making a referral, but it doesn't apply to every person ....*

Health unit support was a valuable community factor to support implementation. As part of our pilot study, we made connections between the practice and their public health unit if those relationships were not already in place. One site had already been using NutriSTEP® due to advocacy by the public health unit, and they had moved the use of the tool forward internally before coming on with our pilot study:

*I think it was probably the initiation by the public health unit, they had reached out to us and said listen, we're hoping to partner and get this rolled out, get this data, and we just said okay, sure, I don't see why we couldn't try, and so when I brought it to my team, the front office staff were truly receptive, they were like yeah, no problem, we don't have an issue with that, you know, it's a couple kids a week, not a big add-on to our workload, so it was good, and easy to move forward, and then making it into a form was another easy step within Accuro®. Again, that was front office staff, with them being very proficient within Accuro®, was a big factor there, as well.*

#### Characteristics of the Prevention Support System

Durlak and Dupre's (21) model also suggests that supports for implementation, such as training and technical assistance, would be an important facilitator of implementation. The key informants reported that the training and resources the Beyond BMI team provided had been somewhat helpful, although it seemed that the primary facilitator of implementation was their willingness and interest in completing the screen. NutriSTEP® is designed for parent completion, and thus is easy to complete, and although some primary care providers may not be comfortable discussing nutrition-related topics, these specific providers had expressed an interest in implementing the screen and may have had considerable comfort with the topic before beginning implementation.

All practice sites did make the parent-directed resources available to parents, whether directly as part of discussion, or indirectly in the waiting room. This included the site that did not engage in regular completion of NutriSTEP®. Thus, resources to support the screening were used, and were described as helpful both for parents, and to support practitioners and build their confidence.

*We put some in the waiting room, but also the physicians know that they're there as well, so if we're talking about healthy eating, most of the questions are about the transition from formula or breast milk to food, but I think, you know, it's not too early to give them the information on healthy toddler eating and that sort of thing, and it's very point-form, straightforward, so we just hand it out, when we have parents who are receptive to it.*

*I have some of your resources that I always carry with me. And [parents] also get a package applicable to their child's age. So they get an 18-month package, for instance, and it has the NutriSTEP® little checklist for feeding in it, so that's where we*

*implemented some of your tools, the NutriSTEP® tools, is in the packages. So that was good. I actually asked the health unit for some more of them, because I like them, I quite like them, and I like that little book too, that's a really nice little booklet that has each question, I really like that. I read that cover to cover, so I knew what I was doing, I thought I did, but making sure I knew everything.*

The EMR itself can be considered as part of the support system, and was an aspect of implementation that was of interest in this pilot study. Having the form in the EMR was valuable to the practices, whether they entered the data with the patient during the appointment or data-entered the results at some later time. One key informant could see the potential for EMR functionality related to flags and follow up steps to be further integrated into the use of NutriSTEP®, as is done with some other systems they have in place.

*Yeah, I think it would be good ... if there was a flag somewhere. Like, in our antenatal forms we have flags, so if there's any abnormal it'll flag and say, you know, you should be doing an ultrasound, or whatever, but it would be great if at some point it would flag somewhere, and there would be a process, if there was a concern about nutrition, or weight gain, or whatever that would flag as a next step, through the NutriSTEP® form as a guide or a tool we can use.*

Other informants had ideas for better integration of screening into the EMR, and could see great potential for clinical care and management in that functionality in future.

*I'm disappointed that the EMR doesn't track our referrals and stuff like they promised, but maybe that'll come someday. So say, because of the 18-month you do speech and language referrals, and audiology referrals, and say we do a dietitian referral, there's no tracking of those kept in the EMR, and that's unfortunate. Someday, they promised it, but someday it might happen, and that will be beneficial when it does. So you'd have red flags that say NutriSTEP® failed, you know, speech and language failed...*

*We could definitely put it in there, and we're actually just going through, in our quality committee, looking at how we can do preventative care bands in our EMR, and I talked about NutriSTEP® potentially being one of them, and identifying screen time based on the new recommendations, etc. So that's something that could be as a band, that we're identifying that it can be completed at these stages.*

One informant worked at two locations that had two different EMR systems. She remarked on the different functionalities of the EMRs, such that with one system (Accuro®EMR) it was easy to attach a reminder for all patients in the NutriSTEP® age range, whereas another EMR did not have an easy way to create this type of flag or reminder. For this study, the use of Accuro® EMR made it easy for providers to build in the flag if they chose to do so. For consideration of completion of NutriSTEP® universally, as part of a surveillance system, it would be important to explore the potential for various EMRs to build in a flag for patients within the applicable age ranges. Without this capacity, the implementation of NutriSTEP® completed routinely for all patients in the age range would be mediated to a certain extent by the functionality of the particular EMR system.

## Conclusions

An electronic version of NutriSTEP® worked well in primary care settings when certain contextual challenges, such as time in the appointment and establishing a routine for completion were addressed. Having NutriSTEP® as a standardized form in the EMR was valuable from a data extraction perspective, and was used in some practices to save clinical time by minimizing data entry when NutriSTEP® was completed directly in the EMR.

NutriSTEP® data could be combined with height and weight data in 70% of the records from EMRs of primary care practices. Addressing some of the measurement challenges could improve the completeness of the data. For our study, the practices were not required to collect height and weight at the same time as they completed NutriSTEP®, and the query pulled the most recent height and weight (which could have happened subsequent to the administration of NutriSTEP®). Thus, some information was unavailable, incomplete or invalid. For population level surveillance, an alternative query that extracted data based on visit date would likely be preferable. This change in query would have to accompany recommendations and training on the measurement of height and weight at the same time as the NutriSTEP® tool in order to ensure complete data.

To move forward with a healthy growth surveillance system, supports for increased routinization of NutriSTEP® would be needed within primary care. The implementation process for our study was not prescriptive; practices were encouraged to implement in whatever way made sense for their practice and context. We did see evidence that there are several ways to implement NutriSTEP® screening that were successful. However, because we did not provide direction on how and when to implement, some practices were slow to implement, or in one case, never got to a satisfactory way of implementing. This practice expressed continued interest in NutriSTEP® screening, but remarked that they had never made decisions about the process by which NutriSTEP® would be implemented, and thus they had very few completed screens. It seems that some implementation advice or direction would be useful for practices, and based on this research we have more knowledge about what methods have been effective.

Our interactions with the implementation sites were by telephone, webinar and email. In-person site visits, although resource-intensive, might have supported increased implementation and compliance (e.g., using the correct form; collecting height and weight at the same appointment). Future integration of NutriSTEP® into practices might benefit from the presentation of some options for implementation that the practice would choose from. The options could be adapted based on their workflows, but a basic checklist could be developed, covering decision points such as: age of child (toddler, preschooler, both); possible flag in EMR for this visit or age range; administration at which appointment (18-month WBV or other); which practitioners will complete; paper or on-screen administration; timing of NutriSTEP® completion (during appointment or before appointment); who enters the data (if needed); who follows up if needed, etc.

As with the Beyond BMI Phase 2 research, the limitations of *ad hoc* implementation of NutriSTEP® became apparent (18). Informants reflected on the provincial requirements for the 18-month enhanced WBV, which had led most practices to use the Rourke Baby Record and the Nipissing District Developmental Screen routinely, in contrast to the optional nature of NutriSTEP®. Practices with experience using NutriSTEP® saw the value in having provincial direction on the use of NutriSTEP®.

Partnerships are key to the vision of a surveillance system for healthy growth. The data would require collaboration across organizations and sectors, and would benefit multiple audiences as well. BORN

Ontario's Healthy Growth Initiative, and their partnership with the Ministry of Children and Youth Service's 18-month enhanced WBV project, are examples of ways that surveillance data can be drawn from patient data to support, and improve, clinical care together with population health monitoring.

This project was able to work with the Accuro® EMR system that included NutriSTEP® as a standardized form. During recruitment, there was interest from practices that used other EMRs, and ideally other EMR vendors will move ahead and make NutriSTEP® available in their EMRs. The inclusion of NutriSTEP® into the EMR of primary care practices would facilitate future transmission to BORN Ontario to expand their data holdings to support quality care and management.

Through this pilot study, we have taken some steps toward demonstrating the feasibility of our overall vision of a surveillance system for childhood healthy weights, including risk and protective factors, using primary health care EMR data. EMRs are a practical way to access data, and for wide-scale surveillance, they would be critical. This pilot study has shown that NutriSTEP® data, along with heights and weights, can be incorporated into, and extracted from, EMRs. NutriSTEP® is acceptable to and valued by practitioners and patients and families, and thus, is a viable way to capture nutritional risk and protective factors for a comprehensive healthy growth surveillance system.

## Limitations

This study was a small-scale pilot study with a convenience sample of practices that use Accuro® EMR. This project represents a valuable step in demonstrating the feasibility of incorporating NutriSTEP® into EMRs and the potential for a province-wide surveillance system. However, a limitation of a project of this size is that results will not be generalizable to all primary care practices. It is possible that practices that chose to participate in this project were different from non-participating sites in terms of their interest in or willingness to utilize nutrition screening tools and contribute the resulting data to provincial initiatives. Although our small sample may not be generalizable to all primary care practices, our intent was to understand and learn from the processes and experiences of these primary care practices as they implemented and integrated an electronic version of NutriSTEP®, and in that intention, we have been successful. Our knowledge exchange efforts will share our learnings from this research and may be persuasive in future as an example to other practices who may be interested in implementing NutriSTEP®.

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## Appendix A: Resource Materials Supplied to Participating Practices

- Two reference binders. Each binder includes a copy of the *NutriSTEP® Implementation Toolkit*, a sample of each resource provided as parent handouts, as well as a copy of the *NutriSTEP® Key Message* booklets (1 toddler + 1 preschooler).
- Parent handouts, including:
  - *Canada's Food Guide*. 40 copies.
  - *How to feed your growing child (ages 2-5)*: 40 copies
  - *How to build a healthy toddler*: 40 copies
  - *Eat Right Be Active toddler*: 20 copies
  - *How to build a healthy preschooler*: 40 copies
  - *Eat Right Be Active preschooler*: 20 copies
  - *EatRight Ontario Food choices when money is tight* toolkit: 20 copies
  - *Canadian 24-hour movement guidelines for children & youth*: 40 copies
  - *Canadian Physical Activity Guidelines (0-4 years)*: 40 copies
  - *Canadian Sedentary Behaviour Guidelines (0-4 years)*: 40 copies

## Appendix B: Percentile Cut-Offs for Growth Status Classifications, Birth to 2 Years (0-24 Months)

**Table B-1: Growth Status Classifications (0-24 months)**

<b>Growth Status</b>	<b>Indicator</b>	<b>Percentile Cut-off</b>
<b>Underweight</b>	Weight-for-age	<3 <sup>rd</sup> (<0.03)
<b>Risk of overweight</b>	Weight-for-length	>85 <sup>th</sup> (>0.85-0.97)
<b>Overweight</b>	Weight-for-length	>97 <sup>th</sup> (>0.97-0.999)
<b>Obese</b>	Weight-for-length	>99.9 <sup>th</sup> (>0.999)
<b>Healthy weight</b>	Weight-for-age and weight-for-length	If weight-for-age not <0.03 AND weight-for-length not >0.85

\*Stunted and wasted classifications were not used for the purposes of this data analysis

## Appendix C: Percentile Cut-Offs for Growth Status Classifications, Age 2 to 5 Years (25 Months and Older)

**Table C-1: Growth Status Classifications (25+ months)**

Growth Status	Indicator	Percentile Cut-off	
		2-5 years (25-60 months)	5-19 years (≥61 months)
<b>Underweight</b>	Weight-for-age	<3 <sup>rd</sup> (<0.03)	<3 <sup>rd</sup> (<0.03)
<b>Risk of overweight</b>	BMI-for-age	>85 <sup>th</sup> (>0.85-0.97)	N/A
<b>Overweight</b>	BMI-for-age	>97 <sup>th</sup> (>0.97-0.999)	>85 <sup>th</sup> (>0.85-0.97)
<b>Obese</b>	BMI-for-age	>99.9 <sup>th</sup> (>0.999)	>97 <sup>th</sup> (>0.97-0.999)
<b>Severely obese</b>	BMI-for-age	N/A	>99.9 <sup>th</sup> (>0.999)
<b>Healthy weight</b>	Weight-for-age and BMI-for-age	If weight-for-age not <0.03 AND BMI-for-age not >0.85	

\*Stunted and wasted classifications were not used for the purposes of this data analysis.

## Appendix D: Coding Frame for Qualitative Data

- Implementation:
  - a. How NutriSTEP® is used
    - Which providers use it
    - How do patients complete it? (e.g., hard copy, e-version, tablet...)
    - When is the screen administered (e.g., 18-month WBV, or other scheduled visits)?
    - How many completed – how universal was the implementation?
  - b. EMR integration and extraction:
    - How are the data from the screen entered into the EMR?
    - Extraction of NutriSTEP® data from EMR: assessment of process
  - c. Practice integration:
    - What is done once the screening is completed?
      - Who interprets the results?
      - What actions are taken? (e.g., recommendations, follow-up, referrals)
      - Any evaluation being done for screening and the follow up/referral process
- Challenges (including individual and organizational)
- Enablers and benefits (including individual and organizational)
- Suggestions to improve the NutriSTEP® screening process