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Clinical Outcomes Associated with Appropriate Use of Percutaneouscoronary Intervention

Najmi Fauzan Tarsidin[1], Panji Fortuna Hadisoemarto[2], Noormarina Indraswari[3], Lusiana Siti Masytoh[4], Badai Bhatara Tiksnadi[5]

[1] Center for Health Technology Assessment, Universitas Padjadjaran, Indonesia
[2,3]Department of Public Health, Faculty of Medicine, Universitas Padjadjaran, Indonesia
[4]Health Technology Assessment Committee, Ministry of Health of the Republic of Indonesia, Indonesia
[5]Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Padjadjaran, Indonesia
**Corresponding Author: panji.fortuna@unpad.ac.id*

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Abstract

The Appropriate Use Criteria (AUC), developed by the American College of Cardiology Foundation, serve as a guideline to optimize patient selection for percutaneous coronary intervention (PCI); however, their association with clinical outcomes remains unclear. This systematic review examines the relationship between AUC classification and clinical outcomes in patients undergoing PCI for stable ischemic heart disease and acute coronary syndrome, based on publications retrieved from The Cochrane Library, EMBASE, and MEDLINE from January 2009 to October 2024, including studies utilizing the 2009 and 2012 AUC versions as well as a country-specific adaptation. Five studies comprising 55,687 patients met the inclusion criteria. Two studies assessed short-term and in-hospital clinical outcomes; one reported a higher incidence of major adverse cardiovascular events (MACE) among patients receiving inappropriate PCI. At the same time, the other found no significant impact of AUC classification on short-term outcomes. Regarding long-term outcomes, three out of four studies found no significant association between AUC classification and long-term clinical outcomes. Taken together, the available evidence remains limited and inconsistent, underscoring the need to refine the AUC framework further to ensure a more evidence-based approach to guiding patient selection and improving outcomes among patients undergoing PCI.

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Introduction

The American College of Cardiology Foundation (ACCF) established appropriateness criteria for revascularization as a complement to the American College of Cardiology and the American Heart Association (ACC/AHA) guideline documents (Patel et al., 2009). These criteria provide expert

consensus opinions to help clinicians deliver optimal patient care. A scoring system was established to evaluate the appropriateness of revascularization procedures, including percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG) surgery (Patel et al., 2012).

The scoring methodology involves presenting panelists with hundreds of scenarios that replicate possible real-world patient presentations. Each scenario is rated on a scale from one to nine: scores of seven to nine indicate that revascularization is appropriate, scores of four to six indicate that appropriateness is uncertain, and scores of one to three indicate that revascularization is inappropriate (Lin et al., 2020; Liu et al., 2023). Inappropriate revascularization is assumed to expose patients to avoidable procedural risks and unnecessary healthcare costs, whereas appropriate procedures are expected to provide clearer clinical benefits (Patel et al., 2009). However, whether these appropriateness categories are associated with real-world clinical outcomes remains uncertain. Therefore, this review aims to determine whether PCI classified as inappropriate (scores 1–3) is associated with higher short-term (in-hospital or 30-day) and long-term (1-year or longer) rates of major adverse cardiovascular events (MACE), defined as death, myocardial infarction, and repeat revascularization, compared with PCI classified as appropriate (scores 7–9).

Materials and Methods

We conducted and reported this systematic review in accordance with the Cochrane Handbook for Systematic Reviews of Interventions. We searched The Cochrane Library, MEDLINE, and EMBASE databases for cohort and randomized trials reports written in English or Bahasa Indonesia, published from January 2009 to October 2024. The search terms used were ("percutaneous coronary intervention" OR "PCI" OR "drug-eluting stents") AND ("appropriate use" OR "appropriate use criteria") AND ("outcome" OR "coronary artery bypass" OR "myocardial revascularization" OR "coronary thrombosis" OR "quality-adjusted life years" OR "major adverse cardiac events" OR "mortality"). In addition, a manual search was conducted to identify relevant articles not indexed in the databases. We included peer-reviewed published studies that met all of the following criteria: (1) used a randomized controlled trial (RCT), cluster-randomized trial, or cohort design; (2) were written in English or Bahasa Indonesia; (3) evaluated PCI performed in patients with acute coronary syndrome (ACS) or stable ischemic heart disease (SIHD) and classified the procedures according to appropriateness categories; and (4) reported clinical outcomes, including major adverse cardiovascular events (MACE), such as death, myocardial infarction (MI), and repeat revascularization, across two or more appropriateness categories. Studies were excluded if they evaluated only one appropriateness category and therefore lacked a comparison group.

We included peer-reviewed published studies that met the following criteria: (1) used a randomized-controlled trial (RCT), cluster-randomized trial, or cohort designs; (2) classified PCI procedure in acute coronary syndrome (ACS) or stable ischemic heart disease (SIHD) based on appropriateness categories; (3) studies examining clinical outcomes, including major adverse cardiovascular events (MACE) such as death, myocardial infarction (MI) and revascularization across various appropriateness categories. Studies were excluded if they focused on only one appropriateness category (i.e., no comparison group). Two investigators (NFT and PFH) independently evaluated the studies for inclusion in the review.

Two investigators (NI and BBT) assessed the potential risk of bias of the included studies using the Cochrane Risk of Bias tool for randomized trials and the Risk of Bias in Non-randomized Studies tool for cohort studies (Higgins et al., 2024). Two investigators (NFT and PFH) extracted the data independently using a standardized data extraction form. The following variables were recorded: author(s), sample size, study population (ACS and/or SIHD), study setting, study design,

AUC version used, presence of angina, extent of coronary vessel disease, cardiovascular risk factors, comorbidities, appropriateness categories, clinical outcomes assessed, and follow-up length.

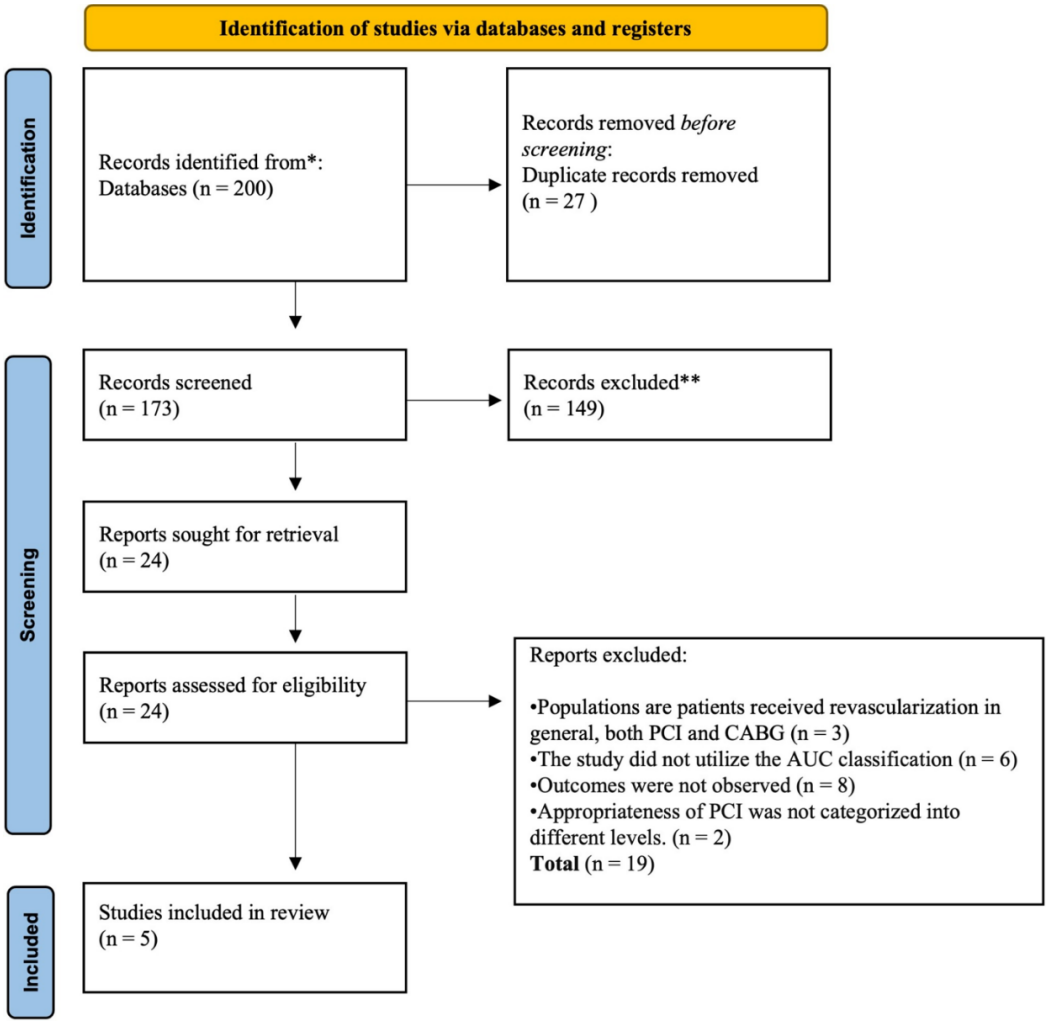
This review assesses differences in the incidence of predefined clinical outcomes across appropriateness categories. PCI appropriateness was categorized as appropriate, uncertain, or inappropriate according to the 2009/2012 ACC/AHA AUC (Patel et al., 2009; Patel et al., 2012). The 2017 ACC UAC categorized patients into appropriate, maybe appropriate, and rarely appropriate (see appendix) (Patel et al., 2017). The Korean AUC categorized PCI appropriateness differently but provided a direct comparison with the 2009/2012 ACC AUC (Gwon et al., 2017). For comparability, study results were summarized using descriptive statistics grouped by the respective AUC version.

Results and Discussions

Result

A total of 200 studies were identified through database searches. After removing 27 duplicate records, 173 studies underwent title and abstract screening, with 149 excluded for irrelevance to the study objectives. The remaining 24 studies were further evaluated for full-text eligibility. Ultimately, five studies met the inclusion criteria and were included in the final analysis (Figure 1).

Figure 1. *Summary of Study Selection Process*



The five included studies involved a total of 55.687 patients, comprising 43.439 SIHD and 12.248 ACS patients. SIHD cases were observed in all studies, whereas only two included ACS cases (Seixas et al., 2017; Gwon et al., 2017). The 2009 and 2012 ACCF AUC (Bradley et al., 2015; Seixas et al., 2017) were evaluated in one study and three studies, respectively (Barbash et al., 2013), (Bradley et al., 2015), (Seixas et al., 2017), (Koshy et al., 2024). One of the included studies evaluated country-specific adaptation of AUCs. The longest follow-up period among the studies was three years, while the shortest included an immediate or in-hospital period (Table 1).

Table 1
Characteristics of included studies

Study	Barbash (2013)	Bradley (2015)	Seixas (2017)	Gwon (2017)	Koshy (2024)
Sample Size	3817	1987	1108	44967	3687
ACS	NR	NR	529	11719	NR
SIHD	3817	1987	579	33248	3687
Setting	USA	USA and Canada	Brazil	Korea	USA
Design	Prospective cohort	RCT (post-hoc analysis)	Prospective cohort	Retrospective cohort	Prospective cohort
Follow-up Length	In-hospital, 30 days & 1 year	3 years	2 years	In-hospital	1 year
AUC version	2009	2012	2012	Korean PCI Practice Pattern	2012
Classification	A, U, I	A, U, I	A, U, I	Class A/A, Class B/U, Class C/I	A, U, I
Outcome	MACE	Death, MI, revascularization. Health status (angina, quality of life)	MI, death or MI, revascularization, and MACE	Death, MI, death or MI, and stent thrombosis	Death, MI, stroke

A: appropriate, ACS: acute coronary syndrome, AUC: appropriate use criteria, I: inappropriate, MACE: major adverse cardiac event, MI: myocardial infarction, NR: not recorded, SIHD: stable ischemic heart disease, U: uncertain.

The included cohort studies were considered to have moderate to serious biases (Table 2). In contrast, the included trial was considered to have some concerns regarding selection bias due to its post hoc analysis (Bradley et al., 2015).

Table 2
Risk of Bias of the Included Cohort

Study	Confounding	Selection of participants into the study	Classification of Interventions	Deviations from intended interventions	Due to missing data	Measurement outcomes	Selection of reported results	Overall Bias
Barbash (2013)	Moderate	Low	Moderate	Moderate	Serious	Moderate	Low	Serious
Seixas	Serious	Low	Low	Moderate	Moderate	Moderat	Low	Serious

(2017)						e		
Gwon (2017)	Moderate	Low	Low	Moderate	Moderate	Low	Low	Moderate
Koshy (2024)	Moderate	Low	Low	Moderate	Moderate	Low	Low	Moderate

The population characteristics of the included studies are described in Table 3.

Table 3
Summary of findings: population characteristics

	Barbash 2013			Bradley 2015			Seixas 2017			Gwon 2017			Koshy 2024		
Appropriateness	A	U	I	A	U	I	A	U	I	A	U	I	A	U	I
N	654	1604	54	654	279	53	375	480	215	30426	12963	1578	1718	374	1595
CCS															
No Angina (%)	-	-	-	7,0	12,0	77,0	-	-	-	2,0	3,0	25,0	-	-	-
I - II (%)	-	-	-	64,0	77,0	23,0	-	-	-	17,0	11,0	52,0	-	-	-
III - IV (%)	-	-	-	29,0	11,0	-	-	-	-	4,0	1,0	-	-	-	-
Extent of coronary disease															
1VD (%)	-	-	-	22,0	57,0	38,0	-	-	-	-	-	-	-	-	-
2VD (%)	-	-	-	41,0	38,0	58,0	-	-	-	59,0	51,0	39,0	-	-	99,4
3VD (%)	-	-	-	36,0	5,0	4,0	-	-	-	28,0	17,0	-	6,4	81,0	15,1
LM (%)	-	-	-	-	-	-	-	-	-	10,0	0,2	0,2	26,2	36,1	30,6
Cardiovascular disease history															
Previous MI (%)	48,0	24,0	24,0	47,0	37,0	37,0	47,0	14,0	14,0	-	-	-	-	-	-
Previous HF (%)	34,0	16,0	15,0	5,0	6,0	6,0	-	-	-	-	-	-	50,2	42,0	43,2
Previous PCI (%)	62,0	27,0	20,0	36,0	13,0	8,0	74,0	14,0	19,0	-	-	-	22,6	20,1	11,8
Previous CABG (%)	23,0	-	39,0	10,0	9,0	2,0	52,0	14,0	5,0	-	-	-	-	-	-
Stroke (%)	-	-	-	8,0	7,0	2,0	-	-	-	-	-	-	-	-	-
PAD (%)	37,0	18,0	13,0	-	4,0	11,0	-	-	-	-	-	-	9,7	17,9	10,8
Risk factor and comorbidities															
Hypertension (%)	92,0	87,0	82,0	70,0	63,0	45,0	80,0	77,0	80,0	-	-	-	93,3	92,8	94,9
Dyslipidemia (%)	86,0	86,0	82,0	47,0	53,0	49,0	63,0	62,0	63,0	-	-	-	92,5	88,5	94,7
Diabetes (%)	42,0	41,0	20,0	35,0	28,0	22,0	39,0	31,0	31,0	36,0	36,0	39,0	37,7	54,3	56,6
CKD (%)	48,0	21,0	17,0	-	-	6,0	7,0	5,0	5,0	7,0	6,0	1,0	4,4	4	9,1
COPD (%)	-	-	-	10,0	7,0	-	-	-	-	-	-	-	-	-	-
Smoking (%)	-	-	-	27,0	31,0	34,0	14,0	5,0	6,0	-	-	-	20,3	25,7	23,4

CCS: Canadian Cardiovascular Society Class, CKD: Chronic Kidney Disease, COPD: Chronic Obstructive Pulmonary Disease,
VD: Vessel Disease, LM: Left-main, MI: Myocardial Infarction, HF: Heart Failure, PCI: Percutaneous Coronary Intervention,
CABG: Coronary Artery Bypass Graft, PAD: Peripheral Arterial Disease

Summary of MACE and revascularization outcomes from the included studies is presented in Table 4.

Table 4
Summary of Findings: MACE and revascularization

AUC	Study	Population	Appropriate-ness category	Number of major adverse cardiovascular events observed (%)					
				MACE	Death	MI	Death or MI	Stroke	Revascu-larization
ACC 2009	Barbash (2013)	SIHD (in-hospital)	A	29 (1.9)	20 (1.3)	1 (0.1)			
			U	39 (1.9)	31 (1.9)	0			
			I	6 (11)	4 (7.4)	0			
		SIHD (30 days)	A	32 (3.2)	22 (2.2)	1 (0.1)			
			U	41 (4.1)	34 (3.4)	0			
			I	3 (7)	4 (9.3)	0			
		SIHD (1 year)	A	103 (13.1)	55 (7)	4 (0.5)			
			U	122 (15.3)	80 (10.1)	1 (0.1)			
			I	4 (11.8)	4 (11.8)	0			
ACC 2012	Bradley (2015)	SIHD	A		56 (9.0)	91 (14.0)	135 (21.0)		154 (24.0)
			U		11 (4.0)	25 (9.0)	34 (12.0)		32 (11.0)
			I		1 (2.0)	5 (9.0)	6 (11.0)		5 (9.0)
	Seixas (2017)	ACS and SIHD	A	51 (13.6)		36 (9.6)	12 (3.2)		7 (1.0)
			U	60 (12.5)		46 (9.6)	9 (1.9)		10 (2.1)
			I	20 (9.3)		15 (7.0)	3 (1.4)		2 (0.9)
	Koshy (2024)	SIHD	A	55 (4.1)	20 (1.5)	33 (2.5)		2 (0.2)	
			U	41 (14.8)	122 (9.1)	84 (6.3)		10 (0.8)	
			I	91 (7.0)	45 (3.4)	53 (4.0)		5 (0.4)	
Korean PCI	Gwon (2017)	ACS	Class A		940 (4.1)	536 (2.4)		66 (0.3)	

	Class B	38 (0.4)	62 (0.6)	15 (0.1)
	Class A	25 (0.3)	95 (1.2)	5 (0.1)
SIHD	Class B	13 (0.5)	7 (0.3)	4 (0.2)
	Class C	7 (0.4)	1 (0.1)	0 (0)

A: Appropriate, ACC: American College of Cardiology, ACS: Acute Coronary Syndrome, AUC: Appropriate Use Criteria, I: Inappropriate, MACE: Major Adverse Cardiovascular Events, MI: Myocardial Infarction, U: Uncertain

The incidence of clinical outcomes in a study using the 2009 ACCF AUC

A prospective analysis by Barbash et al. (2013) reported the cumulative incidence of MACE and major complications at the in-hospital or immediate period, at 30-day follow-up, and at 30-day and 1-year follow-up. Patients who underwent inappropriate PCI experienced worse in-hospital outcomes, as evidenced by significantly higher rates of major complications compared to the appropriate and uncertain PCI categories (11% vs. 1.9% vs. 2.4%, respectively, p<0.001) that were associated with longer stays in the intensive care unit (ICU) and overall hospitalization. MACE was highest in the inappropriate PCI category at 30-day follow-up30-day follow-up (3.2% appropriate, 4.1% uncertain, and 7% inappropriate; p=0.32) (Barbash et al., 2013).

At the 1-year follow-up, MACE was highest in the uncertain PCI category (13.1% appropriate, 15.3% uncertain, 11.8% inappropriate; p=0.43). A multivariable analysis of 1-year mortality revealed that PCI appropriateness was not a significant predictor of long-term MACE. The hazard ratio (HR) for appropriate compared to inappropriate PCI was 0.54 (95% CI: 0.19–1.5), while the HR for uncertain compared to Inappropriate PCI was 0.76 (95% CI: 0.28–2.1) (Barbash et al., 2013).

Differences in the incidence of clinical outcomes in studies using the 2012 ACCF AUC

Bradley et al. (2015) conducted a post hoc analysis of a 3-year prospective RCT, in which SIHD patients were randomized to an intervention group (PCI + optimal medical therapy (OMT)) or a control group (OMT alone) (Bradley et al., 2015; Desai et al., 2015; Panuccio et al., 2024). There were no statistically significant differences in death, MI, or composite clinical outcomes between PCI categories and OMT alone (Chacko et al., 2020; Soriano-Moreno et al., 2024). The cumulative incidence of death in the PCI categories compared to OMT alone was 9% in appropriate (HR = 0.96, 95% CI: 0.67–1.37, p=0.81), 4% in uncertain (HR=0.59, 95% CI: 0.28–1.25, p=0.17), and 2% in inappropriate (HR=0.22, 95% CI: 0.02–1.94, p=0.17) PCI categories. The cumulative incidence of MI was 14% in appropriate (HR=1.11, 95% CI: 0.83–1.49, p=0.48), 9% in uncertain (HR=1.85, 95% CI: 0.95–3.61, p=0.07), and 9% in inappropriate (HR=0.63, 95% CI: 0.20–2.01, p=0.43) PCI categories. The cumulative incidence of the composite outcome of death or MI was 21% in appropriate (HR=1.09, 95% CI: 0.86–1.39, p=0.48), 12% in uncertain (HR=1.15, 95% CI: 0.70–1.90, p=0.58), and 11% in inappropriate (HR=0.48, 95% CI: 0.18–1.30, p=0.15) PCI categories. Rates of revascularization were significantly lower among patients in the intervention group who received PCI within the appropriate and uncertain categories with a cumulative incidence of 24% in appropriate (HR=0.65, 95% CI: 0.53–0.80, p<0.001), 11% in uncertain (HR=0.49, 95% CI: 0.32–0.76, p=0.001), and 9% in inappropriate (HR=0.42, 95% CI: 0.14–1.22, p=0.11) PCI categories (Bradley et al., 2015; Mootz et al., 2024; Perera et al., 2022).

In a 2-year prospective study evaluating the use of PCI in cases of ACS and SIHD, Seixas et al. (2017) reported no statistically significant difference in the cumulative incidence of MACE between PCI categories (13.6% in the appropriate group, 12.5% in the uncertain group, and 9.3% in the inappropriate group, p=0.47). Likewise, they did not observe a statistically significant difference in

the cumulative incidence of revascularization (1.0% in the appropriate group, 2.1% in the uncertain group, and 0.9% in the inappropriate group; p=0.59). This study found no correlation between appropriateness classification and adverse clinical outcomes. Procedures classified as uncertain or inappropriate did not lead to higher complication rates than those in the appropriate PCI category (Seixas et al., 2017).

Koshy et al. (2024) conducted a study to evaluate the one-year outcomes following PCI in patients with SIHD. The study included three groups based on the appropriateness of the procedure, namely 1) patients for whom PCI was recommended according to clinical guidelines (classified as appropriate), 2) patients who were indicated for CABG but underwent PCI instead (classified as inappropriate), and 3) patients who were ineligible for CABG and underwent PCI (classified as uncertain). The study found that the primary composite outcome of MACE at one year occurred in 4.1% of patients in the appropriate PCI category, 7.0% in the inappropriate PCI category (HR=1.67, 95% CI 1.08–3.56, p=0.02), and 14.8% in the uncertain PCI category (HR=3.26, 95% CI 1.28–3.65, p=0.004). Patients in the inappropriate and uncertain PCI groups faced a significantly higher risk of all-cause death and stroke when compared to those in the appropriate PCI group (Koshy et al., 2024).

The incidence of clinical outcomes in a study using the Korean AUC

A study conducted by Gwon et al. (2017) used the Korean PCI Practice Pattern (KP3) algorithm, adapted from the ACCF AUC 2009 and 2012. In this system, class A follows a more conservative approach, using PCI only when strongly supported by randomized trials, often favoring medical therapy or CABG when appropriate. Class C represents a more aggressive approach, where PCI is performed despite weaker supporting evidence, often in cases where medical therapy or CABG might be preferable. Lastly, Class B was defined as a strategy that was partly Class A and partly Class C, encompassing cases with conflicting evidence and/or differing expert opinions. KP3 classes A, B, and C correspond to the ACCF PCI categories appropriate, uncertain, and inappropriate, respectively. This system was then applied to data from the Korean PCI registry (Gwon et al., 2017).

The cumulative incidence of MACE in non-ACS patients was assessed at discharge. The study found a statistically significant difference in MI cumulative incidence among the three appropriateness classes ($p<0.001$), with the highest cumulative incidence in class A (1.2%), followed by classes B and C (0.3% and 0.1%, respectively). There was no significant difference in the incidence of death, cardiac death, and stroke among non-ACS patients across Class A, B, and C (Gwon et al., 2017).

Among ACS patients, the highest cumulative incidence of death was observed in Class A (cumulative incidence of death in Class A and B: 4.1% and 0.4%, respectively; $p < 0.001$). Similarly, the cumulative incidence of cardiac death was also highest in Class A (cumulative incidence of cardiac death in Class A and B: 3.0% and 0.1%, respectively; $p < 0.001$). Additionally, the incidence of stroke was significantly higher in Class A than in Class B (0.3% vs. 0.1%, respectively; $p = 0.011$). Class B patients had better in-hospital outcomes than class A patients in ACS cases (Gwon et al., 2017).

Discussion

This review explores studies that investigate the association between procedural appropriateness, as measured by different versions of AUCs, and clinical outcomes in patients with ACS and SIHD undergoing PCI (Hadisoemarto et al., 2021; Klein et al., 2021; Liu et al., 2023; Popova et al., 2021). Our findings suggest that AUC categories are associated with several clinical outcomes in a limited number of cases. Specifically, AUC seems to be most beneficial for clinical decision making for populations faced with a choice between PCI and CABG, albeit limited in its usefulness to predict the length of post-procedure hospital stay (Banning et al., 2022; Byrne et al., 2023; Klein et al., 2021; Koshy et al., 2024).

When examining MACE as a long-term outcome, available evidence failed to support a significant clinical impact of the appropriateness categories. This may demonstrate the limited predictive value of expert opinion. Hence, while the AUCs were developed by a multidisciplinary panel of experts through a detailed and comprehensive process, within the hierarchy of evidence levels, expert opinion ranks at the lowest level, providing the weakest recommendations for clinical decision-making (Khosravi et al., 2023). A study comparing appropriateness ratings for practicing cardiologists and the AUC Technical Panel revealed significant differences, particularly between individual physicians and the panel (Chan et al., 2011). This aligns with the limitations reported in the ACC/AHA guidelines, which reveal that approximately 48% of recommendations are based on Level C evidence (Tricoci et al., 2009). When recommendations lack strong evidence, clinicians must approach them cautiously.

This study also suggests that the use of AUC for improving quality of care and cost-effectiveness, as one of its original purposes in development, was limited. A study reported that reducing inappropriate PCIs, guided by the AUC, significantly improves cost-effectiveness and minimizes complications; however, the specific number of complications was not reported (Hannan et al., 2017). This finding should be interpreted cautiously. In the post-hoc analysis by Bradley et al. (2015), the cumulative incidence of the composite outcome of death or MI was numerically lower in the inappropriate PCI category than in the appropriate PCI category (11% vs. 21%). However, this difference was not statistically significant, and the effect estimates were imprecise. Similar non-significant findings were observed for death and MI. Therefore, these results should not be interpreted as evidence that inappropriate PCI yields better clinical outcomes. Rather, they indicate that AUC classification alone may not fully capture patient-level risk, disease complexity, and other clinical factors that influence outcomes after PCI.

In 2021, the ACC/AHA/SCAI published the Guideline for Coronary Artery Revascularization, incorporating data from recent clinical trials and studies. While the guideline and the AUC complement each other and share similar objectives, the AUC focuses more on specific clinical scenarios. It uses a scoring system to guide decision-making (Lawton et al., 2022). However, the PREVENT trial demonstrated that preventive PCI performed on plaques that may appear angiographically mild but are vulnerable significantly reduced long-term MACE (Ahn et al., 2023). Hence, although preventive PCI would likely be categorized as uncertain or even inappropriate by AUC, it has shown promising outcomes. Currently, plaque vulnerability is not assessed in either the AUC system or the Coronary Artery Revascularization guideline, which is understandable given that this is a relatively new area of research. Consideration of plaque vulnerability status in the AUC scoring system may improve the AUC's association with long-term outcomes.

This systematic review included all relevant studies from major databases. However, a quantitative analysis could not be performed because the included studies did not report effect sizes (Yang et al., 2020). Additionally, the cohort design of these studies introduces the potential for confounding bias that cannot be fully mitigated. Furthermore, this review does not assess the updated AUC versions from 2016/2017, which may limit its applicability to current clinical practice. Nevertheless, to the best of our knowledge, this is the first systematic review to evaluate the impact of different PCI appropriateness categories on MACE.

Conclusion

This systematic review found that the association between PCI appropriateness categories and clinical outcomes remains limited and inconsistent across studies. Most included studies did not demonstrate a significant association between AUC classification and long-term MACE. However, one study reported worse outcomes among patients undergoing inappropriate PCI, and another found a higher risk among patients classified as uncertain or inappropriate. Overall, the current

evidence suggests that AUC may be useful as a decision-support framework, but its ability to predict clinical outcomes after PCI remains uncertain. Further refinement of the AUC, including incorporation of broader patient-specific factors and updated clinical evidence, is needed to improve its relevance in contemporary PCI practice.

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