RCPCH Digital Growth Charts

Complete Documentation Manual

The Royal College of Paediatrics and Child Health

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1. About

1.1 The RCPCH Growth Charts Project

1.1.1 From MVP to global product 🌍

The RCPCH dGC project team was originally commissioned by the NHS in early 2020 to produce a Minimum Viable Product (MVP) to generate reliable results for growth data from children aged 1 year and below. The project team began work in May 2020. In development, the project developers found it was feasible and practical to extend the scope of the MVP to include children of **all** ages.

Since those early days, our platform has developed into the world's only Digital Growth Charts API, and we now provide digital growth charting functions for a wide range of customers across the world.

1.1.2 Open Source ⊚

For transparency, accuracy, and maximum reuse, our Growth Charts API and associated libraries are 100% open source. We welcome code reviews, feedback, issues and pull requests. **Check us out on GitHub** - we're the first Royal College to have clinical code in its own GitHub organisation!

1.1.3 Gold Standard 🧈

Working with the UK's top experts in growth monitoring, growth charts, centile and SDS calculation, and child development, we've created an API that takes away the heavy lifting of calculating child growth parameters. You get instant reliable and safe results.

The API allows the returned structured data to be displayed in a number of different ways, depending on the clinician's needs. It also allows for the data to be saved, charted, and trended within the EPR.

1.1.4 Implementation toolkits 🧰

To help you implement the API, our team has built reference implementations and reusable UI components to help take the pain out of displaying an RCPCH standards-compliant Growth Chart, as well as simplifying and standardising the integration process. These tools are all **open source** and **permissively licensed** to allow code reuse in your application without affecting the Intellectual Property rights of your developed solution. For more information on licensing see **Licensing and Copyright**.

1.1.5 Videos 🎥

We now have a series of videos explaining the Digital Growth Charts, these are now on their own page at **Videos**.

1.1.6 Current Scope 🔭

Currently, the specification is to provide reliable growth calculations for children in the UK for height centile, weight centile, body mass index (BMI) centile and head circumference ('*OccipitoFrontal Circumference*' or OFC) centile.

To this base specification, we added bone age, midparental heights, and specialist charts for Turner and Down syndrome.

API Features

In addition to calculating SDS, centiles and corrected decimal ages against a child's birth date, sex and gestation, the API also offers the following features to users:

- fictional growth data on an individual child: this can be used to test and demonstrate the API.
- the raw data required for constructing the centile lines in a growth chart. This is offered either in the standard 9 centile format, or can generate custom centiles if requested.
- mid-parental height calculation.

These features are offered for all 5 growth references - UK-WHO (preterm and child references), Down syndrome (UK and US versions), Turner syndrome and WHO 2006/7.

Chart Features

Alongside the API, RCPCH offer a charting component built to receive the results from the API. It has been built to meet the exact standards of the RCPCH Growth Chart committee and includes:

- corrected and chronological age plotting
- mid-parental height
- bone age
- event tracking
- tool tips for contextual information customisable based on user type
- zoom in/out
- life-course view
- cut/paste
- choices of RCPCH-designed themes
- customisable styling

Supported References

- UK-WHO
- Down Syndrome (UK)
- Down Syndrome (USA) - American Academy of Pediatrics *added 2024* - **under testing**
- Turner Syndrome
- CDC (USA) - *added 2024* - **under testing**
- WHO - *added 2024* - **under testing**

1.1.7 Future Scope

We have plans to incorporate other growth references and tools to the platform in the future.

> ⓘ **Get involved in setting our roadmap**
>
> You can create GitHub Issues which can help set the agenda for the features we will develop next in the API. **See our Issues on GitHub**
>
> You can also join our online forum community to learn more about Growth Charts and discuss the future of the API. **Join our community** .

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1.2 Digital Growth Charts Team Members

1.2.1 Project Board

The project board is responsible for the clinical, academic, and governance oversight of the project. During the development of the dGC products, regular Project Board meetings enabled the Project Board to maintain an overview of progress, to comment on the development work, and to feed back about the clinical usability of the system.

- **Prof Helen Bedford**, Professor of Children's Health, Population, Policy & Practice Department, UCL GOS Institute of Child Health, London.
- **Dr Simon Chapman**, Consultant Paediatrician (Diabetes & Endocrinology), King's College Hospital, London.
- **Prof Tim Cole**, Professor of Medical Statistics, Population, Policy & Practice Department, UCL GOS Institute of Child Health, London.
- **Prof Mary Fewtrell**, Professor of Paediatric Nutrition, Population, Policy & Practice Department, UCL GOS Institute of Child Health, London.
- **Victoria Jackson**, Project Coordinator, Institute of Health Visiting.
- **Dr Liz Marder**, Consultant Paediatrician in Community Child Health and Neurodisability, Nottingham Children's Hospital.
- **Prof Charlotte Wright**, Professor of Community Child Health (Medicine), University of Glasgow.

1.2.2 RCPCH Staff

RCPCH internal project staff provided invaluable support from project concept, through initiation and planning, and all the way to pilots and full live deployment. Critical project functions provided by the RCPCH team included project management, commercial modelling and planning, financial governance, design and branding review, web publishing and arranging and chairing meetings.

- **Jo Ball**, Design and Brand Manager, Content and Brand Team, RCPCH.
- **Michael Barton**, Lead Software Developer, RCPCH
- **Richard Burley**, Chief Digital Officer, RCPCH.
- **Alex Brown**, Head of Commercial and Corporate Partnerships, RCPCH.
- **Susan Hansford**, Digital Product Manager, RCPCH.
- **Joanne Hatton**, Enterprise Systems Manager, RCPCH.
- **Jonathan Miall**, Director of Membership and Development, (now ret'd from RCPCH).
- **Rachel McKeown**, Policy Lead & Project Manager, RCPCH (now left RCPCH).
- **Kirsten Olson**, Website Content Manager, Content and Brand Team, RCPCH.
- **Vicki Osmond**, Health Policy Assistant, RCPCH.
- **Andrew Palmer**, Head of Information Systems, RCPCH (now left RCPCH).
- **Adele Picken**, Data Protection Officer, RCPCH
- **Olly Rice**, Infrastructure and Operations Manager, RCPCH.
- **Magdalena Umerska**, Digital Product Manager, RCPCH (now left RCPCH).

1.2.3 Development Team

The development team was drawn from RCPCH internal staff, RCPCH members with software development skills, and external specialists. As a multidisciplinary development team, the various duties of software development, quality assurance, testing, deployment, and maintenance were apportioned amongst the team according to experience and skill-set.

- **Michael Barton**, Lead Software Developer, Royal College of Paediatrics and Child Health
- **Dr Marcus Baw**, General Hacktitioner, Developer and Informatician, Yorkshire and The Internet.
- **Dr Anchit Chandran**, Doctor and Software Developer, London.
- **Dr Simon Chapman**, Consultant Paediatric (Diabetes & Endocrinology), King's College Hospital, London.
- **Prof Tim Cole**, Professor of Medical Statistics, Population, Policy & Practice Department, UCL GOS Institute of Child Health, London.
- **Danny Cowen**, Medical Student, Imperial College London.
- **Dr Charles van Lennep**, Paediatrician in Training, London.

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1.3 Acknowledgements

1.3.1 Clinical Acknowledgements

- Prof Tim Cole and the **RCPCH Digital Growth Charts Project Board** for their invaluable specialist advice and guidance during the process of transforming paper growth charts into digital.

1.3.2 Additional Contributors

- Dr Dan Leach for advice on MHRA Medical Device Registration.
- Dr Charles van Lennep for many contributions to React code and building the React Native client.
- Dr Anchit Chandran for proofreading, corrections, and contributions to the documentation.
- 'William' Nai-Wei Wang for proofreading, corrections, and contributions to the documentation.

Significant implementations and contributions have been made by our users. They are all acknowledged on Github, but include:

- Cambric (Scotland)
- Digital Health and Care Wales
- Isle of Wight NHS Foundation Trust
- SigmaMD (USA)

1.3.3 Technical Acknowledgements

- **DigitalOcean** (ancillary cloud services)
- **Discourse** (forum platform for openhealthhub.org)
- **FastAPI** (used for the current version of the API server)
- **Flask** (used for the first draft of the API server)
- **Flutter** (used for mobile)
- **GitHub** (code hosting, issues, actions, projects)
- **Gravitee.io** (open source API management platform)
- **Heroku** (used in early alpha stages for quick hosting)
- **Material for MkDocs** and **MkDocs** itself (documentation sites)
- **Microsoft Azure** (main cloud platform)
- **openhealthhub.org** (free forum hosting, used for support before https://forum.rcpch.tech)
- **Python** and the Python Software Foundation (main language used for the RCPCH dGC project)
- **ReactJS** (frontend JavaScript framework for Chart component and demo app)

> ✅ **Additions**
>
> Have we missed someone? Let us know by **editing this page in your own fork and making a PR**!

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1.4 Who's Using the Digital Growth Charts

Since the inception of the RCPCH Digital Growth Charts we have worked with NHS and non-NHS organisations, software suppliers, and clinical teams to implement the Digital Growth Charts in their systems. Below is a list of some of the organisations and software suppliers that are currently using the Digital Growth Charts.

We built our system to work well for any size or shape of EPR or organisation, with convenient integration options, pricing to match all requirements, and comprehensive support.

NHS Organisations

NHS Organisation Name	System / EPR in use
Digital Health and Care Wales	Welsh Clinical Portal (WCP)
Hampshire and Isle of Wight Healthcare NHS Foundation Trust	RiO (Access Group)
IOW and Portsmouth Hospital	Minestrone
Kent Community Health NHS Foundation Trust	RiO (Access Group)
NHS Fife	Morse (Cambric)
NHS Forth Valley	Morse (Cambric)
NHS Lanarkshire	Morse (Cambric)
NHS Tayside	Morse (Cambric)
Northumbria Healthcare	In-house clinical portal
Royal Cornwall Hospitals NHS Trust	Cerner
Salford Royal/Northern Care Alliance NHS Foundation Trust	Altera Sunrise

Research Organisations

Organisation Name	Description
University of Nottingham	Developing and validating an explainable digital mortality prediction tool for extremely preterm infants. T'ng Chang Kwok, Chao Chen, Jayaprakash Veeravalli, Carol AC Coupland, Edmund Juszczak, Jonathan Garibaldi, Kirsten Mitchell, Kate L Francis, Christopher J D McKinlay, Brett J Manley, Don Sharkey medRxiv 2025.07.09.25331175 doi: **https://doi.org/10.1101/2025.07.09.25331175**

Other Organisations

Organisation Name	System / EPR in use
ADHD 360	In-house system
Cinnamon Digital	Independent EPR

Software Suppliers

Supplier name	Product Name	Region
Cambric	Morse	UK (Scotland)
Halaxy	Halaxy	Australia
SigmaMD	SigmaMD	USA
TPP (The Phoenix Partnership)	SystmOne	UK

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1.5 Awards, Press, Blogs, and other Mentions of the digital Growth Charts Project

1.5.1 2020 Health Tech Awards

WINNER: "Best Health Tech Solution" Category

Beginning the project at the pinnacle of the 2020 global coronavirus pandemic, we remotely collaborated to build the Digital Growth Charts project. We went on to win the 2020 Health Tech Award category for Best Health Tech Solution – against a strong field of established health tech companies and NHS trusts. It was heartening to see infrastructural projects like ours being recognised as the building blocks of incredible future clinical interfaces.

Winner Best Health Tech Solution HTN Health Teach Awards 2020

Winner Best Solution for Clinicians HTN Health Teach Awards 2024

1.5.2 Blogs

"Royal Colleges 3.0" - Best Practice As Code Marcus Baw's discussion of what it means for Royal Colleges to be developing in-house open-source software, and how this might be the future of how Royal Colleges interact with the wider clinical world – distributing "Best Practice As Code".

August 2020 - RCPCH announces forthcoming digital growth charts for parents and families

November 2020 - Digital child growth assessment – from print to digital

January 2021 - Why we chose Python for the RCPCH Digital Growth Charts project

1.5.3 Academic Press

Wright CM, Chapman S, Cole TJ. How can we best chart children's growth in the paperless age? The UK experience. Arch Dis Child. 2024 Jan 22;109(2):78-82. **doi: 10.1136/archdischild-2023-325363. PMID: 37463736.**

1.5.4 Background reading

Digital Growth pages on RCPCH website

Marcus Baw's series of Open Health Hub background articles explaining the problem of Growth Charts and why previous solutions just didn't cut the mustard

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1.6 Videos

Over the years we have been designing and running the Digital Growth CHarts we have presented them to online audiences numerous times, including at conferences, webinars, and other events. Below is a selection of videos that we have recorded, which explain the Digital Growth Charts and how to use them.

1.6.1 2025

Originally recorded for our application for the Memcom Awards 'Best Use of Technology' 2025. This video is a screencast recorded by team member Dr Marcus Baw demonstrating the features of the dGC.

1.6.2 2020

Recorded in 2020, this video is a 35 minute overview of the RCPCH Digital Growth Charts project, including the background to the project, the challenges it solves, and how it works. It was recorded by dGC team members Dr Marcus Baw and Dr Simon Chapman. **Understanding the RCPCH Digital Growth Charts Project - 35 minute YouTube video**

1.6.3 2020

Originally recorded for the HTN Now event in November 2020.

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2. Products

2.1 Get Digital Growth Charts

2.1.1 Are paper growth charts holding up digital transformation?

We know from talking to experienced child health clinicians that they absolutely **must have** growth charts in any new digital solution. The lack of good quality and richly functional digital growth charts on the EPR/EHR market has held back digital transformation in many care settings. Some care-giving organisations have been forced to either hold up plans for digitisation, or use a parallel paper chart workflow.

> ✅ **RCPCH Digital Growth Charts are a safe and cost-effective solution**
>
> Our solution is a UKCA/CE-marked Registered Medical Device, with a full DCB0129 clinical safety file, and is already in use in numerous NHS organisations across the UK, and within third-party EPR systems.

2.1.2 Trusted, familiar-looking Digital Growth Charts

- Produced and warranted by the RCPCH itself – the international authority on child health.
- Designed to be familiar to clinicians used to paper growth charts.
- Richly functional, adding features like automatic gestational age correction, bone age, mid-parental height, event recording, and specialist references for Turner and Down syndromes.

2.1.3 The heavy lifting is done for you

We know that calculation and display of growth parameters is technically hard, and comes with many clinical caveats. Our SaaS (Software As A Service) platform does all the hard work for you, meaning your clinicians get dependable, trustworthy charts, and digital transformation can proceed.

2.1.4 Who's using the RCPCH Digital Growth Charts?

The RCPCH Digital Growth Charts are already used in numerous NHS Trusts across England. Also, they are currently being adopted by UK General Practice clinical systems, at National level in UK Devolved Nations, and within major neonatal and maternity systems.

See the **full list of organisations using our charts**.

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2.2 Products Overview

Winner Best Health Tech Solution HTN Health Teach Awards 2020

Winner Best Solution for Clinicians HTN Health Teach Awards 2024

2.2.1 The RCPCH Digital Growth Charts (dGC) Platform

It's important to understand the architecture of the Digital Growth Charts Platform. It is not built as a single 'app' or product. For important reasons of interoperability and reusability of the code, it is split into functional units:

The Digital Growth Charts API Server

The **RCPCH Digital Growth Charts** (**RCPCH dGC**) platform centres around a 'backend' REST API which provides **calculated growth parameters** derived from **supplied child measurements** such as **height** and **weight**. It accepts growth data in a JSON format and returns Growth Chart Calculations in a JSON format, all over REST. The response from the API contains everything needed to display a graphical Growth Chart, as well as many other parameters which are helpful to clinicians caring for children.

The React.js chart component

This can be thought of as the complementary 'frontend' to the 'backend' server previously mentioned. It is designed as a React.js component library written in Typescript (a superset of Javascript), making it relatively easy to use in third-party applications, significantly reducing the work involved in displaying a standard chart. It can also be used as a 'template' to help implement charting in another programming language or framework.

> ℹ️ **Commercial Support**
>
> The RCPCH can provide commercial support to aid in the development of charting in other languages and frameworks.

The Digital Growth Charts demonstration client

This demo in React.js shows the main features of the API and serves as 'living documentation' of the standard chart view. It uses both the backend server and the frontend charting library, serving as a reference implementation, which can assist with future implementations.

You can see and test out the charts on our live demo site: **growth.rcpch.ac.uk**.

`rcpch-growth` Python package

This is the API 'calculation engine' extracted out of the API so that it can be used as a standalone utility in other Python programs, such as in large-scale growth research or academia.

The Digital Growth Charts command line utility

This is a CLI which wraps the `rcpch-python` package. It makes it easy to use the growth calculation functions of the python packages in the command line.

Clinical Safety documentation

Including our complete Clinical Safety Management File for the development/manufacture (DCB0129) of the API and associated clients, libraries and tools, and for implementers to use as an information source for their own clinical safety cases.

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`rcpch-growth` Python package

This is the API 'calculation engine' extracted out of the API so that it can be used as a standalone utility in other Python programs, such as in large-scale growth research or academia.

2.3 Pricing and Commercial Information

The RCPCH is a registered charity, and the Digital Growth Charts API's cost model is designed to ensure sustainable future maintenance and development of the Digital Growth Charts APIs. We also have a commitment to always provide a Free Tier to ensure rapid on-boarding and novel and exploratory uses.

💰 **The most up-to-date pricing and support information is on the RCPCH website**.

We have a range of options for API usage tiers and developer support, which we've developed to cater for a range of organisational sizes and requirements, however if you don't see what you need then please do **contact our Commercial team**.

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GitHub

2.4 dGC API Server

DOI 10.5281/zenodo.10713620

▶ **Run in Postman**

GitHub repository

Developer Portal (Sign up and get API keys here)

API Gateway Base URL (NB: Without a valid API key, the endpoint will always respond with 404)

▸ UK-WHO Weight Calculation   Examples 0 ▾   BUILD

POST ▾   {{baseUrl}}/uk-who/calculation   Send ▾

Params   Auth   Headers (8)   **Body** ●   Pre-req.   Tests   Settings   •••

raw ▾   JSON ▾   Beautify

```json
{
    "birth_date": "2020-06-12",
    "observation_date": "2020-06-26",
    "observation_value": 60,
    "sex": "male",
    "gestation_weeks": 40,
    "gestation_days": 0,
    "measurement_method": "bmi"
}
```

Body ▾   200 OK   1707 ms   3.56 KB   Sav

Pretty   Raw   Preview   Visualize   JSON ▾

```json
{
    "birth_data": {
        "birth_date": "Fri, 12 Jun 2020 00:00:00 GMT",
        "estimated_date_delivery": "Fri, 12 Jun 2020 00:00:00 GMT",
        "estimated_date_delivery_string": "Fri 12 June, 2020",
        "gestation_days": 0,
        "gestation_weeks": 40,
        "sex": "male"
    },
    "child_observation_value": {
        "measurement_method": "bmi",
        "observation_value": 60.0,
        "observation_value_error": null
    },
    "measurement_calculated_values": {
        "chronological_centile": 100.0,
        "chronological_centile_band": "This body mass index measurement
            above the normal range. Please review its accuracy.",
        "chronological_measurement_error": null,
        "chronological_sds": 21.6956075034097,
        "corrected_centile": 100.0,
        "corrected_centile_band": "This body mass index measurement is w
            above the normal range. Please review its accuracy.",
        "corrected_measurement_error": null,
        "corrected_sds": 21.6956075034097
```

2.4.1 Getting Started with integrating our API

If you want to integrate the RCPCH Digital Growth Charts API into an application, then start **here**.

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GitHub

2.5 React Demo Client

 GitHub repository

 Online Demo

Winner Best Health Tech Solution HTN Health Teach Awards 2020

Winner Best Solution for Clinicians HTN Health Teach Awards 2024

This client, written in the React framework, demonstrates the React Chart Component library interoperating with the dGC API. These two are all you need to integrate our RCPCH Digital Growth Charts platform in your EPR.

We have built the best of growth chart theory and practice into the React client, including guidance given to us by the RCPCH Digital Growth Charts Project Board, and accepted best practice from the days of paper growth charts.

2.5.1 Notes regarding the React client

Colours for the charts have been updated

It was felt that representing boys' charts with blue lines and girls' charts with pink lines did not necessarily fit with 21st Century sensibilities of sex and gender. A Project Board decision was made to make the default chart colour monochrome black/grey.

'Traditional' pink and blue colours are available as an option, and we have created some other colour options named after James Tanner who pioneered the study of childrens' growth. The charts can be themed with any colours you like, we would recommend discussion with your clinicians for guidance on what is appropriate and clinically safe.

Other documentation

- **Clinician documentation**
- **Integrator documentation**
- **API documentation**
- **Developer documentation**
- **Contributor documentation**

If you spot errors or inconsistencies in any documentation, please do point them out to us either by creating an Issue in the relevant repository, or by making a pull request with a fix. We will **acknowledge** all contributors.

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2.6 React Chart Component

digital-growth-charts-react-component-library is a React 18.2 Typescript component library which 'knows' how to display the results from the REST API, as a familiar digital growth chart.

Storybook

⭘ **GitHub repository**

🌐 **Online Demo**

2.6.1 Features

- Calculation and display of height, weight, BMI, head circumference, and BMI centiles.
- Support for Down syndrome and Turner syndrome. **Now includes CDC (US) reference and Down Syndrome (AAP - USA) as of November 2024** *Note these are still under testing*
- Automatic gestational age correction, throughout the life course.
- Zoomable, scrollable charts.
- Event logging - clinical events can be associated with measurements.
- Bone age integration.
- Mid-parental heights with mid-parental centile lines (at +2 and -2 SDS).
- SDS (Standard Deviation Score) charts.
- Decimal age support.
- Customisable chart colours.
- Save chart image to clipboard.
- Tooltip information which can be optimised for clinicians or families.
- 'Whole Life Course' toggle to view only measurements or whole chart.
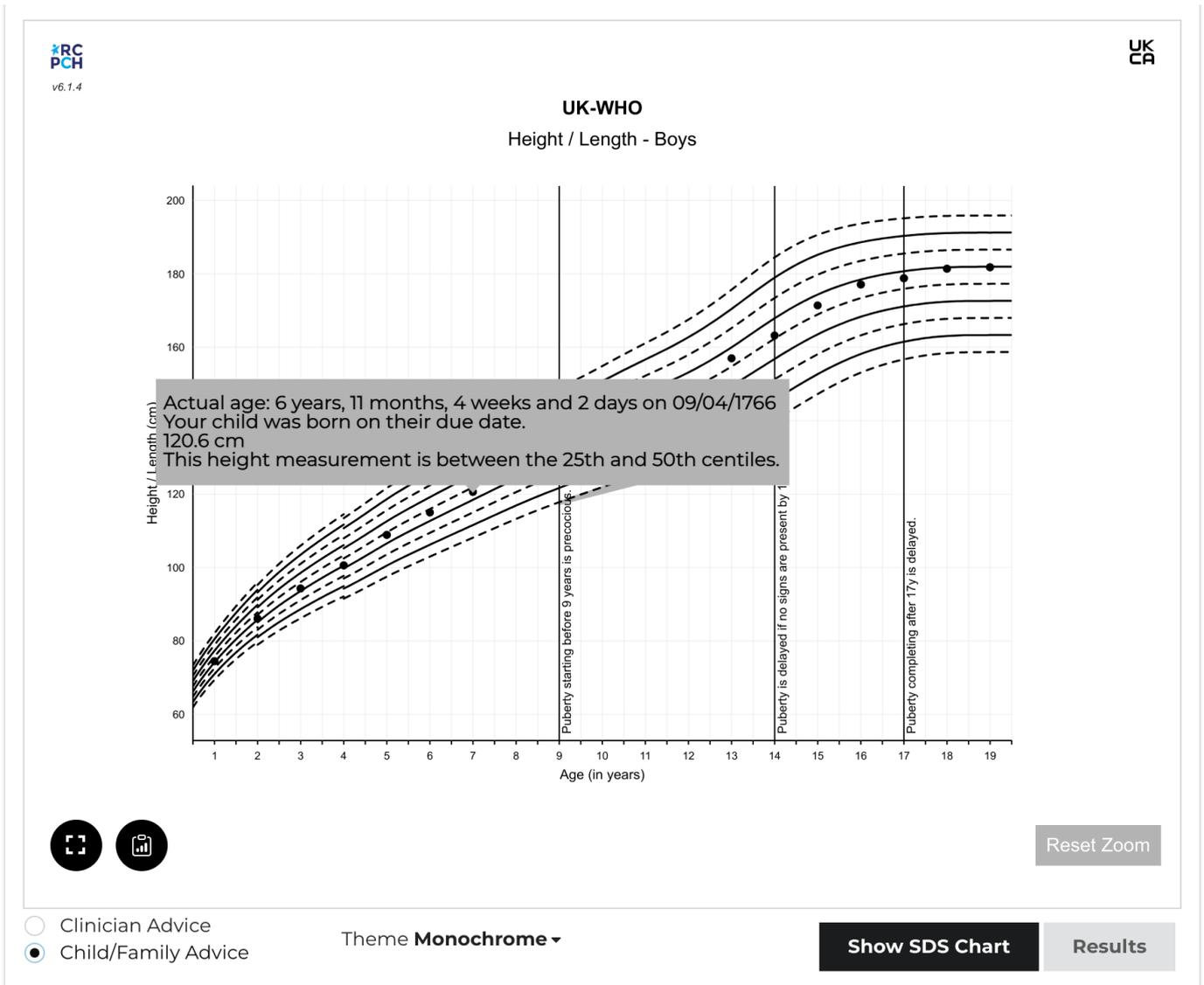
You can use the component as-is in a React app, or include it in plain HTML or any other JavaScript framework.

2.6.2 Supported Features

- Corrected/Chronological age with toggle
- Zoom with zoom reset (optional prop)
- Event logging - events associated with measurements
- Bone ages
- Mid-parental heights with mid-parental centile lines (at +2 and -2 SDS)

Version 7 new features

- Update to react 18.2
- Centile label toggle
- React testing with Jest
- Deprecate styles in favour of themes (custom theme can be supplied)
- **In 7.1, includes CDC (US) reference as of November 2024**
- **In 7.2, includes Down Syndrome (AAP - US) reference as of November 2024**

Version 6 new features

- Rework the data structure to match that from API to prevent persisting data in the component in future
- BMI SDS lines
- SDS charts
- Save to clipboard

New in 6.1

- Dates included in tooltips
- `clinicianFocus` (optional prop) to toggle between advice strings aimed at clinicians or those aimed at families / children & young people
- Toggle button to allow user to constrain viewable chart to measurements or view the whole chart

2.6.3 Background

Why a Chart library?

In the process of building the API, we realised the difficulty for developers unfamiliar with growth charts to produce one acceptable to clinicians.

For example, charts typically have 9 main centile lines (though there are other formats), each of which can be rendered as a series. However, the UK-WHO chart is made of several growth references, each from different datasets, and it is a stipulation that they must not overlap. This means that for the four datasets which make up UK-WHO, the developer must render 36 separate 'sections' of centile lines, marrying them up correctly.

Even then, there are certain rules which are key, published by the RCPCH project board. These relate to usability of the charts. For example, the 50th centile should be de-emphasised. These and other rules are listed on the **Client Specification**.

Given the complexity, we decided to create a React component library for developers to use. We designed it to be customisable for direct use, but also as a demonstration for developers wanting to build the charts from the ground up.

For this reason, we have produced a permissively-licensed, open-source React component, which aims to simplify the process of creating a chart from the chart data received from the API. It makes the job of drawing a vector-graphic centile chart much easier.

If you want to see how the library is implemented, we have built a full client for the RCPCHGrowth API in React, which uses this component library, and can be found **here**.

Why use React?

React is a popular UI library for Javascript. It has endured well and seems like a popular choice for developers. Importantly, unlike some other Javascript frameworks which are primarily designed for Single Page Applications, React doesn't expect to have the entire webpage to itself. It can be used as a small component in any other web page, even if the main framework being used is completely different.

> **❓ Tell us what you think**
>
> Let us know what you think of our design decisions, on this or any other area of the dGC Project, by chatting to us on our **dGC Forum** 🗩.

What about other frameworks/UI libraries?

If you need us to develop a charting component in a different language or framework, we may be able to do this with you or your company. We would need to discuss the requirements and quote for this service. You should be aware that all such RCPCH-

developed artefacts will also be open source. We ensure the licensing of open source components is compatible with commercial use.

> ✏️ **Contact us**
>
> To contact us for this service, email **commercial@rcpch.ac.uk**.

2.6.4 Contributing and Implementing

See **Contributing** for information on how to get involved in the project or how to implement the digital growth charts component into a project.

You can get in touch with the primary developers to talk about the project using any of the methods on our **contact page**.

2.6.5 Acknowledgements

This Typescript library was built from the starter created by **Harvey Delaney**

The charts are built using **Victory Charts** for React. We tried several chart packages for React, but we chose Victory because of their documentation and their ability to customise components.

2.6.6 Licensing

This chart component software is is subject to copyright and is owned by the RCPCH, but is released under the MIT license.

There is important chart line rendering data bundled in the component, which subject to copyright and is owned by the RCPCH. It is specifically excluded from the MIT license mentioned above. If you wish to use this software, please **contact the RCPCH** so we can ensure you have the correct license for use. Subscribers to the Digital Growth Charts API will automatically be assigned licenses for the chart plotting data.

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2.7 RCPCHGrowth Package

`DOI` `10.5281/zenodo.16900578`

 GitHub Repository

 PyPi Package

The calculation functions within the Digital Growth Charts API are powered by a self-contained Python package extracted out into a separate repository and published on **PyPi** (the Python Package Index). This enables the centile calculation functions to be used in other programs.

```
└─$ python
Python 3.8.0 (default, Aug 23 2020, 17:45:09)
[GCC 9.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import rcpchgrowth                      # import package

>>> rcpchgrowth.sds_for_measurement(reference="uk-who", measurement_method="height",
sex="female", age=1.000, observation_value=75.3)
0.4990326436669809                          # calculate a UK-WHO SDS

>>> rcpchgrowth.centile(0.4990326436669809)
69.11218063266153                           # convert it to a centile
```

2.7.1 Installation

To add the `rcpchgrowth` package to your project, install via `pip`

```
pip install rcpchgrowth
```

2.7.2 License

We have taken the slightly unusual step of licensing the python package under the **GNU Affero General Public License version 3**, which may restrict commercial reuse models. This is because all the 'heavy lifting' of the API server depends on this package. We wanted to protect from 'unofficial' commercial competing APIs, at least until the model of Royal College-delivered APIs is established and secure.

> **Helpful licensing**
>
> If this licensing issue restricts your valid, patient-benefiting, non-profit use-case, then please do reach out to us. We will consider dual-license options or some other arrangement that helps you.

2.7.3 Feedback

We'd be interested to hear from people who are using the RCPCHGrowth Python package, so we can learn more about the use-cases and how we might continue to improve the package. Please do **create issues on our GitHub repo**, or discuss the package in the **dGC Forums**

2.7.4 Contributing

If you want to contribute to the project, please read the section on **Contributing**.

This page was last updated on: January 21, 2026

This site was last updated on: March 3, 2026

GitHub

2.8 Google Sheets Plugin

 GitHub Repository

 Link to copy our example spreadsheet

To make accurate centile calculation accessible to researchers, hobbyists and enthusiasts, a Google Sheets extension has been developed using **Google Apps Script**, which makes API calls for up to 1000 data points.

For now, only UK-WHO is supported but Down and Turner syndromes will be added in the future.

2.8.1 Installation

Copy from our example spreadsheet

The easiest way to get started with the plugin is to use our Google Sheets link to make a copy of our example spreadsheet in your own Google Apps account.

 Link to copy our example spreadsheet

Copy and paste the code from our GitHub repository

Alternatively, you can copy-paste the **JavaScript code in this file** into the Google Apps Script IDE, which will enable the functions inside your Google Sheet.

The following are step-by-step instructions of how to do this.

Open Apps Script within your Google Sheets

Open the Google Sheet which contains your measurement data. In the navigation tabs at the top, go to `Extensions > Apps Script`.
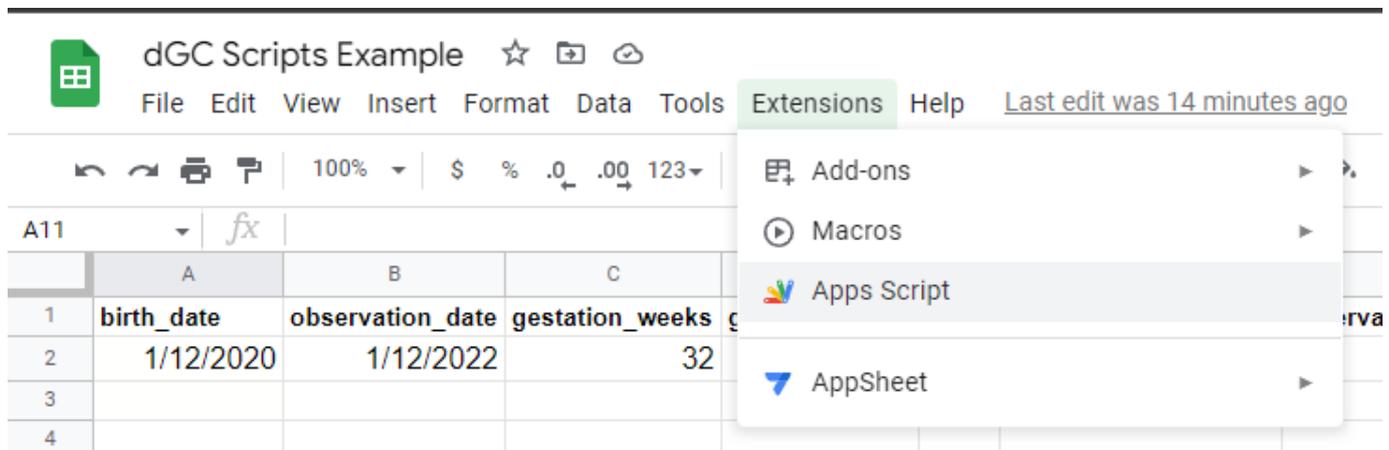
This should open a new blank Apps Script project, similar to the screenshot below, and automatically open a file called `Code.gs` with the following starter code:
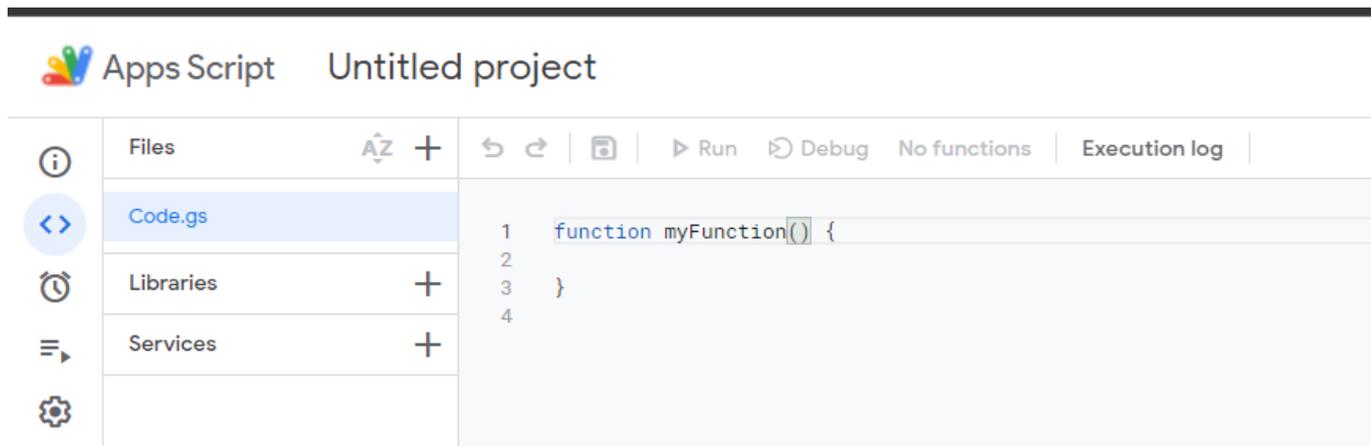
Inserting the dGC Sheets Plugin Code

First, remove the starter code so you are left with a blank file:
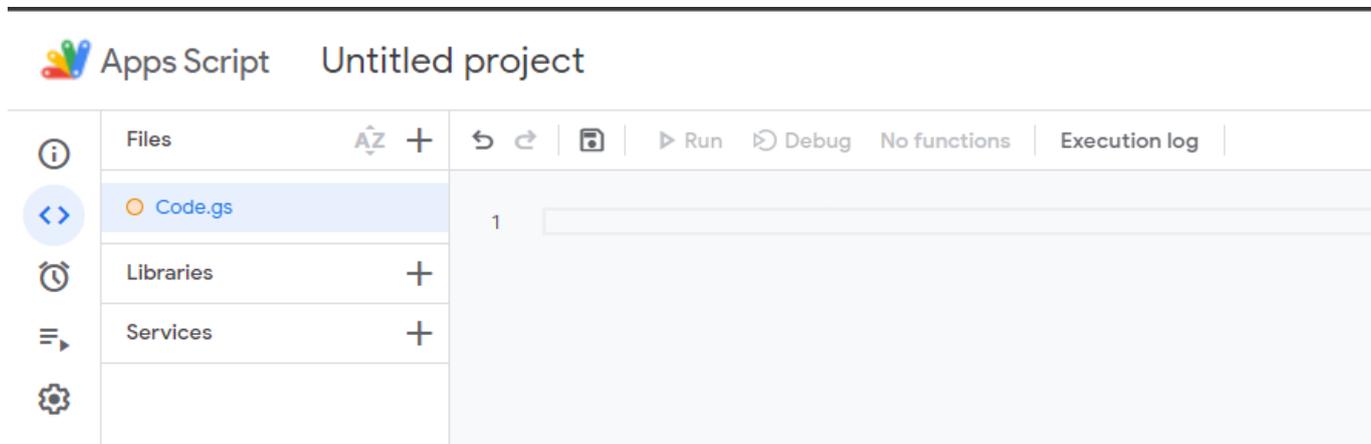
Copy and paste all of the **JavaScript code** into your Apps Script `Code.gs` file and **save the file**:
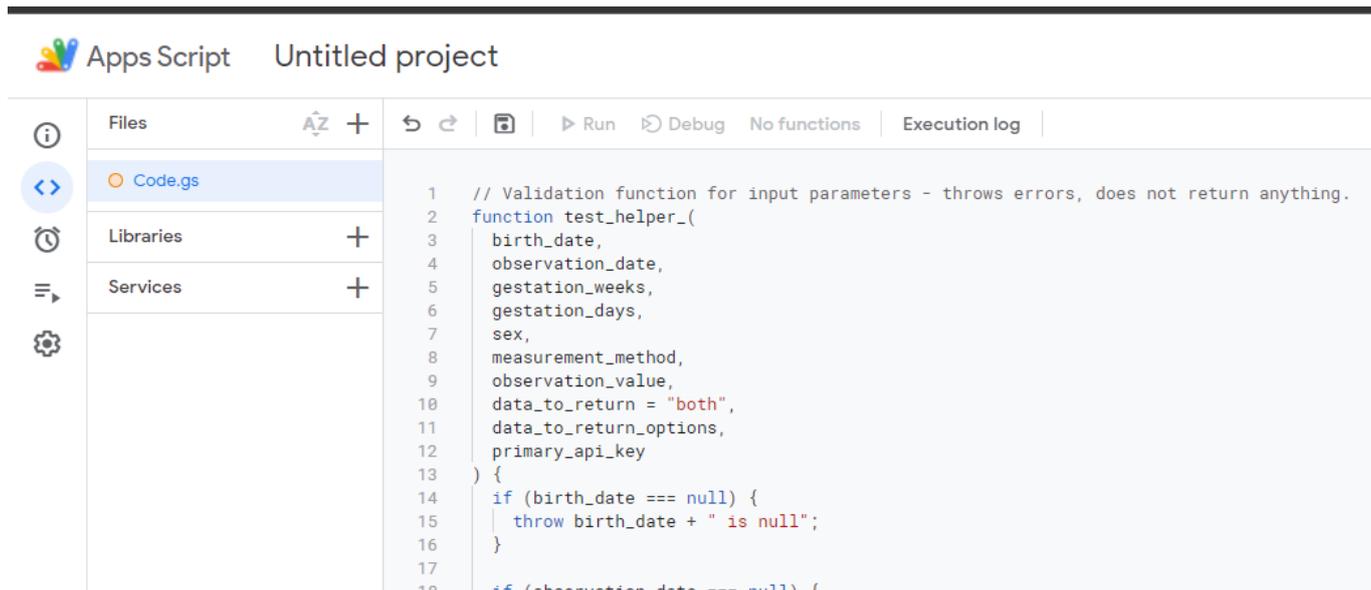
Now, when you go back to your Google Sheet, you will be able to access both functions like normal:
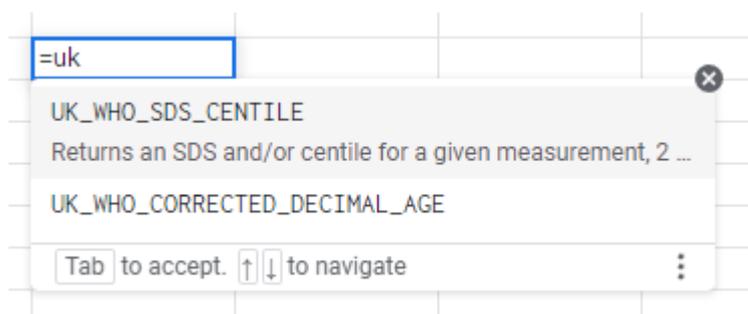
2.8.2 Usage

There are 2 available functions: `UK_WHO_SDS_CENTILE` and `UK_WHO_CORRECTED_DECIMAL_AGE`.

Once installed, you will be able to use both as native Google Sheets functions.

UK_WHO_SDS_CENTILE

This function returns an SDS and/or centile for a given measurement, depending on inputted variables, using the UK-WHO reference.

PARAMETERS

Every parameter is required, except `data_to_return`:

```
UK_WHO_SDS_CENTILE (
  birth_date,
  observation_date,
  gestation_weeks,
  gestation_days,
  sex,
  measurement_method,
  observation_value,
  data_to_return,
  primary_api_key
)
```

> ### Note on data types
>
> The data types for the arguments relate to Google Sheets data types. In practice, this just means entering the values into cells, and Google Sheets should automatically convert to the appropriate type. An error message will display if incorrect data types are used.

Parameter name	Details
`birth_date`	*(datetime)*: the child's birth date (DD-MM-YYYY format)
`observation_date`	*(datetime)*: the date when the observation was taken (DD-MM-YYYY format)
`gestation_weeks`	*(integer)*: the child's number of gestational weeks
`gestation_days`	*(integer)*: the child's number of gestational days
`sex`	*(string)*: the child's sex; must be one of `male`, `female`
`measurement_method`	*(string)*: the measurement method used; must be one of `height`, `weight`, `ofc`, `bmi`
`observation_value`	*(number)*: the measured value of the chosen observation
`data_to_return`	*(string) OPTIONAL*: specifies the desired calculations to return; default `both` (used if no value specified) returns in the following order: chronological SDS -> corrected SDS -> chronological centile -> corrected centile; must be one of `both`, `centiles`, `sds`
`primary_api_key`	*(string)*: your `primary_api_key`. Please see **Getting Started integrating Digital Growth Charts** for details on acquiring your API key

OUTPUT

If `both` specified, returns:

```
Corrected SDS, Chronological SDS, Corrected centile, Chronological centile
```

EXAMPLE

UK_WHO_CORRECTED_DECIMAL_AGE

This function returns the chronological age as a decimal and/or decimal age corrected for gestational age if premature (< 37 weeks gestation), depending on inputted variables, using the UK-WHO reference.

PARAMETERS

Every parameter is required, except `data_to_return`:

```
UK_WHO_CORRECTED_DECIMAL_AGE (
  birth_date,
  observation_date,
  gestation_weeks,
  gestation_days,
  sex,
  measurement_method,
  observation_value,
  data_to_return,
  primary_api_key
)
```

> ℹ️ **Note on data types**
>
> The data types for the arguments relate to Google Sheets data types. In practice, this just means entering the values into cells, and Google Sheets should automatically convert to the appropriate type. An error message will display if incorrect data types are used.

INPUT PARAMETERS

Parameter name	Details
birth_date	*(datetime)*: the child's birth date (DD-MM-YYYY format)
observation_date	*(datetime)*: the date when the observation was taken (DD-MM-YYYY format)
gestation_weeks	*(integer)*: the child's number of gestational weeks
gestation_days	*(integer)*: the child's number of gestational days
sex	*(string)*: the child's sex; must be one of `male`, `female`
measurement_method	*(string)*: the measurement method used; must be one of `height`, `weight`, `ofc`, `bmi`
observation_value	*(number)*: the measured value of the chosen observation
data_to_return	*(string) OPTIONAL*: specifies the desired calculations to return; default `both` (used if no value specified) returns in the following order: chronological SDS -> corrected SDS -> chronological centile -> corrected centile; must be one of `both`, `centiles`, `sds`
primary_api_key	*(string)*: your `primary_api_key`. Please see **Getting Started integrating Digital Growth Charts** for details on acquiring your API key

OUTPUT

If `both` specified, returns `chronological age` and `corrected age`.

EXAMPLE

	A	B	C	D	E	F	G	H	I
	birth_date	observation_date	gestation_weeks	gestation_days	sex	measurement_method	observation_value	data_to_return	primary_api_key
2	1/12/2020	1/12/2022	32	1	male	height	78	both	aaaaYourPrimaryAPIKeyaa23333

`fx` =UK_WHO_CORRECTED_DECIMAL_AGE(A2,B2,C2,D2,E2,F2,G2,H2,I2)

This page was last updated on: October 17, 2023

This site was last updated on: March 3, 2026

🐙 GitHub

2.9 RCPCH Digital Growth Charts App

This is a project written in **Flutter** still in alpha and not in production.

Flutter has been chosen as it is a mature framework that compiles to iOS, Android, Web and Linus from a single codebase.

It is a mobile client wrapper for the dGC API and therefore needs an API key.

2.9.1 Getting started

See **Github**

2.9.2 Development IDE

Android studio is well set up for Flutter development, but VSCode works equally well. It is important first to create a development environment that includes the Android and iOS SDKs. Note that if you are using iOS, you will need to use a Mac and have XCode installed.

2.9.3 Credentials

These should be stored in a `.env` file in the root of the project and include:

```
DGC_BASE_URL=https://api.rcpch.ac.uk/growth/v1
DGC_API_KEY="YOUR-API-KEY"
```

> ⚡ **Credentials - Clinical Safety Risk**
>
> **Do not commit credentials to GitHub**

The Digital Growth Charts App makes API calls to the `/uk-who/calculation` and `/uk-who/chart-coordinates` endpoints. It caches the charts only for those requested measurements for the duration of the session.

2.9.4 Contribute

This is a new (2025) project. Please post **issues** and suggestions for improvement.

This page was last updated on: January 21, 2026

This site was last updated on: March 3, 2026

 GitHub

3. Integrators

3.1 Getting Started with Digital Growth Charts

The RCPCH Digital Growth Charts platform centres around a REST API which provides calculated growth parameters derived from supplied child measurements such as height and weight.

The next few pages will take you through the process of using the API. If you are an experienced user of REST APIs, this should be straightforward. We have deliberately designed this API to be simple and clear.

3.1.1 Sign up for a free tier API key

To use the Digital Growth Charts API, you need to sign up for an account and obtain **API keys**. API keys allow us to manage usage and billing for the API. We do have a perpetually free tier of access for testing and exploring the platform. It has full access to the API but the number of requests are limited.

⚡ Fair Use Policy for the dGC API's Free Tier

We haven't yet encountered any issues with abuse of our free tier, but we thought it would be sensible to outline some elements of our fair use policy for the free tier of the Digital Growth Charts API.

- The free tier is intended for testing and exploration of the API, and is not intended for production use.
- Creation of multiple free tier accounts will result in deletion of all accounts and a ban/block.
- Use of any endpoints other than the api.rcpch.ac.uk endpoint is prohibited.
- 'Reselling' the API through a proxy service is banned and could result in legal action due to the Medical Device status of the API.

SIGN UP TO OUR FORUM AT HTTPS://FORUM.RCPCH.TECH/

💧 Tip

Sign up to the forum is subject to our approval process, please **contact us** if you are not approved automatically.

NAVIGATE TO YOUR USER SUMMARY PAGE USING THE DROP DOWN IN THE TOP RIGHT HAND MENU
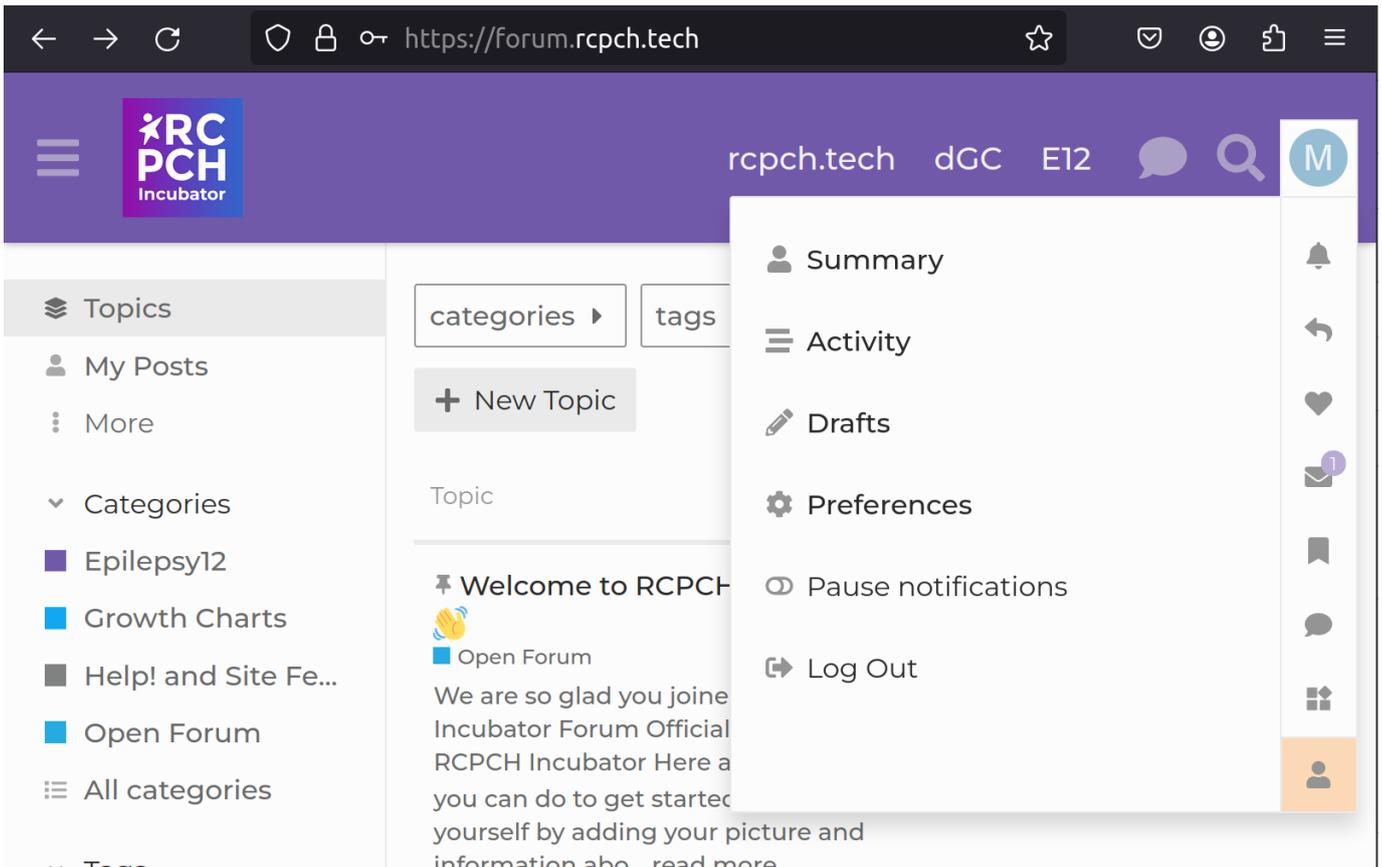
CLICK ON THE API KEYS TAB

CLICK GENERATE API KEY
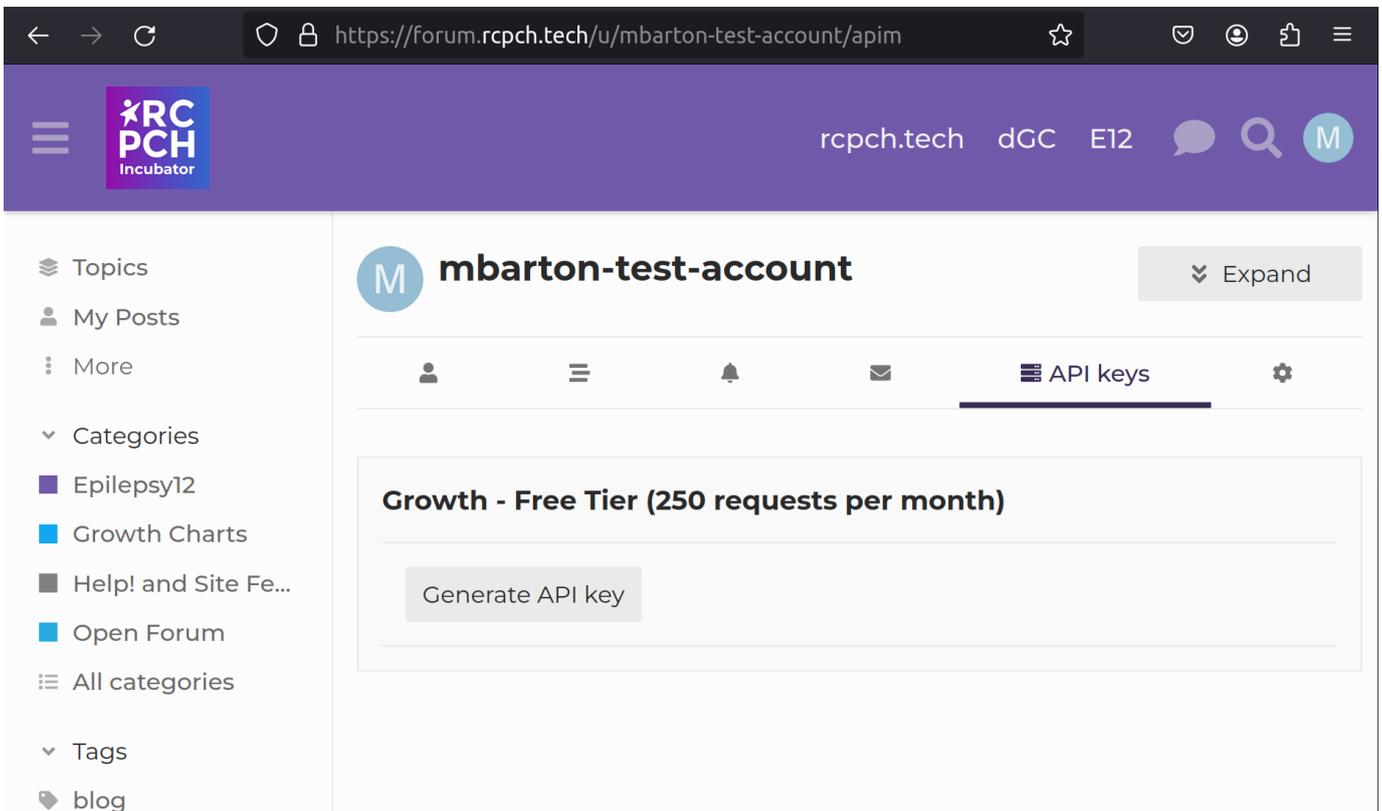
> ⚡ **API keys are secrets!**
>
> API keys identify you to the API, so they should be considered '*secrets*'. If someone else can access and use your API keys, then they **are** effectively 'you' as far as our servers are concerned. Therefore, you must keep your API keys private, especially when using keys in a real application.
>
> The most common cause of accidental API key exposure is inadvertently committing a hard-coded API key to version control, such as Git, and then pushing it to a public site such as GitHub. The slution to this is not to ever hard-code your API keys in your code, but to use environment variables or a secure vault service to store them.
>
> If you do accidentally expose your API keys, you should immediately delete them and generate new ones.

> 🔥 **Tip**
>
> To launch your integration we offer a wide range of paid access tiers that do not have the restrictions of the free tier. See our **pricing**.

3.1.2 Next: Making API calls

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This site was last updated on: March 3, 2026

GitHub

3.2 Making calls to the Digital Growth Charts API

There are as many ways to make an API call as there are software developers, but here are some common ways. We'll start by using **cURL** to get you started but if you prefer a graphical tool, then feel free to skip ahead to the **Postman** section.

> ⚠️ **API baseURL**
>
> For all API calls to the Growth Charts API, you should use the baseURL
>
> ```
> https://api.rcpch.ac.uk/growth/v1
> ```
>
> - **path**: Our API path naming policy (`growth`) is designed to allow the same baseUrl to be used for other APIs in the future.
> - **versioning**: We have versioned the API `v1` to allow for future versions to be developed without interfering with existing integrations.
> - **relative**: All API requests should be made to this URL, and the endpoints described in the API definition are relative to this base URL.
> - **authentication**: The API will return Unauthorized or Not Found (4xx) responses if the request does not include a valid API key.

3.2.1 cURL

`cURL` is a very simple and common tool for making web requests from the command line (also known as the 'terminal' or 'command prompt'). Official documentation for cURL can be found **here**.

Installing cURL

Download cURL **here**. Scroll to the correction download for your Operating System.

> 🔥 **Windows download, install, and usage**
>
> For Windows, please see **this guide** on how to download and install cURL.
>
> Use the **Git Bash** command line to save headaches regarding formatting.

Using cURL to make a test request

Copy and paste the following cURL request into your command line, inserting your `Primary key`:

```
curl --location --request POST 'https://api.rcpch.ac.uk/growth/v1/uk-who/calculation' \
--header 'Subscription-Key: YOUR_PRIMARY_API_KEY_GOES_HERE' \
--header 'Content-Type: application/json' \
--data-raw '{
    "birth_date": "2020-04-12",
    "observation_date": "2028-06-12",
    "observation_value": 115,
    "sex": "female",
    "gestation_weeks": 40,
    "gestation_days": 0,
    "measurement_method": "height",
    "bone_age": 10,
    "bone_age_centile": 98,
    "bone_age_sds": 2.0,
    "bone_age_text": "This bone age is advanced",
```

```
        "bone_age_type": "greulich-pyle",
        "events_text": ["Growth hormone start", "Growth Hormone Deficiency diagnosis"]
    }'
```

The response should be a large JSON response like the following (truncated):

```
{"birth_data":{"birth_date":"2020-04-12", ... :{"events_text":["Growth hormone start","Growth Hormone Deficiency diagnosis"]}}
```

> **🔥 jq**
>
> A neat tool for pretty-printing JSON in the command line is `jq`. With `jq` installed, you can pipe the `cURL`
> output to `jq` and get a much easier-to-read response:

```
curl --location --request POST 'https://api.rcpch.ac.uk/growth/v1/uk-who/calculation' \
--header 'Subscription-Key: YOUR_PRIMARY_API_KEY_GOES_HERE' \
--header 'Content-Type: application/json' \
--data-raw '{
    "birth_date": "2020-04-12",
    "observation_date": "2028-06-12",
    "observation_value": 115,
    "sex": "female",
    "gestation_weeks": 40,
    "gestation_days": 0,
    "measurement_method": "height",
    "bone_age": 10,
    "bone_age_centile": 98,
    "bone_age_sds": 2.0,
    "bone_age_text": "This bone age is advanced",
    "bone_age_type": "greulich-pyle",
    "events_text": ["Growth hormone start", "Growth Hormone Deficiency diagnosis"]
}' | jq
```

You should get a nicely formatted JSON response object:

```
{
  "birth_data": {
    "birth_date": "2020-04-12",
    "gestation_weeks": 40,
... # truncated
    "events_text": [
        "Growth hormone start",
        "Growth Hormone Deficiency diagnosis"
    ]
  }
}
```

A note about dates

The response object from the API contains dates without times in the format `YYYY-MM-DD`. This is the format that the digital growth charts react component library expects. If the output of the API is passed directly to the charts they will render the measurements automatically. RCPCH recommend that the response is persisted, so that an API call is only required for each new measurement.

If in the process of serializing or deserializing the response, the date format is changed, RCPCH advise ensuring that the dates do not change format. In case this happens, the charting component is optimized to process common date types, but will log this as a warning in the console. Any unparseable dates will log as errors.

3.2.2 Postman 🖊

Postman is a tool for API development. The RCPCH team used Postman extensively during the API development and testing process. Download Postman **here**.

We have produced a set of Postman Collections and Environments which can help you explore the dGC API.

[▶ Run in Postman]

3.2.3 openAPI3 (Swagger) API documentation ⊙

As we've specified our API documentation in the openAPI3 (formerly known as 'Swagger') format, we can auto-generate API documentation.

The Swagger API reference is **here**.

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This site was last updated on: March 3, 2026

GitHub

+2

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3.3 API Reference

> ⚠️ **API baseURL**
>
> For all API calls to the Growth Charts API, you should use the baseURL
>
> ```
> https://api.rcpch.ac.uk/growth/v1
> ```
>
> - **path**: Our API path naming policy (`growth`) is designed to allow the same baseUrl to be used for other APIs in the future.
> - **versioning**: We have versioned the API `v1` to allow for future versions to be developed without interfering with existing integrations.
> - **relative**: All API requests should be made to this URL, and the endpoints described in the API definition are relative to this base URL.
> - **authentication**: The API will return Unauthorized or Not Found (4xx) responses if the request does not include a valid API key.

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GitHub

3.4 Using the chart component

3.4.1 Installing the RCPCH Digital Growth Charts React Component

The API and the charting component have been built to work together, but exist separately. The **RCPCH Digital Growth Charts API calculation endpoint** returns centiles and SDS against children's growth measurements in the form of a structured JSON `Measurement` object. Most users want to chart these.

The **RCPCH Digital Growth Charts React Component Library** is written in typescript and react and accepts the RCPCH Digital Growth Charts API response as a prop. There is a **Storybook** and an **interactive demonstration**.

The RCPCH Digital Growth Charts React Component Library has a list of **features** for a diverse range of use cases. The charts can be customized to be viewed by families and children, or by clinicians, from health visitors and midwives, to paediatric endocrinology growth specialists.

Currently the RCPCH Digital Growth Charts React Component Library do not support mobile screens. It is likely that chart visualisation will need to be reimagined for the smaller screen. This is on the RCPCH roadmap.

React

The best way to implement the RCPCH Digital Growth Charts React Component Library is to embed it in a react application. The library is hosted on **npm** and can be added to the dependencies in the `package.json` of your application. There is a working **RCPCH Digital Growth Charts React client** which includes a simple data entry form and RCPCH Digital Growth Charts React Component Library implementation which can be used as a starter if required. The client calls the API and passes the response into the RCPCH Digital Growth Charts React Component Library for charting. The code can be found on **Github**.

The RCPCH Digital Growth Charts React Component Library is written in **React 18.2** and will be periodically updated to support later versions of React as they are published.

VERSIONING

The charts are versioned using the **semver** system. Documentation is published with each new release, though breaking changes are uncommon. Note users will need to update and rebuild their application as and when new releases are published.

STYLING

The charts are deliberately shipped with a monochrome theme. In addition to this RCPCH offer four other themes (Traditional, Tanner 1, Tanner 2, Tanner 3), but custom styles can be applied to the base monochrome theme to alter most aspects of the look and feel. There is extensive documentation in the **Storybook docs** on which props the charts accept and how to wire the charts up to your React project.

Note that the RCPCH logo and chart version appears by default in the top left hand corner. For implementers who prefer less prominence of the logo, an RCPCH acknowledgement statement can be used instead at the foot of the chart using the `logoVariant` prop.

Theme Builder 🎨 - NEW IN 2025

For those who want to customize the chart, the style props can be overridden if the `custom` theme option is selected. This exposes a variety of styles, from font and colour to line and background colour. Use the Storybook Theme Builder to customize

the elements you need and click to save the settings object to the clipboard to be attached to the `customThemeStyles` prop.
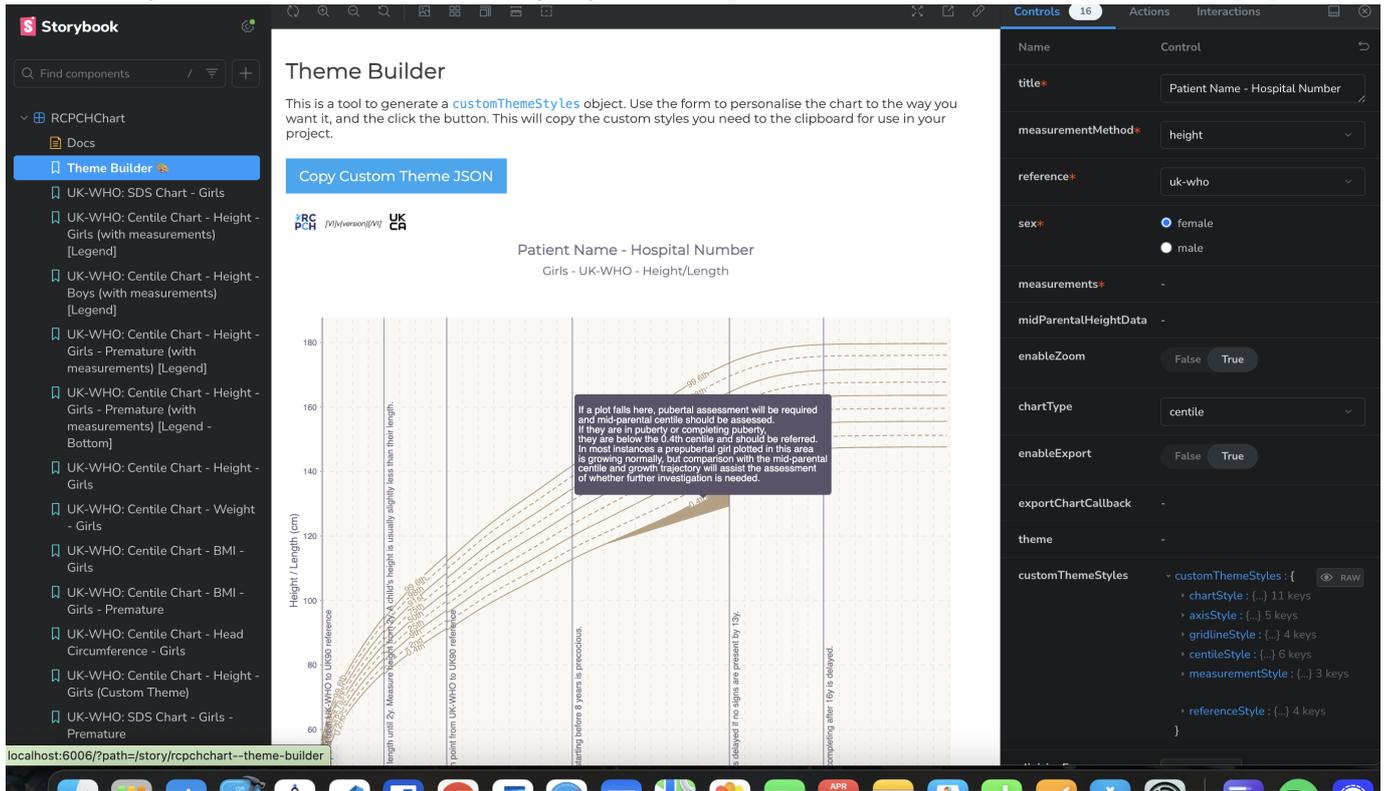
What if I can't use React?

It is common in healthcare environments not to be able to use frameworks like React. For this reason RCPCH have published the charts on **jsdeliver** and **unpkg**. This allows implementers to import the javascript in the head tag of their page. This gives access to the `RCPCHGrowthCharts` wrapper which accepts all the props detailed above for instantiating a single chart, as well as the id of the div in the DOM where the charts are to be located, within the `render` attribute.

```html
<!doctype html>
<html>
    <head>
        <title>Growth Chart Example</title>
        <!-- React dependencies. Must come first -->
        <script crossorigin src="https://unpkg.com/react@18/umd/react.production.min.js" defer></script>
        <script crossorigin src="https://unpkg.com/react-dom@18/umd/react-dom.production.min.js" defer></script>
        <!-- RCPCH Growth Charts library -->
        <!-- You must use the integrity check to ensure you are using the expected code as this component   -->
        <!-- can render patient data. You can get the value from this file, adjusting the version as needed -->
        <!-- https://cdn.jsdelivr.net/npm/@rcpch/digital-growth-charts-react-component-library@7.5.0/build/sri-hash.txt -->
        <script
            src="https://cdn.jsdelivr.net/npm/@rcpch/digital-growth-charts-react-component-library@7.5.0/build/rcpch-digital-growth-charts.umd.min.js"
            integrity="sha384-yu1MIbRclkM3UCyciRAULihnERx26NqFKjP/EuddYVumiom3Oy5p9KBGSUHABc8g"
            crossorigin="anonymous"
            defer>
        </script>
        <script defer>
            document.addEventListener('DOMContentLoaded', function () {
                const demoMeasurements = [ /* RCPCH digital growth charts API response goes here */ ];
                window.RCPCHGrowthCharts.render({
                    targetElementId: 'growth-chart-container',
                    title: 'Demo UK-WHO Growth Chart for Children',
                    measurementMethod: 'height',
                    reference: 'uk-who',
                    sex: 'female',
                    measurements: { height: demoMeasurements },
                    midParentalHeightData: {},
                    enableZoom: false,
                    chartType: 'centile',
                    enableExport: false,
                    clinicianFocus: false,
                    theme: 'tanner3',
                    height: 800,
                    width: 800,
                });
            });
        </script>
    </head>
```

```
    <body>
        <div id="growth-chart-container"></div> <!-- The charts will appear here -->
    </body>
</html>
```

This page was last updated on: March 3, 2026

This site was last updated on: March 3, 2026

GitHub

3.5 Support

3.5.1 Commercial Support

> 🔥 **Commercial support**
>
> For our integration service, which can provide bespoke support to help you integrate the API with your healthcare software solution, please contact **commercial@rcpch.ac.uk**.
>
> Please also see our **Pricing** section for more details on the support included with each pricing tier.

To obtain the information you need for the best use of the RCPCH dGC platform depending on your role, please navigate to the appropriate section through the following options:

⟨⟩ Integrator

I am a developer looking to integrate Digital Growth Charts into an app, EPR, or other existing system.

→ **Integrators**

Clinician

I am a clinician wanting to find out more about Digital Growth Charts and how I can get them at my place of work.

→ **Clinicians**

Contributor

I want to know how to set up a development environment and start improving the Digital Growth Charts platform.

→ **Contributors**

Clinical Safety Officer

I'm a Clinical Safety Officer looking for DCB0129 and other compliance information.

→ **Clinical Safety Management File**

3.5.2 Free Support

Discourse Forum

Our primary support method is through the forum at **forum.rcpch.tech**. You can search for previous answers to your question, connect with the developers and team behind the API, and find a community of other integrators, with whom you can share tips and ideas.

Go to the forums 💬

rcpch.tech   dGC   E12

		categories ▸	tags ▸	**Latest**	Top	Categories				+ New Topic

Topics
My Posts
More

Categories
- Epilepsy12
- Growth Charts
- Help! and Site Feedback
- Open Forum
- All categories

Tags
- blog
- All tags

Messages
- Inbox

Channels
- General

DMs

Topic		Replies	Views	Activity
📌 Welcome to RCPCH Incubator Forum! 👋 ■ Open Forum We are so glad you joined us. RCPCH Incubator Forum Official forum of the RCPCH Incubator Here are some things you can do to get started: 💬 Introduce yourself by adding your picture and information abo... read more		0	17	Mar 26
Automatic data upload? ■ Epilepsy12		3	23	May 21
Digital Growth Charts at the Young Rewired State Festival Of Code 2015 - ICC Birmingham ■ blog blog		0	21	Apr 12
RCPCH 'Incubator Playbook' - to be a documentation site which encapsulates our ways of working, best practices, tips and tricks ■ Open Forum		0	7	Mar 28
Discourse New User Guide ■ Help! and Site Feedback		0	7	Mar 27
RCPCH recruiting for Lead Developer (Python/React/HTMX/Django/				

This page was last updated on: June 4, 2025

This site was last updated on: March 3, 2026

GitHub

3.6 Client Specification

In this document, we have collated the exact specification mandated by the Digital Growth Charts Project Board for Digital Growth Charts. Much of the specification is inherited from the preceding paper growth charts, so clinicians have immediate familiarity using the digital version.

3.6.1 Background

> ⚠️ **A safe and familiar Client User Interface is a requirement of the Licensing Agreement**
>
> **A requirement of the API licence is that any charts rendered must meet these standards as agreed by the Digital Growth Charts Project Board. A large amount of documentation has been produced to guide the clinically-safe design and rendering of UK growth charts.**

> 🔥 **Implementation support service**
>
> The RCPCH can assist in both the technical implementation and clinical assurance of any new charts implementations. This ensures adherence to the Project Board specification, a clinically-safe User Interface, and increased likelihood of clinical-user acceptance. Please contact us to discuss your needs on **commercial@rcpch.ac.uk**.

Understanding the UK-WHO dataset

It is critically important to understand the dataset is **not** a simple 'lookup table' of height/weight against ages and centiles.

Such a table would rapidly become large and unusable because of the number of variables involved. More, since variables like weight, height, etc. are *continuous*, not discrete, a 'lookup table' approach would involve a loss of accuracy.

The UK growth charts are made up of four datasets taken from two different growth references (see **clinical documentation** for more detail).

- The UK 1990 preterm dataset runs from 23 weeks gestation to 42 weeks post-menstrual age as length (from 25 weeks), weight and head circumference.
- The WHO 2006 dataset runs from 2 weeks of age to 2 years of age as length, weight, BMI and head circumference.
- The WHO 2006 dataset continues as **height** (now measured *standing*) from 2 years to 4 years of age
- The UK90 dataset picks up from 4 years until 20 years (head circumference to 17 years in girls and 18 years in boys)

There is established clinical guidance for how these different datasets should be combined to produce a correct chart. This results in slight visual anomalies, such as small steps in the chart at 2 and 4 years of age, however, these are **intentional** and **clinically valid**.

3.6.2 Implications for digital charting

These datasets all overlap. Therefore, when plotting, they must be rendered as four individual series. They will appear discontinuous, with breaks in the lines where they meet / overlap.

A natural step exists at each of these time points which **must** be respected. In particular, this is clinically relevant at age 2 years, where infants are no longer measured lying flat, and instead measured standing up, leading to a natural small step. If all 4 datasets are presented 0-20 years as a continuous dataset, chart packages will interpolate the gaps and the intentional 'step' will

be lost. There is no change in references at this transition from infancy to childhood, but at exactly 2 years, the reference data have values for both lying and standing, so **both** should be plotted.

The API endpoint returns the chart data in an array of arrays.

- The first level array represents the 9 centiles `[0.4, 2, 9 , 25, 50, 75, 91, 98, 99.6]`, with each centile sequentially having a nested array of 4 arrays of data, one for each dataset (see below).

- The individual data points are reported as float values for x and y coordinates. X corresponds to decimal age, y to the measurement value of the chart requested. If the optional `three-percent-centiles` is passed - instead of the default `cole-nine-centiles` - an older format of 9 centiles `[3, 5, 10, 25, 50, 75, 90, 95, 97]` is returned. The `nine-cole-centiles` is the UK standard - each centlie represents 0.67 of a SDS. WHO and CDC datasets variously use different collections of centiles. The centiles returned from the API accept a `centile_format` parameter for one of: `"three-percent-centiles"`, `"five-percent-centiles"`, `"eighty-five-percent-centiles"`, `"cole-nine-centiles"`, `"extended-who-centiles"` or a custom list of centiles, or a custom list of standard deviation scores (if the `is_sds` flag is passed).

The chart data is only returned for the measurement method requested e.g. if only height is supplied, only height centile data will be returned. Multiple API calls are required to obtain a full set of measurement data.

Along with the centile data, the growth data (presented to the endpoint in the request) are returned as an array of x and y coordinate values for plotting on the chart.

3.6.3 Specifications for implementing your own charting

> ✅ **React component reference charting implementation**
>
> In terms of technical, statistical and clinical skill-sets, making growth charts adhere to the specification, which are clinically safe and usable is quite difficult. That's why we built a **reference implementation** of the charts, as a permissively-licensed React component, so you can use it in your own application.
>
> We **strongly** recommend the use of this package if possible. If not possible, we recommend discussion with the RCPCH Digital Growth Charts team to help properly start your implementation.

Chart plotting

- Provide the facility to toggle between height chart and weight chart or display together.

- Offer option of BMI and head circumference charts for health staff use.

- Allow the chart to be scalable, i.e. zooming in or out, whilst maintaining variable, visible axes, or offer a variety of age ranges displayed to optimise data view.

- Provide option of Z-score (SD) plots for health staff use (see below).

- The 50th centile should be de-emphasised: this middle line must not be made darker or wider than others, as it might give the impression to families that being on it is desirable or normal. Standard notation is for the 0.4th, 9th, 50th, 91st and 99.6th centiles to be dashed, the 2nd, 25th, 75th and 98th centiles to be solid.

- Chart colour choices are not mandated by this document. The lines and data points need to meet accessibility guidelines, be clearly visible and avoid colour combinations that reduce usability. Also, we try to avoid gender stereotypical colours (pink and pale blue), as these seem dated in 2022.

- Information for the user must not be crowded, and where possible, contextualised. For example, information on puberty for girls should be shown only on girls' charts.

- Highlight the pitfalls of measuring weight in the first weeks after birth of a term infant. It is normal for babies to lose up to 10% of their birth weight; this should be made clear to users.

- Signpost reference transitions. The user should be made aware of why the lines are discontinuous between data sets, or when going from lying measurements to standing.

- Chart labelling: axes must be labelled appropriately with the correct intervals. Below 42 weeks gestation, the x-axis should reflect gestation. Beyond 42 weeks to 2 years, weeks and months should be shown. Above 2 years, months and years should be shown. Above 4 years, yearly and 6-monthly intervals are shown. On the y-axis, measurement units should be used, with scope of the chart showing only the measurements, not the whole chart.

- Provide help and information facility to access instructions drawn from the RCPCH educational materials (see separate documents: **information for parents**, **information for health staff**).

- If using the RCPCH Charts, the RCPCH acknowledgement should be included. There is a prop to de-emphasise this to make less prominent if required.

When plotting centile charts

Certain key presentation principles should be included:

- Use Cole nine-centile format (see above).

- Scale different elements of the chart to best display information in each period.

- When hovering over a point, either show exact age and centile band (see below), or show in an embedded table.

- Different data points should not be joined by lines.

- Data points should follow standard notation: a child's growth point plotted at their chronological age is a round dot. If plotted at their age adjusted for gestation, it is plotted as a cross. If plotted together, they are joined by a line, often with an 'arrow back', denoting the relationship.

- Bone ages can additionally be plotted on the chart. These are skeletal ages calculated using standard scores from x-rays of the left hand. They are associated with a height value measured on the same day. They are plotted as a cross, with the bone age on the x-axis and the measurement on the y-axis. The measurement is plotted against age (corrected and chronological) as standard. The two plots are connected by a dotted/dashed line to denote they are linked.

- Events can be plotted on the chart also - these are contextual information, such as starting a treatment or the time a diagnosis is made. They are a vertical arrow above or below the measurement in question, outside the centiles for clarity.

- There should be a toggle button to allow the user to see the chronological and corrected ages separately or together.

- Omit grid lines, which are only useful for manual plotting, and the y-axis can be inconspicuous.

When plotting Z-score (SD) charts

- Z-score centile charts may be created with age on the x-axis and Z-score on the y-axis. This converts the centile curves to horizontal straight lines.

- All available measurements (weight, height, head, BMI) should be plotted as series on the same chart, with consistent colour coding of the different series (e.g. weight is always be red and height is always blue etc.).

- The data points may be joined by fine lines.

- The y-axis should cross the x-axis at Z = 0, and have horizontal centile lines at intervals of 0.67 Z between -2.67 and 2.67.

Adjusting for Gestation at birth

On the centile chart, it should be clear that allowance has been made for varying age of gestation at birth, by offering the option of plotting at chronological age with a **circle**, as well as gestational age (age – number of weeks premature) with a **cross**. If plotted together, they should be joined by a line. An option should be offered to toggle between the plotted chronological, corrected ages and both.

> ✏️ **Gestation Age Correction through the life course**
>
> **The standard has recently changed**: gestational age is now taken into account, even when born at 'term gestational ages', and across the whole lifespan. This change was adopted because digital charting makes gestational age correction much easier to do. In fact, it is now a completely automated process because of the Digital Growth Charts API.
>
> *Note: this is different from paper charts, where gestational age correction was manual, and therefore only done up to 1 or 2 years depending on the degree of prematurity.*

EXAMPLES

Example Gestation	Old policy	New policy
39 weeks + 4 days	Plot on 'Term' reference	'Term' reference has been abandoned in favour of plotting on UK90 preterm chart, up till corrected gestational age of 42 weeks + 0 days
26 weeks + 0 days	Gestational age correction applied until 2 years old (corrected)	Correct for the whole life span
35 weeks + 6 days	Gestational age correction applied until 1 years old (corrected)	Correct for the whole life span

DEFINITIONS

- **Gestational age**: time period for foetal development inside the uterus, beginning with conception and ending at birth
- **Weeks premature**: number of weeks prior to 37 weeks of gestation, for a live birth
- **Chronological age**: time period starting from birth until a given date

Gestational adjustment option provided for all birth gestations and continues indefinitely.

On a Z-score plot, the adjusted Z-score for gestation should be plotted against actual (chronological) age, with a label on the plot specifying the number of weeks premature.

3.6.4 Essential standards for rendering

Whilst not essential to show the whole life course when plotting measurements against centile lines, the rendering of the centile lines and the plots must meet the following design standards:

- Centiles should be clearly labelled.
- Overlap between datasets for each centile should be clearly visible, and no interpolation function should be used to link them.
- The 0.4th, 9th, 50th, 91st and, 99.6th centiles should all be dashed lines (**not** dotted, **not** continuous).
- The 2nd, 25th, 75th and 98th centiles should be continuous lines (thin).
- Axes should be clearly labelled: (Height/Length in cm, Weight in kg, Body Mass Index in kg/m^2, head circumference in cm, age in years).
- X-axis (age in years) increments should be monthly under the age of 2 years, 3-monthly over the age of 2 years.
- Precision of measurements (height, weight, etc.) should be one decimal place.
- Centiles should be reported as integers, except if > 99 or < 1. If outside threshold, they should be reported as > 99.6 or < 0.4.

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3.6.5 The UK Nine centile chart format

The nine centile lines used in the British 1990 and UK-WHO charts are labelled in terms of rounded centiles (see table below), but they are precisely defined in terms of the underlying Z-scores. The following Z-score thresholds are used to define the centiles in the British charts:

Approximate centile	Exact Z-score	Line format
0.4th	-2.67	Dashed
2nd	-2.00	Continuous
9th	-1.33	Dashed
25th	-0.67	Continuous
50th	0	Dashed
75th	0.67	Continuous
91st	1.33	Dashed
98th	2.00	Continuous
99.6th	2.67	Dashed

3.6.6 Definitions and terminology of Centile Bands

A "centile space" is the distance between two centile lines.

A child is defined as being "on" a centile when within 0.17 SD (0.25 centile space) of the underlying exact Z-score, otherwise, they are "between".

Centile band	SDS Lower limit	SDS Upper limit	Additional Message - Weight/Height/Head	Additional Message - BMI
	< -6		Probable error	Probable error
Below 0.4th	-6.00	-2.84	Below normal range	Very thin
0.4th	-2.84	-2.50		Low BMI
0.4th-2nd	-2.50	-2.17		Low BMI
2nd	-2.17	-1.83		
2nd-9th	-1.83	-1.50		
9th	-1.50	-1.16		
9th-25th	-1.16	-0.84		
25th	-0.84	-0.5		
25th-50th	-0.50	-0.17		
50th	-0.17	0.17		
50th-75th	0.17	0.50		
75th	0.5	0.84		
75th-91st	0.84	1.16		
91st	1.16	1.50		
91st-98th	1.50	1.83		Overweight
98th	1.83	2.17		Overweight
98th-99.6th	2.17	2.50		Overweight (obese)
99.6th	2.50	2.84		Overweight (obese)
>99.6th	2.84	6	Above normal range	Severely obese
	> 6		Probable error	Probable error

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3.7 FAQs for Integrators

In our documentation, we use the term **Integrator** to refer to a person or team who is integrating the API into a product or service. We also recognise the term 'customer'. This distinguishes 'Integrators' from 'clients' (by which *we* mean software which consumes the API), and 'developers' (by whom *we* mean those who are developing the Digital Growth Charts project)

Information about the dGC client products

Information for dGC Developers

3.7.1 Q: Can we self-host the API?

A: Technically yes. However, there are several important considerations, of which the downsides outweigh any benefits.

We have open-sourced the API to align with our policy on transparency and clinical safety. However, we advise you do not self-host it. Only the version deployed and managed by the RCPCH team is warranted to be correct.

⚡ **Self Hosting - Clinical Safety Risk**

TL;DR: Don't self-host in production. Use our warranted API.

The only version of the Digital Growth Charts API which is warranted to be correct for clinical use is that which is served by the RCPCH itself from our API endpoint at **https://api.rcpch.ac.uk**.

For reasons of transparency, equity-of-access and safety, we have made it *possible* to use our open-source code to set up a server providing Digital Growth Charts API calculations. **However, we strongly advise *against* doing this**, except for testing, verification, development purposes or research (which is not for academic publication).

WE STRONGLY RECOMMEND NOT TO SELF-HOST THE SERVER FOR PRODUCTION, CLINICAL or other 'LIVE' USE.

By self-hosting, you would not have a warranty from the RCPCH: you are liable for misconfigurations in the server leading to clinical issues. To ensure safe service with the complexity of Growth Charts, you likely require large amounts of statistical, clinical and technical consultancy.

You must understand and accept that any version of this API running **outside** our controlled environment must have been:

1. Independently **technically-assured**, such that the platform, deployment, and modifications are secure, safe, and reliable.
2. Independently **clinically-assured**, such that the application is safe and has a qualified Clinical Safety Officer, a Clinical Safety Management File, and is fully compliant with DCB0129 and DCB0160.
3. Registered with the MHRA as a Medical Device (for UK deployment) and EU MDR, with Declaration of Conformity (for EU deployment).

For this reason, we STRONGLY recommend you DO NOT SELF-HOST any of our platform, but instead use the hosted (and attractively-priced) Digital Growth Charts API platform. Self-hosting means your organisation is fully liable for any errors in calculation, deployment, or functioning. We will not provide any free support for self-hosting organisations.

> ## 🔥 RCPCH On-Premise Hosting Service
>
> The RCPCH offers an 'on-premise' managed service which may suit some customers requiring the service to be hosted within their own data centre, or on their own cloud infrastructure. Find out more about **pricing**.

By using the RCPCH-provided API, you avoid all that requirement and use our commodity server.

3.7.2 Q: Is entering a gestational age mandatory?

A: Gestational age is **not** mandatory for the API to return a value. If not supplied, the child will be assumed to be born at 40 weeks. For the UK-WHO charts, the standard term references will be used for calculations and charts.

From a DPCHR implementer perspective, if a birth notification has not flowed into the DPCHR, suppliers will need to require parents to enter it.

3.7.3 Q: What development effort is required to integrate this API into an app or Electronic Patient Record?

A: Minimal development is required. The tricky stuff (calculating centiles from complex statistical tables, selecting the correct UK90 or WHO references for age, and gestational age correction) is all done for you. The data returned will be the correct centiles, which can be displayed to the user.

Producing a visual 'growth chart' with this data is a little more involved, however, we have simplified the process by building API endpoints which return coordinate data from which to build the chart lines. We've also made an open-source library which takes that source data and makes a chart for you. This is built in React and is MIT licensed, but if you are using another technology, you can inspect the source to build your own client.

We are keen to build a 'catalogue' of chart clients, so other open-source clients are very welcome. We will also help you build and test them!

3.7.4 Q: Is corrected gestational age passed back by the API?

A: Yes, corrected age is passed back by the API, if a gestational age is included in the request.

NOTE: The API can only correct for gestational age if a gestational age has been supplied!

This correction is applied throughout the life course. (In the past the correction was only applied to 1 or 2 years depending on the degree of prematurity. This is no longer the case, following an RCPCH dGC Project Board decision. It is trivial to have the computer correct throughout the life course, so we made this the default. Uncorrected age is still available in the API response, if required.)

3.7.5 Q: Does my application need to validate inputs?

A: The API has validation and error handling for out-of-range requests, but it is good practice for the front-end software to also reject input values outside the valid range since the user will receive immediate feedback from your application.

3.7.6 Q: Is there a source from where we can get a list of extreme input values to use for our validation?

A: Yes, we have included one in our source code: **Validation Constants**. This is used internally to validate API inputs, as well as by the internal `rcpchgrowth` Python module to validate inputs to the `Measurement` class.

3.7.7 Q: Would it be good enough to plot the returned centile values on a pre-prepared image of a growth chart?

A: Maybe. It would depend on the implementation.

Images of charts are definitely **not** good enough for calculating a centile from, although many General Practice software packages currently do it this way. Plotting on an image is a hack, and it's why we had to create the API in the first place. However, since we are calculating the centiles for you, the chart is only for displaying the trend. An image **could** be used, but we generally advise against it.

It is very easy to accidentally offset or incorrectly scale images, leading to *some* correctly plotted points, but others not. The best practice is to always use the *same* vector graphic tooling to both construct lines **and** plot the points, avoiding offsets/scaling inaccuracy. If you use an image (against our advice), you must ensure the correct one is selected for the presented data. More, you must ensure scaling and offset are not just programmed to be correct, but also clinically tested to be correct!

We would in every situation recommend using the **React Chart Component** to render the chart. It is open-source, and can be used as a reference implementation if you wish to build your own.

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4. Clinicians

4.1 How the API Works

Details for interested clinicians and statisticians.

4.1.1 Growth Charting Introduction

The UK-WHO 0-4 year old charts were officially launched on May 11th 2009. Any child born after that date should be plotted on a UK-WHO growth chart. Children born before May 11th 2009 are plotted on British 1990 (UK90) charts and subsequent measurements must be plotted using those charts. After age 4, the two charts are the same.

4.1.2 The LMS Method

It is now common practice to express child growth status in the form of **SD score (SDS)** - the number of standard deviations away from the mean (also known as a **z-score**). The SD score can be converted to a centile.

The LMS method provides a way of obtaining normalised growth centiles from a reference dataset, applying smoothing and extrapolation so the resulting L, M and S curves contain the information to draw **any** centile curve, and to convert measurements (even extreme values) into exact SD scores. The growth reference is summarised by a table of LMS values at a series of ages.

How the LMS method is used

- Using the LMS table, look up the age and sex-specific values of L, M and S for the relevant measurement (e.g. height). If the child's age falls between the tabulated ages, use *cubic interpolation* to obtain values for the child's exact age.
- To obtain the z-score, plug the LMS values with the child's measurement into the formula:

$$z = \frac{(measurement/M)^L - 1}{LS}$$

4.1.3 Growth References

This is a growing list of growth references for children. These cover a number of specific medical conditions and a range of different physiological parameters. It will continue to grow as more data become available. As a side-project of this work, we are interested in collating an international library of growth references in computable format, found at the **Growth References repository**. Further details are available there.

If you have a reference which you would like us to add, please contact us on **growth.digital@rcpch.ac.uk**.

4.1.4 Gold Standard

The preceding 'gold standard' for LMS calculation was **LMSgrowth**, an Excel add-in written in Visual Basic by Huiqi Pan and Tim Cole (copyright Medical Research Council 2002–10).

Results from RCPCHGrowth agree with LMSgrowth to 3 decimal places, though beyond this, there are discrepancies. This is partly because of the decimal age calculation. In LMS Growth, months and weeks are handled differently to RCPCHGrowth, which uses the Python `date-utils` library to calculate differences between dates.

4.1.5 Interpolation

The process involves the following steps:

1. Calculate decimal age in years (age in days / 365.25, to account for leap years)

2. Look up nearest decimal ages in the reference data and read off associated L, M and S values

3. If necessary use interpolation to obtain L, M and S values for the required age

4. Substitute L, M and S in the final equation to generate an SDS.

In most situations, the decimal age of the child falls *between* the available decimal ages in the reference data. In this case, an *interpolation* needs to be performed on the ages either side of the child's age, and the same applied in turn to the L, M and S values associated with each of the ages below and above.

Cubic Interpolation

In most circumstances, *cubic* interpolation is used - this involves identifying 2 ages below and 2 ages above the child's age and substituting into the following equation:

If t_0, t_1, t_2, t_3, y_0, y_1, y_2, y_3, are given, and $t_0 < t_1 < t_2 < t_3$, t is in the range of $[t_1, t_2]$, the cubic interpolation of y for t is:

$$y = \frac{y_0(t-t_1)(t-t_2)(t-t_3)}{(t_0-t_1)(t_0-t_2)(t_0-t_3)} + \frac{y_1(t-t_0)(t-t_2)(t-t_3)}{(t_1-t_0)(t_1-t_2)(t_1-t_3)} + \frac{y_2(t-t_0)(t-t_1)(t-t_3)}{(t_2-t_0)(t_2-t_1)(t_2-t_3)} + \frac{y_3(t-t_0)(t-t_1)(t-t_2)}{(t_3-t_0)(t_3-t_1)(t_3-t_2)}$$

$$dt = (t - t_1)/0.5$$

$$a_0 = -\frac{y_0}{6} + \frac{y_1}{2} - \frac{y_2}{2} + \frac{y_3}{6}$$

$$a_1 = \frac{y_0}{2} - y_1 + \frac{y_2}{2}$$

$$a_2 = -\frac{y_0}{3} - \frac{y_1}{2} + y_2 - \frac{y_3}{6}$$

$$a_3 = y_1$$

$$y = a_0 dt^3 + a_1 dt^2 + a_2 dt + a_3$$

Note: this derived formula is equivalent to the above cubic interpolation only when the age interval is 0.5.

Alternatively, it is possible to use the `CubicSpline` function from the SciPy interpolate package, or the `interpolate.splev` function - details can be found in the comments in the **global_functions.py** module.

During our testing, the original Cole method above ran faster than the SciPy interpolate functions, with the same level of accuracy.

Linear Interpolation

Where a child's measurement falls close to a reference threshold, and there is only one age below or above them, linear rather than cubic interpolation is used. Here, the `interp1d` **Scipy** function has been used to keep code less verbose.

4.1.6 Reference Thresholds

It is documented in several places how there are age thresholds for different measurements.

This is either due to a lack of measurements, or an overlap in references. Because the different datasets overlap, there is a certain amount of logic throughout the functions to ensure that the correct reference is selected. The thresholds are:

- Length runs from 25 weeks to 2 years. There is overlap here where children are measured standing (height) rather than lying (length), and therefore have 2 LMS values for the same age. This means a measurement at exactly 2 years is treated as height. From 2 years, the data continues as height to 4 years, where again there are 2 values. This is the join between the WHO 2006 and UK90 data. Length/Height appears as such on charts, and can be found simply as a parameter `'height'` for simplicity.
- Weight appears as a `'weight'` parameter and is continuous from 23 weeks gestation through to 20 y for both sexes. There are overlaps as with height, between UK90 preterm, UK-WHO infant and child, and UK90 child datasets.
- BMI appears as a `'bmi'` parameter and is a calculated value requiring height in metres and weight in kilograms, expressed as kg/m². Reference data for BMI are available from 2 weeks of age in the UK-WHO dataset, up to 20 years. Overlaps, as with height and weight, exist at 2 and 4 years.
- Head circumference is referred to as occipitofrontal circumference and appears as an `'ofc'` parameter. Reference data exist for both sexes from 23 weeks gestation to 17 years in girls, and 18 years in boys. There are overlaps as above where datasets meet.

4.1.7 Prematurity and Term

An infant is considered premature (preterm) if born below 37 weeks gestation. The reference data stops at 23 weeks, but the limits of viability may stretch occasionally below this. It is important to note that reference data on length do not exist until 25 weeks gestation, or 42 weeks gestation in the case of BMI. For babies born premature, a gestation is provided in weeks and supplemental days, which together with the birth and measurement dates, can be used to calculate a corrected decimal age. The reference data for these are found in the `uk_who_0_20_preterm.json` file.

Removal of Term Dates Averaging

The entire Term period (from 37-42 weeks gestation) used to be defined as a decimal age of exactly 0 years, and the Growth Chart Reference Group at the inception of the UK-WHO paper charts had previously stipulated that no growth data should be reported over the 2-week period after delivery in term infants.

The growth chart reference data covering this Term period used to be averaged across the period, so regardless of actual gestational age, all term-born children were considered to be the same gestation, for paper and PDF growth charts.

However, during the development of the Digital Growth Charts, the **dGC Project Board** determined we should abolish the 'averaging' effect of the concept of term, and simply correct all children for gestational age. This is because of evidence there *is* a difference between the outcomes of children born as early term and late term. More, the dGC makes it easy to correct for all gestational ages.

4.1.8 Helpful reference documents

These are some helpful references for understanding what centiles are, how they are calculated, and how they are used:

- **OpenHealthHub- What are centiles?**
- **CDC - Percentile Data Files with LMS Values**
- **Construction of LMS Parameters for the CDC 2000 Growth Charts**
- **The development of growth references and growth charts - T J Cole**

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4.2 Chart information for Health staff

4.2.1 How the UK-WHO Charts work

The UK–WHO growth chart combines World Health Organization (WHO) standards with UK 1990 preterm and birth data:

- The chart for birth measurements (23–42 weeks gestation) is based on British children measured around 1990.
- The chart from 2 weeks to 4 years of age is based on the WHO growth standard, derived from measurements of healthy, non-deprived, breast-fed children of mothers who did not smoke.
- The UK 1990 growth reference for children is used from 4 years - 20 years.
- The charts depict a healthy pattern of growth that is desirable for all children, whether breast-fed or formula-fed, and of whichever ethnic origin.

4.2.2 Reason for combining UK 1990 and WHO 2006

Though the UK 1990 data spans 23 weeks gestation to 20 years old, it also includes children who were bottle-fed and breast-fed. Thus, the breast-fed cohort from the WHO 2006 cohort were deemed more accurate and replaced the UK 1990 for the 2 week to 4 year age groups. As the UK 1990 data are no longer used for children in this age bracket, they have been omitted to create a continuous data set.

The final dataset has 4 parts:

1. Pre-term (up to 42 weeks)
2. Infants (under 2 years)
3. WHO 2006 children (< 4 years)
4. UK 1990 children (4 years - 20 years)

Where datasets overlap, there are 2 ages at the junction, one from each of UK90 and WHO 2006. There is a purposeful step at the junction between the data sets. There is an additional step at 2 y in height/length where children go from being measured lying down to standing up.

4.2.3 Instructions for the Down Syndrome charts

The PDF linked below was produced in 2012 to accompany the Down Syndrome charts. In due course, we will update and reformat the text and adapt the presentation for the API version of the charts. Note that the Down Syndrome AAP (USA) reference is also supported.

PDF Down Syndrome Chart Information (2012)

4.2.4 Centile Terminology
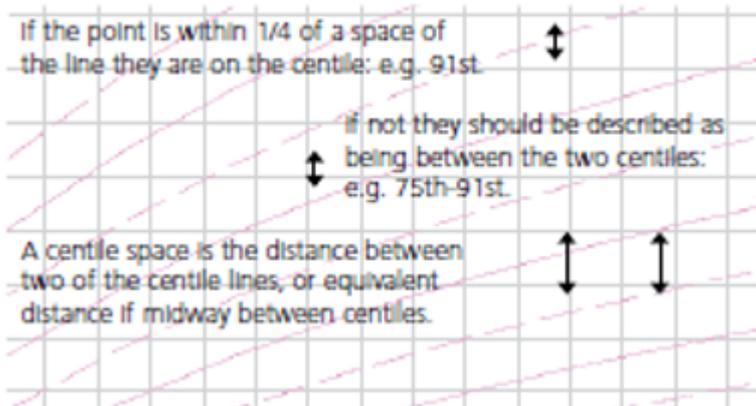
These charts indicate a child's size compared with children of the same age and maturity who have shown optimum growth. The chart also shows how quickly a child is growing. The centile lines on the chart show the expected range of weights and heights (or lengths); each describes the number of children expected to be below that line (e.g. 50% below 50th, 91% below the 91st). Children come in all shapes and sizes, but 99 out of 100 children, who are growing optimally, will be between the two outer lines (0.4th and 99.6th centiles); half will lie between the 25th and 75th centile lines.

Being very small or very big can sometimes be associated with underlying illness. There is no single threshold below which a child's weight or height is definitely abnormal, but only 4 per 1000 children who are growing optimally are below the 0.4th centile, so these children should be assessed at some point to exclude any problems. Those above the 99.6th centile for height are almost always healthy. The BMI should be calculated if weight and height centiles appear very different.

4.2.5 Measuring children

Anyone who measures a child, plots or interprets charts should be suitably trained, or be supervised by someone qualified to do so. For further information and training materials, see the **RCPCH website**.

!!! tip "Clothing and nappies" - When measuring children **up to 2 years**, remove all clothes and nappy. - Children **older than 2 years** should wear minimal clothing only. - Always remove the child's shoes.

- Weight: use only Class III clinical electronic scales in metric setting.
- Length: (before 2 years of age): proper equipment is essential (length board or mat). Measurers should be trained.
- Height: (from 2 years): position head and feet as illustrated, with child standing as straight as possible. Measure height recorded to the last millimetre. A correctly installed stadiometer, or approved portable measuring device rigid rule with T piece, is the only equipment that can be reliably used.
- Head circumference: use a narrow plastic or paper tape to measure where the head circumference is greatest.

4.2.6 Frequently Asked Questions

When to weigh?

Babies should be weighed in the first week, as part of the assessment of feeding, and after as needed. Recovery of birthweight indicates that feeding is effective and the child is well. Once feeding is established, babies should usually be weighed at around 8, 12 and 16 weeks and 1 year at the time of routine immunisations.

Weights measured too close together may be misleading, but if there are concerns about **faltering growth**, weight should be measured more often, but usually no more often than:

- daily if less than 1 month old.
- weekly between 1–6 months old.
- fortnightly between 6–12 months.
- monthly from 1 year of age.

When to measure length or height?

Length or height should be measured whenever there are any worries about a child's weight gain, growth or general health. Measure length until age 2; measure height after age 2. A child's height is usually slightly less than their length.

How to assess weight loss after birth?

Weight gain in the early days varies a lot from baby to baby, however, by 2 weeks of age most babies will be on a centile close to their birth centile. Most babies lose some weight in the first 3-4 days after birth, but most have regained birth weight by 3 weeks of age. Careful clinical assessment and evaluation of feeding technique is indicated when weight loss exceeds 10% or recovery of birth weight is slow.

Calculating the percentage weight loss is a useful way to identify babies who need assessment. Percentage weight loss can be calculated as follows:

$$\% \, Weight \, loss = \frac{Birth \, weight - Current \, weight}{Birth \, weight} \times 100\%$$

For example, a child born at 3.500kg who drops to 3.150kg at 5 days has lost 350g or 10%; in a baby born at 3.000kg, a 300g loss is 10%.

What is a normal rate of weight gain and growth?

Babies do not all grow at the same rate, so a baby's weight often does not follow a particular centile line, especially in the first year. Weight is most likely to track within one centile space (the gap between two centile lines, see diagram). In infancy, acute illness can lead to sudden weight loss and a weight centile fall, but on recovery the child's weight usually returns to its normal centile within 2–3 weeks. However, a sustained drop through 2 or more weight centile spaces is unusual (fewer than 2% of infants), and should be carefully assessed by the primary care team, including measuring length/height.

Because it is difficult to measure length and height accurately in pre-school children, successive measurements commonly show wide variation. If there are worries about growth, it is useful to measure occasionally over time; most healthy children will show a stable average position over time.

UK children have relatively large heads compared to the WHO standard, particularly after the age of 6 months. After the age of 6 weeks, a head circumference below the 2nd centile will be seen in only 1 in 250 children. A head circumference above the 99.6th centile, or crossing upwards through 2 centile spaces, should only cause concern if there is a continued rise after 6 months, or other signs or symptoms.

Why do the length/height centiles change at 2 years?

The growth standards show length data up to 2 years of age, and height from age 2 onwards. When a child is measured standing up, the spine is squashed a little, so their height is slightly less than their length; the centile lines shift down slightly at age 2 to allow for this. It is important this difference does not worry parents; what matters is whether the child continues to follow the same centile after the transition.

When is further assessment required in school aged children?

If any of the following occur:

- Where weight or height or BMI is below the 0.4th centile, unless already fully investigated at an earlier age.
- If the height centile is more than 3 centile spaces below the mid-parental centile.
- A drop in height centile position of more than 2 centile spaces, as long as measurement error has been excluded.
- Smaller centile falls or discrepancies between child's and mid-parental centile, if seen in combination, or if associated with possible underlying disease.
- If there are any other concerns about the child's growth.

How do SDS charts work?

Centiles are derived mathematically from standard deviation scores (SDS), also known as z scores. These values in turn are related to p values - the probability of finding a child with a given measurement in a sample. An SDS of 0 equates to the 50th centile, with positive values relating to centiles above this, and a negative value relating to centiles below. The benefit of reporting and charting SDS rather than centiles is that values can all be plotted on the same chart. It is important to note that plotting the z score against age must be against the *corrected* age, not the *chronological* one, as the chart otherwise becomes crowded and hard to interpret.

4.2.7 Calculations as yet not implemented in the API

Weight–height to BMI conversion chart

$$BMI = weight; in; kg/(height; in; m)^2$$ BMI indicates how heavy a child is relative to his or her height and is the simplest measure of thinness and fatness from the age of 2, when height can be measured fairly accurately. In a child over 2 years of age, the BMI centile is a better indicator of overweight or underweight than the weight centile; a child whose weight is average for their height will have a BMI between the 25th and 75th centiles, whatever their height centile. BMI above the 91st centile suggests that the child is overweight; a child above the 98th centile is very overweight (clinically obese). BMI below the 2nd centile is unusual and may reflect under-nutrition.

Percentage median BMI

The child or young person's BMI is compared with the median value for age and sex and expressed as a percentage. It is used mainly for risk assessment in eating disorders.

Mid-Parental Height

When assessing a child's stature, comparing their height centile against that of their parents is helpful for clinicians, to find out if the child is short or tall for the family. How this is calculated has been debated in the medical literature and clinicians often use a simple calculation which involves adding 13 cm to a mother's height (for a boy) or subtracting 13 cm from a father's height (for a girl) and then taking the average of that and the other parent. The RCPCH charts have a calculator however that research on large numbers of children to shows a more accurate way: instead, an average is taken of the parents' height z-scores (standard deviation scores) and this is multiplied by a factor calculated from linear regression in a large cohort of children. This has the effect of correcting mid-parental particularly where there is a large difference in heights between parents. This is shown on the RCPCH paper growth charts in an inset on the top right-hand corner of the charts. The methodology is repeated in the digital growth chart calculations. For more information on this, see: **The strengths and limitations of parental heights as a predictor of attained height, Charlotte M Wright, Tim D Cheetham, Arch Dis Child 1999;81:257–260**

An further improvement on the paper charts has been to render the mid-parental height centile rangesnext to the latest plotted measurements, rather than at the top.

Predicting adult height

Parents like to know how tall their child will be as an adult. The child's most recent height centile (aged 2–4 years) gives a good idea of this for healthy children. Plot this centile on the adult height predictor to the right of the height chart to find the average

- 64/173 -

adult height for children on this centile. This will predict the child's adult height based on their current height, but with a regression adjustment to allow for the tendency of very tall and short children to be less extreme in height as adults. Four out of five children will have adult heights that are within ± 6cm of this value.

> **ℹ️ info**

Adult Height Prediction is an upcoming feature of the Digital Growth Chart API

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4.3 Date and Age Calculations

4.3.1 Decimal Age

Decimal age is expressed as a decimal fraction in units of years. It is calculated as the number of days / 365.25. The extra 0.25 is to account for the leap year which comes round every 4 years.

A pregnancy lasts 40 weeks (280 days). This is calculated from the date of the baby's mother's last menstrual period. In fact, from that date, ovulation occurs midway through the following cycle (on average 14 days into a 28-day cycle). This means that from conception, a pregnancy actually lasts only 266 days. Babies are considered to have been born 'term' if delivered anywhere from 37 to 42 weeks gestation (3 weeks before to 2 weeks after the due date).

The due date is referred to as the Estimated Date of Delivery (EDD).

4.3.2 Gestational Age / Post-menstrual Age

Gestational age at birth is the gestation at which the infant was born, and represents the number of weeks (and extra days) since the last menstrual period. It is often shortened to gestational age, with "at birth" being assumed.

After delivery, the gestational age of preterm infants is often tracked by clinicians in addition to chronological age (and is sometimes referred to as post-menstrual age).

4.3.3 Chronological Decimal Age

This is the time elapsed since birth, in years, irrespective of the gestational age at birth. For example the chronological age at EDD, i.e. at 40 weeks gestation, of a baby born at 24 weeks gestation would be 16 weeks or (16 x 7)/365.25 = 0.31 years.

4.3.4 Corrected Decimal Age

Used for preterm children, the *corrected decimal age* is calculated from their *due date*, rather than their birth date (which will be earlier than their due date, owing to prematurity).

This correction adjusts for the immaturity of preterm babies born early. The process is referred to as *gestational age correction* (or sometime 'adjustment'). Prior to digital growth charts, it was a manual process.

The previous convention was to apply gestational age correction to all babies born before 37 weeks gestation. For those born at 32-36 weeks, the correction was applied until the baby was 1 year old (in *corrected* years), and below 32 weeks until they were 2 years old (in *corrected* years). The reason for this was because correcting past these ages was practically very difficult on a paper chart; years on the x-axis in older children are closer together and the impact of age correction becomes less pronounced.

Now that correction can be applied automatically and accurately by the API at any age, the Project Board decided that age correction should be applied throughout childhood. Of course, the difference between corrected and uncorrected age becomes less apparent as the child gets older.

A further Project Board decision was to extend the gestational age correction to all children, including those born at term. This represents a departure from the previous practice of using a common reference for all term gestation babies, averaged across gestations 37-42 weeks. Now term babies, like preterm babies, are assessed using their gestational age. Equally, babies born post 40 weeks are corrected backwards. There is no upper limit to this.

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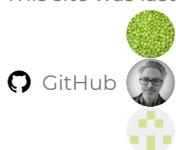
4.4 Growth Chart References

Growth Charts are built from reference data. A number of different datasets are available, and in the UK, we currently use a hybrid of two: the British 1990 or **UK 1990** dataset and the **World Health Organization (WHO)** dataset. The current UK charts are referred to as **UK-WHO**.

In general, datasets or growth references relate to the population of a geographical area (UK90, US Centers for Disease Control or CDC 2000), or are specific to a particular condition or disease state.

As part of this project, we have internationally catalogued the available datasets or growth references. The UK references are only usable under MRC licence. The WHO or CDC data are freely available open data.

Though not an exhaustive list, the aim is a repository for all LMS references - not only for growth, but for all other physiological parameters. This collection is incomplete at present. We welcome submissions to the repository to build the collection - please send **pull requests** or contact us on **growth.digital@rcpch.ac.uk**.

The codebase we have built is capable of utilising any reference or dataset, but there might need to be small configurations necessary to allow for the differences between them.

> **i**nfo
>
> We are working on a 'standard format' of JSON, which contains reference metadata alongside the LMS tables themselves, in a 'key-value' format that makes programmatic lookups consistent across different references. Along with the data file, we request the following: file name, parameters described, acknowledgement text, authors, publication / reference.

4.4.1 Reference Library

identifier	Age Range	Description	Country	Links
cdc2000		length/height, weight & head circumference for ages 0 to 19.9y; BMI 2 to 19.9y	🇺🇸	**link**
spirometry	4 - 80 years	FEV1, FVC, FEV1FVC & FEF2575	🇬🇧	**link**
down		Down Syndrome Growth Standards 2002	🇬🇧 🇮🇪	**link**
down		Down Syndrome Growth Standards 2015	🇺🇸	**link**
turner		Turner Syndrome, Heights 2002	🇬🇧 🇮🇪	**link**
uk-who	23 weeks - 20y	UK90 and WHO Child Growth Standards	🇬🇧	**link**
uk90	23 weeks - 20 years	UK 1990 reference data, reanalysed 2009	🇬🇧	**link**
who2006		WHO Child Growth Standards	🇺🇳	**link**
who2007		WHO Child Growth Standards	🇺🇳	**link**

NOTE: The UK-WHO Term reference is NOW DEPRECATED but still active on paper charts. It comprises average values at birth for weight, length and head circumference for all term births (gestations 37+0 to 42+6 weeks) computed from UK 1990 reference database .

4.4.2 Age Thresholds by Reference

reference table	measurement method	thresholds
WHO 2006	length / weight / head circumference / BMI	0 - 5 y
WHO 2007	length / weight / head circumference / BMI	5 - 19 y (weight 5-10y)
WHO (US)	length / weight / head circumference	0 -3 y
CDC[^3]	height / weight / bmi (extended)	2 - 20y
UK-WHO preterm	height[^1]	25 weeks - 42 weeks
UK-WHO preterm	weight[^1]	23 weeks - 42 weeks
UK-WHO preterm	head circumference[^1]	23 weeks - 42 weeks
UK-WHO infant [^2]	height or length / weight / BMI / head circumference	2 weeks - 4 years
UK-WHO child	height or length / weight / BMI	4 - 20 years
UK-WHO child	head circumference (boys)	4 - 18 years
UK-WHO child	head circumference (girls)	4 - 17 years
Down Syndrome (UK)	height / weight / BMI	0 - 20 years
Down Syndrome (UK)	head circumference	0 - 18 years
Down Syndrome (AAP - US)	height / head circumference	1mth to 20 years
Down Syndrome (AAP - US)	weight / BMI	0 to 20 years
Turner	height	1 to 20 years

Context

[^1]. Weight, and head circumference at birth (gestations 23 to 43 weeks) and length at birth (gestations 26 to 43 weeks), computed from UK 1990 reference database and shown by week - UK90 preterm reference [^2]. This is the WHO standard for weight, BMI and head circumference from 2 weeks to 4 years, for length 2 weeks to 2 years and height 2-4 years. It is shown by week to 13 weeks and then by calendar month. It is exactly the same data as the LMS data included in the Z-score tables accessed from the WHO website **WHO**, except there is no birthweight. [^3]. CDC: runs from 2y to 20 y. From 0-2y the CDC interposes its own version of WHO (2006). - height / weight / BMI centiles 0-2 y (CDC) with extended BMI centiles included (published 2022) - height / weight / head circumference 0-2 y (WHO - US) - preterm data for height / weight / head circumference exists as the Canadian Fenton reference. This has not been implemented

To be added

1. **LMSdata_BP** systolic & diastolic blood pressure for ages 4 to 24 yr.

Citations

1. Freeman JV, Cole TJ, Chinn S, Jones PRM, White EM, Preece MA. Cross sectional stature and weight reference curves for the UK, 1990. Arch Dis Child 1995;73:17-24.
2. Cole TJ, Freeman JV, Preece MA. 1998. British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. Stat Med 1998;17:407-29

3. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/Height-for-age, Weight-for-age, Weight-for-length, Weight-for-height and Body Mass Index-for age. Methods and Development. 2006. ISBN 924 15 4 693X.

4. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Head circumference-for-age, arm circumference-for-age, triceps skinfold-for-age and subscapular skinfold-for age. Methods and Development. 2007. ISBN 978 92 4 1547185.

5. Down syndrome centiles - Styles ME, Cole TJ, Dennis J, Preece MA. New cross sectional stature, weight and head circumference references for Down's syndrome in the UK and Republic of Ireland. Arch Dis Child 2002;87:104-8. BMI centiles added 11/11/2013

6. Lyon AJ, Preece MA, Grant DB. Growth curve for girls with Turner syndrome. Arch Dis Child 1985;60:932-935.

7. Zemel BS, Pipan M, Stallings VA, Hall W, Schgadt K, Freedman DS, Thorpe P. Growth Charts for Children with Down Syndrome in the U.S. Pediatrics, 2015.

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4.5 Frequently Asked Questions for Clinicians

4.5.1 Q: What are the main differences between the old paper or PDF Growth Charts and the dGC Project?

A: Paper or PDF charts required a human to plot the measurement and then read off the Centile. Digital Growth Charts automatically calculate Centiles and SDS (Standard Deviation Score) from the measurements, and plot these on a digital chart for you.

Not only do the charts calculate the centile and SDS more accurately than the paper charts, but they also handle correction for prematurity if present. Digital growth charts also support all the features of a paper chart used by paediatric endocrinologists (mid-parental height and bone ages), as well as extra features such as event tracking, cut and paste, pan and zoom.

4.5.2 Q: How do I get the RCPCH Digital Growth Charts in my EPR?

A: As a first step, we would suggest initial discussions with the CIO (Chief Information Officer) and CCIO (Chief Clinical Information Officer) at your trust, or their equivalents in your place of work.

Hopefully, this leads to further discussion with the IT team at your place of work, and establishing lines of communication with the supplier of the Electronic Patient Record (EPR).

Many EPR suppliers have already started the process of integrating the RCPCH Digital Growth Charts API into their product, and we are happy to assist vendors with integration once they purchase a subscription. The more clinicians who are asking for Digital Growth Charts, the more likely it is that suppliers will prioritise this essential part of digital transformation.

4.5.3 Q: How much do the RCPCH Digital Growth Charts APIs cost?

A: The APIs themselves are run on a sustainable non-profit basis by the RCPCH, which is a charitable organisation. The aim is for modest revenues from the API to be fed back into development of future APIs and new features.

Pricing tiers for the API are **available on the RCPCH website**. Usually, the EPR vendor or integration service would pay directly, however the costs are likely to be passed on to you, the customer.

Pricing depends on the volume of requests the vendor requires and the amount of support they need.

The process of integrating the API into an existing EPR product is technically straightforward and the amount of work is modest. EPR suppliers may levy a fee for this additional integration work, however after being done once for a product, there should be zero to minimal additional work rolling out to other sites, so you should check whether the vendor has already deployed the dGC elsewhere.

4.5.4 Q: Can I try out the Digital Growth Charts APIs?

A: Yes, you can use the demo site at **https://growth.rcpch.ac.uk/** to evaluate the service.

4.5.5 Q: If we have a calculated centile from the API, then why do we need the traditional 'curved-lines' growth charts at all?

A: Good question. Maybe, this style of chart will no longer be needed in the future. Perhaps they will be replaced by SDS charts, which would allow us to view height, weight, head circumference, and BMI all on one chart too!

The traditional growth charts were actually a form of 'paper calculator' for the centile values. The clinician plotted the age, height/weight data, and then looked for which centile lines it was between: this was the data read off and recorded. We would also keep the charts for future plotting.

The Growth Charts API removes the need for this step, since **we** calculate the centiles for you. However, another important function of the chart was to visualise **trends** in the growth. Our API does not do this, so there will be a need for some form of chart to visualise the trend.

Initially, we expect that clinical users will want to see the traditional growth chart, out of simple familiarity. But in time, researchers may develop better visualisations of the trend in centiles/SDS, which don't necessitate such confusing curvy charts. The future of displaying growth trends is entirely open to new ideas and innovation.

4.5.6 Q: Where can I see your clinical safety documentation?

A: Our clinical safety documentation is completely open and public, and is all in the **Clinical Safety** section.

Feedback is welcome: contact **growth.digital@rcpch.ac.uk**, including "*Clinical Safety:*" in the subject for ease of routing to the Clinical Safety Officer. Alternatively, you can **create an Issue in the documentation site source code on GitHub**, or talk to us on our **Forum**.

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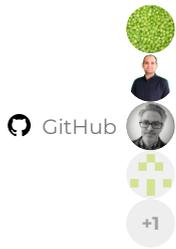
5. Researchers

5.1 How to Use RCPCHgrowth in Research

It is common to need to calculate z-scores and centiles against children's growth measurements for datasets in research, and using the RCPCH API is not always possible, for example when operating inside a Secure Research Environment (SRE) or when working offline. The RCPCHgrowth python package can be installed inside a Trusted Research Environment or Secure Data Environment and the calculations can be run locally, using familiar tools like Jupyter Notebooks.

5.1.1 Getting Started

Python notebooks are popular as they combine Markdown-formatted text with computational tools like `pandas` and `scipy` or `numpy`.

The notebooks themselves are their own best documentation. To get them running there are two options: using Docker, or installing directly into your local Python environment.

Python Environment

Setting up a Python environment is discussed in detail **here**

Once a virtual environment has been created, RCPCHGrowth can be installed directly:

```
pip install rcpchgrowth['notebook']
```

The `['notebook']` is optional - it automatically installs all the notebook related dependencies. These are essential if you are planning to use the notebooks. If you already have these installed, you can simply:

```
pip install rcpchgrowth
```

To access the calculations within the RCPCHGrowth package, import it to access the functions in your `.ipynb` file.

```
import rcpchgrowth
```

Docker

The Docker setup helps you easily interact with the notebook examples provided by RCPCH. You will need Docker **installed**

Then from the command line:

```
s/up
```

This will create a container which will build RCPCHGrowth and in the console you can follow the link:

```
...
rcpchgrowth-dev  | [I 2025-08-17 15:32:27.147 ServerApp] jupyterlab | extension was successfully loaded.
rcpchgrowth-dev  | [I 2025-08-17 15:32:27.147 ServerApp] Serving notebooks from local directory: /app/notebooks
rcpchgrowth-dev  | [I 2025-08-17 15:32:27.147 ServerApp] Jupyter Server 2.16.0 is running at:
rcpchgrowth-dev  | [I 2025-08-17 15:32:27.147 ServerApp] http://7f2a9b1a289c:8888/lab
rcpchgrowth-dev  | [I 2025-08-17 15:32:27.147 ServerApp]     http://127.0.0.1:8888/lab
rcpchgrowth-dev  | [I 2025-08-17 15:32:27.147 ServerApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).
...
```

which will open the notebooks in your browser.

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6. Parents

6.1 Information for Parents

6.1.1 Why do we use growth charts?

The UK-WHO growth charts show how your child compares with other children of the same age and sex. They are drawn using measurements from many infants and children: from ages two weeks to 4 years, they use measurements of healthy breastfed babies collected by the World Health Organization (WHO) in six different countries. These charts show how healthy babies are expected to grow, whatever their ethnic origin and however they are fed.

At birth, and for babies born more than 3 weeks early, the charts use the birth weights of British infants and from age 4 to 20 years, measurements of British children collected in the 1980-90s. These charts show how children used to grow and gain weight when obesity was less common.

6.1.2 What do the charts show?

Children come in all shapes and sizes, so no two filled-in charts will look the same, but the chart helps us to check that your child is growing and developing as expected. Each centile line on the chart describes the number of children expected to be below that line, so half of all healthy children will be below the 50th centile, but only 9% below the 9th . Only one in a hundred children will be outside the two outer lines (0.4th and 99.6th centiles). As more measurements are collected and plotted, the chart also shows a child's growth pattern.

6.1.3 When and how to weigh

Weigh babies and children up to 2 years of age without clothes or nappy, as this can make a big difference to the weight.

Be aware that different scales can give different readings, particularly if they are not electronic. If you notice this, try to take your baby/child to the same place for weighing each time.

Your baby should be weighed in the first week as part of the assessment of feeding. It is normal for a baby to lose weight in the first few days after birth. Most babies regain their birth weight by 3 weeks of age. Regaining weight after birth helps to show that your baby is healthy, and that feeding is going well.

After that, your baby will usually be weighed only when seen routinely, unless there is concern.

Some parents like to have their babies weighed often, but this can be misleading and cause unnecessary worry. For example, if one week your baby was weighed just after a big feed but the next week they were weighed before a feed, it could look as if they had not gained weight. Longer gaps between weights are more likely to show the true weight change. Your health visitor or doctor may recommend more frequent weights for children if there are concerns about slow weight gain or weight loss, but it is still important not to weigh too often:

Age	No concerns	If there is slow weight gain or weight loss, no more often than:
Up to 3 months	Age 5-10 days and at 8 and 12 weeks with immunisations	Weekly
3-6 months	Age 16 weeks with immunisations	Fortnightly
6-12 months	Age 1 year with immunisations	Monthly
Over 12 months		Every 6-8 weeks

Remember that if you want advice, you can always phone your health visitor or visit the clinic, without having your child weighed.

6.1.4 Measuring height and length

Up to the age of 2 years length, rather than height, is measured, lying down without shoes or nappy. Special equipment is needed for this, and it is difficult to measure length accurately, so this will not be done every time your child is seen. Usually, your Health Visitor or GP will only measure length if they are worried about your child's growth or weight gain.

After 2 years of age, height is measured, standing up with shoes removed. It is important to measure height accurately, using proper measuring equipment. A tape measure or a book against the wall is not accurate enough. It is not usually necessary to measure height if your child is growing as expected. Once they go to school, in England, they will be measured with their classmates for the National Child Measurement Programme in their reception class and their last year in primary school.

6.1.5 Body mass index

From age 4 years, your child's Body Mass Index (BMI) can be calculated from a measure of both weight and height. This measures how much weight your child is carrying, allowing for their height. It is calculated by dividing their weight (in kilograms) by their height (in metres), squared. The cut-off for a high BMI varies with age, but if a child's BMI is above the cut-off, this generally suggests that they are overweight. A child with a low BMI is more likely to have a lean build rather than too little fat. Your GP or other health professional caring for your child will be able to discuss your child's BMI with you.

The NHS has a website which can calculate Body Mass Index **https://www.nhs.uk/health-assessment-tools/calculate-your-body-mass-index/** for children over 2 years of age.

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6.2 Frequently Asked Questions

I didn't breastfeed, or I stopped early – are these charts still right for my baby?

The charts show how healthy babies grow. Babies grow most naturally when fed on breast milk and this chart helps you check that your baby is still growing in the same healthy pattern.

My baby was born prematurely. Is this taken into account?

If your baby was born 4-8 weeks early, weight and head circumference will be plotted on the preterm section of the charts, until they are 2 weeks past their due date. After this, weight and other measurements will be plotted on the main chart using an arrow, with the tail at your baby's actual age and the head at their 'corrected' age, allowing for the number of weeks your baby was born early. For babies who are born more than 8 weeks early, there is a special chart that automatically allows for prematurity which will be used until they are two years old.

How do I know my baby's weight is OK in the first 2 weeks?

Your baby's weight at about 2 weeks of age should be compared with their birth weight. If your baby loses more than a tenth of their birth weight, or takes more than 3 weeks to get back to their birth weight, your midwife or health visitor will check how your baby is feeding, make suggestions that may help, and may recommend a check-up by your GP or refer you to a breast feeding specialist. Your midwife or health visitor will then weigh them again to follow their progress.

My child was ill and lost some weight, what should I do?

Children often lose some weight when they are not well. Once your child recovers from the illness, their weight should go back to the centile it was on before the illness within 2–3 weeks.

My baby's weight was on one centile, but now it's nearly down to the next line – is this normal?

It is normal for your child's weight centile drop by up to one centile space (the distance between two centile lines) between measurements, but it is less common for a child's weight to cross two spaces; if this happens your health visitor or doctor may want to measure their length, ask about their eating and possibly do some investigations.

My baby's head size has risen to the top of the centile chart – should I be worried?

British children have relatively large heads compared to the WHO standard, particularly after the age of 6 months. It's fairly common for the head centile to be at the very top of the chart or even above it. This should only cause concern if the head centile goes on rising after the first few weeks, or if there are other concerning signs or symptoms.

Why are there only two kinds of chart - 'boys' and 'girls'?

Although some children may identify as a sex which is not the same as the sex they were identified at birth, their growth will still in most cases follow the chart ('boys' or 'girls') which most closely represents their sex assigned at birth. If your child is under the care of a specialist in growth, gender, or hormones, they will be able to advise you on which chart to use.

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7. Contributors

7.1 Getting Started Developing the Digital Growth Charts project

> ⚠️ **Warning**
>
> **This section of the documentation is for people developing and extending the dCG API software tools - *not* for users or integrators of the Digital Growth Charts API.**
>
> **If you are an integrator and want to use the dGC API and other components to build growth charts into your digital health solution then go to [Integrators/Support](#).**

If you would like to get involved in *developing* and *improving* the codebase of the RCPCH Digital Growth Charts API project, these and following pages detail some of the setup and working practices we are using.

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7.2 Running locally with Python

7.2.1 Scripts

The `scripts/` folder contains some simple scripts to help with development. To run them, ensure they are made executable in your filesystem (they may not be by default depending on your OS).

You can do that in whichever File > Permissions > Make Executable menu your desktop provides.

For *nix environments or the WSL, you can type `chmod +x <filename>` to add executable permissions.

Run all scripts from the root of the project, or they won't work.

7.2.2 Running the dGC Server locally with Python

> **Note**
>
> Some of this setup is obvious to experienced Python developers, but it's documented here so we all know the *same* obvious 😁. This helps us reduce development difficulty and speeds up onboarding of new team members.

Managing Python versions, and dependencies such as libraries

MANAGING PYTHON VERSIONS

Currently, we use Python 312.0 for these algorithms.

There are different tools available to help you manage multiple different Python versions on the same machine. We use `pyenv` here, however, there are other ways to solve this problem. If you already have a preferred method, you should be able to use that.

MANAGING LIBRARY / DEPENDENCIES VERSIONS

If you `pip install` every dependency in `requirements.txt` **globally** on your machine, you can encounter problems if you develop other Python applications on the same machine. For example, different projects may need different versions of the same library.

Our solutions are:

1. If using Mac / Linux, use `pyenv-virtualenv` which is an extension to `pyenv` which helps you to manage separate 'environments' for each Python project you work on.
2. If using Windows, use `virtualenv`, which is a popular too to create isolated Python environments for Python libraries.

   Please see this **StackOverflow post** to find out more about the differences.

> **Reason for not using `pyenv` on Windows**
>
> `pyenv` does not directly support Windows. There *is* a **Windows port** in development, however, it is simpler to just use `virtualenv` (and also leads to fewer headaches setting up the development environment!).

Mac/Linux - installing `pyenv`

pyenv installer

After installing and setting up `pyenv`, the correct Python version will be automatically selected when you navigate to the directory containing this repository, because of the `.python-version` file.

EXAMPLE SETUP COMMANDS FOR THIS REPOSITORY

`git clone` this repository into a suitable location on your development machine

```
git clone https://github.com/rcpch/digital-growth-charts-server.git
```

`cd` into the directory

```
cd digital-growth-charts-server
```

Install the correct Python version

```
pyenv install 3.12.0
```

Create a virtualenv for this project 'growth-charts', abbreviated to 'gc-3.8' using Python 3.12.0

```
pyenv virtualenv 3.12.0 dgc-server
```

> 🔥 **Auto-selection of Python and virtualenv**
>
> Using 'dgc-server' as the name will enable it to be automatically selected when navigating to this repo (but you *can* call your own virtualenv whatever you like). This all works using the `.python-version` file in the project root. This can contain either a Python version name which `pyenv` recognises, or it can contain a virtualenv name, which `pyenv` will select for you (and this automatically selects the Python version too).
>
> A helpful article about this is here: **https://realpython.com/intro-to-pyenv/#activating-your-versions**.

CHECK VIRTUALENV CREATION WORKED

`pyenv virtualenv`s should return something like:

```
dgc-server (created from /home/my-user/.pyenv/versions/3.12.0)
```

Activate the virtualenv manually if it's not already selected

```
pyenv activate dgc-server
```

Install the dependencies inside this virtualenv

```
pip install -r requirements.txt
```

Refer to the **pyenv command reference** if you need further information on `pyenv`

> ### 🔥 Extra development packages that may be required on some setups
>
> On some platforms, you may need the additional development header packages. On Ubuntu/Linux Mint this was required when using `pyenv` and thus compiling Python from source. This should not be necessary if you're running a binary Python, it only affects setups which are compiling a specific Python version from source, on demand, such as `pyenv`.
>
> ```
> sudo apt-get install liblzma-dev libbz2-dev zlib1g-dev
> ```
>
> and then recompile the Python that `pyenv` built earlier
>
> ```
> pyenv install 3.8.3
> ```

> ### 🔧 If installing on macOS Big Sur, pyenv install of python 3.12.0 and requirements.txt may fail
>
> To install 3.12 via pyenv, set the following 2 environment variables (requires homebrew installed versions of bzip2, openssl and zlib):

```
export CFLAGS="-I$(brew --prefix openssl)/include -I$(brew --prefix bzip2)/include -I$(brew --prefix readline)/include -I$(xcrun --show-sdk-path)/usr/include"
export LDFLAGS="-L$(brew --prefix openssl)/lib -L$(brew --prefix readline)/lib -L$(brew --prefix zlib)/lib -L$(brew --prefix bzip2)/lib"
```

Now, run the pyenv install with a patch for Big Sur:

```
pyenv install --patch 3.8.0 < <(curl -sSL https://github.com/python/cpython/commit/8ea6353.patch\?full_index\=1)
```

Now, once ready to install requirements.txt with pip, set one more environment variable:

```
export SYSTEM_VERSION_COMPAT=1
```

Skip the following Windows section, to **Start the API server natively with default settings** once complete.

Windows - installing `virtualenv`

`git clone` this repository into a suitable location on your development machine

```
git clone https://github.com/rcpch/digital-growth-charts-server.git
```

`cd` into the directory

```
cd digital-growth-charts-server
```

First, ensure you update `pip`, then use it to install `virtualenv`

```
python.exe -m pip install --upgrade pip

pip install virtualenv
```

Create a virtual environment called `env` (or any name you want - but make sure to reference the correct name going forwards)

```
py -m venv env
```

Navigate to the `/Scripts` folder

```
cd env/Scripts
```

Run `activate.bat`

```
activate.bat
```

You should then see the name of your virtual environment prepend your prompts e.g.

```
(env) C:\Users\...\digital-growth-charts-server\env\Scripts>
```

Now, go back to the root directory

```
(env) C:\Users\...\digital-growth-charts-server\env\Scripts> cd ..
(env) C:\Users\...\digital-growth-charts-server\env\> cd ..
```

And install the dependences e.g.

```
(env) C:\Users\...\digital-growth-charts-server> pip install -r requirements/common-requirements.txt
```

Start the API server natively with default settings

From the application's root directory, type

Mac/Linux

```
s/uvicorn-start
```

Windows

```
uvicorn main:app --reload
```

You should see messages from the uvicorn development server like:

```
INFO:     Uvicorn running on http://127.0.0.1:8000 (Press CTRL+C to quit)
INFO:     Started reloader process [61645] using watchgod
INFO:     Started server process [61647]
INFO:     Waiting for application startup.
INFO:     Application startup complete.
```

There may be other messages at the end of the output for other processes which run on server start-up.

If you need to vary any of the parameters passed, you can either:

1. Modify the start-up script

2. Manually pass the commands to the shell, using the commands in the start-up script as a guide

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7.3 Developing locally in a Docker container

Docker containers avoid many of the problems and irritating snags related to conflicting versions of Python and libraries when setting up a development environment on your machine.

In the Dockerized environment, all the code is running in an isolated virtual environment, so there are no version conflicts. This is similar to a virtual machine, but more efficient in terms of resources.

The Docker container closely resembles our deployment environment, helping to prevent "Well It Works On *My* Machine"-type deployment difficulties.

7.3.1 Running the API server locally in Docker

If you haven't already, `git clone` the server repository to a suitable place on your local machine.

```
git clone https://github.com/rcpch/digital-growth-charts-server.git
```

7.3.2 Scripts

The `s/` folder contains some simple scripts to help with development.

To run them, ensure they are made executable in your filesystem. This may not happen by default, depending on your OS. You can do that in whatever File > Permissions > Make Executable menu your desktop provides. For *nix environments or the WSL, you can type `chmod +x <filename>` to add executable permissions.

Run all scripts from the root of the project, or they won't work.

7.3.3 Build the Docker image with all required dependencies

Run the `s/up` script, which builds the Docker image with all the required dependencies/

This is useful for rapid development environment set-up. It pulls the `python` Docker base image, deletes any existing identically-named images, and builds the new image with the server code linked into it.

7.3.4 Start the Docker container

Run the `s/up` script, which will run the image in a Docker container.

The dGC server will then be running in development mode in the container. It will be available at **https://localhost:8000**.

Alternatively, if you want to make updates to the RCPCHGrowth package locally and then see how that works in the server without deploying first to PyPi, a useful script is `s/dev`. As above, this will create a Docker container but will install the local version of RCPCHGrowth as an editable (`pip install . -e`) instead of pulling the live version from PyPi. For this to work the folder containing the RCPCHGrowth package must be parallel and at the same level in the file system as your digital-growth-charts-server folder.

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+1
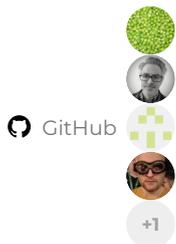
7.4 Testing the API

7.4.1 Using the Postman collection runner for tests

Postman, the API creation and testing tool, has a command line version of the tooling called **Newman**. Newman can run locally from the command line to test a locally-running version of the Digital Growth Charts API against all our standard queries.

At present, this only checks for a 200 (OK) response, not the actual content of the response. This will be improved in the near future.

```
newman run https://www.getpostman.com/collections/e1ac5fe1fef92761c2ed --env-var "baseUrl=localhost:8000"
```

This command gets the Collection information from our public RCPCH Postman workspace, and runs it against the local server.

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 GitHub

7.5 React Chart Component

7.5.1 Getting started

```
npm i --save @rcpch/digital-growth-charts-react-component-library
```

Circular import errors

Victory Charts are a dependency (see below), built on top of D3.js. On build, it is likely you will get an error relating to circular dependencies for some files in the d3-interpolate module. This issue is logged **here**.

Build error

v7.0.0 uses Rollup 4.11, and has the following build script in `package.json` : `"build": "ROLLUP_WATCH=false rollup -c -- bundleConfigAsCjs",` If users are using later versions, this has has changed and should be `"build": "ROLLUP -w -c -- bundleConfigAsCjs",` (thanks to Caroline Kirkhope at System C for noticing this)

Running the Charts Package locally

To run the package locally alongside the React client, there are some extra steps. Since the Chart library and the React client both use React, the Charts will throw an error if you import them in the `package.json` of your app from a folder on your local machine.

To develop the charts you can use Storybook: `npm run storybook`

or to run the client and charts together:

1. in the root of the chart library: `npm link`

2. in the root of the client: `npm link @rcpch/digital-growth-charts-react-component-library`

3. Note that you need to be running the same version of node (>=20) in both consoles for this symlink to work

4. If you get a 'hooks error' on running the client, delete react and react-dom from the node_modules folder in the library. Note you will need to reinstall it if you later run storybook.

5. For changes to appear in the client, in the library console: `npm run build`

7.5.2 Structure

This library has been written in Typescript. The main component is `<RCPCHChart>` : this returns the whole chart (either centiles or SDS), including toggle buttons. It takes the following `props` . Note that each component will only render a single chart type instance, so if you wanted to render a weight *and* a height chart, these must be done as two separate instances of the component.

RCPCH Digital Growth Charts React Component Library

Documentation for this has moved into the **Storybook**

The RCPCH Digital Growth Charts React Component Library supports both Centile Charts and SDS Charts. Each chart is created on instantiation for the `<RCPCHChart />` component with the relevant props. Note that there needs to be a single instance of the component for each chart rendered - for example, if height and weight charts are requested, two instances of the component are required.

More detail on props, particularly for themes or individual styles, is found in the Storybook docs. RCPCH provide 4 supported themes that include the traditional pink and blue charts, a monochrome theme as well as themes in line with RCPCH colours. For those who have more specific requirements, a custom theme is also provided where developers can override individual styles.

To support this, a **Theme Builder** is provided to generate the necessary style props.

- 83/173 -

> ☰ **Requests for additional functionality in props**
>
> In time, more props can be added if users request them. If you have requests, please post issues on our **GitHub** or get involved to contribute as below.

WHAT IF I CAN'T USE REACT?

Colleagues in health care environments are often not easily able to use React. A further option offered is to import React, React-Dom and the RCPCH Digital Growth Charts React Component Library in the head tag from a CDN.

This is addressed **here**

Mid-Parental Height

`midParentalHeightData` : This is the return value from the RCPCH API and takes the structure:

> ✏️ **midParentalHeightData**
>
> ```
> export interface MidParentalHeightObject {
>     mid_parental_height?: number;
>     mid_parental_height_sds?: number;
>     mid_parental_height_centile?: number;
>     mid_parental_height_centile_data?: Reference[]
>     mid_parental_height_upper_centile_data?: Reference[]
>     mid_parental_height_lower_centile_data?: Reference[]
>     mid_parental_height_lower_value?: number
>     mid_parental_height_upper_value?: number
> }
> ```

This returns a mid-parental height, mid-parental SDS and centile, along with the centile data if the user wishes to plot a mid-parental centile. The structure of the Reference and Centile interfaces is:

> ✏️ **Reference and Centile interface structures**
>
> export interface Reference { [name: string]: ISexChoice } export interface ICentile { centile: number, data: IPlottedCentileMeasurement[], sds: number } export interface IPlottedCentileMeasurement { "l": string | number, "x": number, "y": number } export interface ISexChoice { male: IMeasurementMethod, female: IMeasurementMethod } export interface IMeasurementMethod{ height?: ICentile[], weight?: ICentile[], bmi?: ICentile[], ofc?: ICentile[], }

Centile data are returned from the RCPCH API in this same structure, though no API call is made from this component - all the centile data for all the references is included.

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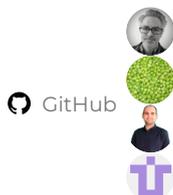
7.6 React Client

7.6.1 Developer documentation

The demonstration React client for the dGC API is built in React (Vite) and styled with Semantic UI React. It is intended as a good starting point for understanding the dGC API backend and serves as a prototype client from which you can build your own client, if that is what you require.

It's important to understand the three parts of the dGC platform that are in play here:

1. **React client application** - this comprises the left sidebar with the input boxes and UI tools for inputting data such as heights, weights, age, sex, and gestation at birth. The React client imports the React chart component from NPM, so the chart component is a dependency of the client. When data are entered into the forms and submitted, the React client sends a HTTP request to the:

2. **dGC API server** - which processes the data and returns a JSON response containing calculated centile data, corrected gestational ages, etc. This response is received by the React client which passes it direct into the React chart component without any JSON transformation being required.

3. **React chart component** - this is the right hand side two thirds section of the screen in the demo client, containing the chart vector image. The component can be embedded in any web page and it natively 'understands' the JSON response from the API call. Passing an array of JSON API responses to the React chart component will result in all those measurements being plotted for you.

Set Up for local development using Docker

1. Enter into your Code Projects directory

```
cd YourCodeProjects
```

1. Clone the React Client repo

```
git clone https://github.com/rcpch/digital-growth-charts-react-client.git
```

1. Build the Docker image

```
s/docker-rebuild
```

1. Start the Docker container

```
s/docker-start
```

1. Open the React Client in your browser

```
open http://localhost:3000
```

If you make changes to the dependencies you will need to rebuild the Docker image using `s/docker-rebuild` and restart the Docker container using `s/docker-start`.
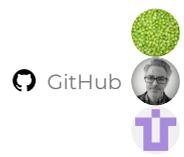
Without Docker

If you do not want to use Docker, you can start the project from the command line within the project root:

```
npm run dev
```

Style

We recommend the use of the Prettier Javascript linter.

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GitHub

7.7 RCPCHGrowth library

7.7.1 Overview

The centile and SDS calculations are performed in our separate **RCPCHGrowth Python package**.

As we developed the Digital Growth Charts codebase, we felt it was necessary to extract the centile calculation code into a separate package for easier reuse elsewhere.

Background

There have been several packages that calculate centiles.

The most influential software in growth, produced by *Huiqi Pan* and *Tim Cole*, was an add-in for Microsoft Excel, called **LMSGrowth**. It is still freely **downloadable** and contains the reference tables as `.xls`.

The name, *RCPCHGrowth*, was chosen as it is intended to supersede LMSGrowth.

RCPCHGrowth has been primarily built to work with the UK-WHO dataset. LMS calculations can theoretically work with any LMS data table. In practice, each data table has its own idiosyncrasies and is hard to standardise. In time, it is hoped the most mature and stable references can be included.

Growth Reference data

The references included are:

1. UK90 dataset – runs from 23 weeks to 20 years
2. WHO 2006 standard – runs from 2 weeks to 4 years
3. WHO 2007 standard - runs from 5 - 19 y
4. Down reference (both UK 2002 and US 2015 references)
5. Turner reference
6. CDC (US) reference - comprises a US interpretation of WHO 2006 0-2y, CDC 2-20y. It also has extended BMI centiles which reinterpret z score calculation above the 95th centile.
7. Fenton (Canada) - this reference licensed to Dr Fenton is a preterm reference from 22-50 weeks gestation, with median values in weight in grams. This dataset is closed source and licensed so not in the repo. It is currently not implemented in RCPCHGrowth.

   Data tables are stored in the `data_tables` folder as `.json`. There is a separate **repository** to store references from across the world. Currently, they are stored as `.csv` and `.json` file types.

Package Structure

CONSTANTS

Constants have been created for measurement, references and validation. All are stored in the `constants` folder. All string constants are lower case. All number constants are upper case.

Measurement Class

REQUIRED PARAMETERS

The core class of RCPCHGrowth is `Measurement`.

The following parameters are **required** for `Measurement` on initialisation:

```
birth_date: datetime.date

observation_date: datetime.date
```

```
sex: ['male', 'female']

measurement_method: ['height', 'weight', 'bmi', 'ofc']

observation_value: float

reference: ['uk-who', 'trisomy-21' 'turners-syndrome', 'cdc']
```

OPTIONAL PARAMETERS

The following **optional parameters** default to `None` if not provided:

```
bone_age: float

bone_age_centile: float

bone_age_sds: float

bone_age_text: str

bone_age_type ["greulich-pyle", 'tanner-whitehouse-ii', 'tanner-whitehouse-iii', 'fels']

events_text: list of str
```

`bone_age` , `bone_age_centile` , `bone_age_sds`

- No formatting is performed. Returned in the `Measurement` Class as provided. The chart plugin is optimised to recognise them.

`bone_age_text`

- Contextual information to describe the bone age. It may be a radiology report or author comment.

`events_text`

- List of `str` ings

- Events to tag the measurement with: e.g. starting a treatment or receiving a diagnosis.

The Measurement Object

The `Measurement.measurement` attribute will return a full `Measurement` object.

The `Measurement` Class calls private methods and other package functions to perform calculations, leading to the construction of the `Measurement` object.

The `Measurement` object is returned to the user as `json` in the following example structure:

```
{
    "birth_data": {
        "birth_date": "2020-04-12",
        "gestation_weeks": 40,
        "gestation_days": 0,
        "estimated_date_delivery": "2020-04-12",
        "estimated_date_delivery_string": "Sun 12 April, 2020",
        "sex": "female"
    },
    "measurement_dates": {
        "observation_date": "2028-06-12",
        "chronological_decimal_age": 8.167008898015059,
        "corrected_decimal_age": 8.167008898015059,
        "chronological_calendar_age": "8 years and 2 months",
        "corrected_calendar_age": "8 years and 2 months",
        "corrected_gestational_age": {
            "corrected_gestation_weeks": null,
            "corrected_gestation_days": null
        },
        "comments": {
            "clinician_corrected_decimal_age_comment": "Born at term. No correction has been made for gestation.",
            "lay_corrected_decimal_age_comment": "Your baby was born on their due date.",
            "clinician_chronological_decimal_age_comment": "Born Term. No correction has been made for gestation.",
            "lay_chronological_decimal_age_comment": "Your baby was born on their due date."
        },
        "corrected_decimal_age_error": null,
        "chronological_decimal_age_error": null
    },
    "child_observation_value": {
        "measurement_method": "height",
        "observation_value": 115.0,
        "observation_value_error": null
    },
    "measurement_calculated_values": {
```

```
            "corrected_sds": -2.406593606646068,
            "corrected_centile": 0.8,
            "corrected_centile_band": "This height measurement is between the 0.4th and 2nd centiles.",
            "chronological_sds": -2.406593606646068,
            "chronological_centile": 0.8,
            "chronological_centile_band": "This height measurement is between the 0.4th and 2nd centiles.",
            "corrected_measurement_error": null,
            "chronological_measurement_error": null,
            "corrected_percentage_median_bmi": null,
            "chronological_percentage_median_bmi": null
        },
        "plottable_data": {
            "centile_data": {
                "chronological_decimal_age_data": {
                    "x": 8.167008898015059,
                    "y": 115.0,
                    "b": 10.0,
                    "events_text": [
                        "Growth hormone start",
                        "Growth Hormone Deficiency diagnosis"
                    ],
                    "bone_age_label": "This bone age is advanced",
                    "bone_age_type": "greulich-pyle",
                    "bone_age_sds": 2.0,
                    "bone_age_centile": 98.0,
                    "observation_error": null,
                    "age_type": "chronological_age",
                    "calendar_age": "8 years and 2 months",
                    "lay_comment": "Your baby was born on their due date.",
                    "clinician_comment": "Born Term. No correction has been made for gestation.",
                    "age_error": null,
                    "centile_band": "This height measurement is between the 0.4th and 2nd centiles.",
                    "observation_value_error": null
                },
                "corrected_decimal_age_data": {
                    "x": 8.167008898015059,
                    "y": 115.0,
                    "b": 10.0,
                    "events_text": [
                        "Growth hormone start",
                        "Growth Hormone Deficiency diagnosis"
                    ],
                    "bone_age_label": "This bone age is advanced",
                    "bone_age_type": "greulich-pyle",
                    "bone_age_sds": 2.0,
                    "bone_age_centile": 98.0,
                    "observation_error": null,
                    "age_type": "corrected_age",
                    "corrected_gestational_age": "",
                    "calendar_age": "8 years and 2 months",
                    "lay_comment": "Your baby was born on their due date.",
                    "clinician_comment": "Born at term. No correction has been made for gestation.",
                    "age_error": null,
                    "centile_band": "This height measurement is between the 0.4th and 2nd centiles.",
                    "observation_value_error": null
                }
            },
            "sds_data": {
                "chronological_decimal_age_data": {
                    "x": 8.167008898015059,
                    "y": -2.406593606646068,
                    "b": 10.0,
                    "events_text": [
                        "Growth hormone start",
                        "Growth Hormone Deficiency diagnosis"
                    ],
                    "bone_age_label": "This bone age is advanced",
                    "bone_age_type": "greulich-pyle",
                    "bone_age_sds": 2.0,
                    "bone_age_centile": 98.0,
                    "age_type": "chronological_age",
                    "calendar_age": "8 years and 2 months",
                    "lay_comment": "Your baby was born on their due date.",
                    "clinician_comment": "Born Term. No correction has been made for gestation.",
                    "age_error": null,
                    "centile_band": "This height measurement is between the 0.4th and 2nd centiles.",
                    "observation_value_error": null
                },
                "corrected_decimal_age_data": {
                    "x": 8.167008898015059,
                    "y": -2.406593606646068,
                    "b": 10.0,
                    "events_text": [
                        "Growth hormone start",
                        "Growth Hormone Deficiency diagnosis"
                    ],
                    "bone_age_label": "This bone age is advanced",
                    "bone_age_type": "greulich-pyle",
                    "bone_age_sds": 2.0,
                    "bone_age_centile": 98.0,
                    "age_type": "corrected_age",
                    "corrected_gestational_age": "",
                    "calendar_age": "8 years and 2 months",
                    "lay_comment": "Your baby was born on their due date.",
```

```
                "clinician_comment": "Born at term. No correction has been made for gestation.",
                "age_error": null,
                "centile_band": "This height measurement is between the 0.4th and 2nd centiles.",
                "observation_value_error": null
            }
        }
    },
    "bone_age": {
        "bone_age": 10.0,
        "bone_age_type": "greulich-pyle",
        "bone_age_sds": 2.0,
        "bone_age_centile": 98.0,
        "bone_age_text": "This bone age is advanced"
    },
    "events_data": {
        "events_text": [
            "Growth hormone start",
            "Growth Hormone Deficiency diagnosis"
        ]
    }
}
```

Global Functions

DATE FUNCTIONS

There are **two** relevant date calculations:

1. `corrected_decimal_age` : takes into account gestational age at birth

2. `chronological_decimal_age` : does *not* take into account gestational age at birth

   Note that age correction now occurs across the life course, even when term. Age correction is discontinued at *42 weeks* gestation.

   Decimal age is calculated by calculating the difference in days between the two dates using the `dateutil` package, then dividing this by `365.25` (as every fourth year is a leap year).

   Ages can be calculated as decimal ages, or calendar ages which are returned as a string. Advice relating to age correction is also returned as a string from functions in `growth_interpretations.py` .

LMS CALCULATIONS

The primary calculation is to generate a z-score (SDS) from two dates, sex, measurement method, and observation value, comparing against a reference, detailed in **How the UK-WHO Charts Work**.

Each reference comprises an L, M and S value for a decimal age. The decimal ages in the reference data are not separated at uniform intervals. Depending on age, intervals are weeks, months or years apart.

The calculation involves first calculating a decimal age (corrected or chronological), then using this to look up the nearest L, M and S values. If there is no exact match, the intermediate L, M, and S values are calculated using *cubic interpolation* (if there are 2 values either side of the decimal age requested in the reference data) or *linear interpolation* (if the age falls at the extremes of a given reference and there is therefore only one value above or below the age provided). The resulting L, M and S values are put into the equation to generate an *SDS*, which is used to generate a centile.

This latter calculation is done using the SciPy package.

Note that CDC and WHO references outside of the UK context use only linear interpolation.

The CDC BMI calculation has a complexity well described **here**. At higher BMI values (>95th centile) it introduces a new *sigma* value. Sigma is the dispersion parameter used in the calculation of BMI percentiles and z-scores above the 95th percentile (z-score 1.645), and is applied to calculations only for the extended BMI range in the CDC reference. ![formula](https://latex.codecogs.com/svg.image?BMIZ=\frac{(BMI/M)^L-1}{L * S} ![formula](https://latex.codecogs.com/svg.image?BMIPercentile = \Phi(BMIZ) If the BMI centile is above 95%, a correction is applied: ![formula](https://latex.codecogs.com/svg.image?BMIPercentile = 90 + 10\Phi \frac{BMI-P95}{sigma} ![formula](https://latex.codecogs.com/svg.image?BMIZ = \Phi^{-1}\frac{BMIPercentile}{100}

Steps

The functions called by the Measurement class are `sds_for_measurement` , or its inverse `measurement_from_sds` , found in the `global_functions.py` file.

The correct reference is selected based on the parameter passed in from the user in the function `lms_value_array_for_measurement_for_reference`.

From this, the individual L, M and S values are returned using the `fetch_LMS` function. This function finds the lowest nearest decimal age in the LMS list (`nearest_lowest_index`), and if there is a match, the L, M and S are returned. If there is no match, interpolation is performed, depending on how many values are present below and above that value in the list. If there are 2 values, `cubic_interpolation` can be performed, otherwise `linear_interpolation` can be performed.

Note that our cubic interpolation method is subtly different from those in the SciPy and NumPy packages. The code using these functions remains and has been commented out. We found the library functions to be slower and less precise.

The L, M and S are then converted to SDS using the `lms_to_z` and either returned, or converted to centile using the `centile` function and then returned.

Reference Selection

As there are several references, the selection of the correct LMS table is essential before beginning calculation. The references are all stored as JSON files in the `data_tables` folder. There are individual files (`uk_who.py`, `turner.py`, `trisomy_21.py`, `trisomy_21_aap.py`, `who.py` and `cdc.py`) which select the correct tables and contain error handling, particularly to return meaningful errors to users. For example, in UK-WHO, weight and head circumference but not length data are available at 23 and 24 weeks gestation. Head circumference in girls stops at 17 years but in boys it stops at 18 years. To handle all these idiosyncrasies, an individual file for table selection has been created.

Centile Advice Strings

There was much discussion about these at project board. Found in `centile_bands.py`, these strings are returned in the `Measurement` object to guide users on interpretation of the centile values they receive. The Project Board were very clear they wished to dissuade users from quoting exact centile values, instead to refer to ranges. Further details can be found in the clinician information. Although the `Measurement` object returns an exact centile value, the advice strings are better suited for reporting to users and are rendered in tooltips in the Typescript RCPCHGrowth Chart Component package.

Thresholds

A list of all the reference thresholds can be found **here**.

A discussion about suitable cut-offs to distinguish between impossible and unlikely values is well documented **here**.

An RCPCHGrowth base decision that all values should be returned to the user, no matter how improbable. This is because the python package maybe used in research where values of this nature maybe meaningful. In a clinical context however, through review of datasets and the literature (detailed in the issue), a decision was made to set absolute cut-offs for height, weight and head circumference at +/- 8 SDS, while BMI would have cut-offs of +/-15 SDS.

CHART FUNCTIONS

These are for the creation of plottable centile charts.

`chart_functions.py` contains a `create_chart` function which accepts a reference as a parameter and returns a large object with plottable values to render a centile chart, and a label for each centile series.

For the UK-WHO references, there are 4 `json` objects generated, with the following structure:

```
uk90_preterm: {
  male: {
      height: [
          {
              sds: -2.667,
              centile: 0.4,
              data: [{l: , x: , y: }, ...]
          }
      ],
      weight: [...]
  },
  female: {...}
}
uk_who_infant: {...}
uk_who_child:{...}
uk90_child: {...}
```

Each centile is created using the `generate_centile` function found in `global_functions` . This creates plottable x and y coordinates (x is decimal age in years, y is the measurement, l is the centile label) at regular time intervals, usually weekly to the age of 2y, and monthly thereafter. This could be more granular, but at the cost of a much bigger object, which is more than 1MB, even when minified.

There is an endpoint in the API which calls this function and returns the chart for those users who need it. Equally, the Typescript Charting Component (built for React) has the reference data included.

`create_plottable_child_data` , largely deprecated now, receives a list of Measurement objects and returns a `PlottableChild` object. Earlier versions of the API required 2 API calls - one to make the calculations, one to convert those to a plottable format. This has now been moved into the Measurement object so is only used with older versions of the API.

Utilities

MID-PARENTAL HEIGHT

Functions that relate to this are found in `mid_parental_height.py` . Methodology is documented in **this paper** and involves taking the mean of parental height Z-scores and applying a regression factor (0.5). This corrects for the well-recognised concept of regression to the mean, where by parents who are either very tall or very short have a tendency to have children whose heights are less extreme. The simplified calculation therefore is: (MatHtz +PatHtz)/4

This is reported as a centile and SDS as well as absolute value, with values approximately 2 centiles either side. This is because the same paper found that 90% of children of parents fell within 2 centiles of the mid-parental height centile. In the chart, this is rendered as a three centile lines (upper, mph and lower) over the latest measurement if present.

Other functions

There are more experimental functions in `dynamic_growth.py` which calculate height velocity and acceleration from a list of Measurement objects, and some implementations of thrive lines based using correlation tables in the `data_tables` folder. These features still have significant work and testing required - contributions are welcome.

This page was last updated on: January 20, 2026

This site was last updated on: March 3, 2026

GitHub

7.8 Developing the RCPCH CLI tools

Setup and installation of Python proceeds similar to the description in **Python setup**.

7.8.1 Get the code

Git clone the repository to your development machine, and `cd` into it.

```
git clone https://github.com/rcpch/rcpchgrowth-python-cli.git
```

7.8.2 Virtualenv

We recommend the use of Pyenv and a virtual environment. Any recent Python version should be fine.

```
pyenv virtualenv 3.10.2 rcpchgrowth-python-cli
```

Using the same name `rcpchgrowth-python-cli` for your virtualenv will enable Pyenv to automatically select it when you navigate to the directory. This magic uses the `.python-version` *dotfile* in the project root.

7.8.3 Locally install for testing

To test changes, install the development version of the library locally through

```
pip install -e .
```

Now, any changes you make to the local code will immediately be reflected in the CLI tool.

7.8.4 Versioning

We use a package called `bump2version` which is a maintained fork of the original, but abandoned, `bumpversion`.

You need to start with a clean commit status i.e. any new changes are committed in Git.

To update the version with a small patch change or fix, use:

```
bumpversion patch
```

For 'minor' version changes, use:

```
bumpversion minor
```

For 'major' version changes, use:

```
bumpversion major
```

Bump2version will update the version in `setup.py`, creating a new commit and tag.

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This site was last updated on: March 3, 2026

GitHub

7.9 Versioning the API Server's code

We distinguish between:

1. The API version itself

2. The server code which creates API responses

All of this documentation relates to **Version 1** of the RCPCH Digital Growth Charts API.

Server code versions may vary.

7.9.1 Semantic Versioning

We use **Semantic Versioning (SemVer)** to ensure server versions are systematically applied.

7.9.2 Bump2version

We use `bump2version` tool to simplify versioning in the `digital-growth-charts-server` and `rcpchgrowth-python` packages.

7.9.3 References

With every deploy of the server, `generate_and_store_chart_data` gets run, which skips centile chart generation from references if they already exist. On the command line though it is possible to override this and rebuild all the centile data files.

```python
from main import generate_and_store_chart_data
generate_and_store_chart_data(overwrite=True)
```

This page was last updated on: January 11, 2025

This site was last updated on: March 3, 2026

GitHub

7.10 Writing dGC Documentation

Where possible, we have tried to bring together **all** documentation relating to any aspect of the dGC project into this one MkDocs site, published at **growth.rcpch.ac.uk**

7.10.1 Material for MkDocs

The documentation for the Digital Growth Charts project is created using the MkDocs documentation framework. It uses the '*Material for MkDocs*' theme, which adds a number of extra features and a more modern appearance.

As you'd expect, there is delightful documentation for both projects: **Material for MkDocs**, and for the underlying **MkDocs**, on which it's built. At times, you may need to refer to **both** for different features.

7.10.2 Adding or editing documentation

Mostly this just requires creating Markdown files in the `docs/` directory of the **documentation repository**.

Use other pages within this repo to get ideas on the style and the features available such as **emoji**, **icons**, and **admonitions**.

Continuous Integration via GitHub Actions

Any changes to the `live` branch of the documentation repository trigger a **GitHub Action**. This runs Material for MkDocs in a temporary application container, builds the site from the Markdown source into a set of static HTML pages, and **publishes the site to Azure**, with a **backup in GitHub Pages**.

This occurs whether changes are made using online or local, offline editing methods.

> ✏️ **GitHub Branch Protection**
>
> Ensure you make Pull Requests to `prerelease`, or any other branch name of your choosing, but not `live`.
>
> We have enabled GitHub branch protection to `live` so changes cannot be made directly there but **must** be made through an intermediate branch, and then Pull Requested into `live`.

Online editing of the Markdown

If you are new to Markdown editing, you can use GitHub's interface itself to edit online, by clicking the 'pencil' edit icon in the top right corner of any source code page. There are also external tools like **Prose.io** and **StackEdit** which give you a nice interface for editing MarkDown online, and will sync the changes with GitHub for you.

We will need to review your changes before they are merged into the `live` branch, so please make a Pull Request to the `prerelease` branch, or any other branch of your choosing, and we will review it and merge it into `live` when ready.

Once merged, the changes will be automatically deployed to the live site, and you can see them at **growth.rcpch.ac.uk**.

Using a text editor and editing locally

More experienced coders can `git clone` the repo and make changes offline on their local machine before pushing to the remote to either the `rcpch` organisation's remote, or their own fork. This allows you to run Material for MkDocs locally and preview the site as it will appear when pushed to `live`.

Setting up a development environment for the dGC documentation site

For all platforms we recommend using the `docker compose` setup, which will run the MkDocs site in a Docker container, so you don't need to install Python or MkDocs locally. This is the easiest way to get started, and it isolates your local development environment from any conflicting dependencies.

PREREQUISITES

- **Docker** installed and running on your machine.
- **Docker Compose** installed (this is included with Docker Desktop on Windows and Mac, but needs to be installed separately on Linux).
- **Git** installed on your machine, to clone the repository.

STEPS TO SET UP THE DEVELOPMENT ENVIRONMENT

1. Clone the repository:

```
git clone https://github.com/rcpch/digital-growth-charts-documentation.git
```

1. Change into the cloned directory:

```
cd digital-growth-charts-documentation
```

1. Start the MkDocs development server using Docker Compose:

```
docker compose up
```

`git-committers` and `mkdocs-with-pdf` plugins

These plugins can add 10-15 seconds of build time to the site, so when developing locally, they are disabled by default. They are enabled by using environment variables, if you want to test that they work locally before pushing to the remote:

```
export ENABLE_GIT_COMMITTERS=true; mkdocs serve
export ENABLE_PDF_EXPORT=true; mkdocs serve
```

You should always build the site at least once with both PDF export and Git Committers enabled, to ensure there are no issues, before pushing to the remote.

7.10.3 Adding a new page

- Create a new Markdown file in a subfolder in the `docs` folder. There is now also a template to get you started, in `docs/_utilities/page-template.md`, which you would copy into your new page file.

> ℹ️ **Info**

Because of the way we have set up the left sidebar navigation, new pages are **not** automatically added to the navigation.

```
(This allows us to have pages which are work-in-progress, available on the live site for review, but not in the navigation, hence only those who have the link
would easily find it)

See the next section for how to add pages to the navigation.
```

Adding navigation for the page

Add navigation by editing the `nav:` tree element in `mkdocs.yml`. Below is an excerpt from the `nav:` in this project. You can see how the top level Navbar headings `Home` and About `are` defined, and how the sidebar headings work. You can nest several levels deep, if needed.

```
nav:
  - Home: "index.md"
```

```
    - About:
        - "about/about.md"
        - "about/overview.md"
```

By manually specifying the navigation in this way, we have control over the precise appearance of subfolder names (which are otherwise rendered in Title Case, but this doesn't work for acronyms). Also, we can customise the order of listing of sidebar headings, which would otherwise be ordered alphabetically.

Page title in the navigation

The page title that will be displayed in the left sidebar navigation is set in the YAML front matter:

```
---
title: Some Page Title
reviewers: Dr Reviewer
---
```

Heading on the page

The heading that will be displayed on the page is set using the first `<h1>` heading (i.e. one hashtag `#`)

```
# Heading, which can be different to the sidebar title
```

Reviewers

Reviewers are encouraged to add their details to the `reviewers:` section of the YAML front matter, this enables us to evidence that each page has been reviewed by multiple members of the team.

```
---
title: Some Page Title
reviewers: Dr Marcus Baw, Dr Simon Chapman, Other Reviewer ...
---
```

7.10.4 Publishing is automated

When you push new changes to ANY branch of this repo, or it you open a Pull Request, Azure will automatically build a version of the site for review. You need to visit **this Static Web App deployment resource on the Azure portal** to see the URL of the deployment, as it depends on the branch name. To obtain Azure access contact Marcus Baw of the RCPCH developer team.

Therefore, you don't need to do `mkdocs build` or `mkdocs gh-deploy --force` commands manually or locally - it's done for you if you push to branches or PRs on GitHub.

7.10.5 Plugins

MkDocs has **many plugins available**. We already use some to extend the capabilities of MarkDown, making the documentation look nicer and function better.

This page was last updated on: January 20, 2026

This site was last updated on: March 3, 2026

GitHub

7.11 FAQs for Developers

7.11.1 Q: Where is all your dGC code?

A: The entirety of our Digital Growth Chart code is publicly available on GitHub, in the `rcpch` organisation. See **https://github.com/rcpch**.

7.11.2 Q: Why did you build the API in Python?

A: Python has become the de facto language of the scientific and bioinformatics communities. Also:

- Most of the packages needed were '1st party' i.e. maintained by the PSF. Therefore, they have a level of reliability and provenance.
- It's a nice and easily readable language whilst being powerful enough for our requirements. Python has everything needed for building an API, demo sites, web platforms, etc.
- It's accessible to clinicians who want to learn to code; it's easy enough to learn, it's taught in schools!

> **❞ Quote**
>
> Marcus Baw wrote a blog post on **'Why Python...'** which has a little more detail.

This page was last updated on: October 17, 2023
This site was last updated on: March 3, 2026

GitHub

7.12 Contributing

7.12.1 Contributing

We're a friendly bunch, and happy to chat. You can get in touch with the primary developers to talk about the project using **our Forum**. These are the main community discussion hubs around the dGC project.

How to contribute

- Fork the repository to your own GitHub account.
- Set up your development environment (ideally using our instructions **here** for maximum compatibility with our own development environments).
- Ideally, you should discuss the proposed change with our team, because we can only accept pull requests with an accepted need for a new feature or fix.
- We can discuss with you our recommendations for implementation of the new feature, for maximum potential 'mergeability' of your PR.
- Once you are ready to show us your work, create a pull request on our repo, detailing what the change is and details about the fix or feature. PRs that affect the calculations or any other 'mission critical' part of the code will need suitable tests which we can run.
- We will endeavour to review and merge in a reasonable time frame, but will usually not merge straight into `master`, rather we will merge into an upcoming release branch.

Coding style

We are not Python experts, but encourage use of Python best practices where possible. We are not going to get too pedantic over style though.

Some helpful sources of information on Python style are:

- **https://www.python.org/dev/peps/pep-0008**
- **https://google.github.io/styleguide/pyguide.html**

For more guidance on our house style, visit our **RCPCH Playbook**.

7.12.2 Intellectual Property (IP) of contributions

- The copyright over the IP in this and other Growth Chart related repositories is owned by the Royal College of Paediatrics and Child Health, which releases it under an open source license. Consult the individual repository for specifics on which license we have used.
- If you submit a contribution to the repository, we ask that you agree to transfer all IP rights of the contribution, both now and in the future, to the Royal College of Paediatrics and Child Health, in perpetuity. This clause is purely to allow RCPCH to continue to exert an unchallenged copyright over the open source work. Clearly, asserting a copyright is crucial to open source work.
- For larger contributions we may require a Contributor Covenant to support this agreement over transfer of title, however for small contributions, it is probably sufficient that you have read and understood this document, and that the act of submitting a PR is acceptance of these terms.
- All contributors will, of course, proudly be acknowledged in the **Acknowledgements** section (if you make a PR, don't forget to add yourself there!).

This page was last updated on: July 2, 2025

This site was last updated on: March 3, 2026

GitHub

8. Clinical Safety

8.1 Clinical Safety of the dGC Project

Clinical Safety of these clinical tools is of paramount importance to us at the RCPCH. We are a standard-setting organisation with an international reputation and as such clinical safety has been at the forefront of our minds throughout the development of the project.

> ⚠️ **England, Wales and Scotland compliance**
>
> Our primary focus has been on clinical safety certification and Medical Device regulatory compliance **for the UK market and specifically England**, because the initial work on the dGC platform was commissioned by NHSX, which (at the time of commissioning) was an England-only body. We do however recognise the need for the dGC Platform to be recognised as safe for use in other UK nations including Northern Ireland and this is our next most important priority for regulatory compliance.

> ✏️ **Other territories**
>
> Compliance for EU, US and other territories may follow, but will be subject to customer engagement in those countries or global regions. If you are an API consumer and you need the dGC platform to be certified in your region of operation, then please **get in touch with us** and we can discuss the requirements. Note that **different growth chart references** (eg WHO, CDC) are used in other countries, and we may need to commission further development of the API functions in order to support these. Adding new references is not technically difficult, but mandates significant testing and assurance processes.

8.1.1 Clinical Safety

Open Source, Transparency and Open Governance

In addition to the standard NHS clinical safety practices, a key aspect of the augmented clinical safety measures we have taken with the dGC platform is the open source codebase and completely open governance profile of the project.

Our entire codebase is open for inspection by other specialists, in a manner similar to the open peer review of academic publications, which ensures high quality by enabling others to replicate our results and verify or challenge the veracity of the calculations and testing independently. (Note the Digital Growth Charts do not **rely** on external validation - they are extensively internally tested)

DCB0129 and DCB0160 Compliance

We comply with the requirements of DCB0129 and DCB0160, and for details you can go **here** to review our entire Clinical Safety Management File.

Hazard Logs

Our Hazard Logs are managed on GitHub in the open. Details of how this works are **here**.

Project Board

The members of the Project Board, a clinical expert group who oversee and advise on the clinical aspects of the development and ongoing maintenance and operation of the dGC Platform, are listed **here**

The Project Board decided on all changes to the **nature** of Growth Charts which came into effect during the dGC project - such as the application of Gestational Age Correction *throughout* the chart (instead of stopping at either 1 or 2 years of age, depending on the degree of prematurity, as was previously the case), and the abolition of the use of the averaged Term reference between 37 and 42 weeks.

Digital Technology Assessment Criteria (DTAC)

• DTAC is a UK(England)-only grouping of assessment criteria. It is relatively new, and aims to simply bring together and harmonise *existing* assessment criteria for digital technologies. More information is available on **the NHSX website**

• DTAC incorporates the DCB0129 and DCB0160 standards for clinical safety, which the RCPCH dGC platform is compliant with.

More information on our DTAC compliance is **here**

This page was last updated on: January 21, 2026
This site was last updated on: March 3, 2026

GitHub

8.2 Clinical Safety File

8.2.1 Clinical Risk Management System

Royal College Digital Growth Charts Team

MARCH 2021

Document Management

REVISION HISTORY

- This document is versioned in Git and published in GitHub.
- Refer to the document's Releases section in GitHub to see a history of releases.
- This document was created from the CRMP template provided on the NHS Digital Website.

REVIEWERS AND PROCESS

This document must be reviewed by:

- Dr Simon Chapman
- Prof Tim Cole
- Magda Umerska

The review mechanism for update is via Pull Request review on GitHub, with opportunity for reviewers to comment and amend the text.

APPROVERS AND PROCESS

This document must be **approved** by:

- Dr Marcus Baw - Clinical Safety Officer, RCPCH dGC Team
- Following satisfactory review by the Reviewers, the nominated Approvers merge the pull request into the main branch of the code.
- The current version of this document will always be selected as the 'default branch' in GitHub### Related Documents

Introduction

This Clinical Risk Management System (CRMS) outlines the processes to be followed to ensure that all healthcare IT used to support care withinthe Organisation is developed, implemented and used in a safe manner.

This CRMS provides a framework that promotes the effective risk management, by the Organisation, of potential health IT hazards andoperational incidents.

This CRMS complements existing risk management processes that should be defined in the Royal College Digital Growth Charts Team's Risk Management Strategy and wherever practical, uses existing procedures, processes and governance arrangements.

This CRMS addresses the requirements of **DCB0129** and **DCB0160** and follows best practice in clinical safety, development practice, security, and transparency.

This CRMS will be reviewed and maintained in accordance with the the Royal College Digital Growth Charts Team's policies.

This page was last updated on: January 21, 2026

This site was last updated on: March 3, 2026

8.2.2 Clinical Risk Management Plan

Document Controls

As part of our commitment to automation, transparency and open governance, this document's versioning is managed using the **Git** Distributed Version Control Software (DVCS), and the **GitHub** online code repository platform. These are currently regarded as the 'industry standard' for DVCS and online repositories, and are used by the majority of open and closed source developers worldwide. We also maintain our application and library code in Git and GitHub, meaning that our clinical safety case and documentation is managed close to our actual code.

Using the combination of Git and GitHub removes much of the manual work of maintaining document control processes, and so we have abandoned manual document controls entirely, in favour of GitHub's automatically updated controls.

To see the contributors to the documentation site you can view them here on GitHub. Contributors: **https://github.com/rcpch/ digital-growth-charts-documentation/graphs/contributors**

Most recent update:

Purpose

The aim of the Clinical Risk Management Plan is to ensure that all of the RCPCH Digital Growth Charts Team involved with the development, implementation and use of healthcare IT systems are aware of the activities that are required to be undertaken to ensure patient safety is improved rather than compromised from the introduction of healthcare IT systems.

The RCPCH Digital Growth Charts Team is required to adhere to National Information standards created and monitored via the Data Coordination Board (DCB) within NHS Information Standards frameworks.

The mechanisms used are approved Clinical Risk Management System compliance documents.

This Clinical Risk Management System will be reviewed periodically to ensure that:

- changes in working practices are incorporated.
- issues identified through an established internal audit programme are addressed.
- the safety approach continues to adhere to the requirements of applicable international standards.
- the system continues to protect the safety of patients in a complex and changing environment.

Audience

This document is for the RCPCH Digital Growth Charts Team staff that are involved in ensuring the safety of the RCPCH's healthcare IT systems, products or services, but is made publicly available as part of our commitment to transparency and open governance.

Scope

This policy applies to the the RCPCH Digital Growth Charts Team's organisation and to all of the RCPCH Digital Growth Charts Team's IT systems. The policy also applies to any local customisations, upgrades or specific configurations made to a healthcare IT system by the RCPCH Digital Growth Charts Team.

If clarification is required of whether any system falls within scope of this CRMS this should be raised with the nominated Clinical Safety Officer (CSO) for clarification. This nominated person provides clinical and organisational leadership on healthcare IT Patient Safety on behalf of the Organisation.

⚡IMPORTANT NOTICE FOR SELF-HOSTING

IMPORTANT: This Clinical Risk Management File applies ONLY to RCPCH open source software as deployed and managed by the RCPCH Digital Growth Charts Team under our direct control.

⚡Self Hosting - Clinical Safety Risk

TL;DR: Don't self-host in production. Use our warranted API.

The only version of the Digital Growth Charts API which is warranted to be correct for clinical use is that which is served by the RCPCH itself from our API endpoint at **https://api.rcpch.ac.uk**.

For reasons of transparency, equity-of-access and safety, we have made it *possible* to use our open-source code to set up a server providing Digital Growth Charts API calculations. **However, we strongly advise *against* doing this**, except for testing, verification, development purposes or research (which is not for academic publication).

WE STRONGLY RECOMMEND NOT TO SELF-HOST THE SERVER FOR PRODUCTION, CLINICAL or other 'LIVE' USE.

By self-hosting, you would not have a warranty from the RCPCH: you are liable for misconfigurations in the server leading to clinical issues. To ensure safe service with the complexity of Growth Charts, you likely require large amounts of statistical, clinical and technical consultancy.

You must understand and accept that any version of this API running **outside** our controlled environment must have been:

1. Independently **technically-assured**, such that the platform, deployment, and modifications are secure, safe, and reliable.
2. Independently **clinically-assured**, such that the application is safe and has a qualified Clinical Safety Officer, a Clinical Safety Management File, and is fully compliant with DCB0129 and DCB0160.
3. Registered with the MHRA as a Medical Device (for UK deployment) and EU MDR, with Declaration of Conformity (for EU deployment).

For this reason, we STRONGLY recommend you DO NOT SELF-HOST any of our platform, but instead use the hosted (and attractively-priced) Digital Growth Charts API platform. Self-hosting means your organisation is fully liable for any errors in calculation, deployment, or functioning. We will not provide any free support for self-hosting organisations.

Definitions

Note - Also see the RCPCH Risk Management Strategy

CSO: Clinical Safety Officer - the person responsible for ensuring that the healthcare IT Clinical Risk Management System is applied to all clinical systems. The Clinical Safety Officer (CSO) for the Organisation is responsible for ensuring the safety of a healthcare IT system through the application of clinical risk management. The Clinical Safety Officer must hold a current registration with an appropriate professional body relevant to their training and experience. They also need to be suitably trained and qualified in risk management or have an understanding in principles of risk and safety as applied to healthcare IT systems. The Clinical Safety Officer ensures that the processes defined by the clinical risk management system are followed.

DCB: Data Coordination Board

Healthcare IT Clinical Risk Management (CRM) Governance Arrangements

The responsibility for healthcare IT CRM within the Organisation resides with the Clinical Safety Officer

Organisational management of healthcare IT related risks is as per the existing management arrangements as specified in the Organisation's Risk Management Strategy.

CLINICAL RISK MANAGEMENT TEAM ORGANISATION CHART

The RCPCH's team is not yet of a size that it requires an org chart to explain. Left here as a placeholder in case an org chart is needed in the future.

PERSONNEL

Clinical Safety Officer

Dr Marcus Baw NHS Digital-trained Clinical Safety Officer
Registered General Medical Practitioner, GMC Number 4712729
Software Developer
Github **@pacharanero**

Senior Clinical Adviser

Dr Simon Chapman Consultant Paediatrician, King's College Hospital Trust
Specialist in Diabetes and Endocrinology
Software Developer
Github **@eatyourpeas**

Chief Digital Officer

Richard Burley Chief Digital Officer, RCPCH

Chief Executive Officer

Overall governance for the RCPCH Digital Growth Charts project is provided not by a single individual, but by the R**CPCH Digital Growth Charts Project Board**, which is composed of senior leadership within the RCPCH and the most eminent clinicians in the field of Growth charts.

Governance

Governance for patient safety within the Organisation is provided through the following forums:

CLINICAL RISK MEETINGS

- Clinical Safety is discussed as a fixed item on the two-weekly Sprint Planning Meeting at which the project is planned and priorities set for the next sprint of development.
- In the event of an **urgent** clinical safety issue or incident, a supplementary Clinical Risk meeting is held at the earliest possible time.

OPEN, TRANSPARENT PUBLIC ISSUE TRACKING

- Open, public issue tracking ensures the widest possible reporting base, and unparalleled access to report issues compared to the majority of Health IT systems. These Issues, tracked in GitHub, directly form part of the development workflow used by the clinical and technical teams.

PUBLIC FORUM

RCPCH maintains a web forum (**forum.rcpch.tech**), where users, implementers, and clinicians can feed back on the system. This is a transparent and open mechanism for safety feedback and aftermarket surveillance of the platform. Using the same system or using our contact page it is also possible to send a private message or contact via email in the event of a private communication being necessary.

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Healthcare IT Clinical Risk Management Deliverables

CLINICAL RISK MANAGEMENT FILE CRMF (THIS REPOSITORY)

The RCPCH Digital Growth Charts Team will establish a Clinical Risk Management File (CRMF) for each safety related healthcare IT system. The purpose of the CRMF is to provide a central repository where all safety related information pertaining to the healthcare IT system is stored and controlled. This GitHub repository contains out Clinical Risk Management File.

CLINICAL RISK MANAGEMENT PLAN CRMP (THIS DOCUMENT)

The RCPCH Digital Growth Charts Team will establish a Clinical Risk Management Plan (CRMP) for each safety related healthcare IT system. The purpose of the CRMP is to identify the clinical risk management activities that are to be undertaken and the phasing of these activities in the project lifecycle.

The CRMP will also identify the resources required to discharge these clinical risk management activities.

HAZARD LOG

The RCPCH Digital Growth Charts Team will establish and maintain a Hazard Log (HL) for each safety related healthcare IT system. The HL will be controlled and configured in accordance with the RCPCH Digital Growth Charts Team's document control policy.

The Hazard Log details can be viewed on the **Hazard Log page**

CLINICAL SAFETY CASE

The RCPCH Digital Growth Charts Team will establish and develop a Clinical Safety Case (CSC) for each safety related HIT system:

- **RCPCH dGC Application Programming Interface**

CLINICAL SAFETY CASE REPORT

The RCPCH Digital Growth Charts Team will issue a Clinical Safety Case Report (CSCR) for each safety related healthcare IT system. The CSCR will be issued to support initial deployment and will be updated during the lifecycle of the Healthcare IT system should the safety characteristics change. The CSCR will be controlled and configured in accordance with the RCPCH Digital Growth Charts Team's document control policy. The Hazard Log will be made available within the CRMF.

- **RCPCH dGC Application Programming Interface**

Healthcare IT Clinical Risk Management Activities

HAZARD IDENTIFICATION

The RCPCH Digital Growth Charts Team will conduct hazard identification workshops to identify potential hazards associated with the deployment and use of our healthcare IT system. The **CSO** will be responsible for facilitating such workshops and ensuring attendance from the RCPCH Digital Growth Charts Team. Typically, representatives from the following domains will be required:

- Technical testing team
- User research and User Experience team
- Clinical testing team
- Statistical support
- Project Board

If a healthcare IT solution is deemed not to be safety related then this decision will be formally recorded.

The technical team will advise on the best mechanism for addition of new issues to the the RCPCH Digital Growth Charts Team's project management workflow.

Where any third-party components are used to support the healthcare IT system then they will be considered in the scope of the hazard identification activities and subsequent risk assessment. Where none are used a positive declaration to this effect will be recorded in the minutes.

All identified hazards will be recorded in the **Hazard Log**.

RISK ASSESSMENT

The RCPCH Digital Growth Charts Team will conduct healthcare IT system risk assessment in accordance with the Risk Management Strategy. The Hazard Log will be updated to capture the risk assessment.

RISK EVALUATION

The RCPCH Digital Growth Charts Team will conduct healthcare IT system risk evaluation in accordance with the Risk Management Strategy The Hazard Log will be updated to capture the risk evaluation.

RISK CONTROL

Where the initial risk evaluation is deemed unacceptable, further risk controls will be required. the RCPCH Digital Growth Charts Team will manage healthcare IT system risk in accordance with the Risk Management Strategy.

Details of the risk control measures and evidence of effective implementation will be captured in the Hazard Log.

DEPLOYMENT AND ONGOING MAINTENANCE

To support clinical safety activities undertaken during any deployment phases of a project or programme of work the following documentation will be required to form a part of the overall approval process.

Deployment of changes to any of the RCPCH dGC Health IT systems follows an industry-standard pattern of 'code promotion' using a Git Branch-based strategy. New features are developed in branches specific to that feature. Following successful testing, user acceptance, and automated tests, a successful feature can be merged into the next branch 'up' which may be a `test` branch or other nomenclature. The process of merging requires code review by nominated individuals and is a further opportunity for clinical safety review.

Code in the `live` branch is changed relatively infrequently (except for urgent security or safety updates) but the code which is promoted into `live` would have by then undergone several rounds of review as it progressed through our branch promotion strategy.

INCIDENT MANAGEMENT

Clinical Risk Management activities within the Organisation and the healthcare IT programmes and services offered are completed within the corporate risk management strategy. As such, clinical safety related incidents are dealt with in a similar manner as other incidents within the organisation such as financial, reputational, technical and other service-impacting categories.

SAFETY INCIDENT MANAGEMENT PROCESS

The first step in any possible Safety Incident is to inform the Clinical Safety Officer. The CSO will determine the most appropriate course of action and will record the incident, the hazards identified (if any) and the mitigations and other remediation taken in a GitHub Issue relevant to the software element in question. Senior management of RCPCH will be informed at the earliest opportunity.

SECURITY INCIDENT MANAGEMENT PROCESS

Security issues may be responsibly disclosed to **growth.digital@rcpch.ac.uk** for immediate action. We recognise and respect the work of security researchers and will treat your contribution with gratitude and appropriate action. We do not engage in vexatious CMA litigation.

Internally we treat security issues with the highest priority. Once the 'acute phase' of any security threat is handled, we will then follow the Safety Incident Management Process, usually converting to a public GitHub Issue.

Clinical Safety Competence and Training

OVERVIEW

The clinical safety activities described in this Clinical Risk Management System shall be undertaken by competent staff. Suitable training shall be undertaken by staff to maintain and expand their level of competence.

COMPETENCY

All of the staff identified in the clinical safety documentation shall be sufficiently competent for the roles and tasks which they are asked to undertake. Where an individual does not yet have sufficient experience or knowledge, then that person shall be monitored, and his/her work reviewed, by someone who has the necessary competence. Such supervision shall prevail until it is judged that the individual has amassed the necessary experience to undertake such tasks unsupervised.

In assessing competency, the different functional roles required to fully discharge the obligations of the Clinical Risk Management System,and the necessary skills and knowledge needed for each, shall be considered. Primary functional roles may include: - Conducting discrete safety analyses (for example, a HAZOP or FFA) or defining the Hazard Risk Indicators for a particular project.

- Making a valid judgement on the safety tasks, activities and techniques required for a given Health Software Product in order to justify the comprehensiveness and completeness of the safety assessment and produce the safety argument with supporting evidence.
- Assurance of safety assessments and healthcare IT software products. Performance of safety techniques and development of the safety argument for a particular healthcare IT software product must be independent to any assurance activities for the same.
- Improving and refining the overall Clinical Risk Management System, for example, audit, process change, quality.
- Ownership and leadership, for example, ultimate safety accountability, culture change, influencing and strategic direction.
- The first test in establishing competency shall be at the interview stage where potential staff shall be assessed against the above representative roles and agreed job descriptions. Thereafter, competence shall be monitored through the organisation's established appraisal scheme. Any perceived deficiencies identified during the course of the work or at the appraised stage, especially during probation, shall be addressed immediately, for example, through the assignment of a competent supervisor or the provision of suitable training.
- All registered clinicians involved in safety roles shall, as a minimum,have completed an accredited training course.

TRAINING

- As part of the employment process and thereafter through the appraisal scheme, clinical safety personnel will undergo suitable training to develop, maintain or enhance their competency level. Such training can comprise: - 'on the job' training conducted under supervision - Internal training courses - Approved external training courses.
- All registered clinicians involved in clinical safety roles shall, as a minimum, have completed an accredited training course.
- Completion of any safety training shall be recorded by the individual on the annual appraisal form.

Audits

OVERVIEW

Audits shall be undertaken to ensure that projects are adhering to the defined safety requirements. Such audits will focus on the **Clinical Safety Team** and **third-party** suppliers.

INTERNAL SAFETY AUDITS

- the RCPCH Digital Growth Charts Team shall undertake regular internal safety audits to ensure that projects undertaken within the organisation are compliant with this Clinical Risk Management System. These audits shall be conducted and recorded in accordance with the internal quality management procedure.
- The scope of an internal safety audit will be the formal Clinical Risk Management System and the organisation's documentation supporting this document.

SUPPLIER AUDITS

The RCPCH Digital Growth Charts Team shall undertake regular third-party supplier audits, as a minimum annually, to ensure compliance with their Clinical Risk Management System. The audit shall focus on the Clinical Risk Management System, the evidence which demonstrates its effective operation and any issues arising from the deployment of the healthcare IT products and services. The basis for the audit shall be DCB0129.

This page was last updated on: January 21, 2026
This site was last updated on: March 3, 2026

GitHub

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8.2.3 Clinical Safety Case Report for the RCPCH Digital Growth Charts Platform

Document Controls

Version control
The latest revision of this document is recorded in the commit history here: **https://github.com/rcpch/digital-growth-charts-documentation/commits/live/docs/safety/csmf**.

Reviewers	
Dr Marcus Baw	Lead Developer, General Practitioner, Clinical Safety Officer
Dr Simon Chapman	Lead Developer, Consultant Paediatrician, Clinical Safety Officer

Approvers	
Dr Marcus Baw	Clinical Safety Officer

Introduction

The purpose of the DCB0129 Clinical Safety Case Report is to describe the clinical safety processes and assurances applied to the RCPCH Digital Growth Charts Platform in its manufacture. In deployment or implementation, a further DCB0160 clinical safety case will be required.

System Definition / Overview

The RCPCH Digital Growth Charts Platform consists of a suite of software tools which together enable the calculation and display of important growth-related parameters for children ranging in age from severely premature up to the age of around 20.

For the purposes of this Safety Case, the principal components are:

1. **The Digital Growth Charts API**, which receives growth measurements and returns growth calculations.
2. **The React Chart Component**, which takes the returned growth calculation JSON data and displays as a HTML-based RCPCH standard visual growth chart that is familiar to clinicians.
3. **The RCPCH Growth Python Library**, which provides the calculation functionality within the API Server.

Intended Use

The RCPCH Digital Growth Charts Platform is intended to be deployed within other systems, principally Electronic Patient Records (EPRs), Electronic Health Records (EHRs), Personal Health Records (PHRs), and other software platforms. **ONLY The commercial subscription API service provided by the RCPCH is warranted to have undergone the testing and assurance described in this document.**

> ⚠️ **DISCLAIMER**

If using the API service in any other 'unofficial' way, such as self-hosting, reverse-engineering, or misusing internal dGC components outwith the RCPCH Platform - this is deemed to be usage outwith any provisions of this document. The RCPCH Clinical Safety Officer expressly disclaims any responsibility for usage of the RCPCH dGC Platform outwith of its intended commercial use.

The intended user of these digital growth charts is a healthcare professional with sufficient training and knowledge to be able to understand the meaning of the values or charts displayed. Although growth charts have been present in the Red Book for parents

to see for many years, parents are unlikely to have the understanding of the charts to operate or interpret the charts independently. Parents may freely be given access to charts but the interpretation of a growth trend remains a clinician task.

Growth charts are only **one** of numerous sources of information available to a clinician when assessing a patient. They do not in themselves provide a diagnosis and can only be helpful as **part** of a full assessment of the patient. Clinicians must actively seek other confirmatory evidence for conclusions reached by their use of a growth chart.

Although the utmost care has been taken during the design and delivery of the dGC platform, the RCPCH and its Digital Growth Charts team accept no responsibility for clinical errors made where the chart has been misinterpreted or an operator of insufficient training has used them wrongly.

Clinical Risk Management System

A full description of the Clinical Risk Management System in place at the RCPCH is detailed in the section on **Clinical Risk Management System**.

Clinical safety and risk management are well-embedded within the culture of the RCPCH and its Digital Incubator Team.

The Clinical Risk Management File is currently maintained by the **Clinical Safety Officer**, and contains all the relevant documentation related to the clinical safety of the RCPCH Digital Growth Charts Platform.

The Clinical Safety Officer (CSO) is responsible for clinical safety of RCPCH Digital Growth Charts Platform, through the application of clinical risk management procedure. The CSO is a suitably qualified and experienced clinician who holds current registration with their relevant professional body and has had appropriate training for this role. In the RCPCH the CSO role is held by one of the lead developers.

Clinical Risk Analysis

Hazard Identification Workshops were held, involving the entire RCPCH dGC Project Board, the Clinical Safety Officer, the Development team, and the supporting RCPCH staff team, at which hazards affecting the Digital Growth Charts were discussed and the risk levels identified.

Hazard Log

A **Hazard Log** was established using GitHub Issues as a mechanism for logging the Hazard, quantifying risk severity and likelihood and overall risk level. Steps were then taken to reduce and mitigate risks down to acceptable levels, using the DCB0129 definitions for acceptability.

More detail of the individual risks and descriptions of the pre- and post-mitigation risk levels are within the text of each of the Hazards in the Hazard Logs.

Likelihood		Minor	Significant	Considerable	Major	Catastrophic
	Very High	3	4	4	5	5
	High	2	3	3	4	5
	Medium	2	2	3	3	4
	Low	1	2	2	3	4
	Very Low	1	1	2	2	3
		Severity				

HAZARD: UNAVAILABILITY OF THE DGC API CALCULATION AND CHARTING FUNCTIONS

https://github.com/rcpch/digital-growth-charts-documentation/issues/51

Description of initial Risk and mitigation steps

The API server runs on high-availability Microsoft Azure public cloud infrastructure and is hardened to above industry standard.

The Project Board felt the unavailability of the API would be unlikely to cause any form of harm to a patient because there are immediately available fallback methods such as manual calculation on printed paper charts.

Severity

Minor

Likelihood

Medium

Residual Risk Level

Outcome

```
                         |                     | Level 1 - Acceptable  |
```

| | RCPCH endeavours to ensure that implementer organisations have appropriate support in order to reduce the risk of errors in passing data to the API | Level 1 - Transferred | | Misuse of the API code by external organisations

---

HAZARD: WRONG DATA IS *ENTERED INTO* THE DIGITAL GROWTH CHART API

Description of initial Risk and mitigation steps

In both the above scenarios, our Project Board of clinical paediatrics and growth experts agreed that the absolute risk of directly attributable harm to a child is rather low, because of the multiple clinical practice safeguards that exist whether the growth chart is paper, PDF or digital.

Severity

Likelihood

Residual Risk Level

Outcome

RCPCH endeavours to ensure that implementer organisations have appropriate support in order to reduce the risk of errors in passing data to the API, however much of the implementation risk must necessarily be passed on to the DCB0160 clinical safety assessment.

HAZARD: INCORRECT CENTILE DATA IS *RETURNED BY* THE API

Description of initial Risk and mitigation steps

Prior to deployment of the Digital Growth Charts, significant 'static' software testing was performed, to ensure that the complex statistical calculations returned by the API had been confirmed to have a very high degree of conformity to previous statistical Centile calculation engines, across a synthetic 'test harness' of approximately 4000 children's data. It is worth noting that the agreement between the systems was to 4 decimal places, the small variation between these is accounted for by the fact that statistics uses complex modelling of curves and interpolation, so it is impossible to get perfect alignment between two systems written in different languages (in this case, R and Python).

This testing process was supervised directly by Prof Tim Cole, a distinguished UK Child Health statistician and the originator of using the LMS Method for centile charts. The degree of error in calculation was deemed to be clinically insignificant, representing around *one-ten-thousandth* of a Centile percentage point, in a clinical measurement context in which significant variations are found simply in the measurement technique itself (for example weighing and measuring a moving baby).

End-to-end testing of the platform was also manually performed to 'spot check' that the data entered for a generated synthetic child was corroborated against analogue calculations of centile values.

Severity

Major

Likelihood

Very Low

Residual Risk Level

Outcome

HAZARD: MISUSE OF THE API CODE BY EXTERNAL ORGANISATIONS

Description of initial Risk and mitigation steps

Severity

Likelihood

Residual Risk Level

Outcome

Test Issues

There are no outstanding test issues from a DCB0129 standpoint. Implementers will be expected to conduct their own User Acceptance Testing as part of development and roll-out of their solution, and their feedback may inform future development of the RCPCH Digital Growth Charts Platform.

Summary Safety Statement

This document recommends that the RCPCH Digital Growth Charts platform is suitable for clinical deployment and use, subject to further DCB0160 clinical risk management within the deploying organisation, and with support from the RCPCH in correct and safe deployment.

Quality Assurance and Document Approval

This document is currently written by the CSO with support from the RCPCH Incubator and Development Team who have undergone the necessary training on clinical safety in Healthcare IT systems. The other activities which support the creation of this document include the hazard identification workshops which are supported by the RCPCH Project Board and other clinical and administrative staff.

This report is then reviewed by the Deputy Clinical Safety Officer, Lead Developers, dGC Product Owner, dGC Project Manager, and Chief Digital Officer before a recommendation is made.

This page was last updated on: February 12, 2026
This site was last updated on: March 3, 2026

8.2.4 Digital Growth Charts Hazard Log

In keeping with our commitment to transparency and openness, our Hazard Log is **publicly** visible and managed in GitHub using the Issues feature.

Each Issue represents a Hazard potentially affecting the project.

Hazards can be viewed (and indeed commented on, discussed, and improved) at the URL below:

https://github.com/rcpch/digital-growth-charts-documentation/issues

Instead of the more usual and somewhat outdated and chaotic 'spreadsheet' model, often used for Hazard Logs, we are using the **Issues** facility in GitHub to record Hazards.

- *Labels* are used to annotate Hazard Issues with `severity-` and `likelihood-` scores, from which we can derive a `risk-level-`. See all Labels **here**
- *Milestones* are used to designate the Initial Risk Assessment and Residual Risk Assessment. See all Milestones **here**

Most importantly, the **discussion and evidence** relating to any given risk is included in the recording of the risk. A complete history of the labelling is kept in the issue. Spreadsheet-based risk and hazard handling is inferior to this model, because spreadsheets are unsuited to discussion, text handling, and long-form discourse.

> ⚠️ **Beware of spreadsheets**
>
> A Hazard which is *never* recorded in any Spreadsheet-based Hazard Log is 'Accidental deletion of a Hazard before it has been mitigated/risk-eliminated', yet anyone who has used a spreadsheet knows how easy it is to accidentally delete or modify a cell or row inadvertently. Put simply, a spreadsheet is a poor choice of technology for managing text and a totally unacceptable choice of technology for handling Hazards, yet it has become the industry standard across the NHS simply because the Hazard Log template issued by NHS Digital is a spreadsheet.

Monitoring of Risk

Using the Label search feature, one can search for Hazards at any Risk Level, in order to triage the most risky Hazards for further action.

risk-level-5-unacceptable
risk-level-4-mandatory-risk-elimination
risk-level-3-undesirable
risk-level-2-acceptable
risk-level-1-acceptable

- We can filter for multiple labels.

Deletion

Hazards are **never** deleted but may be *closed* if no longer relevant.

Alternative views

We are planning to develop a simple application which can view Issues in a tabular form, for familiarity.

Creating a Hazard

1. Navigate to **Issues**

2. Click on New Issue

3. Use the **Hazard Issue Template** to guide you through adding the necessary information.

4. Label according to Severity and Likelihood, then calculate Risk Level.

5. Assign to CSO @pacharanero.

6. Save by 'committing' to the repository.

7. Review and ensure complete.

8. Invite others to review and comment using @mention or by sharing the URL

Hazard Table

This page was last updated on: February 12, 2026
This site was last updated on: March 3, 2026

8.2.5 Third Party Tools Safety

This section documents the steps taken in order to minimise risk incurred from using third party tools in our software stack. Each of the tools is selected

List of Third Party Tools

Python FastAPI React.js

Cloud Services Providers

Microsoft Azure GitHub

This page was last updated on: January 21, 2026
This site was last updated on: March 3, 2026

8.2.6 License file for the RCPCH dGC Clinical Safety Management File

This clinical safety management file is unusual in that it is in a public repository. Having completely open clinical safety documention is a good way to increase transparency and to demonstrate genuine attention to clinical safety issues.

We are happy for it to be reused by others implementing open source projects. If you do reuse any part of this work, you **must** attribute the Royal College of Paediatrics and Child Health, and follow the other terms of this license. If you are a commercial organisation wishing to use this documentation then we may consider dual-licensing to allow for this. Please contact us.

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This site was last updated on: March 3, 2026

8.3 DTAC

8.3.1 Digital Technology Assessment Criteria (DTAC)

> 📝 **DTAC Assessment Document**
>
> This DTAC assessment is based on the template downloaded from the **NHS England Transformation Directorate website**.
>
> As part of our effort to use modern web standards and publish documents more openly, we have converted the `.odt` original document into a native web page in our documentation site.

DTAC Document

The assessment criteria is made up of five core components. Sections A and B will provide the assessors the context required to understand your product and support your evidence. The core assessment criteria is defined in section C1-C4. Section D details the key Usability and Accessibility principles required. Further frequently asked questions are available at the end of the document.

The core criteria in Section C will determine the overall success of the assessment of your product or service. The accompanying score provided from Section D will show the level of adherence to the NHS Service Standard.

Section A. Company information

Non-assessed section

Information about your organisation and contact details.

Code	Question	Response
A1	Provide the name of your company	**Royal College of Paediatrics and Child Health (RCPCH)**
A2	Provide the name of your product	**RCPCH Digital Growth Charts**
A3	Provide the type of product	**Digital Growth Charts Application Programming Interface and related tools and platform**
A4	Provide the name and job title of the individual who will be the key contact at your organisation	**Richard Burley - Chief Digital Officer**
A5	Provide the key contact's email address	**richard.burley@rcpch.ac.uk**
A6	Provide the key contact's phone number	**020 70926037**
A7	Provide the registered address of your company	**5-11, Theobalds Rd, London WC1X 8SH, United Kingdom**
A8	In which country is your organisation registered?	**England, Wales and Scotland**
A9	If you have a Companies House registration in the UK please provide your number	**A Registered Charity in England and Wales (1057744) and in Scotland (SC038299)**
A10	If applicable, when was your last assessment from the Care Quality Commission (CQC)?	**Not applicable**
A11	If applicable, provide your latest CQC report.	**N/A**

Section B. Value proposition

Non-assessed section

Please set out the context of the clinical, economic or behavioural benefits of your product to support the review of your technology. This criteria will not be scored but will provide the context of the product undergoing assessment.

Where possible, please provide details relating to the specific technology and not generally to your organisation.

Code	Question	Options	Response
B1	Who is this product intended to be used for?	Patients | Diagnostics | Clinical Support | Infrastructure | Workforce | Other	**Diagnostics/Clinical Support** **This product is used by a range of health care professionals (GPs, paediatricians, nurses, health visitors, midwives, school nurses) to evaluate and record a child's growth.**
B2	Provide a clear description of what the product is designed to do and of how it is expected to be used	Free text	**The RCPCH Digital Growth Charts API provides reliable growth calculation for children of all ages capturing sex, DOB, weight, length, head circumference and BMI, for the range of 23 weeks premature to 20 years old for standard charts, and also provides Turner Syndrome and Down Syndrome calculations.** **The product allows the returned structured data to be displayed in a number of different ways depending on the clinician's needs, and for the data to be saved, charted, and trended within Electronic Patient Record systems. This richly functional solution with features such as automatic gestational age correction, bone age, mid-parental height, event recording, and specialist references is designed to bring high-quality growth parameter calculations to clinicians at the point of care.**
B3	Describe clearly the intended or proven benefits for users and confirm if / how the benefits have been validated	Free text	

Code	Question	Options	Response
			• **Produced by a multidisciplinary group of members and other experts from clinical paediatrics, health informatics, statistics and programming, as well as childhood growth and nutrition specialists, health visitors and information governance experts.**
			• **Access includes RCPCH-created guidelines and advice for health professionals aiming to improve standards of growth measurement and assessment.**
			• **API returns structured data, and recommended SNOMED -CT clinical terminology.**
			• **Easy creation of apps and interfaces that will give clinicians accurate data to improve care and give access to their children's growth records online.**
			• **Access to ongoing maintenance and future development.**
			• **The ability to receive longitudinal growth data of individual children, which will enable the API to map children's growth pattern, trajectory and thrive lines.**
			• **Standardised open data format for all growth references, allowing research groups to develop specialist or localised growth charts using third party dataset.**
			• **Registered with the Medicines and Healthcare Products Regulatory Agency as a UKCA marked Medical Device.**
			• **Provision of the Clinical Standard Service Level Agreement, i.e., provision of support from 9am to 5pm, Monday to Friday.**
B4	Please attach one or more user journeys which were used in the development of this product Where possible please also provide your data flows	Provided | Not available	**User journeys are provided on our documentation website.** **https://growth.rcpch.ac.uk**

Section C. Technical questions

Assessed sections

C1 - CLINICAL SAFETY

Establishing that your product is clinically safe to use.

You must provide responses and documentation relating to the specific technology product that is subject to assessment.

The DCB0129 standard applies to organisations that are responsible for the development and maintenance of health IT systems. A health IT system is defined as "product used to provide electronic information for health and social care purposes". DTAC is designed as the assessment criteria for digital health technologies and C1 Clinical Safety Criteria is intended to be applied to all

assessments. If a developer considers that the C1 Clinical Safety is not applicable to the product being assessed, rationale must be submitted exceptionally detailing why DCB0129 does not apply.

The DCB0160 standard applies to the organisation in which the health IT is deployed or used. It is a requirement of the standard (2.5.1) that in the procurement of health IT systems the organisation must ensure that the manufacturer and health IT system complies with DCB0129. The organisation must do so in accordance with the requirements and obligations set out in the DCB0160 standard. This includes personnel having the knowledge, experience and competences appropriate to undertaking the clinical risk management tasks assigned to them and organisations should ensure that this is the case when assessing this section of the DTAC.

If the Clinical Safety Officer or any other individual has concerns relating to safety of a medical device including software and apps, this should be reported to the Medicines and Healthcare products Regulatory Agency (MHRA) using the Yellow Card reporting system:

Report a problem with a medicine or medical device - GOV.UK (www.gov.uk).

Code	Question	Options	Supporting information	Response
C1.1	Have you undertaken Clinical Risk Management activities for this product which comply with DCB0129?	Yes | No	The **DCB0129** standard applies to organisations that are responsible for the development and maintenance of health IT systems. A health IT system is defined as "a product used to provide electronic information for health and social care purposes".	**Yes**
C1.1.1	Please detail your clinical risk management system	Provided | No evidence available	DCB0129 sets out the activities that must and should be undertaken for health IT systems. An example **clinical risk management system template** can be downloaded from the NHS Digital website.	**Provided.** **All details of the Clinical Risk Management System in place at RCPCH Digital Growth Charts are held on our public documentation site at** **https:// growth.rcpch.ac.uk/ safety/overview/**
C1.1.2	Please supply your Clinical Safety Case Report and Hazard Log	Provided | No evidence available	Specifically, your DTAC submission should include: • A summary of the product and its intended use • A summary of clinical risk management activities • A summary of hazards identified which you have been unable to mitigate to as low as it is reasonably practicable • The clear identification of hazards which will require user or commissioner action to reach acceptable mitigation (for example, training and business process change) It should not include the hazard log in the body of the document - this should be supplied separately.	**Provided.** **Clinical Safety Case Report:** **https:// growth.rcpch.ac.uk/ safety/csmf/clinical-safety-case-report/** **Hazard Log:** **https:// growth.rcpch.ac.uk/ safety/csmf/hazard-log/**

Code	Question	Options	Supporting information	Response
			Example **Clinical Safety Case Report and Hazard Log templates** can be downloaded from the NHS Digital website.	
C1.2	Please provide the name of your Clinical Safety Officer (CSO), their profession and registration details	Free Text	The CSO must: • Be a suitably qualified and experienced clinician • Hold a current registration with an appropriate professional body relevant to their training and experience • Be knowledgeable in risk management and its application to clinical domains • Be suitably trained and qualified in risk management or have an understanding in principles of risk and safety as applied to Health IT • Have completed appropriate training The work of the CSO can be undertaken by an outsourced third party.	**Dr Marcus Baw** **GMC: 4712729** **General Practitioner** **Software Developer** **NHS Digital Trained Clinical Safety Officer**
C1.3	If your product falls within the UK Medical Devices Regulations 2002, is it registered with the Medicines and Healthcare products Regulatory Agency (MHRA)?	Yes | No | Not applicable	If this question is not applicable, because your product does not fall within the UK Medical Devices Regulations 2002, continue to question C1.4. If No, but the product falls within the UK Medical Devices Regulations 2002, continue to question C.1.3.2. The MHRA provides guidance on medical devices to place them on the market in Great	**Yes, the RCPCH Digital Growth Charts API is registered as a Class I Medical Device with the MHRA.** **Our GMDN Term is 65712 - Paediatric growth calculation API software**

Code	Question	Options	Supporting information	Response
			Britain and Northern Ireland, **regulatory requirements** for all medical devices to be placed on the UK market, **conformity assessment** and the UK Conformity Assessed (UKCA) mark, **classification of stand-alone medical device software** (including apps) and **how to tell if your product falls within the UK Medical Devices Regulations 2002**.	
C1.3.1	If yes, please provide your MHRA registration number	Free text		**MHRA Account Number 13251** **Digital Growth Charts Device Application reference 2022020401237576**
C1.3.2	If the UK Medical Device Regulations 2002 are applicable, please provide your Declaration of Conformity and, if applicable, certificate of conformity issued by a Notified Body / UK Approved Body	Provided | No evidence available	Medical device manufacturers must ensure that their device complies with the relevant Essential Requirements of the legislation and draw up a Declaration of Conformity to declare this. Class I devices with a measuring function and devices in Class IIa, IIb and III must undergo conformity assessment from an EU Notified Body or UK Approved Body which has been designated for medical devices, and be issued a certificate of conformity (commonly referred to as a "CE certificate" or "UKCA certificate"	**Provided.** **https:// growth.rcpch.ac.uk/ safety/medical-device-reg/doc-api/** **As a Class I Medical Device there is no requirement for Notified Body / UK Approved Body certificate of conformity.**
C1.4	Do you use or connect to any third-party products?	Yes | No	If no, continue to section C2. **DCB0129** contains the requirements in	**No**

Code	Question	Options	Supporting information	Response
			relation to third party products.	
C1.4.1	If yes, please attach relevant Clinical Risk Management documentation and conformity certificate	Provided | No evidence available		**Not applicable**

C2 - DATA PROTECTION

Establishing that your product collects, stores and uses data (including personally identifiable data) compliantly.

Code	Question	Options	Supporting information	Response

This section applies to the majority of digital health technology products however there may be some products that do not process any NHS held patient data or any identifiable data. If this is the case, the Data Protection Officer, or other suitably authorised individual should authorise this data protection section being omitted from the assessment.

Code	Question	Options	Supporting information	Response
C2.1	If you are required to register with the Information Commissioner, please attach evidence of a current registration. If you are not required to register, please attach a completed self-assessment showing the outcome from the Information Commissioner and your responses which support this determination.	Provided | Not provided	There are some instances where organisations are not required to register with the Information Commissioner. This includes where no personal information is being processed. The Information Commissioner has a **registration self-assessment tool** to support this decision making.	**Provided.** **The RCPCH has ICO Registration, registration number: Z5143673**
C2.2	Do you have a nominated Data Protection Officer (DPO)?	Yes | No | We do not need one	Not all organisations are required to have a **Data Protection Officer** (DPO). This is determined by the type of organisation and core activities. The most common reason for organisations providing digital health technologies to have a DPO is due to the core activities involving processing health data (being a special category). The Information Commissioner has a **self-assessment tool** to determine whether you must appoint a DPO.	**Yes.**
C2.2.1	If you are required to have a nominated Data	Free text | Provided		**Adele Picken**

Code	Question	Options	Supporting information	Response
	Protection Officer, please provide their name. If you are not required to have a DPO please attach a completed self-assessment showing the outcome from the Information Commissioner and your responses which support this determination.			**RCPCH Head of Information Governance** **Tel. 020 7092 6030**
C2.3	Does your product have access to any personally identifiable data or NHS held patient data?	Yes | No	The UK General Data Protection Regulation (GDPR) applies to the processing of **personal data**. If no, continue to question C2.4	**No**
C2.3.1	Please confirm you are compliant (having standards met or exceeded status) with the annual Data Security and Protection Toolkit Assessment. If you have not completed the current year's assessment and the deadline has not yet passed, please confirm that you intend to complete this ahead of the deadline and that there are no material changes from your previous years submission that	Confirmed | Unable to confirm	The **Data Security and Protection Toolkit** allows organisations to measure performance against the National Data Guardian's 10 data security standards.	**Confirmed.** **Standards Exceeded.** **https:// www.dsptoolkit.nhs.uk/ OrganisationSearch/8HV48**

Code	Question	Options	Supporting information	Response
	would affect your compliance.			
C2.3.2	Please attach the Data Protection Impact Assessment (DPIA) relating to the product.	Provided | Not provided	**DPIAs** are a key part of the accountability obligations under the UK GDPR, and when done properly help organisations assess and demonstrate how they comply with data protection obligations. The Information Commissioner has provided guidance on **how to complete a DPIA** and a **sample DPIA template**.	**The RCPCH used the ICO DPIA Checklist to determine if a DPIA was required and the outcome was that a DPIA was NOT required on the basis that personally identifiable data is not handled.** **The information submitted does not identify the individual on its own. RCPCH also does not have access to the information nor stores. RCPCH does not use the information to learn, record or decide anything about the data subject. RCPCH is not data controller of this information. The healthcare organization using the tool, as data controller of the data being provided, may be required to undertake a DPIA but this will depend on their own assessment. We have consulted with our Data Protection Officer on all matters of data protection and have their agreement.**
C2.4	Please confirm your risk assessments and mitigations / access controls / system level security policies have been signed-off by your Data Protection Officer (if one is in place) or an accountable officer where exempt in question C2.2.	Confirm | Cannot confirm		**Confirm.**
C2.5	Please confirm where you store and process data (including any third-party	UK only | In EU | Outside of EU	Individual organisations within the Health and Social Care system are accountable for	**UK Only** **(London, England)**

Code	Question	Options	Supporting information	Response
	products your product uses)		the risk-based decisions that they must take.	
C2.5.1	If you process store or process data outside of the UK, please name the country and set out how the arrangements are compliant with current legislation	Free text	From 1 January 2021, the UK GDPR applies in the UK in place of the "EU GDPR'. The UK GDPR will carry across much of the existing EU GDPR legislation. The Department for Digital, Culture, Media & Sport has published two **Keeling Schedules** which show the changes to the Data Protection Act 2019 and EU GDPR. The Information Commissioner has published guidance on **international data transfers** after the UK exit from the EU Implementation Period.	**Not applicable. All data is processed in the UK.**

C3 - TECHNICAL SECURITY

Establishing that your product meets industry best practice security standards and that the product is stable.

Dependent on the digital health technology being procured, it is recommended that appropriate contractual arrangements are put in place for problem identification and resolution, incident management and response planning and disaster recovery.

Please provide details relating to the specific technology and not generally to your organisation.

Code	Question	Options	Supporting information	Response
C3.1	Please attach your Cyber Essentials Certificate	Provided | No evidence available	**Cyber Essentials** helps organisations guard against the most common cyber threats. The National Cyber Security Centre (NCSC) have published **cyber security guidance for small to medium enterprises** (SME's).	**Our Cyber Essentials certificate is published here** **https://growth.rcpch.ac.uk/technical/security/#cyber-essentials**
C3.2	Please provide the summary report of an external penetration test of the product that included Open Web Application Security Project (OWASP) Top 10 vulnerabilities from within the previous 12-month period.	Provided | No evidence available	The NCSC provides guidance on **penetration testing**. The OWASP Foundation provides guidance on the **OWASP top 10 vulnerabilities**.	**Penetration testing is in the process of being conducted.** **Evidence from this is to be provided.**
C3.3	Please confirm whether all custom code had a security review.	Yes - Internal code review | Yes - External code review | No | No because there is no custom code	The NCSC provides guidance on **producing clean and maintainable code**.	**Yes - Internal code review**
C3.4	Please confirm whether all privileged accounts have appropriate Multi-Factor Authentication (MFA)?	Yes | No	The NCSC provides guidance on **Multi-Factor Authentication**.	**Yes.**
C3.5	Please confirm whether logging and reporting requirements have been clearly defined.	Yes | No	The NCSC provides guidance on **logging and protective monitoring**. To confirm yes to this question, logging (e.g., audit trails of all access) must be in place. It is acknowledged that not all developers will have advanced audit capabilities.	**Yes.**

Code	Question	Options	Supporting information	Response
C3.6	Please confirm whether the product has been load tested	Yes | No	Load testing should be performed.	**Yes.**

C4 - INTEROPERABILITY CRITERIA

Establishing how well your product exchanges data with other systems.

To provide a seamless care journey, it is important that relevant technologies in the health and social care system are interoperable, in terms of hardware, software and the data contained within. For example, it is important that data from a patient's ambulatory blood glucose monitor can be downloaded onto an appropriate clinical system without being restricted to one type. Those technologies that need to interface within clinical record systems must also be interoperable. Application Programme Interfaces (APIs) should follow the Government Digital Services Open API Best Practices, be documented and freely available and third parties should have reasonable access in order to integrate technologies.

Good interoperability reduces expenditure, complexity and delivery times on local system integration projects by standardising technology and interface specifications and simplifying integration. It allows it to be replicated and scaled up and opens the market for innovation by defining the standards to develop upfront.

This section should be tailored to the specific use case of the product and the needs of the buyer however it should reflect the standards used within the NHS and social care and direction of travel.

Please provide details relating to the specific technology and not generally to your organisation.

Code	Question	Options	Supporting information	Response
C4.1	Does your product expose any Application Programme Interfaces (API) or integration channels for other consumers?	Yes | No	The NHS website developer portal provides guidance on **APIs and the NHS**. Government Digital Services provide guidance on **Open API best practice**.	**Yes.**
C4.1.1	If yes, please provide detail and evidence: • The API's (e.g., what they connect to) set out the healthcare standards of data interoperability e.g. Health Level Seven International (HL7) / Fast Healthcare Interoperability Resources (FHIR) • Confirm that they follow Government Digital Services Open API Best Practice • Confirm they are documented and freely available • Third parties have reasonable access to connect If no, please set out why your product does not have APIs.	Free text		**Our product is entirely designed to be interoperable and our primary offering is a Digital Growth Charts API which is interoperable.** **Our API and ancillary development toolkits are fully documented at our public documentation site at** **https:// growth.rcpch.ac.uk/** **API documentation is in the international OpenAPI3 documentation standard.** **Government Digital Services Open API Best Practice is followed throughout.** **Connection to third parties is our intended business model as we actively encourage connection and full integration, providing both free access at lower levels of usage, and supported enterprise integration support.**
C4.2	Do you use NHS number to identify patient record data?	Yes | No | No, because product does not identify patient record data	NHS Digital provides guidance on **NHS Login for partners and developers**.	**No, because product does not identify patient record data**

Code	Question	Options	Supporting information	Response
C4.2.1	If yes, please confirm whether it uses NHS Login to establish a user's verified NHS number. If no, please set out the rationale, how your product established NHS number and the associated security measures in place.	Free text		**N/A**
C4.3	Does your product have the capability for read/write operations with electronic health records (EHRs) using industry standards for secure interoperability (e.g. OAuth 2.0, TLS 1.2)	Yes | No | No, because the product does not read/ write into EHRs		**No, because the product does not read/ write into EHRs**
C4.3.1	If yes, please detail the standard	ree text		
C4.3.2	If no, please state the reasons and mitigations, methodology and security measures.	ree text		
C4.4	Is your product a wearable or device, or does it integrate with them?	Yes | No	If no, continue to section D.	**No**
C4.4.1	If yes, provide evidence of how it complies with ISO/ IEEE 11073 Personal Health Data (PHD) Standards.	Provided | No evidence available	**Access the ISO Standard.** This is a paid-for document.	

Section D. Key principles for success

The core elements defined in this section will form part of the overall review of the product or service and is a key part to ensuring that the product or service is suitable for use. The assessment will set a compliance rating and where a product or developer is not compliant highlight areas that the organisation could improve on with regards to following the core principles.

This section will be scored in relation to the **NHS service standard**. This will not contribute to the overall Assessment Criteria as set out in Section C.

D1 - USABILITY AND ACCESSIBILITY

scored section

Establishing that your product has followed best practice.

Please note that not all sections of the NHS Service Standard are included where they are assessed elsewhere within DTAC, for example clinical safety.

Code	Question	Options	Supporting information	Weighted score	Scoring criteria
D1.1	**Understand users and their needs in context of health and social care** Do you engage users in the development of the product?	Yes | No | Working towards it	**NHS Service Standard Point 1**	0%	**Yes.** **User needs are continually integrated into the development workflow.** **The user needs of Paediatricians, nurses and other clinical staff are represented by the Digital Growth Charts Project Board, which is composed of nominated user representatives** **https:// growth.rcpch.ac.uk/ about/team/ #project-board** **Additionally we have open Issue reporting which allows anyone, whether user, patient, or parent/ carer to report a user need or requirement for consideration by the development team.**
D1.1.1	If yes or working towards it, how frequently do you consider user needs in your product development and what methods do you use to engage users and understand their needs?	text			**User needs are constantly re-evaluated and are a central part of our development workflow. New user needs can be incorporated into our 2-weekly development cycles quite easily and new deployments of improved platform features can be achieved rapidly**
D1.2	**Work towards solving a whole problem for users**	Yes | No | Working towards it	**NHS Service Standard Point 2 and Point 3** are	0%	**User journeys to follow**

Code	Question	Options	Supporting information	Weighted score	Scoring criteria
	Are all key user journeys mapped to ensure that the whole user problem is solved, or it is clear to users how it fits into their pathway or journey?		often dealt with by teams together.		
D1.2.1	If yes or working towards it, please attach the user journeys and/or how the product fits into a user pathway or journey	Provided | No evidence available			
D1.3	**Make the service simple to use** Do you undertake user acceptance testing to validate usability of the system?	Yes | No | Working towards it	**NHS Service Standard Point 4**	0%	**No.** **The product we provide is a toolkit and API which is integrated into EHRs by our customers (the EHR suppliers). Our toolkit does not *in itself* have users.** **Those EHR suppliers perform their own UAT on their implementation of our toolkit and API, to validate usability of their system.** **If a supplier found a usability issue which originated within our toolkit or API they would escalate this back to us for action.**
D1.3.1	If yes or working towards it, please attach information that	Provided | No evidence available			N/A

Code	Question	Options	Supporting information	Weighted score	Scoring criteria
	demonstrates that user acceptance testing is in place to validate usability.				
D1.4	**Make sure everyone can use the service** Are you international Web Content Accessibility Guidelines (WCAG) 2.1 level AA compliant?	Yes | No | Working towards it	a href="https://service-manual.nhs.uk/service-standard/5-make-sure-everyone-can-use-the-service">NHS Service Standard Point 5 The Service Manual provides information on **WCAG 2.1** level AA. The Government Digital Service provides guidance on **accessibility and accessibility statements**, including a sample template.	0%	**Yes.**
D1.4.1	Provide a link to your published accessibility statement.	Free text		0%	**https://growth.rcpch.ac.uk/**
D1.5	**Create a team that includes multi-disciplinary skills and perspectives** Does your team contain multidisciplinary skills?	Yes | No | Working towards it	a href="https://service-manual.nhs.uk/service-standard/6-create-a-team-that-includes-multidisciplinary-skills-and-perspectives">NHS Service Standard Point 6	2.5%	**Yes.**
D1.6	**Use agile ways of working** Do you use agile ways of working to deliver your product?	Yes | No | Working towards it	a href="https://service-manual.nhs.uk/service-standard/7-use-agile-ways-of-working">NHS Service Standard Point 7	2.5%	**Yes.**
D1.7				%	**Yes.**

Code	Question	Options	Supporting information	Weighted score	Scoring criteria
	Iterate and improve frequently Do you continuously develop your product?	Yes | No | Working towards it	a href="https://service-manual.nhs.uk/service-standard/8-iterate-and-improve-frequently">NHS Service Standard Point 8		
D1.8	**Define what success looks like and be open about how your service is performing** Do you have a benefits case that includes your objectives and the benefits you will be measuring and have metrics that you are tracking?	Yes | No| Working towards it	**NHS Service Standard Point 10**	0%	**Yes.**
D1.9	**Choose the right tools and technology** Does this product meet with NHS Cloud First Strategy?	Yes | No | No because it is not applicable	a href="https://service-manual.nhs.uk/service-standard/11-choose-the-right-tools-and-technology">NHS Service Standard Point 11 **NHS Internet First Policy**.	%	**Yes.** **Yes.**
D1.9.1	Does this product meet the NHS Internet First Policy?	es | No | No because it is not applicable			
D1.10	**Use and contribute to open standards, common components and patterns** Are common components and patterns in use?	Yes | No | Working towards it	**NHS Service Standard Point 13**	%	**Yes.**

Code	Question	Options	Supporting information	Weighted score	Scoring criteria
D1.10.1	If yes, which common components and patterns have been used?	Free text			**Microsoft Azure API Management Platform** **FastAPI framework** **React.js** **Semantic UI** **Python** **SNOMED-CT**
D1.11	**Operate a reliable service** Do you provide a Service Level Agreement to all customers purchasing the product?	es | No	**NHS Service Standard Point 14**	0%	**Yes.**
D1.12	Do you report to customers on your performance with respect to support, system performance (response times) and availability (uptime) at a frequency required by your customers?	es | No			**Yes.** **A public uptime monitor is always visible on our documentation site** **https://growth.rcpch.ac.uk/technical/status**
D1.12.1	Please attach a copy of the information provided to customers	Provided | No evidence available			**Provided (SLA)**
D1.12.2	Please provide your average service availability for the past 12 months, as a percentage to two decimal places	Free text			**Last 90 days 99.839% uptime.** **Information for last 12 months is not yet available.**

Supporting documentation

Please ensure that when providing evidence, documents are clearly labelled with the name of your company, the question number and the date of submission.

Possible documents to be provided are:

- A11 - CQC Report
- B4 - User journeys and data flows
- C1.1.1 - Clinical Risk Management System
- C1.1.2 - Clinical Safety Case Report
- C1.1.2 - Hazard Log
- C1.3.2 - UK Medical Device Regulations 2002 Declaration of Conformity and if applicable Certificate of Conformity
- C1.4.1 - Clinical Risk Management documentation and Conformity certificate for third party suppliers
- C2.1 - Information Commissioner's registration or completed Self-assessment Outcome Tool
- C2.2.1 Completed Information Commissioner's Self-Assessment Outcome Tool
- C2.3.2 - Data Protection Impact Assessment (DPIA)
- C3.1 - Cyber Essentials Certification
- C3.2 - External Penetration Test Summary Report
- C4.4.1 - If a wearable, evidence of how the product complies with ISO/IEEE 11073 Personal Health Data (PHD) Standards
- D1.2.1 - User Journeys and/or how the product fits into a user pathway or journey
- D1.3.1 - Supporting information showing user acceptance testing to validate usability
- D1.13.2 - Customer Performance Report

Document origin

Based on the OpenDocument version of the Digital Technology Assessment Criteria for Health and Social Care (DTAC), Version 1.0 22 February 2021, last updated 16th April 2021. RCPCH responses are in bold type.

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This site was last updated on: March 3, 2026

GitHub

8.4 Medical Devices Registration

8.4.1 UK Medical Device Registration

The Digital Growth Charts API server and associated user interface libraries (together termed the RCPCH dGC Platform) are a Medical Device as determined under the **Medical Devices Regulations 2002**, *Regulation 2 (1) "medical device" (a) (i)* in that it "is intended by the manufacturer to be used for human beings for the purpose of diagnosis, prevention, monitoring, treatment or alleviation of disease".

> ✅ **MHRA Medical Device Registration and GMDN Nomenclature**
>
> **UKCA**   The RCPCH Digital Growth Charts API is registered with the MHRA as a Class I medical device, with the GMDN Identifier of **65712 - Paediatric growth calculation API software**

Determination of Medical Device Class

Determination of the class of medical device applicable was performed using the **MHRA Medical Device Class tool** on 7th May 2021 by Dr Marcus Baw, with reference to relevant supporting documents and legislation.

Post Market Surveillance

- User/API key registry enables communication with each implementer
- Forum
- Email list

UK Responsible Person

- **Information of Responsible Persons**

References

- **EU Exit and post-transition guidance, Regulation of Medical Devices Webinar - October 2020, webinar by MHRAgovuk on YouTube**
- **EU Medical Device Regulation (MDR)**
- **EU Declaration of Conformity**
- **CE Marking**

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8.4.2 MHRA Essential Requirements

> **ⓘ MHRA Medical device essential requirements - general**
>
> This is the reference standard which we used as a starting point in assuring safety and quality when developing the Digital Growth Charts.

THE FOLLOWING APPLY TO ALL DEVICES

- The devices must be designed and manufactured in such a way that, when used under the conditions and for the purposes intended, they will not compromise the clinical condition or the safety of the patients, or the safety and health of users or, where applicable, other persons, provided that any risks which may be associated with their intended use constitute acceptable risks when weighed against the benefits to the patient and are compatible with a high level of protection of health and safety. This shall include

- reducing as far as possible, the risk of use error due to the ergonomic features of the device and the environment in which the device is intended to be used (design for patient safety), and

- consideration of the technical knowledge, experience, education and training and where applicable the medical and physical conditions of intended users (design for lay, professional, disabled or other users).

- The solutions adopted by the manufacturer for the design and construction of the devices must conform to safety principles, taking account of the generally acknowledged state of the art. In selecting the most appropriate solutions, the manufacturer must apply the following principles in the following order

a. eliminate or reduce risks as far as possible (inherently safe design and construction),

b. where appropriate take adequate protection measures including alarms if necessary, in relation to risks that cannot be eliminated,

c. inform users of the residual risks due to any shortcomings of the protection measures adopted.

- The devices must achieve the performances intended by the manufacturer and be designed, manufactured and packaged in such a way that they are suitable for one or more of the functions referred to in UK MDR 2002 - Part I Section 2(1), as specified by the manufacturer.

- The characteristics and performances referred to in Sections 1, 2 and 3 must not be adversely affected to such a degree that the clinical conditions and safety of the patients and, where applicable, of other persons are compromised during the lifetime of the device as indicated by the manufacturer, when the device is subjected to the stresses which can occur during normal conditions of use.

- The devices must be designed, manufactured and packed in such a way that their characteristics and performances during their intended use will not be adversely affected during transport and storage taking account of the instructions and information provided by the manufacturer.

- Any undesirable side-effect must constitute an acceptable risk when weighed against the performances intended.

6a. Demonstration of conformity with the essential requirements must include a clinical evaluation in accordance with Annex X.

DESIGN AND CONSTRUCTION ESSENTIAL REQUIREMENTS

The manufacturer will need to determine which apply to their software by reviewing Regulation 9 of UK MDR 2002. The following are likely to apply to software devices:

9.1 If the device is intended for use in combination with other devices or equipment, the whole combination, including the connection system must be safe and must not impair the specified performances of the devices. Any restrictions on use must be indicated on the label or in the instructions for use.

12.1 Devices incorporating electronic programmable systems must be designed to ensure the repeatability, reliability and performance of these systems according to the intended use. In the event of a single fault condition (in the system) appropriate means should be adopted to eliminate or reduce as far as possible consequent risks.

12.1a For devices which incorporate software or which are medical software in themselves, the software must be validated according to the state of the art taking into account the principles of development lifecycle, risk management, validation and verification.

12.4 Devices intended to monitor one or more clinical parameters of a patient must be equipped with appropriate alarm system to alert the user of situations which could lead to death or severe deterioration of the patient's state of health.

12.9.1 Where a device bears instructions required for its operation or indicates operating or adjustment parameters by means of a visual system, such information must be understandable to the user and, as appropriate, the patient.

13.1 Each device must be accompanied by the information needed to use it safely and properly, taking account of the training and knowledge of the potential users, and to identify the manufacturer.

THIS INFORMATION COMPRISES THE DETAILS ON THE LABEL AND THE DATA IN THE INSTRUCTIONS FOR USE

13.3 The label must bear the following particulars.

13.6 Where appropriate, the instructions for use must contain the following particulars:

(c) if the device must be installed with or connected to other medical devices or equipment in order to operate as required for its intended purpose, sufficient details of its characteristics to identify the correct devices or equipment to use in order to obtain a safe combination;

d) all the information needed to verify whether the device is properly installed and can operate correctly and safely, plus details of the nature and frequency of the maintenance and calibration needed to ensure that the devices operate properly and safely at all times;

THE FOLLOWING ARE POSSIBLY APPLICABLE TO SOFTWARE DEVICES

10.1. Devices with a measuring function must be designed and manufactured in such a way as to provide sufficient accuracy and stability within appropriate limits of accuracy and taking account of the intended purpose of the device. The limits of accuracy must be indicated by the manufacturer.

10.2. The measurement, monitoring and display scale must be designed in line with ergonomic principles, taking account of the intended purpose of the device.

10.3. The measurements made by devices with a measuring function must be expressed in legal units conforming to the Units of Measurement Regulations 1986.

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8.4.3 Declaration of Conformity (API Server)

EU DECLARATION OF CONFORMITY

1. **UNIQUE IDENTIFICATION OF THE PRODUCT**

   The Royal College of Paediatrics and Child Health Digital Growth Charts Application Programming Interface **Server**, all versions. **https://github.com/rcpch/digital-growth-charts-server**

1. **NAME AND ADDRESS OF THE MANUFACTURER OR HIS AUTHORISED REPRESENTATIVE**

   The Royal College of Paediatrics and Child Health (RCPCH), 5-11 Theobalds Road, London, WC1X 8SH (telephone: +44 (0)20 7092 6000).

1. **THIS DECLARATION OF CONFORMITY IS ISSUED UNDER THE SOLE RESPONSIBILITY OF THE MANUFACTURER (OR INSTALLER)**

   The Royal College of Paediatrics and Child Health (RCPCH)

1. **OBJECT OF THE DECLARATION (IDENTIFICATION OF PRODUCT ALLOWING TRACEABILITY. IT MAY INCLUDE A COLOUR IMAGE OF SUFFICIENT CLARITY TO ENABLE THE IDENTIFICATION OF THE PRODUCT, WHERE APPROPRIATE.)**

   There is no image, this is an entirely software product, with no dedicated hardware.

   Server application code is located at **https://github.com/rcpch/digital-growth-charts-server**

1. **THE OBJECT OF THE DECLARATION DESCRIBED IN POINT 4 IS IN CONFORMITY WITH THE RELEVANT UNION HARMONISATION LEGISLATION**

2. Regulation (EU) 2017/745 - Medical Devices

3. **REFERENCES TO THE RELEVANT HARMONISED STANDARDS USED, OR REFERENCES TO THE SPECIFICATIONS IN RELATION TO WHICH CONFORMITY IS DECLARED**

4. **TECHNICAL FILE**

   The complete unabridged technical file, all documentation, instructions for use, and the application source code itself are available publicly within this **RCPCH dGC documentation site** and the GitHub repository **https://github.com/rcpch/digital-growth-charts-server**.

Signed for and on behalf of	The Royal College of Paediatrics and Child Health
Place of Issue	Cawood, North Yorkshire, UK
Date of Issue	7th May 2021
Name	Dr Marcus Baw
Position	Lead Developer, Clinical Safety Officer, GP and EM Clinician.
Signature	
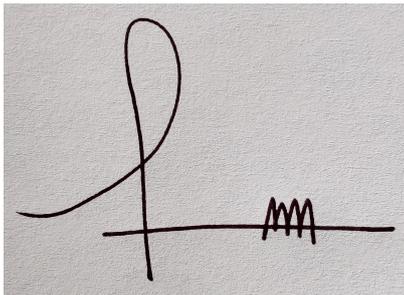
This page was last updated on: January 21, 2026
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8.4.4 Technical Documentation for EU Medical Device Regulation

Digital Growth Charts Project

1. **YOUR NAME AND ADDRESS, OR THOSE OF ANY AUTHORISED REPRESENTATIVES**

   The Royal College Of Paediatrics and Child Health (RCPCH), 5-11 Theobalds Road, London, WC1X 8SH (telephone: +44 (0)20 7092 6000).

1. **A BRIEF DESCRIPTION OF THE PRODUCT**

   A web-based software program which allows communication between user and/or back-end applications/databases (API - application programming interface) intended to assist a clinician by calculating variation in children's growth parameters [e.g., height, weight, head circumference, body mass index (BMI)] based on input data (e.g., birth height and weight, gender, gestation). The information may be used to detect children developing underweight or overweight, with height abnormalities or other related disorders.

1. **IDENTIFICATION OF THE PRODUCT, FOR EXAMPLE, THE PRODUCT'S SERIAL NUMBER**

   RCPCH Digital Growth Charts Platform, comprising of:

1. **The Digital Growth Charts API**, which receives growth measurements and returns growth calculations.
2. **The React Chart Component**, which takes the returned growth calculation JSON data and displays as a HTML-based RCPCH standard visual growth chart that is familiar to clinicians.
3. **The RCPCH Growth Python Library**, which provides the calculation functionality within the API Server.

   This documentation pertains to **all versions** of the product. Current latest versions can be viewed by consulting the relevant repository at the RCPCH GitHub organisation **https://github.com/rcpch**

1. **THE NAME(S) AND ADDRESS(ES) OF THE FACILITIES INVOLVED IN THE DESIGN AND MANUFACTURE OF THE PRODUCT**

   The product was designed and developed entirely remotely by a geographically dispersed team, and online using collaboration software such as Git, GitHub, Google Meet, Microsoft Teams, and Signal instant messaging.

The 'place of manufacture' of the product could be most accurately said to be the code collaboration platform **GitHub**, and the primary tooling used in the manufacture was Microsoft Visual Studio Code.

1. **THE NAME AND ADDRESS OF ANY NOTIFIED BODY INVOLVED IN ASSESSING THE CONFORMITY OF THE PRODUCT**

   Not Applicable due to the Class I designation of the Device

1. **A STATEMENT OF THE CONFORMITY ASSESSMENT PROCEDURE THAT HAS BEEN FOLLOWED**

   Not Applicable due to the Class I designation of the Device

1. **THE EU DECLARATION OF CONFORMITY**

   See **Declaration of Confomity**

1. **LABEL AND INSTRUCTIONS OF USE**

   All instructions for use are contained within **this documentation website**.

1. **A STATEMENT OF RELEVANT REGULATIONS TO WHICH THE PRODUCT COMPLIES**
2. Regulation (EU) 2017/745 - Medical Devices
3. **IDENTIFICATION OF TECHNICAL STANDARDS WITH WHICH COMPLIANCE IS CLAIMED**

   There are no technical standards pertaining directly to the manufacture of this kind of medical device.

1. **A LIST OF PARTS**
2. **Compliant parts**
3. Digital Growth Charts Application Programming Interface **Server**, **Version 1**
4. Digital Growth Charts Application Programming Interface **React Charting Component**, **Version 1**
5. Digital Growth Charts Application Programming Interface **Demo React Client**, **Version 1**
6. Digital Growth Charts Application Programming Interface **Demo React Native Client**, **Version 1**
7. **Supplementary parts (for which compliance is not claimed)**
8. **TEST RESULTS**

Automated tests on the programs are run on every code change. If the tests fail then the new code cannot be incorporated into the program, and the previous version will remain in place.

Tests can be viewed in the `test/` directory within each repository.

All repositories are listed at **https://github.com/rcpch**

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8.5 Download

8.5.1 PDF export

📄 **Download full Documentation including Clinical Safety Management File, in PDF format**

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 GitHub

9. Legal

9.1 DISCLAIMER

> ⚡ **Self Hosting - Clinical Safety Risk**
>
> **TL;DR: Don't self-host in production. Use our warranted API.**
>
> The only version of the Digital Growth Charts API which is warranted to be correct for clinical use is that which is served by the RCPCH itself from our API endpoint at **https://api.rcpch.ac.uk**.
>
> For reasons of transparency, equity-of-access and safety, we have made it *possible* to use our open-source code to set up a server providing Digital Growth Charts API calculations. **However, we strongly advise *against* doing this**, except for testing, verification, development purposes or research (which is not for academic publication).
>
> **WE STRONGLY RECOMMEND NOT TO SELF-HOST THE SERVER FOR PRODUCTION, CLINICAL or other 'LIVE' USE.**
>
> By self-hosting, you would not have a warranty from the RCPCH: you are liable for misconfigurations in the server leading to clinical issues. To ensure safe service with the complexity of Growth Charts, you likely require large amounts of statistical, clinical and technical consultancy.
>
> You must understand and accept that any version of this API running **outside** our controlled environment must have been:
>
> 1. Independently **technically-assured**, such that the platform, deployment, and modifications are secure, safe, and reliable.
> 2. Independently **clinically-assured**, such that the application is safe and has a qualified Clinical Safety Officer, a Clinical Safety Management File, and is fully compliant with DCB0129 and DCB0160.
> 3. Registered with the MHRA as a Medical Device (for UK deployment) and EU MDR, with Declaration of Conformity (for EU deployment).
>
> **For this reason, we STRONGLY recommend you DO NOT SELF-HOST any of our platform, but instead use the hosted (and attractively-priced) Digital Growth Charts API platform. Self-hosting means your organisation is fully liable for any errors in calculation, deployment, or functioning. We will not provide any free support for self-hosting organisations.**

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 GitHub

9.2 Licensing and Copyright

9.2.1 Open Source

As responsible clinicians, the Project Board and Project Team all agreed the growth references and calculation code should be open source, enabling peer review, improving quality, and development of an international community of practice around these clinical tools.

> ### ⓘ Open Source Mythbuster - clarifying common misconceptions
>
> **Control**: control over the open source code still remains completely and exclusively under the control of the RCPCH software development team.
>
> **Modifications**: outside contributors **cannot** make any direct changes to our code. One of the most common myths about open-source software relates to it being insecure because "anyone can change your code". This is simply not true. However, we **can** accept positive improvements and contributions from the community via 'Pull Request' on GitHub. Even then, the development team still control when and how these are introduced. We are under no obligation to accept contributions.
>
> **Ownership**: the code and intellectual property is still under the full and outright ownership of the RCPCH. This assertion of ownership and copyright is not in **any** way lessened by releasing the code under an open-source license.
>
> **Licensing**: if necessary, the terms of the licenses we issue *can* be changed for future versions of the software. However, we would only do this for reasons of improving the project. Multiple licensing models can be used simultaneously: this is called a *dual-* (or even *tri-*) licensing arrangement.
>
> **Security**: allowing outsiders to see the source code does not introduce any security vulnerability. Security does not come from obscurity - hiding your code, as in the closed-source model. It comes from high standards of security practice, using the best industry practices, robust cryptography, and modern tools and approaches, described in Factor III of the **"12-Factor" application development philosophy**.
>
> Other myths exist which imply some weakness about open-source projects. We are happy to discuss them if required in the **dGC Forum**.

9.2.2 Copyright Notices

Software

All code in the Project is Copyright ⓒ 2020-2021 Royal College of Paediatrics and Child Health, except where explicitly stated.

Algorithms

The 'LMS' method used to create data tables from raw observational data, and to reverse the process, is in the Public Domain, being a widely-published scientific and statistical/mathematical innovation. The RCPCH makes no claim of ownership over this algorithm, neither is the algorithm subject to any of the licensing arrangements herein discussed.

Growth References

- UK90 Growth References are Copyright ⓒ Royal College of Paediatrics and Child Health.

- Other references, such as those for Turner syndrome and Down Syndrome, are the copyright of their respective owners.

9.2.3 Licensing summary

For details of licenses, please consult the root folder of the specific software component.

Primarily, we have used two different **Open Source Initiative**-recognised licenses:

GNU Affero General Public License version 3

The RCPCH Digital Growth Charts API Server and its accompanying Python package library is licensed under the Affero GPL, to use the 'copyleft' (also known as 'sharealike') feature within the license. The aim is to ensure any other entities wishing to deploy the API, or Python package code as a web service, are **still required to share all source code modifications they make, back to the community**.

The MIT License

Components which other organisations would benefit from being able to directly reuse within their own commercial products have been licensed using the MIT License, which permits reuse of this nature, and does not encumber the resulting commercial product with any copyleft or other restrictive conditions. This license is widely used for licensing open-source programming languages, libraries, and other reusable software components, and is considered one of the 'industry standard' licenses for this purpose.

9.2.4 Open Source Licenses and Software Bill of Materials

Tool / Framework / Library	License
Python	**PSF License**
FastAPI	**MIT License**
React	**MIT License**
MkDocs	**MIT License**

All the above licenses are compatible with the AGPL terms of the Digital Growth Charts API Server and Python package part of the project, and the MIT terms of the other parts.

All the above projects remain the copyright of their respective owners.

> **Further reading on Open Source**
>
> **Open Source is the Only Way For Medicine** - a blog post by one of the dGC team, Dr Marcus Baw, describes some reasons why open source is so fundamental for science and medicine in particular.

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GitHub
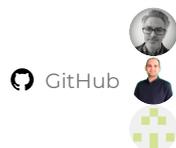
9.3 Data Protection Considerations

9.3.1 For the Digital Growth Charts API Server

The dGC server Application Programming Interface (API), and the service we provide around it, has been designed with privacy and information security in mind.

API Requests Contain No PID

The data sent to our server does not contain any Personally Identifiable Data (PID) or identifiers such as patient name, NHS number, any other numeric identifier, or address data. It does contain date of birth because this is required to calculate the age of the patient, but this is not saved to the server.

The API is Stateless

The term 'State' in computing is equal to 'saved data'. In computing terminology, if an application is 'State*ful*' it means it saves some information on the API server and thus can remember 'state' between two requests to the API. Conversely, a system that is 'state*less*' does not save any data on the API server.

The Digital Growth Charts API is 'Stateless' by design, meaning it does **not** persist information between web requests. Each request from the API-consuming application to our API contains all the information required for our Growth Chart server to calculate a set of centile data. The response we send back contains this data, and it is never saved on our server. Some information about the requests made is kept for a maximum of 72 hours in the logs of our server, to enable us to monitor performance and debug problems, however, this information is anonymous.

Persistence of results in Medical Records

Because our API is stateless, any 'persistence' (data saving) **must** happen in **the application which is consuming the API**, which is the natural place to persist data anyway, since this client system is likely to be an existing GP system, hospital Electronic Patient Record, or Personal Health Record - which likely persists lots of data about the patient.

Legal basis for Requester (client) persistence

Your legal basis for persisting data on the client side is likely to be 'Direct Care', **if** your organisation is providing medical care for the patients whose data you're persisting. If your organisation doesn't provide direct individual care for these patients, then you may need a different legal basis.

For example, if your project is purely for research or planning then you may need to have consent from patients to persist their data. **Either way**, your organisation should be registered as a Data controller with the Information Commissioner's Office (ICO) and there should be a named person in a role, such as Data Protection Officer or Caldicott Guardian, who can provide advice and ensure there is a valid legal basis for the data you collect. You may need to conduct a Data Protection Impact Assessment.

RCPCH dGC Data Protection Impact Assessment

In view of the stateless nature of the server, the RCPCH doesn't handle any Patient Identifiable Data for this platform. We have reviewed the privacy implications of the Digital Growth Charts platform, and it does not require a full Data Protection Impact Assessment, according to our review of **current Information Commissioner's Office guidance**, for the reasons described above.

9.3.2 For the Digital Growth Charts API Service provided by the RCPCH

The API developer portal collects the essential minimum details from Consumers/Integrators/Customers, so we can provide them a safe, reliable API service. Use of the service requires some data to be collected. This data is retained only for the duration of the customer's use of the API service, after which is it deleted.

Data elements	Reason for collection
Name	As a point of contact with the organisation
Email Address	As a point of contact with the organisation
Name of Organisation	To understand the likely needs of the customer
Customer's intended products for integration	To understand the likely needs of the customer
Estimated API volume usage	To help us find the best API usage plan for the customer

See our **Privacy Notice** for further details.

9.3.3 For other products

Most of our products do not collect or store **any** data whatsoever. These include:

- the dGC `rcpchgrowth-python` package
- the dGC React client demo
- the dGC React component library
- the React Native client
- the dGC command line tools
- the Google Sheets plugin (note: it's possible that Google or other services collect data about you during your use of this plugin)

This page was last updated on: June 11, 2024

This site was last updated on: March 3, 2026

GitHub

9.4 Privacy Notice

9.4.1 What information do we collect about you?

If you choose to create an account for the API service, we collect your name and email address and ask you to create a password. If you upgrade to a paid subscription, we will ask you for more details to process the payment.

We will process your data as part of a contract with you. Information collected will be used to create and manage your account, and to contact you about Growth API. We do not use your personal data to make automated decisions or undertake profiling about you.

It is important to distinguish between **the account data we collect about Integrators** (developer account data) and **the data we process on your behalf**. The personal data we collect about you is your account information, which is used to manage your account and contact you about the service. The measurements you send to the API, which are used to calculate centiles and SDS scores are not personal data but anonymised data.

9.4.2 What do we do with your developer account information?

We have stringent security measures in place to ensure your information is securely stored. Your information will not be shared outside the RCPCH. Information will be stored with third-party suppliers who are acting on our behalf as data processors to provide certain products and services for the College. Your personal data will not be transferred outside of the UK.

We will only retain your information for as long as necessary to fulfil our contract with you. If you decide to end your subscription with us, we will retain your account details for two years after the end of your subscription and then delete your data.

9.4.3 What do we do with the data you send to the API?

The RCPCH Digital Growth Chart API is **stateless**, meaning it does not persist **any** data about the measurements sent to it. This is a crucial part of the API's privacy design and has enabled us to keep the API development simple and constrained to solving the specific problem of providing centile/SDS calculations as a service.

It is the responsibility of the *consuming application* to store the measurements. This is the logical place to store data about the child since this consuming application will already have other stored data about the child within it, such as demographics. The consuming application also already has an appropriate legal basis for storing the data, such as Direct Care.

9.4.4 Your Rights

You have the following rights in relation to your data:

- Right of access and right to have a copy of your account data in a standard format (right to data portability). You can ask us for a copy of the information that we hold about you. You can also ask us for a copy of your data in a standard format where this is technically possible. This only applies where we are holding your information with consent or as part of a contract with you.

- Change any factual errors or inaccuracies (right of rectification). If you have an RCPCH developer account you can change and update your personal data. It is your responsibility to update us with any changes to the personal information you have provided. You can also contact us either via our contact form or contact the relevant team directly.

- Delete your personal data (called a right to erasure). We cannot delete all personal data as we may have a legal obligation or because we have a requirement to retain it for a task in the public interest, but we can delete non-essential data.

- Restrict the use of your data (right of restriction). You can request that we deactivate your RCPCH developer account or that we only store your data but undertake no further processing. However, this only applies to certain circumstances.

- Object to processing (right to objection). You can ask that we stop using data that is not necessary for fulfilling our legal obligations.

9.4.5 How to contact us

Please contact the RCPCH Data Protection Officer if you wish to make a request or enquiry.

Our Contact Details
Royal College of Paediatrics and Child Health (RCPCH)
📇 5-11 Theobalds Road, London, WC1X 8SH
📞 +44 (0)20 7092 6000
@ Data Protection Officer **information.governance@rcpch.ac.uk**
@ **growth.digital@rcpch.ac.uk**

If you make a request, we have one month to respond to you.

9.4.6 DataRep - Our EU Partner

> ℹ️ **Our EEA Representative**
>
> If you are located in the EEA or EU, you can contact DataRep if you wish to make a request under EU GDPR.
>
> As we sometimes process the personal data of individuals in the EU and EEA area, in either the role of 'data controller' or 'data processor', we have appointed DataRep as our Data Protection Representative in the European Union for the purposes of EU GDPR, so that you can contact them directly in your home country.
>
> If we have processed or are processing your personal data and you are located outside of the UK, you may be entitled to exercise your rights under EU GDPR in respect of that personal data. For more details on your rights in the EU, please refer to the European Commission or the national Data Protection Authority in your country.
>
> If you want to raise a question to RCPCH, or otherwise exercise your rights in respect of your personal data, you may do so by:
>
> - Sending an email to DataRep at **datarequest@datarep.com** quoting "RCPCH" in the subject line;
> - Contacting DataRep on their online web form; or
> - Mailing your enquiry to DataRep at the most convenient of the addresses on the subsequent pages.
>
> Please note, when mailing inquiries, you must mark your letters for 'DataRep' and not 'RCPCH', or your inquiry will not reach them. Please refer clearly to RCPCH in your correspondence. On receiving your correspondence, RCPCH is likely to request evidence of your identity, to ensure your personal data and information connected with it is not provided to anyone other than you.
>
> If you have any concerns over how DataRep will handle the personal data they will require to undertake for their services, please refer to their privacy notice.
>
> For general enquiries about RCPCH and its data processing contact:
> **information.governance@rcpch.ac.uk**

9.4.7 How to make a complaint

If you are unhappy with how we are using your personal data, you should contact us in the first instance so that we can understand and try to resolve your concern. If we can't resolve the issue you have the right to complain to the Information Commissioners Office (ICO). The ICO is the UK's independent body set up to uphold information rights.

ICO details
📞 Helpline number: 0303 123 1113
📇 Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF
🌐 **https://www.ico.org.uk**

If you have any questions about our privacy policy, the information we hold about you or you wish to make a complaint, please send an email to: **information.governance@rcpch.ac.uk**

9.4.8 Changes to this Privacy Policy

We keep our privacy policy under review, and we will place any updates on this web page. The last review of this policy is as per the 'updated at' date below.

This page was last updated on: March 18, 2025

This site was last updated on: March 3, 2026

GitHub

10. Technical

10.1 Security

Security is taken extremely seriously by this project and we are compliant with the **Data Security and Protection Toolkit (DSPT)** which is part of latest NHS Digital Data Security Standards (see **DSPT** section for evidence).

10.1.1 Deployment Security 'Code Chain'

To maintain security and safety, while still enabling 'agile' software development practices, we have carefully built a DevOps (Developer Operations) strategy which is consistent with industry best practice, yet is low-friction in practice, therefore easy to comply with.

These practices ensure tight security of the code, restricting deployment to the live environment. These security practices are in operation in every part of the 'code chain' from writing the code on individual development machines, through to deployment on the live server, and each of the many steps in between.

Within these practices are also measures which ensure the deployed code is tested, safe, and does not contain regressions (changes which break a feature or introduce risk).

Development machines

- Development machines are password-protected and have full-disk encryption requiring strong passwords to decrypt the disk and access the contents.
- Development machines are maintained with latest operating system patches and security updates.
- All SSH Keys are protected by a passphrase.

GitHub Repository

- Login to the GitHub organisation is restricted to specific authorised users, who are in the RCPCH Developer Team, who are all required to use **two-factor authentication** (username + password + another factor such as Google Authenticator).
- 'Pushes' of new code to the GitHub repositories are authenticated using **SSH Keys** which are secure, long, cryptographic tokens held on the computers used to develop the growth charts. Use of the token requires a further password, so possession of the computer alone is not enough to use the computer's SSH key to make a push of unauthorised code to GitHub.
- Commits of code are 'signed' using GPG (Gnu Privacy Guard - an open source implementation of the PGP protocol). This is a further attestation to the correct identity of the committer of the code.

Deployments of the server

- Deployment is completely automated, meaning no code can be manually added to our Azure WebApps, before or after deployment. All code comes directly from the trusted GitHub servers.
- Security is handled via long cryptographic keys from Microsoft Azure which are known to GitHub but never made public.
- GitHub's 'Action' workflow can use this key to authenticate itself to the Microsoft Azure cloud platform, and can push new code from the GitHub repository to the Azure WebApp where it runs as an application and is available as an API.

Code 'Promotion' Safety Strategy

- New code is never deployed to the `live` branch. Safety mechanisms on the relevant branches of our GitHub repositories prevent direct 'pushes' of code. Instead, new features must be developed on the `development` branch or in a branch created specially for that feature.

- From `development` or feature branches, code is 'promoted', following successful passing of tests for correct operation, to a `staging` branch, which allows for further testing, and where necessary review and confirmation of interoperation with other components of the dGC products.
- Once further user acceptance testing and stability tests are satisfactorily passed, this code can be merged into the `live` branch.
- We believe that this strategy reduces the risk of errors being introduced into the API code to a very low level.

Cyber Essentials

The RCPCH has been certified as compliant with the requirements of the Cyber Essentials scheme. Cyber Essentials is a government-backed, industry-supported scheme to help organisations protect themselves against common online threats. The certification demonstrates our commitment to cyber security and provides assurance to our users that we take the protection of their data seriously.

If the PDF cannot be displayed inline here, it is available as a download from **this link**

This page was last updated on: February 12, 2026
This site was last updated on: March 3, 2026

10.2 Data Security and Protection Toolkit

The Royal College of Paediatrics and Child Health is registered with the NHS Digital Data Security and Protection Toolkit, where we achieve a rating of 'Standards Exceeded'.

Our organisation reference code is 8HV48. You can see our public entry at the link below:

https://www.dsptoolkit.nhs.uk/OrganisationSearch/8HV48

> **About the Data Security and Protection Toolkit**
>
> The Data Security and Protection Toolkit is an online self-assessment tool that allows organisations to measure their performance against the National Data Guardian's 10 data security standards.
>
> All organisations that have access to NHS patient data and systems must use this toolkit to provide assurance they are practising good data security and that personal information is handled correctly.

This page was last updated on: January 21, 2026

This site was last updated on: March 3, 2026

10.3 dGC Service Status

This page was last updated on: January 21, 2026
This site was last updated on: March 3, 2026

11. Contact

11.1 Technical and Clinical Enquiries

> **ⓘ Discourse Forum**
>
> For all technical and clinical enquiries, we encourage the use of our open forum. This develops a community resource of previously asked and answered questions.
>
> These are the basis of an open, searchable knowledge base about the dGC Platform.
>
> **RCPCH Forum** 💬

11.2 Commercial Enquiries

Email our Commercial Team to ask questions about support and pricing tiers, invoicing, contracts and other commercial matters.

✉ **commercial@rcpch.ac.uk**

11.3 General Enquiries

For other enquiries, or if you are not sure how best to ask us, email our Growth Charts enquiries team.

✉ **growth.digital@rcpch.ac.uk**

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 GitHub