

Package ‘kidney.epi’

May 8, 2026

Title Kidney-Related Functions for Clinical and Epidemiological Research

Version 1.4.0

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Description Contains kidney care oriented functions.

Current version contains functions for calculation of:

- Estimated glomerular filtration rate by CKD-EPI (2021 and 2009), MDRD, CKiD, FAS, EKFC, etc.
- Kidney Donor Risk Index and Kidney Donor Profile Index for kidney transplant donors.
- Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-

Tools.Org, <<https://Scientific-Tools.Org>>. <[doi:10.32614/CRAN.package.kidney.epi](https://doi.org/10.32614/CRAN.package.kidney.epi)>.

Depends R (>= 3.4.0)

License LGPL (>= 2)

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Imports readxl, openxlsx, purrr

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

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Contents

ckd.data	3
ckd.kdigo_category.albuminuria	4
ckd.kdigo_category.gfr	5
ckd.kdigo_category.proteinuria	6
ckd.kdigo_category.risk	7
egfr.all_adults.cr	8
egfr.all_adults.cr_cys	9
egfr.all_adults.cys	11
egfr.bis.cr	12
egfr.bis.cr_cys	13
egfr.cg.cr	15
egfr.ckdepi.cr	16
egfr.ckdepi.cr.2009	17
egfr.ckdepi.cr.2021	18
egfr.ckdepi.cr_cys.2021	20
egfr.ckid_u25.cr	21
egfr.ckid_u25.cys	23
egfr.ekfc.cr	24
egfr.ekfc.cys	26
egfr.fas.cr	27
egfr.fas.cr_cys	28
egfr.fas.cys	30
egfr.lm.cr	31
egfr.mdrd4	32
egfr.schwartz	34
egfr.schwartz.cr	34
egfr.schwartz.cr_cys	36
egfr.schwartz.cys	38
ktx.data	39
ktx.kdpi.optn	40
ktx.kdpi.optn.show.years	43
matrix.cross_table	43
matrix.get_named_matrix_value	44
matrix.read_excel_to_named_matrix	45
matrix.save_named_matrix_to_excel	45
nephro.albuminuria_category	46
nephro.gfr_category	47
nephro.proteinuria_category	47
service.convert_creatinine	48
service.convert_cystatin	48

Index

50

ckd.data

A synthetic dataset contains variables for eGFR calculation.

Description

A synthetic dataset contains variables for eGFR calculation for 1000 adults and 1000 children.

Usage

ckd.data

Format

A data frame with 2000 rows (1000 adults and 1000 children/young adults) and 12 variables:

cr Serum creatinine, micromol/L

cys Serum cystatin C, mg/L

age Age, years

sex Sex

ethnicity Ethnicity

height Height, cm

category Indication on whether the generated data refer to adults or children

Details

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Source

Synthetic dataset was generated based on two publications:

- adults: Lamb EJ, Barratt J, Brettell EA et al. Accuracy of glomerular filtration rate estimation using creatinine and cystatin C for identifying and monitoring moderate chronic kidney disease: the eGFR-C study. *Health Technol Assess* 2024;28(35), doi:10.3310/HYHN1078.
- children/young adults: Pierce CB, Muñoz A, Ng DK et al. Age- and sex-dependent clinical equations to estimate glomerular filtration rates in children and young adults with chronic kidney disease. *Kidney International*. 2021;99(4):948–956, doi:10.1016/j.kint.2020.10.047.

 ckd.kdigo_category.albuminuria

Calculate KDIGO albuminuria categories

Description

Calculate KDIGO albuminuria categories

Usage

```
ckd.kdigo_category.albuminuria(
  albuminuria,
  albuminuria_units = "mg/g",
  semiquantitative_values = "forbidden"
)
```

Arguments

albuminuria Numeric vector. Urine albumin, could be expressed in "mg/day" (24-hour urine collection), "mg/mmol" (UACR) or "mg/g" (UACR). Units of measurement should be defined in variable `albuminuria_units` (if not defined explicitly by user, the default value is "mg/g").

albuminuria_units Character string. Units in which urine albumin is measured. Could be one of the following: "mg/day", "mg/mmol" or "mg/g".

semiquantitative_values Character string. Defines whether semiquantitative values are allowed in the data. If "any", all semiquantitative values ('<30', '30-300', '>300') and any numeric values (29, 30, 35, etc) will be classified into A categories (NB! both '30-300' and '30-299' will be classified as A2). If "only_limits", only limiting semiquantitative values ('<30', '>300') will be classified into A categories, but middle semiquantitative values ('30-300') will be omitted; but numeric values (29, 30, 35, etc) will be classified into A categories. If "forbidden", only numeric values will be classified into A categories.

Details

Calculate albuminuria categories (A1, A2, A3) based on albuminuria values.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

string albuminuria category.

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
ckd.kdigo_category.albuminuria(albuminuria = 25, albuminuria_units = "mg/g")
# for a dataset - see vignettes for details
# ckd.kdigo_category.albuminuria(albuminuria = dta$alb, albuminuria_units = "mg/g")
```

```
ckd.kdigo_category.gfr
```

Calculate eGFR categories

Description

Calculate eGFR categories

Usage

```
ckd.kdigo_category.gfr(gfr)
```

Arguments

`gfr` Numeric vector. eGFR, expressed in "ml/min/1.73m²".

Details

Calculate eGFR categories (G1, G2, G3a, G3b, G4, G5) based on eGFR values.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

string gfr category.

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
ckd.kdigo_category.gfr(gfr = 25)
# for a dataset - see vignettes for details
# ckd.kdigo_category.gfr(gfr = dta$egfr)
```

```
ckd.kdigo_category.proteinuria
      Calculate proteinuria categories
```

Description

Calculate proteinuria categories

Usage

```
ckd.kdigo_category.proteinuria(
  proteinuria,
  proteinuria_units = "mg/g",
  semiquantitative_values = "forbidden"
)
```

Arguments

proteinuria Numeric vector. Urine protein, could be expressed in "mg/day" (24-hour urine collection), "mg/mmol" (UPCR) or "mg/g" (UPCR). Units of measurement should be defined in variable `proteinuria_units` (if not defined explicitly by user, the default value is "mg/g").

proteinuria_units Character string. Units in which urine protein is measured. Could be one of the following: "mg/day", "mg/mmol" or "mg/g".

semiquantitative_values Character string. Defines whether semiquantitative values are allowed in the data. If "any", all semiquantitative values ('<30', '30-300', '>300') and any numeric values (29, 30, 35, etc) will be classified into A categories (NB! both '30-300' and '30-299' will be classified as A2). If "only_limits", only limiting semiquantitative values ('<30', '>300') will be classified into A categories, but middle semiquantitative values ('30-300') will be omitted; but numeric values (29, 30, 35, etc) will be classified into A categories. If "forbidden", only numeric values will be classified into A categories.

Details

Calculate albuminuria categories (A1, A2, A3) based on proteinuria values.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

string albuminuria category.

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
ckd.kdigo_category.proteinuria(proteinuria = 25, proteinuria_units = "mg/g")
# for a dataset - see vignettes for details
# ckd.kdigo_category.proteinuria(proteinuria = dta$alb, proteinuria_units = "mg/g")
```

```
ckd.kdigo_category.risk
```

Calculate KDIGO risk categories

Description

Calculate KDIGO risk categories

Usage

```
ckd.kdigo_category.risk(gfr_cat, alb_cat)
```

Arguments

gfr_cat	Character vector. eGFR categories coded as G1, G2, G3a, G3b, G4, G5.
alb_cat	Character vector. Albuminuria categories coded as A1, A2, A3.

Details

Calculate KDIGO risk of complications categories (Low, Moderate, High, Very high) based on eGFR and albuminuria grades.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

string risk category.

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
ckd.kdigo_category.risk(gfr_cat = "G2", alb_cat = "A3")
# for a dataset - see vignettes for details
# ckd.kdigo_category.risk(gfr_cat = dta$gfr_cat, alb_cat = dta$alb_cat)
```

egfr.all_adults.cr *Calculate eGFR by all creatinine-based equations for adults*

Description

Calculate eGFR by all creatinine-based equations for adults

Usage

```
egfr.all_adults.cr(
  creatinine,
  age,
  sex,
  ethnicity = NA,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  label_african = c("Afroamerican"),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
ethnicity	Vector. Ethnicity. If no ethnicity will be defined, the calculation will use coefficients for Caucasian subjects. Specify ethnicity labels in the function parameter label_african.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
label_african	List. Label(s) for African ethnicity. Required only by race-specific equations.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate eGFR by all creatinine-based equations for adults available in the kidney.epi package.

References to the equations are available in single functions of the kidney.epi package.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.all_adults.cr (creatinine = 1.4, age = 60, sex = "Male",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.all_adults.cr (creatinine = dta$scr, age = dta$age, sex = dta$sex,
# creatinine_units = "mg/dl")
```

egfr.all_adults.cr_cys

Calculate eGFR by all creatinine-cystatin-based equations for adults

Description

Calculate eGFR by all creatinine-cystatin-based equations for adults

Usage

```
egfr.all_adults.cr_cys(
  creatinine,
  cystatin,
  age,
  sex,
  creatinine_units = "micromol/l",
  cystatin_units = "mg/L",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

<code>creatinine</code>	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable <code>creatinine_units</code> (if not defined explicitly by user, the default value is "micromol/L").
<code>cystatin</code>	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable <code>cystatin_units</code> (if not defined explicitly by user, the default value is "mg/L").
<code>age</code>	Numeric vector. Age, in years.
<code>sex</code>	Vector. The value of variable refers to the parameters <code>label_sex_male</code> and <code>label_sex_female</code> .
<code>creatinine_units</code>	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
<code>cystatin_units</code>	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
<code>label_sex_male</code>	List. Label(s) for definition(s) of male sex.
<code>label_sex_female</code>	List. Label(s) for definition(s) of female sex.
<code>max_age</code>	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate eGFR by all creatinine-cystatin-based equations for adults available in the kidney.epi package.

References to the equations are available in single functions of the kidney.epi package.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

egfr.all_adults.cys *Calculate eGFR by all cystatin-based equations for adults*

Description

Calculate eGFR by all cystatin-based equations for adults

Usage

```
egfr.all_adults.cys(cystatin, age, cystatin_units = "mg/L", max_age = 100)
```

Arguments

cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
age	Numeric vector. Age, in years.
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate eGFR by all cystatin-based equations for adults available in the kidney.epi package.

References to the equations are available in single functions of the kidney.epi package.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.all_adults.cys (cystatin = 1.4, age = 60,
  cystatin_units = "mg/L")
# for a dataset - see vignettes for details
# egfr.all_adults.cys (cystatin = dta$cys, age = dta$age,
# cystatin_units = "mg/L")
```

egfr.bis.cr

Calculate eGFR by the Berlin Initiative Study (BIS1) creatinine-based equation

Description

Calculate eGFR by the Berlin Initiative Study (BIS1) creatinine-based equation

Usage

```
egfr.bis.cr(
  creatinine,
  age,
  sex,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the Berlin Initiative Study (BIS1) creatinine-based equation.

Reference to the equation: Schaeffner ES, Ebert N, Delanaye P et al. Two novel equations to estimate kidney function in persons aged 70 years or older. *Ann Intern Med* 2012; 157: 471–481 doi: 10.7326/0003-4819-157-7-201210020-00003.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.bis.cr (creatinine = 1.4, age = 80, sex = "Male",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.bis.cr (creatinine = dta$scr, age = dta$age, sex = dta$sex,
# creatinine_units = "mg/dl")
```

egfr.bis.cr_cys	<i>Calculate eGFR by the Berlin Initiative Study (BIS2) creatinine-cystatin C-based equation</i>
-----------------	--

Description

Calculate eGFR by the Berlin Initiative Study (BIS2) creatinine-cystatin C-based equation

Usage

```
egfr.bis.cr_cys(
  creatinine,
  cystatin,
  age,
  sex,
  creatinine_units = "micromol/l",
  cystatin_units = "mg/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
age	Numeric vector. Age, in years.

sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the Berlin Initiative Study (BIS2) creatinine-cystatin C-based equation.

Reference to the equation: Schaeffner ES, Ebert N, Delanaye P et al. Two novel equations to estimate kidney function in persons aged 70 years or older. *Ann Intern Med* 2012; 157: 471–481 doi: 10.7326/0003-4819-157-7-201210020-00003.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.bis.cr_cys (creatinine = 1.4, cystatin = 1.0, age = 80,
  sex = "Male", creatinine_units = "mg/dl",
  cystatin_units = "mg/L")
# for a dataset - see vignettes for details
# egfr.bis.cr_cys (creatinine = dta$scr, cystatin = dta$cys,
#   age = dta$age, sex = dta$sex,
#   creatinine_units = "mg/dl", cystatin_units = "mg/l")
```

egfr.cg.cr

Calculate creatinine clearance by the Cockcroft-Gault equation

Description

Calculate creatinine clearance by the Cockcroft-Gault equation

Usage

```
egfr.cg.cr(
  creatinine,
  age,
  sex,
  weight,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
weight	Numeric vector. Weight, kg.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate Cockcroft-Gault by the Cockcroft-Gault equation.

Reference to the equation: Cockcroft, DW, Gault MH. Prediction of creatinine clearance from serum creatinine. *Nephron*. 1976. 16(1):31-41.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric creatinine clearance expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.cg.cr (creatinine = 1.4, age = 60, sex = "Male",
           weight = 80, creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
```

egfr.ckdepi.cr

Alias to the latest eGFR CKD-EPI creatinine-based equation

Description

Alias to the latest eGFR CKD-EPI creatinine-based equation

Usage

```
egfr.ckdepi.cr(...)
```

Arguments

... all arguments for the egfr.ckdepi.cr.2021 function.

Details

The function is just an alias to the latest eGFR CKD-EPI creatinine-based equation.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

egfr.ckdepi.cr.2009 *Calculate eGFR based on CKD-EPI 2009 creatinine-based equation*

Description

Calculate eGFR based on CKD-EPI 2009 creatinine-based equation

Usage

```
egfr.ckdepi.cr.2009(
  creatinine,
  age,
  sex,
  ethnicity = NA,
  creatinine_units = "micromol/l",
  label_afroamerican = c("Afroamerican"),
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
ethnicity	Vector. Ethnicity. If no ethnicity will be defined, the calculation will use coefficients for White subjects. Specify ethnicity if a study includes African-American subjects, and define the the values of variable in the parameter label_afroamerican.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_afroamerican	List. Label(s) for Afroamerican ethnicity.
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by CKD-EPI 2009 creatinine-based equation.

Reference to the equation: Levey AS, Stevens LA, Schmid CH et al. A New Equation to Estimate Glomerular Filtration Rate. *Ann Intern Med* 2009;150:604–12.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.ckdepi.cr.2009 (creatinine = 1.4, age = 60, sex = "Male", ethnicity = "White",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.ckdepi.cr.2009 (creatinine = dta$scr, age = dta$age, sex = dta$sex,
#   ethnicity = dta$race, creatinine_units = "mg/dl")
```

egfr.ckdepi.cr.2021 *Calculate eGFR by the CKD-EPI 2021 creatinine-based equation*

Description

Calculate eGFR by the CKD-EPI 2021 creatinine-based equation

Usage

```
egfr.ckdepi.cr.2021(
  creatinine,
  age,
  sex,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the CKD-EPI 2021 creatinine-based equation.

Reference to the equation: Inker LA, Eneanya ND, Coresh J, et al. New creatinine- and cystatin C–based equations to estimate GFR without race. *N Engl J Med.* 2021;385:1737-1749.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.ckdepi.cr.2021(creatinine = 1.4, age = 60, sex = "Male",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.ckdepi.cr.2021(creatinine = dta$scr, age = dta$age, sex = dta$sex,
# creatinine_units = "mg/dl")
```

 egfr.ckdepi.cr_cys.2021

Calculate eGFR by the CKD-EPI 2021 creatinine-cystatin-based equation

Description

Calculate eGFR by the CKD-EPI 2021 creatinine-cystatin-based equation

Usage

```
egfr.ckdepi.cr_cys.2021(
  creatinine,
  cystatin,
  age,
  sex,
  creatinine_units = "micromol/l",
  cystatin_units = "mg/L",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the CKD-EPI 2021 creatinine-cystatin-based equation.

Reference to the equation: Inker LA, Eneanya ND, Coresh J, et al. New creatinine- and cystatin C–based equations to estimate GFR without race. *N Engl J Med.* 2021;385:1737-1749.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.ckdepi.cr_cys.2021 (creatinine = 1.4, cystatin = 0.8, age = 60,
  sex = "Male", creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.ckdepi.cr_cys.2021 (creatinine = dta$scr, cystatin = dta$cys,
# age = dta$age, sex = dta$sex, creatinine_units = "mg/dl")
```

egfr.ckid_u25.cr	<i>Calculate eGFR by CKiD U25 creatinine-based equation (for children and young adults less than 25 years old)</i>
------------------	--

Description

Calculate eGFR by CKiD U25 creatinine-based equation (for children and young adults less than 25 years old)

Usage

```
egfr.ckid_u25.cr(
  creatinine,
  age,
  sex,
  height_cm = 0,
  height_ft = 0,
  height_inch = 0,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0)
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
height_cm	Numeric vector. Could be defined either as height_cm if is measured in cm, or as height_ft and height_inch if is measured in feet and inches. If the parameter height_cm is greater than 0, the function uses cm, otherwise - feet and inches.
height_ft	see height_cm
height_inch	see height_cm
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.

Details

Calculate estimated glomerular filtration rate (eGFR) by creatinine-based CKiD U25 equation.

Reference to the equation: Pierce CB, Muñoz A, Ng DK, Warady BA, Furth SL, Schwartz GJ. Age- and sex-dependent clinical equations to estimate glomerular filtration rates in children and young adults with chronic kidney disease. *Kidney International*. 2021;99(4):948–956. doi:10.1016/j.kint.2020.10.047.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.ckid_u25.cr (creatinine = 1.4, age = 10, height_cm = 90, sex = "Male",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.ckid_u25.cr (creatinine = dta$scr, age = dta$age, height_cm = dta$ht,
# sex = dta$sex, creatinine_units = "mg/dl")
```

egfr.ckid_u25.cys	<i>Calculate eGFR by CKiD U25 cystatin-based equation (for children and young adults less than 25 years old)</i>
-------------------	--

Description

Calculate eGFR by CKiD U25 cystatin-based equation (for children and young adults less than 25 years old)

Usage

```
egfr.ckid_u25.cys(
  cystatin,
  age,
  sex,
  cystatin_units = "mg/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0)
)
```

Arguments

cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
age	Numeric vector. Age, in years. Age does not accounted in Schwartz equation, but used in the function to check whether Schwartz equation could be applied to a given patient.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.

Details

Calculate estimated glomerular filtration rate (eGFR) by cystatin-based CKiD U25 equation.

Reference to the equation: Pierce CB, Muñoz A, Ng DK, Warady BA, Furth SL, Schwartz GJ. Age- and sex-dependent clinical equations to estimate glomerular filtration rates in children and young adults with chronic kidney disease. *Kidney International*. 2021;99(4):948–956. doi:10.1016/j.kint.2020.10.047.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.ckid_u25.cys (cystatin = 0.8, age = 10, sex = "Male",
  cystatin_units = "mg/l")
# for a dataset - see vignettes for details
# egfr.ckid_u25.cys (cystatin = dta$cystatin, age = dta$age,
# sex = dta$sex, cystatin_units = "mg/l")
```

 egfr.ekfc.cr

Calculate eGFR by the EKFC creatinine-based equation

Description

Calculate eGFR by the EKFC creatinine-based equation

Usage

```
egfr.ekfc.cr(
  creatinine,
  age,
  sex,
  ethnicity = NA,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  label_african = c("African"),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.

ethnicity	Vector. Ethnicity. If no ethnicity will be defined, the calculation will use coefficients for White European subjects. Specify ethnicity if a study includes African and Black European subjects, and define the values of variable in the parameter label_african.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
label_african	List. Label(s) for African ethnicity.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the EKFC creatinine-based equation.

References to the equation:

- Initial creatinine-based equation was reported in Pottel H, Björk J, Courbebaisse M, et al. Development and validation of a modified full age spectrum creatinine-based equation to estimate glomerular filtration rate. a cross-sectional analysis of pooled data. *Ann Int Med.* 2021;174:183–192 doi:10.7326/M20-4366.
- Subsequent definition of Q coefficients for African and Black European subjects was reported in Pottel H, Björk J, Rule AD, et al. Cystatin C–based equation to estimate GFR without the inclusion of race and sex. *N Engl J Med.* 2023;388:333-343 doi: 10.1056/NEJMoa22037.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.ekfc.cr (creatinine = 1.4, age = 60, sex = "Male",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.ekfc.cr (creatinine = dta$scr, age = dta$age, sex = dta$sex,
# creatinine_units = "mg/dl")
```

 egfr.ekfc.cys

Calculate eGFR by the EKFC cystatin-based equation

Description

Calculate eGFR by the EKFC cystatin-based equation

Usage

```
egfr.ekfc.cys(cystatin, age, cystatin_units = "mg/L", max_age = 100)
```

Arguments

cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
age	Numeric vector. Age, in years.
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the EKFC cystatin-based equation.

Reference to the equation: Pottel H, Björk J, Rule AD, et al. Cystatin C–based equation to estimate GFR without the inclusion of race and sex. *N Engl J Med.* 2023;388:333-343 doi: 10.1056/NEJ-Moa22037.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.ekfc.cys (cystatin = 0.8, age = 60)
# for a dataset - see vignettes for details
# egfr.ekfc.cys (cystatin = dta$cys, age = dta$age)
```

egfr.fas.cr	<i>Calculate eGFR by the Full age spectrum (FAS) creatinine-based equation</i>
-------------	--

Description

Calculate eGFR by the Full age spectrum (FAS) creatinine-based equation

Usage

```
egfr.fas.cr(
  creatinine,
  age,
  sex,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the Full age spectrum (FAS) creatinine-based equation.

Reference to the equation: Pottel H, Hoste L, Dubourg L et al. An estimating glomerular filtration rate equation for the full age spectrum. *Nephrol Dial Transplant* 2016; 31:798–806 doi:10.1093/ndt/gfv454.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.fas.cr (creatinine = 1.4, age = 60, sex = "Male",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.fas.cr (creatinine = dta$scr, age = dta$age, sex = dta$sex,
# creatinine_units = "mg/dl")
```

egfr.fas.cr_cys	<i>Calculate eGFR by the Full age spectrum (FAS) creatinine-cystatin-based equation</i>
-----------------	---

Description

Calculate eGFR by the Full age spectrum (FAS) creatinine-cystatin-based equation

Usage

```
egfr.fas.cr_cys(
  creatinine,
  cystatin,
  age,
  sex,
  alpha = 0.5,
  creatinine_units = "micromol/l",
  cystatin_units = "mg/L",
  equation_type = "precise",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").

age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
alpha	Numeric vector. Alpha coefficient for the combined creatinine-cystatin equation. By default is equal to 0.5.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
equation_type	Character string. Whether to use "precise" or "simplified" equation.
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the Full age spectrum (FAS) creatinine-cystatin-based equation.

Reference to the equation: Pottel H, Delanaye P, Schaeffner E et al. Estimating glomerular filtration rate for the full age spectrum from serum creatinine and cystatin C. *Nephrol Dial Transplant* 2017; 32:497–507 doi:10.1093/ndt/gfw425.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.fas.cr_cys (creatinine = 1.4, cystatin = 0.8, age = 60,
  sex = "Male", creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.fas.cr_cys (creatinine = dta$scr, cystatin = dta$cys,
# age = dta$age, sex = dta$sex, creatinine_units = "mg/dl")
```

egfr.fas.cys	<i>Calculate eGFR by the Full age spectrum (FAS) cystatin-based equation</i>
--------------	--

Description

Calculate eGFR by the Full age spectrum (FAS) cystatin-based equation

Usage

```
egfr.fas.cys(
  cystatin,
  age,
  cystatin_units = "mg/L",
  equation_type = "precise",
  max_age = 100
)
```

Arguments

cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
age	Numeric vector. Age, in years.
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"
equation_type	Character string. Whether to use "precise" or "simplified" equation.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the Full age spectrum (FAS) cystatin-based equation.

Reference to the equation: Pottel H, Delanaye P, Schaeffner E et al. Estimating glomerular filtration rate for the full age spectrum from serum creatinine and cystatin C. *Nephrol Dial Transplant* 2017; 32:497–507 doi:10.1093/ndt/gfw425.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.fas.cys (cystatin = 0.8, age = 60)
# for a dataset - see vignettes for details
# egfr.fas.cys (cystatin = dta$cys, age = dta$age)
```

 egfr.lm.cr

Calculate eGFR by the revised Lund-Malmö creatinine-based equation

Description

Calculate eGFR by the revised Lund-Malmö creatinine-based equation

Usage

```
egfr.lm.cr(
  creatinine,
  age,
  sex,
  creatinine_units = "micromol/l",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by the revised Lund-Malmö creatinine-based equation.

Reference to the equation: Björk J, Grubb A, Sterner G, Nyman U. Revised equations for estimating glomerular filtration rate based on the Lund-Malmö Study cohort. *Scand J Clin Lab Invest.* 2011;71: 232-239.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.lm.cr (creatinine = 1.4, age = 60, sex = "Male",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.lm.cr (creatinine = dta$scr, age = dta$age, sex = dta$sex,
# creatinine_units = "mg/dl")
```

egfr.mdrd4

Calculate estimated glomerular filtration rate (eGFR) by MDRD equation

Description

Calculate estimated glomerular filtration rate (eGFR) by MDRD equation

Usage

```
egfr.mdrd4(
  creatinine,
  age,
  sex,
  ethnicity = NA,
  creatinine_units = "micromol/l",
  creatinine_method = "non-IDMS",
  label_afroamerican = c("Afroamerican"),
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0),
  max_age = 100
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
ethnicity	Vector. Ethnicity, specify in case of African-American patients. The value of variable refers to the parameter label_afroamerican.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
creatinine_method	Character string. Creatinine standardisation method in a laboratory. Could be either "IDMS" or "non-IDMS". If not explicitly defined by user, the default assumption is "non-IDMS".
label_afroamerican	List. Label(s) for Afroamerican ethnicity.
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.
max_age	Numeric. Maximal age suitable for the equation application, in years. By default is 100 years, but change this value in case you would like to apply equation to older persons.

Details

Calculate estimated glomerular filtration rate (eGFR) by MDRD equation.

Reference to the equation: Levey AS, Coresh J, Greene T, et al. Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. *Annals of Internal Medicine* 2006;145:247–54.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.mdrd4 (creatinine = 1.4, age = 60, sex = "Male", ethnicity = "White",
  creatinine_units = "mg/dl")
# for a dataset - see vignettes for details
# egfr.mdrd4 (creatinine = dta$scr, age = dta$age, sex = dta$sex,
# ethnicity = dta$race, creatinine_units = "mg/dl")
```

egfr.schwartz	<i>Deprecated function name. Use specific functions egfr.schwartz.cr(), egfr.schwartz.cys(), egfr.schwartz.cr_cys().</i>
---------------	--

Description

Deprecated function name. Use specific functions egfr.schwartz.cr(), egfr.schwartz.cys(), egfr.schwartz.cr_cys().

Usage

```
egfr.schwartz(...)
```

Arguments

... used for legacy only.

Details

Deprecated function name.

egfr.schwartz.cr	<i>Calculate eGFR by Schwartz creatinine-based equation (for children only, both "classic" bedside and "quadratic")</i>
------------------	---

Description

Calculate eGFR by Schwartz creatinine-based equation (for children only, both "classic" bedside and "quadratic")

Usage

```
egfr.schwartz.cr(
  creatinine,
  age,
  sex,
  height_cm = 0,
  height_ft = 0,
  height_inch = 0,
  creatinine_units = "micromol/l",
  equation_type = "classic",
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0)
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
age	Numeric vector. Age, in years. Age does not accounted in Schwartz equation, but used in the function to check whether Schwartz equation could be applied to a given patient.
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female. Required only in case of quadratic Schwartz equation.
height_cm	Numeric vector. Could be defined either as height_cm if is measured in cm, or as height_ft and height_inch if is measured in feet and inches. If the parameter height_cm is greater than 0, the function uses cm, otherwise - feet and inches.
height_ft	see height_cm
height_inch	see height_cm
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
equation_type	Character string. Define whether to calculate eGFR either by classic Schwartz or quadratic Schwartz equation. Could be one of the following: "classic", "quadratic". If not explicitly defined by user, the default assumption is "classic".
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.

Details

Calculate estimated glomerular filtration rate (eGFR) by Schwartz creatinine-based equation.

References to the equation: Gao A, Cachat F, Faouzi M et al. Comparison of the glomerular filtration rate in children by the new revised Schwartz formula and a new generalized formula. *Kidney International* 2013;83:524–30.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.schwartz.cr (creatinine = 1.4, age = 10, height_cm = 90, sex = "Male",
  creatinine_units = "mg/dl")
egfr.schwartz.cr (creatinine = 1.4, age = 10, height_cm = 90, sex = "Male",
  creatinine_units = "mg/dl", equation_type = "quadratic")
# for a dataset - see vignettes for details
# egfr.schwartz.cr (creatinine = dta$scr, age = dta$age, height_cm = dta$ht,
# sex = dta$sex, creatinine_units = "mg/dl")
```

```
egfr.schwartz.cr_cys Calculate eGFR by Schwartz multivariate equation with cystatin C,
  ht/Scr, and BUN(for children only)
```

Description

Calculate eGFR by Schwartz multivariate equation with cystatin C, ht/Scr, and BUN(for children only)

Usage

```
egfr.schwartz.cr_cys(
  creatinine,
  creatinine_units = "mg/dL",
  cystatin,
  cystatin_units = "mg/L",
  bun,
  bun_units = "mg/dL",
  sex,
  height_cm = 0,
  height_ft = 0,
  height_inch = 0,
  label_sex_male = c("Male", 1),
  label_sex_female = c("Female", 0)
)
```

Arguments

creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L".
bun	Numeric vector. Blood urea nitrogen, could be expressed in "mg/dL" or "mmol/L". Units of measurement should be defined in variable bun_units (if not defined explicitly by user, the default value is "mg/dL").
bun_units	Character string. Units in which blood urea nitrogen is expressed. Could be one of the following: "mg/dL" or "mmol/L".
sex	Vector. The value of variable refers to the parameters label_sex_male and label_sex_female.
height_cm	Numeric vector. Could be defined either as height_cm if is measured in cm, or as height_ft and height_inch if is measured in feet and inches. If the parameter height_cm is greater than 0, the function uses cm, otherwise - feet and inches.
height_ft	see height_cm
height_inch	see height_cm
label_sex_male	List. Label(s) for definition(s) of male sex.
label_sex_female	List. Label(s) for definition(s) of female sex.

Details

Calculate estimated glomerular filtration rate (eGFR) by Schwartz multivariate equation with cystatin C, ht/Scr, and BUN.

Reference to the equation: Schwartz GJ, Schneider MF, Maier PS et al. Improved equations estimating GFR in children with chronic kidney disease using an immunonephelometric determination of cystatin C. *Kidney Int* 2012; 82: 445–453.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

egfr.schwartz.cys	<i>Calculate eGFR by Schwartz cystatin C-based equation (for children only)</i>
-------------------	---

Description

Calculate eGFR by Schwartz cystatin C-based equation (for children only)

Usage

```
egfr.schwartz.cys(cystatin, cystatin_units = "mg/L")
```

Arguments

cystatin	Numeric vector. Serum cystatin, could be expressed in "mg/L" or "nanomol/L". Units of measurement should be defined in variable cystatin_units (if not defined explicitly by user, the default value is "mg/L").
cystatin_units	Character string. Units in which serum cystatin is expressed. Could be one of the following: "mg/L" or "nanomol/L"

Details

Calculate estimated glomerular filtration rate (eGFR) by Schwartz cystatin C-based equation.

Reference to the equation: Schwartz GJ, Schneider MF, Maier PS et al. Improved equations estimating GFR in children with chronic kidney disease using an immunonephelometric determination of cystatin C. *Kidney Int* 2012; 82: 445–453.

Citation: Bikbov B. kidney.epi: Kidney-Related Functions for Clinical and Epidemiological Research. Scientific-Tools.Org, <https://Scientific-Tools.Org>. DOI: 10.32614/CRAN.package.kidney.epi

Value

numeric eGFR expressed in ml/min/1.73m².

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
egfr.schwartz.cys(cystatin = 1.4)
# for a dataset - see vignettes for details
```

ktx.data	<i>A sample dataset with kidney transplant patients.</i>
----------	--

Description

A dataset contains 10 records for kidney transplant patients, including information about deceased donors.

Usage

ktx.data

Format

A data frame with 10 rows and 12 variables:

ptid patient identifier

rec.age age of the recipient, in years

don.age age of the donor, in years

don.height height of the donor, in cm

don.weight weight of the donor, in kg

don.ethnicity ethnicity of the donor

don.hypertension history of hypertension for the donor

don.diabetes history of diabetes for the donor

don.causeofdeath cause of death for the donor

don.creatinine serum creatinine of the donor, in mg/dL

don.hcv hepatitis c virus status of the donor

don.dcdstatus donation after circulatory death status of the donor

don.sex sex of the donor

Source

Generation from different patients' records

ktx.kdpi.optn

Calculate KDRI and KDPI for deceased kidney donor

Description

Calculate KDRI and KDPI for deceased kidney donor

Usage

```
ktx.kdpi.optn(
  age,
  height_cm = 0,
  height_ft = 0,
  height_inch = 0,
  weight_kg = 0,
  weight_lb = 0,
  ethnicity = NA,
  hypertension,
  diabetes,
  causeofdeath,
  creatinine,
  hcv,
  dcdstatus,
  creatinine_units = "micromol/l",
  return_output_type = "KDPI",
  mapping_values_year = "latest",
  label_afroamerican = c("Afroamerican"),
  label_hypertension_positive = c("yes"),
  label_hypertension_unknown = "NA",
  label_diabetes_positive = c("yes"),
  label_diabetes_unknown = "NA",
  label_causeofdeath = c("cva"),
  label_hcv_positive = c("positive"),
  label_hcv_unknown = "NA",
  label_dcdstatus = c("yes")
)
```

Arguments

age	Numeric vector. Age, in years.
height_cm	Numeric vector. Could be defined either as height_cm if is measured in cm, or as height_ft and height_inch if is measured in feet and inches. If the parameter height_cm is greater than 0, the function uses cm, otherwise - feet and inches.
height_ft	see height_cm
height_inch	see height_cm

weight_kg	Numeric vector. Could be defined either as weight_kg if measured in kg, or as weight_lb if is measured in pounds. If the parameter weight_kg is greater than 0, the function uses kg, otherwise - pounds.
weight_lb	see weight_kg
ethnicity	Vector. Ethnicity, specify in case of African-American donors which have special coefficient in the regression equation. The value of variable refers to the parameter label_afroamerican.
hypertension	Vector. History of hypertension, specify in case of hypertensive donors which have special coefficient in the regression equation. The value of variable refers to the parameters label_hypertension_positive and label_hypertension_unknown.
diabetes	Vector. History of diabetes, specify in case of donors with diabetes which have special coefficient in the regression equation. The value of variable refers to the parameters label_diabetes_positive and label_diabetes_unknown.
causeofdeath	Vector. Cause of death, specify whether death was due to cerebrovascular disease, or other reasons.
creatinine	Numeric vector. Serum creatinine, could be expressed in "micromol/L", "mmol/L" or "mg/dL". Units of measurement should be defined in variable creatinine_units (if not defined explicitly by user, the default value is "micromol/L").
hcv	Vector. Hepatitis C virus status. The value of variable refers to the parameters label_hcv_positive and label_hcv_unknown.
dcdstatus	Vector. Donation after circulatory death status. Specify whether organ was from a donor after circulatory death or not. The value of variable refers to the parameter label_dcdstatus.
creatinine_units	Character string. Units in which serum creatinine is expressed. Could be one of the following: "micromol/L", "mmol/L" or "mg/dL".
return_output_type	Character string. Specify which calculated parameter to return from the function: "KDRI_Rao" - Raw Kidney Donor Risk Index, "KDRI_median" - scaled to the median Kidney Donor Risk Index, or "KDPI" - Kidney Donor Profile Index.
mapping_values_year	Numeric value or character string. Specify which year to take for the OPTN mapping table, as well as KDRI scaling factor and chances of hypertension and diabetes in case if they were unknown for donor. By default the value is "latest", and the function takes the latest available OPTN mapping table and coefficients from the internal dataframes ktx.kdpi_mapping_table and ktx.kdpi_coefficients_table. But if necessary, a user could define the exact year (i.e. mapping_values_year = 2015). For a list of available years run the following: ktx.kdpi.optn.show.years().
label_afroamerican	List. Label(s) for Afroamerican ethnicity.
label_hypertension_positive	List. Label(s) for a positive history of hypertension.

label_hypertension_unknown
List. Label(s) for donors with unknown history of hypertension.

label_diabetes_positive
List. Label(s) for a positive history of diabetes.

label_diabetes_unknown
List. Label(s) for donors with unknown history of diabetes.

label_causeofdeath
List. Label(s) for a cause of death due to cerebrovascular/stroke.

label_hcv_positive
List. Label(s) for a positive HCV status.

label_hcv_unknown
List. Label(s) for an unknown, not done, indeterminate, or pending HCV status.

label_dcdstatus
List. Label(s) for a donor after circulatory death status.

Details

Calculate Kidney Donor Risk Index (KDRI) and Kidney Donor Profile Index (KDPI) based on the algorithm of US Organ Procurement and Transplantation Network. The Kidney Donor Profile Index (KDPI) is a numerical measure that combines ten donor factors to summarize into a single number the quality of deceased donor kidneys relative to other recovered kidneys. *KDRI could be calculated only for a deceased donor!*

More reading:

- [OPTN web-based calculator](#)
- [Guide to calculating and interpreting KDPI](#)
- [Latest data for mapping table, scaling factor, etc](#)

Citation: Bikbov B. R open source programming code for calculation of the Kidney Donor Profile Index and Kidney Donor Risk Index. *Kidney Diseases*, 2018; 4:269–272. DOI: 10.1159/000492427

Value

numeric One of the following values based on the return_output_type argument: Raw Kidney Donor Risk Index (KDRI), Scaled to the median Kidney Donor Risk Index (KDRI), or Kidney Donor Profile Index (KDPI).

Author(s)

Programming: Boris Bikbov <https://www.linkedin.com/in/boris-bikbov>.

Examples

```
# for a single patient
ktx.kdpi.optn (age = 60, height_cm = 168, weight_kg = 93, ethnicity = "White",
  hypertension = "yes", diabetes = "no", causeofdeath = "roadinjury",
  creatinine = 1.4, hcv = "negative", dcdstatus = "no",
  creatinine_units = "mg/dl", return_output_type = "KDRI_Rao")
ktx.kdpi.optn (age = 30, height_cm = 176, weight_kg = 82, ethnicity = "White",
```

```
hypertension = "NA", diabetes = "no", causeofdeath = "roadinjury", # note that NA is in the quotes
creatinine = 150, hcv = "negative", dcdstatus = "no", return_output_type = "KDPI")
# for a dataset - see vignettes for details
```

```
ktx.kdpi.optn.show.years
```

Shows which years are available in the R package for the OPTN mapping table, KDRI scaling factor, etc.

Description

Shows which years are available in the R package for the OPTN mapping table, KDRI scaling factor, etc.

Usage

```
ktx.kdpi.optn.show.years()
```

Details

Service function which shows for user for which year(s) the OPTN mapping table, as well as KDRI scaling factor and chances of hypertension and diabetes in case if they were unknown for donor in the ktx.kdpi_mapping_table and ktx.kdpi_coefficients_table. This years could be used for the argument *mapping_values_year* of the ktx.kdpi.optn function.

This function has no arguments.

Value

numeric List of years which could be used for the argument *mapping_values_year* of the ktx.kdpi.optn function.

```
matrix.cross_table      Creates a named matrix from two variables.
```

Description

Creates a named matrix from two variables.

Usage

```
matrix.cross_table(var1, var2, predefined_levels = NA)
```

Arguments

<code>var1</code>	Character vector. Values representing first variable.
<code>var2</code>	Character vector. Values representing second variable.
<code>predefined_levels</code>	Character vector. Levels for <code>var1</code> and <code>var2</code> . If omitted, the variables just coded according to the levels they have. If contains vector, the variables are coded according to <code>predefined_levels</code> values, the latter could be useful if <code>var1</code> and <code>var2</code> contain not all levels of interest

Details

Creates a named matrix from two variables.

Value

matrix with cross-tabulation of `var1` and `var2`.

`matrix.get_named_matrix_value`

Access matrix cells by row and column names

Description

Access matrix cells by row and column names

Usage

```
matrix.get_named_matrix_value(matrix_data, row_name, col_name)
```

Arguments

<code>matrix_data</code>	matrix. Matrix with data.
<code>row_name</code>	character. Row name in the matrix.
<code>col_name</code>	character. Column name in the matrix.

Details

Access matrix cells by row and column names.

Value

vector. Matrix value.

```
matrix.read_excel_to_named_matrix
```

Read Excel file and convert it to matrix with row and column names.

Description

Read Excel file and convert it to matrix with row and column names.

Usage

```
matrix.read_excel_to_named_matrix(file_path, sheet_name = NULL)
```

Arguments

file_path	character. Path to Excel file.
sheet_name	character. Name of Excel sheet. Optional, if there is only one sheet with data, the function will read it with no need to specifying the sheet name.

Details

Read Excel file and convert it to matrix with row and column names.

Value

Excel file saved to a specified folder.

```
matrix.save_named_matrix_to_excel
```

Save a named matrix as an Excel file.

Description

Save a named matrix as an Excel file.

Usage

```
matrix.save_named_matrix_to_excel(  
  matrix_data,  
  file_path,  
  sheet_name = "Sheet1",  
  save_type = "new"  
)
```

Arguments

matrix_data	matrix. Matrix for saving.
file_path	character. Path to the Excel file.
sheet_name	character. Name of the Excel sheet.
save_type	character. Defines whether the Excel file should be created or overwritten (save_type = "new"), or new sheet should be added to the existing Excel file (save_type = "add").

Details

Save a named matrix as an Excel file.

Value

Excel file saved to a specified folder.

nephro.albuminuria_category

Legacy function to calculate albuminuria categories

Description

Legacy function to calculate albuminuria categories

Usage

```
nephro.albuminuria_category(...)
```

Arguments

... all arguments for the ckd.kdigo_category.albuminuria() function.

Details

Legacy function to calculate albuminuria categories (A1, A2, A3) based on albuminuria values. Alias to the ckd.kdigo_category.albuminuria() function. This function is for legacy use only.

nephro.gfr_category *Legacy function to calculate KDIGO GFR categories*

Description

Legacy function to calculate KDIGO GFR categories

Legacy function to calculate KDIGO risk categories

Usage

```
nephro.gfr_category(...)
```

```
nephro.kdigo_risk_category(...)
```

Arguments

... all arguments for the ckd.kdigo_category.risk() function.

Details

Legacy function to calculate KDIGO GFR categories. Alias to the ckd.kdigo_category.gfr() function. This function is for legacy use only.

Legacy function to calculate KDIGO risk categories. Alias to the ckd.kdigo_category.risk() function. This function is for legacy use only.

nephro.proteinuria_category
 Legacy function to calculate proteinuria categories

Description

Legacy function to calculate proteinuria categories

Usage

```
nephro.proteinuria_category(...)
```

Arguments

... all arguments for the ckd.kdigo_category.proteinuria() function.

Details

Legacy function to calculate albuminuria categories (A1, A2, A3) based on proteinuria values. Alias to the ckd.kdigo_category.proteinuria() function. This function is for legacy use only.

`service.convert_creatinine`*Convert creatinine values between measurement units.*

Description

Convert creatinine values between measurement units.

Usage

```
service.convert_creatinine(  
    creatinine,  
    creatinine_units,  
    creatinine_reference_units = "mg/dl"  
)
```

Arguments

`creatinine` Numeric. The creatinine value from a data set.
`creatinine_units`
 Character. Creatinine measurement units in a data set.
`creatinine_reference_units`
 Character. Creatinine measurement units as a desired output (mg/dl by default).

Details

Service function which check measurement units and convert creatinine values to selected by user.

Value

numeric Creatinine values converted into reference measurement units.

`service.convert_cystatin`*Convert cystatin C values between measurement units.*

Description

Convert cystatin C values between measurement units.

Convert blood urea nitrogen values between measurement units.

Usage

```
service.convert_cystatin(cystatin, cystatin_units)
```

```
service.convert_bun(bun, bun_units)
```

Arguments

- `cystatin` Numeric. The cystatin C values from a data set.
- `cystatin_units` Character. Cystatin C measurement units in a data set.
- `bun` Numeric. The blood urea nitrogen values from a data set.
- `bun_units` Character. Blood urea nitrogen measurement units in a data set.

Details

- Service function which check measurement units and convert cystatin C values to mg/l.
- Service function which check measurement units and convert blood urea nitrogen values.

Value

- numeric Cystatin C values converted in mg/l.
- numeric Blood urea nitrogen values converted in mg/dl.

Index

* datasets

- ckd.data, [3](#)
- ktx.data, [39](#)

- ckd.data, [3](#)
- ckd.kdigo_category.albuminuria, [4](#)
- ckd.kdigo_category.gfr, [5](#)
- ckd.kdigo_category.proteinuria, [6](#)
- ckd.kdigo_category.risk, [7](#)

- egfr.all_adults.cr, [8](#)
- egfr.all_adults.cr_cys, [9](#)
- egfr.all_adults.cys, [11](#)
- egfr.bis.cr, [12](#)
- egfr.bis.cr_cys, [13](#)
- egfr.cg.cr, [15](#)
- egfr.ckdepi.cr, [16](#)
- egfr.ckdepi.cr.2009, [17](#)
- egfr.ckdepi.cr.2021, [18](#)
- egfr.ckdepi.cr_cys.2021, [20](#)
- egfr.ckid_u25.cr, [21](#)
- egfr.ckid_u25.cys, [23](#)
- egfr.ekfc.cr, [24](#)
- egfr.ekfc.cys, [26](#)
- egfr.fas.cr, [27](#)
- egfr.fas.cr_cys, [28](#)
- egfr.fas.cys, [30](#)
- egfr.lm.cr, [31](#)
- egfr.mdrd4, [32](#)
- egfr.schwartz, [34](#)
- egfr.schwartz.cr, [34](#)
- egfr.schwartz.cr_cys, [36](#)
- egfr.schwartz.cys, [38](#)

- ktx.data, [39](#)
- ktx.kdpi.optn, [40](#)
- ktx.kdpi.optn.show_years, [43](#)

- matrix.cross_table, [43](#)
- matrix.get_named_matrix_value, [44](#)

- matrix.read_excel_to_named_matrix, [45](#)
- matrix.save_named_matrix_to_excel, [45](#)

- nephro.albuminuria_category, [46](#)
- nephro.gfr_category, [47](#)
- nephro.kdigo_risk_category
(nephro.gfr_category), [47](#)
- nephro.proteinuria_category, [47](#)

- service.convert_bun
(service.convert_cystatin), [48](#)
- service.convert_creatinine, [48](#)
- service.convert_cystatin, [48](#)