SOFTWARE REQUIREMENT SPECIFICATION (SRS)

ANTHROCLOUD

Software Modernization for Cloud-based Pediatric Anthropometry

December 4, 2019

Version 2

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Change History

Version	Date	Author	Changes
0.1	July 7, 2019	Dusty Wright	Initial Document
1.0	July 31, 2019	Dusty Wright	Baseline
2.0	December 4, 2019	Dusty Wright	Document revisions: 1.5 rephrased 2.1.1 simplified 2.1.7 clarified 2.5 stated web technology alternative 3.2.3 Removed nonessential tables

1 Table of Contents

1 Introduction

This document is a Software Requirements Specification (SRS). An overview of this document can be found in the subsections below. This document lays out what the system must do. The software requirements specifications will be used to design the system.

1.1 Purpose

The purpose of this document is to specify requirements for the AnthroCloud software solution. This document adapts the outline in IEEE Standard 830-1998 Recommended Practice for Software Requirements Specifications. The intended audience for this document is both stakeholders and developers. This document establishes what AnthroCloud will do. This will decrease the overall development effort, make for accurate estimation, and provide a basis for validation and verification.

1.2 Scope

The AnthroCloud software solution is a modern cloud-based WHO Child Growth Standards compliant anthropometric calculator designed to provide a more flexible, maintainable, and portable solution to meet the changing needs of users. The scope of this project is limited to WHO Child Growth Standards, z-score calculations, percentile calculations, growth curves, and plotted scores. A WIC MIS work product with individual assessment, nutritional survey, and integration is not created here. This project does not advocate a specific reference dataset amongst NCHS, CDC, or WHO, for nutritional screening. The WHO Growth Standard is chosen for ease of verification and validation against an existing application. An application will provide inputs and a web service calculates outputs. This project will use the metric system for inputs and outputs.

The objectives of the projects are as follows:

1. Choose an application platform to improve the ability of the calculator to change to new specifications or operating environments.
2. Design software that decouples the application into components to reduce the effort necessary to change the calculator.
3. Provide a common interface to better exchange data between calculator components.
4. Build a test suite to reduce the effort necessary to verify calculator changes.

1.3 Definitions, acronyms, abbreviations

BMI	Body Mass Index	Body mass index (BMI) is a height and weight body fat measure.
CDC	Center for Disease Control and Prevention	The national public health institute in the United States.
MIS	Management Information System	A computerized information system used for decision-making in the WIC program.
MUAC	Mid Upper Arm Circumference	The circumference of the left upper arm.
SD	Standard Deviation	The variation of a set of values.
WHO	World Health Organization	A United Nations agency concerned with international public health.
WIC	Women, Infants, & Children	A federally funded nutrition program for women, infants, and children.

1.4 References

IEEE. IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications. IEEE Computer Society, 1998.

Center for Disease Control and Prevention (CDC). 2013. Use and Interpretation of the WHO and CDC Growth Charts for Children from Birth to 20 Years in the United States [PDF file]. Retrieved from https://www.cdc.gov/nccdphp/dnpao/growthcharts/pdfs/growthchart.pdf

WHO Anthro for personal computers, version 3.2.2, 2011: Software for assessing growth and development of the world's children. Geneva: WHO, 2010. Retrieved from https://www.who.int/childgrowth/software/anthro_pc_manual.pdf

1.5 Overview

The next sections of this document lay out product factors then specific requirements. Section two details a basis for requirements. A functional overview and informal requirements are described giving a context for the requirements specifications in the next section. Section three details requirements necessary to design the product. Requirements for system inputs, outputs, and functions are detailed.

2 Overall Description

This section outlines the general factors that impact the product for the stakeholders.

2.1 Product Perspective

This system will consist of three components: one application, one service, and one database. The system will reside on a Cloud platform. The application will be used to capture inputs. The service calculates inputs and generates outputs. The application will then display the results. The database is the repository for growth standards.

This project is a desktop to Cloud effort. The new product provides a modern cloud-based enterprise solution as an alternative to a self-contained desktop application.

A client browser communicates with the web application. The web application will communicate with a web service. The web service will communicate with a database. The web application will be called by a client browser. The web application validates inputs. The web service will calculate inputs. The web service will also retrieve the data necessary to draw growth charts and plot scores. The database stores WHO growth standards. All communication from the browser to the cloud platform will be performed over the Internet. The block diagram shows the major system components and interconnectivity.

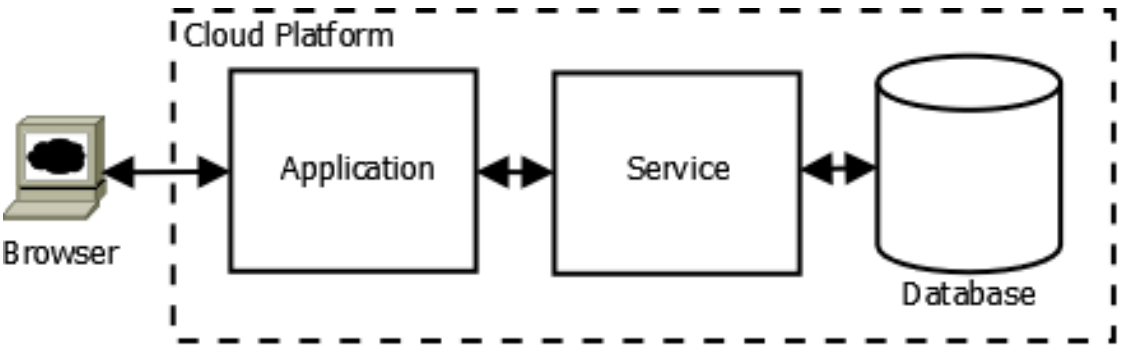

Figure 1 Block Diagram

2.1.1 System Interface

No external interface is required as no external systems, components, or hardware are interfaced.

2.1.2 User interfaces

The web application is a graphical user interface rendered to a browser. A single form should capture the following inputs: date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold. Z-score and percentiles should be output for the following anthropometric indices: weight-for-length, weight-for-age, length-for-age, BMI-for-age, HC-for-age, MUAC-for-age, TSF-for-age, and SSF-for-age. A chart is displayed for each measure. Each measure has a z-score chart and a percentile chart. A score is plotted for each chart type. Age and BMI values are calculated and displayed on the screen.

2.1.3 Hardware interfaces

The operating environment consists of a cloud-based web application, a cloud-based application service, and a cloud-based database.

2.1.4 Software interfaces

Visual Studio 2019 is the integrate development environment. An Azure Subscription is needed to target web application, application service, and database deployment. A GitHub account is necessary to access the source code repository.

2.1.5 Communications interfaces

The web service will conform to the representational state transfer (REST) style to provide interoperability between the application and service. The REST approach leverages HTTP operations such as GET, PUT, POST, DELETE, PATCH.

2.1.6 Memory

There are no physical memory constraints for this application. The designer is cautioned against retrieving the entire database to run the calculator.

2.1.7 Operations

The solution can build and deploy an image allowing a portable full-feature environment.

2.1.8 Site adaptation requirements

No site adaptations are required.

2.2 Product functions

The product measures child growth. The solution hosts a web application, web service, and WHO Child Growth Standard data. The user will enter input values to calculate measures for assessment. The results are based on input values, then calculated and displayed. Major functions performed by the software are as follows:

- The application uses WHO Child Growth Standards.
- The application calculates Age.
- The application calculates Body Mass Index (BMI).
- The application calculates Z-scores.
- The application calculates Percentiles.

- The application displays a growth chart for eight anthropometric indices.
- The application charts growth curves for z-scores and percentiles data.
- The application charts the individual patient score and percentile.
- The application and service will reside in the Cloud.
- The database instance will reside in the Cloud.

2.3 User characteristics

Child Growth Monitor	Users of a nutritional assessment and survey software consists of doctors, nutritionists, dietician, nurses, clinicians, and other clinical and medical professionals. End users of this application are most likely to be software implementors such as public health software vendors. They create the software used by clinical and medical professionals. They expect the software to work just like any Anthropometric calculator module. The software consumer uses the software to derive nutritional status for a child based on WHO standards.

2.4 Constraints

Application, service, and database performance on a cloud platform is tied directly to server resources allocated to the student account.

To display all eight anthropometric indices, the chart data is either loaded on-demand or loaded in a single event.

2.5 Assumptions and dependencies

It is assumed that the latest release of Microsoft's cross platform framework will be available. .NET Core 3.0 General Availability is Monday, September 2, 2019. ASP.NET Core Blazor becomes available with .NET Core 3.0. The AnthroCloud project will target Blazor as a first option for a client-side Web User Interface framework. This impacts the options available to the web application project type. Alternate ASP.NET web technologies may be considered.

2.6 Apportioning of requirements

No future versions of this software are planned.

3 Specific Requirements

This section contains specifications written for designers and developers.

3.1 External interface requirements

No external interface is required as no external systems, components, or hardware are interfaced. No files are imported or exported.

3.1.1 User interfaces

UI-1: The solution shall allow data entry for the following inputs: date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

3.1.1.1 Input elements

The following anthropometric measurements have range restrictions. The maximum precision for measurement data entered is 2 decimals.

Table 1 Input Restrictions

Name	Type	Units	Precision	Range
Weight	Decimal	kg	0.00	0.9 – 58.0
Length/height	Decimal	cm	0.00	45.0 – 120.0
Head circumference	Decimal	cm	0.00	25.0 – 64.0
Arm circumference	Decimal	cm	0.00	6.0 – 35.0
Triceps skinfold	Decimal	mm	0.00	1.8 – 40.0
Subscapular skinfold	Decimal	mm	0.00	1.8 – 40.0

UII-1: The solution shall follow the input restrictions specified in Table 1.

3.1.1.2 Chart Elements

This section describes requirements for charts. The common elements repeated in WHO Child Growth Standard charts are expected. Each standard indicator and associated charts can be viewed from the World Health Organization website, https://www.who.int/childgrowth/standards/en/.

UIG-1: The chart shall have a title indicating the anthropometric index.

UIG-2: The chart growth standard used shall be displayed.

UIG-3: The chart shall display a title and unit of measure, if applicable, on the x-axis.

UIG-4: The chart shall display a title and unit of measure, if applicable, on the y-axis.

UIG-5: The chart shall adhere to color coded curve lines.

UIG-6: The chart curve will be labeled with the standard deviation or percentile.

UIG-7: The plotted score shall be a symbol marker (like an open circle).

3.1.1.3 Color Coding

The on-screen calculated z-scores and percentiles including growth curves convey levels of severity visually via background color and foreground color respectively.

Table 2 Color Coding (WHO, 2011)

Color	Applied to	Z-scores	Percentiles
Green	numeric range	-1 SD ≤ z ≤ +1 SD	
	chart line	Median	50th percentile
Gold	numeric range	-2 SD ≤ z ≤ -1 SD; or +1 < z ≤ +2 SD	
	chart line	-1 SD and +1 SD	15th and 85th percentiles
Red	numeric range	-3 ≤ z < -2 SD; or +2 < z ≤ +3 SD	
	chart line	-2 SD and +2 SD	3rd and 97th percentiles
Black	numeric range	z < -3 SD; z > +3 SD	
	chart line	-3 SD and +3 SD	NA*

UIC-1: The solution shall follow the color coding specified in Table 2.

3.1.1.4 Ouput Elements

Z-score and percentiles should be output for the following anthropometric indices: weight-for-length, weight-for-age, length-for-age, BMI-for-age, HC-for-age, MUAC-for-age, TSF-for-age, and SSF-for-age. A chart is displayed for each measure. Each measure has a z-score chart and a percentile chart. A score is plotted score for each chart type. Age and BMI values are calculated and displayed on the screen.

UIO-1: The application shall display z-score results on the entry screen for all anthropometric indices.

UIO-2: The application shall display percentile results on the entry screen for all anthropometric indices.

UIO-3: The application shall display Age and BMI values on the entry screen.

UIO-4: The application shall display a chart for all anthropometric indices.

3.1.2 Hardware interfaces

HI-1: The solution shall use the Azure cloud platform.

HI-2: The solution shall use an Azure App Service.

HI-3: The solution shall use an Azure database.

3.1.3 Software interfaces

SI-1: The solution shall use a Visual Studio integrated development environment.

SI-2: The solution shall use an Azure subscription.

SI-3: The solution shall use a GitHub repository.

3.1.4 Communications interfaces

CI-1: The service shall use a RESTful API for HTTP requests.

3.2 System features

The following feature requirements are summarized here and detailed in the following sections:

SF-1: The application service shall calculate Age.

SF-2: The application service shall calculate Body Mass Index (BMI).

SF-3: The application service shall calculate Z-scores.

SF-4: The application service shall calculate Percentiles.

SF-5: The application shall display a growth chart for eight anthropometric indices.

SF-6: The application shall chart growth curves for z-scores and percentiles data.

SF-7: The application shall chart the individual patient score and percentile.

SF-8: The database shall store WHO Child Growth Standard data.

3.2.1 Calculation Anthro Measures

The service calculates measures, scores, percentiles, and retrieves growth data.

3.2.1.1 Calculate Patient BMI

The application calculates the patient's Body Mass Index (BMI).

3.2.1.1.1 Input

BMI is calculated using weight and stature. The patient must be measured either recumbent (flat) or standing. The weight must be entered. The length must be entered. Length is the term used under 24 months and height is used over 2 years. The label is displayed as Length/Height.

3.2.1.1.2 Formula

Formula: weight (kg) / height $(m)^2$

BMI = Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000 (CDC, 2013)

BMI = 9.00kg ÷ 73.00cm ÷ 73.00cm x 10,000 = 16.88872208669544 = 16.9

3.2.1.1.3 Output

The calculated BMI should be displayed as follows:

BMI: 16.9

NOTE: In WHO Anthro, 0.7 cm is added to length for BMI calculation if a child younger than 2 years has been measured standing. Per standard procedure children under 2 years are to be measured in a recumbent position.

3.2.1.2 Calculate Patient Age

The application calculates Age.

3.2.1.2.1 Input

The date of birth must be entered. The date of visit must be entered.

3.2.1.2.2 Formula

Two age calculations are made. One for internal calculation and another for human readable display, 2yr 6mo (30mo).

Age in days is used for internal calculation of nutritional status indicators. Days are the standard unit of measure used in age-based indicator tables of the WHO Child Growth Standard. Age in days is Date of Visit minus Date of Birth.

> In order to account for leap years, age in completed months is calculated on the principal that one year has 365.25 days and thus one month (365.25 divided by 12 [months]) is equal to 30.4375 days. Therefore [,] a child born 11 November 2004 and measured 11 November 2005 appears as having an age of 11 completed months (365 divided by 30.4375 equals 11.99) (WHO, 2010).

Year and months are derived from the result of subtraction of Date of Visit from Date of Birth. This is used for the on-screen display of age, defined in 3.2.1.2.3 Output below.

Table 3 Age (CDC, 2013)

	Year	Month	Day
Date of Measurement	1998	4	4
Convert one month to days	1998	(4 - 1) 3	(30 + 4) 34
Convert one year to months	(1998 - 1) **1997**	(3 + 12) **15**	 **34**
Birth Date	1994	9	15
Child's Age	3	6	19

Table 3 shows hand calculation to derive year, month, and day.

Some age calculator libraries can more accurately calculate age in year, month, and day format using the difference between date of birth and date of visit. When calculated the age of a child where leap year has not yet occurred, 365.25 is not an ideal consideration.

3.2.1.2.3 Output

The calculated Age should be displayed with the year, months, and total completed months in parenthesis as follows:

Age: 2yr 6mo (30mo)

3.2.1.3 Calculate Patient Z-scores

Z-scores are standard deviation (SD) scores that represent child nutritional status above or below the mean. The score is measured against other children of the same age. Weight at 1.93 SD (z-score) or 97.3 percentile, could be indicative of increased food demands contributing to weight gain. Z-score is calculated for the following anthropometric indices: Weight-for-length, Weight-for-age, Length-for-age, BMI-for-age, HC-for-age, MUAC-for-age, TST-for-age, and SSF-for-age.

3.2.1.3.1 Input

Enter the following data in the calculator to generate the expected results in the Output section below:

date of visit: 7/11/2019
sex: Female
date of birth: 7/11/2018
weight: 9.00 kg
length/height: 73 cm
measure type: Recumbent
oedema type: No
head circumference: 45.00 cm
MUAC: 15 cm
triceps skinfold: 8.00 mm
subscapular skinfold: 7.00 mm

3.2.1.3.2 Formula

This formula describes the adjustment made outside normal z-score calculation necessary for a third-party library supporting statistics. An adjustment is made using the following formula for z-scores that are above 3 or below -3. The new formula for computation per WHO guidelines is as follows:

$$Z_{ind} = \frac{\left[{}^{y}/_{M(t)}\right]^{L(t)} - 1}{S(t)L(t)} = \frac{y - M(t)}{StDev(t)}$$

3.2.1.3.3 Output

The following Z-scores are calculated for each anthropometric index based on Inputs above:

Weight-for-length:	0.29
Weight-for-age:	0.05
Length-for-age:	-0.39
BMI-for-age:	0.36
HC-for-age:	0.08
MUAC-for-age:	0.65
TST-for-age:	0.00
SSF-for-age:	0.38

3.2.1.4 Calculate Patient Percentiles

Percentile is the value in the distribution that holds a specified percentage of the population below it. The score is measured against other children of the same age. Weight at 1.93 SD (z-score) or 97.3 percentile, could be indicative of increased food demands contributing to weight gain. Percentile is calculated for the following anthropometric indices: Weight-for-length, Weight-for-age, Length-for-age, BMI-for-age, HC-for-age, MUAC-for-age, TST-for-age, and SSF-for-age.

3.2.1.4.1 Input

The following percentiles are calculated for each anthropometric index based on Inputs above:

date of visit:	7/11/2019
sex:	Female
date of birth:	7/11/2018
weight:	9.00 kg
length/height:	73 cm
measure type:	Recumbent
oedema type:	No
head circumference:	45.00 cm
MUAC:	15 cm
triceps skinfold:	8.00 mm
subscapular skinfold:	7.00 mm

3.2.1.4.2 Formula

This formula describes the adjustment made outside normal percentile calculation necessary for a third-party library supporting statistics. An adjustment is made using the following formula for percentiles that are above 99.865th or below .0135th. The new formula for computation per WHO guidelines is as follows:

$$C_{100a}(t) = M(t)[1 + L(t)S(t)Z_a]^{1/L(t)} = M(t)[1 + S(t)Z_a] = M(t) + StDev(t)Z_a, \quad -3 \le Z_a \le 3$$

3.2.1.4.3 Output

The following percentiles are calculated for each anthropometric index based on Inputs above:

Weight-for-length:	61.4
Weight-for-age:	51.9
Length-for-age:	34.8
BMI-for-age:	64.1
HC-for-age:	53.1
MUAC-for-age:	74.3
TST-for-age:	49.9
SSF-for-age:	65.0

3.2.2 Chart Anthro Indices

The application displays a growth chart for eight anthropometric indices. Each chart has a z-score view and a percentile view of the same data. Each chart displays both views. Each chart displays growth curves based on standard data. The plotted point represents the individually calculated patient score for the measure.

3.2.2.1 Display Weight-for-length Chart

The weight-for-length chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.1.1 Purpose

Weight-for-length shows body weight in proportion to growth in length.

3.2.2.1.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the Weight-for-length chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User enters data for date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on Weight-for-length chart icon.

2. System draws Z-score chart (Z-score is the default view) with 7 growth curves including +3SD, +2SD, +1SD, Median, -1SD, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views Weight-for-Length z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97th, 85th, 50th, 15th, and 3rd.

7. System plots patient's percentile on chart.

8. User views Weight-for-Length z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.2.2 Display Weight-for-age Chart

The weight-for-age chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.2.1 Purpose

Weight-for-age shows body weight relative to age on a specific day.

3.2.2.2.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the Weight-for-age chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User enters data for date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on Weight-for-age chart icon.

2. System draws Z-score chart (Z-score is the default view) with 5 growth curves including +3SD, +2SD, Median, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views Weight-for-age z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97^{th}, 85^{th}, 50^{th}, 15^{th}, and 3^{rd}.

7. System plots patient's percentile on chart.

8. User views Weight-for-age z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.2.3 Display Length-for-age Chart

The Length-for-age chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.3.1 Purpose

Length-for-age shows body height relative to age on a specific day.

3.2.2.3.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the Length-for-age chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User enters data for date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on Length-for-age chart icon.

2. System draws Z-score chart (Z-score is the default view) with 5 growth curves including +3SD, +2SD, Median, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views Length-for-age z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97^{th}, 85^{th}, 50^{th}, 15^{th}, and 3^{rd}.

7. System plots patient's percentile on chart.

8. User views Length-for-age z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.2.4 Display BMI-for-age Chart

The BMI-for-age chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.4.1 Purpose

BMI-for-age shows weight proportional to height for the same age.

3.2.2.4.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the BMI-for-age chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User provides date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on BMI-for-age chart icon.

2. System draws Z-score chart (Z-score is the default view) with 7 growth curves including +3SD, +2SD, +1SD, Median, -1SD, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views BMI-for-age z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97th, 85th, 50th, 15th, and 3rd.

7. System plots patient's percentile on chart.

8. User views BMI-for-age z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.2.5 Display HC-for-age Chart

The HC-for-age chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.5.1 Purpose

HC-for-age shows head circumference relative to age on a specific day.

3.2.2.5.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the HC-for-age chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User enters data for date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on HC-for-age chart icon.

2. System draws Z-score chart (Z-score is the default view) with 7 growth curves including +3SD, +2SD, +1SD, Median, -1SD, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views HC-for-age z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97^{th}, 85^{th}, 50^{th}, 15^{th}, and 3^{rd}.

7. System plots patient's percentile on chart.

8. User views HC-for-age z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.2.6 Display MUAC-for-age Chart

The MUAC -for-age chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.6.1 Purpose

MUAC-for-age shows arm circumference relative to age on a specific day. MUAC is considered a good predictor of mortality.

3.2.2.6.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the MUAC-for-age chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User enters data for date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on MUAC-for-age chart icon.

2. System draws Z-score chart (Z-score is the default view) with 7 growth curves including +3SD, +2SD, +1SD, Median, -1SD, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views MUAC -for-age z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97th, 85th, 50th, 15th, and 3rd.

7. System plots patient's percentile on chart.

8. User views MUAC-for-age z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.2.7 Display TSF-for-age Chart

The TSF-for-age chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.7.1 Purpose

TSF-for-age shows triceps skinfold thickness relative to age on a specific day. TSF estimates stored body fat.

3.2.2.7.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the TSF-for-age chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User enters data for date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on TSF-for-age chart icon.

2. System draws Z-score chart (Z-score is the default view) with 7 growth curves including +3SD, +2SD, +1SD, Median, -1SD, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views TSF-for-age z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97th, 85th, 50th, 15th, and 3rd.

7. System plots patient's percentile on chart.

8. User views TSF-for-age z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.2.8 Display SSF-for-age Chart

The SSF-for-age chart displays both z-score and percentile growth curves and a plotted score.

3.2.2.8.1 Purpose

SSF-for-age shows scapula skinfold thickness relative to age on a specific day. SSF estimates stored body fat.

3.2.2.8.2 Sequence

Actor(s): Child growth monitor

Trigger: Clicking the SSF-for-age chart icon. [An option is to display the chart on the form]

Precondition(s):

1. User enters data for date of visit, sex, date of birth, weight, height, measure type, oedema type, head circumference, MUAC, triceps skinfold, and subscapular skinfold.

Procedure:

1. User clicks on SSF-for-age chart icon.

2. System draws Z-score chart (Z-score is the default view) with 7 growth curves including +3SD, +2SD, +1SD, Median, -1SD, -2SD, -3SD.

3. System plots patient's z-score on chart.

4. User views SSF-for-age z-score chart.

5. Select view type drop-down to select Percentile view.

6. System draws Percentile chart with 5 growth curves including 97th, 85th, 50th, 15th, and 3rd.

7. System plots patient's percentile on chart.

8. User views SSF-for-age z-score chart.

9. User exits display chart.

Post condition(s):

1. Chart was viewed and exited.

Exception(s):

Cannot connect to database.

Unable to display chart.

3.2.3 Child Data Tables

This section describes WHO Child Growth Standard data tables necessary for drawing growth curves in a chart for display. Each standard indicator and associated data table can be downloaded from the World Health Organization website, https://www.who.int/childgrowth/standards/en/.

DAT-1: A database script will be created to load data tables.

3.2.3.1 Length/height-for-age

Girls z-scores Length-for-age: Birth to 2 years

Girls z-scores Height-for-age: 2 to 5 years

Boys z-scores Length-for-age: Birth to 2 years

Boys z-scores Height-for-age: 2 to 5 years

Girls percentiles Length-for-age: Birth to 2 years

Girls percentiles Height-for-age: 2 to 5 years

Boys percentiles Length-for-age: Birth to 2 years

Boys percentiles Height-for-age: 2 to 5 years

3.2.3.2 Weight-for-age

Girls z-scores Weight-for-age: Birth to 5 years

Boys z-scores Weight-for-age: Birth to 5 years

Girls percentiles Weight-for-age: Birth to 5 years

Boys percentiles Weight-for-age: Birth to 5 years

3.2.3.3 Weight-for-length/height

Girls z-scores Weight-for-length: Birth to 2 years

Girls z-scores Weight-for-height: 2 to 5 years

Boys z-scores Weight-for-length: Birth to 2 years

Boys z-scores Weight-for-height: 2 to 5 years

Girls percentiles Weight-for-length: Birth to 2 years

Girls percentiles Weight-for-height: 2 to 5 years

Boys percentiles Weight-for-length: Birth to 2 years

Boys percentiles Weight-for-height: 2 to 5 years

3.2.3.4 BMI-for-age

Girls z-scores BMI-for-age: Birth to 2 years

Girls z-scores BMI-for-age: 2 to 5 years

Boys z-scores BMI-for-age: Birth to 2 years

Boys z-scores BMI-for-age: 2 to 5 years

Girls percentiles BMI-for-age: Birth to 2 years

Girls percentiles BMI-for-age: 2 to 5 years

Boys percentiles BMI-for-age: Birth to 2 years

Boys percentiles BMI-for-age: 2 to 5 years

3.2.3.5 Head circumference-for-age

Girls z-scores Head circumference-for-age: Birth to 5 years

Boys z-scores Head circumference-for-age: Birth to 5 years

Girls percentiles Head circumference-for-age: Birth to 5 years

Boys percentiles Head circumference-for-age: Birth to 5 years

3.2.3.6 Arm circumference-for-age

Girls z-scores Arm circumference-for-age: 3 months to 5 years

Boys z-scores Arm circumference-for-age: 3 months to 5 years

Girls percentiles Arm circumference-for-age: 3 months to 5 years

Boys percentiles Arm circumference-for-age: 3 months to 5 years

3.2.3.7 Subscapular skinfold-for-age

Girls z-scores Subscapular circumference-for-age: 3 months to 5 years

Boys z-scores Subscapular circumference-for-age: 3 months to 5 years

Girls percentiles Subscapular circumference-for-age: 3 months to 5 years

Boys percentiles Subscapular circumference-for-age: 3 months to 5 years

3.2.3.8 Triceps skinfold-for-age

Girls z-scores Triceps circumference-for-age: 3 months to 5 years

Boys z-scores Triceps circumference-for-age: 3 months to 5 years

Girls percentiles Triceps circumference-for-age: 3 months to 5 years

Boys percentiles Triceps circumference-for-age: 3 months to 5 years

3.3 Performance requirements

Postman can issue a request and response to a test a RESTful web service.

PER-1: The service shall not exceed 5 seconds for the longest running call.

3.4 Design constraints

DC-1: All HTML code shall conform to HTML 5.0 standard.

3.5 Software system attributes

3.5.1 Maintainability

A maintainable solution is not tightly coupled. Its components can be changed and used again. The components can be tested and measured.

MNT-1: The solution shall use an application, service, and database.

MNT-2: The solution shall be architected using layers.

3.5.2 Portability

A flexible solution can change, move, and adapt outside of current requirements. Application developed on the .NET Core open source framework can target Windows, Linux, and macOS, including devices and the cloud. A portable solution can change environments or even be replaced. A container image packages up software along with dependencies so it can run across computing environments.

PRT-1: The solution shall use the .NET Core framework.

PRT-2: The solution shall contain a Dockerfile.