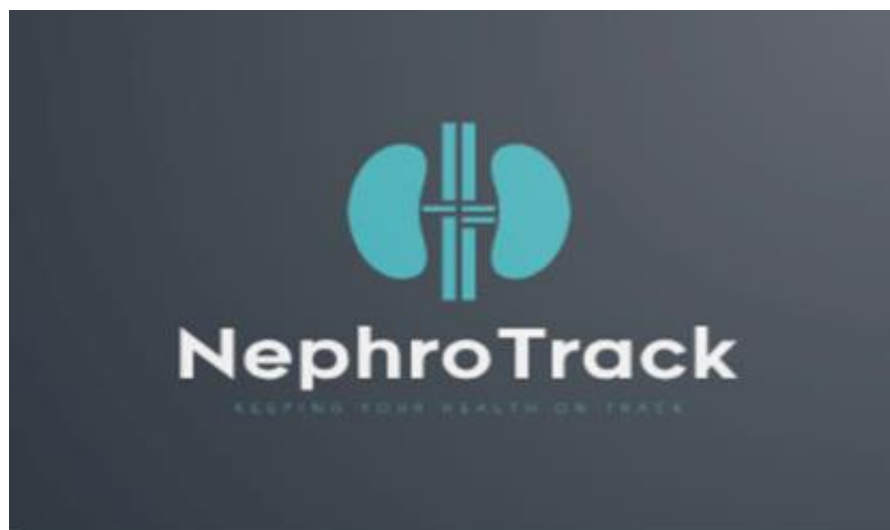# User Manual

CKD Calculator

(Team 33)

NephroTrack

1. **Introduction**

   1.1 Purpose of the App:

   NephroTrack is a Unity app designed to assist clinicians and expert patients in the rapid and accurate assessment of chronic kidney disease (CKD) risk through easy-to-use eGFR calculation tools. By enabling users to input patient data and instantly generate estimated glomerular filtration rate (eGFR) values, the app supports informed decision-making both live consultations and off-hours clinical review.

   1.2 Target Users:

   The app primarily targets healthcare professionals such as general practitioners, nephrologists, and clinical support staff, as well as knowledgeable patients managing their own CKD conditions. It offers multiple eGFR calculation options, including the MDRD 2005 and CKD-EPI 2021 equations, and incorporates global and UK-specific guidelines from the National Kidney Foundation, Kidney Research UK, the UK Kidney Association, and the International Society of Nephrology, Clinical insights and thresholds are also shaped by peer-reviewed academic research in nephrology.

   1.3 Key Features Overview:

   In addition to real-time individual calculations, the app supports bulk CSV uploads, allowing clinicians to analyse multiple patient records at once. Each result is paired with a clearly presented CKD risk level, aiding in treatment planning, monitoring progression, and recommending lifestyle and dietary adjustments. Currently designed for Android mobile use, a desktop version is in development to expand accessibility across platforms.

2. **Getting Started**

   2.1 System Requirements:
   To run NephroTrack, your device must meet the following minimum requirements:

   Operating System: Android 6.0 (Marshmallow, API level 23) or higher Architecture.

Internet Access: Required for full functionality and cloud data communication.

2.2 Installation Guide:

As the app is currently in its pre-release phase, it must be sideloaded onto Android devices manually:

2.2.1 Download the latest .apk file from the official distribution link provided by the development team or support.

2.2.2 Enable installation from unknown sources in your device settings:

Settings > Security > Install unknown apps > [Your browser or file manager] > Allow

2.2.3 Open the downloaded .apk file to install the app.

Always ensure you download the app from a verified source to avoid security risks.

2.3 First-Time Setup:

To access the app, all users must have a valid account.
Currently, accounts are created manually:

2.3.1 Contact the app support team to request an account.

2.3.2 You will be issued a username and password.

2.3.3 On Login, you will be required to select your user role:

-Clinician
-Expert Patient

Your selected role will customise the app experience and access permissions accordingly.

2.4 Permissions Required

The app requires the following permissions to function correctly:

  -Internet Access: For cloud-based syncing and communication with the Oracle APEX backend.

  -File Access: To allow clinicians to upload and process patient data from .csv files.

Upon installation, the app will prompt for these permissions. Please allow them to ensure proper operation.

3. User Roles and Permissions

NephroTrack currently supports two user roles: Clinician and Expert Patient. Each role is designed to provide a tailored experience based on the user's needs and responsibilities, with specific permissions applied accordingly.

3.1 Overview of Roles:

  3.1.1 Clinician: Medical professionals managing multiple patients and using the app for both real-time and bulk analysis.

  3.1.2 Expert Patient: Informed individuals managing their own CKD condition using the app for self-monitoring and lifestyle guidance.

3.2 Permissions and Capabilities

Feature	Clinician	Expert Patient
Access eGFR Calculator (All equations)	Yes	Yes
View CKD Risk Level	Yes	Yes
MDRD CSV Upload	Yes	No

Expert Patients do not have access to CSV uploads or batch processing features, maintaining NHS data security boundaries.

4. Navigation Overview

NephroTrack uses a simple, tap-based navigation system designed for ease of use by both Clinicians and Expert Patients. The layout focuses on clarity and speed, helping users get to the tools, they need without unnecessary complexity.

4.1 Main Screens:

The app is structured around a few key screens:

4.1.1 Login Screen:

Secure login interface where users enter their credentials and role (Clinician or Expert Patient).

4.1.2 Home Screen:

A grid-based layout with large square buttons providing access to the app's primary tools.

4.1.3 eGFR Calculator Screen:

For performing adult eGFR calculations using MDRD and CKD-EPI equations.

4.1.4 Paediatric Calculator Screen:

Specifically for patients under 18, using Schwartz Paediatric (Bedside and Full) equations.

4.2 Navigating the App:

- **-**Main Navigation is handled by tapping buttons on the Home Menu grid.
- **-**Each screen contains relevant inputs and toggles for specific tools (e.g., equation selection within the eGFR Calculator screen).
- **-**Users must return to the Home Menu to switch between different calculators or screens.

4.3 Contextual Behaviour & Icons

- If a user inputs an age under 18 on the standard eGFR screen, a pop-up message appears prompting the user to switch to Paediatric Calculator screen.

-While most screens are consistent between roles, the CSV upload button is only visible to Clinicians within the MDRD calculator screen.
-No bottom navigation bar or swipe gestures are used; navigation is strictly button-driven.

5. Feature Walkthroughs

This section explains how to use each tool available in the NephroTrack app, including input steps, toggles, and how results are displayed. The app supports multiple internationally recognised equations for eGFR calculation, each tailored to the user's age and clinical context.
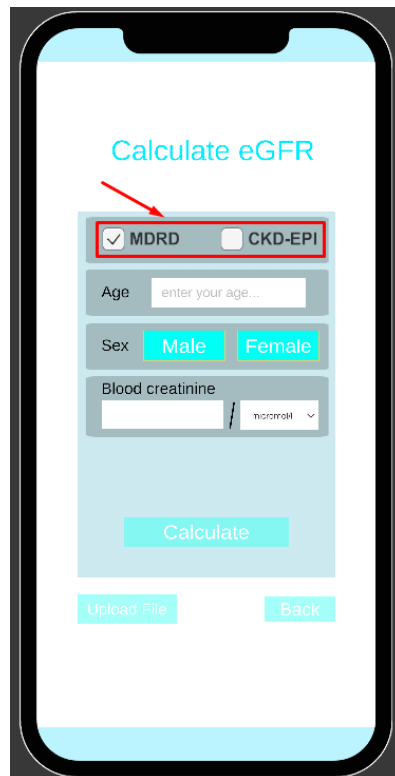
5.1 eGFR Calculator:

This tool allows both Clinicians and Expert Patients to calculate eGFR using the MDRD (2005) or CKD-EPI(2021) equations.
Steps:

5.1.1 From the Home Menu, tap eGFR Calculator.

5.1.2 Select the desired equation using the MDRD or CKD-EPI toggle at the top of the screen.
 **-** When selecting CKD-EPI, an info pop-up appears recommending it for early

stage CKD in younger and middle-aged adults.

5.1.3 Enter:
- Age
- Sex (Male/Female)
- Blood Creatinine value
- Creatinine Unit (choose between μmol/L or mg/dL)

5.1.4 Tap Calculate
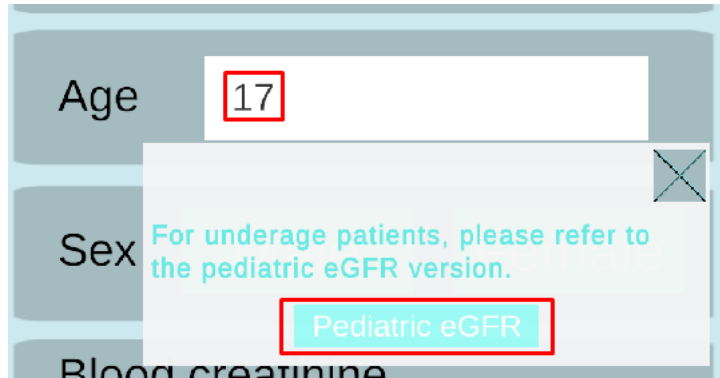
5.1.5 You'll be taken to a Result Screen that displays:
- eGFR value in mL/min/1.73
- CKD stage label
- Coloured summary phrase describing kidney function
- Lifestyle and dietary recommendations relevant to the stage.
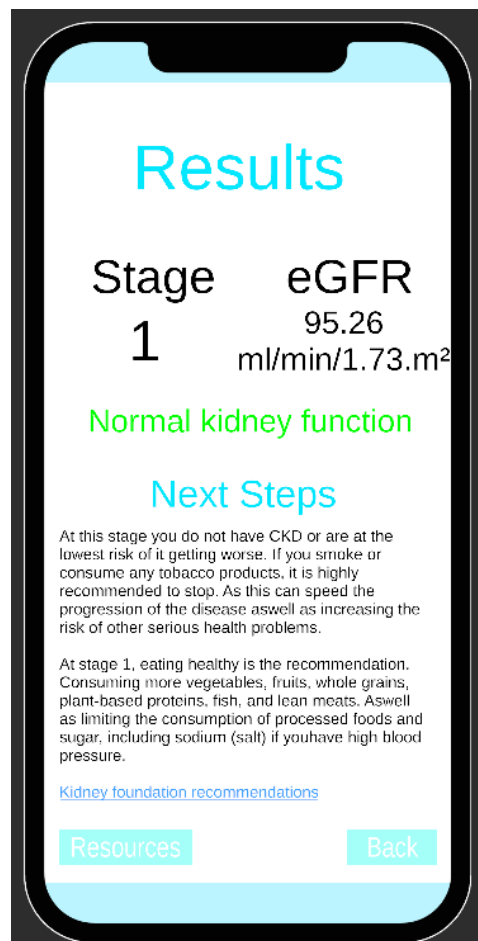
5.2 Paediatric eGFR Calculator

For users under the age of 18, a dedicated interface is available, offering two calculation methods:

Access:
- Enter an age under 18 in the adult calculator's age input field.
- A pop-up panel appears prompting the user to switch to the Paediatric Calculator.
- Tap the button to proceed to the Paediatric interface.

Simple Schwartz (Bedside) Equation:
5.2.1 Input:
   - Blood Creatinine (µmol/L or mg/dL)
   - Height (cm)

Full Schwartz Equation:
5.2.2 Input:
   - Blood Creatinine (µmol/L or mg/dL)
   - Height (cm)
   - Cystatin C (mg/L)
   - Blood Urea Nitrogen(BUN) (mg/dL)
   - Sex (Male/Female)

5.3 CSV Upload (Clinician Only)

This tool allows Clinicians to upload CSV files containing multiple patients data for bulk eGFR calculation using the MDRD equation.

Note: Only available to users logged in as Clinicians. The CSV upload button will not appear for Expert Patients.

5.4 Result and Risk Interpretation

5.4.1 After each calculation for eGFR Calculator Menu, results are presented in a dedicated Result Screen, for Paediatric Calculator, results are shown in the same interface without lifestyle or dietary recommendations.

5.4.2 The Result Screen includes:
- Calculated eGFR value.
- CKD Stage/Risk Level (e.g., Stage 1 – Normal Kidney Function).
- Color-coded background or label for quick interpretation.
- A brief summary of kidney function.
- Next steps including lifestyle and dietary recommendations.

5.4.3 Currently, results are not saved or stored, but support for result history is in development.

6. Data Security and Privacy

6.1 How User Data is Handled

NephroTrack collects minimal personal information strictly for authentication (username, password, user role). No identifiable patient data is stored locally. All single-use eGFR calculations are processed locally on the device and are not retained. CSV uploads (Clinician only) are processed in-memory and are not stored after session ends.

6.2 Patient Confidentiality Measures

-Encryption: User credentials are secured using SHA-256 hashing, and Oracle Transparent Data Encryption (TDE) protects data at rest in the database.

-Role-Based Access Control (RBAC): Ensures that only clinicians can upload and view batch data; expert patients cannot access features beyond their role.

-Secure Communication: All network interactions use HTTPS via UnityWebRequest to prevent interception.

-GDPR Compliance: Aligned with GDPR Article 32, the app enforces secure processing, avoids unnecessary storage, and ensures user data remains confidential.

7. Backend Overview

The backend of NephroTrack is responsible for securely managing user authentication, cloud-based data communication, and connectivity with external clinical systems. While users interact with a simple and intuitive interface, key processes behind the scenes ensure reliability, data integrity, and separation of roles.

7.1 Data Storage:
All user-related data is stored in the Oracle Apex cloud database, including login credentials and uploaded CSV files. No data is stored locally on the user's mobile device, ensuring that clinical data remains secure and centralised.

7.2 Login Validation
When a user logs in, the app uses a secure method to check their credentials:
- UnityWebRequest is used to send the username and password to the Oracle Apex database.
- Depending on the selected role (Clinician or Expert Patient), the app queries the relevant table.
- If the credentials match a record, the user is granted access and navigated to the main menu.

7.3 eGFR Calculations
All eGFR calculations are performed locally on the device, not on the server. This ensures quick results without needing to send sensitive medical data over the internet for computation.

7.4 Server Communication
Backend communication is handled by a custom-built DatabaseManager class, which:
-Send requests to the Oracle Apex server using UnityWebRequest.
-Manages data flow for login authentication and CSV uploads and patient data retrieval.

7.5 APIs and Cloud Logic
All backend interaction is based on REST APIs hosted on Oracle Apex. These

endpoints provide secure access to specific databases tables where data is separated in user roles.

8. FAQs

Q: Can I use the app offline?
A: No, an internet connection is required for the app to function.

Q: What happens if I leave a required field empty or enter invalid data?
A: A red error message will appear, guiding the user to fill in the missing or incorrect information.

Q: What if I enter creatinine data in the wrong unit?
A: The app assumes the user selects the correct unit manually. It is the user's responsibility to verify the correct unit (µmol/L or mg/dL) based on their data source.

Q: When should I choose CKD-EPI instead of MDRD?
A: The choice depends on the user's clinical knowledge and judgement. CKD-EPI may provide improved accuracy for early-stage CKD, especially in younger and middle-aged adults.

Q: Can I switch between MDRD and CKD-EPI after entering data?
A: Yes, you can toggle between equations at any point before calculation.

Q: Are the results saved after calculation?
A: Not currently. Support for storing and reviewing past results is planned in future versions.

Q: Can I export or share results?
A: Not at this time. This feature may be introduced in future updates.

Q: What format does the CSV upload accept?
A: Patient ID (string), Gender (int - expected values: 0 for Male, 1 for Female), Ethnicity(Obsolete), Age (int – must be > 0), Creatinine (µmol/L).

Q: Will the app be available on iOS?
A: An iOS version is planned for future release.

Q: How will I receive updates?

A: Currently, updates will be shared through the official repository. Once listed, updates will be available via the Google Play Store and Apple App Store.

Q: Why does the app ask for file and internet access?
A: These permissions are needed for CSV file uploads (for clinicians) and for secure communication with the cloud-based database.

Q: Where is my data stored?
A: All user and calculation data is securely stored in the cloud using Oracle APEX infrastructure.

9. **Glossary**

$$eGFR = 175 * (SCr)^{-1.154} * (age)^{-0.203} * 0.742[\text{if female}]$$ **eGFR**
(Estimated Glomerular Filtration Rate):
   An estimate of how well the kidneys are filtering waste from the blood, measured in mL/min/1.73 m^2. It is a key indicator of kidney function and is used to determine the stage of Chronic Kidney Disease (CKD).

MDRD (Modification of Diet in Renal Disease):
   An equation used to estimate eGFR. It is widely used for assessing kidney function, particularly in patients with moderate to severe CKD.

CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration):
   A newer equation introduced in 2021 that offers improved eGFR accuracy in

$$eGFR = 0.413 * (height/SCr)$$
   early-stage CKD, especially in younger and middle-aged adults.

$$eGFR = 142 * min(\text{standardised } SCr/K, 1)^{\alpha} * max(\text{standardised } SCr/K, 1)^{-1.200}$$
$$* 0.9938^{age} * 1.012[\text{if female}]$$

Schwartz's Paediatric Simple (Bedside) Equation:
   A paediatric eGFR equation using patient height and serum creatinine. It is a simplified version designed for quick clinical use in children under 18.

Schwartz's Paediatric Full Equation:
A more comprehensive paediatric eGFR equation that includes serum creatinine, Cystatin C, Blood Urea Nitrogen (BUN), height, and sex. It provides a more detailed estimate of kidney function in paediatric patients.

$$eGFR = 39.1(height/SCr)^{0.516} * (1.8/\text{cystatin C})^{0.294} * (30/\text{BUN})^{0.169} * (1.099)^{male} * (height/1.4)^{0.188}$$

Blood Creatinine:
Also known as Serum Creatinine (SCr), It's a waste product produced by muscles and filtered by the kidneys. Its concentration in the blood is used in all major eGFR equations to assess kidney function.

Cystatin C:
A protein produced by all cells in the body, filtered by the kidneys. It is used as an additional biomarker in advanced eGFR equations (e.g., Full Paediatric Schwartz) for more accurate kidney function estimation.

Blood Urea Nitrogen (BUN):
A measure of the amount of nitrogen in the blood from the waste product urea. It is sometimes used alongside other markers in eGFR calculations for a more complete picture of kidney function.

μmol/L (Micromoles per Liter):
A metric unit of concentration commonly used in blood tests, especially in the UK, to report levels of substances like creatinine.

mg/dL (Milligrams per Deciliter):
Another unit of concentration used in blood tests, more common in the US. Users can select this unit when entering blood test values.

cm (Centimeter):
A unit of length used in the app when inputting patient height, especially in the paediatric eGFR calculations.

Expert Patient
A non-clinician user with a deep understanding of their own CKD condition. They can use the app to calculate eGFR and receive lifestyle guidance but

cannot perform CSV uploads.

Clinician

A medical professional (e.g. doctor, nurse, renal specialist) who uses the app to assess kidney function in patients. Clinicians have access to both single and multiple (CSV) calculation tools, including CSV upload features.