PROTOCOL

Subject/Title: **Childhood Growth Measurement – Public Health and Clinical Settings**	Date: **April 4, 2014**
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OBJECTIVES

To enhance growth monitoring practices and child health outcomes by providing guidelines to ensure accurate and reliable measurements of infants, children and adolescents (birth to 19 years of age)

This protocol will address:

Procedure (Public Health and Clinical Settings)
Background
1. Equipment for weighing and measuring
2. Maintenance and calibration of equipment
3. Infection prevention and control
4. General guidelines for weighing and measuring

Public Health
5. Measuring weight
6. Measuring length or height
7. Measuring head circumference

Clinical Settings (inpatient and ambulatory)
8. Measuring weight
9. Measuring length or height
10. Measuring head circumference

Appendices to the protocol include:

APPLICABILITY

This protocol applies to all Alberta Health Services (AHS) staff, students and volunteers involved in childhood growth measurement in Public Health and Clinical Settings (inpatient and ambulatory).

This protocol is to be used when taking standard measurements of children (birth to 19 years of age) in both Public Health and Clinical Settings. It also provides general recommendations for measuring children with physical disabilities. It does not provide direction for all special circumstances (e.g. spica casts) where modifications may be required to obtain accurate measurements.

How to use this Protocol

The protocol is divided into 3 sections:

- Procedure which relates to both Public Health and Clinical Settings
- Public Health specific measurement criteria
- Clinical Settings (inpatient and ambulatory) specific measurement criteria

BACKGROUND

Growth monitoring and promotion of optimal growth are essential components for determining the health and nutritional status of infants, children and adolescents.[1] Serial measurements of weight, length or height for all children, head circumference for children birth to 24 months of age, and interpretation of these measurements relative to the growth of a large sample population of children depicted on a selected growth chart, help to confirm a child's healthy growth and development, or identify early a potential nutritional or health problem, enabling prompt action before a child's health is seriously compromised.[1]

In February 2010, a collaborative statement entitled *Promoting Optimal Monitoring of Child Growth in Canada: Using the New WHO Growth Charts* was released from Dietitians of Canada, Canadian Paediatric Society, The College of Family Physicians of Canada and the Community Health Nurses of Canada.[1] The Statement recommends that growth monitoring should be a routine part of health care for all Canadian children. It also states that "serial measurements of recumbent length (birth to 24 months) or standing height (≥ 2 years), weight and head circumference (birth to 24 months) should be part of scheduled well-baby and well-child or well-adolescent health visits. Measurements should also be performed at unwell visits for those who are not brought for recommended well-health visits."[1]

Accurate, reliable measurements are fundamental to growth monitoring and to making sound clinical judgements on the appropriateness of a child's pattern of growth.[2] They are used to monitor the growth of an individual child; detect growth abnormalities; monitor nutritional status and track the effects of medical or nutritional interventions. If measurements are in error, then the foundation of the growth assessment is also in error.[3]

Accurate measurements have three components: [2]

- Quality equipment which is regularly calibrated and accurate
- A standardized measurement technique
- Trained measurers who are reliable and precise in their technique.

It is important that an appropriate technique for each measure be utilized. These techniques should be similar to those used when developing the growth charts to ensure the measures are both accurate and reliable.[3] Accurate and reliable measurements also allow for an ongoing, systematic process of collection, analysis, interpretation and dissemination of descriptive information for monitoring growth and for use in program planning and evaluation.

A child's measurements should be consistently and accurately recorded in an age and gender-appropriate growth record, carefully plotted and analyzed to identify any disturbances in the pattern of growth.

PROCEDURE (Public Health and Clinical setting)

1) **Equipment for weighing and measuring** (refer to ***Appendix A*** *Specifications for New Growth Measurement Equipment*)

   a) The following equipment should be used for weighing and measuring infants birth to 24 months of age:
      i. Infant scale
      ii. Infant length board (infantometer)
      iii. Head circumference tape
   b) The following equipment should be used for weighing and measuring children 2 to19 years of age:
      i. Child and adolescent scale (adult scale)
      ii. Wheelchair scale for non ambulatory children
      iii. Stadiometer
      iv. Recumbent length board for non ambulatory children
   c) Equipment for measuring must be used for the purpose for which it was designed.
   d) Length devices attached to scales, rulers or tapes on examination tables are notably inaccurate and should not be used to measure length.[3]
   e) Height devices attached to scales are notably inaccurate and should not be used to measure height.[3]
   f) Equipment that shows evidence of damage must be repaired or replaced.[4]
   g) New stationary or portable equipment should be purchased following the equipment specifications in ***Appendix A*****.**
   h) There are many sources of high quality, reliable measurement equipment that will meet the equipment specifications outlined in ***Appendix A*****.** Consult with your purchasing department and refer to ***Appendix B*** *Childhood Growth Measurement Initiative: Equipment List* to determine which products are currently available for purchase.
   i) Equipment should have contact surfaces that are smooth and easy to clean with AHS approved disinfectants. Equipment with many complex surfaces or with unsealed joints and crevices cannot be cleaned and are not acceptable for use.[4]

2) **Maintenance and calibration of equipment** (*refer to* ***Appendix C*** Maintenance and Calibration of Growth Measurement Equipment)

   a) Regular maintenance and calibration helps to ensure that growth measurement equipment produces accurate and reliable measurements when proper measurement techniques are followed.

3) **Infection prevention and control**[4,5]

Refer to AHS, Infection Prevention and Control (IPC) for more detailed information and current standards.

   a) Follow AHS Infection Prevention and Control (IPC) policies and protocols for hand hygiene, cleaning and disinfecting of measuring equipment (non critical multi-use medical equipment/devices) and cleaning/transporting of portable equipment.
   b) Use a new paper barrier between infant/child and measuring equipment. The same barrier can be used for both pieces of equipment with the same child. Discard used paper barrier after use.
   c) Weighing and measuring equipment that cannot be cleaned adequately must be repaired or replaced.

4) General guidelines for weighing and measuring

a) When weighing and measuring infants and children follow procedures that yield accurate and reliable measurements and use equipment that is well maintained.
b) Explain all procedures to the parent/caregiver/child and enlist their help as needed.
c) Work with the parent/caregiver/child to weigh and measure in a manner that respects their personal, religious or cultural perspectives.
d) For all children there is a need to respect privacy. Privacy includes where the measurements are taken, describing the measuring process, and interpreting the numbers.
e) Ensure equipment is placed on a flat, hard, stable and even surface.[6]
f) Immediately record measurements after taking them.
g) When there is a need to re-measure a child, for example when a plotted point on a growth chart seems unreasonable (i.e. an infant's length is shorter than at the previous visit) or is inconsistent with previous visits (i.e. the child is on roughly the same percentile lines as before), repeat the measurement in question and compare.[3,6]
h) An acceptable standard for differences between repeat measurements is as follows:[3]
    i. Weight is within 0.01 kg (10 g) for children birth to 24 months of age.
    ii. Weight is within 0.1 kg (100 g) for children 2 to 19 years of age.
    iii. Length/height is within 0.5 cm.[7]
    iv. Head circumference is within 0.2 cm.
i) If measurements are not within the above ranges, measure a third time.

Table 1: Standard body measurements and equipment to be used by age category

Infants - Birth to 24 months[2]		**Children - 2 to 19 years**[2]	
Measure	**Equipment to be used**	**Measure**	**Equipment to be used**
Weight	Infant scale	Weight	Child and adolescent (adult) scale *Wheel chair scale for non ambulatory children
Recumbent length	Infant length board	Standing height	Stadiometer *Recumbent length board for non ambulatory children
Head circumference	Head circumference tape		

* Guidelines for weighing and measuring in special circumstances are included under the appropriate sections below.
Note: Purchase and use of special circumstances equipment to be determined by setting and need refer to ***Appendix D*** *Special Considerations for Length/Height Measurement*.

5) Measuring weight

a) When a weight measurement is needed

i. Weight should be measured at birth and during the postnatal period (birth to 8 weeks) as required.
ii. Children should be weighed at all routine well-child visits according to the following immunization schedule: 2, 4, 6, 12 and 18 months and 4-6 years of age. Children may also be weighed at other scheduled immunization times.
iii. Weights are measured on follow-up visits when feeding or when child's health warrant careful monitoring.
iv. Weights are also measured in other settings to track the effects of medical or nutritional interventions.

b) Determine which scale to use

i. Infants/toddlers birth to 24 months of age, or weigh less than 20 kg, should be weighed on a beam or electronic infant scale.[2]
ii. Children 2 to 19 years of age are weighed standing on a beam balance or electronic child and adolescent scale, provided they can stand on their own.[2]

iii. Special Circumstances:

- Children who weigh less than 20 kg and are unable to stand on their own should be weighed on an infant scale.[2]
- Children who weigh greater than 20kg and are unable to stand on their own may need to be weighed held by someone, with the weight of the person holding the child subtracted from their combined weight. [2]
- A larger child unable to stand on their own or too heavy to be held, may need to be weighed on a sit-down or wheel chair scale. [2]

c) How to measure infant weight (birth to 8 weeks of age)

i. Weigh infant (birth to 8 weeks) nude.
ii. Place a paper barrier over the measuring pan of the scale. [3]
iii. With the paper barrier in place, tare to zero. [3]
iv. Place the infant in the middle of the scale (the parent/caregiver can be asked to do this). [3]
v. Obtain the measurement once the infant is still. It may be necessary to wait a minute or so until the infant is still, or ask the parent/caregiver to distract an active infant. [3]
vi. Immediately record the weight in grams to the nearest 0.001 kg (1 g).[3]

d) How to measure infant weight (2 to 24 months of age)

i. Weigh infant (2 to 24 months) wearing a clean dry diaper. Weighing with a disposable diaper is recommended as cloth diapers are considerably heavier and vary in weight.
ii. Place a paper barrier over the measuring pan of the scale. [3]
iii. With the paper barrier in place, tare to zero. [3] Place the infant in the middle of the scale (the parent/caregiver can be asked to do this). [3]

iv. Obtain the measurement once the infant is still. It may be necessary to wait a minute or so until the infant is still, or ask the parent/caregiver to distract an active infant. [3]
v. Immediately record the weight in grams to the nearest 0.001 kg (1 g) or 0.01 kg (10 g). [3]
vi. If the infant is too active, weigh the infant being held by someone on a child and adolescent scale, with the weight of the person holding the child subtracted from their combined weight. [3] Immediately record the weight to the nearest 0.1 kg.

Note: Child and adolescent scales are generally only accurate to 0.1 kg increments and therefore you will receive a less accurate measure. Indicate how the weight was obtained on the chart if possible.

e) How to measure child and adolescent weight (2 to 19 years of age)

i. A child 2 to 19 years of age should be weighed wearing lightweight outer clothing. Shoes, hats or bulky items such as coats/jackets and sweaters should be removed.[2,3]
ii. Place a paper barrier over the measuring pan of the scale.
iii. With the paper barrier in place, tare to zero.
iv. The child should be weighed standing, without assistance, in the middle of the scale platform.
v. Immediately record the weight to the nearest 0.1 kg.[2]

6) Measuring length or height

a) When a length or height measurement is needed

i. Length is measured at birth and during the postnatal period (birth to 8 weeks) as required.
ii. Length/height of children should be measured at all routine clinic visits according to the recommended immunization schedule: 2, 4, 6, 12 and 18 months, and 4-6 years of age.
iii. Lengths/heights are measured on follow-up contacts when feeding or when childs' health warrant careful monitoring.
iv. Lengths/heights are also measured in other settings to track the effects of medical or nutritional interventions.

b) Determine when to measure length versus height

Note: In general, standing height is about **0.7 cm** less than recumbent length. It is important to adjust the measurements if length is taken instead of height for children 2 to 19 years of age or if height is taken instead of length for children birth to 24 months of age.[6]

i. When to measure length:

- If a child is less than 24 months of age, measure the child's length lying down. [2]
- If a child is less than 24 months of age and will not lie down for measurement of length, measure standing height and **add 0.7 cm** to convert it to length.[6] It should be documented that this was done.

ii. When to measure height:

- Measure height for children 2 to 19 years of age who can stand unassisted on a stadiometer. [2]
- If a child 2 to 19 years of age cannot stand unassisted, measure recumbent length and **subtract 0.7 cm** to convert it to height.[6] It should be documented that this was done
- Children with physical disabilities (unable to stand) may require length measured using a length board or may require the use of other segment length measurements. [3,6]
- Refer to ***Appendix D*** *Special Considerations for Length/Height Measurement*.

c) How to measure length

i. The child should be measured wearing light clothing and/or diaper. Remove shoes, hat and bulky clothing such as coats/jackets and sweaters.[2,3]
ii. Ask the parent/caregiver to remove or undo hair styles and hair accessories that interfere with taking a measurement.[3,6]
iii. Two people are needed to get an accurate measurement.[2,3]
iv. Cover the length board with a paper barrier.
v. Ask the parent/caregiver to place the infant on their back in the centre of the length board with their head against the fixed headboard, compressing the hair. Eyes should be looking up.[2,3]
vi. Quickly position the head so that the infant is looking vertically upward, with the crown of the head in contact with the headpiece in the Frankfort Horizontal Plane.[3]
vii. Have the parent/caregiver gently cup the infant's ears while holding the head so it is firmly but gently held in position. Make sure the infant's chin is not tucked in against the chest or stretched too far back.[3]
viii. Standing on the side of the board where the measuring tape can be seen and you can move the footboard, align the infant's trunk and legs, gently extend both legs, and bring the footboard firmly against the heels with feet against the footboard. Place one hand on the infant's knees to maintain full extension of the legs. The infant's toes should be pointed upward. It is important that both legs be fully extended for an accurate length measurement.[3]
ix. Immediately record the length to the nearest 0.1 cm. [2]
x. If the child is 2 to 19 years of age **subtract 0.7 cm** to convert it to height and immediately record.[6] It should be documented that this was done.

d) How to measure height

i. Remove shoes, hat and bulky clothing such as coats/jackets and sweaters.[3,6]
ii. Remove or undo hair styles and hair accessories that interfere with taking a measurement.[3,6]
iii. Ask the child to stand against the stadiometer, with heels together, legs straight, arms at sides, and shoulders relaxed.[3]
iv. The child is measured standing with heels, buttocks, shoulders and head touching a flat upright surface.[3]
v. The child should be looking straight ahead in the Frankfort Horizontal Plane.[3]
vi. Bring the perpendicular headpiece down to touch the crown of the head with enough pressure to compress the hair.[3]
vii. Measurer's eyes should be parallel with the headpiece in order to read the measurement.[3]

viii. Immediately record the height to the nearest 0.1 cm. [2]
ix. If the child is less than 24 months of age **add 0.7 cm** to convert it to length and immediately record.[6] It should be documented that this was done.

Special considerations for length/height measurement
There are some conditions or circumstances which pose challenges to obtaining accurate length and height measurements. *Refer to **Appendix D** Special Considerations for Length/Height Measurement* for suggested approaches.

7) Measuring head circumference

Note: Head circumference or occipital frontal circumference is measured over the most prominent part on the back of the head (occiput) and just above the eyebrows over the supraorbital ridges.[3]

a) When a head circumference measurement is needed

i. Head circumference should be measured at birth and during the postnatal period (birth to 8 weeks) as required.
ii. Measure head circumference at all routine well-child visits according to the following recommended immunization schedule: 2, 4, 6, 12 and 18 months of age.[1]
iii. Head circumference is also measured in older children as determined by clinical requirements.

b) How to measure head circumference

i. Ask parent/caregiver to remove or undo any hair styles and hair accessories that interfere with taking a measurement.[3,6]
ii. Sit the child on a flat surface or on the parent/caregiver's lap.[3] The child may be more comfortable in the arms of a parent/caregiver.
iii. Position a flexible, non-stretchable measuring tape just above the eyebrows over the supraorbital ridges, above the ears and around the prominent part on the back of the head (occiput).[2,3]
iv. Pull the tape snugly to compress the hair.[3]
v. Immediately record the head circumference to the nearest 0.1 cm.[2]

CLINICAL SETTINGS (INPATIENT AND AMBULATORY)

8) Measuring weight

a) When a weight measurement is needed

Recommended frequency of measurements taken in clinical settings depends on age, illness and degree of nutritional intervention. General, minimum guidelines are outlined below: [8]

Table 2: Recommended frequency of measurements taken in clinical settings

Status	Age	Frequency of Weighing*
Inpatient	Preterm infants	At admission and daily until meeting growth expectations, then weigh as per recommendation based on age
	Infant (Birth-12 months)	At admission and then 3X/week
	12-24 months	At admission and then 3X/week
	2-19years	At admission and then 2X/week
Ambulatory Clinics	Birth-19 years	Weight should be obtained at each appointment or as per clinic protocol

* Guidelines may vary for children who are at higher risk of malnutrition and inadequate growth due to clinical condition

b) Determine which scale to use

i. Infants/toddlers birth to 24 months of age, or weigh less than 20 kg, should be weighed on a beam or electronic infant scale.[2]
ii. Children 2 to 19 years of age are weighed standing on a beam balance or electronic child and adolescent scale, provided they can stand on their own.[2]

iii. Special Circumstances:

- Children who weigh less than 20 kg and are unable to stand on their own should be weighed on an infant scale.[2]
- Children who weigh greater than 20kg and are unable to stand on their own may need to be weighed held by someone, with the weight of the person holding the child subtracted from their combined weight. [2]
- A larger child unable to stand on their own or too heavy to be held, may need to be weighed on a sit-down or wheel chair scale.[2,6]

c) How to measure infant weight (birth to 24 months of age)

i. It is preferred to weigh an infant nude to increase accuracy[8]
ii. Alternatively, if a nude weight cannot be obtained, an infant should be weighed in a clean, dry diaper. A clean dry diaper should be weighed prior to weighing the infant and the weight of the diaper should then be subtracted from the child's final weight in order to obtain a nude weight.
iii. Place a paper barrier over the measuring pan of the scale.
iv. With the paper barrier in place, tare to zero.
v. Place the infant in the middle of the scale (the parent/caregiver can be asked to do this).

vi. Obtain the measurement once the infant is still. It may be necessary to wait a minute or so until the infant is still, or ask the parent/caregiver to distract an active infant. [3]
vii. Immediately record the weight in grams to the nearest 0.001 kg (1 g) or 0.01 kg (10 g) increment.
viii. If the infant is too active, weigh the infant being held by someone on a child and adolescent scale, with the weight of the person holding the child subtracted from their combined weight. Immediately record the weight to the nearest 0.1 kg.

Note: Child and adolescent scales are generally only accurate to 0.1 kg increments and therefore you will receive a less accurate measure. Indicate how the weight was obtained on the chart if possible.

d) How to measure child and adolescent weight (2 to 19 years of age)

i. A child 2 to 19 years of age should be weighed wearing lightweight outer clothing. Shoes, hats or bulky items such as coats/jackets and sweaters should be removed.[2,3]
ii. Place a paper barrier over the measuring pan of the scale.
iii. With the paper barrier in place, tare to zero.
iv. The child should be weighed standing, without assistance, in the middle of the scale platform.
v. Immediately record the weight to the nearest 0.1 kg.[2]

9) Measuring length or height

a) When a length or height measurement is needed

Recommended frequency of measurements taken in clinical settings depends on age, illness and degree of nutritional intervention. General, minimum guidelines are outlined below.[8,9]

Table 3: Recommended frequency of measurements taken in clinical settings

Status	Age	Frequency of Length/Height Measurement
Inpatient	Preterm infants	At admission or birth and then weekly until meeting growth expectations, then measure as per recommended based on age
	Infant (Birth -12 months)	At admission and then every 3 months
	12-24 months	At admission and then every 3 months
	2-19 years	At admission and then every 3 months
Ambulatory Clinics	Birth-19 years	At each outpatient appointment or as per clinic protocol

b) Determine when to measure length versus height

Note: In general, standing height is about **0.7 cm** less than recumbent length. It is important to adjust the measurements if length is taken instead of height for children 2 to 19 years of age or if height is taken instead of length for children birth to 24 months of age.[6]

i. When to measure length

- If a child is less than 24 months of age, measure the child's length lying down.[2]
- If a child is less than 24 months of age will not lie down for measurement of length, measure standing height and **add 0.7 cm** to convert it to length.[6] It should be documented that this was done.

ii. When to measure height

- Measure height for children 2 to 19 years of age who can stand unassisted on a stadiometer.[2]
- If a child 2 to 19 years of age cannot stand unassisted, measure recumbent length and **subtract 0.7 cm** to convert it to height.[6] It should be documented that this was done
- Children with physical disabilities (unable to stand) may require length measured using a length board or may require the use of other segment length measurements.[3] Refer to ***Appendix D*** *Special Considerations for Length/Height Measurement*

c) How to measure length

i. The child should be measured wearing light clothing and/or diaper. Remove shoes, hat and bulky clothing such as coats/jackets and sweaters.[2,3]
ii. Ask the parent/caregiver to remove or undo hair styles and hair accessories that interfere with taking a measurement.[3,6]
iii. Two people are needed to get an accurate measurement.[2,3]
iv. Cover the length board with a paper barrier.
v. Ask the parent/caregiver to place the infant on their back in the centre of the length board with their head against the fixed headboard, compressing the hair. Eyes should be looking up.[2,3]
vi. Quickly position the head so that the infant is looking vertically upward, with the crown of the head in contact with the headpiece in the Frankfort Horizontal Plane.[3]
vii. Have the parent/caregiver gently cup the infant's ears while holding the head so it is firmly but gently held in position. Make sure the infant's chin is not tucked in against the chest or stretched too far back.[3]
viii. Standing on the side of the board where the measuring tape can be seen and you can move the footboard, align the infant's trunk and legs, gently extend both legs, and bring the footboard firmly against the heels with feet against the footboard. Place one hand on the infant's knees to maintain full extension of the legs. The infant's toes should be pointed upward. It is important that both legs be fully extended for an accurate length measurement.[3]
ix. Immediately record the length to the nearest 0.1 cm.[2]
x. If the child is 2 to 19 years of age **subtract 0.7 cm** to convert it to height and immediately record.[6] It should be documented that this was done.

d) How to measure height

i. Remove shoes, hat and bulky clothing such as coats/jackets and sweaters.[3,6]
ii. Remove or undo hair styles and hair accessories that interfere with taking a measurement.[3,6]

iii. Ask the child to stand against the stadiometer, with heels together, legs straight, arms at sides, and shoulders relaxed.[3]
iv. The child is measured standing with heels, buttocks, shoulders and head touching a flat upright surface.[3]
v. The child should be looking straight ahead in the Frankfort Horizontal Plane.[3]
vi. Bring the perpendicular headpiece down to touch the crown of the head with enough pressure to compress the hair.[3]
vii. Measurer's eyes should be parallel with the headpiece in order to read the measurement.[3]
viii. Immediately record the height to the nearest 0.1 cm.[2]
ix. If the child is less than 24 months of age **add 0.7 cm** to convert it to length and immediately record.[6] It should be documented that this was done.

Special considerations for length/height measurement

There are some conditions or circumstances which pose challenges to obtaining accurate length and height measurements. *Refer to* ***Appendix D*** *Special Considerations for Length/Height Measurement* for suggested approaches

10) Measuring head circumference

Note: Head circumference or occipital frontal circumference is measured over the most prominent part on the back of the head (occiput) and just above the eyebrows over the supraorbital ridges.[3]

a) When a head circumference measurement is needed

Recommended frequency of head circumference measures are outlined below.[8]

Table 4: Recommended frequency of measurements taken in clinical settings

Status	Age	Frequency of Head Circumference Measurement
Inpatient	Preterm infants	At birth then weekly, until meeting growth expectations, then measure as per recommended based on age
	Infant (Birth- 24 months)	At admission, and then monthly
Ambulatory Clinics	Birth -2 months	Monthly
	2- 6 months	Every 2 months
	6-24 months	Every 3 months

Head circumference is also measured in older children as determined by clinical requirements.

b) How to measure head circumference

i. Ask parent/caregiver to remove or undo any hair styles and hair accessories that interfere with taking a measurement.[3,6]
ii. Sit the child on a flat surface or on the parent/caregiver's lap.[3] The child may be more comfortable in the arms of a parent/caregiver.
iii. Position a flexible, non-stretchable measuring tape just above the eyebrows over the supraorbital ridges, above the ears and around the prominent part on the back of the head (occiput).[2,3]
iv. Pull the tape snugly to compress the hair.[3]
v. Immediately record the head circumference to the nearest 0.1 cm.[2]

DEFINITIONS

Accurate means the nearness of the measure to the 'true' value.[3]

Calibrate means to check, adjust, or determine by comparison with a standard.

Calibration means a comparison or validation of the height or length or weight of an object with a known value.

Frankfort Horizontal Plane means an imaginary horizontal line extending from the most inferior point of the orbital margin to the left tragion. The tragion is the deepest point in the notch superior to the tragus of the auricle.[3]

Growth monitoring means the serial weighing and measuring of the length/height (and head circumference if ≤ 2 years old) of a child and graphing both measurements on a growth chart.[1,6]

Height means the measure from the crown of the head (the superior point) to the bottom of the feet. Height is always measured standing.[3]

Length means the measure from the crown of the head (superior point) to the bottom of the feet with the subject lying horizontally in a supine position. Length is always measured recumbent.[3]

Postnatal Period means the period from birth up to 8 weeks.

Reliable means how close repeated measures are to each other.[3]

Tare means to set the weight of the scale at 'zero' when a weight (person or paper barrier) is on the scale. Another person, such as an infant, can then be added and the weight of the infant read directly from the scale.[3]

Tolerance of a Measure means the difference between two measures that is accepted as reasonable accuracy.

Zeroed means being sure that when there is nothing being weighed that a scale registers zero.[3]

Appendix A
Specifications for New Growth Measurement Equipment

General Information:

- Equipment for measuring must be used for the purpose for which it was designed.
- Equipment specifications are for both stationary and portable equipment.
- There are many sources of high quality, reliable measurement equipment that will meet the equipment specifications outlined below. Consult with your purchasing department and refer to ***Appendix B*** *Childhood Growth Measurement Initiative: Equipment List* to determine which products are currently available for purchase
- Equipment purchased should have contact surfaces that are smooth and easy to clean with AHS-approved disinfectants. Equipment with many complex surfaces or with unsealed joints and crevices cannot be cleaned and are not acceptable.

The following specifications should be used when purchasing new equipment:

INFANTS (birth to 24 months of age)

1) Scales for weighing infants:

An accurate scale for weighing infants can be either a beam balance or electronic scale. Scale should be durable, accurate and safe for the infant. Length devices attached to infant scales are notably inaccurate and should not be used because they do not have a stable footpiece.[3]

a) Infant scale specifications:

i. Medical quality balance beam or electronic scale.[2,3]
ii. Weigh to a maximum weight of 20 kg.[2,3]
iii. Weigh in 0.001 kg (1 g) or 0.01 kg (10 g) increments.[2,3]
iv. Easily 'zeroed' and checked.[2,3]
v. Can easily be 'tared' to zero.[3]
vi. Tray is large enough to support the infant.[3]
vii. No sharp edges.[3]
viii. Can be calibrated.[3]
ix. Length devices are not attached to scale.[3]
x. Desirable features for electronic scales include: "average weight", ability to 'lock in' weight and a motion detector/stabilizer.[2,3]

2) Length boards for measuring length:

The length board will be durable, accurate and safe for the infant or child being measured. Devices attached to scales, rulers or tapes on examination tables should not be used. Inappropriate equipment used for measuring has a tendency to measure 'short'.[3]

a) Infant length board specifications (infantometer):

i. A firm, flat horizontal surface. [3]
ii. Measuring tape will have 0.1 cm (1 mm) increments. [2,3]
iii. Fixed tape is stable and easily read. [3]
iv. An immovable headpiece at a right angle to the tape. [2,3]
v. A moveable foot piece, perpendicular to the tape. [2,3]
vi. It is desirable that the length board have a measuring range to at least 40 to 99 cm so that the majority of infants from birth to 24 months of age can be measured in a recumbent position.

3) Tapes for measuring infant head circumference:

Insertion tapes provide a more accurate 'view' of the head circumference measure than that obtained by overlapping the edges of a tape measure.[3]

a) Head circumference tape measure specifications:

i. Flexible, non-stretchable measuring tape.[2,3]
ii. A plasticized tape is recommended.[3]
iii. Measures in 0.1 cm (1 mm) increments.[2,3]
iv. It is desirable that an insertion tape be used.[3]

CHILDREN AND ADOLESCENTS (2 to 19 years of age)

1) Scales for weighing children and adolescents:

An accurate scale for weighing children and adolescents can be either a beam balance or electronic scale. Bathroom 'spring' scales should not be used to weigh children or adolescents. Safety and accuracy require that the scale has a large enough platform to support the child being weighed.[3]

a) Scale specifications:

i. Medical quality balance beam or electronic scale.[2,3]
ii. Weigh in 0.1 kg (100 gm) increments.[2,3]
iii. Can be calibrated.[3]
iv. Can easily be 'tared' to zero.[3]
v. Stable weighing platform.[3]
vi. No height (stature) device attached to the scale.[3]
vii. Ability to 'lock in' weight is desirable on electronic scales.[3]
viii. It is desirable that the scale should weigh from at least 5 kg to 105 kg so that it can be used with the majority of children.

b) Wheel chair scales:

Providing accessible weigh scales can improve the quality of care provided to those with disabilities and activity limitations. The most common type of accessible scale is a

wheelchair scale. They can be used for those in a wheelchair, with limited stability and those needing to sit on a chair while being weighed.

i. These types of scales include:
   - Folding portable
   - Stationary and
   - Platform (portable and in ground).

ii. In addition to the specifications for child and adolescent scales wheel chair scales should have contain:
   - Sturdy handrails
   - Wide platform to accommodate power wheelchairs
   - Slip resistant platform
   - Large, easy to read digital display

iii. Some manufacturers of Accessible scales are as follows:
   - Detecto, www.detectoscale.com 1-800-641-2008
   - Heath-o-Meter, www.healthometer.com
   - SECA, www.itinscale.com
   - Tantia, www.tanita.com 1-847-640-9241

Note: The Scaletronix wheel chair scale model 6002 supplied by Global Medical Products meets the specifications for clinical settings in Alberta Health Services

2) Stadiometers and length boards for measuring height of children and adolescents:

Height devices attached to scales are notably inaccurate and should not be used. A common failing of the portable stadiometer is a base that is too small. If the base is too small the stadiometer is not stable and entirely perpendicular to the floor.[3]

a) Stadiometer specifications:

i. A vertical board with an attached metric rule.[2,3]
ii. An easily moveable horizontal headpiece that can be brought into contact with the superior part of the head.[2,3]
iii. A wide and stable platform or firm uncarpeted floor as the base.[3]
iv. Easily read, stable tape or digital readout in 0.1 cm (1 mm) increments.[2,3]
v. It is desirable that the stadiometer have a height range of at least 70 cm to 205 cm so that it can be used with the majority of children and adolescents.

b) Recumbent length board specifications for non ambulatory children

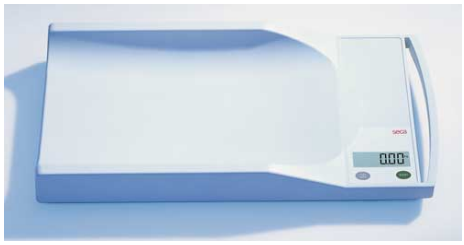
i. A firm, flat horizontal surface. [3]
ii. Measuring tape will have 0.1 cm (1 mm) increments.[2,3]
iii. Fixed tape is stable and easily read. [3]
iv. An immovable headpiece at a right angle to the tape.[2,3]
v. A moveable footpiece, perpendicular to the tape.[2,3]
vi. It is desirable that the length board have a measuring range to least 180cm so that the majority of children from 2 to 19 years of age can be measured in a recumbent position.

Note: The O'Leary Adult Recumbent Board Model REC LB-6X supplied by Ellard Instrumentation meets the specifications for clinical settings in Alberta Health Services.

Appendix B
Childhood Growth Measurement Initiative: Equipment List

General Information:

- This is a list of the equipment purchased during the Childhood Growth Measurement Initiative 2010-2013 with grant funding from the Alberta Cancer Prevention Legacy Fund. This list may support the purchase of new growth measurement equipment
- The equipment listed below may or may not be still available. Refer to ***Appendix A*** *Specifications for New Growth Measurement Equipment* and consult with your purchasing department.

Description	Image
Infant Scale	
Clinic Use: Seca 727 Electronic Baby Scale with damping system **Dimensions: 55.12 x 32cm** Capacity: 20 kg Graduation: 2 g Features: Adaptor/batteries, automatic switch off, TARE, auto-HOLD, kg/lbs, damping system 11lbs	
Portable: Seca 334 Mobile Electronic Portable Infant Scale **Dimensions: 48.26 x 25.4cm** Capacity: 20 kg / 44 lbs Graduation: 5 g < 10 kg > 10g Features: Power supply: Battery / Mains adapter optional Functions: TARE / Automatic switch-off / Auto-Hold / BMIF / kg/lbs switch-over Weight: 2.8 kg	

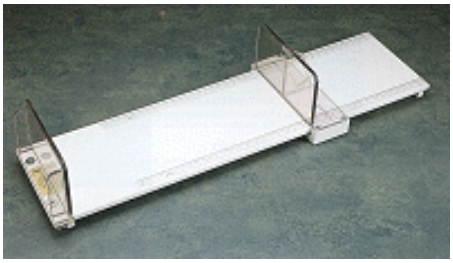
Infant Length Board

Clinic Use:

Perspective Enterprises
PE-RILB-BRG2

Dimensions: 118 x 31 x 22 cm

Measuring Range:12.5 - 99cm
Graduation: 1mm



Portable:

Seca 417 Measuring Board

Dimensions: 111 x 11.5 x 33.3 cm

Measuring range:10 - 100cm
Graduation: 1 mm

Features:
Folds for easier portability
Weight: 1.6 kg

Child/Adolescent Scale

Clinic Use:

Seca 703

Dimensions: 36.0 x 93.0 x 52.0 cm
Platform 35.0 x 8.4 x 36.0 cm

Capacity: 250 kg
Graduation: 100 g

Features:
Power supply: Battery / Mains adapter optional
Functions: Transport castors / Hold / Automatic switch-off / BMI / Auto-Hold / Mother/child-function / kg/lbs switch-over / Pre-TARE

Child/Adolescent Scale

Portable:

Seca 876

Dimensions: 32.1 x 6.0 x 35.6 mm

Capacity: 250 kg
Graduation Weight: 100 g < 150 kg > 200 g

Features:
Power supply: Power Supply Batteries
Functions: Tap-on function / Automatic switch-off / Mother/child-function
Weight: 4.2 kg

Stadiometer

Clinic Use:

Seca 222

Dimensions: 308 x 2,320 x 286 mm

Measuring range: 6 - 230 cm
Graduation: 1 mm

Portable:

Seca 213

Dimensions: 33.7 x 213.0 x 59.0 cm

Measuring range: 20 - 205 cm
Graduation: 1 mm

Features:
Weight: 2.4 kg

Appendix C
Maintenance and Calibration of Growth Measurement Equipment

General Information:

- The purpose of this appendix is to provide maintenance and calibration guidelines that can be used to ensure the accuracy and reliability of childhood growth measurement equipment.
- Regular calibration and maintenance helps ensure that growth measurement equipment produces accurate and reliable measurements when proper measurement techniques are followed. Quality equipment which is regularly calibrated and accurate is one of three components essential to achieving accurate measurements.[3]

The following guidelines should be use for maintenance and calibration of equipment:

1) Care of measurement equipment[4,5]

Refer to AHS, Infection Prevention and Control (IPC) for more detailed information and current standards.

a) Follow AHS Infection Prevention and Control (IPC) policies and protocols for hand hygiene, cleaning and disinfecting of measuring equipment (non critical multi-use medical equipment/devices) and cleaning/transporting of portable equipment.
b) Store equipment at normal indoor temperature, protected from humidity and wetness.

2) When to check calibration

Table 5: Growth Measurement Equipment Calibration Schedule

Equipment	Check Calibration	Responsible	Calibration equipment used:
Stationary equipment			
Infant scales	Upon installation and monthly thereafter	End user	Calibration weights
Length board (infantometer) and stadiometer	Upon installation and monthly thereafter	End user	Calibration rod
Wheel chair scale for non ambulatory children	Upon installation and yearly	Professional calibration	Professional calibration
Child/adolescent scale	Upon installation and yearly thereafter	Professional calibration	Professional calibration
Recumbent length board for non ambulatory children	Upon installation and monthly thereafter	End user	Calibration rod

Equipment	Check Calibration	Responsible	Calibration equipment used:
Portable equipment			
Infant scales	At least once per day if used daily Before each use, if used less frequently	End user	Calibration weights
Length board (pediatric) and stadiometers	At least once per day if used daily Before each use, if used less frequently	End user	Calibration rod
Child/adolescent scale	Upon installation and yearly thereafter	Professional calibration	Professional calibration

3) Equipment to use when checking calibration

The following equipment is used to check calibration of growth measurement equipment.

a) Calibration weight: A standard weight used to check the calibration of the stationary and portable scales.
b) Calibration rod: A rod of known and fixed length is used to check the calibration of stationary and portable equipment that measures length/height. A calibration rod is used to calibrate the stadiometer and infant length board.

4) Maintenance and calibration of an infant scale[3]

a) Check for damage. Equipment that shows evidence of damage and/or cannot be cleaned adequately must be repaired or replaced.

b) <u>Check calibration:</u>

i. Zero the scale.
ii. Gently place the calibration weight (e.g. 5 kg) in the centre of the scale. To ensure an accurate measurement reading, the weight(s) must be placed evenly over the center area of the scale.
iii. Read the measurement to the nearest gram.
iv. Repeat steps a second time. (i.e. weigh the calibration weight a total of two times).
v. The measurement reading should be exactly the same as the known weight of the calibration weight each time (e.g. a 5.00 kg calibration weight should read 5.000 kg on the scale).
vi. An acceptable tolerance range is +/- 0.01 kg over or under the weight of a known calibration weight (e.g. a scale with a 5 kg weight on it should read between 4.99- 5.01 kg).[3]
vii. Record the outcome on the 'Calibration Record' and indicate any action taken if needed.
viii. If the scale reads outside the acceptable tolerance range (e.g. 5.02 kg), calibrate the scale following the calibration guidelines for the piece of measurement equipment (calibration guidelines are available from the manufacturer for each model). If you are unable to calibrate the scale and the error is consistent, adjust measurements accordingly (e.g. off by 0.02 kg or more consistently, subtract 0.02 kg).

c) Professional calibration:

i. Professional calibration should be conducted if a piece of measurement equipment, when checked with standard weights, is found to be weighing inaccurately and the site is unable to calibrate it 'in-house' following manufacturer's directions.
ii. Professional calibration is recommended yearly (or according to manufacturer's direction if different) for infant scales that are not checked with standard weights according to the schedule outlined in ***Growth Measurement Equipment Calibration Schedule*** (Table 5).

5) Maintenance and calibration of length boards[3]

a) Check that the joints of the length board are tight and straight. If not, tighten or straighten them.
b) Check that the measuring tape can be read. If it is too worn to be read, it should be replaced.
c) Check for damage. Equipment that shows evidence of damage and/or cannot be cleaned adequately must be repaired or replaced.

d) Check calibration:

i. A rod of known and fixed length can be used to check the calibration of stationary and portable infant length boards.
ii. Place the rod directly on the base with one end firmly against the head board.
iii. Bring the footboard to rest firmly against the other end of the calibration rod.
iv. Read the measurement to the last completed millimetre.
v. The measurement reading should be exactly the same as the known height/length of the calibration rod (e.g. a 95 cm calibration rod should be measured as 95 cm with the length board).
vi. An acceptable tolerance range is 1.0 cm over or under the length or a known calibration rod (e.g. a length board being checked with a 95 cm rod should read between 94 and 96 cm).
vii. Record the outcome on the 'Calibration Record' and indicate any action taken if needed.
viii. If the length board reads outside the acceptable tolerance range (e.g. 97 cm), calibrate the length board if possible following the calibration guidelines for your piece of measurement equipment (calibration guidelines are available from the manufacturer for each model).
ix. If you are unable to calibrate and the error is consistent, adjust measurements accordingly until the length board can be calibrated or replaced (e.g. off by 2 cm adjust measurements by subtracting or adding 2 cm). It should be documented that this was done
x. If measurements are off by variable amounts, or you are unable to calibrate your piece of equipment, notify your manager and follow local procedures for professional calibration.

e) Professional calibration:

i. Professional calibration should be conducted if the infant length board is found to be measuring inaccurately and the site is unable to calibrate it 'in-house' following manufacturer's directions.
ii. Professional calibration is recommended yearly (or according to manufacturer's direction if different) for infant length boards that are not checked with standard rods according to the ***Growth Measurement Equipment Calibration Schedule*** (Table 5).

6) Maintenance and calibration of a stadiometer[3]

a) Check that the joints of the stadiometer are tight and straight. If not, tighten or straighten them.
b) Check that the measuring tape can be read. If it is too worn to be read, it should be replaced.
c) Check for damage. Equipment that shows evidence of damage and/or cannot be cleaned adequately must be repaired or replaced.

d) Check calibration:

i. Place one end of the calibration rod on the stadiometer base.
ii. Lower the stadiometer head piece to rest firmly against the top end of the calibration rod.
iii. Ensure that the rod stands perpendicular to the base.
iv. Read the measurement to the last completed millimetre.
v. Record the outcome on the 'Calibration Record' and indicate any action taken if needed.
vi. The measurement reading should be exactly the same as the known height/length of the calibration rod (e.g. an 95 cm calibration rod should be measured as 95 cm).
vii. If the measurement is not consistent with the length of the calibration rod, adjust according to manufacturer's instructions.
viii. If you are unable to calibrate and the error is consistent, adjust measurements accordingly until the stadiometer be calibrated or replaced (e.g. off by 2 cm adjust measurements by subtracting or adding 2 cm). It should be documented that this has been done.

e) Professional calibration:

i. Professional calibration should be conducted if the stadiometer is found to be measuring inaccurately and the site is unable to calibrate it 'in-house' following manufacturer's directions.
ii. Professional calibration is recommended yearly (or according to manufacturer's direction if different) for stadiometers that are not checked with standard rods according to the ***Growth Measurement Equipment Calibration*** *Schedule* (Table 5).

7) Maintenance and calibration of a child/adolescent scale

a) Check for damage. Equipment that shows evidence of damage and/or cannot be cleaned adequately must be repaired or replaced.

b) Professional calibration:

i. Professional calibration is recommended yearly (or according to manufacturer's direction if different) for child/adolescent scales.
ii. Record the outcome of calibration in the 'Calibration Record'.

Appendix D
Special Considerations for Length/Height Measurement

1. Vertical Plane[7]

If the child cannot easily place their head, scapulae, buttocks, and heels in one vertical plane, (i.e. a child above a healthy weight) a minimum of two contact points (the back of the head and buttocks, or the heels and buttocks) should be in contact with the wall or vertical surface of the measuring device with the trunk vertical and balanced over the waist. Record the points of contact.[7]

2. Measuring a Child with Leg Length Asymmetry[7]

If the child has leg length asymmetry, the child should stand on the longer leg with the shorter leg supported by a block or wedge of suitable height until the pelvis is level and both knees are fully extended. When measuring length, keep the legs together and measure to the heel of the longest leg. Record the presence of leg length asymmetry.

3. Measuring a Child Wearing a Cultural headpiece

a) Sikh children aged up to 11 years often have topknots rather than turbans. In children with topknots, the measuring arm of the stadiometer can be placed to one side of the topknot to obtain a reading.
b) If the head covering does not fit close to the head, such as a turban, choose an alternative means of measuring height, such as upper arm length.
c) Record the method used to obtain height measurement

4. Measuring height in children with physical disabilities

If measurement of standing height of a child with a disability is not possible, the following methods are recommended:

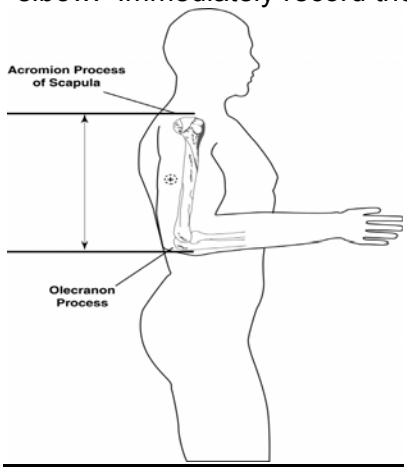
a) In children without contractures but who are non ambulatory, use full body recumbent (supine) length. The child should be positioned on an infantometer or a recumbent length board made for this purpose. A tape measure should not be used to measure length of infants or children due to poor reliability.[7] Measure to the nearest 0.1cm, **subtract 0.7cm** to convert to height and immediately record.[6]
b) If recumbent length is measured in a child with spasticity, contractures, and/or other musculoskeletal abnormalities, measure the side of the body that is unaffected or less affected and that can be extended the fullest. Record the side measured and the presence of spasticity, joint contractures, and/or other musculoskeletal abnormalities.
c) If the child has severe contractures, spasticity or scoliosis or is too heavy to be lifted from wheelchair, upper arm length may be used to track growth in height over time. Refer to ***5. Upper Arm Length (UAL)*** method below. This measurement should be taken by a trained individual to help minimize error.

5. Upper Arm Length (UAL):

a) Upper arm length can be used to estimate height in children who have significant lower leg involvement or have their knee, hip or ankle at a 90 degree angle and therefore cannot be measured in a recumbent position.
b) The child should face away from the measurer.
c) The right arm should be bent at a 90 degree angle at the elbow with the right palm facing up.
d) Mark the measurement site: Locate the end of the spine of the right scapula by following the scapula out to the arm until it makes a sharp V-turn to the front of the body. Using the cosmetic pencil, make a horizontal line on the uppermost edge of the posterior border of the spine extending from the acromion process.

Marking spine extending from acromion process
Reprinted with permission from CDC

e) Hold the zero end of the measuring tape at this mark and extend the tape down the posterior surface of the arm to the tip of the olecranon process, the bony part of the mid-elbow. Immediately record the length to the nearest 0.1 cm.[10]



Correct tape placement for UAL
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f) In order to plot the child on a growth chart, use the following equation to convert upper arm length to height: (standing ht)=(4.35 x UAL in cm)+21.8. [10]

*If other proxy measurements of height are desired (knee height, tibia length, crown to rump, etc., these should be performed by a trained clinician.

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