

Coronary Artery Disease - Reporting and Data System

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The **Coronary Artery Disease - Reporting and Data System (CAD-RADS)** is a standardized method for reporting and communicating [coronary CT angiography](#) findings and serves as a clinical decision support tool to guide subsequent patient management.

History and etymology

The system was created by a collaboration of the Society for Cardiovascular Computed Tomography (SCCT), the [American College of Radiology \(ACR\)](#), and the North American Society for Cardiovascular Imaging (NASCI) and was also endorsed by the American College of Cardiology (ACC). The CAD-RADS system was initially published in 2016 ¹. The system was then updated to CAD-RADS 2.0 in 2022 and is an expert document intended to serve as a practice guideline ². The new version incorporates several methods for the categorization including new descriptors of overall coronary plaque burden and options to include CT fractional flow reserve or myocardial CT perfusion results for the assessment of lesion-specific ischemia if obtained ². It also now includes the description of non-atherosclerotic coronary abnormalities as a separate modifier "E" for exceptions ².

Usage

The usage of the CAD-RADS 2.0 system includes the following ²:

- application on a per-patient basis in two different clinical settings
- description of the most clinically relevant and usually most severe coronary artery luminal stenosis (applies for vessels ≥ 1.5 mm in diameter)
- different methods for the estimation, quantification and description of the overall plaque burden
- option to include lesion-specific CT-based [myocardial ischemia](#) testing results obtained by CT-FFR or CT perfusion
- guide to patient management based on the above findings

The different clinical settings in which CAD-RADS is used include ¹⁻³:

- patients presenting with stable chest pain
- patients presenting with acute chest pain

CAD-RADS categories

Stable chest pain

CAD-RADS 0

- interpretation: absence of [coronary artery disease](#)
- maximal stenosis: 0% - no coronary luminal stenosis and no plaque
- management recommendations:
 - no further cardiac investigation
 - reassurance; consider nonatherosclerotic causes of chest pain

CAD-RADS 1

- interpretation: minimal nonobstructive coronary artery disease
- maximal stenosis: 1-24% - minimal stenosis or plaque with no stenosis (includes positive remodeling)
- management recommendations:
 - no further cardiac investigation
 - consider nonatherosclerotic causes of chest pain
 - P1: consider preventive therapy and risk factor modification
 - P2: preventive therapy and risk factor modification
 - P3 or P4: aggressive preventive therapy and risk factor modification

CAD-RADS 2

- interpretation: mild nonobstructive coronary artery disease
- maximal stenosis: 25-49% - mild stenosis
- management recommendations:
 - no further cardiac investigation
 - consider nonatherosclerotic causes of chest pain
 - P1 or P2: preventive therapy and risk factor modification
 - P3 or P4: aggressive preventive therapy and risk factor modification

CAD-RADS 3

- interpretation: moderate stenosis
- maximal stenosis: 50-69% - moderate stenosis
- management recommendations:
 - consider functional assessment
 - P1-P4: aggressive preventive therapy and risk factor modification
 - consider other treatments including anti-anginal therapy as per guideline
 - I+: consider invasive coronary angiography, in particular in the setting of persistent symptoms despite optimal medical therapy

CAD-RADS 4

- interpretation: severe stenosis
- maximal stenosis:
 - **4a:** 70-99% severe coronary stenosis
 - **4b:** left main >50% stenosis or three-vessel obstructive disease with ≥70% stenosis
- management recommendations:

- **4a:** consider invasive coronary angiography or functional assessment
- **4b:** invasive coronary angiography (recommended)
- P1-P4: aggressive preventive therapy and risk factor modification
- consider other treatments including anti-anginal therapy and revascularization options as per guideline

CAD-RADS 5

- interpretation: total or subtotal coronary occlusion
- maximal stenosis: 100% - coronary occlusion
- management recommendations:
 - consider invasive coronary angiography, functional and/or viability assessment
 - P1-P4: aggressive preventive therapy and risk factor modification
 - consider other treatments including anti-anginal therapy and revascularization options as per guideline

CAD-RADS N

- interpretation: exclusion of obstructive coronary artery disease not possible
- maximal stenosis: nondiagnostic
- management recommendations: additional or alternative assessment as necessary

Acute chest pain

CAD-RADS 0

- interpretation: acute coronary syndrome is highly unlikely
- maximal stenosis: 0% - no coronary luminal stenosis and no plaque
- management recommendations:
 - no further evaluation of acute coronary syndrome is necessary
 - Tn+: consider other causes of increased troponin
 - reassurance

CAD-RADS 1

- interpretation: acute coronary syndrome is unlikely
- maximal stenosis: 1-24% - minimal stenosis or plaque with no stenosis (includes positive remodeling)
- management recommendations:
 - no further evaluation of acute coronary syndrome is necessary
 - Tn+: consider other causes of increased troponin
 - P1 or P2: referral to outpatient follow-up for preventive therapy and risk factor modification
 - P3 or P4: referral to outpatient follow-up for preventive therapy and aggressive risk factor modification

CAD-RADS 2

- interpretation: acute coronary syndrome is less likely
- maximal stenosis: 25-49% - mild stenosis
- management recommendations:
 - no further evaluation of acute coronary syndrome is necessary
 - in the setting of high clinical suspicion, Tn+ or features of high-risk plague: consider hospital admission with inpatient cardiology consultation
 - P1 or P2: referral to outpatient follow-up for preventive therapy and risk factor modification
 - P3 or P4: referral to outpatient follow-up for preventive therapy and aggressive risk factor modification

CAD-RADS 3

- interpretation: acute coronary syndrome possible
- maximal stenosis: 50-69% - moderate stenosis
- management recommendations:
 - consider hospital admission with inpatient cardiology consultation
 - consider functional assessment
 - I+: consider invasive coronary angiography
 - P1-P4: aggressive preventive therapy and risk factor modification
 - consider other treatments including anti-anginal therapy as per guideline

CAD-RADS 4

- interpretation: acute coronary syndrome is likely
- maximal stenosis:
 - **4a:** 70-99% severe coronary stenosis
 - **4b:** left main >50% stenosis or three-vessel obstructive disease with $\geq 70\%$ stenosis
- management recommendations:
 - hospital admission with inpatient cardiology consultation
 - **4a:** consider invasive coronary angiography or functional assessment
 - **4b:** invasive coronary angiography (recommended)
 - P1-P4: aggressive preventive therapy and risk factor modification
 - consider other treatments including anti-anginal therapy and revascularization options as per guideline

CAD-RADS 5

- interpretation: acute coronary syndrome is very likely
- maximal stenosis: 100% - coronary occlusion
- management recommendations:
 - hospital admission with inpatient cardiology consultation
 - urgent invasive coronary angiography and revascularization in the setting of suspected acute coronary occlusion

- P1-P4: aggressive preventive therapy and risk factor modification
- consider other treatments including anti-anginal therapy and revascularization options as per guideline

CAD-RADS N

- interpretation: exclusion of acute coronary syndrome not possible
- maximal stenosis: nondiagnostic
- management recommendations: additional or alternative evaluation required

Plaque burden

Coronary plaque burden has been included in the CAD-RADS system under the designation “P” and can be categorized or graded according to the severity or overall amount into the following ²:

- P1: mild amount of plaque
- P2: moderate amount of plaque
- P3: severe amount of plaque
- P4: extensive amount of plaque

Since CAD-RADS 0 excludes the presence of plaques, the designation P0 is considered redundant ².

Different methods to grade or categorize the overall amount of coronary plaque include the following:

- [coronary artery calcium](#) (such as [Agatston score](#), [calcium volume score](#))
- [segment involvement score](#)
- [overall visual assessment](#)

However, there is currently no recommendation for a single specific method but rather the advice to select the technique considered most appropriate for a particular institution ².

Modifiers

The CAD-RADS categories can be supplemented by various modifiers that convey additional information including the following ²:

- modifier N: nondiagnostic study
- modifier HRP: high-risk plaque (updated from V = vulnerable)
- modifier I: ischemia (new)
- modifier S: stent
- modifier G: graft
- modifier E: exceptions (new)

The CAD-RADS coding is intended to follow the categories stenosis, plaque burden and finally modifiers with the symbol "/" (slash) separating categories and potential modifiers. If several modifiers are present they are listed in the above order ².

Non-diagnostic (N)

"N" can be used as a CAD-RADS category or as a modifier concerning the respective context of a non-diagnostic study. It has been recommended to be used as a category as a replacement for the numerical stenosis assessment in the setting of a non-diagnostic coronary segment and no other segment with at least moderate coronary stenosis (>50%) ². On the other hand, in the setting of significant coronary stenosis (>50%), it has been recommended to be used as a modifier following the category "P" for plaque burden.

High-risk plaque (HRP)

The term 'high-risk plaque features' has been recommended to replace the previous term [vulnerable plaque](#) and is the second listed modifier ². High-risk features have been associated with a higher risk or likelihood of the following ²:

- acute coronary syndrome irrespective of the degree of stenosis
- [major adverse cardiovascular events](#) in the setting of stable chest pain
- lesion-specific ischemia

As a result, patients might require hospital admission or observation in the setting of acute chest pain and require more aggressive preventive management ².

Ischemia (I)

The modifier "I" demonstrates that a CT-specific ischemia test has been performed either CT-FFR or stress CT perfusion, which might be used in the setting of moderate to severe stenosis or in proximal lesions $\geq 40\%$ including high-risk plaque features to further evaluate the stenosis and to define whether it is haemodynamically relevant. The modifier can be categorized as the following ²:

- positive (I+): in the setting of concordant lesion-specific abnormal CT-FFR (≤ 0.75), myocardial ischemia or peri-infarction ischemia in the defined coronary territory
- negative (I-): in the background of concordant lesion-specific normal CT-FFR (> 0.80) or absence of ischemic changes in a defined coronary territory on stress CT perfusion
- borderline (I+/-): in the setting of borderline CT-FFR (0.76-0.80)

Stent (S)

The modifier "S" marks the presence of a [coronary stent](#); [coronary in-stent restenosis](#) and [stent occlusion](#) are classified like the native [coronary arteries](#).

Graft (G)

The modifier “G” designates the presence of at least one [coronary artery bypass graft](#). In this setting lesions of the graft, the distal anastomosis and the run-off vessel as well as the non-bypassed are considered in the classification whereas stenosis bypassed by a patent graft is not. However, the overall plaque burden is assessed for both native coronary arteries and bypass grafts ².

Exceptions (E)

The modifier “E” indicates the presence of non-atherosclerotic coronary abnormalities also as a potential cause for coronary narrowing or stenosis such as [coronary artery dissection](#) or [congenital coronary artery anomalies](#) ².

Examples

- mild stenosis due to plaque with high-risk features: CAD-RADS 2/HRP
- non-interpretable coronary stent with a mild amount of plaque burden without evidence of additional obstructive coronary artery disease: CAD-RADS N/P1/S
- presence of stent and new moderate stenosis showing a plaque with high-risk features: CAD-RADS 3/HRP/S
- presence of a stent, bypass grafts, extensive amount of plaque and non-evaluable segments due to metal artifacts and circumferential plaques: CAD-RADS N/P4/S/G
- severe amount of plaque, presence of patent left [internal mammary artery](#) (LIMA) to the [left anterior descending artery \(LAD\)](#) and expected occluded proximal LAD, mild non-obstructive stenosis in the [right coronary artery \(RCA\)](#) and [left circumflex artery \(LCx\)](#): CAD-RADS 2/P3/G
- severe amount of plaque, patent left internal mammary artery (LIMA) to the left anterior descending artery (LAD) and occluded saphenous vein graft to the circumflex artery (Cx) and moderate stenosis in the right coronary artery: CAD-RADS 5/P3/G
- a moderate amount of plaque, severe stenosis (70-99%) in one segment with abnormal lesion-specific CT-FFR ≤ 0.75 and a non-diagnostic area in another segment: CAD-RADS 4/P2/N/I+
- no plaque, moderate stenosis due to coronary dissection: CAD-RADS 3/E