

QcDM Project User Guide

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1. Overview and Installation

The QcDM (Quality care for Diabetes Mellitus) Project provides R-Shiny applications for generating glucometrics measures from point-of-care blood glucose data at three different units of analysis: patient-sample, patient-day, and patient-stay. The application facilitates convenient and flexible generation of glucometrics measures by providing user-friendly graphical user interfaces (GUIs) that runs in a browser on the user's desktop.

The QcDM Project consists of two R-Shiny GUIs and an R package. The first GUI, QcDMconverter, processes raw glucose data files to conform to the data format required by the application. The second GUI, QcDMui, is the main tool of the QcDM Project that uses functions in the [QcDM package](#) to analyses processed glucose data to generate glucometrics measures.

The application operates on Windows and Mac operating systems, and is provided for free under an academic non-commercial license. The current version of this application can be downloaded from a [Github repository](#). Installation of this application is described in details in the following sections.

1.1. Install R and RStudio

Install R from the installer downloadable from the official website of the R Project.

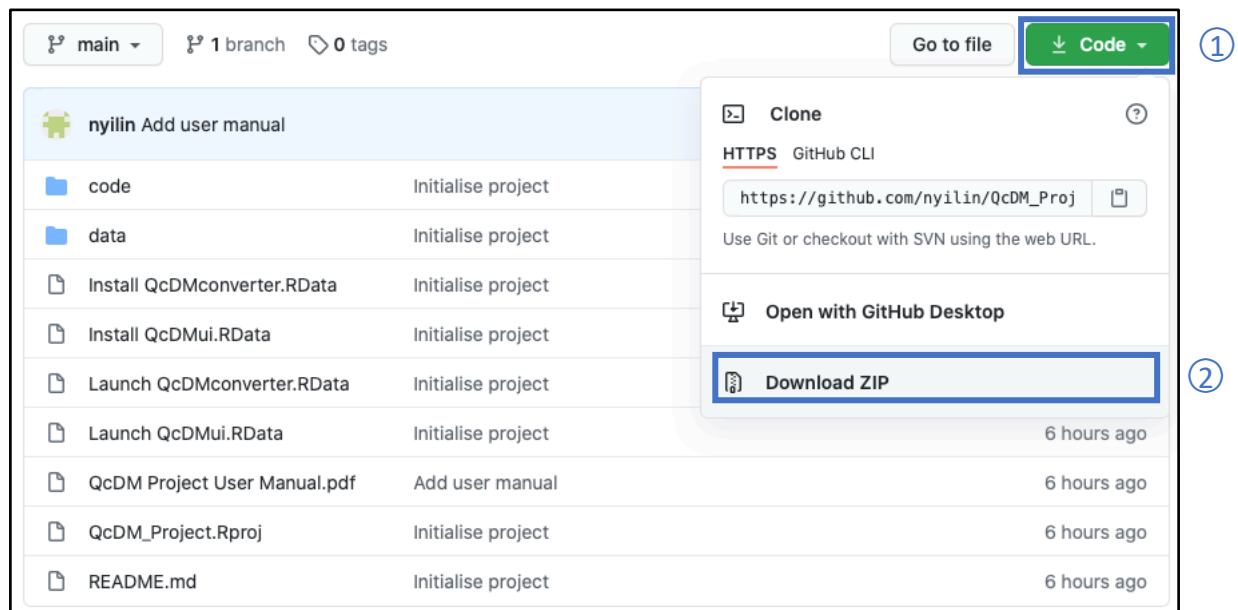
- For Windows: download the Setup Wizard from <https://cran.r-project.org/bin/windows/base/>. Follow through the installation steps and keep the default options.
- For macOS: download the installer (a pkg file) from <https://cran.r-project.org/bin/macosx/>. Follow through the installation steps and keep the default options.

Install RStudio Desktop from the installar downloadable from the official website, <https://rstudio.com/products/rstudio/download/#download>.

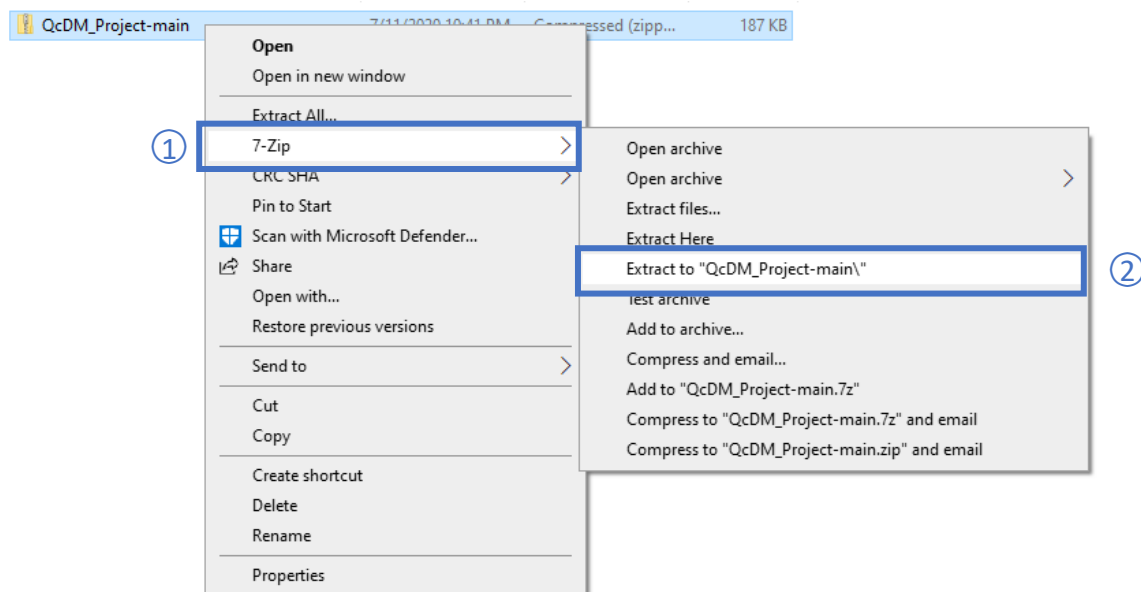
For macOS, an additional application, XQuartz, is required, which can be downloaded from the official website: <https://www.xquartz.org>.

1.2. Download QcDM Project

From the [Github repository for the QcDM Project](#), download the project as a zip file, named 'QcDM_Project-main.zip':



For Windows, unzip the file by right-clicking on 'QcDM_Project-main.zip' and selecting the following:



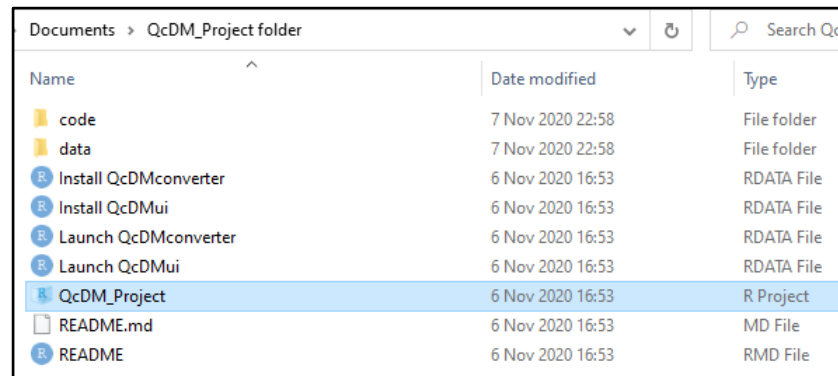
For macOS, unzip the file by doubling clicking on the file.

We recommend users to rename the folder as 'QcDM_Project folder' and move it to the 'Documents' folder. We assume users have followed this recommendation and are using the Windows operating system in the rest of this document.

1.3. Install required R packages

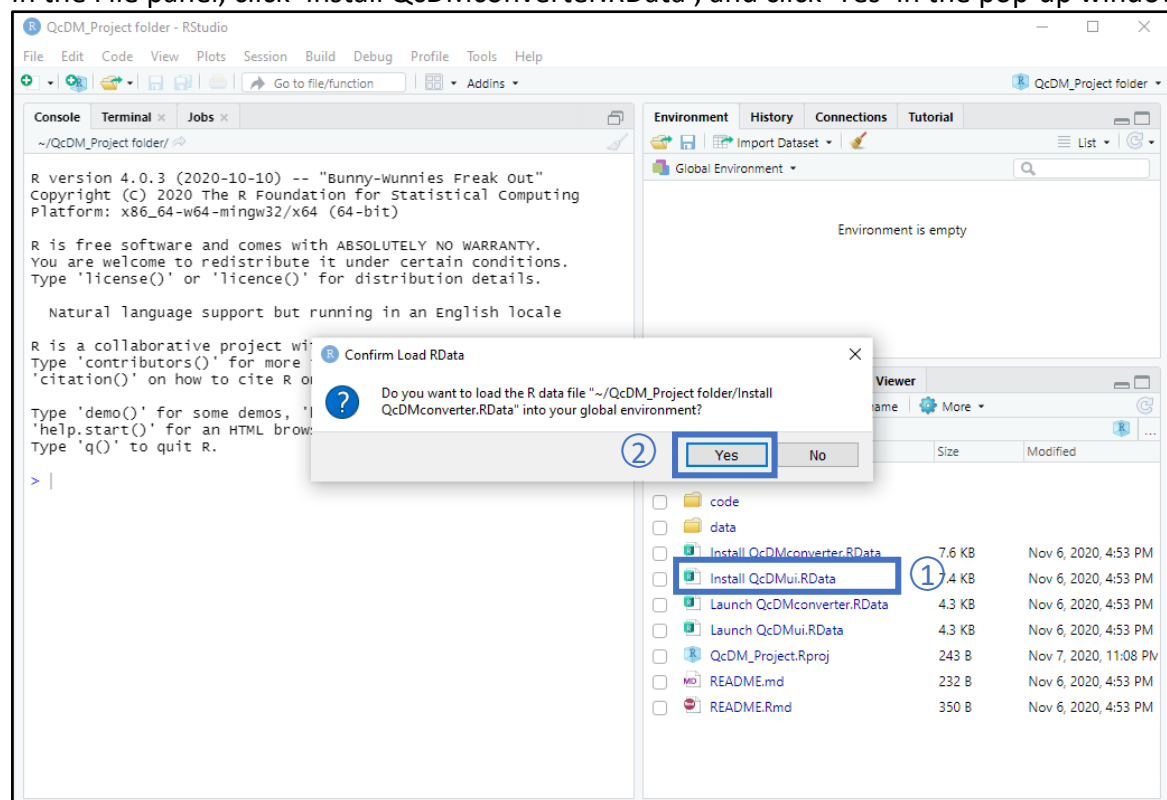
A few R packages are required to use the two GUIs in the QcDM Project, and they can be installed by using the RData files in the 'QcDM_Project folder' following the instructions bellow.

Firstly, users need to open RStudi by doubling-clicking 'QcDM_Project.Rproj' in the 'QcDM_Project folder'.

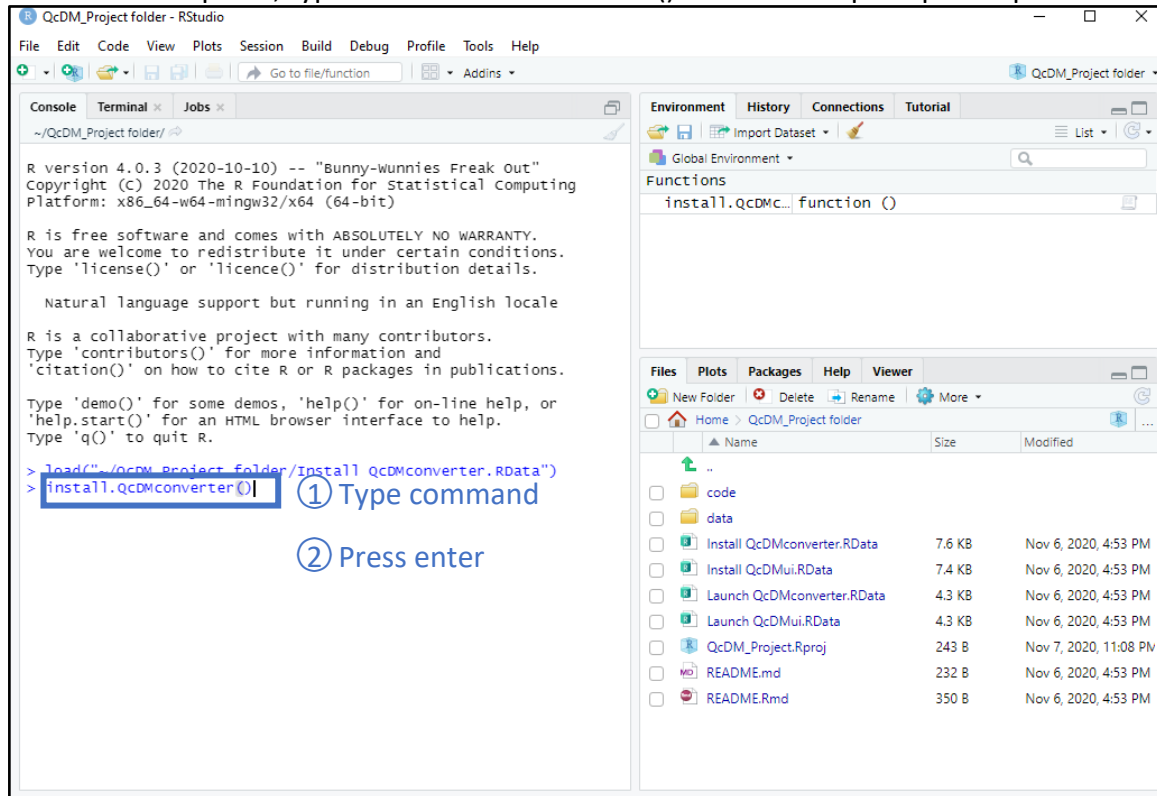


1.3.1. Install QcDMconverter

In the File panel, click 'Install QcDMconverter.RData', and click 'Yes' in the pop-up window.



In the Console panel, type 'install.QcDMconverter()' after the '>' prompt and press Enter.



Installation is successful when a message '* QcDMconverter is installed' is displayed in the Console panel (please ignore 'warning message' if any).

1.3.2. Install QcDMui

Similar to the steps in the previous section, click on 'Install QcDMui.RData' in the File panel and click 'Yes' in the pop-up window.

In the Console panel, type 'install.QcDMui()' after the '>' prompt and press Enter.

Installation is successful when a message '* QcDMui is installed' is displayed in the Console panel.

Close the RStudio window after successfully installing QcDMconverter and QcDMui.

2. User guide for QcDMconverter

QcDMconverter is an R-Shiny application that processes raw input glucose data based on the requirements of the QcDMui to simplify the analytical steps when generating glucometrics measurements. Section 2.1 describes these requirements in details, and Section 2.2 and 2.3 describe how to use QcDMconverter to process different types of raw input files to conform to these requirements.

2.1. Required data format of QcDM Project

QcDM Project requires a specific data format and folder structure for the input glucose data files. Specifically, users need to create a data folder that contains the following three subfolders:

- 'data_new': users are required to put new data file(s) in this subfolder, which will be batch-processed by QcDMui;
- 'data_historical': QcDMui moves all files in the 'data_new' subfolder to this subfolder after processing them for archiving purpose;
- 'GLU_data': QcDMui uses this subfolder to store processed montly data, which will be organized in this subfolder by ward, followed by year, and then by month. This is the subfolder that the GUI will work on to generate the glucometrics (1).

For easy management, users are recommended to provide glucose data by month, and indicate the calendar time of each file using the first seven characters of the file name, where the first three characters are the abbreviated month, and the next four characters correspond to the four-digit calendar year (e.g., 'Jul2020' for glucose data in July 2020).

Each data file in 'data_new' should contain the following variables:

- ADMISSION.ID: the identifier for a specific hospital stay experienced by a patient.
- RESULT.DATE: the date-time stamp associated with each glucose measurement, where:
 - only '/' or '-' is used to separate date, month and year, and no mixture of the two symbols is allowed in a single time variable (see below for an example)
 - ':' is used to separate hour, minute and second, and the order is always 'hh:mm:ss' (see below for an example). Second can be missing, but not minute or hour. This is to allow us to perform distributional analytics for assessing timeliness of glucose measurements (2).
- RESULT: the value of glucose measurement. It can be in mg/dL or mmol/L, but not a mixture of the two units. If 95% of glucose values are greater than 33.3, then the unit of these values is taken as mg/dL, otherwise, the unit will be taken as mmol/L.
- LOCATION: the ward location where the glucose measurements were taken.

The following is a preview of a simulated dataset that follows the required data format:

	A	B	C	D
1	ADMISSION.ID	RESULT	RESULT.DATE	LOCATION
2	17	3.4	07/01/2020 01:15	A
3	17	6	07/01/2020 02:16	A
4	17	3.4	07/01/2020 07:50	A
5	17	5.8	07/01/2020 09:34	A
6	17	6.2	07/01/2020 11:40	A
7	17	7	07/01/2020 17:21	A
8	17	7.5	07/01/2020 22:18	A
9	17	7.4	07/02/2020 07:00	A
10	17	7.1	07/02/2020 12:05	A

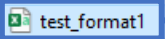
When processing input files using QcDM converter, users may choose to process a single file each time (see Section 2.2), or to batch-process all files within the same folder provided they follow the same format (see Section 2.3).

2.2. Test1: Processing a single input file using QcDMconverter

To simplify the data processing steps for users, QcDMconverter creates the required folder structure and formats the input data as required by QcDM Project.

To illustrate the use of QcDMconverter, we simulated glucose data with 4459 rows for 100 unique hospital stays in July 2020, randomly assigned into 4 ward locations (i.e., A, B, C and D). The unit of measurement of the glucose readings is mmol/L. For illustrative purposes, 6 of the 4459 rows had non-numerical glucose readings. This data, which conforms to the required data format described in Section 2.1, is saved as a CSV file named 'test_format1.csv' in the 'Test1' folder, which is in the 'data' subfolder of 'QcDM_Project folder'.

Documents > QcDM_Project folder > data > Test1

Name ^
 test_format1

	A	B	C	D
1	ADMISSION.ID	RESULT	RESULT.DATE	LOCATION
2	8226	5.7	07/01/2020 00:07	D
3	4194	6.3	07/01/2020 00:03	A
4	143	3.6	07/01/2020 00:08	C
5	6363	19	07/01/2020 00:06	C
6	3931	8.8	07/01/2020 00:04	C
7	4105	16.9	07/01/2020 00:08	C
8	270	7.1	07/01/2020 00:09	D
9	5598	7.5	07/01/2020 00:05	D
10	6709	7.7	07/01/2020 00:07	B

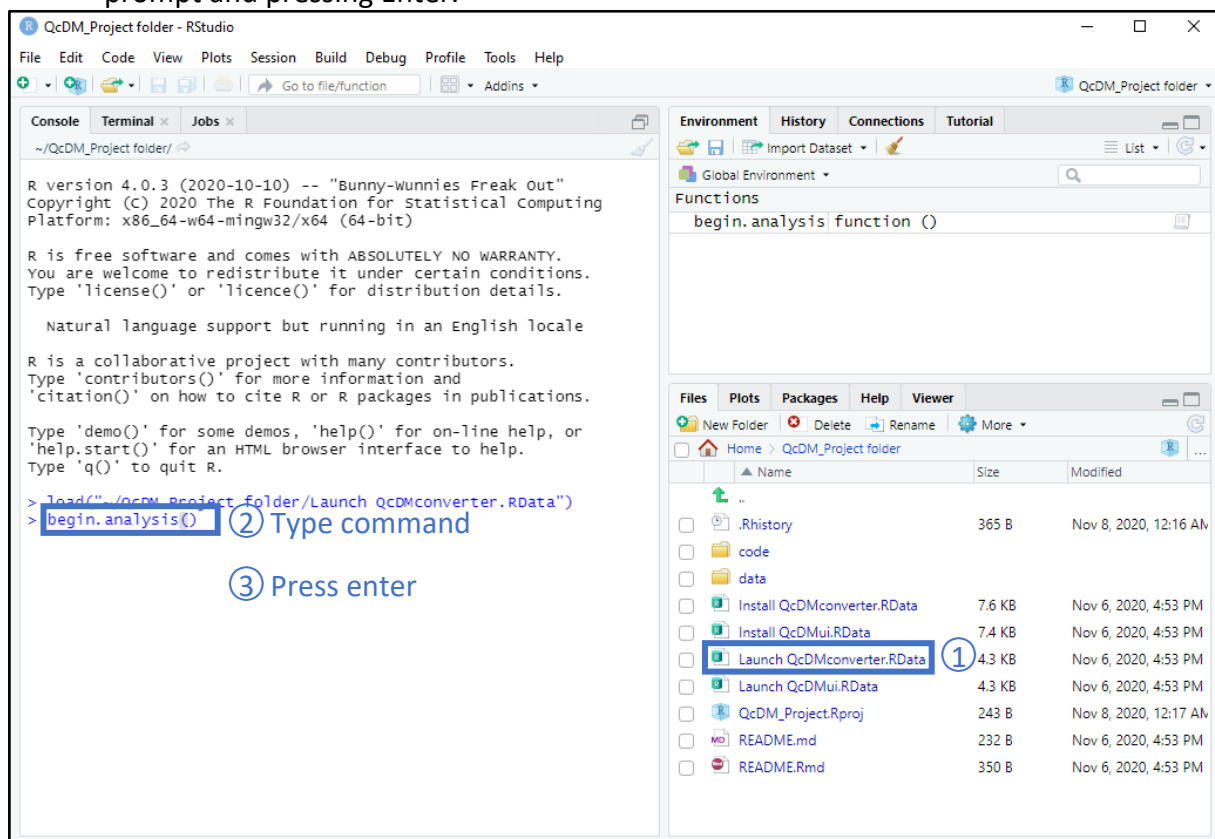
2.2.1. Launch QcDMconverter

QcDMconverter can be launched using the following two approaches.

- a) Goto 'QcDMui_project folder', double click 'QcDM_Project.Rproj' to open RStudio.

Click 'Launch QcDMconverter.RData' in the File panel, click 'Yes' in the pop-up window.

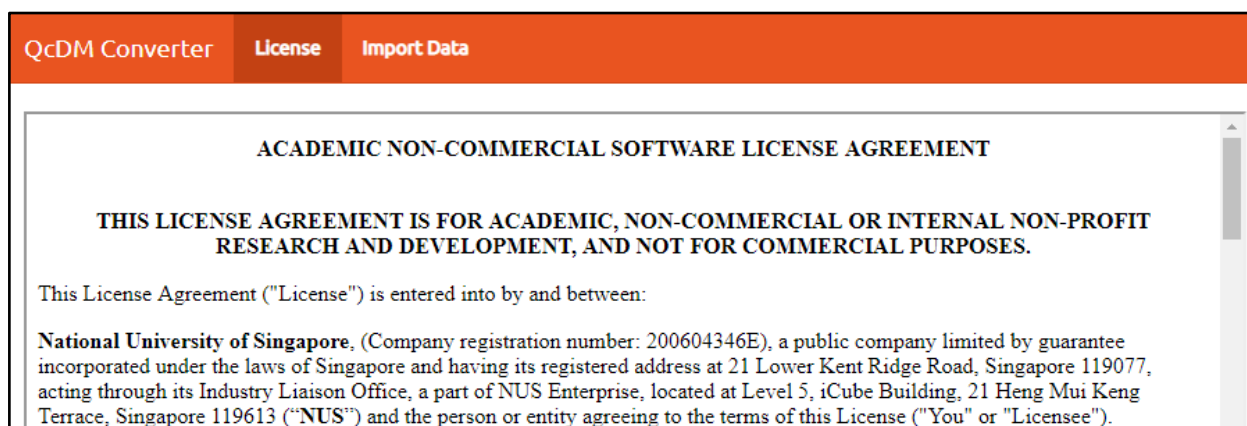
In the Console panel, execute command 'begin.analysis()' by typing it after the '>' prompt and pressing Enter.



- b) Open RStudio and execute the following commands.

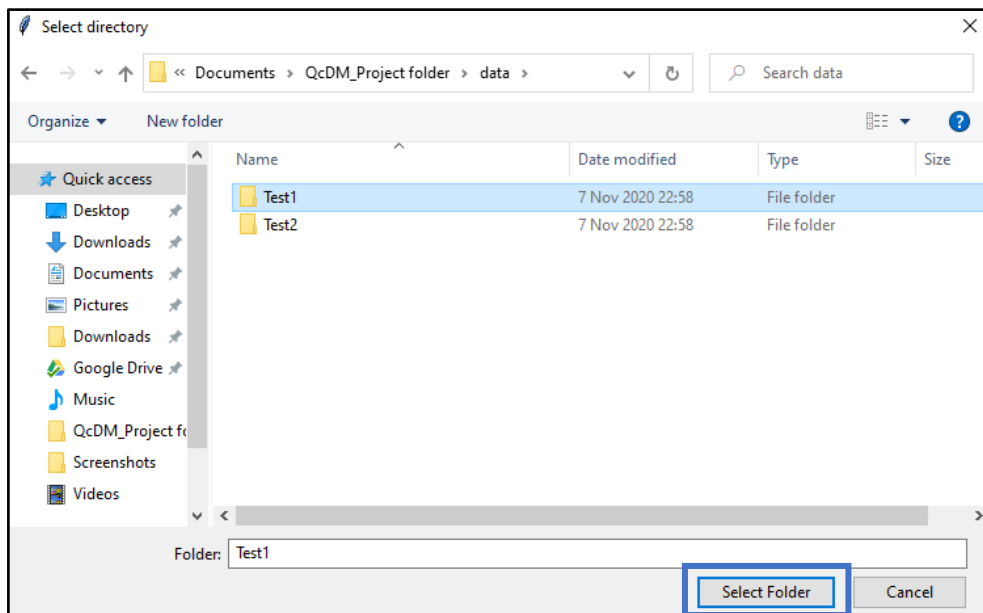
```
setwd("./QcDMui_project folder/code")
shiny::runApp("QcDMconverter")
```

Upon launching QcDMconverter, the following window will be displayed:



2.2.2. Process data

Click on the 'Import Data' tab to begin data processing. The following window will pop out for users to locate the 'Test1' folder:



Click 'Select Folder' to proceed, and the following dashboard will be displayed. Use it to select appropriate options for reading in the input file, and click 'Next' to proceed.

QcDM Converter **License** **Import Data**

Please select a text file to upload and use the radio buttons to format the file into columns. Click Next when done.

Data folder

C:/Users/ningy/Documents/QcDM_Project folder/data/Test1

Select File

test_format1.csv

☒ Header

Separator

☒ Comma

☐ Semicolon

☐ Tab

ADMISSION.ID	RESULT	RESULT.DATE	LOCATION
8226	5.7	07/01/2020 00:07	D
4194	6.3	07/01/2020 00:03	A
143	3.6	07/01/2020 00:08	C
6363	19	07/01/2020 00:06	C

C:/Users/ningy/Documents/QcDM_Project folder/data/Test1/test_format1.csv

Next

Select appropriate options based the format of the file selected, then click 'Next'

Use the following tab to configuration additional data options based on the input file selected, and click 'Import' to begin data processing.

The following text message will be displayed at the top of this tab to indicate the completion of data processing:

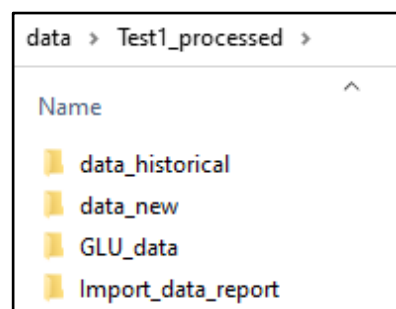
```
Single File Processing Mode:

Processing succeeded for the following files:
SUC: C:/Users/ningy/Documents/QcDM_Project folder/data/Test1/test_format1.csv

1 of 1 processed successfully
```

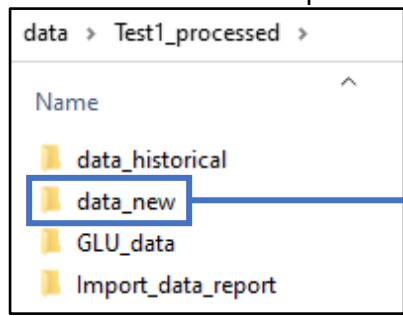
2.2.3. Output from data processing

After clicking the 'Import' button in the 'Import data' tab, a folder named 'Test1_processed' is created in the same folder as 'Test1', which contains the three subfolders required by QcDMui, and an additional subfolder 'Import_data_report' to store PDF summaries of data processing:



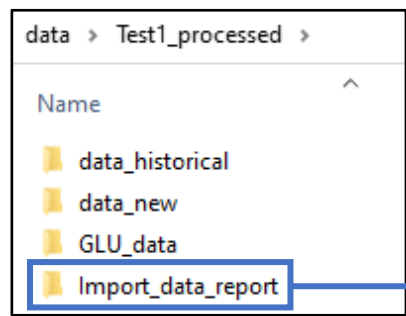
The file 'Jul2020_test_format1.csv' in the folder 'data_new' was created from the input 'test_format1.csv', now with the month and year of the glucose data appended to the

beginning of its file name, and with the date-time stamp converted to format 'yyyy-mm-dd HH:MM:SS'. As seconds are missing in the date-time stamp in the input data, they are assigned to be '11' after data processing.



	A	B	C	D
1	ADMISSION.ID	RESULT.DATE	RESULT	LOCATION
2	8226	2020-07-01 00:07:11	5.7	D
3	4194	2020-07-01 00:03:11	6.3	A
4	143	2020-07-01 00:08:11	3.6	C
5	6363	2020-07-01 00:06:11	19	C
6	3931	2020-07-01 00:04:11	8.8	C
7	4105	2020-07-01 00:08:11	16.9	C
8	270	2020-07-01 00:09:11	7.1	D
9	5598	2020-07-01 00:05:11	7.5	D
10	6709	2020-07-01 00:07:11	7.7	B

Two PDF reports are created for each input data processed by QcDMconverter, with the name of the corresponding data file appended to the end of their file names:



	A	B	C	D
1	ADMISSION.ID	RESULT	RESULT.DATE	LOCATION
2	3588	d9.6	07/05/2020 11:45	B
3	4194	c7.7	07/05/2020 23:51	A
4	4558	a4.4	07/05/2020 06:06	C
5	3588	>33.5	07/09/2020 12:09	B
6	4194	> 33.3	07/10/2020 19:51	A
7	4194	> 33.3	07/10/2020 20:08	A

The overall summary, named 'Overall summary_test_format1.pdf', provides basic summary statistics for the input glucose values and date-time stamps to facilitate the early detection of data entries errors. For example, the 6 entries in 'test_format1.csv' generated with non-numerical glucose values are reported in the overall summary:

'test_format1.csv':

	A	B	C	D
1	ADMISSION.ID	RESULT	RESULT.DATE	LOCATION
2	3588	d9.6	07/05/2020 11:45	B
3	4194	c7.7	07/05/2020 23:51	A
4	4558	a4.4	07/05/2020 06:06	C
5	3588	>33.5	07/09/2020 12:09	B
6	4194	> 33.3	07/10/2020 19:51	A
7	4194	> 33.3	07/10/2020 20:08	A

'Overall summary_test_format1.pdf':

2) Report of invalid readings	
Invalid BG values	
Label	N (%)
> 33.3	2 (0.0)
>33.5	1 (0.0)
a4.4	1 (0.0)
c7.7	1 (0.0)
d9.6	1 (0.0)
Invalid BG timestamps	
There is no invalid BG timestamp in the input data.	

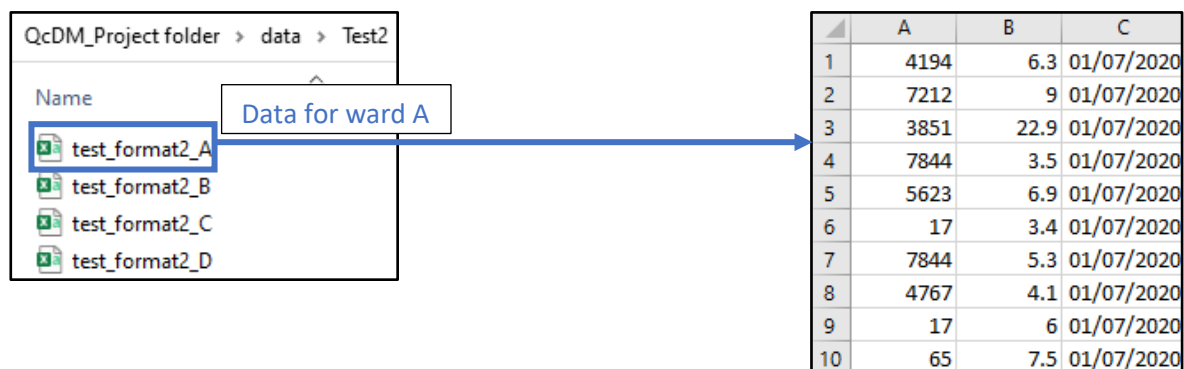
The corresponding glucose values in 'Jul2020_test_format1.csv' are recoded to 'NA'.

A detailed summary, named 'Detailed summary_test_format1.pdf', provides more details on the input glucose values and date-time stamps in each ward location.

2.3. Test2: Processing multiple input files with the same format

QcDMconverter can batch-process multiple files in the folder if they follow the same format. To illustrate this mode of usage, 'test_format1.csv' is split into 4 CSV files and saved to the folder 'Test2' (which is in the 'data' subfolder of 'QcDM_Project' folder), where each file contains all the entries corresponding to the same ward.

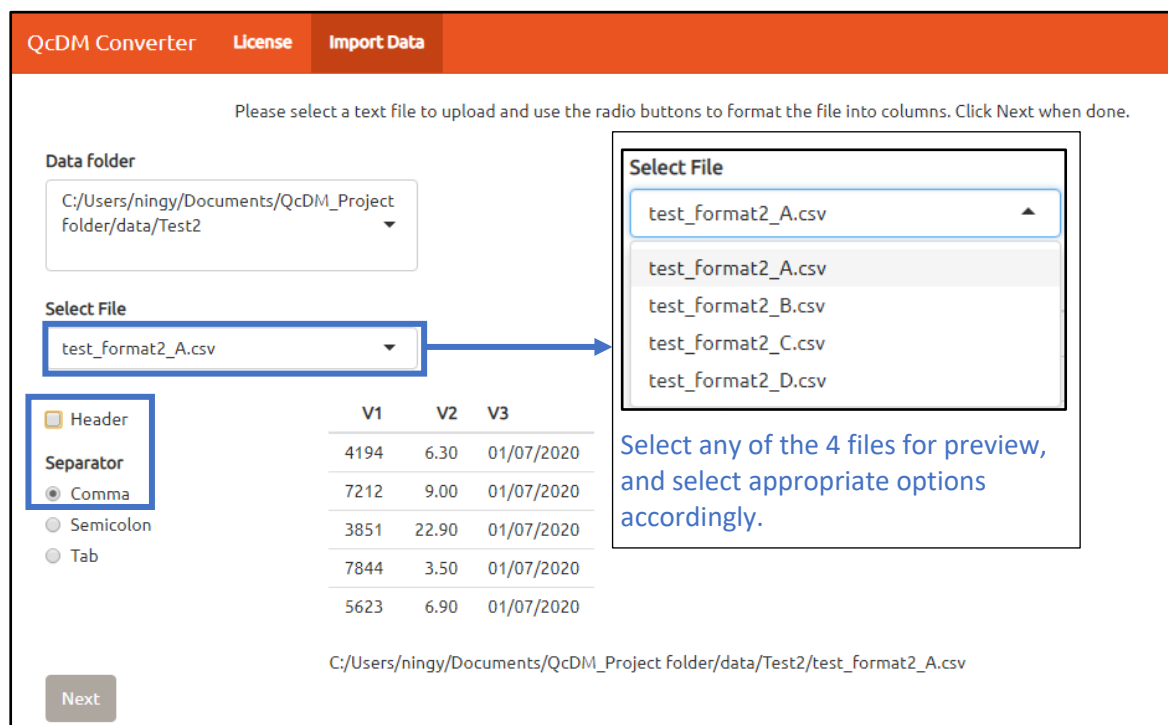
For illustrative purpose, each file now contains three columns, without column names, for the admission ID, glucose values and date stamp for the glucose measurements (without hours or minutes), respectively. As the ward location is no longer included as a data column, it must be specified as the last few characters in the file names, preceded by '_'. Such file format is used in another web application for the generation of glucometrics (1).



	A	B	C
1	4194	6.3	01/07/2020
2	7212	9	01/07/2020
3	3851	22.9	01/07/2020
4	7844	3.5	01/07/2020
5	5623	6.9	01/07/2020
6	17	3.4	01/07/2020
7	7844	5.3	01/07/2020
8	4767	4.1	01/07/2020
9	17	6	01/07/2020
10	65	7.5	01/07/2020

2.3.1. Process data

After launching the QcDMconverter GUI as described in Section 2.2.1 and selecting the 'Test2' folder using the GUI, users can select any of the 4 files in this folder for preview, in order to inform the specification of options when reading in these files.



QcDM Converter License Import Data

Please select a text file to upload and use the radio buttons to format the file into columns. Click Next when done.

Data folder
C:/Users/ningy/Documents/QcDM_Project folder/data/Test2

Select File
test_format2_A.csv

Header
Separator
☒ Comma
☐ Semicolon
☐ Tab

V1	V2	V3
4194	6.30	01/07/2020
7212	9.00	01/07/2020
3851	22.90	01/07/2020
7844	3.50	01/07/2020
5623	6.90	01/07/2020

C:/Users/ningy/Documents/QcDM_Project folder/data/Test2/test_format2_A.csv

Next

Select any of the 4 files for preview, and select appropriate options accordingly.

After clicking 'Next, the GUI displays an additional option E) upon detecting multiple files in the folder selected. Users may still choose to process one file each time, or process all files in the folder by selecting 'Yes', provided that all files follow the same format.

The screenshot shows the 'Import Data' tab of the QcDM Converter application. The interface includes several configuration options on the left and a progress bar on the right.

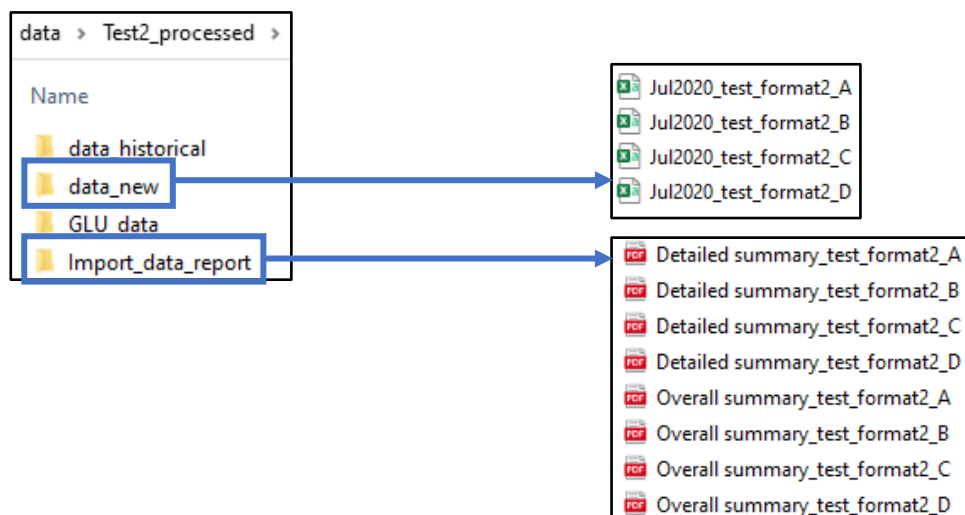
- A) Admission ID:** V1
- B) Result Date:** V3
- B1) Date Format:** dmy
- B2) Time Format:** Not available
- C) Result Value:** V2
- D) Location:** <<From Filename>>
- E) Process all files in this folder with these formats:** Yes

Annotations on the right side of the GUI:

- A message box at the top right states: "Please Configure QcDM using the controls on the left and click the 'Import' button. Please monitor the job status using the progress bar below. If an error occurs information".
- A callout box next to option D states: "Ward location is now specified as part of the file name instead of as a column in the data."
- A callout box next to option E states: "When the GUI detects multiple files in the selected folder, users have this additional option of batch-processing all files using the same configuration."

2.3.2. Output from data processing

As described in Section 2.2.3, a folder named 'Test2_processed' is created after clicking 'Import' in the tab shown above, with the following four subfolders:



Despite the different data formats adopted in Test1 and Test2, the processed data files in the 'data_new' folder follow the same format:

	A	B	C	D
1	ADMISSION.ID	RESULT.DATE	RESULT	LOCATION
2	4194	2020-07-01 11:11:11	6.3	A
3	7212	2020-07-01 11:11:11	9	A
4	3851	2020-07-01 11:11:11	22.9	A
5	7844	2020-07-01 11:11:11	3.5	A
6	5623	2020-07-01 11:11:11	6.9	A
7	17	2020-07-01 11:11:11	3.4	A
8	7844	2020-07-01 11:11:11	5.3	A
9	4767	2020-07-01 11:11:11	4.1	A
10	17	2020-07-01 11:11:11	6	A

As time stamps are not available in the input data files in Test2, they are assigned as 11:11:11 AM after the data processing.

As described in Section 2.2.3, the overall summary reports generated for each input file is useful for detecting invalid entries in glucose values and date-time stamp. For example, 3 glucose values in the input file for ward A are reported to be non-numerical in 'Overall summary_test_format2_A.pdf':

2) Report of invalid readings							
Invalid BG values							
	<table> <tr> <th>Label</th><th>N (%)</th></tr> <tr> <td>> 33.3</td><td>2 (0.3)</td></tr> <tr> <td>c7.7</td><td>1 (0.2)</td></tr> </table>	Label	N (%)	> 33.3	2 (0.3)	c7.7	1 (0.2)
Label	N (%)						
> 33.3	2 (0.3)						
c7.7	1 (0.2)						
Invalid BG timestamps							
There is no invalid BG timestamp in the input data.							

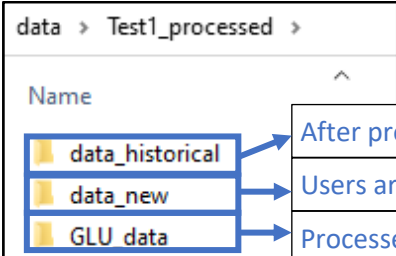
More detailed summaries of glucose values and date-time stamps for each ward can be found in their respective detailed summary reports.

3. User guide for QcDMui

QcDMui is an R-Shiny graphical user interface developed for convenient and flexible generation of glucometrics measures from point-of-care glucose data.

3.1. Required data format of QcDM Project

As described in Section 2.1, QcDMui requires a specific data format and folder structure for the input glucose data files. Specifically, a data folder need to have the following subfolders:



After processing, file(s) in 'data_new' will be moved here for archiving purpose.

Users are required to put new data file(s) to be batch-processed by QcDMui.

Processed monthly data will be organized in this subfolder by ward, year and month.

For easy management, users are recommended to provide glucose data by month, and indicate the calendar time of each file using the first seven characters of the file name, where the first three characters are the abbreviated month, and the next four characters correspond to the four-digit calendar year (e.g., 'Jul2020' for glucose data in July 2020).

As illustrated in the snapshot below, each data file in 'data_new' should contain at least four variables:

	A	B	C	D
1	ADMISSION.ID	RESULT	RESULT.DATE	LOCATION
2	17	3.4	07/01/2020 01:15	A
3	17	6	07/01/2020 02:16	A
4	17	3.4	07/01/2020 07:50	A
5	17	5.8	07/01/2020 09:34	A
6	17	6.2	07/01/2020 11:40	A
7	17	7	07/01/2020 17:21	A
8	17	7.5	07/01/2020 22:18	A
9	17	7.4	07/02/2020 07:00	A
10	17	7.1	07/02/2020 12:05	A

- ADMISSION.ID: the identifier for a specific hospital stay experienced by a patient.
- RESULT.DATE: the date-time stamp associated with each glucose measurement, where:
 - only '/' or '-' is used to separate date, month and year, and no mixture of the two symbols is allowed in a single time variable (see below for an example)
 - ':' is used to separate hour, minute and second, and the order is always 'hh:mm:ss' (see below for an example). Second can be missing, but not minute or hour. This is to allow us to perform distributional analytics for assessing timeliness of glucose measurements (2).
- RESULT: the value of glucose measurement. It can be in mg/dL or mmol/L, but not a mixture of the two units. If 95% of glucose values are greater than 33.3, then the unit of these values is taken as mg/dL, otherwise, the unit will be taken as mmol/L.
- LOCATION: the ward location where the glucose measurements were taken.

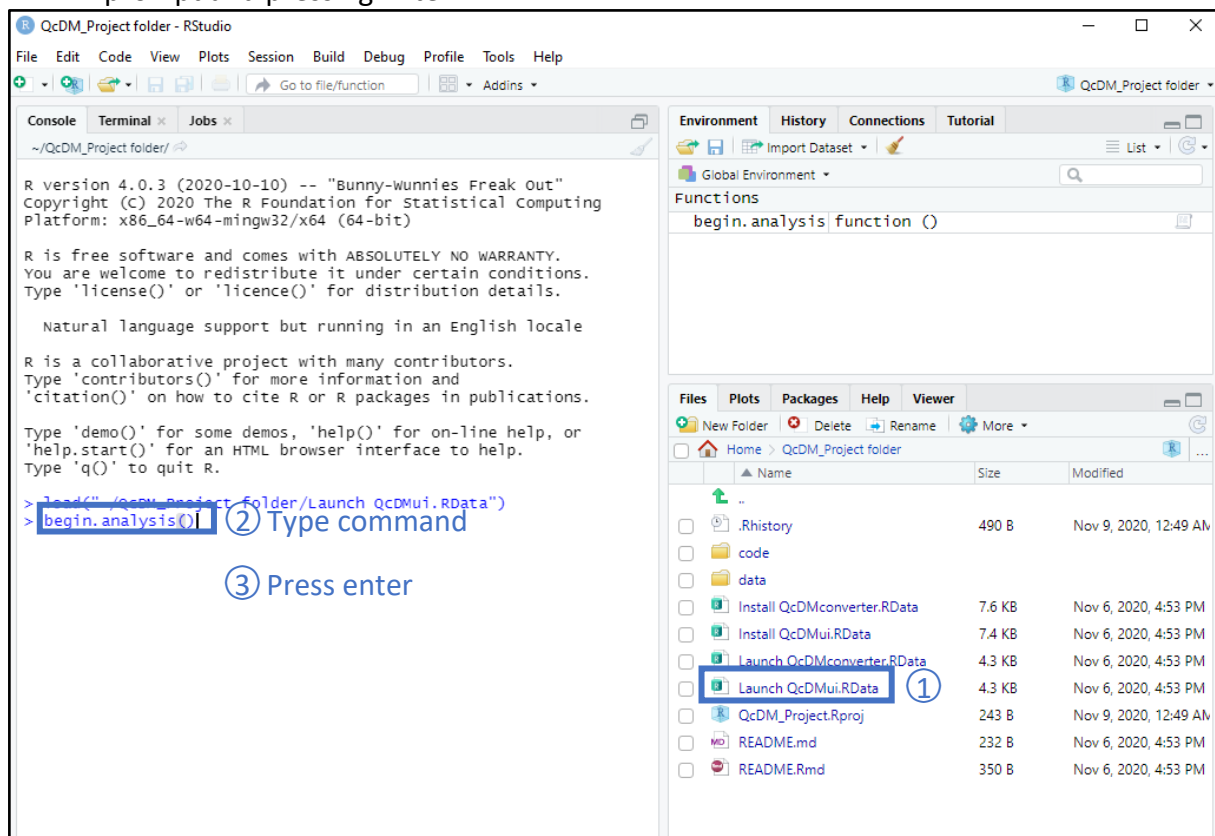
Users are strongly recommended to process raw input data files using the QcDMconverter, as described in Section 2.2 and 2.3, to create the required folder structure and conform to the required data format.

The next two sections illustrate the usage of QcDMui and the corresponding output using example data provided in folder 'Test1', which is available in the 'data' subfolder of 'QcDM_Project folder'. We assume users have followed the instructions in Section 2.2 to create a folder 'Test1_processed' that contains the required subfolders and processed data.

3.2. Launch QcDMui

QcDMui can be launched using the following two approaches.

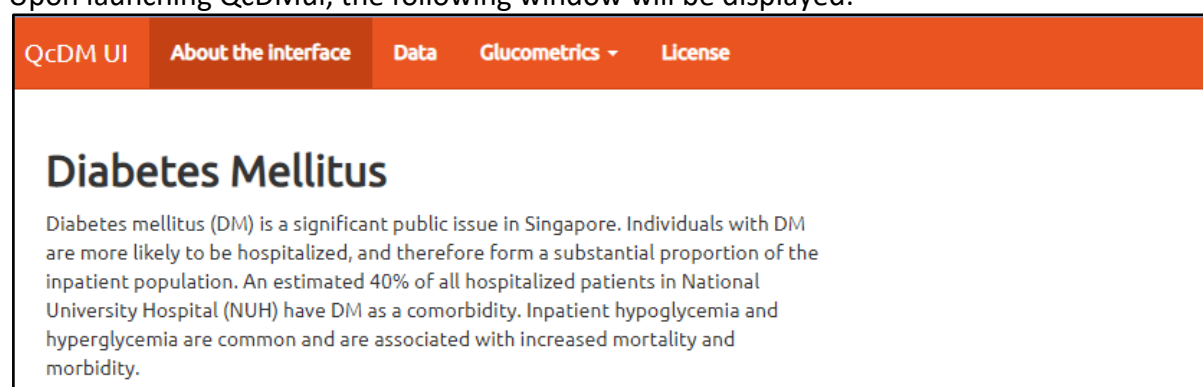
- a) Goto 'QcDMui_project folder', double click 'QcDM_Project.Rproj' to open RStudio. Click 'Launch QcDMui.RData' in the File panel, click 'Yes' in the pop-up window. In the Console panel, execute command 'begin.analysis()' by typing it after the '>' prompt and pressing Enter.



- b) Open RStudio and execute the following commands.

```
setwd("./QcDMui_project folder/code")
shiny::runApp("QcDMui")
```

Upon launching QcDMui, the following window will be displayed:



An introduction to the tool and a brief instruction on how to use it is available under the tab 'About the interface'.

3.3. Process data

Users can use the 'Data' tab to specify the glucose data for which generate glucometrics measurements need to be generated.

The following window will pop out upon clicking on the 'Data' tab for users to locate the 'Test1_processed' folder. Click 'Select Folder' to proceed, and confirm the selection by clicking 'Confirm data folder' in the GUI.

The image shows a Windows file selection dialog and the QcDM UI interface. The dialog is titled 'Select directory' and shows the path 'data > Test1_processed'. It lists several folders: 'data_historical', 'data_new', 'GLU_data', and 'Import_data_report'. The 'Test1_processed' folder is selected, and the 'Select Folder' button is highlighted with a blue box and a circled '1'.

The QcDM UI interface is shown below the dialog. It has a top navigation bar with tabs: 'QcDM UI', 'About the interface', 'Data', 'Glucometrics', and 'License'. The 'Data' tab is active. The 'Data Folder' section shows the path 'C:/Users/ningy/Documents/QcDM_Project folder/data/Test1_processed' and a 'Confirm data folder' button, which is highlighted with a blue box and a circled '2'. Below this, there are four input fields for 'Hypo cutoff', 'Hyper cutoff', 'Target range', and 'Hyperglycemia index (HGI)'. The 'Hypo cutoff' field has a value of 4, 'Hyper cutoff' has 14, 'Target range' has 4, and 'Hyperglycemia index (HGI)' has 10. There are also input fields for 'Please specify the second hypo cutoff (mmol/L):' (3), 'Please specify the second hyper cutoff (mmol/L):' (20), 'Please specify the third hypo cutoff (mmol/L):' (2.5), and 'Please specify the third hyper cutoff (mmol/L):' (24). Below these, there are checkboxes for 'Exclusion criteria' and input fields for 'Exclude patient stays having fewer BG measurements than the number specified below' (2) and 'Exclude patient stays having length of stay less than or equal to the number specified below in terms of hours' (24). At the bottom, there is a 'Confirm' button and the text 'Process complete.'

The 'Time range' section on the right shows 'From Year' and 'To Year' both set to 2020, and 'Month' both set to 11. There is a 'Confirm time range' button. Below this, there is a 'Wards' section with radio buttons for 'All wards with data in the selected time range' and 'Selected wards'. There are 'Confirm choice' and 'Confirm ward' buttons. At the bottom right, there is a section titled 'Number of unique patients in each selected ward and month:' with the instruction 'Please select wards to view and press 'Confirm ward' above.'

The following two subsections describe the 'Data' tab in details.

3.3.1. Specify cutoffs and exclusion criteria

The screenshot shows the 'Data' tab of the QcDM UI. At the top, there is a navigation bar with 'QcDM UI', 'About the interface', 'Data' (selected), 'Glucometrics', and 'License'. Below the navigation bar, the 'Data folder' section contains a dropdown menu showing 'C:/Users/ningy/Documents/QcDM_Project folder/data/Test1_processed' and a 'Confirm data folder' button. The main area is divided into two sections: 'Cutoffs' and 'Exclusion criteria'. The 'Cutoffs' section has four columns: 'Hypo cutoff', 'Hyper cutoff', 'Target range', and 'Hyperglycemia index (HGI)'. Each column has three input fields. The 'Hypo cutoff' column has values 4, 3, and 2.5. The 'Hyper cutoff' column has values 14, 20, and 24. The 'Target range' column has values 4 and 10. The 'Hyperglycemia index (HGI)' column has a value of 10. The 'Exclusion criteria' section has two checkboxes: 'Exclude patient stays having fewer BG measurements than the number specified below' (checked) and 'Exclude patient stays having length of stay less than or equal to the number specified below in terms of hours' (unchecked). Below the first checkbox is an input field with the value 2. Below the second checkbox is an input field with the value 24. At the bottom, there is a 'Confirm' button and a text message 'Process complete.' A blue box highlights the 'Confirm' button and the 'Process complete.' message. A blue box also highlights the 'Cutoffs' section. A blue box highlights the 'Exclusion criteria' section. A blue box highlights the 'Confirm' button and the 'Process complete.' message. A blue box highlights the 'Cutoffs' section. A blue box highlights the 'Exclusion criteria' section. A blue box highlights the 'Confirm' button and the 'Process complete.' message.

Data folder

C:/Users/ningy/Documents/QcDM_Project folder/data/Test1_processed

Confirm data folder

Hypo cutoff	Hyper cutoff	Target range	Hyperglycemia index (HGI)
Please specify the first hypo cutoff (mmol/L): 4	Please specify the first hyper cutoff (mmol/L): 14	Please specify the lower value of the target range (mmol/L): 4	Please specify the cutoff for HGI (mmol/L): 10
Please specify the second hypo cutoff (mmol/L): 3	Please specify the second hyper cutoff (mmol/L): 20	Please specify the lower value of the target range (mmol/L): 10	
Please specify the third hypo cutoff (mmol/L): 2.5	Please specify the third hyper cutoff (mmol/L): 24		

Exclusion criteria

☒ Exclude patient stays having fewer BG measurements than the number specified below

2

☐ Exclude patient stays having length of stay less than or equal to the number specified below in terms of hours

24

After selecting the right data folder and parameters, please click on 'Confirm' button below before proceeding to the panel on the right.

Confirm

Process complete.

Click on 'Confirm' button before proceeding to the panel on the right.

This part allows users to customize cutoff values for hypoglycemia, hyperglycemia, target range and hyperglycemia index. Units of glucose measurement used here (mmol/L or mg/dL) will be inferred from input data.

This part allows users to customize exclusion criteria.

After specifying appropriate cutoff values and exclusion criteria, click on 'Confirm' button to process data in the 'data_new' subfolder, by splitting them by month and ward and adding them into appropriate subfolders in the 'GLU_data' subfolder. A text message 'Process complete.' will be displayed under the button upon completion of data processing, and then

users can proceed to the panel on the right to select time period and wards for the generation of glucometrics.

3.3.2. Select time period and wards

Time range:

From To

Year Year

2020 2020

Month Month

7 7

Confirm time range

Wards

☐ All wards with data in the selected time range ☒ Selected wards

Confirm choice

Please select wards to view (multiple selection allowed)

A

Multiple selection allowed

Confirm ward

Number of unique patients in each selected ward and month:

Show 10 entries Search:

	Wards	Jul 2020
1	A	15

Showing 1 to 1 of 1 entries Previous 1 Next

Users are required to use these two parts to specify the period and ward for which glucometers measurements are to be generated, based on the availability of data in the 'GLU_data' subfolder folder.

After selecting the ward and time range, a summary of the selected data by ward and month will be presented here, so that users could modify their selection if data is not available for some of the ward and/or month selected.

3.4. View glucometrics measurements

After processing glucose data in 'Data' tab, click on 'Glucometrics' tab and then goto 'Summary Statistics' tab to view the following tables that summarize glucometrics measurements generated:

Data Summary

Summary of BG measurements

	Summary
Total (N)	603
Minimum (mmol/L)	3.3
5-th percentile (mmol/L)	4.4
25-th percentile (mmol/L)	5.4
75-th percentile (mmol/L)	9.9
95-th percentile (mmol/L)	16.4
Maximum (mmol/L)	31
Non-numeric values (N)	3

Exclusion Summary

Total number of patient-stays	15
No exclusion criterion was selected.	

Glucometrics

Summary			
Location	A		
Period	01 Jul 2020 to 31 Jul 2020		
	Patient-sample	Patient-day ^{#1}	Patient-stay ^{#2}
Count	600	141	15
GLYCEMIC CONTROL			
Hyperglycemia			
Percent with glucose ≥ 14 mmol/L	56 (9.3%)	25 (17.7%)	6 (40%)
Percent with glucose ≥ 20 mmol/L	15 (2.5%)	7 (5%)	2 (13.3%)
Percent with glucose ≥ 24 mmol/L	8 (1.3%)	3 (2.1%)	1 (6.7%)
Hyperglycemia index (HGI): AUC (> 10 mmol/L)/LOS (in hours)*			
Median (IQR)			0 (1.8)
Mean (SD)			1.6 (2.7)
Other metrics			
Percent with glucose ≥ 4 and < 10 mmol/L	439 (73.2%)	110 (78%)	11 (73.3%)
Glucose (mmol/L)*			
Median (IQR)	6.7 (4.9)	6.9 (4)	7 (4.9)
Mean (SD)	8.2 (4.1)	8.4 (4.2)	8.7 (4)
Average patient-day mean glucose for a patient-stay (mmol/L)*			
Median (IQR)			7 (4.9)
Mean (SD)			8.7 (4)
HYPOGLYCEMIA			
Percent with glucose < 4 mmol/L	13 (2.2%)	10 (7.1%)	7 (46.7%)
Percent with glucose < 3 mmol/L	0 (0%)	0 (0%)	0 (0%)
Percent with glucose < 2.5 mmol/L	0 (0%)	0 (0%)	0 (0%)
Percent of patient-stays with a recurrent hypoglycemia (< 4 mmol/L) day (10-240 mins)			2 (13.3%)
GLYCEMIC VARIABILITY			
Standard deviation: SD (mmol/L) ^{2*}			
Median (IQR)		1.2 (2)	2 (1.9)
Mean (SD)		1.6 (1.3)	2.4 (1.9)
J-index (mmol/L) ^{2*}			
Median (IQR)		22.5 (37.9)	31.2 (57.6)
Mean (SD)		41.5 (48.4)	52 (50.2)

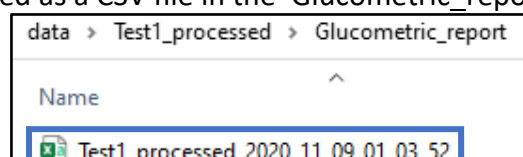
*:The summary statistics of the glucometrics for patient-day means and patient-stay means.

#1: 17 (12.06%) patient-days were removed for calculation of patient-day SD and J-index.

#2: 1 (6.67%) patient-stays were removed for calculation of patient-stay SD and J-index.

Summary Statistics report is saved under: 'C:/Users/ningy/Documents/QcDM_Project folder/data/Test1_processed/Glucometric_report/Test1_processed_2020-11-09 01:03:52.csv'

Tables above are also saved as a CSV file in the 'Glucometric_report' folder for later use:



Bibliography

1. Thomas P, Inzucchi SE. An internet service supporting quality assessment of inpatient glycemic control. In: *Journal of Diabetes Science and Technology*. SAGE Publications Inc.; 2008. p. 402–8.
2. Chen Y, Kao SL, Tai E-S, Wee HL, Khoo EYH, Ning Y, et al. Utilizing distributional analytics and electronic records to assess timeliness of inpatient blood glucose monitoring in non-critical care wards. *BMC Med Res Methodol*. 2016;16(1).