4th Universal Definition of Myocardial Infarction: New Terms, Updated Definitions, and Alternative Focus Areas for Query

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Learning Objectives

• At the completion of this educational activity, the learner will be able to:
  – Define acute myocardial infarction
  – Distinguish the types of acute myocardial infarction
  – Recognized the impact of acute myocardial infarction on payment and Medicare
    Hospital Centric Quality Metrics
Definition of Myocardial Infarction

_Circulation_ 2018; 138: e618–e651 ("Fourth Universal Definition of Myocardial Infarction")
Acute Myocardial Infarction (Acute MI)

Both acute myocardial injury and clinical ischemia must be present to meet the definition of acute MI.
Definition of Acute Myocardial Infarction

**Injury**

“Cardiac biomarkers (troponin)”**

**AND**

Symptoms

**OR**

**Clinical Ischemia**

New EKG findings

**OR**

Imaging studies/autopsy

**Biomarkers not required in defining AMI in setting of sudden cardiac death (type 3)**
Definition of Acute Myocardial Injury

- Detection of rise and/or fall in biomarkers cTn (cardiac troponin) or CKMB (creatine kinase myocardial band) with at least one value above the normal range. Cardiac troponin (cTn T and I) is the preferable marker to use.
- If cTn is elevated but does not fluctuate by at least 20%, this represents chronic elevation and would not be considered acute myocardial injury.
- The degree of elevation of cTn required to delineate acute myocardial injury related to ischemia will be determined by the setting in which the ischemia occurred.
- AMI associated with sudden cardiac death (type 3) can be made without biomarker determination.
Clinical Myocardial Ischemia: Symptoms**

- Angina (chest pain, jaw pain, left shoulder/arm pain)
- Angina equivalents (SOB, fatigue)
- Syncope (often due to arrhythmia)
- Flash pulmonary edema (not gradual decompensation of chronic heart failure)
- Palpitations
- Cardiac arrest

**Many patients are asymptomatic or can’t provide a history."
Clinical Myocardial Ischemia: EKG Changes

New (or presumably new) EKG changes

- ST segment elevation
- ST segment depression
- T wave changes
- Left bundle branch block (LBBB)
- Pathological Q waves
Clinical Definition of Acute Myocardial Ischemia: Imaging & Autopsy

• Nuclear scans (technetium, thallium) showing new loss of viable myocardium (not scar)
• New regional wall abnormality of left ventricle
• Identification of coronary thrombus on catheterization or at autopsy
• Identify a PCI complication (i.e., dissection)
Types of Myocardial Infarction

*Circulation* 2018; 138: e618–e651 (“Fourth Universal Definition of Myocardial Infarction”)
Types of Myocardial Infarction

1. Acute luminal compromise (plaque rupture and thrombosis)

2. Supply/demand mismatch

3. Associated with sudden death without biomarkers
Types of Myocardial Infarction

4a • PCI-related AMI

4b • Stent thrombosis

4c • Stent restenosis

5 • CABG-related
Acute Myocardial Infarction: Type 1 and 2

- Detection of a rise and/or fall of cardiac biomarkers (preferably troponin, cTnT or cTnI) with at least one of the following:
  - Symptoms of ischemia
    - Chest pain; arm pain; jaw pain; epigastric pain; SOB; syncope; fatigue; usually lasting > 20 minutes
    - Flash pulmonary edema; cardiac arrest
    OR
  - One of the following EKG changes
    - ST elevation MI (STEMI)—MCC if initial episode of care
    - Non-ST elevation MI (NSTEMI)—MCC if initial episode of care
    - New onset of left bundle branch block (aka LBBB)
    - Development of pathological Q waves
    OR
  - Imaging studies showing one of the following
    - Imaging studies showing new loss of viable myocardium or new onset of regional wall abnormality (thallium, technetium)
    - Identification of a coronary artery thrombosis on catheterization or at autopsy
## Acute Myocardial Infarction: Type 1 & 2

### Type 1 (Primary Coronary Event)
- Acute coronary artery obstruction or occlusion usually due to plaque rupture with resultant thrombus formation
- The preexisting coronary disease may or may not be obstructive
- Treatment is directed at relieving the obstruction and restoring normal blood flow in the artery

### Type 2 (Demand Ischemia)
- When a condition other than coronary artery disease is contributing to an imbalance between myocardial oxygen supply and/or demand resulting in ischemia that can result in infarction
- Treatment is to increase the supply or relieve the demand for myocardial oxygen
## Causes of Demand Ischemia & Type 2 MI

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Non-Cardiac Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Coronary endothelial dysfunction</td>
<td>• Anemia</td>
</tr>
<tr>
<td>• Coronary spasm</td>
<td>• Acute or worsening hypoxemia from any cause</td>
</tr>
<tr>
<td>• Tachy- or bradyarrhythmia</td>
<td>• Acute hypotension from any causes</td>
</tr>
<tr>
<td>• Uncontrolled hypertension</td>
<td>• Sepsis</td>
</tr>
<tr>
<td>• Acute CHF</td>
<td>• Others (i.e., surgery)</td>
</tr>
<tr>
<td>• Valvular heart disease</td>
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</tbody>
</table>
AMI Resulting in Sudden Cardiac Death Before Biomarkers (Type 3)

• Sudden unexpected cardiac death with symptoms suggestive of myocardial ischemia, accompanied by new ischemic changes on ECG or ventricular fibrillation, but death occurs before biomarkers (preferably troponin) can be adequately assessed
PCI-Related AMI (Type 4a)

- CE elevations of troponins (cTn)
  - > 5x above the normal range in a person with normal baseline troponins or
  - 20% elevation above baseline in persons with stable pre-procedural elevated troponins (however, the absolute value must be 5x above normal)

  AND

- Symptoms of myocardial ischemia

  OR

- New EKG findings

  OR

- Angiographic findings of a procedural complication (i.e., dissection)

  OR

- Imaging studies showing new loss of viable myocardium or new onset of a regional wall abnormality
AMI Due to Stent Thrombosis (Type 4b)

- Stent/scaffold thrombosis detected by angiography or autopsy with a rise and/or fall in the troponins with at least one value being outside the normal range.
  - 4b follows the definition of type 1 & type 2 (i.e., only requires a rise or fall above normal in persons without chronic stable elevations of troponins)
  - There is no time frame
  - Be sure the stent thrombosis is the culprit lesion
AMI Due to In-Stent Restenosis (Type 4c)

- Rise or fall in cardiac troponin with at least one value above the normal range

  AND

- > 50% stenosis at coronary arteriography (or a complex lesion) in the absence of more obstructive CAD since the previously successful PCI that could account for the AMI
AMI Related to CABG (Type 5)*

- Troponins greater than 10 times* the upper limits of normal in patients with normal baseline values within 48 hours
  
  **AND**
  
- EKG findings of new pathological Q waves or new LBBB
  
  **OR**
  
- Angiographic evidence of new graft or new native artery occlusion
  
  **OR**
  
- Imaging studies demonstrating new loss of viable myocardium or new onset of a regional wall abnormality

*This criterion is also applied to other cardiac surgical procedures such as valve replacement (open or transcatheter) and ablation of arrhythmias.*
Acute Ischemic Syndrome: Takotsubo Cardiomyopathy

• “Stress-induced cardiomyopathy” or “broken heart syndrome.”
• These patients present like a type 1 STEMI, but unless you can demonstrate plaque rupture or spontaneous coronary dissection, acute MI should not be coded with this entity.
• There is controversy regarding the cause, but most believe it is due to catecholamine surge causing microvascular ischemia/infarction.
• Usually initiated by physical, emotional, and mental stress.
• Has also been linked to certain medications (SNRIs).
• Acute MI should not be coded in these patients. It is integral to the syndrome.
Acute Ischemic Syndrome: Takotsubo Cardiomyopathy

- Patients present with symptoms suggesting ACS
- ECG may show ST elevation or depression
- Cardiac biomarkers are usually elevated
- Left heart catheterization shows normal coronary arteries
- Left ventriculogram typically shows apical ballooning, though other patterns can exist
Classic Left Ventriculogram Finding in Takotsubo

Ballooning of LV apex
“Octopus jar” configuration

Source: Dr. Huff’s personal teaching file
Impact of Acute MI on Reimbursement & Quality Data

AHA Coding Clinic for ICD-10-CM/PCS, Fourth Quarter 2017, p, 12.

ICD-10-CM Official Guidelines for Coding and Reporting:
   Section I.C. Chapter 9 e.
   Section II.C and G

YNHHSC/CORE via Quality Net

2018 Condition-Specific Measures Updates and Specifications Report Hospital-Level 30-Day Risk-Standardized Mortality Measures
2018 Condition-Specific Measures Updates and Specifications Report Hospital-Level 30-Day Risk-Standardized Readmission Measures
Acute Myocardial Ischemic Syndromes

Signs of myocardial ischemia
OR
Acute elevation of troponin

Acute coronary*
syndrome/USA
Acute myocardial injury**
Demand ischemia

Signs of myocardial ischemia
AND
Acute elevation of troponin

Acute MI
• All types (1–5)
• STEMI
• NSTEMI

*Some physicians include NSTEMI in this definition; however, AMI cannot be coded unless specifically stated.
** There is no code for non-traumatic acute myocardial injury in ICD-10-CM. It is our opinion to use the same code as for demand ischemia, I24.8 “other forms of acute ischemic heart disease” if it is due to oxygen supply and demand mismatch.
Elevated Troponins Without Signs or Symptoms of Ischemia

- “Myocardial Injury without Infarction” (Fourth Universal Definition of MI)
- “Non-MI troponin elevation” (suggested by American College of Cardiology) (R79.89)

It is our position that R79.89 should not be used for myocardial injury on an inpatient basis, when an etiology is established. We feel this code is used when there is no etiology provided or suggested. Our approach:
  - Verify that the patient does NOT meet MI definition
  - If no MI is supported, code only the cause of the elevated troponin.

Physician clarifications will frequently be needed to define the etiology.
Acute Myocardial Injury Without Infarction: Causes

Oxygen supply and demand mismatch (demand ischemia) is #1

- Almost every acute non-traumatic disorder of the heart involves this etiology (acute heart failure; A fib with RVR; hypertensive emergency; acute cor pulmonale, etc.)
- Many acute systemic illnesses also put increased oxygen demands on the myocardium (particularly those with hypoxemia; fever; tachycardia; etc.)
- Demand ischemia without infarction is assigned to I24.8

Traumatic Injury to the heart (blunt injury; chest compression)
Cardiac ablation procedures (injury expected)
Drug induced (toxic cardiomyopathy)
Myocarditis
Acute Myocardial Injury or Acute Type 2 MI

Patient was admitted for SOB with CHF and elevated troponin. Could the cause of the elevated troponin be more clearly specified as:

- Type 2 MI (I21.A1)
- Demand ischemia due to CHF without MI (I24.8)
- Other ___________________ (TBD)
- Clinically Undeterminable (R79.89)

- Patient admitted for SOB with HR of 120 and RR of 32. BNP was elevated at 800. Chest X-ray demonstrated alveolar edema. Oxygen saturations on RA were 90% on room air. EKG revealed regular rhythm at 124. No ST-T changes. Initial troponin was normal but 2 subsequent were mildly elevated above the normal limits. There was no history of CKD.
- Final diagnosis was acute diastolic HF with elevated troponin.
Acute Cardiac Ischemic: Documentation

- **Define** the acute ischemic syndrome and its POA status (don’t forget 4 weeks for AMI of same type)
  
  Ischemia or injury **vs.** infarction

- What is the **etiology** of the acute ischemic syndrome? (culprit lesion)
  
  Native disease **vs.** procedural-related

- When and where were any invasive cardiovascular **procedure(s)** performed?
Without coronary artery revascularization procedures

<table>
<thead>
<tr>
<th>Acute Ischemic Disorder</th>
<th>Principal Dx</th>
<th>ODX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Cath</td>
<td>Cath</td>
</tr>
<tr>
<td>ACS/USA*</td>
<td>311</td>
<td>286–287</td>
</tr>
<tr>
<td>Demand ischemia*</td>
<td>311</td>
<td>286–287</td>
</tr>
<tr>
<td>Acute myocardial injury*</td>
<td>311</td>
<td>286–287</td>
</tr>
<tr>
<td>Acute MI (all)</td>
<td>280–285</td>
<td>280–285</td>
</tr>
</tbody>
</table>

*These entities will infrequently be used as the principal diagnosis. The cause of these entities such as CAD or cause of demand ischemia will be used. Additionally, if acute MI is documented during the same admission, only the acute MI will be coded. These are important ODXs to recognize.
Acute Cardiac Ischemic: Define Syndrome

**Ischemia w/o Infarction**
- **Unstable angina (USA)***—CC
  - Crescendo/accelerated/ worsening
  - Pre-infarction
  - New onset (de novo)
  - Intermediate coronary syndrome
- **Acute coronary syndrome****—CC
- **Demand ischemia****—CC

*Stable and unspecified angina are not CCs.

**Ischemia with Infarction**
- **NSTEMI**
  - Subendocardial
  - Non Q wave
  - Non transmural
- **STEMI**
  - Q wave
  - Transmural

➢ **Acute MI is** used for first 4 weeks
➢ **Subsequent MI is** a new acute MI within the 4-week period

* Some physicians use these terms to include NSTEMI. However, the NSTEMI has to be documented.
Acute Cardiac Ischemic: Etiology

**Not Related to Medical Care**

- **Coronary artery disease (includes CAD of grafts)**
  - Angina only: use CAD as PDX
  - Myocardial infarction: use MI as PDx

- **Demand ischemia**
  - *Typically the cause of the demand ischemia will be the PDx, and AMI (usually NSTEMI) will be listed as an ODX.*

**Complication of Medical Care**

- **Stents, grafts, or procedure**
  - Thrombosis
  - Embolus
  - Unspecified occlusion

If the ischemic syndrome is due to one of the above involving a stent or graft, the complication code is used as the PDX and the type of MI (STEMI; NSTEMI; type 4a, 4b, 4c, or 5) are used as ODXs.
Case #1

- Patient presents with acute onset of chest pain and transient elevation of troponin. EKG demonstrated ST elevation across anterior leads. Heart catheterization revealed a 90% in-stent restenosis (“ISR”) of LAD and a 95% occlusion of the native circumflex. Both lesions were dilated and DES placed. Patient was discharged on Plavix, aspirin, carvedilololol, and atorvastatin.

**Probable culprit lesion

**Option 1

Ac. STEMI – PDx (Query)
- MS-DRG 247 (RW: 2.0771)
- Patient would be in cohort for AMI for 30-day mortality/readmission
- Payment bundle AMI

**Option 2

In-stent restenosis – PDx (Query)
Ac. STEMI MI – ODx1 (Query)
- MS-DRG 246 (RW: 3.2388)
- Payment bundle for AMI

**Probable culprit lesion
Case #2

• Patient presents in atrial fibrillation with rapid ventricular response (HR 180) associated with chest pressure and SOB. The EKG revealed some atrial fibrillation with inverted T waves but no ST elevation. Troponins remained normal. Patient was treated with IV cardizem and returned to sinus rhythm. Patient had an EKG with scan performed revealing no ischemia. Patient was discharged on oral amiodarone and carvedilol. Final diagnosis was new-onset atrial fibrillation and rate-related angina.

Option 1

Atrial fibrillation – PDx
ODx1 – angina unspecified
– MS-DRG 310 (RW: 0.5623)

Option 2

Atrial fibrillation – PDx
ODx1 – unstable angina or demand ischemia – query
– MS-DRG 309 (RW: 0.7635)
Circulatory Medical MS-DRG Hierarchy

• Acute MI is defined as occurring within 4 weeks of initial presentation/diagnosis. If a patient has another acute MI within the 4-week period, the second AMI is considered a subsequent MI. Both would be coded. Sequencing depends upon circumstances of admission.

• When a patient is admitted with any circulatory disorder and does not have an OR procedure, the case will be assigned to MS-DRGs 280–285 regardless of whether the acute MI is listed as PDX or as a secondary diagnosis.

• When a patient is admitted with any circulatory disorder and does not have an OR procedure and does not have an acute MI or a subsequent MI assigned and undergoes a diagnostic cardiac catheterization only, it will be assigned to MS-DRGs 286–287.
Circulatory Medical MS-DRG Hierarchy

- **Example #1A**: Patient admitted with AMI and acute diastolic HF
  - AMI-PDx; Ac diastolic HF-ODx: MS-DRG 280 (RW 1.6571)
  - Acute diastolic HF-PDx; AMI-ODx: MS-DRG 282 (RW 0.7490)
- **Example #1B**: Patient admitted with CHF and develops AMI after admission
  - Acute diastolic HF-PDx; AMI-ODx: MS-DRG 282 (RW 0.7490)
- **Example #2**: Patient is readmitted in 3 weeks for a new AMI
  - Subsequent MI-PDx; AMI-ODx: MS-DRG 282 (RW 0.7490)
- **Example #3**: Acute diastolic HF undergoes diagnostic catheterization
  - Acute diastolic heart failure; heart cath: MS-DRG 293 (RW 0.6656)
- **Example #4**: AMI undergoes diagnostic catheterization
  - AMI-PDX; heart cath: MS-DRG 282 (RW 0.7490)

This hierarchy does not apply if a revascularization procedure is performed.
Case #3

• 76 BF presented with chest pain and SOB. EKG showed new ST depression and chest x-ray revealed pulmonary edema. There was a rise in troponin. Patient received multiple doses of IV Lasix. Cardiac cath revealed no coronary disease and normal EF. Patient was discharged on carvedilol and lisinopril. Patient was diagnosed as acute HFpEF and demand ischemia.

Option 1

Ac. NSTEMI – PDx (Query)
Acute diastolic HF – ODx1
  – MS-DRG 280 (RW: 1.6571)
  – Patient would be in cohort for AMI for 30-day mortality/readmission
  – Payment bundle for AMI

Option 2

Acute diastolic HF – PDx
Ac. NSTEMI MI – ODx1 (Query)
  – MS-DRG 282 (RW: 0.7490)
  – Cohort for 30-day mortality and readmission for CHF
  – Payment bundle for AMI
Case #4

- A 56 female patient presents very SOB and with severe chest pain following an argument with her spouse. EKG showed T wave inversion without ST elevation; chest x-ray demonstrated pulmonary edema; troponins show a significant rise; cardiac catheterization showed apical ballooning and normal coronary arteries. Patient was treated with IV Lasix and placed on beta blockers. Final diagnosis was Takotsubo syndrome with acute systolic heart failure transient and acute MI.
- What should be the principal diagnosis?

Option 1

Takotsubo syndrome – PDx
ODx1 – Ac. systolic HF
- MS-DRG 286 (RW: 2.1808)
## 30-Day Mortality & Readmission: Acute Myocardial Infarction

<table>
<thead>
<tr>
<th>ICD10-CM</th>
<th>Description</th>
<th>Cohort Inclusion*</th>
</tr>
</thead>
<tbody>
<tr>
<td>I21.0x</td>
<td>STEMI/Type 1 MI of Anterior wall</td>
<td>Y</td>
</tr>
<tr>
<td>I21.1x</td>
<td>STEMI/Type 1 MI of Inferior wall</td>
<td>Y</td>
</tr>
<tr>
<td>I21.2x</td>
<td>STEMI/Type 1 MI of other site(s)</td>
<td>Y</td>
</tr>
<tr>
<td>I21.3</td>
<td>STEMI/Type 1 MI unspecified site</td>
<td>Y</td>
</tr>
<tr>
<td>I21.4</td>
<td>NSTEMI/Type 1 (any site)</td>
<td>Y</td>
</tr>
<tr>
<td>I21.9</td>
<td>AMI unspecified</td>
<td>Y</td>
</tr>
<tr>
<td>I21.A1</td>
<td>AMI type 2</td>
<td>N</td>
</tr>
<tr>
<td>I21.A9</td>
<td>AMI type 3, 4, and 5</td>
<td>N</td>
</tr>
<tr>
<td>I22.X</td>
<td>Subsequent MI (only used with type I and unspecified)-First MI must be Type 1 or unspecified</td>
<td>N</td>
</tr>
</tbody>
</table>

*Quality cohort definition is based on the ICD-10 principal diagnosis code and not the DRG assignment.
Case #5

• Patient presents with permanent atrial fibrillation acute onset of atrial fibrillation with heart rate of 140 with chest pain and transient elevation of troponin. EKG demonstrated NSTEMI. Heart catheterization revealed a 95% occlusion of the native circumflex with no thrombus. The lesion were dilated and DES placed. Patient was discharged on Plavix, aspirin, carvedilolol and atorvastatin.

Option 1

Ac. NSTEMI - PDx (Query)
- MSDRG 247 (RW: 2.0771)
- Patient would be in cohort for AMI for 30-day mortality/readmission

Option 2

Type 2 MI– PDx (Query)
- MSDRG 247 (RW: 2.0771)
Thank you. Questions?

Info@Enjoincdi.com

In order to receive your continuing education certificate(s) for this program, you must complete the online evaluation. The link can be found in the continuing education section of the program guide.