Package: pretestcad (via r-universe)

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Type Package

Title Pretest Probability for Coronary Artery Disease

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Description An application to calculate a patient's pretest probability (PTP) for obstructive Coronary Artery Disease (CAD) from a collection of guidelines or studies. Guidelines usually comes from the American Heart Association (AHA), American College of Cardiology (ACC) or European Society of Cardiology (ESC). Examples of PTP scores that comes from studies are the 2020 Winther et al. basic, Risk Factor-weighted Clinical Likelihood (RF-CL) and Coronary Artery Calcium Score-weighted Clinical Likelihood (CACS-CL) models <doi:10.1016/j.jacc.2020.09.585>, 2019 Reeh et al. basic and clinical models <doi:10.1093/eurheartj/ehy806> and 2017 Fordyce et al. PROMISE Minimal-Risk Tool <doi:10.1001/jamacardio.2016.5501>. As diagnosis of CAD involves a costly and invasive coronary angiography procedure for patients, having a reliable PTP for CAD helps doctors to make better decisions during patient management. This ensures high risk patients can be diagnosed and treated early for CAD while avoiding unnecessary testing for low risk patients.

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BugReports https://github.com/JauntyJJS/pretestcad/issues

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`arg_match0_allow_na` *Match an argument to a character vector but skip* `NA`

Description

This is equivalent to `arg_match` but skip `NA`

Usage

```
arg_match0_allow_na(
  arg,
  values,
  arg_nm = rlang::caller_arg(arg),
  error_call = rlang::caller_env()
)
```

Arguments

arg	A symbol referring to an argument accepting strings.
values	A character vector of possible values that arg can take.
arg_nm	Same as error_arg.
error_call	The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

The string supplied to arg.

See Also

caller_arg, stack, arg_match

Examples

```
# No error
input = "male"
arg_match0_allow_na(input, values = c("female","male"))

# Allow NA
input = NA
arg_match0_allow_na(input, values = c("female","male"))

# Error as M is not female or male
input = "emale"
try(arg_match0_allow_na(input, values = c("female","male")))
```

---

arg_match0_integer *Match an argument to a integer vector but skip* NA

Description

This is equivalent to arg_match but an integer variable is needed and skip NA.

Usage

```
arg_match0_integer(
  arg,
  values,
  allow_na = TRUE,
  arg_nm = rlang::caller_arg(arg),
  error_call = rlang::caller_env()
)
```

Arguments

arg	A symbol referring to an argument accepting strings.
values	A character vector of possible values that arg can take.
allow_na	Input boolean to determine if NA or NaN is allowed. Default: TRUE
arg_nm	Same as error_arg.
error_call	The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

The integer supplied to arg.

Examples

```
# No error
input = 5
arg_match0_integer(input, values = c(0:5))

# Allow NA
input = NA
arg_match0_integer(input, values = c(0:5))

# Error as 0 is not within 0 and 5
input = 6
try(arg_match0_integer(input, values = c(0:5)))

# Error as NULL is not within 0 and 5
input = NULL
try(arg_match0_integer(input, values = c(0:5)))

# Error as NA is not within 0 and 5 and allow_na is FALSE
input = NA
try(arg_match0_integer(input, values = c(0:5), allow_na = FALSE))
```

---

arg_match0_no_na_error_message

Error Message For NA *Argument For Non-missing List*

Description

Provides an error message if the argument provided is NA if a non-missing list is provided

Usage

```
arg_match0_no_na_error_message(
  arg,
  values,
  arg_nm = rlang::caller_arg(arg),
  error_call = rlang::caller_env()
)
```

Arguments

arg	A symbol referring to an argument accepting strings.
values	A character vector of possible values that arg can take.
arg_nm	Same as error_arg.
error_call	The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

An error message if the argument provided is NA if a non-missing list is provided. Else if will return NULL invisibly, regardless if arg has a match with the elements in values or not.

See Also

caller_arg, stack cli_abort

Examples

```
# Error as input is NA but value list provided has no NA
input = NA
try(arg_match0_no_na_error_message(input, values = c("female","male")))

# No error as value list provided has NA
input = NA
arg_match0_allow_na(input, values = c("female","male", NA))

# No error as input is not NA
input = "male"
arg_match0_allow_na(input, values = c("female","male", NA))
```

---

arg_match0_true_or_false

Match an argument to a TRUE *or* FALSE *vector but skip* NA

Description

This is equivalent to arg_match but a boolean variable is needed and skip NA.

Usage

```
arg_match0_true_or_false(
  arg,
  allow_na = TRUE,
  arg_nm = rlang::caller_arg(arg),
  error_call = rlang::caller_env()
)
```

Arguments

arg	A symbol referring to an argument accepting strings.
allow_na	Input boolean to determine if NA or NaN is allowed. Default: TRUE
arg_nm	Same as error_arg.
error_call	The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

The TRUE or FALSE value supplied to arg.

Examples

```
# No error
input = TRUE
arg_match0_true_or_false(input)

# Allow NA
input = NA
arg_match0_true_or_false(input)

# Error as 0 is not TRUE or FALSE
input = 0
try(arg_match0_true_or_false(input))

# Error as 1 is not TRUE or FALSE
input = 1
try(arg_match0_true_or_false(input))

# Error as NULL is not TRUE or FALSE
input = NULL
try(arg_match0_true_or_false(input))

# Error as NA is not TRUE or FALSE and allow_na is FALSE
input = NA
try(arg_match0_true_or_false(input, allow_na = FALSE))
```

`calculate_aha_2012_tbl_9_ptp` *Calculate ACCF/AHA/ACP/AATS/PCNA/SCAI/STS 2012 PTP for obstructive CAD*

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on the American College of Cardiology Foundation, American Heart Association, American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons 2012 guidelines. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_aha_2012_tbl_9_ptp(
  age,
  sex,
  chest_pain_type,
  output = c("numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input integer value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`chest_pain_type`	The value of variable in the parameters, `label_cpt_nonanginal`, `label_cpt_atypical`, `label_cpt_typical`, and `label_cpt_unknown`.
`output`	Input text to indicate the how pre-test probability results be expressed Default: c("numeric", "percentage") • numeric means the PTP will be expressed as an integer probability (0-100). • percentage means the PTP will be expressed as percentage text (0-100%).
`label_sex_male`	Label(s) for definition(s) of male sex. Default: `c("male")`
`label_sex_female`	Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_cpt_nonanginal`
: Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

`label_cpt_atypical`
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

`label_cpt_typical`
: Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_cpt_unknown`
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

Details

The predictive model used to create the guidelines are based on patients from the Diamond and Forrester and the Coronary Artery Surgery Study.

Value

An integer or percentage representing the patient's PTP for obstructive CAD based on the ACCF/AHA/ACP/AATS/PCNA/SCAI/STS 2012 guidelines.

Examples

```
# 35 year old female with typical chest pain
calculate_aha_2012_tbl_9_ptp(
    age = 35,
    sex = "female",
    chest_pain_type = "typical",
    output = "percentage"
)

# 65 year old male with nonanginal chest pain
calculate_aha_2012_tbl_9_ptp(
    age = 65,
    sex = "male",
    chest_pain_type = "nonanginal",
    output = "percentage"
)
```

`calculate_aha_2021_ptp` *Calculate AHA/ACC 2021 PTP for obstructive CAD*

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on the American Heart Association/American College of Cardiology (AHA/ACC) 2021 guidelines. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_aha_2021_ptp(
  age,
  sex,
  have_dyspnoea,
  have_chest_pain,
  output = c("grouping", "numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_have_chest_pain_no = c("no"),
  label_have_chest_pain_yes = c("yes"),
  label_have_chest_pain_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input integer value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`have_dyspnoea`	The value of variable in the parameters `label_have_dyspnoea_no`, `label_have_dyspnoea_yes` and `label_have_dyspnoea_unknown`.
`have_chest_pain`	The value of variable in the parameters `label_have_chest_pain_no`, `label_have_chest_pain_yes`, and `label_have_chest_pain_unknown`.
`output`	Input text to indicate the how pre-test probability results be expressed Default: c("grouping", "numeric", "percentage")

- grouping means the PTP will be expressed as Very Low, Low, Intermediate and High.
  - very low if PTP is less than 5%.
  - low if PTP is in between 5% to 15%.
  - intermediate if PTP is in between 15% to 50%.
  - high if PTP is more than 50%.
- numeric means the PTP will be expressed as an integer probability (0-100).
- percentage means the PTP will be expressed as percentage text (0-100%).

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
: Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_have_dyspnoea_no`
: Label(s) for patient having no dyspnoea symptoms. Default: `c("no")`

`label_have_dyspnoea_yes`
: Label(s) for patient having dyspnoea symptoms. Default: `c("yes")`

`label_have_dyspnoea_unknown`
: Label(s) for patient having unknown dyspnoea symptoms. Default: `c(NA, NaN)`

`label_have_chest_pain_no`
: Label(s) for patient not having chest pain symptoms. Default: `c("no")`

`label_have_chest_pain_yes`
: Label(s) for patient having chest pain symptoms. Default: `c("yes")`

`label_have_chest_pain_unknown`
: Label(s) for patient with unknown chest pain symptoms. Default: `c(NA, NaN)`

Details

The predictive model used to create the guidelines are based on patients from European countries with low cardiovascular disease (CVD) risk.

If the patient has both dyspnoea and a particular chest pain type (typical, atypical, nonanginal), The chest pain type will take precedence over dyspnoea

Value

An integer, percentage or category representing the patient's PTP for obstructive CAD based on the AHA/ACC 2021 guidelines. See parameter option `output` for more information.

Examples

```
# 35 year old female with chest pain
calculate_aha_2021_ptp(
    age = 35,
    sex = "female",
    have_dyspnoea = "no",
    have_chest_pain = "yes",
    output = "percentage"
)

# 75 year old male with only dyspnoea
calculate_aha_2021_ptp(
    age = 75,
    sex = "male",
    have_dyspnoea = "yes",
    have_chest_pain = "no",
    output = "percentage"
)
```

`calculate_cad1_2011_ptp` *Calculate 2011 CAD1 Basic PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2011 CAD Consortium 1 (CAD1) basic model. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_cad1_2011_ptp(
  age,
  sex,
  chest_pain_type,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`chest_pain_type`	The value of variable in the parameters, `label_cpt_nonanginal`, `label_cpt_atypical`, `label_cpt_typical` and `label_cpt_unknown`.
`label_sex_male`	Label(s) for definition(s) of male sex. Default: `c("male")`
`label_sex_female`	Label(s) for definition(s) of female sex. Default: `c("female")`
`label_sex_unknown`	Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`
`label_cpt_nonanginal`	Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`
`label_cpt_atypical`	Label(s) for patient having atypical chest pain. Default: `c("atypical")`
`label_cpt_typical`	Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_cpt_unknown`
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

Details

The predictive model is based on patients from 14 hospitals in Europe and the United States.

This model is also called the updated Diamond-Forrester model. Model formula used is from Table 3.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$-4.37 \quad +$$

$$(0.04 * age) \quad +$$

$$(1.34 * sex_is_male) \quad +$$

$$(1.91 * have_typical_chest_pain) \quad +$$

$$(0.64 * have_atypical_chest_pain)$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2011 CAD Consortium 1 (CAD1) basic model.

Examples

```
# 40 year old female with typical chest pain
calculate_cad1_2011_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical"
)
```

`calculate_cad2_2012_basic_ptp` *Calculate 2012 CAD2 Basic PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2012 CAD Consortium 2 (CAD2) basic model. Obstructive coronary artery disease was defined as $\geq$50% diameter stenosis in at least one vessel found on catheter based coronary angiography.

Usage

```
calculate_cad2_2012_basic_ptp(
  age,
  sex,
  chest_pain_type,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`chest_pain_type`	The value of variable in the parameters, `label_cpt_nonanginal`, `label_cpt_atypical`, `label_cpt_typical` and `label_cpt_unknown`.
`label_sex_male`	Label(s) for definition(s) of male sex. Default: `c("male")`
`label_sex_female`	Label(s) for definition(s) of female sex. Default: `c("female")`
`label_sex_unknown`	Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`
`label_cpt_nonanginal`	Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`
`label_cpt_atypical`	Label(s) for patient having atypical chest pain. Default: `c("atypical")`
`label_cpt_typical`	Label(s) for patient having typical chest pain. Default: `c("typical")`
`label_cpt_unknown`	Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

Details

The predictive model is based on patients from 18 hospitals in Europe and the United States.

A web-based calculator is accessible.

Model formula used is from Appendix Table 4.

It is of the form

$$\frac{1}{(1+e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
&-6.917 \quad + \\
&(0.063 * age) \quad + \\
&(1.358 * sex_is_male) \quad + \\
&(0.658 * have_atypical_chest_pain) \quad + \\
&(1.975 * have_typical_chest_pain)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2012 CAD Consortium 2 (CAD2) basic model.

Examples

```
# 40 year old female with typical chest pain
calculate_cad2_2012_basic_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical"
)
```

`calculate_cad2_2012_clinical_ccs_ptp`

Calculate 2012 CAD2 Clinical and CCS PTP for obstructive CAD

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2012 CAD Consortium 2 (CAD2) clinical and coronary calcium score (CCS) model. Obstructive coronary artery disease was defined as $\geq$50% diameter stenosis in at least one vessel found on catheter based coronary angiography.

Usage

```
calculate_cad2_2012_clinical_ccs_ptp(
  age,
  sex,
  chest_pain_type,
  have_diabetes,
  have_hypertension,
  have_dyslipidemia,
  have_smoking_history,
  coronary_calcium_score,
  label_sex_male = c("male"),
```

```
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.
coronary_calcium_score	Input non-negative numeric to indicate the total coronary calcium score of the patient.
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: `c("typical")`

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: `c("no")`

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: `c("yes")`

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: `c("no")`

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: `c("yes")`

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: `c("no")`

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: `c("yes")`

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: `c(NA, NaN)`

Details

The predictive model is based on patients from 18 hospitals in Europe and the United States.

A web-based calculator is accessible.

Model formula used is from Appendix Table 4.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
&-5.975 \quad + \\
&(0.011 * age) \quad + \\
&(0.786 * sex_is_male) \quad + \\
&(0.718 * have_atypical_chest_pain) \quad + \\
&(2.024 * have_typical_chest_pain) \quad + \\
&(0.658 * have_diabetes) \quad + \\
&(0.235 * have_hypertension) \quad + \\
&(0.185 * have_dyslipidemia) \quad + \\
&(0.207 * have_smoking_history) \quad + \\
&(0.577 * ln(CACS + 1)) \quad + \\
&(-0.780 * have_diabetes * have_typical_chest_pain)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2012 CAD Consortium 2 (CAD2) clinical and coronary calcium score (CCS) model.

Examples

```
# 40 year old female with typical chest pain,
# diabetes but no hypertension, dyslipidemia,
# a non-smoker and a coronary calcium score of 0
calculate_cad2_2012_clinical_ccs_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_diabetes = "yes",
    have_hypertension = "no",
    have_dyslipidemia = "no",
    have_smoking_history = "no",
    coronary_calcium_score = 0

)
```

`calculate_cad2_2012_clinical_ptp` *Calculate 2012 CAD2 Clinical PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2012 CAD Consortium 2 (CAD2) clinical model. Obstructive coronary artery disease was defined as $\geq$50% diameter stenosis in at least one vessel found on catheter based coronary angiography.

Usage

```
calculate_cad2_2012_clinical_ptp(
  age,
  sex,
  chest_pain_type,
  have_diabetes,
  have_hypertension,
  have_dyslipidemia,
  have_smoking_history,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.

chest_pain_type
: The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.

have_diabetes
: The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

have_hypertension
: The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_dyslipidemia
: The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.

have_smoking_history
: The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.

label_sex_male
: Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
: Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
: Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: c("atypical")

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: c("no")

`label_have_dyslipidemia_yes`
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

`label_have_dyslipidemia_unknown`
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

`label_have_smoking_history_no`
: Label(s) for patient with no smoking history (current or past). Default: `c("no")`

`label_have_smoking_history_yes`
: Label(s) for patient having smoking history (current or past). Default: `c("yes")`

`label_have_smoking_history_unknown`
: Label(s) for patient having unknown smoking history (current or past). Default: `c(NA, NaN)`

Details

The predictive model is based on patients from 18 hospitals in Europe and the United States.

Model formula used is from Appendix Table 4.

A web-based calculator is accessible.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-7.539 \quad + \\
&(0.062 * age) \quad + \\
&(1.332 * sex_is_male) \quad + \\
&(0.633 * have_atypical_chest_pain) \quad + \\
&(1.998 * have_typical_chest_pain) \quad + \\
&(0.828 * have_diabetes) \quad + \\
&(0.338 * have_hypertension) \quad + \\
&(0.422 * have_dyslipidemia) \quad + \\
&(0.461 * have_smoking_history) \quad + \\
&(-0.402 * have_diabetes * have_typical_chest_pain)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2012 CAD Consortium 2 (CAD2) clinical model.

Examples

```
# 40 year old female with typical chest pain,
# diabetes but no hypertension, dyslipidemia
# and a non-smoker
calculate_cad2_2012_clinical_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_diabetes = "yes",
    have_hypertension = "no",
    have_dyslipidemia = "no",
    have_smoking_history = "no"

)
```

`calculate_chen_2018_mfs_fig_3_ptp` *Calculate 2018 Chen MFS PTP (figure 3 version) for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2018 Chen et. al. modified Framingham scoring (MFS) model. Obstructive CAD was defined as ($\geq$50% stenosis by diameter in at least one major coronary vessel based on coronary angiography)

Usage

```
calculate_chen_2018_mfs_fig_3_ptp(
  age,
  sex,
  have_hypertension,
  tc_mg_dl,
  hdl_mg_dl,
  lvef_percent,
  hsCRP_mg_dl,
  have_anemia,
  output = c("risk_group", "risk_numeric", "risk_percentage", "mfs_points"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_anemia_no = c("no"),
  label_have_anemia_yes = c("yes"),
  label_have_anemia_unknown = c(NA, NaN)
)
```

Arguments

`age` Input integer value to indicate the age of the patient in years.

`sex` The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.

`have_hypertension` The value of variable in the parameters `label_have_hypertension_no`, `label_have_hypertension_yes`, and `label_have_hypertension_unknown`.

`tc_mg_dl` Input positive integer value to indicate the patient's total cholesterol in mg/dL.

`hdl_mg_dl` Input positive numeric value to indicate the patient's high-density lipoprotein (HDL) in mg/dL.

`lvef_percent` Input positive integer value to indicate the patient's Left Ventricular Ejection Fraction (LVEF) in $\%$

`hsCRP_mg_dl` Input positive integer value to indicate the patient's high-sensitivity C reactive protein (hs-CRP) in mg/dL.

`have_anemia` The value of variable in the parameters `label_have_anemia_no`, `label_have_anemia_yes`, and `label_have_anemia_unknown`.

`output` Input text to indicate the how pre-test probability results be expressed Default: c("risk_group", "risk_numeric", "risk_percentage", "mfs_points")

- risk_group means the PTP will be expressed as Low, Moderate, High and Very High.
  - low risk score if MFS is ≤ 17.
  - moderate risk score if MFS is in between 18 to 26.
  - high risk score if MFS is in between 27 to 41.
  - very high risk score if MFS is ≥ 42.
- risk_numeric means the PTP will be expressed as an integer probability (0-100).
- risk_percentage means the PTP will be expressed as percentage text (0-100%).
- mfs_points means the total risk points as calculated in figure 3. This value will be later converted to risk of obstructive CAD `risk_numeric` based on the table presented in figure 3.

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female` Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown` Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_have_hypertension_no` Label(s) for patient with no hypertension. Default: `c("no")`

`label_have_hypertension_yes` Label(s) for patient having hypertension. Default: `c("yes")`

`label_have_hypertension_unknown` Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

label_have_anemia_no
: Label(s) for patient without anemia. Default: `c("no")`

label_have_anemia_yes
: Label(s) for patient with anemia. The paper uses baseline hematocrit value <39% for men and <36% for women. Default: `c("yes")`

label_have_anemia_unknown
: Label(s) for patient with no information if they have anemia or not. Default: `c(NA, NaN)`

Details

The predictive model is based on patients from a prospective observational study Predictive Value of Contrast Volume to Creatinine Clearance Ratio (PRECOMIN) conducted primarily at Guangdong General Hospital.

Value

An integer, percentage or category representing the patient's risk points or PTP for obstructive CAD based on 2018 Chen et. al. predicted risk if obstructive CAD defined as stenosis $\geq$ 50% in any vessel.. See parameter option `output` for more information.

Examples

```
# 40 year old female with no hypertension
# and anemia. She has a
# total cholesterol level of 150 mg/dL
# high-density lipoprotein cholesterol level of 70 mg/dL and
# high-sensitivity C reactive protein level of 1 mg/dL with
# a left Ventricular Ejection Fraction reading of 60%
calculate_chen_2018_mfs_fig_3_ptp(
    age = 40,
    sex = "female",
    have_hypertension = "no",
    tc_mg_dl = 150,
    hdl_mg_dl = 70,
    lvef_percent = 60,
    hsCRP_mg_dl = 1,
    have_anemia = "no",
    output = "risk_percentage"
)
```

---

calculate_chen_2018_mfs_formula_ptp

Calculate 2018 Chen MFS PTP (formula version) for obstructive CAD

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2018 Chen et. al. modified Framingham scoring (MFS) model. Obstructive CAD was defined as ($\geq$50% stenosis by diameter in at least one major coronary vessel based on coronary angiography)

Usage

```
calculate_chen_2018_mfs_formula_ptp(
  age,
  sex,
  have_hypertension,
  tc_mg_dl,
  hdl_mg_dl,
  lvef_percent,
  hsCRP_mg_dl,
  have_anemia,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_anemia_no = c("no"),
  label_have_anemia_yes = c("yes"),
  label_have_anemia_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`have_hypertension`	The value of variable in the parameters `label_have_hypertension_no`, `label_have_hypertension_yes`, and `label_have_hypertension_unknown`.
`tc_mg_dl`	Input positive numeric value to indicate the patient's total cholesterol in mg/dL.
`hdl_mg_dl`	Input positive numeric value to indicate the patient's high-density lipoprotein (HDL) in mg/dL.
`lvef_percent`	Input positive numeric value to indicate the patient's Left Ventricular Ejection Fraction (LVEF) in $\%$
`hsCRP_mg_dl`	Input positive numeric value to indicate the patient's high-sensitivity C reactive protein (hs-CRP) in mg/dL.
`have_anemia`	The value of variable in the parameters `label_have_anemia_no`, `label_have_anemia_yes`, and `label_have_anemia_unknown`.

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
: Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_have_hypertension_no`
: Label(s) for patient with no hypertension. Default: `c("no")`

`label_have_hypertension_yes`
: Label(s) for patient having hypertension. Default: `c("yes")`

`label_have_hypertension_unknown`
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

`label_have_anemia_no`
: Label(s) for patient without anemia. Default: `c("no")`

`label_have_anemia_yes`
: Label(s) for patient with anemia. The paper uses baseline hematocrit value <39% for men and <36% for women. Default: `c("yes")`

`label_have_anemia_unknown`
: Label(s) for patient with no information if they have anemia or not. Default: `c(NA, NaN)`

Details

The predictive model is based on patients from a prospective observational study Predictive Value of Contrast Volume to Creatinine Clearance Ratio (PRECOMIN) conducted primarily at Guangdong General Hospital.

Model formula is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-0.0468 \quad + \\
&(0.0204 * age) \quad + \\
&(1.0961 * sex_is_male) \quad + \\
&(0.5444 * have_hypertension) \quad + \\
&(0.0055 * total_cholesterol_mg_dl) \quad + \\
&(-0.0257 * hdl_mg_dl) \quad + \\
&(-0.022 * LVEF_\%) \quad + \\
&(0.5677 * have_anemia) \quad + \\
&(0.0254 * hs - CRP_mg_dl)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2018 modified Framingham scoring (MFS) model.

Examples

```
# 40 year old female with no hypertension
# and anemia. She has a
# total cholesterol level of 150 mg/dL
# high-density lipoprotein cholesterol level of 70 mg/dL and
# high-sensitivity C reactive protein level of 1 mg/dL with
# a left Ventricular Ejection Fraction reading of 60%
calculate_chen_2018_mfs_formula_ptp(
    age = 40,
    sex = "female",
    have_hypertension = "no",
    tc_mg_dl = 150,
    hdl_mg_dl = 70,
    lvef_percent = 60,
    hsCRP_mg_dl = 1,
    have_anemia = "no"
)
```

---

calculate_come_cct_2025_ptp

Calculate 2025 COME-CCT-PTP for obstructive CAD

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2025 Collaborative Meta-Analysis of Cardiac CT (COME-CCT) PTP model. Obstructive coronary artery disease was defined as at least one $\geq 50\%$ diameter stenosis by invasive coronary angiography (ICA).

Usage

```
calculate_come_cct_2025_ptp(
  age,
  sex,
  chest_pain_type,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_others = c("others"),
  label_cpt_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical, label_cpt_others, and label_cpt_unknown.
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)
label_cpt_nonanginal	Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")
label_cpt_atypical	Label(s) for patient having atypical chest pain. Default: c("atypical")
label_cpt_typical	Label(s) for patient having typical chest pain. Default: c("typical")
label_cpt_others	Label(s) for patient having other forms of chest pain. Default: c("others")
label_cpt_unknown	Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

Details

The predictive model is based on 5332 stable chest pain patients with clinically indicated ICA from 22 countries.

Model formula used is from Table 3 to obtain results as shown in Table 2.

It is of the form

$$\int_{-\infty}^{\infty} \frac{1}{(1+e^{-(F(x)+\zeta)})} * \frac{1}{\sqrt{2\pi * 0.667}} e^{\frac{-\zeta^2}{2*0.667}} \, d\zeta$$

where $F(x)$ equals

$$-1.434 \quad +$$

$$(0.036 * (age - 61.3)) \quad +$$

$$(0.986 * sex_is_male) \quad +$$

$$(1.427 * have_typical_chest_pain) \quad +$$

$$(0.307 * have_atypical_chest_pain) \quad +$$

$$(0.119 * have_nonanginal_chest_pain)$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2025 Collaborative Meta-Analysis of Cardiac CT (COME-CCT) PTP model as shown in Table 2.

Examples

```
# 40 year old female with typical chest pain,
calculate_come_cct_2025_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical"
)
```

`calculate_come_cct_with_cta_2025_ptp`
Calculate 2025 COME-CCT-PTP with CTA for obstructive CAD

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2025 Collaborative Meta-Analysis of Cardiac CT (COME-CCT) with CTA PTP model. Obstructive coronary artery disease was defined as at least one $\geq 50\%$ diameter stenosis by invasive coronary angiography (ICA).

Usage

```
calculate_come_cct_with_cta_2025_ptp(
  age,
  sex,
  chest_pain_type,
  cta_result,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_others = c("others"),
  label_cpt_unknown = c(NA, NaN),
  label_cta_obstructive = c("obstructive"),
  label_cta_non_obstructive = c("non_obstructive"),
  label_cta_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical, label_cpt_others, and label_cpt_unknown.
cta_result	The value of variable in the parameters, label_cta_obstructive, label_cta_non_obstructive, and label_cta_unknown.
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)
label_cpt_nonanginal	Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")
label_cpt_atypical	Label(s) for patient having atypical chest pain. Default: c("atypical")
label_cpt_typical	Label(s) for patient having typical chest pain. Default: c("typical")
label_cpt_others	Label(s) for patient having other forms of chest pain. Default: c("others")
label_cpt_unknown	Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)
label_cta_obstructive	Label(s) for patient having obstructive CAD defined as at least one $\geq$ 50% diameter stenosis in computed tomography angiography (CTA). Default: c("obstructive")
label_cta_non_obstructive	Label(s) for patient having non-obstructive CAD defined as at least one < 50% diameter stenosis in computed tomography angiography (CTA). Default: c("non_obstructive")
label_cta_unknown	Label(s) for patient unknown CTA results. Default: c(NA, NaN)

Details

The predictive model is based on 5332 stable chest pain patients with clinically indicated ICA from 22 countries.

Model formula used is from Table 3 to obtain results as shown in Table 2.

It is of the form

$$\int_{-\infty}^{\infty} \frac{1}{(1+e^{-(F(x)+\zeta)})} * \frac{1}{\sqrt{2\pi * 0.377}} e^{\frac{-\zeta^2}{2*0.377}}\, d\zeta$$

where $F(x)$ equals

$$\begin{aligned}
&-3.030 \quad + \\
&(0.030 * (age - 61.3)) \quad + \\
&(0.868 * sex_is_male) \quad + \\
&(1.346 * have_typical_chest_pain) \quad + \\
&(0.195 * have_atypical_chest_pain) \quad + \\
&(0.156 * have_nonanginal_chest_pain) \quad + \\
&(2.924 * have_obstructive_CAD_in_CTA)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2025 Collaborative Meta-Analysis of Cardiac CT (COME-CCT) with CTA PTP model as shown in Table 2.

Examples

```
# 40 year old female with typical chest pain
# and obstructive CAD in CTA
calculate_come_cct_with_cta_2025_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    cta_result = "obstructive"
)
```

`calculate_come_cta_alone_2025_ptp` *Calculate PTP for obstructive CAD using CTA results from COME-CCT Consortium*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the model that uses only CTA results from the COME-CCT Consortium cohort. Obstructive coronary artery disease was defined as at least one $\geq$ 50% diameter stenosis by invasive coronary angiography (ICA).

Usage

```
calculate_come_cta_alone_2025_ptp(
  cta_result,
  label_cta_obstructive = c("obstructive"),
  label_cta_non_obstructive = c("non_obstructive"),
  label_cta_unknown = c(NA, NaN)
)
```

Arguments

`cta_result`	The value of variable in the parameters, `label_cta_obstructive`, `label_cta_non_obstructive`, and `label_cta_unknown`.
`label_cta_obstructive`	Label(s) for patient having obstructive CAD defined as at least one $\geq$ 50% diameter stenosis in computed tomography angiography (CTA). Default: `c("obstructive")`
`label_cta_non_obstructive`	Label(s) for patient having non-obstructive CAD defined as at least one < 50% diameter stenosis in computed tomography angiography (CTA). Default: `c("non_obstructive")`
`label_cta_unknown`	Label(s) for patient unknown CTA results. Default: `c(NA, NaN)`

Details

The predictive model is based on 5332 stable chest pain patients with clinically indicated ICA from 22 countries.

Model formula used is from Table 3 to obtain results as shown in Table 2.

It is of the form

$$\int_{-\infty}^{\infty} \frac{1}{(1+e^{-(F(x)+\zeta)})} * \frac{1}{\sqrt{2\pi * 0.348}} e^{\frac{-\zeta^2}{2*0.348}} \, d\zeta$$

where $F(x)$ equals

$$-1.893 \quad +$$

$$(2.973 * have_obstructive_CAD_in_CTA)$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the model that uses only CTA results from the COME-CCT Consortium cohort as shown in Table 2.

Examples

```
# A patient with obstructive CAD in CTA
calculate_come_cta_alone_2025_ptp(
    cta_result = "obstructive"
)
```

```
# A patient with non-obstructive CAD in CTA
calculate_come_cta_alone_2025_ptp(
    cta_result = "non_obstructive"
)
```

`calculate_confirm_2015_num_of_rf` *Calculate Number Of Risk Factors (CONFIRM 2015)*

Description

A function used to calculate the number of risk factors the patient has. This is used to calculate the pretest probability of obstructive coronary artery disease (CAD) based on the 2015 CONFIRM Risk Score.

Usage

```
calculate_confirm_2015_num_of_rf(
  have_typical_chest_pain,
  have_diabetes,
  have_hypertension,
  have_family_history,
  is_current_smoker,
  max_na = 0,
  label_have_typical_chest_pain_no = c("no"),
  label_have_typical_chest_pain_yes = c("yes"),
  label_have_typical_chest_pain_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_is_current_smoker_no = c("no"),
  label_is_current_smoker_yes = c("yes"),
  label_is_current_smoker_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`have_typical_chest_pain`
: The value of variable in the parameters `label_have_typical_chest_pain_no`,

label_have_typical_chest_pain_yes and label_have_typical_chest_pain_unknown.

have_diabetes The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

have_hypertension
The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_family_history
The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.

is_current_smoker
The value of variable in the parameters label_is_current_smoker_no, label_is_current_smoker_yes, and label_is_current_smoker_unknown.

max_na Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

label_have_typical_chest_pain_no
Label(s) for patient not having typical chest pain symptom. Default: c("no")

label_have_typical_chest_pain_yes
Label(s) for patient having typical chest pain symptom. Default: c("yes")

label_have_typical_chest_pain_unknown
Label(s) for patient having unknown typical chest pain symptom.

label_have_diabetes_no
Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

label_have_hypertension_no
Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_family_history_no
Label(s) for patient with no family history of CAD. Default: c("no")

label_have_family_history_yes
Label(s) for patient having family history of CAD. Default: c("yes")

label_have_family_history_unknown
Label(s) for patient having unknown family history of CAD. Default: c(NA, NaN)

label_is_current_smoker_no
Label(s) for patients who are not current smokers. Default: c("no")

label_is_current_smoker_yes
: Label(s) for patients who are current smokers. Default: `c("yes")`

label_is_current_smoker_unknown
: Label(s) for patient with unknown smoking status.

error_call
: The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

An integer indicating the number of risk factors the patient has. It can also be `NA` if the number of missing risk factors exceeds the `max_na` input value

Examples

```
calculate_confirm_2015_num_of_rf(
  have_typical_chest_pain = "yes",
  have_diabetes = "yes",
  have_hypertension = "yes",
  have_family_history = "yes",
  is_current_smoker = "no"
)

calculate_confirm_2015_num_of_rf(
  have_typical_chest_pain = "no",
  have_diabetes = "no",
  have_hypertension = "no",
  have_family_history = NA,
  is_current_smoker = "no",
  max_na = 0
)

calculate_confirm_2015_num_of_rf(
  have_typical_chest_pain = "no",
  have_diabetes = "no",
  have_hypertension = "no",
  have_family_history = NA,
  is_current_smoker = "no",
  max_na = 1
)
```

---

calculate_confirm_2015_ptp

Calculate 2015 CONFIRM Risk Score for obstructive CAD

Description

This function returns a patient's risk score for obstructive coronary artery disease based on the 2015 CONFIRM Risk Score. Obstructive coronary artery disease was defined by $\geq$ 50% luminal diameter stenosis in any coronary artery $\geq$ 1.5 mm in diameter.

Usage

```
calculate_confirm_2015_ptp(
  age,
  sex,
  have_typical_chest_pain,
  have_diabetes,
  have_hypertension,
  have_family_history,
  is_current_smoker,
  max_na_num_of_rf = 0,
  output = c("text", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_typical_chest_pain_no = c("no"),
  label_have_typical_chest_pain_yes = c("yes"),
  label_have_typical_chest_pain_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_is_current_smoker_no = c("no"),
  label_is_current_smoker_yes = c("yes"),
  label_is_current_smoker_unknown = c(NA, NaN)
)
```

Arguments

age	Input integer value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
have_typical_chest_pain	The value of variable in the parameters label_have_typical_chest_pain_no, label_have_typical_chest_pain_yes and label_have_typical_chest_pain_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_family_history
: The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.

is_current_smoker
: The value of variable in the parameters label_is_current_smoker_no, label_is_current_smoker_yes, and label_is_current_smoker_unknown.

max_na_num_of_rf
: Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

output
: Input text to indicate the how pre-test probability results be expressed Default: c("text", "percentage")

  - text means the PTP will be expressed as a probability in text (0 to > 82.4).
  - percentage means the PTP will be expressed as percentage text (0-100%).

label_sex_male
: Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
: Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
: Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_have_typical_chest_pain_no
: Label(s) for patient not having typical chest pain symptom. Default: c("no")

label_have_typical_chest_pain_yes
: Label(s) for patient having typical chest pain symptom. Default: c("yes")

label_have_typical_chest_pain_unknown
: Label(s) for patient having unknown typical chest pain symptom.

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_family_history_no
: Label(s) for patient with no family history of CAD. Default: c("no")

label_have_family_history_yes
: Label(s) for patient having family history of CAD. Default: c("yes")

`label_have_family_history_unknown`
: Label(s) for patient having unknown family history of CAD. Default: `c(NA, NaN)`

`label_is_current_smoker_no`
: Label(s) for patients who are not current smokers. Default: `c("no")`

`label_is_current_smoker_yes`
: Label(s) for patients who are current smokers. Default: `c("yes")`

`label_is_current_smoker_unknown`
: Label(s) for patient with unknown smoking status.

Details

The predictive model is based on CCTA images from 9093 patients from Phase I of the Coronary CT Angiography EvaluatioN For Clinical Outcomes: An InteRnational Multicenter (CONFIRM) registry.

Value

A numeric value representing the patient's risk score for obstructive CAD based on the 2015 CONFIRM Risk Score.

Examples

```
# 30 years old male current smoker with typical chest pain
calculate_confirm_2015_ptp(
  age = 30,
  sex = "male",
  have_typical_chest_pain = "yes",
  have_diabetes = "no",
  have_hypertension = "no",
  have_family_history = "no",
  is_current_smoker = "yes",
  max_na_num_of_rf = 0,
  output = "percentage"
)
```

`calculate_dcs_1993_lm_cad_ptp` *Calculate 1993 Duke Clinical Score for Left Main Disease*

Description

This function returns a patient's pre-test probability (PTP) of severe (>75% luminal diameter narrowing of the left main coronary artery) coronary artery disease based on the 1993 Duke Clinical Score.

Usage

```
calculate_dcs_1993_lm_cad_ptp(
  age,
  sex,
  have_typical_chest_pain,
  have_peripheral_vascular_disease,
  have_cerebrovascular_disease,
  have_carotid_bruits,
  duration_of_cad_symptoms_year,
  max_na_vascular_disease_index = 0,
  max_age = 65,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_typical_chest_pain_no = c("no"),
  label_have_typical_chest_pain_yes = c("yes"),
  label_have_typical_chest_pain_unknown = c(NA, NaN),
  label_have_pvd_no = c("no"),
  label_have_pvd_yes = c("yes"),
  label_have_pvd_unknown = c(NA, NaN),
  label_have_cvd_no = c("no"),
  label_have_cvd_yes = c("yes"),
  label_have_cvd_unknown = c(NA, NaN),
  label_have_carotid_bruits_no = c("no"),
  label_have_carotid_bruits_yes = c("yes"),
  label_have_carotid_bruits_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
have_typical_chest_pain	The value of variable in the parameters label_have_typical_chest_pain_no, label_have_typical_chest_pain_yes and label_have_typical_chest_pain_unknown.
have_peripheral_vascular_disease	The value of variable in the parameters label_have_pvd_no, label_have_pvd_yes, and label_have_pvd_unknown.
have_cerebrovascular_disease	The value of variable in the parameters label_have_cvd_no, label_have_cvd_yes, and label_have_cvd_unknown.
have_carotid_bruits	The value of variable in the parameters label_have_carotid_bruits_no, label_have_carotid_bruits_yes, and label_have_carotid_bruits_unknown.

`duration_of_cad_symptoms_year`
: Input integer to indicate the duration of coronary artery disease symptoms in years.

`max_na_vascular_disease_index`
: Input integer 0 to 3 to indicate the maximum number of missing disease history to tolerate before outputting an `NA`. Default: 0

`max_age`
: Input positive integer to indicate the maximum age to tolerate before outputting an `NA`. In the Duke Clinical Score 1993 paper, the maximum value is set as 65. Default: 65

`label_sex_male`
: Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
: Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_have_typical_chest_pain_no`
: Label(s) for patient not having typical chest pain symptom. Default: `c("no")`

`label_have_typical_chest_pain_yes`
: Label(s) for patient having typical chest pain symptom. Default: `c("yes")`

`label_have_typical_chest_pain_unknown`
: Label(s) for patient having unknown typical chest pain symptom.

`label_have_pvd_no`
: Label(s) for patient not having peripheral vascular disease. Default: `c("no")`

`label_have_pvd_yes`
: Label(s) for patient having peripheral vascular disease. Default: `c("yes")`

`label_have_pvd_unknown`
: Label(s) for patient having unknown peripheral vascular disease. Default: `c(NA, NaN)`

`label_have_cvd_no`
: Label(s) for patient not having cerebrovascular disease. Default: `c("no")`

`label_have_cvd_yes`
: Label(s) for patient having cerebrovascular disease. Default: `c("yes")`

`label_have_cvd_unknown`
: Label(s) for patient having unknown cerebrovascular disease. Default: `c(NA, NaN)`

`label_have_carotid_bruits_no`
: Label(s) for patient not having carotid bruits. Default: `c("no")`

`label_have_carotid_bruits_yes`
: Label(s) for patient having carotid bruits. Default: `c("yes")`

`label_have_carotid_bruits_unknown`
: Label(s) for patient having unknown carotid bruits. Default: `c(NA, NaN)`

Details

The predictive model is based on patients referred for cardiac catheterisation between 1969 and 1983.

Model formula used is from Appendix: Study Models.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$-6.7271 \quad +$$

$$(1.1252 * have_typical_chest_pain) \quad +$$

$$(0.0483 * age) \quad +$$

$$(-0.5770 * sex_is_female) \quad +$$

$$(0.5923 * vascular_disease_index) \quad +$$

$$(0.4027 * log_{10}(duration_of_CAD_symptoms_year + 1))$$

Value

A numeric value representing the patient's PTP for left main disease (>75% luminal diameter narrowing of the left main coronary artery) based on the 1993 Duke Clinical Score.

Examples

```
# 40 year old female with typical chest pain for one year,
# She has peripheral vascular and cerebrovascular disease.

calculate_dcs_1993_lm_cad_ptp(
    age = 40,
    sex = "female",
    have_typical_chest_pain = "yes",
    have_peripheral_vascular_disease = "yes",
    have_cerebrovascular_disease = "yes",
    have_carotid_bruits = "no",
    duration_of_cad_symptoms_year = 1,
)
```

`calculate_dcs_1993_pain_index`

Calculate The Pain Index For Duke Clinical Score 1993

Description

A function used to calculate the patient's pain index. This is used to calculate the likelihood of severe coronary artery disease in the Duke Clinical Score 1993 paper.

Usage

```
calculate_dcs_1993_pain_index(
  have_typical_chest_pain,
  frequency_of_angina_pain_per_week,
  have_progressive_angina,
  have_nocturnal_angina,
  have_q_waves,
  have_st_t_changes,
  max_na = 0,
  max_frequency_of_angina_pain_per_week = 35,
  label_have_typical_chest_pain_no = c("no"),
  label_have_typical_chest_pain_yes = c("yes"),
  label_have_typical_chest_pain_unknown = c(NA, NaN),
  label_have_progressive_angina_no = c("no"),
  label_have_progressive_angina_yes = c("yes"),
  label_have_progressive_angina_unknown = c(NA, NaN),
  label_have_nocturnal_angina_no = c("no"),
  label_have_nocturnal_angina_yes = c("yes"),
  label_have_nocturnal_angina_unknown = c(NA, NaN),
  label_have_q_waves_no = c("no"),
  label_have_q_waves_yes = c("yes"),
  label_have_q_waves_unknown = c(NA, NaN),
  label_have_st_t_changes_no = c("no"),
  label_have_st_t_changes_yes = c("yes"),
  label_have_st_t_changes_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`have_typical_chest_pain`
: The value of variable in the parameters `label_have_typical_chest_pain_no`, `label_have_typical_chest_pain_yes` and `label_have_typical_chest_pain_unknown`.

`frequency_of_angina_pain_per_week`
: Input integer to indicate the patient's frequency of angina per week.

`have_progressive_angina`
: The value of variable in the parameters `label_have_progressive_angina_no`, `label_have_progressive_angina_yes`, and `label_have_progressive_angina_unknown`.

`have_nocturnal_angina`
: The value of variable in the parameters `label_have_nocturnal_angina_no`, `label_have_nocturnal_angina_yes`, and `label_have_nocturnal_angina_unknown`.

`have_q_waves`
: The value of variable in the parameters `label_have_q_waves_no`, `label_have_q_waves_yes`, and `label_have_q_waves_unknown`.

have_st_t_changes
: The value of variable in the parameters label_have_st_t_changes_no, label_have_st_t_changes_yes, and label_have_st_t_changes_unknown.

max_na
: Input integer 0 to 6 to indicate the maximum number of missing symptoms to tolerate before outputting an NA. Default: 0

max_frequency_of_angina_pain_per_week
: Input non-negative integer to indicate the maximum frequency angina per week to tolerate before outputting an NA. In the Duke Clinical Score 1993 paper, the maximum value is set as 35. Default: 35

label_have_typical_chest_pain_no
: Label(s) for patient not having typical chest pain symptom. Default: c("no")

label_have_typical_chest_pain_yes
: Label(s) for patient having typical chest pain symptom. Default: c("yes")

label_have_typical_chest_pain_unknown
: Label(s) for patient having unknown typical chest pain symptom.

label_have_progressive_angina_no
: Label(s) for patient not having progressive angina. Default: c("no")

label_have_progressive_angina_yes
: Label(s) for patient having progressive angina. Default: c("yes")

label_have_progressive_angina_unknown
: Label(s) for patient having unknown progressive angina. Default: c(NA, NaN)

label_have_nocturnal_angina_no
: Label(s) for patient not having nocturnal angina. Default: c("no")

label_have_nocturnal_angina_yes
: Label(s) for patient having nocturnal angina. Default: c("yes")

label_have_nocturnal_angina_unknown
: Label(s) for patient having unknown nocturnal angina. Default: c(NA, NaN)

label_have_q_waves_no
: Label(s) for patient not having Q waves on ECG. Default: c("no")

label_have_q_waves_yes
: Label(s) for patient having Q waves on ECG. Default: c("yes")

label_have_q_waves_unknown
: Label(s) for patient with unknown Q waves on ECG. Default: c(NA, NaN)

label_have_st_t_changes_no
: Label(s) for patient not having ST-T changes on ECG. Default: c("no")

label_have_st_t_changes_yes
: Label(s) for patient having ST-T changes on ECG. Default: c("yes")

label_have_st_t_changes_unknown
: Label(s) for patient with unknown ST-T changes on ECG. Default: c(NA, NaN)

error_call
: The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

An integer indicating the patient's pain index. It can also be NA if the number of missing symptoms exceeds the max_na input value or the frequency of angina per week exceed the max_frequency_of_angina_pain_per_week input value.

Examples

```
calculate_dcs_1993_pain_index(
  have_typical_chest_pain = "yes",
  frequency_of_angina_pain_per_week = 10,
  have_progressive_angina = "yes",
  have_nocturnal_angina = "no",
  have_q_waves = "no",
  have_st_t_changes = "no",
  max_na = 0,
  max_frequency_of_angina_pain_per_week = 35
)

calculate_dcs_1993_pain_index(
  have_typical_chest_pain = "yes",
  frequency_of_angina_pain_per_week = 10,
  have_progressive_angina = "yes",
  have_nocturnal_angina = NA,
  have_q_waves = "no",
  have_st_t_changes = "no",
  max_na = 0,
  max_frequency_of_angina_pain_per_week = 35
)

calculate_dcs_1993_pain_index(
  have_typical_chest_pain = "yes",
  frequency_of_angina_pain_per_week = 10,
  have_progressive_angina = "yes",
  have_nocturnal_angina = NA,
  have_q_waves = "no",
  have_st_t_changes = "no",
  max_na = 1,
  max_frequency_of_angina_pain_per_week = 35
)

calculate_dcs_1993_pain_index(
  have_typical_chest_pain = "yes",
  frequency_of_angina_pain_per_week = 40,
  have_progressive_angina = "yes",
  have_nocturnal_angina = "no",
  have_q_waves = "no",
  have_st_t_changes = "no",
  max_na = 0,
  max_frequency_of_angina_pain_per_week = 35
)

calculate_dcs_1993_pain_index(
```

```
  have_typical_chest_pain = "yes",
  frequency_of_angina_pain_per_week = 40,
  have_progressive_angina = "yes",
  have_nocturnal_angina = "no",
  have_q_waves = "no",
  have_st_t_changes = "no",
  max_na = 0,
  max_frequency_of_angina_pain_per_week = NA
)
```

`calculate_dcs_1993_risk_factor_index` *Calculate The Risk Factor Index For Duke Clinical Score 1993*

Description

A function used to calculate the patient's risk factor index. This is used to calculate the likelihood of severe coronary artery disease in the Duke Clinical Score 1993 paper.

Usage

```
calculate_dcs_1993_risk_factor_index(
  have_hypertension,
  have_dyslipidemia,
  have_diabetes,
  max_na = 0,
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`have_hypertension`
: The value of variable in the parameters `label_have_hypertension_no`, `label_have_hypertension_yes`, and `label_have_hypertension_unknown`.

`have_dyslipidemia`
: The value of variable in the parameters `label_have_dyslipidemia_no`, `label_have_dyslipidemia_yes` and `label_have_dyslipidemia_unknown`.

have_diabetes
: The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

max_na
: Input integer 0 to 3 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: c("no")

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: c("yes")

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: c(NA, NaN)

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

error_call
: The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

An integer indicating the patient's risk factor index. It can also be NA if the number of missing risk factors exceeds the max_na input value.

Examples

```
calculate_dcs_1993_risk_factor_index(
  have_hypertension = "yes",
  have_dyslipidemia = "yes",
  have_diabetes = "no"
)

calculate_dcs_1993_risk_factor_index(
  have_hypertension = NA,
  have_dyslipidemia = "yes",
  have_diabetes = "no",
  max_na = 0
)

calculate_dcs_1993_risk_factor_index(
  have_hypertension = NA,
```

```
  have_dyslipidemia = "yes",
  have_diabetes = "no",
  max_na = 1
)
```

`calculate_dcs_1993_severe_cad_ptp` *Calculate 1993 Duke Clinical Score for Severe CAD*

Description

This function returns a patient's pre-test probability (PTP) of severe (>75% luminal diameter narrowing of all three major coronary arteries or of the left main coronary artery) coronary artery disease based on the 1993 Duke Clinical Score.

Usage

```
calculate_dcs_1993_severe_cad_ptp(
  age,
  sex,
  chest_pain_type,
  have_progressive_angina,
  have_nocturnal_angina,
  have_peripheral_vascular_disease,
  have_cerebrovascular_disease,
  have_carotid_bruits,
  have_hypertension,
  have_dyslipidemia,
  have_diabetes,
  have_q_waves,
  have_st_t_changes,
  frequency_of_angina_pain_per_week,
  duration_of_cad_symptoms_year,
  max_na_risk_factor_index = 0,
  max_na_pain_index = 0,
  max_na_vascular_disease_index = 0,
  max_frequency_of_angina_pain_per_week = 35,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_progressive_angina_no = c("no"),
  label_have_progressive_angina_yes = c("yes"),
  label_have_progressive_angina_unknown = c(NA, NaN),
```

```
  label_have_nocturnal_angina_no = c("no"),
  label_have_nocturnal_angina_yes = c("yes"),
  label_have_nocturnal_angina_unknown = c(NA, NaN),
  label_have_pvd_no = c("no"),
  label_have_pvd_yes = c("yes"),
  label_have_pvd_unknown = c(NA, NaN),
  label_have_cvd_no = c("no"),
  label_have_cvd_yes = c("yes"),
  label_have_cvd_unknown = c(NA, NaN),
  label_have_carotid_bruits_no = c("no"),
  label_have_carotid_bruits_yes = c("yes"),
  label_have_carotid_bruits_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_q_waves_no = c("no"),
  label_have_q_waves_yes = c("yes"),
  label_have_q_waves_unknown = c(NA, NaN),
  label_have_st_t_changes_no = c("no"),
  label_have_st_t_changes_yes = c("yes"),
  label_have_st_t_changes_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.
have_progressive_angina	The value of variable in the parameters label_have_progressive_angina_no, label_have_progressive_angina_yes, and label_have_progressive_angina_unknown.
have_nocturnal_angina	The value of variable in the parameters label_have_nocturnal_angina_no, label_have_nocturnal_angina_yes, and label_have_nocturnal_angina_unknown.
have_peripheral_vascular_disease	The value of variable in the parameters label_have_pvd_no,

label_have_pvd_yes, and label_have_pvd_unknown.

have_cerebrovascular_disease
: The value of variable in the parameters label_have_cvd_no, label_have_cvd_yes, and label_have_cvd_unknown.

have_carotid_bruits
: The value of variable in the parameters label_have_carotid_bruits_no, label_have_carotid_bruits_yes, and label_have_carotid_bruits_unknown.

have_hypertension
: The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_dyslipidemia
: The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.

have_diabetes
: The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

have_q_waves
: The value of variable in the parameters label_have_q_waves_no, label_have_q_waves_yes, and label_have_q_waves_unknown.

have_st_t_changes
: The value of variable in the parameters label_have_st_t_changes_no, label_have_st_t_changes_yes, and label_have_st_t_changes_unknown.

frequency_of_angina_pain_per_week
: Input integer to indicate the patient's frequency of angina per week.

duration_of_cad_symptoms_year
: Input integer to indicate the duration of coronary artery disease symptoms in years.

max_na_risk_factor_index
: Input integer 0 to 3 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

max_na_pain_index
: Input integer 0 to 5 to indicate the maximum number of missing symptoms to tolerate before outputting an NA. Default: 0

max_na_vascular_disease_index
: Input integer 0 to 3 to indicate the maximum number of missing disease history to tolerate before outputting an NA. Default: 0

max_frequency_of_angina_pain_per_week
: Input non-negative integer to indicate the maximum frequency angina per week to tolerate before outputting an NA. In the Duke Clinical Score 1993 paper, the maximum value is set as 35. Default: 35

label_sex_male
: Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
: Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
: Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: c("atypical")

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_progressive_angina_no
: Label(s) for patient not having progressive angina. Default: c("no")

label_have_progressive_angina_yes
: Label(s) for patient having progressive angina. Default: c("yes")

label_have_progressive_angina_unknown
: Label(s) for patient having unknown progressive angina. Default: c(NA, NaN)

label_have_nocturnal_angina_no
: Label(s) for patient not having nocturnal angina. Default: c("no")

label_have_nocturnal_angina_yes
: Label(s) for patient having nocturnal angina. Default: c("yes")

label_have_nocturnal_angina_unknown
: Label(s) for patient having unknown nocturnal angina. Default: c(NA, NaN)

label_have_pvd_no
: Label(s) for patient not having peripheral vascular disease. Default: c("no")

label_have_pvd_yes
: Label(s) for patient having peripheral vascular disease. Default: c("yes")

label_have_pvd_unknown
: Label(s) for patient having unknown peripheral vascular disease. Default: c(NA, NaN)

label_have_cvd_no
: Label(s) for patient not having cerebrovascular disease. Default: c("no")

label_have_cvd_yes
: Label(s) for patient having cerebrovascular disease. Default: c("yes")

label_have_cvd_unknown
: Label(s) for patient having unknown cerebrovascular disease. Default: c(NA, NaN)

label_have_carotid_bruits_no
: Label(s) for patient not having carotid bruits. Default: c("no")

label_have_carotid_bruits_yes
: Label(s) for patient having carotid bruits. Default: c("yes")

label_have_carotid_bruits_unknown
: Label(s) for patient having unknown carotid bruits. Default: c(NA, NaN)

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: `c("yes")`

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: `c("no")`

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: `c("yes")`

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

label_have_q_waves_no
: Label(s) for patient not having Q waves on ECG. Default: `c("no")`

label_have_q_waves_yes
: Label(s) for patient having Q waves on ECG. Default: `c("yes")`

label_have_q_waves_unknown
: Label(s) for patient with unknown Q waves on ECG. Default: `c(NA, NaN)`

label_have_st_t_changes_no
: Label(s) for patient not having ST-T changes on ECG. Default: `c("no")`

label_have_st_t_changes_yes
: Label(s) for patient having ST-T changes on ECG. Default: `c("yes")`

label_have_st_t_changes_unknown
: Label(s) for patient with unknown ST-T changes on ECG. Default: `c(NA, NaN)`

Details

The predictive model is based on patients referred for cardiac catheterisation between 1969 and 1983.

Model formula used is from Appendix: Study Models.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
&-3.4732 \quad + \\
&(0.3424 * log_{10}(duration_of_CAD_symptoms_year + 1)) \quad + \\
&(0.3014 * chest_pain_type) \quad + \\
&(0.1559 * log_{10}(duration_of_CAD_symptoms_year + 1) * chest_pain_type) \quad + \\
&(0.0299 * age) \quad + \\
&(0.3513 * have_Q_waves) \quad + \\
&(0.0054 * pain_index) \quad + \\
&(-0.3823 * sex_is_female) \quad + \\
&(0.1734 * risk_factor_index) \quad + \\
&(0.2402 * vascular_disease_index)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for severe (>75% luminal diameter narrowing of all three major coronary arteries or of the left main coronary artery) CAD based on the 1993 Duke Clinical Score.

Examples

```
# 40 year old female with typical chest pain for one year,
# She has progressive angina but no nocturnal angina.
# Angina pain lasted at most five times a week.
# She has peripheral vascular and cerebrovascular disease.
# She has hypertension but has no dyslipidemia and not diabetic.
# She has Q waves and ST-T changes on ECG.

calculate_dcs_1993_severe_cad_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_progressive_angina = "yes",
    have_nocturnal_angina = "no",
    have_peripheral_vascular_disease = "yes",
    have_cerebrovascular_disease = "yes",
    have_carotid_bruits = "no",
    have_hypertension = "yes",
    have_dyslipidemia = "no",
    have_diabetes = "no",
    have_q_waves = "yes",
    have_st_t_changes = "yes",
```

```
    frequency_of_angina_pain_per_week = 5,
    duration_of_cad_symptoms_year = 1,
)
```

`calculate_dcs_1993_sig_cad_ptp`
Calculate 1993 Duke Clinical Score for Significant CAD

Description

This function returns a patient's pre-test probability (PTP) of significant (>75% luminal diameter narrowing of at least one major coronary artery) coronary artery disease based on the 1993 Duke Clinical Score.

Usage

```
calculate_dcs_1993_sig_cad_ptp(
  age,
  sex,
  chest_pain_type,
  have_mi,
  have_smoking_history,
  have_dyslipidemia,
  have_diabetes,
  have_q_waves,
  have_st_t_changes,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_mi_no = c("no"),
  label_have_mi_yes = c("yes"),
  label_have_mi_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_q_waves_no = c("no"),
  label_have_q_waves_yes = c("yes"),
```

```
  label_have_q_waves_unknown = c(NA, NaN),
  label_have_st_t_changes_no = c("no"),
  label_have_st_t_changes_yes = c("yes"),
  label_have_st_t_changes_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.
have_mi	The value of variable in the parameters label_have_mi_no, label_have_mi_yes and label_have_mi_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
have_q_waves	The value of variable in the parameters label_have_q_waves_no, label_have_q_waves_yes, and label_have_q_waves_unknown.
have_st_t_changes	The value of variable in the parameters label_have_st_t_changes_no, label_have_st_t_changes_yes, and label_have_st_t_changes_unknown.
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)
label_cpt_nonanginal	Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")
label_cpt_atypical	Label(s) for patient having atypical chest pain. Default: c("atypical")
label_cpt_typical	Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

label_have_mi_no
: Label(s) for patient not having a previous history of MI. Default: `c("no")`

label_have_mi_yes
: Label(s) for patient having a previous history of MI. Default: `c("yes")`

label_have_mi_unknown
: Label(s) for patient with unknown previous history of MI. Default: `c(NA, NaN)`

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: `c("no")`

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: `c("yes")`

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: `c(NA, NaN)`

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: `c("no")`

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: `c("yes")`

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

label_have_q_waves_no
: Label(s) for patient not having Q waves on ECG. Default: `c("no")`

label_have_q_waves_yes
: Label(s) for patient having Q waves on ECG. Default: `c("yes")`

label_have_q_waves_unknown
: Label(s) for patient with unknown Q waves on ECG. Default: `c(NA, NaN)`

label_have_st_t_changes_no
: Label(s) for patient not having ST-T changes on ECG. Default: `c("no")`

label_have_st_t_changes_yes
: Label(s) for patient having ST-T changes on ECG. Default: `c("yes")`

label_have_st_t_changes_unknown
: Label(s) for patient with unknown ST-T changes on ECG. Default: `c(NA, NaN)`

Details

The predictive model is based on patients referred for cardiac catheterisation between 1969 and 1983.

Model formula used is from Appendix: Study Models.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-7.376 \quad + \\
&(0.1126 * age) \quad + \\
&(-0.328 * sex_is_female) \quad + \\
&(-0.0301 * age * sex_is_female) \quad + \\
&(2.581 * have_typical_chest_pain) \quad + \\
&(0.976 * have_atypical_chest_pain) \quad + \\
&(1.093 * have_history_of_MI) \quad + \\
&(1.213 * have_Q_waves) \quad + \\
&(0.741 * have_history_of_MI * have_Q_waves) \quad + \\
&(2.596 * have_smoking_history) \quad + \\
&(1.845 * have_dyslipidemia) \quad + \\
&(0.694 * have_diabetes) \quad + \\
&(0.637 * have_ST - T_changes) \quad + \\
&(-0.0404 * age * have_smoking_history) \quad + \\
&(-0.0251 * age * have_dyslipidemia) \quad + \\
&(0.550 * sex_is_female * have_smoking_history)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for significant (>75% luminal diameter narrowing of at least one major coronary artery) CAD based on the 1993 Duke Clinical Score.

Examples

```
# 40 year old female with typical chest pain,
# previous history of MI,
# has diabetes but no dyslipidemia and a non-smoker.
# She has Q waves but no ST-T changes on ECG.
```

```
calculate_dcs_1993_sig_cad_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_mi = "yes",
    have_smoking_history = "no",
    have_dyslipidemia = "no",
    have_diabetes = "yes",
    have_q_waves = "yes",
    have_st_t_changes = "no"
)
```

`calculate_dcs_1993_vascular_disease_index` *Calculate The Vascular Disease Index For Duke Clinical Score 1993*

Description

A function used to calculate the patient's vascular disease index. This is used to calculate the likelihood of severe coronary artery disease in the Duke Clinical Score 1993 paper.

Usage

```
calculate_dcs_1993_vascular_disease_index(
  have_peripheral_vascular_disease,
  have_cerebrovascular_disease,
  have_carotid_bruits,
  max_na = 0,
  label_have_pvd_no = c("no"),
  label_have_pvd_yes = c("yes"),
  label_have_pvd_unknown = c(NA, NaN),
  label_have_cvd_no = c("no"),
  label_have_cvd_yes = c("yes"),
  label_have_cvd_unknown = c(NA, NaN),
  label_have_carotid_bruits_no = c("no"),
  label_have_carotid_bruits_yes = c("yes"),
  label_have_carotid_bruits_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`have_peripheral_vascular_disease`
: The value of variable in the parameters `label_have_pvd_no`, `label_have_pvd_yes`, and `label_have_pvd_unknown`.

`have_cerebrovascular_disease`
: The value of variable in the parameters `label_have_cvd_no`, `label_have_cvd_yes`, and `label_have_cvd_unknown`.

have_carotid_bruits
: The value of variable in the parameters label_have_carotid_bruits_no, label_have_carotid_bruits_yes, and label_have_carotid_bruits_unknown.

max_na
: Input integer 0 to 3 to indicate the maximum number of missing disease history to tolerate before outputting an NA. Default: 0

label_have_pvd_no
: Label(s) for patient not having peripheral vascular disease. Default: c("no")

label_have_pvd_yes
: Label(s) for patient having peripheral vascular disease. Default: c("yes")

label_have_pvd_unknown
: Label(s) for patient having unknown peripheral vascular disease. Default: c(NA, NaN)

label_have_cvd_no
: Label(s) for patient not having cerebrovascular disease. Default: c("no")

label_have_cvd_yes
: Label(s) for patient having cerebrovascular disease. Default: c("yes")

label_have_cvd_unknown
: Label(s) for patient having unknown cerebrovascular disease. Default: c(NA, NaN)

label_have_carotid_bruits_no
: Label(s) for patient not having carotid bruits. Default: c("no")

label_have_carotid_bruits_yes
: Label(s) for patient having carotid bruits. Default: c("yes")

label_have_carotid_bruits_unknown
: Label(s) for patient having unknown carotid bruits. Default: c(NA, NaN)

error_call
: The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

An integer indicating the patient's vascular disease index. It can also be NA if the number of missing disease history exceeds the max_na input value.

Examples

```
calculate_dcs_1993_vascular_disease_index(
  have_peripheral_vascular_disease = "yes",
  have_cerebrovascular_disease = "yes",
  have_carotid_bruits = "no"
)

calculate_dcs_1993_vascular_disease_index(
  have_peripheral_vascular_disease = NA,
  have_cerebrovascular_disease = "yes",
  have_carotid_bruits = "no",
  max_na = 0
```

```
)

calculate_dcs_1993_vascular_disease_index(
  have_peripheral_vascular_disease = NA,
  have_cerebrovascular_disease = "yes",
  have_carotid_bruits = "no",
  max_na = 1
)
```

`calculate_diamond_forrester_1979_ptp` *Calculate Diamond-Forrester 1979 PTP for obstructive CAD*

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on Diamond-Forrester 1979 model. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_diamond_forrester_1979_ptp(
  age,
  sex,
  chest_pain_type,
  output = c("numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input integer value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`chest_pain_type`	The value of variable in the parameters, `label_cpt_nonanginal`, `label_cpt_atypical`, `label_cpt_typical`, and `label_cpt_unknown`.
`output`	Input text to indicate the how pre-test probability results be expressed Default: c("numeric", "percentage")

- numeric means the PTP will be expressed as an integer probability (0-100).

- percentage means the PTP will be expressed as percentage text (0-100%).

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_cpt_nonanginal`
Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

`label_cpt_atypical`
Label(s) for patient having atypical chest pain. Default: `c("atypical")`

`label_cpt_typical`
Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_cpt_unknown`
Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

Value

A numeric or percentage representing the patient's PTP for obstructive CAD based on Diamond-Forrester 1979 model.

Examples

```
# 35 year old female with typical chest pain
calculate_diamond_forrester_1979_ptp(
    age = 35,
    sex = "female",
    chest_pain_type = "typical",
    output = "percentage"
)

# 65 year old male with nonanginal chest pain
calculate_diamond_forrester_1979_ptp(
    age = 65,
    sex = "male",
    chest_pain_type = "nonanginal",
    output = "percentage"
)
```

---

calculate_esc_2013_ptp

Calculate ESC 2013 PTP for obstructive CAD

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on the European Society of Cardiology (ESC) 2013 guidelines. Obstructive CAD was defined as a stenosis causing $\geq 50\%$ diameter stenosis on coronary CTA.

Usage

```
calculate_esc_2013_ptp(
  age,
  sex,
  chest_pain_type,
  output = c("numeric", "percentage")
)
```

Arguments

age	Input integer value to indicate the age of the patient.
sex	Input characters (female, male) to indicate the sex of the patient. • female • male
chest_pain_type	Input characters (typical, atypical, nonanginal) to indicate the chest pain characteristics of the patient. • typical stands for the patient having typical chest pain. • atypical stands for the patient having atypical chest pain. • nonanginal stands for the patient having nonanginal or non-specific chest pain.
output	Input text to indicate the how pre-test probability results be expressed Default: c("numeric", "percentage") • numeric means the PTP will be expressed as an integer probability (0-100). • percentage means the PTP will be expressed as percentage text (0-100%).

Details

The predictive model used to create the guidelines are based on the journal A clinical prediction rule for the diagnosis of coronary artery disease: validation, updating, and extension by 2011 Genders et. al.

Value

An integer or percentage representing the patient's PTP for obstructive CAD based on the ESC 2013 guidelines.

Examples

```
# 35 year old female with typical chest pain
calculate_esc_2013_ptp(
    age = 35,
    sex = "female",
    chest_pain_type = "typical",
    output = "percentage"
)
```

```
# 65 year old male with nonanginal chest pain
calculate_esc_2013_ptp(
    age = 65,
    sex = "male",
    chest_pain_type = "nonanginal",
    output = "percentage"
)
```

`calculate_esc_2019_ptp` *Calculate ESC 2019 PTP for obstructive CAD*

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on the European Society of Cardiology (ESC) 2019 guidelines. Obstructive CAD was defined as a stenosis causing $\geq 50\%$ diameter stenosis on coronary CTA.

Usage

```
calculate_esc_2019_ptp(
  age,
  sex,
  have_dyspnoea,
  chest_pain_type,
  output = c("grouping", "numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input integer value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`have_dyspnoea`	The value of variable in the parameters `label_have_dyspnoea_no`, `label_have_dyspnoea_yes` and `label_have_dyspnoea_unknown`.

`chest_pain_type`
: The value of variable in the parameters `label_cpt_no_chest_pain`, `label_cpt_nonanginal`, `label_cpt_atypical`, `label_cpt_typical`, and `label_cpt_unknown`.

`output`
: Input text to indicate the how pre-test probability results be expressed Default: c("grouping", "numeric", "percentage")
  - grouping means the PTP will be expressed as Low, Intermediate and High.
    - low if PTP is less than 5%.
    - intermediate if PTP is in between 5% to 15%.
    - high if PTP is more than 15%.
  - numeric means the PTP will be expressed as an integer probability (0-100).
  - percentage means the PTP will be expressed as percentage text (0-100%).

`label_sex_male`
: Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
: Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_have_dyspnoea_no`
: Label(s) for patient having no dyspnoea symptoms. Default: `c("no")`

`label_have_dyspnoea_yes`
: Label(s) for patient having dyspnoea symptoms. Default: `c("yes")`

`label_have_dyspnoea_unknown`
: Label(s) for patient having unknown dyspnoea symptoms. Default: `c(NA, NaN)`

`label_cpt_no_chest_pain`
: Label(s) for patient having no chest pain. Default: `c("no chest pain")`

`label_cpt_nonanginal`
: Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

`label_cpt_atypical`
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

`label_cpt_typical`
: Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_cpt_unknown`
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

Details

The predictive model used to create the guidelines are based on patients from European countries with low cardiovascular disease (CVD) risk.

If the patient has both dyspnoea and a particular chest pain type (typical, atypical, nonanginal), The chest pain type will take precedence over dyspnoea.

Value

An integer, percentage or category representing the patient's PTP for obstructive CAD based on the ESC 2019 guidelines. See parameter option `output` for more information.

Examples

```
# 35 year old female with typical chest pain
calculate_esc_2019_ptp(
    age = 35,
    sex = "female",
    have_dyspnoea = "no",
    chest_pain_type = "typical",
    output = "percentage"
)

# 75 year old male with only dyspnoea
calculate_esc_2019_ptp(
    age = 75,
    sex = "male",
    have_dyspnoea = "yes",
    chest_pain_type = "no chest pain",
    output = "percentage"
)
```

`calculate_esc_2024_fig_4_ptp`

Calculate ESC 2024 PTP for obstructive CAD

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on the European Society of Cardiology (ESC) 2024 guidelines. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_esc_2024_fig_4_ptp(
  age,
  sex,
  chest_pain_type,
  have_dyspnoea,
  have_family_history,
  have_smoking_history,
  have_dyslipidemia,
  have_hypertension,
  have_diabetes,
  allow_na_symptom_score = TRUE,
  max_na_num_of_rf = 0,
```

```
  output = c("grouping", "numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN)
)
```

Arguments

age	Input integer value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters label_cpt_no_chest_pain, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical, and label_cpt_unknown.
have_dyspnoea	The value of variable in the parameters label_have_dyspnoea_no, label_have_dyspnoea_yes and label_have_dyspnoea_unknown.
have_family_history	The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no,

label_have_smoking_history_yes,
and label_have_smoking_history_unknown.

have_dyslipidemia
: The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.

have_hypertension
: The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_diabetes
: The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

allow_na_symptom_score
: A logical evaluating to TRUE or FALSE indicating whether we can allow chest_pain_type or have_dyspnoea to be NA when calculating the score.

max_na_num_of_rf
: Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

output
: Input text to indicate the how pre-test probability results be expressed Default: c("grouping", "numeric", "percentage")
  - grouping means the PTP will be expressed as Very Low, Low, and Moderate.
    - very low if PTP is less than or equal to 5%.
    - low if PTP is in between 6% to 15%.
    - moderate if PTP is more than 15%.
  - numeric means the PTP will be expressed as an integer probability (0-100).
  - percentage means the PTP will be expressed as percentage text (0-100%).

label_sex_male
: Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
: Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
: Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_have_dyspnoea_no
: Label(s) for patient having no dyspnoea symptoms. Default: c("no")

label_have_dyspnoea_yes
: Label(s) for patient having dyspnoea symptoms. Default: c("yes")

label_have_dyspnoea_unknown
: Label(s) for patient having unknown dyspnoea symptoms. Default: c(NA, NaN)

label_cpt_no_chest_pain
: Label(s) for patient having no chest pain. Default: c("no chest pain")

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: c("atypical")

`label_cpt_typical`
: Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_cpt_unknown`
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

`label_have_family_history_no`
: Label(s) for patient with no family history of CAD. Default: `c("no")`

`label_have_family_history_yes`
: Label(s) for patient having family history of CAD. Default: `c("yes")`

`label_have_family_history_unknown`
: Label(s) for patient having unknown family history of CAD. Default: `c(NA, NaN)`

`label_have_smoking_history_no`
: Label(s) for patient with no smoking history (current or past). Default: `c("no")`

`label_have_smoking_history_yes`
: Label(s) for patient having smoking history (current or past). Default: `c("yes")`

`label_have_smoking_history_unknown`
: Label(s) for patient having unknown smoking history (current or past). Default: `c(NA, NaN)`

`label_have_dyslipidemia_no`
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

`label_have_dyslipidemia_yes`
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

`label_have_dyslipidemia_unknown`
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

`label_have_hypertension_no`
: Label(s) for patient with no hypertension. Default: `c("no")`

`label_have_hypertension_yes`
: Label(s) for patient having hypertension. Default: `c("yes")`

`label_have_hypertension_unknown`
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

`label_have_diabetes_no`
: Label(s) for patient with no diabetes. Default: `c("no")`

`label_have_diabetes_yes`
: Label(s) for patient having diabetes. Default: `c("yes")`

`label_have_diabetes_unknown`
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

Value

An integer, percentage or category representing the patient's PTP for obstructive CAD based on the ESC 2024 guidelines. See parameter option `output` for more information.

Examples

```
# 30 female with symptom score of 0 and 0 risk factors
calculate_esc_2024_fig_4_ptp(
  age = 30,
  sex = "female",
  chest_pain_type = "no chest pain",
  have_dyspnoea = "no",
  have_family_history = "no",
  have_smoking_history = "no",
  have_dyslipidemia = "no",
  have_hypertension = "no",
  have_diabetes = "no",
  allow_na_symptom_score = TRUE,
  max_na_num_of_rf = 0,
  output = "percentage"
)
```

---

calculate_esc_2024_fig_4_ptp_simplfied

Calculate ESC 2024 PTP for obstructive CAD

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on the European Society of Cardiology (ESC) 2024 guidelines.

Usage

```
calculate_esc_2024_fig_4_ptp_simplfied(
  age,
  sex,
  symptom_score,
  num_of_rf,
  output = c("grouping", "numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

age	Input integer value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
symptom_score	An integer indicating the symptom score of the patient. This value can be calculated via the calculate_esc_2024_symptom_score

`num_of_rf` An integer indicating the number of risk factors the patient has. This value can be calculated via the `calculate_esc_2024_num_of_rf` Risk factors are:

- having a family history of CAD.
- having a smoking history (current and past smoker).
- having dyslipidemia.
- having hypertension.
- having diabetes.

`output` Input text to indicate the how pre-test probability results be expressed Default: c("grouping", "numeric", "percentage")

- grouping means the PTP will be expressed as Very Low, Low, and Moderate.
  - very low if PTP is less than or equal to 5%.
  - low if PTP is in between 6% to 15%.
  - moderate if PTP is more than 15%.
- numeric means the PTP will be expressed as an integer probability (0-100).
- percentage means the PTP will be expressed as percentage text (0-100%).

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female` Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown` Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`error_call` The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

An integer, percentage or category representing the patient's PTP for obstructive CAD based on the ESC 2024 guidelines. See parameter option `output` for more information.

Examples

```
# 30 female with symptom score of 0 and 0 risk factors
calculate_esc_2024_fig_4_ptp_simplfied(
  age = 30,
  sex = "female",
  symptom_score = 0,
  num_of_rf = 0,
  output = "percentage"
)
```

`calculate_esc_2024_num_of_rf` *Calculate Number Of Risk Factors (ESC 2024)*

Description

A function used to calculate the number of risk factors the patient has. This is used to calculate the pretest probability of coronary artery disease (CAD) based on the ESC 2024 guidelines.

Usage

```
calculate_esc_2024_num_of_rf(
  have_family_history,
  have_smoking_history,
  have_dyslipidemia,
  have_hypertension,
  have_diabetes,
  max_na = 0,
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`have_family_history`
: The value of variable in the parameters `label_have_family_history_no`, `label_have_family_history_yes` and `label_have_family_history_unknown`.

`have_smoking_history`
: The value of variable in the parameters `label_have_smoking_history_no`, `label_have_smoking_history_yes`, and `label_have_smoking_history_unknown`.

have_dyslipidemia
: The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.

have_hypertension
: The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_diabetes
: The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

max_na
: Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

label_have_family_history_no
: Label(s) for patient with no family history of CAD. Default: c("no")

label_have_family_history_yes
: Label(s) for patient having family history of CAD. Default: c("yes")

label_have_family_history_unknown
: Label(s) for patient having unknown family history of CAD. Default: c(NA, NaN)

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: c("no")

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: c("yes")

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: c(NA, NaN)

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: c("no")

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: c("yes")

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: c(NA, NaN)

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

error_call
: The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

An integer indicating the number of risk factors the patient has. It can also be NA if the number of missing risk factors exceeds the max_na input value.

Examples

```
calculate_esc_2024_num_of_rf(
  have_family_history = "yes",
  have_smoking_history = "yes",
  have_dyslipidemia = "yes",
  have_hypertension = "yes",
  have_diabetes = "no"
)

calculate_esc_2024_num_of_rf(
  have_family_history = "no",
  have_smoking_history = "no",
  have_dyslipidemia = "no",
  have_hypertension = NA,
  have_diabetes = "no",
  max_na = 0
)

calculate_esc_2024_num_of_rf(
  have_family_history = "no",
  have_smoking_history = "no",
  have_dyslipidemia = "no",
  have_hypertension = NA,
  have_diabetes = "no",
  max_na = 1
)
```

---

calculate_esc_2024_symptom_score

Calculate Symptom Score (ESC 2024)

Description

A function used to calculate the symptom score of the patient. This is used to calculate the pretest probability of coronary artery disease (CAD) based on the ESC 2024 guidelines.

Usage

```
calculate_esc_2024_symptom_score(
  chest_pain_type,
  have_dyspnoea,
  allow_na = TRUE,
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
```

```
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`chest_pain_type`
: The value of variable in the parameters `label_cpt_no_chest_pain`, `label_cpt_nonanginal`, `label_cpt_atypical`, `label_cpt_typical`, and `label_cpt_unknown`.

`have_dyspnoea`
: The value of variable in the parameters `label_have_dyspnoea_no`, `label_have_dyspnoea_yes` and `label_have_dyspnoea_unknown`.

`allow_na`
: A logical evaluating to `TRUE` or `FALSE` indicating whether we can allow `chest_pain_type` or `have_dyspnoea` to be `NA` when calculating the score. Default: `TRUE`

`label_have_dyspnoea_no`
: Label(s) for patient having no dyspnoea symptoms. Default: `c("no")`

`label_have_dyspnoea_yes`
: Label(s) for patient having dyspnoea symptoms. Default: `c("yes")`

`label_have_dyspnoea_unknown`
: Label(s) for patient having unknown dyspnoea symptoms. Default: `c(NA, NaN)`

`label_cpt_no_chest_pain`
: Label(s) for patient having no chest pain. Default: `c("no chest pain")`

`label_cpt_nonanginal`
: Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

`label_cpt_atypical`
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

`label_cpt_typical`
: Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_cpt_unknown`
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

`error_call`
: The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

An integer indicating the symptom score of the patient. It can also be NA if both chest_pain_type and have_dyspnoea are NA. Patients with both nonanginal chest pain and dyspnoea will be given a score of 2

Examples

```
calculate_esc_2024_symptom_score(
  chest_pain_type = "nonanginal",
  have_dyspnoea = "yes",
  allow_na = TRUE
)

calculate_esc_2024_symptom_score(
  chest_pain_type = "nonanginal",
  have_dyspnoea = NA,
  allow_na = FALSE
)

calculate_esc_2024_symptom_score(
  chest_pain_type = "nonanginal",
  have_dyspnoea = NA,
  allow_na = TRUE
)
```

---

calculate_lah_2022_clinical_ptp

Calculate 2022 LAH Clinical PTP for obstructive CAD

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2022 Local Assessment of the Heart (LAH) clinical model. Obstructive CAD was defined as a stenosis causing $\geq 50\%$ diameter stenosis on coronary CTA.

Usage

```
calculate_lah_2022_clinical_ptp(
  age,
  sex,
  chest_pain_type,
  have_diabetes,
  have_hypertension,
  have_dyslipidemia,
  have_smoking_history,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
```

```
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)
label_cpt_nonanginal	Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

`label_cpt_atypical`
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

`label_cpt_typical`
: Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_cpt_unknown`
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

`label_have_diabetes_no`
: Label(s) for patient with no diabetes. Default: `c("no")`

`label_have_diabetes_yes`
: Label(s) for patient having diabetes. Default: `c("yes")`

`label_have_diabetes_unknown`
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

`label_have_hypertension_no`
: Label(s) for patient with no hypertension. Default: `c("no")`

`label_have_hypertension_yes`
: Label(s) for patient having hypertension. Default: `c("yes")`

`label_have_hypertension_unknown`
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

`label_have_dyslipidemia_no`
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

`label_have_dyslipidemia_yes`
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

`label_have_dyslipidemia_unknown`
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

`label_have_smoking_history_no`
: Label(s) for patient with no smoking history (current or past). Default: `c("no")`

`label_have_smoking_history_yes`
: Label(s) for patient having smoking history (current or past). Default: `c("yes")`

`label_have_smoking_history_unknown`
: Label(s) for patient having unknown smoking history (current or past). Default: `c(NA, NaN)`

Details

The predictive model is based on patients from a mixed Asian cohort within Singapore with stable chest pain.

Model formula used is from Table 2.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
&-6.268 \quad + \\
&(0.067 * age) \quad + \\
&(1.518 * sex_is_male) \quad + \\
&(0.164 * have_typical_chest_pain) \quad + \\
&(-0.090 * have_atypical_chest_pain) \quad + \\
&(0.457 * have_hypertension) \quad + \\
&(0.417 * have_diabetes) \quad + \\
&(0.370 * have_dyslipidemia) \quad + \\
&(-0.364 * have_smoking_history)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2022 Local Assessment of the Heart (LAH) clinical model.

Examples

```
# 40 year old female with typical chest pain,
# diabetes but no hypertension, dyslipidemia
# and a non-smoker
calculate_lah_2022_clinical_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_diabetes = "yes",
    have_hypertension = "no",
    have_dyslipidemia = "no",
    have_smoking_history = "no"

)
```

`calculate_lah_2022_extended_ptp` *Calculate 2022 LAH Extended PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2022 Local Assessment of the Heart (LAH) extended model. Obstructive CAD was defined as a stenosis causing $\geq 50\%$ diameter stenosis on coronary CTA.

Usage

```
calculate_lah_2022_extended_ptp(
  age,
  sex,
  chest_pain_type,
  have_diabetes,
  have_hypertension,
  have_dyslipidemia,
  have_smoking_history,
  coronary_calcium_score,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.

have_smoking_history
: The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.

coronary_calcium_score
: Input non-negative numeric to indicate the total coronary calcium score of the patient.

label_sex_male
: Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
: Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
: Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: c("atypical")

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: c("no")

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: c("yes")

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: c(NA, NaN)

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: c("no")

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: c("yes")

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: c(NA, NaN)

Details

The predictive model is based on patients a mixed Asian cohort within Singapore with stable chest pain.

Model formula used is from Table 2.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-4.241 \quad + \\
&(0 * age) \quad + \\
&(0.544 * sex_is_male) \quad + \\
&(0.139 * have_typical_chest_pain) \quad + \\
&(-0.242 * have_atypical_chest_pain) \quad + \\
&(-0.143 * have_hypertension) \quad + \\
&(-0.002 * have_diabetes) \quad + \\
&(-0.157 * have_dyslipidemia) \quad + \\
&(-0.315 * have_smoking_history) \quad + \\
&(0.905 * ln(CACS + 1))
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2022 Local Assessment of the Heart (LAH) extended model.

Examples

```
# 40 year old female with typical chest pain,
# diabetes but no hypertension, dyslipidemia,
# a non-smoker and a coronary calcium score of 0
calculate_lah_2022_extended_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_diabetes = "yes",
    have_hypertension = "no",
    have_dyslipidemia = "no",
    have_smoking_history = "no",
    coronary_calcium_score = 0

)
```

`calculate_miller_2023_lm_50_non_lm_70_cad_ptp`
Calculate 2023 Miller PTP for obstructive CAD (stenosis $\geq$ 50% in left main vessel or $\geq$ 70% in non-left main vessel)

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on 2023 Miller et. al. likelihood table likelihood table for CAD (stenosis $\geq$ 50% in left main vessel or $\geq$ 70% in non-left main vessel).

Usage

```
calculate_miller_2023_lm_50_non_lm_70_cad_ptp(
  age,
  sex,
  have_chest_pain,
  coronary_calcium_score,
  output = c("grouping", "numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_chest_pain_no = c("no"),
  label_have_chest_pain_yes = c("yes"),
  label_have_chest_pain_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`age`	Input integer value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`have_chest_pain`	The value of variable in the parameters `label_have_chest_pain_no`, `label_have_chest_pain_yes`, and `label_have_chest_pain_unknown`.
`coronary_calcium_score`	Input non-negative numeric to indicate the total coronary calcium score of the patient.
`output`	Input text to indicate the how pre-test probability results be expressed Default: c("grouping", "numeric", "percentage")

- grouping means the PTP will be expressed as Low, Intermediate and High.
  - low if PTP is less than 15%.
  - intermediate if PTP is in between 15% to 50%.

  - high if PTP is more than 50%.
- numeric means the PTP will be expressed as an integer probability (0-100).
- percentage means the PTP will be expressed as percentage text (0-100%).

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
: Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_have_chest_pain_no`
: Label(s) for patient not having chest pain symptoms. Default: `c("no")`

`label_have_chest_pain_yes`
: Label(s) for patient having chest pain symptoms. Default: `c("yes")`

`label_have_chest_pain_unknown`
: Label(s) for patient with unknown chest pain symptoms. Default: `c(NA, NaN)`

`error_call` The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Details

The predictive model is based on 2055 patients from 3 multinational sites. They are Henry Ford Hospital (n=853), Ottawa Heart Institute (n=808), and University Hospital Zurich (n=394).

Value

An integer, percentage or category representing the patient's PTP for obstructive CAD based on 2023 Miller et. al. likelihood table for CAD defined as stenosis $\geq$ 50% in left main vessel or $\geq$ 70% in non-left main vessel. See parameter option `output` for more information.

Examples

```
# 40 female with cardiac chest pain and coronary calcium score of 0
calculate_miller_2023_lm_50_non_lm_70_cad_ptp(
  age = 40,
  sex = "female",
  have_chest_pain = "yes",
  coronary_calcium_score = 0,
  output = "percentage"
)
```

`calculate_miller_2023_vessel_50_cad_ptp`
Calculate 2023 Miller PTP for obstructive CAD (stenosis ≥ 50% in any vessel)

Description

This function returns a patient's pre-test Probability (PTP) of obstructive coronary artery disease (CAD) based on 2023 Miller et. al. likelihood table for CAD (stenosis ≥ 50% in any vessel).

Usage

```
calculate_miller_2023_vessel_50_cad_ptp(
  age,
  sex,
  have_chest_pain,
  coronary_calcium_score,
  output = c("grouping", "numeric", "percentage"),
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_chest_pain_no = c("no"),
  label_have_chest_pain_yes = c("yes"),
  label_have_chest_pain_unknown = c(NA, NaN),
  error_call = rlang::caller_env()
)
```

Arguments

`age`	Input integer value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`have_chest_pain`	The value of variable in the parameters `label_have_chest_pain_no`, `label_have_chest_pain_yes`, and `label_have_chest_pain_unknown`.
`coronary_calcium_score`	Input non-negative numeric to indicate the total coronary calcium score of the patient.
`output`	Input text to indicate the how pre-test probability results be expressed Default: c("grouping", "numeric", "percentage")

- grouping means the PTP will be expressed as Low, Intermediate and High.
  - low if PTP is less than 15%.
  - intermediate if PTP is in between 15% to 50%.
  - high if PTP is more than 50%.

- numeric means the PTP will be expressed as an integer probability (0-100).
- percentage means the PTP will be expressed as percentage text (0-100%).

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_have_chest_pain_no`
Label(s) for patient not having chest pain symptoms. Default: `c("no")`

`label_have_chest_pain_yes`
Label(s) for patient having chest pain symptoms. Default: `c("yes")`

`label_have_chest_pain_unknown`
Label(s) for patient with unknown chest pain symptoms. Default: `c(NA, NaN)`

`error_call` The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Details

The predictive model is based on 2055 patients from 3 multinational sites. They are Henry Ford Hospital (n=853), Ottawa Heart Institute (n=808), and University Hospital Zurich (n=394).

Value

An integer, percentage or category representing the patient's PTP for obstructive CAD based on 2023 Miller et. al. likelihood table for CAD defined as stenosis $\geq$ 50% in any vessel. See parameter option `output` for more information.

Examples

```
# 40 female with cardiac chest pain and coronary calcium score of 0
calculate_miller_2023_vessel_50_cad_ptp(
  age = 40,
  sex = "female",
  have_chest_pain = "yes",
  coronary_calcium_score = 0,
  output = "percentage"
)
```

`calculate_precise_2021_clinical_ptp`
Calculate 2021 PRECISE Clinical PTP for obstructive CAD

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2021 Predictive Risk scorE for CAD In Southeast Asians with chEst pain (PRECISE) clinical model. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_precise_2021_clinical_ptp(
  age,
  sex,
  chest_pain_type,
  have_neck_radiation,
  have_diabetes,
  have_hypertension,
  smoking_history_type,
  have_q_waves,
  have_st_t_changes,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_neck_radiation_no = c("no"),
  label_have_neck_radiation_yes = c("yes"),
  label_have_neck_radiation_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_smoking_history_type_current = c("current"),
  label_smoking_history_type_past = c("past"),
  label_smoking_history_type_none = c("none"),
  label_smoking_history_type_unknown = c(NA, NaN),
  label_have_q_waves_no = c("no"),
  label_have_q_waves_yes = c("yes"),
  label_have_q_waves_unknown = c(NA, NaN),
  label_have_st_t_changes_no = c("no"),
  label_have_st_t_changes_yes = c("yes"),
  label_have_st_t_changes_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.
have_neck_radiation	The value of variable in the parameters label_have_neck_radiation_no, label_have_neck_radiation_yes, and label_have_neck_radiation_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
smoking_history_type	The value of variable in the parameters label_smoking_history_type_current, label_smoking_history_type_past, label_smoking_history_type_none and label_smoking_history_type_unknown
have_q_waves	The value of variable in the parameters label_have_q_waves_no, label_have_q_waves_yes, and label_have_q_waves_unknown.
have_st_t_changes	The value of variable in the parameters label_have_st_t_changes_no, label_have_st_t_changes_yes, and label_have_st_t_changes_unknown.
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)
label_cpt_nonanginal	Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")
label_cpt_atypical	Label(s) for patient having atypical chest pain. Default: c("atypical")
label_cpt_typical	Label(s) for patient having typical chest pain. Default: c("typical")
label_cpt_unknown	Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_neck_radiation_no
: Label(s) for patient without chest pain radiating to the neck. Default: `c("no")`

label_have_neck_radiation_yes
: Label(s) for patient with chest pain radiating to the neck. Default: `c("yes")`

label_have_neck_radiation_unknown
: Label(s) for patient with unknown chest pain radiating to the neck Default: `c(NA, NaN)`

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: `c("no")`

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: `c("yes")`

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: `c("no")`

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: `c("yes")`

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

label_smoking_history_type_current
: Label(s) for patient who is a current smoker. Default: `c("current")`

label_smoking_history_type_past
: Label(s) for patient who is a past smoker. Default: `c("past")`

label_smoking_history_type_none
: Label(s) for patient who is a non-smoker. Default: `c("none")`

label_smoking_history_type_unknown
: Label(s) for patient with unknown smoking history. Default: `c(NA, NaN)`

label_have_q_waves_no
: Label(s) for patient not having Q waves on ECG. Default: `c("no")`

label_have_q_waves_yes
: Label(s) for patient having Q waves on ECG. Default: `c("yes")`

label_have_q_waves_unknown
: Label(s) for patient with unknown Q waves on ECG. Default: `c(NA, NaN)`

label_have_st_t_changes_no
: Label(s) for patient not having ST-T changes on ECG. Default: `c("no")`

label_have_st_t_changes_yes
: Label(s) for patient having ST-T changes on ECG. Default: `c("yes")`

label_have_st_t_changes_unknown
: Label(s) for patient with unknown ST-T changes on ECG. Default: `c(NA, NaN)`

Details

The predictive model is based on patients a mixed Asian cohort within Singapore with stable chest pain.

An online calculator is accessible at https://webapps.duke-nus.edu.sg/tools/PRECISE.

Model formula is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-6.714 \quad + \\
&(0.033 * age) \quad + \\
&(1.75 * sex_is_male) \quad + \\
&(0.597 * have_diabetes) \quad + \\
&(0.497 * have_hypertension) \quad + \\
&(0.733 * is_current_smoker) \quad + \\
&(0.07 * is_past_smoker) \quad + \\
&(1.374 * have_typical_chest_pain) \quad + \\
&(0.875 * have_atypical_chest_pain) \quad + \\
&(1.157 * pain_radiating_to_neck) \quad + \\
&(1.020 * have_Q_waves) \quad + \\
&(0.552 * have_ST - T_changes)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2021 Predictive Risk scorE for CAD In Southeast Asians with chEst pain (PRECISE) clinical model.

Examples

```
# 40 year old female with typical chest pain
# radiating to the neck, has diabetes
# but no hypertension and a non-smoker.
# She has Q waves but no ST-T changes on ECG.

calculate_precise_2021_clinical_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_neck_radiation = "yes",
    have_diabetes = "yes",
    have_hypertension = "no",
    smoking_history_type = "none",
    have_q_waves = "yes",
    have_st_t_changes = "no"
```

```
)
```

`calculate_precise_2021_simple_ptp` *Calculate 2021 PRECISE Simple PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2021 Predictive Risk scorE for CAD In Southeast Asians with chEst pain (PRECISE) simple model. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_precise_2021_simple_ptp(
  age,
  sex,
  chest_pain_type,
  have_neck_radiation,
  have_diabetes,
  have_hypertension,
  smoking_history_type,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_neck_radiation_no = c("no"),
  label_have_neck_radiation_yes = c("yes"),
  label_have_neck_radiation_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_smoking_history_type_current = c("current"),
  label_smoking_history_type_past = c("past"),
  label_smoking_history_type_none = c("none"),
  label_smoking_history_type_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical and label_cpt_unknown.
have_neck_radiation	The value of variable in the parameters label_have_neck_radiation_no, label_have_neck_radiation_yes, and label_have_neck_radiation_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
smoking_history_type	The value of variable in the parameters label_smoking_history_type_current, label_smoking_history_type_past, label_smoking_history_type_none and label_smoking_history_type_unknown
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)
label_cpt_nonanginal	Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")
label_cpt_atypical	Label(s) for patient having atypical chest pain. Default: c("atypical")
label_cpt_typical	Label(s) for patient having typical chest pain. Default: c("typical")
label_cpt_unknown	Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)
label_have_neck_radiation_no	Label(s) for patient without chest pain radiating to the neck. Default: c("no")
label_have_neck_radiation_yes	Label(s) for patient with chest pain radiating to the neck. Default: c("yes")
label_have_neck_radiation_unknown	Label(s) for patient with unknown chest pain radiating to the neck Default: c(NA, NaN)

`label_have_diabetes_no`
: Label(s) for patient with no diabetes. Default: `c("no")`

`label_have_diabetes_yes`
: Label(s) for patient having diabetes. Default: `c("yes")`

`label_have_diabetes_unknown`
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

`label_have_hypertension_no`
: Label(s) for patient with no hypertension. Default: `c("no")`

`label_have_hypertension_yes`
: Label(s) for patient having hypertension. Default: `c("yes")`

`label_have_hypertension_unknown`
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

`label_smoking_history_type_current`
: Label(s) for patient who is a current smoker. Default: `c("current")`

`label_smoking_history_type_past`
: Label(s) for patient who is a past smoker. Default: `c("past")`

`label_smoking_history_type_none`
: Label(s) for patient who is a non-smoker. Default: `c("none")`

`label_smoking_history_type_unknown`
: Label(s) for patient with unknown smoking history. Default: `c(NA, NaN)`

Details

The predictive model is based on patients a mixed Asian cohort within Singapore with stable chest pain.

An online calculator is accessible at https://webapps.duke-nus.edu.sg/tools/PRECISE.

Model formula is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
&-6.632 \quad + \\
&(0.035 * age) \quad + \\
&(1.694 * sex_is_male) \quad + \\
&(0.613 * have_diabetes) \quad + \\
&(0.542 * have_hypertension) \quad + \\
&(0.791 * is_current_smoker) \quad + \\
&(0.063 * is_past_smoker) \quad + \\
&(1.395 * have_typical_chest_pain) \quad + \\
&(0.877 * have_atypical_chest_pain) \quad + \\
&(1.143 * pain_radiating_to_neck)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2021 Predictive Risk scorE for CAD In Southeast Asians with chEst pain (PRECISE) simple model.

Examples

```
# 40 year old female with typical chest pain
# radiating to the neck, has diabetes
# but no hypertension and a non-smoker

calculate_precise_2021_simple_ptp(
    age = 40,
    sex = "female",
    chest_pain_type = "typical",
    have_neck_radiation = "yes",
    have_diabetes = "yes",
    have_hypertension = "no",
    smoking_history_type = "none"

)
```

`calculate_prms_2017_ptp` *Calculate 2017 PROMISE Minimal-Risk Score for obstructive CAD*

Description

This function returns a symptomatic (have chest pain or dyspnoea) patient's minimal risk score for obstructive coronary artery disease (CAD) based on the 2017 PROMISE Minimal-Risk Score. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_prms_2017_ptp(
  age,
  sex,
  hdl_mg_dl,
  is_minority_ethnicity,
  have_diabetes,
  have_hypertension,
  have_dyslipidemia,
  have_smoking_history,
  have_family_history,
  have_stress_symptoms = NA,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_is_minority_ethnicity_no = c("no"),
  label_is_minority_ethnicity_yes = c("yes"),
  label_is_minority_ethnicity_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_have_stress_symptoms_no = c("no"),
  label_have_stress_symptoms_yes = c("yes"),
  label_have_stress_symptoms_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.

sex The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.

hdl_mg_dl Input positive numeric value to indicate the patient's high-density lipoprotein (HDL) in mg/dL.

is_minority_ethnicity
The value of variable in the parameters label_is_minority_ethnicity_no, label_is_minority_ethnicity_yes, and label_is_minority_ethnicity_unknown.

have_diabetes The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

have_hypertension
The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_dyslipidemia
The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.

have_smoking_history
The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.

have_family_history
The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.

have_stress_symptoms
The value of variable in the parameters label_have_stress_symptoms_no, label_have_stress_symptoms_yes, and label_have_stress_symptoms_unknown. Default: NA

label_sex_male Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_is_minority_ethnicity_no
Label(s) for patient not from a racial or minority ethnicity (or patient is a non-Hispanic/Latino White). Default: c("no")

label_is_minority_ethnicity_yes
Label(s) for patient from a racial or minority ethnicity (or patient is not a non-Hispanic/Latino White). E.g. Blacks, Asians, etc. Default: c("yes")

label_is_minority_ethnicity_unknown
Label(s) for patient from an unknown ethnicity Default: c(NA, NaN)

label_have_diabetes_no
Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: `c("no")`

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: `c("yes")`

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: `c("no")`

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: `c("yes")`

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: `c(NA, NaN)`

label_have_family_history_no
: Label(s) for patient with no family history of CAD. Default: `c("no")`

label_have_family_history_yes
: Label(s) for patient having family history of CAD. Default: `c("yes")`

label_have_family_history_unknown
: Label(s) for patient having unknown family history of CAD. Default: `c(NA, NaN)`

label_have_stress_symptoms_no
: Label(s) for patient with no symptoms (negative results) related to physical or mental stress. Default: `c("no")`

label_have_stress_symptoms_yes
: Label(s) for patient with symptoms (positive results) related to physical or mental stress. Default: `c("yes")`

label_have_stress_symptoms_unknown
: Label(s) for patient with inconclusive results or patient has not taken any stress test Default: `c(NA, NaN)`

Details

The predictive model is based on CCTA images from 4632 patients in the Prospective Multicenter imaging Study for Evaluation of Chest Pain (PROMISE) trial.

Model formula used is from Table 3.

It is of the form

$$\frac{1}{(1+e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
&-1.783 \quad + \\
&(0.084 * age) \quad + \\
&(-1.026 * sex_is_female) \quad + \\
&(-0.142 * is_minority_ethnicity) \quad + \\
&(-0.526 * is_non_smoker) \quad + \\
&(-0.314 * have_no_diabetes) \quad + \\
&(-0.412 * have_no_dyslipidemia) \quad + \\
&(-0.309 * have_no_family_history) \quad + \\
&(-0.408 * have_no_hypertension) \quad + \\
&(-0.309 * have_no_stress_symptoms) \quad + \\
&(-0.195 * have_unknown_stress_symptoms) \quad + \\
&(-0.006 * hdl_mg_dl)
\end{aligned}
$$

Value

A numeric value representing the patient's minimal risk score for obstructive CAD based on the 2017 PROMISE Minimal-Risk Score.

Examples

```
# 50 year old white female with chest pain
# a medical history of hypertension, and a
# high-density lipoprotein cholesterol level of 70 mg/dL
calculate_prms_2017_ptp(
    age = 50,
    sex = "female",
    hdl_mg_dl = 70,
    is_minority_ethnicity = "no",
    have_diabetes = "no",
    have_hypertension = "yes",
    have_dyslipidemia = "no",
    have_smoking_history = "no",
    have_family_history = "no",
    have_stress_symptoms = "no"
)

# 40 year old non-white male with chest pain
# a medical history of diabetes, unknown stress symptoms and a
```

```
# high-density lipoprotein cholesterol level of 70 mg/dL
calculate_prms_2017_ptp(
    age = 40,
    sex = "male",
    hdl_mg_dl = 70,
    is_minority_ethnicity = "yes",
    have_diabetes = "yes",
    have_hypertension = "no",
    have_dyslipidemia = "no",
    have_smoking_history = "no",
    have_family_history = "no",
    have_stress_symptoms = NA
)
```

`calculate_rasmussen_2025_cacs_cl_ccta_ptp` *Calculate 2025 Rasmussen $CACS-CL_CCTA$ PTP model for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease based on 2025 Rasmussen et. al. Coronary Artery Calcium Score-Weighted Clinical Likelihood CCTA ($RF-CL_{CCTA}$) model. Obstructive CAD was defined as a stenosis causing $\geq 50\%$ diameter stenosis on coronary CTA.

Usage

```
calculate_rasmussen_2025_cacs_cl_ccta_ptp(
  age,
  sex,
  chest_pain_type,
  have_dyspnoea,
  have_family_history,
  have_smoking_history,
  have_dyslipidemia,
  have_hypertension,
  have_diabetes,
  coronary_calcium_score,
  allow_na_symptom_score = TRUE,
  max_na_num_of_rf = 0,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
```

```
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters label_cpt_no_chest_pain, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical, and label_cpt_unknown.
have_dyspnoea	The value of variable in the parameters label_have_dyspnoea_no, label_have_dyspnoea_yes and label_have_dyspnoea_unknown.
have_family_history	The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.

have_diabetes The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

coronary_calcium_score
Input non-negative numeric to indicate the total coronary calcium score of the patient.

allow_na_symptom_score
A logical evaluating to TRUE or FALSE
indicating whether we can allow chest_pain_type
or have_dyspnoea to be NA when calculating the score.

max_na_num_of_rf
Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

label_sex_male Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_have_dyspnoea_no
Label(s) for patient having no dyspnoea symptoms. Default: c("no")

label_have_dyspnoea_yes
Label(s) for patient having dyspnoea symptoms. Default: c("yes")

label_have_dyspnoea_unknown
Label(s) for patient having unknown dyspnoea symptoms. Default: c(NA, NaN)

label_cpt_no_chest_pain
Label(s) for patient having no chest pain. Default: c("no chest pain")

label_cpt_nonanginal
Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

label_cpt_atypical
Label(s) for patient having atypical chest pain. Default: c("atypical")

label_cpt_typical
Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_family_history_no
Label(s) for patient with no family history of CAD. Default: c("no")

label_have_family_history_yes
Label(s) for patient having family history of CAD. Default: c("yes")

label_have_family_history_unknown
Label(s) for patient having unknown family history of CAD. Default: c(NA, NaN)

label_have_smoking_history_no
Label(s) for patient with no smoking history (current or past). Default: c("no")

`label_have_smoking_history_yes`
: Label(s) for patient having smoking history (current or past). Default: `c("yes")`

`label_have_smoking_history_unknown`
: Label(s) for patient having unknown smoking history (current or past). Default: `c(NA, NaN)`

`label_have_dyslipidemia_no`
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

`label_have_dyslipidemia_yes`
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

`label_have_dyslipidemia_unknown`
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

`label_have_hypertension_no`
: Label(s) for patient with no hypertension. Default: `c("no")`

`label_have_hypertension_yes`
: Label(s) for patient having hypertension. Default: `c("yes")`

`label_have_hypertension_unknown`
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

`label_have_diabetes_no`
: Label(s) for patient with no diabetes. Default: `c("no")`

`label_have_diabetes_yes`
: Label(s) for patient having diabetes. Default: `c("yes")`

`label_have_diabetes_unknown`
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2025 Rasmussen et. al. Coronary Artery Calcium Score-Weighted Clinical Likelihood CCTA ($RF - CL_{CCTA}$) model.

Model formula used is from Development Table 2.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
& 0.014533 \quad + \\
& (0.27093 * rf_ptp) \quad + \\
& (0.047056 * cacs_1_to_9) \quad + \\
& (0.11890 * cacs_10_to_99) \quad + \\
& (0.34417 * cacs_100_to_399) \quad + \\
& (0.5881 * cacs_400_to_999) \quad + \\
& (0.73892 * cacs_1000_or_more) \quad + \\
& (0.054423 * rf_ptp * cacs_1_to_9) \quad + \\
& (0.14347 * rf_ptp * cacs_10_to_99) \quad + \\
& (0.18439 * rf_ptp * cacs_100_to_399) \quad + \\
& (0.085774 * rf_ptp * cacs_400_to_999) \quad + \\
& (-0.081776 * rf_ptp * cacs_1000_or_more)
\end{aligned}
$$

Examples

```
# 40 year old Male with nonanginal chest pain and coronary calcium score of 0
calculate_rasmussen_2025_cacs_cl_ccta_ptp(
    age = 40,
    sex = "male",
    chest_pain_type = "no chest pain",
    have_dyspnoea = "no",
    have_family_history = "no",
    have_smoking_history = "no",
    have_dyslipidemia = "no",
    have_hypertension = "no",
    have_diabetes = "no",
    coronary_calcium_score = 0,
    allow_na_symptom_score = TRUE,
    max_na_num_of_rf = 0
)
```

`calculate_rasmussen_2025_rf_cl_ccta_ptp`

Calculate 2025 Rasmussen $RF-CL_CCTA$ PTP model for obstructive CAD

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2025 Rasmussen et. al. Risk Factor-Weighted Clinical Likelihood CCTA ($RF - CL_{CCTA}$) model. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_rasmussen_2025_rf_cl_ccta_ptp(
  age,
  sex,
  chest_pain_type,
  have_dyspnoea,
  have_family_history,
  have_smoking_history,
  have_dyslipidemia,
  have_hypertension,
  have_diabetes,
  allow_na_symptom_score = TRUE,
  max_na_num_of_rf = 0,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters label_cpt_no_chest_pain, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical, and label_cpt_unknown.
have_dyspnoea	The value of variable in the parameters label_have_dyspnoea_no, label_have_dyspnoea_yes and label_have_dyspnoea_unknown.
have_family_history	The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
allow_na_symptom_score	A logical evaluating to TRUE or FALSE indicating whether we can allow chest_pain_type or have_dyspnoea to be NA when calculating the score.
max_na_num_of_rf	Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)
label_have_dyspnoea_no	Label(s) for patient having no dyspnoea symptoms. Default: c("no")
label_have_dyspnoea_yes	Label(s) for patient having dyspnoea symptoms. Default: c("yes")

label_have_dyspnoea_unknown
: Label(s) for patient having unknown dyspnoea symptoms. Default: c(NA, NaN)

label_cpt_no_chest_pain
: Label(s) for patient having no chest pain. Default: c("no chest pain")

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: c("atypical")

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_family_history_no
: Label(s) for patient with no family history of CAD. Default: c("no")

label_have_family_history_yes
: Label(s) for patient having family history of CAD. Default: c("yes")

label_have_family_history_unknown
: Label(s) for patient having unknown family history of CAD. Default: c(NA, NaN)

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: c("no")

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: c("yes")

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: c(NA, NaN)

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: c("no")

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: c("yes")

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: c(NA, NaN)

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

Details

The predictive model is based on 38,269 symptomatic patients with CACS and interpretable CCTA from 2008 to 2017 across 13 hospitals in Western Denmark. These patients are registered under the Western Denmark Heart Registry. It is then further calibrated against observed obstructive CAD at CCTA and corresponding prevalence of diagnosed obstructive CAD at Invasive Coronary Angiography.

Model formula used is from Development Table 2.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
& -7.1076 \quad + \\
& (1.1332 * sex_is_male) \quad + \\
& (0.072819 * age) \quad + \\
& (1.4252 * have_typical_chest_pain) \quad + \\
& (-0.55152 * have_nonanginal_chest_pain) \quad + \\
& (1.1145 * risk_factor_subgroups) \quad + \\
& (-0.005578 * age * have_typical_chest_pain) \quad + \\
& (-0.0079662 * age * risk_factor_subgroups) \quad + \\
& (-0.11213 * have_typical_chest_pain * risk_factor_subgroups) \quad + \\
& (-0.18948 * sex_is_male * risk_factor_subgroups)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2025 Rasmussen et. al. Risk Factor-Weighted Clinical Likelihood CCTA ($RF - CL_{CCTA}$) model.

Examples

```
# 40 year old Male with nonanginal chest pain
calculate_rasmussen_2025_rf_cl_ccta_ptp(
    age = 40,
    sex = "male",
    chest_pain_type = "no chest pain",
    have_dyspnoea = "no",
    have_family_history = "no",
    have_smoking_history = "no",
    have_dyslipidemia = "no",
    have_hypertension = "no",
```

```
    have_diabetes = "no",
    allow_na_symptom_score = TRUE,
    max_na_num_of_rf = 0
)
```

`calculate_reeh_2019_basic_ptp` *Calculate 2019 Reeh Basic PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2019 Reeh et. al. basic model. Obstructive CAD was defined from invasive angiography as >70% stenosis of any epicardial vessel or 50–70% stenosis with a fractional flow reserve <0.8 or any lesion that was revascularized.

Usage

```
calculate_reeh_2019_basic_ptp(
  age,
  sex,
  symptom_type,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_symptom_type_typical = c("typical"),
  label_symptom_type_atypical = c("atypical"),
  label_symptom_type_nonanginal = c("nonanginal"),
  label_symptom_type_dyspnoea = c("dyspnoea"),
  label_symptom_type_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`symptom_type`	Input characters (typical, atypical, nonanginal, dyspnoea) to indicate the symptom characteristics of the patient. • typical stands for the patient having typical chest pain. • atypical stands for the patient having atypical chest pain. • nonanginal stands for the patient having nonanginal or non-specific chest pain. • dyspnoea stands for the patient having dyspnoea.
`label_sex_male`	Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
: Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_symptom_type_typical`
: Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_symptom_type_atypical`
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

`label_symptom_type_nonanginal`
: Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

`label_symptom_type_dyspnoea`
: Label(s) for patient having dyspnoea. Default: `c("dyspnoea")`

`label_symptom_type_unknown`
: Label(s) for patient having unknown symptoms. Default: `c(NA, NaN)`

Details

The predictive model is based on 3903 patients free of CAD and heart failure and suspected of angina, who were referred to a single, large, urban university hospital for assessment in 2012–15.

Model formula used is from Table 3.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned} & -7.6348 \quad + \\ & (1.4067 * sex_is_male) \quad + \\ & (0.4820 * (age/10)) \quad + \\ & (2.8779 * have_typical_chest_pain) \quad + \\ & (1.8690 * have_atypical_chest_pain) \quad + \\ & (0.7916 * have_dyspnoea) \end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2019 Reeh et. al. basic model.

Examples

```
# 40 year old female with typical chest pain
calculate_reeh_2019_basic_ptp(
    age = 40,
    sex = "female",
```

```
    symptom_type = "typical"
)
```

`calculate_reeh_2019_clinical_ptp` *Calculate 2019 Reeh Clinical PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2019 Reeh et. al. clinical model. Obstructive CAD was defined from invasive angiography as >70% stenosis of any epicardial vessel or 50–70% stenosis with a fractional flow reserve <0.8 or any lesion that was revascularized.

Usage

```
calculate_reeh_2019_clinical_ptp(
  age,
  sex,
  symptom_type,
  have_dyslipidemia,
  have_family_history,
  have_diabetes,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_symptom_type_typical = c("typical"),
  label_symptom_type_atypical = c("atypical"),
  label_symptom_type_nonanginal = c("nonanginal"),
  label_symptom_type_dyspnoea = c("dyspnoea"),
  label_symptom_type_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.

`symptom_type` Input characters (typical, atypical, nonanginal, dyspnoea) to indicate the symptom characteristics of the patient.

- typical stands for the patient having typical chest pain.
- atypical stands for the patient having atypical chest pain.
- nonanginal stands for the patient having nonanginal or non-specific chest pain.
- dyspnoea stands for the patient having dyspnoea.

`have_dyslipidemia`
: The value of variable in the parameters `label_have_dyslipidemia_no`, `label_have_dyslipidemia_yes` and `label_have_dyslipidemia_unknown`.

`have_family_history`
: The value of variable in the parameters `label_have_family_history_no`, `label_have_family_history_yes` and `label_have_family_history_unknown`.

`have_diabetes` The value of variable in the parameters `label_have_diabetes_no`, `label_have_diabetes_yes` and `label_have_diabetes_unknown`.

`label_sex_male` Label(s) for definition(s) of male sex. Default: `c("male")`

`label_sex_female`
: Label(s) for definition(s) of female sex. Default: `c("female")`

`label_sex_unknown`
: Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

`label_symptom_type_typical`
: Label(s) for patient having typical chest pain. Default: `c("typical")`

`label_symptom_type_atypical`
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

`label_symptom_type_nonanginal`
: Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

`label_symptom_type_dyspnoea`
: Label(s) for patient having dyspnoea. Default: `c("dyspnoea")`

`label_symptom_type_unknown`
: Label(s) for patient having unknown symptoms. Default: `c(NA, NaN)`

`label_have_dyslipidemia_no`
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

`label_have_dyslipidemia_yes`
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

`label_have_dyslipidemia_unknown`
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

`label_have_family_history_no`
: Label(s) for patient with no family history of CAD. Default: `c("no")`

`label_have_family_history_yes`
: Label(s) for patient having family history of CAD. Default: `c("yes")`

`label_have_family_history_unknown`
: Label(s) for patient having unknown family history of CAD. Default: `c(NA, NaN)`

`label_have_diabetes_no`
: Label(s) for patient with no diabetes. Default: `c("no")`

`label_have_diabetes_yes`
: Label(s) for patient having diabetes. Default: `c("yes")`

`label_have_diabetes_unknown`
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

Details

The predictive model is based on 3903 patients free of CAD and heart failure and suspected of angina, who were referred to a single, large, urban university hospital for assessment in 2012–15.

Model formula used is from Table 3.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-8.5499 \quad + \\
&(1.4468 * sex_is_male) \quad + \\
&(0.5031 * (age/10)) \quad + \\
&(2.7699 * have_typical_chest_pain) \quad + \\
&(1.7839 * have_atypical_chest_pain) \quad + \\
&(0.8071 * have_dyspnoea) \quad + \\
&(0.9551 * have_dyslipidemia) \quad + \\
&(0.4394 * have_family_history_of_CAD) \quad + \\
&(0.3767 * have_diabetes)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2019 Reeh et. al. clinical model.

Examples

```
# 40 year old female with typical chest pain
calculate_reeh_2019_clinical_ptp(
    age = 40,
    sex = "female",
    symptom_type = "typical",
    have_dyslipidemia = "no",
    have_family_history = "no",
```

```
    have_diabetes = "no"
)
```

`calculate_winther_2020_basic_ptp` *Calculate 2020 Winther Basic PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2020 Winther et. al. basic model (Basic_PTP). Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_winther_2020_basic_ptp(
  age,
  sex,
  chest_pain_type,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`chest_pain_type`	The value of variable in the parameters `label_cpt_no_chest_pain`, `label_cpt_nonanginal`, `label_cpt_atypical`, `label_cpt_typical`, and `label_cpt_unknown`.
`label_sex_male`	Label(s) for definition(s) of male sex. Default: `c("male")`
`label_sex_female`	Label(s) for definition(s) of female sex. Default: `c("female")`
`label_sex_unknown`	Label(s) for definition(s) of missing sex. Default: `c(NA, NaN)`

label_cpt_no_chest_pain
: Label(s) for patient having no chest pain. Default: `c("no chest pain")`

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: `c("nonanginal")`

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: `c("atypical")`

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: `c("typical")`

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: `c(NA, NaN)`

Details

The predictive model is based on > 40000 symptomatic patients from 2008 to 2017 from 13 hospitals in Western Denmark. These patients are registered under the Western Denmark Heart Registry.

Model formula used is from Table S3.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-7.0753 \quad + \\
&(1.2308 * sex_is_male) \quad + \\
&(0.0642 * age) \quad + \\
&(2.2501 * have_typical_chest_pain) \quad + \\
&(-0.5095 * have_nonanginal_chest_pain) \quad + \\
&(-0.0191 * age * have_typical_chest_pain)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2020 Winther et. al. basic model (Basic_PTP).

Examples

```
# 40 year old Male with typical chest pain
calculate_winther_2020_basic_ptp(
    age = 40,
    sex = "male",
    chest_pain_type = "typical"
)
```

```
# 40 year old Male with nonanginal chest pain
calculate_winther_2020_basic_ptp(
    age = 40,
    sex = "male",
    chest_pain_type = "nonanginal"
)
```

`calculate_winther_2020_cacs_cl_ptp` *Calculate 2020 Winther CACS-CL PTP model for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on 2020 Winther et. al. Coronary Artery Calcium Score-Weighted Clinical Likelihood (CACS-CL) model. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_winther_2020_cacs_cl_ptp(
  age,
  sex,
  chest_pain_type,
  have_dyspnoea,
  have_family_history,
  have_smoking_history,
  have_dyslipidemia,
  have_hypertension,
  have_diabetes,
  coronary_calcium_score,
  allow_na_symptom_score = TRUE,
  max_na_num_of_rf = 0,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
```

```
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters label_cpt_no_chest_pain, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical, and label_cpt_unknown.
have_dyspnoea	The value of variable in the parameters label_have_dyspnoea_no, label_have_dyspnoea_yes and label_have_dyspnoea_unknown.
have_family_history	The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
coronary_calcium_score	Input non-negative numeric to indicate the total coronary calcium score of the patient.

allow_na_symptom_score
: A logical evaluating to TRUE or FALSE
indicating whether we can allow chest_pain_type
or have_dyspnoea to be NA when calculating the score.

max_na_num_of_rf
: Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0

label_sex_male
: Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
: Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
: Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_have_dyspnoea_no
: Label(s) for patient having no dyspnoea symptoms. Default: c("no")

label_have_dyspnoea_yes
: Label(s) for patient having dyspnoea symptoms. Default: c("yes")

label_have_dyspnoea_unknown
: Label(s) for patient having unknown dyspnoea symptoms. Default: c(NA, NaN)

label_cpt_no_chest_pain
: Label(s) for patient having no chest pain. Default: c("no chest pain")

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain.
Default: c("nonanginal")

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: c("atypical")

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_family_history_no
: Label(s) for patient with no family history of CAD. Default: c("no")

label_have_family_history_yes
: Label(s) for patient having family history of CAD. Default: c("yes")

label_have_family_history_unknown
: Label(s) for patient having unknown family history of CAD. Default: c(NA, NaN)

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: c("no")

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: c("yes")

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: c(NA, NaN)

`label_have_dyslipidemia_no`
: Label(s) for patient with no dyslipidemia. Default: `c("no")`

`label_have_dyslipidemia_yes`
: Label(s) for patient having dyslipidemia. Default: `c("yes")`

`label_have_dyslipidemia_unknown`
: Label(s) for patient having unknown dyslipidemia. Default: `c(NA, NaN)`

`label_have_hypertension_no`
: Label(s) for patient with no hypertension. Default: `c("no")`

`label_have_hypertension_yes`
: Label(s) for patient having hypertension. Default: `c("yes")`

`label_have_hypertension_unknown`
: Label(s) for patient having unknown hypertension. Default: `c(NA, NaN)`

`label_have_diabetes_no`
: Label(s) for patient with no diabetes. Default: `c("no")`

`label_have_diabetes_yes`
: Label(s) for patient having diabetes. Default: `c("yes")`

`label_have_diabetes_unknown`
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

Details

The predictive model is based on > 40000 symptomatic patients from 2008 to 2017 from 13 hospitals in Western Denmark. These patients are registered under the Western Denmark Heart Registry.

Model formula used is from Table S3.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
& 0.0013 \quad + \\
& (0.2021 * rf_ptp) \quad + \\
& (0.0082 * cacs_1_to_9) \quad + \\
& (0.0238 * cacs_10_to_99) \quad + \\
& (0.1131 * cacs_100_to_399) \quad + \\
& (0.2306 * cacs_400_to_999) \quad + \\
& (0.4040 * cacs_1000_or_more) \quad + \\
& (0.1311 * rf_ptp * cacs_1_to_9) \quad + \\
& (0.2909 * rf_ptp * cacs_10_to_99) \quad + \\
& (0.4077 * rf_ptp * cacs_100_to_399) \quad + \\
& (0.4658 * rf_ptp * cacs_400_to_999) \quad + \\
& (0.4489 * rf_ptp * cacs_1000_or_more)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2020 Winther et. al. Coronary Artery Calcium Score-Weighted Clinical Likelihood (CACS-CL) model.

Examples

```
# 40 year old Male with nonanginal chest pain and coronary calcium score of 0
calculate_winther_2020_cacs_cl_ptp(
    age = 40,
    sex = "male",
    chest_pain_type = "no chest pain",
    have_dyspnoea = "no",
    have_family_history = "no",
    have_smoking_history = "no",
    have_dyslipidemia = "no",
    have_hypertension = "no",
    have_diabetes = "no",
    coronary_calcium_score = 0,
    allow_na_symptom_score = TRUE,
    max_na_num_of_rf = 0
)
```

`calculate_winther_2020_rf_cl_ptp` *Calculate 2020 Winther RF-CL PTP model for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2020 Winther et. al. Risk Factor-Weighted Clinical Likelihood (RF-CL) model. Obstructive CAD was defined as a stenosis causing $\geq$ 50% diameter stenosis on coronary CTA.

Usage

```
calculate_winther_2020_rf_cl_ptp(
  age,
  sex,
  chest_pain_type,
  have_dyspnoea,
  have_family_history,
  have_smoking_history,
  have_dyslipidemia,
  have_hypertension,
  have_diabetes,
  allow_na_symptom_score = TRUE,
  max_na_num_of_rf = 0,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyspnoea_no = c("no"),
  label_have_dyspnoea_yes = c("yes"),
  label_have_dyspnoea_unknown = c(NA, NaN),
  label_cpt_no_chest_pain = c("no chest pain"),
  label_cpt_nonanginal = c("nonanginal"),
  label_cpt_atypical = c("atypical"),
  label_cpt_typical = c("typical"),
  label_cpt_unknown = c(NA, NaN),
  label_have_family_history_no = c("no"),
  label_have_family_history_yes = c("yes"),
  label_have_family_history_unknown = c(NA, NaN),
  label_have_smoking_history_no = c("no"),
  label_have_smoking_history_yes = c("yes"),
  label_have_smoking_history_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_hypertension_no = c("no"),
  label_have_hypertension_yes = c("yes"),
  label_have_hypertension_unknown = c(NA, NaN),
```

```
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN)
)
```

Arguments

age	Input numeric value to indicate the age of the patient in years.
sex	The value of variable in the parameters label_sex_male, label_sex_female and label_sex_unknown.
chest_pain_type	The value of variable in the parameters label_cpt_no_chest_pain, label_cpt_nonanginal, label_cpt_atypical, label_cpt_typical, and label_cpt_unknown.
have_dyspnoea	The value of variable in the parameters label_have_dyspnoea_no, label_have_dyspnoea_yes and label_have_dyspnoea_unknown.
have_family_history	The value of variable in the parameters label_have_family_history_no, label_have_family_history_yes and label_have_family_history_unknown.
have_smoking_history	The value of variable in the parameters label_have_smoking_history_no, label_have_smoking_history_yes, and label_have_smoking_history_unknown.
have_dyslipidemia	The value of variable in the parameters label_have_dyslipidemia_no, label_have_dyslipidemia_yes and label_have_dyslipidemia_unknown.
have_hypertension	The value of variable in the parameters label_have_hypertension_no, label_have_hypertension_yes, and label_have_hypertension_unknown.
have_diabetes	The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.
allow_na_symptom_score	A logical evaluating to TRUE or FALSE indicating whether we can allow chest_pain_type or have_dyspnoea to be NA when calculating the score.
max_na_num_of_rf	Input integer 0 to 5 to indicate the maximum number of missing risk factors to tolerate before outputting an NA. Default: 0
label_sex_male	Label(s) for definition(s) of male sex. Default: c("male")
label_sex_female	Label(s) for definition(s) of female sex. Default: c("female")
label_sex_unknown	Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_have_dyspnoea_no
: Label(s) for patient having no dyspnoea symptoms. Default: c("no")

label_have_dyspnoea_yes
: Label(s) for patient having dyspnoea symptoms. Default: c("yes")

label_have_dyspnoea_unknown
: Label(s) for patient having unknown dyspnoea symptoms. Default: c(NA, NaN)

label_cpt_no_chest_pain
: Label(s) for patient having no chest pain. Default: c("no chest pain")

label_cpt_nonanginal
: Label(s) for patient having nonanginal or non-specific chest pain. Default: c("nonanginal")

label_cpt_atypical
: Label(s) for patient having atypical chest pain. Default: c("atypical")

label_cpt_typical
: Label(s) for patient having typical chest pain. Default: c("typical")

label_cpt_unknown
: Label(s) for patient having unknown chest pain type symptoms. Default: c(NA, NaN)

label_have_family_history_no
: Label(s) for patient with no family history of CAD. Default: c("no")

label_have_family_history_yes
: Label(s) for patient having family history of CAD. Default: c("yes")

label_have_family_history_unknown
: Label(s) for patient having unknown family history of CAD. Default: c(NA, NaN)

label_have_smoking_history_no
: Label(s) for patient with no smoking history (current or past). Default: c("no")

label_have_smoking_history_yes
: Label(s) for patient having smoking history (current or past). Default: c("yes")

label_have_smoking_history_unknown
: Label(s) for patient having unknown smoking history (current or past). Default: c(NA, NaN)

label_have_dyslipidemia_no
: Label(s) for patient with no dyslipidemia. Default: c("no")

label_have_dyslipidemia_yes
: Label(s) for patient having dyslipidemia. Default: c("yes")

label_have_dyslipidemia_unknown
: Label(s) for patient having unknown dyslipidemia. Default: c(NA, NaN)

label_have_hypertension_no
: Label(s) for patient with no hypertension. Default: c("no")

label_have_hypertension_yes
: Label(s) for patient having hypertension. Default: c("yes")

label_have_hypertension_unknown
: Label(s) for patient having unknown hypertension. Default: c(NA, NaN)

label_have_diabetes_no
: Label(s) for patient with no diabetes. Default: `c("no")`

label_have_diabetes_yes
: Label(s) for patient having diabetes. Default: `c("yes")`

label_have_diabetes_unknown
: Label(s) for patient having unknown diabetes. Default: `c(NA, NaN)`

Details

The predictive model is based on > 40000 symptomatic patients from 2008 to 2017 from 13 hospitals in Western Denmark. These patients are registered under the Western Denmark Heart Registry.

Model formula used is from Table S3.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$
\begin{aligned}
& -9.5260 \quad + \\
& (1.6128 * sex_is_male) \quad + \\
& (0.0844 * age) \quad + \\
& (2.7112 * have_typical_chest_pain) \quad + \\
& (-0.4675 * have_nonanginal_chest_pain) \quad + \\
& (1.4940 * risk_factor_subgroups) \quad + \\
& (-0.0187 * age * have_typical_chest_pain) \quad + \\
& (-0.0131 * age * risk_factor_subgroups) \quad + \\
& (-0.2799 * have_typical_chest_pain * risk_factor_subgroups) \quad + \\
& (-0.2091 * sex_is_male * risk_factor_subgroups)
\end{aligned}
$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2020 Winther et. al. Risk Factor-Weighted Clinical Likelihood (RF-CL) model.

Examples

```
# 40 year old Male with nonanginal chest pain
calculate_winther_2020_rf_cl_ptp(
    age = 40,
    sex = "male",
    chest_pain_type = "no chest pain",
```

```
    have_dyspnoea = "no",
    have_family_history = "no",
    have_smoking_history = "no",
    have_dyslipidemia = "no",
    have_hypertension = "no",
    have_diabetes = "no",
    allow_na_symptom_score = TRUE,
    max_na_num_of_rf = 0
)
```

`calculate_zuo_2025_predict_ocad_ptp` *Calculate 2025 Zuo PREDICT-OCAD PTP for obstructive CAD*

Description

This function returns a patient's pre-test probability (PTP) of obstructive coronary artery disease (CAD) based on the 2025 Zuo et. al. PREDICT-OCAD model. Obstructive CAD was defined as $\geq$50% stenosis on CCTA.

Usage

```
calculate_zuo_2025_predict_ocad_ptp(
  age,
  sex,
  have_dyslipidemia,
  have_diabetes,
  coronary_calcium_score,
  label_sex_male = c("male"),
  label_sex_female = c("female"),
  label_sex_unknown = c(NA, NaN),
  label_have_dyslipidemia_no = c("no"),
  label_have_dyslipidemia_yes = c("yes"),
  label_have_dyslipidemia_unknown = c(NA, NaN),
  label_have_diabetes_no = c("no"),
  label_have_diabetes_yes = c("yes"),
  label_have_diabetes_unknown = c(NA, NaN)
)
```

Arguments

`age`	Input numeric value to indicate the age of the patient in years.
`sex`	The value of variable in the parameters `label_sex_male`, `label_sex_female` and `label_sex_unknown`.
`have_dyslipidemia`	The value of variable in the parameters `label_have_dyslipidemia_no`, `label_have_dyslipidemia_yes` and `label_have_dyslipidemia_unknown`.

have_diabetes The value of variable in the parameters label_have_diabetes_no, label_have_diabetes_yes and label_have_diabetes_unknown.

coronary_calcium_score
Input non-negative integer to indicate the total coronary calcium score of the patient.

label_sex_male Label(s) for definition(s) of male sex. Default: c("male")

label_sex_female
Label(s) for definition(s) of female sex. Default: c("female")

label_sex_unknown
Label(s) for definition(s) of missing sex. Default: c(NA, NaN)

label_have_dyslipidemia_no
Label(s) for patient with no dyslipidemia. Default: c("no")

label_have_dyslipidemia_yes
Label(s) for patient having dyslipidemia. Default: c("yes")

label_have_dyslipidemia_unknown
Label(s) for patient having unknown dyslipidemia. Default: c(NA, NaN)

label_have_diabetes_no
Label(s) for patient with no diabetes. Default: c("no")

label_have_diabetes_yes
Label(s) for patient having diabetes. Default: c("yes")

label_have_diabetes_unknown
Label(s) for patient having unknown diabetes. Default: c(NA, NaN)

Details

The predictive model is based on 2649 patients suspected of CAD at Jinling Hospital, Nanjing University (Jiangsu, China), spanning from January 2010 to December 2020.

Model formula used is taken from the web-based calculator.

It is of the form

$$\frac{1}{(1 + e^{-F(x)})}$$

where $F(x)$ equals

$$\begin{aligned}
&-4.336859 \quad + \\
&(-0.422110 * sex_is_female) \quad + \\
&(0.029603 * age) \quad + \\
&(-0.539890 * no_dyslipidemia) \quad + \\
&(-0.210570 * no_diabetes) \quad + \\
&(1.925711 * cacs_1_to_100) \quad + \\
&(3.362762 * cacs_101_to_400) \quad + \\
&(4.377606 * cacs_more_than_400)
\end{aligned}$$

Value

A numeric value representing the patient's PTP for obstructive CAD based on the 2025 Zuo et. al. PREDICT-OCAD model.

Examples

```
# 40 year old female without dyslipidemia and diabetes
# with coronary calcium score of 0
calculate_zuo_2025_predict_ocad_ptp(
    age = 40,
    sex = "female",
    have_dyslipidemia = "no",
    have_diabetes = "no",
    coronary_calcium_score = 0
)
```

---

check_if_four_categories_are_mutually_exclusive

Check If Four Categories Are Mutually Exclusive

Description

Check if the four input categories are mutually exclusive from each other

Usage

```
check_if_four_categories_are_mutually_exclusive(
  label_cat_1,
  label_cat_2,
  label_cat_3,
  label_cat_4,
  label_cat_missing = NULL,
  arg_cat_1 = rlang::caller_arg(label_cat_1),
  arg_cat_2 = rlang::caller_arg(label_cat_2),
  arg_cat_3 = rlang::caller_arg(label_cat_3),
  arg_cat_4 = rlang::caller_arg(label_cat_4),
  arg_cat_missing = rlang::caller_arg(label_cat_missing),
  error_call = rlang::caller_env()
)
```

Arguments

label_cat_1	First vector to check for mutually exclusiveness with another vector.
label_cat_2	Second vector to check for mutually exclusiveness with another vector.
label_cat_3	Third vector to check for mutually exclusiveness with another vector
label_cat_4	Fourth vector to check for mutually exclusiveness with another vector

label_cat_missing
: Missing values vector to check for mutually exclusiveness with another vector if needed. Default: NULL

arg_cat_1
: An argument name as a string for the first vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

arg_cat_2
: An argument name as a string for the second vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

arg_cat_3
: An argument name as a string for the third vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

arg_cat_4
: An argument name as a string for the fourth vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

arg_cat_missing
: An argument name as a string for the missing values vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

error_call
: The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

An error message if the four input categories are not mutually exclusive

See Also

`caller_arg`, `stack` `cli_vec`, `cli_abort`

Examples

```
# No error
cat_1 <- c("no chest pain")
cat_2 <- c("typical")
cat_3 <- c("atypical")
cat_4 <- c("nonanginal")
cat_missing <- c("NA")
check_if_four_categories_are_mutually_exclusive(
  cat_1, cat_2, cat_3, cat_4
)
check_if_four_categories_are_mutually_exclusive(
  cat_1, cat_2, cat_3, cat_4, cat_missing
)

# Common labels found
cat_1 <- c("no chest pain","typical", "atypical", "nonanginal")
cat_2 <- c("no chest pain","typical", "atypical", "nonanginal")
cat_3 <- c("no chest pain","typical", "atypical", "nonanginal")
cat_4 <- c("no chest pain","typical", "atypical", "nonanginal")
cat_missing <- c("no chest pain","typical", "atypical", "nonanginal")

try(check_if_four_categories_are_mutually_exclusive(
```

```
  cat_1, cat_2, cat_3, cat_4
))

try(check_if_four_categories_are_mutually_exclusive(
  cat_1, cat_2, cat_3, cat_4, cat_missing
))
```

`check_if_integer` *Check If Integer*

Description

Check if the input variable is an integer

Usage

```
check_if_integer(
  x,
  allow_na = TRUE,
  arg = rlang::caller_arg(x),
  error_call = rlang::caller_env()
)
```

Arguments

`x`	Input variable to check if it is an integer
`allow_na`	Input boolean to determine if `NA` or `NaN` is allowed. Default: `TRUE`
`arg`	An argument name as a string. This argument will be mentioned in error messages as the input that is at the origin of a problem.
`error_call`	The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

The variable itself or an error message if variable is not non-negative

See Also

`caller_arg`, `stack` `cli_abort`

Examples

```
# No error
input = 0
try(check_if_integer(input))

# Error as 5.5 is not an integer
input = 5.5
try(check_if_integer(input))
```

`check_if_non_negative` *Check If Non-Negative*

Description

Check if the input variable is a non-negative number

Usage

```
check_if_non_negative(
  x,
  allow_na = TRUE,
  arg = rlang::caller_arg(x),
  error_call = rlang::caller_env()
)
```

Arguments

`x`	Input variable to check if it is non-negative number
`allow_na`	Input boolean to determine if `NA` or `NaN` is allowed. Default: `TRUE`
`arg`	An argument name as a string. This argument will be mentioned in error messages as the input that is at the origin of a problem.
`error_call`	The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

The variable itself or an error message if variable is not non-negative

See Also

`caller_arg`, `stack` `cli_abort`

Examples

```
# No error
input = 0
try(check_if_non_negative(input))

# Error as -5 is not a non-neagtive number
input = -5
try(check_if_non_negative(input))
```

`check_if_numeric` *Check If Numeric*

Description

Check if the input variable is numeric

Usage

```
check_if_numeric(
  x,
  allow_na = TRUE,
  arg = rlang::caller_arg(x),
  error_call = rlang::caller_env()
)
```

Arguments

`x`	Input variable to check if it is numeric
`allow_na`	Input boolean to determine if `NA` or `NaN` is allowed. Default: `TRUE`
`arg`	An argument name as a string. This argument will be mentioned in error messages as the input that is at the origin of a problem.
`error_call`	The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

The variable itself or an error message if variable is not numeric

See Also

`caller_arg`, `stack` `cli_abort`

Examples

```
# No error
input = 1
try(check_if_numeric(input))

# Error as "5" is not numeric
input = "5"
try(check_if_numeric(input))

# Error as NULL is not numeric
input = NULL
try(check_if_numeric(input))

# Error as NA is not numeric and allow_na is FALSE
input = NA
try(check_if_numeric(input, allow_na = FALSE))
```

`check_if_positive` *Check If Positive*

Description

Check if the input variable is a positive number

Usage

```
check_if_positive(
  x,
  allow_na = TRUE,
  arg = rlang::caller_arg(x),
  error_call = rlang::caller_env()
)
```

Arguments

`x`	Input variable to check if it is positive number
`allow_na`	Input boolean to determine if `NA` or `NaN` is allowed. Default: `TRUE`
`arg`	An argument name as a string. This argument will be mentioned in error messages as the input that is at the origin of a problem.
`error_call`	The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

The variable itself or an error message if variable is not positive

See Also

caller_arg, stack cli_abort

Examples

```
# No error
input = 1
try(check_if_positive(input))

# Error as 0 is not a positive number
input = 0
try(check_if_positive(input))

# Error as -5 is not a positive number
input = -5
try(check_if_positive(input))
```

---

check_if_three_categories_are_mutually_exclusive

Check If Three Categories Are Mutually Exclusive

Description

Check if the three input categories are mutually exclusive from each other

Usage

```
check_if_three_categories_are_mutually_exclusive(
  label_cat_1,
  label_cat_2,
  label_cat_3,
  label_cat_missing = NULL,
  arg_cat_1 = rlang::caller_arg(label_cat_1),
  arg_cat_2 = rlang::caller_arg(label_cat_2),
  arg_cat_3 = rlang::caller_arg(label_cat_3),
  arg_cat_missing = rlang::caller_arg(label_cat_missing),
  error_call = rlang::caller_env()
)
```

Arguments

label_cat_1	First vector to check for mutually exclusiveness with another vector.
label_cat_2	Second vector to check for mutually exclusiveness with another vector.
label_cat_3	Third vector to check for mutually exclusiveness with another vector
label_cat_missing	Missing values vector to check for mutually exclusiveness with another vector if needed. Default: NULL

arg_cat_1 An argument name as a string for the first vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

arg_cat_2 An argument name as a string for the second vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

arg_cat_3 An argument name as a string for the third vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

arg_cat_missing An argument name as a string for the missing values vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.

error_call The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

An error message if the three input categories are not mutually exclusive

See Also

`caller_arg`, `stack` `cli_vec`, `cli_abort`

Examples

```
# No error
cat_1 <- c("typical")
cat_2 <- c("atypical")
cat_3 <- c("nonanginal")
cat_missing <- c("NA")
check_if_three_categories_are_mutually_exclusive(cat_1, cat_2, cat_3)
check_if_three_categories_are_mutually_exclusive(cat_1, cat_2, cat_3, cat_missing)

# Common labels found
cat_1 <- c("typical", "atypical", "nonanginal", "NA")
cat_2 <- c("typical", "atypical", "nonanginal", "NA")
cat_3 <- c("typical", "atypical", "nonanginal", "NA")
cat_missing <- c("typical", "atypical", "nonanginal", "NA")

try(check_if_three_categories_are_mutually_exclusive(cat_1, cat_2, cat_3))

try(check_if_three_categories_are_mutually_exclusive(cat_1, cat_2, cat_3, cat_missing))
```

---

check_if_two_categories_are_mutually_exclusive

Check If Two Categories Are Mutually Exclusive

Description

Check if the two input categories are mutually exclusive from each other

Usage

```
check_if_two_categories_are_mutually_exclusive(
  label_cat_1,
  label_cat_2,
  label_cat_missing = NULL,
  arg_cat_1 = rlang::caller_arg(label_cat_1),
  arg_cat_2 = rlang::caller_arg(label_cat_2),
  arg_cat_missing = rlang::caller_arg(label_cat_missing),
  error_call = rlang::caller_env()
)
```

Arguments

label_cat_1	First vector to check for mutually exclusiveness with another vector.
label_cat_2	Second vector to check for mutually exclusiveness with another vector.
label_cat_missing	Missing values vector to check for mutually exclusiveness with another vector if needed. Default: NULL
arg_cat_1	An argument name as a string for the first vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.
arg_cat_2	An argument name as a string for the second vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.
arg_cat_missing	An argument name as a string for the missing values vector. This argument will be mentioned in error messages as the input that is at the origin of a problem.
error_call	The execution environment of a currently running function, e.g. `caller_env()`. The function will be mentioned in error messages as the source of the error. See the `call` argument of `abort()` for more information.

Value

An error message if the two input categories are not mutually exclusive

See Also

`caller_arg`, `stack` `cli_vec`, `cli_abort`

Examples

```
# No error
cat_1 <- c("male")
cat_2 <- c("female")
cat_missing <- c("not saying")
check_if_two_categories_are_mutually_exclusive(cat_1, cat_2)
check_if_two_categories_are_mutually_exclusive(cat_1, cat_2, cat_missing)

# Common labels found
cat_1 <- c("male", "female", "not saying")
```

```
cat_2 <- c("male", "female", "not saying")
cat_missing <- c("male", "female", "not saying")

try(check_if_two_categories_are_mutually_exclusive(cat_1, cat_2))

try(check_if_two_categories_are_mutually_exclusive(cat_1, cat_2, cat_missing))
```

---

chr_quoted *Quoted Characters*

Description

Add a quote around characters.

Usage

```
chr_quoted(chr, type = "`")
```

Arguments

chr	A character vector to add quotes in each element. (e.g. c("a", "b", "c")).
type	Character to be used as a quote. Default: ’‘’

Details

DETAILS

Value

A character vector with quotes added in each element. (e.g. c("a", "b", "c")).

Examples

```
chr_quoted(c("a","b", "c"))
```

harmonise_four_labels *Harmonise Four Labels*

Description

Function to map an input from four different list into one of the four standardise labels

Usage

```
harmonise_four_labels(
  arg,
  label_one,
  label_two,
  label_three,
  label_four,
  label_unknown,
  harmonise_label_one = "group_1",
  harmonise_label_two = "group_2",
  harmonise_label_three = "group_3",
  harmonise_label_four = "group_4",
  harmonise_label_unknown = NA,
  error_call = rlang::caller_env()
)
```

Arguments

arg	Input argument, in characters to be harmonised
label_one	Input character vector representing the ways to identify harmonise_label_one
label_two	Input character vector representing the ways to identify harmonise_label_two
label_three	Input character vector representing the ways to identify harmonise_label_three
label_four	Input character vector representing the ways to identify harmonise_label_four
label_unknown	Input character vector representing the ways to identify harmonise_label_unknown
harmonise_label_one	Input character representing the harmonised label for label_one Default: 'group_1'
harmonise_label_two	Input character representing the harmonised label for label_two Default: 'group_2'
harmonise_label_three	Input character representing the harmonised label for label_three Default: 'group_3'

harmonise_label_four
: Input character representing the harmonised label for label_four
Default: 'group_4'

harmonise_label_unknown
: Input character representing the harmonised label for label_unknown
Default: NA

error_call
: The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

Character representing one of the four standardise labels.

Examples

```
label_cpt_no_chest_pain <- c("no chest pain", "normal")
label_cpt_nonanginal <- c("nonanginal", "unspecified")
label_cpt_atypical <- c("atypical", "Atypical")
label_cpt_typical <- c("typical", "angina")
label_cpt_unknown <- c(NA, NaN)

# Gives harmonise_label_one if there is valid input of chest_pain_type
chest_pain_type <- "normal"

harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_two if there is valid input of chest_pain_type
chest_pain_type <- "unspecified"

harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
```

```
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_three if there is valid input of chest_pain_type
chest_pain_type <- "Atypical"

harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_four if there is valid input of chest_pain_type
chest_pain_type <- "angina"

harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_unknown if there is valid missing input of chest_pain_type
chest_pain_type <- NaN

harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
```

```
)

# Gives harmonise_label_unknown if there is valid missing input of chest_pain_type
chest_pain_type <- "NIL"
label_cpt_unknown <- c("NIL")

harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
)

# Gives error of invalid typical chest pain input with partial match
chest_pain_type <- "Typical"
label_cpt_unknown <- c(NA, NaN)

try(harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
))

# Gives error of invalid typical chest pain input without partial match
chest_pain_type <- "Something"
label_cpt_unknown <- c(NA, NaN)

try(harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
```

```
   harmonise_label_unknown = NA
))

# Gives error of invalid missing input of chest_pain_type
chest_pain_type <- NA
label_cpt_unknown <- c("NIL")

try(harmonise_four_labels(
   arg = chest_pain_type,
   label_one = label_cpt_no_chest_pain,
   label_two = label_cpt_nonanginal,
   label_three = label_cpt_atypical,
   label_four = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "no chest pain",
   harmonise_label_two = "nonanginal",
   harmonise_label_three = "atypical",
   harmonise_label_four = "typical",
   harmonise_label_unknown = NA
))
```

`harmonise_three_labels` *Harmonise Three Labels*

Description

Function to map an input from three different list into one of the three standardise labels

Usage

```
harmonise_three_labels(
  arg,
  label_one,
  label_two,
  label_three,
  label_unknown,
  harmonise_label_one = "group_1",
  harmonise_label_two = "group_2",
  harmonise_label_three = "group_3",
  harmonise_label_unknown = NA,
  error_call = rlang::caller_env()
)
```

Arguments

arg	Input argument, in characters to be harmonised
label_one	Input character vector representing the ways to identify harmonise_label_one
label_two	Input character vector representing the ways to identify harmonise_label_two
label_three	Input character vector representing the ways to identify harmonise_label_three
label_unknown	Input character vector representing the ways to identify harmonise_label_unknown
harmonise_label_one	Input character representing the harmonised label for label_one Default: 'group_1'
harmonise_label_two	Input character representing the harmonised label for label_two Default: 'group_2'
harmonise_label_three	Input character representing the harmonised label for label_three Default: 'group_3'
harmonise_label_unknown	Input character representing the harmonised label for label_unknown Default: NA
error_call	The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

Character representing one of the three standardise labels.

Examples

```
label_cpt_nonanginal <- c("nonanginal", "unspecified")
label_cpt_atypical <- c("atypical", "Atypical")
label_cpt_typical <- c("typical", "angina")
label_cpt_unknown <- c(NA, NaN)

# Gives harmonise_label_one if there is valid input of chest_pain_type
chest_pain_type <- "unspecified"

harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
   label_three = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "nonanginal",
```

```
   harmonise_label_two = "atypical",
   harmonise_label_three = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_two if there is valid input of chest_pain_type
chest_pain_type <- "Atypical"

harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
   label_three = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "nonanginal",
   harmonise_label_two = "atypical",
   harmonise_label_three = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_three if there is valid input of chest_pain_type
chest_pain_type <- "angina"

harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
   label_three = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "nonanginal",
   harmonise_label_two = "atypical",
   harmonise_label_three = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_unknown if there is valid missing input of chest_pain_type
chest_pain_type <- NaN

harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
   label_three = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "nonanginal",
   harmonise_label_two = "atypical",
   harmonise_label_three = "typical",
   harmonise_label_unknown = NA
)

# Gives harmonise_label_unknown if there is valid missing input of chest_pain_type
chest_pain_type <- "NIL"
label_cpt_unknown <- c("NIL")
```

```
harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
   label_three = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "nonanginal",
   harmonise_label_two = "atypical",
   harmonise_label_three = "typical",
   harmonise_label_unknown = NA
)

# Gives error of invalid typical chest pain input with partial match
chest_pain_type <- "Typical"
label_cpt_unknown <- c(NA, NaN)

try(harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
   label_three = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "nonanginal",
   harmonise_label_two = "atypical",
   harmonise_label_three = "typical",
   harmonise_label_unknown = NA
))

# Gives error of invalid typical chest pain input without partial match
chest_pain_type <- "Something"
label_cpt_unknown <- c(NA, NaN)

try(harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
   label_three = label_cpt_typical,
   label_unknown = label_cpt_unknown,
   harmonise_label_one = "nonanginal",
   harmonise_label_two = "atypical",
   harmonise_label_three = "typical",
   harmonise_label_unknown = NA
))

# Gives error of invalid missing input of chest_pain_type
chest_pain_type <- NA
label_cpt_unknown <- c("NIL")

try(harmonise_three_labels(
   arg = chest_pain_type,
   label_one = label_cpt_nonanginal,
   label_two = label_cpt_atypical,
```

```
  label_three = label_cpt_typical,
  label_unknown = label_cpt_unknown,
  harmonise_label_one = "nonanginal",
  harmonise_label_two = "atypical",
  harmonise_label_three = "typical",
  harmonise_label_unknown = NA
))
```

`harmonise_two_labels` *Harmonise Two Labels*

Description

Function to map an input from two different list into one of the two standardise labels

Usage

```
harmonise_two_labels(
  arg,
  label_one,
  label_two,
  label_unknown,
  harmonise_label_one = "no",
  harmonise_label_two = "yes",
  harmonise_label_unknown = NA,
  error_call = rlang::caller_env()
)
```

Arguments

`arg`	Input argument, in characters to be harmonised
`label_one`	Input character vector representing the ways to identify `harmonise_label_one`
`label_two`	Input character vector representing the ways to identify `harmonise_label_two`
`label_unknown`	Input character vector representing the ways to identify `harmonise_label_unknown`
`harmonise_label_one`	Input character representing the harmonised label for `label_one` Default: 'group_1'
`harmonise_label_two`	Input character representing the harmonised label for `label_two` Default: 'group_2'

harmonise_label_unknown
: Input character representing the harmonised label for label_unknown
Default: NA

error_call
: The execution environment of a currently running function, e.g. caller_env(). The function will be mentioned in error messages as the source of the error. See the call argument of abort() for more information.

Value

Character representing one of the two standardise labels.

Examples

```
label_have_dyspnoea_no <- c("no", "No")
label_have_dyspnoea_yes <- c("yes", "Yes")
label_have_dyspnoea_unknown <- c(NA, NaN)

# Gives harmonise_label_one if there is valid input of have_dyspnoea
have_dyspnoea <- "No"

harmonise_two_labels(
  arg = have_dyspnoea,
  label_one = label_have_dyspnoea_no,
  label_two = label_have_dyspnoea_yes,
  label_unknown = label_have_dyspnoea_unknown,
  harmonise_label_one = "no",
  harmonise_label_two = "yes",
  harmonise_label_unknown = NA
)

# Gives harmonise_label_two if there is valid input of have_dyspnoea
have_dyspnoea <- "Yes"

harmonise_two_labels(
  arg = have_dyspnoea,
  label_one = label_have_dyspnoea_no,
  label_two = label_have_dyspnoea_yes,
  label_unknown = label_have_dyspnoea_unknown,
  harmonise_label_one = "no",
  harmonise_label_two = "yes",
  harmonise_label_unknown = NA
)

# Gives harmonise_label_unknown if there is valid missing input of have_dyspnoea
have_dyspnoea <- NaN

harmonise_two_labels(
  arg = have_dyspnoea,
  label_one = label_have_dyspnoea_no,
  label_two = label_have_dyspnoea_yes,
  label_unknown = label_have_dyspnoea_unknown,
  harmonise_label_one = "no",
```

```
  harmonise_label_two = "yes",
  harmonise_label_unknown = NA
)

# Gives harmonise_label_unknown if there is valid missing input of have_dyspnoea
have_dyspnoea <- "NIL"
label_have_dyspnoea_unknown <- c("NIL")

harmonise_two_labels(
  arg = have_dyspnoea,
  label_one = label_have_dyspnoea_no,
  label_two = label_have_dyspnoea_yes,
  label_unknown = label_have_dyspnoea_unknown,
  harmonise_label_one = "no",
  harmonise_label_two = "yes",
  harmonise_label_unknown = NA
)

# Gives error of invalid have_dyspnoea input with partial match
have_dyspnoea <- "Not"
label_have_dyspnoea_unknown <- c(NA, NaN)

try(harmonise_two_labels(
   arg = have_dyspnoea,
   label_one = label_have_dyspnoea_no,
   label_two = label_have_dyspnoea_yes,
   label_unknown = label_have_dyspnoea_unknown,
   harmonise_label_one = "no",
   harmonise_label_two = "yes",
   harmonise_label_unknown = NA
))

# Gives error of invalid have_dyspnoea input without partial match
have_dyspnoea <- "Something"
label_have_dyspnoea_unknown <- c(NA, NaN)

try(harmonise_two_labels(
   arg = have_dyspnoea,
   label_one = label_have_dyspnoea_no,
   label_two = label_have_dyspnoea_yes,
   label_unknown = label_have_dyspnoea_unknown,
   harmonise_label_one = "no",
   harmonise_label_two = "yes",
   harmonise_label_unknown = NA
))

# Gives error of invalid missing input of have_dyspnoea
have_dyspnoea <- NA
label_have_dyspnoea_unknown <- c("NIL")

try(harmonise_two_labels(
   arg = have_dyspnoea,
   label_one = label_have_dyspnoea_no,
```

```
   label_two = label_have_dyspnoea_yes,
   label_unknown = label_have_dyspnoea_unknown,
   harmonise_label_one = "no",
   harmonise_label_two = "yes",
   harmonise_label_unknown = NA
))
```

`is_integer_value` *Is Integer Value*

Description

Function to check if the input value is an integer.

Usage

```
is_integer_value(input_value, allow_na = FALSE)
```

Arguments

`input_value`	The input value
`allow_na`	If true, NA values are ignored and output is considered TRUE. Default: FALSE

Value

A boolean indicating TRUE when the input value is an integer and FALSE otherwise.

Examples

```
# An integer
is_integer_value(1)

# Not an integer
is_integer_value(1.1)

# Not numeric
is_integer_value("1")

# NA cases
is_integer_value(NA, allow_na = FALSE)
is_integer_value(NA, allow_na = TRUE)
```

oxford_comma *Character Vector To List Phrase With Oxford Comma*

Description

A function that converts a character vector into a list phrase that uses the Oxford comma.

Usage

```
oxford_comma(chr, sep = ", ", final = "or")
```

Arguments

chr	A character vector to turn into a list phrase (e.g. c("a", "b", "c")).
sep	Separator symbols used to separate the elements in the character vector, Default: ', '
final	String to use in place of the final separator when we have at least two elements in the character vector, Default: 'or'.

Value

A string in the form of a list that has a comma if there are at least three elements in the list (e.g. "a, b, or c")

Examples

```
oxford_comma(c("James", "John", "Jeremy"))

oxford_comma(c("James", "John", "Jeremy"), final = "and")

oxford_comma(c("James", "John"))

oxford_comma(c("James"))
```

round_to_nearest_digit *Round To Nearest Digit*

Description

A function that does symmetric rounding to the nearest digits.

Usage

```
round_to_nearest_digit(number, digits = 0)
```

Arguments

number	Input numeric value
digits	Input integer indicating the number of decimal places to be used. By default, it rounds off to the nearest integer. Default: 0

Value

A numeric value rounded off to a number of decimal places specified in the input digits.

Examples

```
round_to_nearest_digit(0.5)
round_to_nearest_digit(1.5)
round_to_nearest_digit(-0.5)
round_to_nearest_digit(-1.5)
round_to_nearest_digit(1021.125, digits = 2)
```

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