**Problem Statement/Need for the Product**

Portable, accurate and precise height/length measurement devices are needed to support regular UNICEF programming as well as anthropometric data collection in the field, such as the UNICEF supported Multiple Indicator Cluster Survey (MICS) Programme, the USAID supported Demographic and Health Surveys program (DHS) and the World Bank Group’s Living Standard Measurement Study (LSMS) programme. [1] Recent reviews of household survey data quality have shown that the current techniques and devices used to measure height and length of infants, children and adults may not produce accurate results.

UNICEF is therefore seeking solutions that will respond to the requirements of both use cases and are capable of producing highly accurate recorded readings.

While standardized protocols are in place, anthropometric data collection continues to be challenging due to the limitations of the equipment and the context and environment of the assessments. Several areas of improvement for the user, such as making the measurement equipment easier to transport and operate have also been identified, however, the main challenge remains being able to adequately produce, read and record correct and reliable measurements in the field.

The main reasons which lead to inaccurate measurements using traditional measuring boards have been identified as:

- Inaccurate positioning of the body against the board
- Infant and children moving during the measurement assessment
- Inaccurate readings caused by:
  - Reading the measurement from an incorrect angle
  - Difficulty seeing and reading the measuring tape which in some cases lead to rounding up or down to the nearest 5 or zero (digit preference)\(^1\)
  - Assessment performed in dim light settings
- Inability to document/estimate correct age
- Data entry error

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\(^1\) Digit preference is a departure from a uniform distribution across final digits that indicates a preference for one or more digits, such as 0 and 5, in the reporting of height and weight, over others.
It is important to note that UNICEF is not looking for a solution that only focuses on the accuracy of a device, but rather on a device’s capability to accurately record readings in the hands of trained health workers/survey staff, in the given context by eliminating all, or as many of the above mentioned reasons for error as possible. UNICEF is therefore looking for virtually foolproof device(s) that supports accurate measurements and readings by minimizing the possibilities of human error.

Programmatic Relevance for UNICEF

Monitoring the growth and development of pregnant women, infants and children is central to providing reliable estimates of anthropometric indicators such as the prevalence of stunting and wasting among children, in order to track the progress of long-term and short-term health and nutrition interventions. In addition, anthropometric indicators are used to monitor global progress toward the Sustainable Development Goals (SDGs) of ending all forms of malnutrition, eradicating poverty and improving health.

Current Products or Response Used by UNICEF:

UNICEF Supply Division currently procures and supplies a range of anthropometric equipment including three portable height/length measuring systems to support growth monitoring through various programmes and surveys.

The three systems are:

• A portable baby/child length and height measuring board, made of wood. Accuracy/Precision of the device: ± 0.2 cm. Range 0-120cm.

• A portable baby/child/adult length and height measuring board, made of wood. Accuracy/Precision of the device: ± 0.2 cm. Range 0-210cm. (2 items: main board + extension).

• A portable baby/child length/height Stadiometer, made of plastic. Accuracy/Precision of the device: ± 0.2 cm. (2 devices: one for length measurements and one for height).

More information is available in the UNICEF Supply Catalogue.

Volume & Potential Impact

Household surveys are used to collect nationally representative data on nutrition in many low and middle-income countries, meaning that the accuracy of portable measuring devices is of great significance. For example, the USAID supported Demographic and Health Surveys (DHS) Programme has collected height and weight data in 238 surveys in 77 countries since 1986 to date, and the UNICEF supported Multiple Indicator Cluster Survey (MICS) Programme has carried out 288 surveys in 108 countries, most collecting height and weight data. In addition to these, the Living Standards Measurement Study (LSMS) and many national nutrition surveys all require accurate and portable measuring equipment.

UNICEF Supply Division has supplied 124,525 height/length measurement devices for a value of 11,167,267 USD between 2012 – July 2016. Local procurement and procurement by other UN

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2 A reduced growth rate in human development; Moderate and severe - below minus two standard deviations from median height for age of reference population.

3 Moderate and severe - below minus two standard deviations from median weight for height of reference population.

4 Accuracy/Precision levels are provided by the suppliers but recent reviews of field measurements proves that such levels cannot be sustained when applied to the context of UNICEF (see use case A & B below).
organisations and NGOs are excluded from these figures which means that the total procurement volume is higher.

Use of Product in UNICEF Context

Use Case A: Household Surveys:

- **User description:** Measurers and their assistants (interviewers) can be of either sex and are normally aged 20-50 years, but younger and older field workers may sometimes be used. A minimum level of fitness is recommended, but not required. Good eyesight is also recommended.

- **Level of training/education:** Typically secondary school graduation is the minimum requirement for any position on field teams, but field workers with a higher level of education are common, and occasionally field workers may have less than a high school education due to the country context as well as to the specific tasks of the Measurer. MICS teams receives 4 weeks of training prior to the survey of which 1 week is fully dedicated to training in taking anthropometric measurements.

- **Use environment:** The Height Measurement Devices (HMDs) will travel on vehicles including motorbikes, and be carried on foot, often encountering rough terrain. They will be used typically indoors in family homes, though poor lighting and/or poor levelling or firmness of ground in such homes may require setting up outdoors. Temperatures range from extreme heat (and exposure to sunlight) to freezing, though extreme freezing is very uncommon.

- **Geographic location:** Any and all. Surveys are conducted anywhere in the populated world.

Field survey teams normally travel by car between data collection areas (known as “clusters”) but sometimes go by boat, motorbike or by public transportation. Even within a cluster, field staff may have to walk long distances between households, although in other cases households may be a few meters apart.

Field survey teams may struggle to find a suitable place to perform the measurements. The currently used device (wooden board) should be on a flat surface and, for height measurement, rest against a wall or other flat surface for support. This implies finding a 90 degree angle which may not exist in the settings where measurements are taken. Furthermore, data collection may take place at night and/or in dimly lit settings thereby making reading of measurements difficult when using the current device.

Under ideal circumstances, two trained measurers will work together to position the body, measure the child, and then record the measurement. In some cases, however, the trained measurer will need to work with an untrained person, such as the child’s parent assisting.

It can be stressful to take the measurements due to a number of factors. Children may for example be uncooperative, crying or moving. Some of the children are afraid of the measuring board and run away when they see it. Positioning the body correctly can be extremely challenging: this is particularly true of newborns, whose bodies cannot be easily straightened out, but also older children, where there is distress.

This type of fieldwork can make device maintenance challenging. The currently used boards get dirty, both due to the subjects’ feet (particularly in places where shoes may be less commonly worn) but also due to dust and dirt in the general environment. Boards may also be subject to temperature extremes, particularly if they are left in vehicles, and humidity and rain. All these factors can cause the accuracy of the measurements to decrease. As the boards are constantly being moved, they are subjected to harsh usage. Even where backpacks or cases are available, they will not be used all the time — for example, while transporting shorter distances (such as house to house) or in locales with security issues such as Afghanistan and Pakistan (where they can be mistaken for weapons). It is therefore important that new solutions used for household surveys are robust and durable enough to withstand temperature extremes and significant usage but also portable and child-friendly to increase efficiency for the interviewing teams.
Use Case B: Health Clinic:

- **User description:** Healthcare providers including physicians, nurses and health assistants, but also nutritionists, dietitians, public health specialists, child and health advocates, and researchers of either sex.
- **Level of training/education:** Measurers have a wide range of education. Many have medical or nursing degrees but there are no standard global minimum education requirements for health assistants although employers may have literacy and arithmetic proficiency requirements. Training of measurers varies greatly depending on the healthcare facility setting.
- **Use environment:** HMDs will be in use typically indoors, in public and private health facilities at every tier of the health system. These include primary, secondary and tertiary care facilities. These range from community health centres and centres with inpatient capability, to district hospitals with higher clinical capacity, and regional or national hospitals and medical centres, equipped with physicians and specialists, more beds for inpatient care and advanced technological capabilities. Regardless of the tier, access to clean water and uninterrupted electricity varies among facilities. HMDs will be transported on vehicles and carried on foot for use in the community, in both indoor and outdoor environments. Temperatures range from extreme heat (and exposure to sunlight) to freezing, though extreme freezing is very uncommon.
- **Geographic location:** Any and all.

HMDs are utilized to monitor the growth of children worldwide, regardless of ethnicity, socioeconomic status and type of feeding.

Health centre staff (e.g. doctors, nurses, health extension workers, etc.) take the measurements of the children. They may do so either in a fixed health facility but also in community settings as part of outreach or mobile clinics.

For in-clinic use, in most cases, the measurements are easier to facilitate as the equipment can be set up against a 90 degree wall and rest on a solid floor. Most of the clinics have decent lighting and access to water.

For out-reach or mobile clinics, health centre staff would need to travel, either by vehicle or by foot to a fixed location such as a smaller facility where outreach clinics are held or also possibly to an open area in a village or similar location. Challenges related to these scenarios are similar to the challenges described for field survey staff under use case A.

**Requirements**

The purpose of the TPP is to enable development and subsequent procurement of both low and high tech devices responding to the Use Case Requirements in the table below.

Desired solutions are:

1. Improvements of current type of designs (measurement boards, stadiometers, etc.) with a digital output.
2. Innovative devices using technologies such as laser, infrared, ultrasound and optics for height/length measurement.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Minimum Performance</th>
<th>Ideal Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key function(s)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td>Growth monitoring (Length and height measurement).</td>
<td>Growth monitoring (Length and height measurement).</td>
</tr>
</tbody>
</table>
**Operating Conditions**  
Stored and used in a wide ranging climate (heat, cold, humid, dry, dust, wet). Used at health clinics and for mobile field use. Often moved in and out of vehicles; carried over distance on harsh and bumpy terrain.

**Method of Use**  
a) Recumbent length of a baby up to 24 months old.  
b) Height of a child aged 24 months and up in vertical position.  
c) Height of adults in vertical position.

Measurement of height/length regardless of position and performed with a single device.

**Power requirements**  
Long lasting rechargeable battery  
Long lasting rechargeable battery including a/c plug, DC 12 volt plug (for recharge through a car battery) solar powered battery, or a combination.

**Notifications**  
Low power  
Low power, remaining time of functionality indicated.

**Calibration**  
Manual  
Automatic or not necessary

**Output**  
Digital display in cm with one decimal digit (mm). E.g. 176.3 cm.  
Supports data download from device (USB Stick), Wi-Fi and/or Bluetooth transfer.

**Ready for operational use**  
Within 3 minutes by one person  
Immediate

**Performance Requirements**

<table>
<thead>
<tr>
<th></th>
<th>Device ± 1 mm</th>
<th>Device ± 1mm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td>Readings recorded by trained surveyors within ± 3mm</td>
<td>Readings recorded by trained surveyors within ± 1 mm</td>
</tr>
<tr>
<td><strong>Precision</strong></td>
<td>± 2 mm</td>
<td>± 1 mm</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>30-210 cm.</td>
<td>30-210 cm.</td>
</tr>
<tr>
<td><strong>Time for Result</strong></td>
<td>Immediate</td>
<td>Immediate</td>
</tr>
</tbody>
</table>

**Product Requirements**

<table>
<thead>
<tr>
<th></th>
<th>Minimum 12 months</th>
<th>Minimum 24 months</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage life</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operational life (after first use)</strong></td>
<td>Minimum 3 years</td>
<td>Minimum 5 years</td>
</tr>
<tr>
<td><strong>Durability</strong></td>
<td>The device must be able to withstand the intended use during its operational life without compromising functionality or accuracy.</td>
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</tr>
<tr>
<td><strong>Physical characteristics</strong></td>
<td>The device must be child-friendly and designed to avoid distress or harm of the individual by use of factors such as soft edges and surfaces, colours and children friendly illustrations.</td>
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</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>The device must be easy to maintain both in terms of daily cleaning and small repairs. Repairs must be possible with</td>
<td>No maintenance required with the exception of light cleaning.</td>
</tr>
<tr>
<td>User Requirements</td>
<td></td>
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<td>--------------------</td>
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</tr>
<tr>
<td><strong>Portability</strong></td>
<td>The device is comfortably and easily relocated from one site to another by the use/support of handles, straps of backpacks. Max. 6 kg.</td>
<td>The device is comfortably and easily relocated from one site to another by the use/support of handles, straps of backpacks. Max. 2 kg.</td>
</tr>
<tr>
<td><strong>Assembly/setup</strong></td>
<td>Assembly and setup is managed by one person without tools</td>
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</tr>
<tr>
<td><strong>Operational by</strong></td>
<td>Subjects can be positioned, measured, and readings documented accurately by 2 persons.</td>
<td>Subjects can be positioned, measured, and readings documented accurately by 1 person.</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td>Display must facilitate quick and easy reading of results even at dim light settings or in direct sunlight</td>
<td>Outputs are recorded automatically and data transferred to preferred device. (See Data Storage Capacity under Operational/Functional Requirements). The device must include a display with same requirements as mentioned under minimum performance.</td>
</tr>
<tr>
<td><strong>Training Requirements</strong></td>
<td>3 days training that can be understood by non-technical users.</td>
<td>1 day training that can be understood by non-technical users.</td>
</tr>
<tr>
<td><strong>Supply Chain Requirements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Packaging</strong></td>
<td>High packing density. Compatible with standard pallet sizes.</td>
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</tr>
<tr>
<td><strong>Environmental Footprint</strong></td>
<td>Device including packaging must be made of environment friendly and safe materials.</td>
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</tr>
<tr>
<td><strong>Commercialization Requirements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Certificates/standards</strong></td>
<td>Should include evidence of accuracy/precision with reference to relevant international standards</td>
<td>Should include evidence of accuracy/precision and durability, with reference to relevant international standards</td>
</tr>
<tr>
<td><strong>Safety Requirements</strong></td>
<td>The device including all components and packaging must be non-hazardous and non-toxic. The device must be child-friendly e.g. no exposed sharp edges or protruding hardware, avoid moving parts close to the body and rough materials etc.</td>
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</tr>
<tr>
<td><strong>Target Unit price</strong></td>
<td>150-200 USD</td>
<td>300 USD</td>
</tr>
<tr>
<td><strong>Children’s Rights and Business Principles</strong></td>
<td>Adherence to UNICEF’s Children’s Rights and Business Principles</td>
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</tr>
</tbody>
</table>
References