National Institute for Health and Care Excellence

Draft for consultation

Acute Kidney Injury (update)

Evidence reviews for risk prediction tools and eGFR for the prediction of iodine-based contrast media-associated acute kidney injury

NICE guideline <number>

Evidence reviews underpinning recommendations 1.1.1 to 1.1.8 and recommendations for research in the NICE guideline

[August 2024]

Draft for Consultation

These evidence reviews were developed by NICE

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1. Prognostic accuracy of risk assessment tools/questionnaires

1.1. Review question

What is the prognostic accuracy of risk assessment tools/questionnaires to predict the occurrence of AKI following the administration of iodine-based contrast media?

1.1.1. Introduction

The focus of the 2024 guideline update is to update the recommendations on assessing risk factors for acute kidney injury in adults having iodine-based contrast media. Topic experts highlighted that the recommendation to measure eGFR in all adults before a contrast scan in the NICE guideline on acute kidney injury may lead to unnecessary cancellation of scans.

Topic experts also stated that concerns about iodine-based contrast media causing acute kidney injury are reducing, especially with modern contrast agents that are much less toxic than older agents. The NICE recommendations were developed in 2013, and since then, several external guidelines have moved away from a 'test all' position to a risk stratification policy and recommend a screening questionnaire ahead of eGFR measurement. Topic experts have indicated that a questionnaire-based approach might be satisfactory for most patients. This review update evaluates the latest evidence for validated risk assessment tools and questionnaires.

1.1.2. Summary of the protocol

For full details see the review protocol in Appendix A.

Table 1: PICO characteristics of review question

Population	Adults receiving iodine-based contrast media Strata: • Intravenous vs intra-arterial media administration Exclusion: • High osmolar contrast media
Risk tool	Validated risk assessment tools/questionnaires for acute kidney injury
Patient outcomes	Diagnosis of an acute kidney injury using any study definition Timeframe: • Within 7 days of contrast administration
Statistical outcomes	Primary outcomes: • Sensitivity and specificity • Positive and negative predictive values • Positive and negative likelihood ratios • Area under the receiver operator curve (AUC) o Had to report variance. Calibration (Hosmer-Lemeshow test)

	Minimal important difference (MID): • Sensitivity: upper= 80%, lower= 60% • Specificity: upper= 90%, lower= 80% • AUC: upper= 0.70, lower= 0.50 • Hosmer-Lemeshow: p value >0.05 Secondary Outcomes (include only if reported in papers reporting primary outcomes): • Mortality (risk ratio, odds ratio or hazard ratio) • Dialysis (risk ratio, odds ratio or hazard ratio)
Study design	• Prospective cohort studies • Systematic reviews of prognostic cohort studies

1.1.3. Methods and process

This evidence review was developed using the methods and process described in [Developing NICE guidelines: the manual](). Methods specific to this review question are described in the review protocol in appendix A.

Declarations of interest were recorded according to [NICE's conflicts of interest policy]().

1.1.4. Risk prediction tools evidence

1.1.4.1. Included studies

Nineteen studies on twenty eight risk tools for contrast associated acute kidney injury (CA-AKI) were included in the review;(Liang, et al., 2023; Buratti, et al., 2021; Lei, et al., 2020; Liu, et al., 2020; Liu, et al., 2020; Seibert, et al., 2020; Serif, et al., 2020; Alan, et al., 2019; Chaudhary, et al., 2019; Connolly, et al., 2018; Lu, et al., 2016; Kul, et al., 2015; Ando, et al., 2014; Ando, et al., 2013; Gurm, et al., 2013; Tziakas, et al., 2013; Sgura, et al., 2010; Liu, et al., 2014; Victor, et al., 2014) Evidence from these studies is summarised in the clinical evidence summary below.

All evidence identified was for intra-arterial contrast administration. No evidence was identified for intravenous administration. The most frequently reported risk prediction tool was the Mehran risk tool, included in fourteen studies. Other risk prediction tools reported in multiple papers were those developed by Ando, Bartholomew, Marenzi, Inohara, Ghani, Gurm and Tziakas. All other risk prediction tools were reported in a single study. Not all data was from derivation studies, with some studies reporting risk tools that had previously been developed in separate populations. Derivation studies that also included appropriate validation methods from Bartholomew, Ghani, Liu, Maioli and Mehran were not included in this review due to incomplete reporting (AUC without variance data). Subsequent studies that utilised the risk tools developed in the aforementioned studies were included.

1.1.4.2. Excluded studies

See the excluded studies list in Appendix I.

1 ### 1.1.5. Summary of studies included in the prognostic evidence

2 **Table 3: Summary of studies included in the evidence review**

Study	Risk tool	Population	Outcomes (including definitions)	No. of event (n)
Alan 2019 (Alan, Guenancia, Arnould, Azemar, Pitois, Maza, Bichat, Zeller, Gabrielle, Bron, Creuzot-Garcher and Cottin, 2019)	Mehran risk score (cut-off: 5) GRACE score (cut-off: 142)	N=216 Patient records from a regional survey of patients hospitalised with acute coronary syndrome who underwent coronary angiography Mean age (SD): 62.68 (12.38) years France	AKI (referred to as acute renal failure in the paper), as per KDIGO criteria: increase in serum creatinine of ≥26.5 µmol/L at 48h after injection or >50% compared to the initial dosage within 7 days	21 (10%)
Ando 2014 (Ando, de Gregorio, Morabito, Trio, Saporito and Oreto, 2014)	Study-developed risk score (AGEF score): • Age • eGFR • LVEF • Contrast volume : eGFR ratio	N=126 Non-consecutive patients undergoing primary PCI admitted within 12 hours of STEMI symptom onset Mean age (SD): 64.3 (14.1) years Italy	Contrast-induced AKI, defined as: increase in serum creatinine concentration ≥0.5 mg/dL or ≥25% from baseline within 72 hours after the administration of contrast medium, without any other plausible cause	12 (9.5%)
Ando 2013 (Ando, Morabito, de Gregorio, Trio, Saporito and Oreto, 2013)	ACEF score: • Age • Ejection fraction • Serum creatinine Mehran risk score (cut-off: 5)	N=481 Consecutive patients referred for primary PCI due to STEMI admitted within 12 hours of symptom onset Mean age (SD): 62 (12) years Italy	Contrast-induced nephropathy, defined as: increase in serum creatinine ≥0.5 mg/dL or an increase ≥25% from baseline within 72 hours of contrast administration, without any other plausible aetiology	25 (5.2%)
Buratti 2021 (Buratti, Crimi, Somaschini,	Study-developed risk score:	N=1782	Contrast-induced acute kidney injury, defined as:	136 (7.6%)

Study	Risk tool	Population	Outcomes (including definitions)	No. of event (n)
Cornara, Camporotondo, Cosentino, Moltrasio, Rubino, De Metrio, Marana, De Servi, Marenzi and De Ferrari, 2021)	• Killip class • Diabetes • Anterior STEMI • Age >75 • eGFR <60 Mehran risk score Marenzi risk score Inohara risk score	Consecutive STEMI patients undergoing PCI Mean age (SD): 63.7 (12.2) years Italy	an absolute serum creatinine increase ≥0.5 mg/dl in the first 72 hours	
Chaudhary 2019 (Chaudhary, Pathak, Kunal, Shukla and Pathak, 2019)	CHA2DS2 score (cut-off: ≥4): • Congestive heart failure or ejection fraction ≤40% • Hypertension • Age • Diabetes • Vascular disease • Female • Previous stroke or transient ischemic attack	N=300 Consecutive patients presenting with acute coronary syndrome and undergoing PCI Mean age (SD): 55.03 (9.56) years India	Contrast induced nephropathy, defined as the elevation of serum creatinine ≥0.5 mg/dL or ≥25% increase in the baseline serum creatinine levels within 48 hours	41 (13.7%)
Connolly 2018 (Connolly, Kinnin, McEneaney, Menown, Kurth, Lamont, Morgan and Harbinson, 2018)	Mehran risk score (cut-off: ≥10)	N=301 Patients at high risk of AKI (eGFR ≤60 ml/min) who were assessed prior to cardiac catheterisation Mean age (SD): 72.53 (8.30) years UK	Contrast induced AKI, defined as per KDIGO guidelines: absolute delta rise in creatinine of ≥26.5 mmol/l or a 50% relative rise from baseline at 48 hours following contrast	28 (9.3%)
Gurm 2013 (Gurm, Seth,	Study-developed risk score (full model):	N=20,572	Contrast-induced nephropathy, defined as:	505 (2.5%)

Study	Risk tool	Population	Outcomes (including definitions)	No. of event (n)
Kooiman and Share, 2013)	contained 46 variables, see evidence tables for full details. Study-developed risk score (reduced model): contained the 15 most important variables from the full model.	Consecutive patients undergoing PCI Mean age (SD): 65.0 (12.2) years USA	impairment in renal function resulting in ≥0.5 mg/dl absolute increase in serum creatinine level from baseline	
Kul 2015 (Kul, Uyarel, Kucukdagli, Turfan, Vatankulu, Tasal, Erdogan, Asoglu, Sahin, Guvenc and Goktekin, 2015)	Mehran risk score (cut-off: >5) Zwolle risk score (cut-off: >2)	N=314 Consecutive patients admitted with STEMI undergoing urgent cardiac catheterisation Mean age (SD): 56.33 (11.41) years Germany	Contrast-induced AKI, defined as: a relative increase in baseline serum creatinine of >25% and/or an absolute increase of 0.5 mg/ dl within 72 hours after contrast administration	38 (12.1%)
Lei 2020 (Lei, Xue, Guo, Liu, He, Liu, Nie, Chen, Chen, Huang, Liang, Chen, Liu and Chen, 2020)	Mehran risk score Study-developed nomogram (cut-off: 129) • Age • Heart rate • Weight • Hypotension • PCI • Beta blocker use	N=643 Consecutive patients undergoing coronary angiography or PCI Mean age (SD): 69.88 (9.67) years China	Contrast-induced AKI, defined as: serum creatinine elevation ≥0.5 mg/dL or 25% from baseline within the first 48–72 hours following contrast exposure	96 (14.9%)
Liang 2023 (Liang, Li, Zeng, Zhang, Lv, Wei and Wan, 2023)	Mehran risk score	N=842 Patients admitted with chest pain who were diagnosed with acute coronary syndrome and underwent PCI	AKI, defined as per KDIGO standard: elevated serum creatinine level >0.3 mg/dL (26.5 mmol/L) less than 2 days; serum creatinine increase to 1.5–1.9-fold from the baseline level; urine output<0.5	139 (16.5%)

Study	Risk tool	Population	Outcomes (including definitions)	No. of event (n)
		Mean age (SD): 66.9 (13.0) years China	mL/kg/h for 6–12 hours	
Liu 2020 (Liu, Liu, Lei, Wang, Sun, Guo, He, Song, Lun, Liu, Chen, Chen, Yang, Liu and Chen, 2020)	Study-developed nomogram: • eGFR • Age • Albumin • IABP Mehran risk score	N=428 Patients with hypoalbuminemia who were undergoing coronary angiography or PCI Mean age (SD): 65.96 (11.02) years China	Contrast associated AKI, defined as: increase of ≥0.3 mg/dL or 50% in serum creatinine compared to baseline in the 48 to 72 hours post procedure	48 (11.2%)
Liu 2020a (Liu, Chen, Ye, Xian, Wang, Xuan, Tan, Li, Chen and Ni, 2020)	Study-developed model (full model): see evidence table for full details Study-developed model (reduced model) Mehran risk score ACEF risk score	N=1041 Consecutive patients undergoing PCI or coronary angiogram Mean age (SD): 62.82 (11.24) years China	Contrast induced nephropathy, defined as: increase in serum creatinine ≥0.5 mg/dL	37 (3.5%)
Liu 2014 (Liu, Liu, Tan, Chen, Chen, Chen, He, Ran, Ye and Li, 2014)	GRACE risk score (cut-off: >160) Mehran risk score	N=251 Consecutive patients with STEMI undergoing PCI Mean age(SD): 62.74 (12.27) years China	Contrast-associated AKI, defined by three separate cut-offs: • absolute increase in serum creatinine of ≥0.3 mg/dL • or ≥0.5 mg/dL • 50% increase within 48–72 hours after contrast exposure	≥0.3 mg/dL definition: 43 (17.1%) ≥0.5 mg/dL definition: 22 (8.8%) 50% increase definition: 19 (7.6%)
Lu 2016 (Lu, Hsu, Chang, Lin, Lee, Lin	Mehran risk score (cut-off: 7)	N=664	Contrast-induced AKI, defined as: increase of serum	78 (11.7%)

Study	Risk tool	Population	Outcomes (including definitions)	No. of event (n)
and Chan, 2016)		Consecutive patients referred for coronary angiography for investigation of chest pain and/or suspected coronary artery disease Mean age (SD): 67 (12) years Taipei	creatinine concentration of ≥0.3 mg/dl or a 25% increase from the baseline value measured at 48 hours after exposure to contrast media	
Seibert 2020 (Seibert, Heringhaus, Pagonas, Rudolf, Rohn, Bauer, Timmesfeld, Trappe, Babel and Westhoff, 2020)	Inohara risk model Ghani risk model	N=490 Patients with an indication for coronary angiography Mean age (IQR): 66 (57-73) years Germany	AKI defined as per AKIN criteria	30 (6.1%)
Serif 2020 (Serif, Chalikias, Didagelos, Stakos, Kikas, Thomaidis, Lantzouraki, Ziakas and Tziakas, 2020)	Seventeen risk scores previously developed in other papers: • Brown 2015 • Tsai 2014 • Gurm 2013 • Caspi 2017 • Victor 2014 • Maioli 2010 • Marenzi 2004 • Liu 2015 • Gao 2014 • Fu 2012 • Chen 2014 • Ghani 2009 • Bartholomew 2004	N=1247 Consecutive patients treated with PCI on an emergency or elective basis Mean age (SD): 62 (10) years Greece	Contrast-induced AKI was given two definitions: Liberal criterion: increase of ≥25% or ≥0.5 mg/dl in pre-PCI serum creatinine at 48 h to 72 h post PCI Strict criterion: increase of ≥0.5 mg/dl in pre-PCI serum creatinine at 48 h to 72 h post PCI	Liberal definition: 206 (16.5%) Strict definition: 24 (1.9%)

Study	Risk tool	Population	Outcomes (including definitions)	No. of event (n)
	• Mehran 2004 • Tsiakas 2013 • Ando 2013 • McCullough 1997			
Sgura 2010 (Sgura, Bertelli, Monopoli, Leuzzi, Guerri, Spart, Politi, Aprile, Amato, Rossi, Biondi-Zoccai, Sangiorgi and Modena, 2010)	Mehran risk score Marenzi risk score	N=891 Consecutive patients admitted for STEMI who were treated with PCI Mean age (SD): 63.9 (13.1) years Italy	Contrast induced nephropathy, defined as: 0.5 mg/dL (44 mmol/L) increase in serum creatinine or 25% increase compared with baseline values within 48 hours of the procedure	126 (14.1%)
Tziakas 2013 (Tziakas, Chalikias, Stakos, Apostolakis, Adina, Kikas, Alexoudis, Passadakis, Thodis, Vargemezis and Konstantinides, 2013)	Mehran risk score Bartholomew risk score Study-developed risk score (cut-off >3): • Pre-existing renal disease • Metformin use • Previous PCI • Peripheral artery disease • Contrast volume ≥300 mL	N=488 for previously established models, N=200 for study-developed model Consecutive patients treated with PCI on an elective or emergency basis Mean age (SD): n=488, 64 (11) years, n=200, 61 (12) years Greece	Contrast induced nephropathy, defined as an increase of ≥25% or ≥0.5 mg/dl in pre-PCI serum creatinine at 48 hours post procedure	Derivation cohort (n=488): 50 (10.2%) Validation cohort (n=200): 28 (14%)
Victor 2014 (Victor, Gnanaraj, S, Deshmukh, Kandasamy, Janakiraman, Pandurangi, Latchumanadhas, Abraham	Study-developed risk score (cut-off: 10%): • GFR • Amount of contrast	N=300 Consecutive patients undergoing PCI Mean age (SD): 57.3 (10.2) years India	Contrast-induced nephropathy, defined as: an increase of ≥25% and/or ≥0.5 mg/dl in serum creatinine at 48 hours after PCI when compared to baseline value	26 (8.7%)

Study	Risk tool	Population	Outcomes (including definitions)	No. of event (n)
and Mullasari, 2014)	• Diabetic microangiography • Hypotension • Albuminuria • Peripheral vascular disease			

See Appendix D for full evidence tables.

1.1.6. Summary of prognostic evidence

Table 2: Clinical evidence profile: discrimination of risk prediction tools for the prediction of contrast-associated acute kidney injury in adults receiving iodine-based contrast media

Risk tool	No of studies	n	Risk of bias	Inconsistency	Indirectness	Imprecision	Mean effect size (95% CI or 95%CI range if >1 study for AUC)	GRADE overall quality
Mehran risk tool	11	8374	Very high[1]	Very high[2]	High[3]	Very high[4]	Median AUC= 0.780 (0.480-0.912)	VERY LOW
Mehran risk tool (cut-off: >5)	3	910	Very high[1]	Low	High[3]	Very high[5]	Sensitivity= 75.7% (45.3-92.6)	VERY LOW
			Very high[1]	Low	High[3]	High[6]	Specificity= 73.8% (47.9-89.7)	VERY LOW
Mehran risk tool (cut-off: >7)	1	644	Very high[7]	NA	High[3]	High[8]	Sensitivity= 64.1% (52.0-75.0)	VERY LOW
			Very high[7]	NA	High[3]	Low	Specificity= 54.9% (51.0-59.0)	VERY LOW
Mehran risk tool (cut-off: ≥10)	1	301	Very high[7]	NA	High[3]	Very high[5]	Sensitivity= 64% (44.0-81.0)	VERY LOW
			Very high[7]	NA	High[3]	Low	Specificity= 62% (56.0-68.0)	VERY LOW
Marenzi risk score	3	3920	Very high[9]	High[10]	High[3]	High[11]	Median AUC= 0.57 (range: 0.51-0.83)	VERY LOW
Bartholomew risk score	2	1735	Very high[7]	Low	High[3]	Very high[4]	AUC= 0.59 (0.47-0.72)	VERY LOW
Ghani risk score	2	1737	Very high[1]	Low	Low	High[12]	AUC= 0.55 (0.41-0.67)	VERY LOW
Ando risk score	2	1373	Very high[13]	Very high[2]	High[3]	High[11]	AUC= 0.70 (0.50-0.92)	VERY LOW
Gurm (reduced model) risk score	2	21,819	Very high[14]	Very high[2]	High[3]	High[11]	AUC= 0.69 (0.51-0.86)	VERY LOW
Inohara risk score	2	2272	Very high[7]	Low	Low	High[11]	AUC= 0.705 (0.600-0.770)	VERY LOW
Tziakas risk score	2	1447	Very high[13]	Very high[2]	High[3]	Very high[4]	AUC= 0.68 (0.46-0.93)	VERY LOW
ACEF score	2	1522	Very high[9]	Low	Low	High[11]	AUC= 0.791 (0.656-0.850)	VERY LOW
Victor risk score (cut-off: 10%)	1	300	Very high[15]	NA	High[3]	High[16]	Sensitivity= 92.3% (75-99)	VERY LOW
			Very high[15]	NA	High[3]	High[6]	Specificity= 82.1% (77-86)	VERY LOW

Risk tool	No of studies	n	Risk of bias	Inconsistency	Indirectness	Imprecision	Mean effect size (95% CI or 95%CI range if >1 study for AUC)	GRADE overall quality
GRACE score	1	216	Very high[1]	NA	Low	Low	AUC= 0.828 (0.724-0.932)	LOW
GRACE score (cut-off >142)	1	216	Very high[1]	NA	Low	Very high[5]	Sensitivity= 81.0% (58.0-95.0)	VERY LOW
			Very high[1]	NA	Low	Low	Specificity= 71.0% (64.0-77.0)	LOW
GRACE score (cut-off >160)	1	251	Very high[7]	NA	Low	High[16]	Sensitivity= 79.1% (64.0-90.0)	VERY LOW
			Very high[7]	NA	Low	Low	Specificity= 61.0% (54.0-68.0)	LOW
de Ferrari risk score	1	1782	Very high[17]	NA	Low	Low	AUC= 0.838 (0.802-0.874)	LOW
CH2DS2-VASc score (cut-off: ≥4)	1	300	High[18]	NA	Low	Low	AUC= 0.81 (0.73-0.90)	MODERATE
			High[18]	NA	Low	High[16]	Sensitivity= 90.2% (77.0-97.0)	LOW
			High[18]	NA	Low	Low	Specificity= 62.9% (57.0-69.0)	MODERATE
Gurm (full model) risk score	1	20,572	Very high[19]	NA	High[3]	Low	AUC= 0.852 (0.835-0.869)	VERY LOW
Zwolle risk score (cut-off: >2)	1	314	Very high[7]	NA	High[3]	Low	AUC= 0.85 (0.78-0.92)	VERY LOW
			Very high[7]	NA	High[3]	High[16]	Sensitivity= 76.3% (68.0-84.0)	VERY LOW
			Very high[7]	NA	High[3]	High[6]	Specificity= 75.4% (66.0-83.0)	VERY LOW
Lei risk score (cut-off: >129)	1	643	Very high[18]	NA	Low	Low	AUC= 0.78 (0.73-0.83)	LOW
			Very high[18]	NA	Low	High[5]	Sensitivity= 81.2% (72.0-88.0)	VERY LOW
			Very high[18]	NA	Low	Low	Specificity= 63.3% (58.0-66.0)	LOW
Liu risk score	1	428	Very high[20]	NA	High[3]	High[11]	AUC= 0.693 (0.608-0.779)	VERY LOW
Liu full risk score	1	1041	Very high[21]	NA	Low	Low	AUC= 0.858 (0.794-0.923)	LOW
Liu reduced risk score	1	1041	Very high[21]	NA	Low	Low	AUC= 0.854 (0.796-0.913)	LOW
Maioli risk score	1	1247	High[18]	NA	Low	Low	AUC= 0.58 (0.56-0.61)	MODERATE

Risk tool	No of studies	n	Risk of bias	Inconsistency	Indirectness	Imprecision	Mean effect size (95% CI or 95%CI range if >1 study for AUC)	GRADE overall quality
Brown risk score	1	1247	High[18]	NA	Low	High[12]	AUC= 0.52 (0.47-0.56)	LOW
Tsai risk score	1	1247	High[18]	NA	High[3]	High[12]	AUC= 0.51 (0.49-0.54)	VERY LOW
Caspi risk score	1	1247	High[18]	NA	Low	Low	AUC= 0.53 (0.51-0.56)	MODERATE
Liu risk score	1	1247	High[18]	NA	Low	High[12]	AUC= 0.52 (0.48-0.57)	LOW
Victor risk score	1	1247	High[18]	NA	High[3]	Low	AUC= 0.54 (0.50-0.59)	LOW
Gao risk score	1	1247	High[18]	NA	High[3]	High[12]	AUC= 0.49 (0.45-0.53)	VERY LOW
Fu risk score	1	1247	High[18]	NA	High[3]	High[12]	AUC= 0.50 (0.46-0.54)	VERY LOW
Chen risk score	1	1247	High[18]	NA	Low	High[11]	AUC= 0.48 (0.43-0.52)	LOW
McCullough risk score	1	1247	High[18]	NA	High[3]	Low	AUC= 0.58 (0.53-0.62)	LOW

1. *Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, most frequently due to unclear definition and assessment of predictors (timing and criteria not specified), unclear interval between predictor and outcome assessment (not specified when predictors were assessed), unclear flow of participants through the study (missing data with no imputation of missing values), inadequate sample size (<100 events) and incomplete analysis reporting (discrimination reported without calibration)*
2. *Downgraded by two increments due to substantial differences between the point estimate and 95%CI's reported in studies examining the same risk prediction tool*
3. *Downgraded by one increment due to high levels of concern surrounding the applicability of the risk prediction tool (not all predictors available at the intended time of assessment (prior to contrast administration))*
4. *Downgraded by two increments due to the 95%CI overlapping both the upper and lower thresholds for decision making (0.50-0.70)*
5. *Downgraded by two increments due to the 95%CI overlapping both the threshold corresponding to 'low sensitivity' (60%) and 'high sensitivity' (80%)*
6. *Downgraded by one increment due to the 95%CI overlapping the threshold corresponding to 'low specificity' (80%)*
7. *Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to unclear definitions and assessments of predictors (timing and criteria not specified), inadequate sample size (<100 events) and incomplete analysis reporting (discrimination reported without calibration)*
8. *Downgraded by one increment due to the 95%CI overlapping the threshold corresponding to 'low sensitivity' (60%)*
9. *Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, most frequently due to inadequate sample size (<100 events) and incomplete analysis reporting (discrimination reported without calibration)*
10. *Downgraded by one increment due to considerable differences between the point estimate and 95%CI's reported in studies examining the same risk prediction tool*
11. *Downgraded by one increment due to the 95%CI overlapping the upper threshold for decision making (0.70)*
12. *Downgraded by one increment due to the 95%CI overlapping the lower threshold for decision making (0.50)*
13. *Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to inadequate sample size (<100 events) and concerns arising from the analysis method (model developed using univariate analysis to identify relevant predictors, unclear if the validation study applied the risk prediction tool as intended)*

14. Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to inadequate sample size (<100 events), unclear definition and assessment of predictors (timing and criteria not specified) and concerns arising from the analysis method (model development study validated the tool using random split sampling and unclear if the external validation study applied the risk prediction tool as intended)
15. Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to unclear definition and assessment of predictors (timing and criteria not specified), inadequate sample size (<10 events per predictor) and concerns arising from the analysis method (model developed using univariate analysis to identify relevant predictors and random split sampling to validate)
16. Downgraded by one increment due to the 95%CI overlapping the threshold corresponding to 'high sensitivity' (80%)
17. Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to unclear definition and assessment of predictors (timing and criteria not specified), inadequate sample size (<10 events per predictor) and concerns arising from the analysis method (model developed using univariate analysis to identify relevant predictors)
18. Downgraded by one increment due to high risk of bias arising from the PROBAST risk of bias tool, namely due to inadequate sample size (<100 events)
19. Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to unclear definition and assessment of predictors (timing and criteria not specified), inadequate sample size (<10 events per predictor) and concerns arising from the analysis method (model validated using random split sampling)
20. Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to inadequate sample size (<100 events) and concerns arising from the analysis method (model developed using univariate analysis to identify relevant predictors and random split sampling to validate)
21. Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to inadequate sample size (<10 events per predictor) and concerns arising from the analysis method (model validated using random split sampling)

Table 3: Clinical evidence profile: risk prediction tools for the prediction of dialysis in adults receiving iodine-based contrast media

Risk tool	No of studies	n	Risk of bias	Inconsistency	Indirectness	Imprecision	Mean effect size (95% CI)	GRADE overall quality
Gurm risk tool (full model)	1	22,572	Very high[1]	NA	High[2]	Low	AUC= 0.875 (0.819-0.931)	VERY LOW
Gurm risk tool (reduced model)	1	22,572	Very high[1]	NA	High[2]	Low	AUC= 0.875 (0.823-0.931)	VERY LOW
GRACE score (<136)	1	251	Very high[3]	NA	Not serious	Low	Sensitivity= 0% (0-46)	LOW
			Very high[3]	NA	Not serious	Low	Specificity= 75% (69-80)	LOW
GRACE score (136-158)	1	251	Very high[3]	NA	Not serious	Low	Sensitivity= 0% (0-46)	LOW
			Very high[3]	NA	Not serious	Low	Specificity= 74% (68-80)	LOW

Risk tool	No of studies	n	Risk of bias	Inconsistency	Indirectness	Imprecision	Mean effect size (95% CI)	GRADE overall quality
GRACE score (159-180)	1	251	Very high[3]	NA	Not serious	High[4]	Sensitivity= 33% (4-78)	VERY LOW
			Very high[3]	NA	Not serious	Low	Specificity= 75% (69-80)	LOW
GRACE score (>180)	1	251	Very high[3]	NA	Not serious	Very high[5]	Sensitivity= 67% (22-96)	VERY LOW
			Very high[3]	NA	Not serious	High[6]	Specificity= 76% (70-81)	VERY LOW

1. *Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to unclear definition and assessment of predictors (timing and criteria not specified), inadequate sample size (<10 events per predictor) and concerns arising from the analysis method (model validated using random split sampling)*
2. *Downgraded by one increment due to high levels of concern surrounding the applicability of the risk prediction tool (not all predictors available at the intended time of assessment (prior to contrast administration))*
3. *Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to unclear definitions and assessments of predictors (timing and criteria not specified), inadequate sample size (<100 events) and incomplete analysis reporting (discrimination reported without calibration)*
4. *Downgraded by one increment due to the 95%CI overlapping the threshold corresponding to 'low sensitivity' (60%)*
5. *Downgraded by two increments due to the 95%CI overlapping both the threshold corresponding to 'low sensitivity' (60%) and 'high sensitivity' (80%)*
6. *Downgraded by one increment due to the 95%CI overlapping the threshold corresponding to 'low specificity' (80%)*

Table 4: Clinical evidence profile: risk prediction tools for the prediction of mortality in adults receiving iodine-based contrast media

Risk tool	No of studies	n	Risk of bias	Inconsistency	Indirectness	Imprecision	Mean effect size (95% CI)	GRADE overall quality
Mehran risk score	1	891	High[1]	NA	High[2]	High[3]	AUC= 0.74 (0.59-0.79)	VERY LOW
Mehran risk score (medium risk) vs low risk	1	891	High[1]	NA	High[2]	Low	HR= 3.61 (2.19-5.98)	LOW

Risk tool	No of studies	n	Risk of bias	Inconsisten cy	Indirectnes s	Imprecision	Mean effect size (95% CI)	GRADE overall quality
Mehran risk score (high risk) vs low risk	1	891	High[1]	NA	High[2]	Low	HR= 8.00 (4.53-14.13)	LOW
Mehran risk score (very high risk) vs low risk	1	891	High[1]	NA	High[2]	Low	HR= 15.29 (8.11-28.83)	LOW
Marenzi risk score	1	891	High[1]	NA	High[2]	Low	AUC= 0.60 (0.55-0.65)	LOW
GRACE score (<136)	1	251	Very high[4]	NA	Not serious	Low	Sensitivity= 0% (0-31)	LOW
			Very high[4]	NA	Not serious	Low	Specificity= 75% (69-80)	LOW
GRACE score (136-158)	1	251	Very high[4]	NA	Not serious	Low	Sensitivity= 20% (3-56)	LOW
			Very high[4]	NA	Not serious	Low	Specificity= 75% (69-80)	LOW
GRACE score (159-180)	1	251	Very high[4]	NA	Not serious	Low	Sensitivity= 20% (3-56)	LOW
			Very high[4]	NA	Not serious	Low	Specificity= 74% (68-80)	LOW
GRACE score (>180)	1	251	Very high[4]	NA	Not serious	Very serious[5]	Sensitivity= 60% (26-88)	VERY LOW
			Very high[4]	NA	Not serious	Serious[6]	Specificity= 76% (70-82)	VERY LOW

1. *Downgraded by one increment due to very high risk of bias arising from the PROBAST risk of bias tool, namely due to unclear timing of the assessment of predictors relative to outcome assessment and concerns arising from the analysis method (discrimination reported without calibration)*
2. *Downgraded by one increment due to high levels of concern surrounding the applicability of the risk prediction tool (not all predictors available at the intended time of assessment (prior to contrast administration))*
3. *Downgraded by one increment due to the 95%CI overlapping the upper threshold for decision making (0.70)*

4. *Downgraded by two increments due to very high risk of bias arising from multiple domains of the PROBAST risk of bias tool, namely due to unclear definitions and assessments of predictors (timing and criteria not specified), inadequate sample size (<100 events) and incomplete analysis reporting (discrimination reported without calibration)*
5. *Downgraded by two increments due to the 95%CI overlapping both the threshold corresponding to 'low sensitivity' (60%) and 'high sensitivity' (80%)*
6. *Downgraded by one increment due to the 95%CI overlapping the threshold corresponding to 'low specificity' (80%)*

1.1.7. Economic evidence

A literature search was carried out for both review questions (i.e. risk prediction tools and eGFR evidence) to identify relevant published economic studies. In total, 244 records were retrieved from database. After title and abstract screening, no relevant studies were found for this review question.

1.1.7.1. Included studies

No health economic studies were included.

1.1.7.2. Excluded studies

Not applicable.

1.1.8. Summary of included economic evidence

No health economic evidence was identified for this review question.

1.1.9. Economic model

No original health economic model was developed for this review question.

2. Prognostic accuracy of eGFR for iodine-based contrast media-associated AKI

2.1. Review question

What is the prognostic accuracy of eGFR for iodine-based contrast media-associated AKI?

2.1.1. Introduction

The surveillance review of the Acute kidney injury guideline found that there was a need to re-evaluate the eGFR risk threshold in the NICE guideline, as the threshold currently recommended may be too high. Some recent evidence has shown that contrast media may only pose a risk for people with an eGFR of 30 ml/min/1.73 m^2 or less. External guidelines have stated that risk of acute kidney injury from iodine-based contrast media is likely to be non-existent with eGFR greater than 45 ml/min/ 1.73 m^2, and very likely to be low or non-existent for eGFR 30 to 45 ml/min/1.73 m^2. This review re-evaluates the evidence for eGFR thresholds indicating risk of iodine-based contrast kidney injury.

2.1.2. Summary of the protocol

For full details see the review protocol in Appendix A.

Table 5: PICO characteristics of review question

Population	Adults receiving iodine-based contrast media Strata: • Intravenous vs intra-arterial media administration Key confounding variables: (excluded unless all accounted for) • Diabetes • Heart failure • Age Additional confounder: (included if not accounted for, but recorded) • Hypertension Exclusion: • High osmolar contrast media
Prognostic factor	Estimated glomerular filtration rate (eGFR) • Cut-offs pooled depending on stage of chronic kidney disease indicated: ○ 45-60 (stage 3a) ○ 44-30 (stage 3b) ○ 29-15 (stage 4) ○ <15 (stage 5) Recorded within 3 months of contrast media administration

Patient outcomes	Occurrence of an event following intravenous administration of iodine-based contrast media. • Study defined AKI • Mortality • Dialysis Timeframe: • Within 7 days of contrast administration
Statistical outcomes	Risk of mortality, dialysis, or an AKI occurring: • Adjusted relative risk (RR) • Adjusted odds ratio (OR) • Adjusted hazard ratio (HR)
Study design	• Prognostic cohort studies • Case control studies • Systematic reviews of prognostic cohort studies Studies will only be included if all of the key confounders have been accounted for in a multivariate analysis. In the absence of multivariate analysis, studies that account for key confounders with univariate analysis or matched groups will be considered.

2.1.3. Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in appendix A and the methods document.

Declarations of interest were recorded according to NICE's conflicts of interest policy.

2.1.4. Prognostic evidence

2.1.4.1. Included studies

Six studies that examined the prognostic accuracy of eGFR, adjusted for the protocol-listed confounders, for predicting CA-AKI were included in the review;(Buratti, Crimi, Somaschini, Cornara, Camporotondo, Cosentino, Moltrasio, Rubino, De Metrio, Marana, De Servi, Marenzi and De Ferrari, 2021; Caspi, et al., 2017; Liu, et al., 2015; Lunyera, et al., 2021; Mohebi, et al., 2022; Shacham, et al., 2016). A range of cut-off values were used across the identified studies with eGFR values ranging from <15 to ≤60. Three different referent values were used, with ≥90 used in three comparisons, ≥60 used in three, and >60 used in one comparison.

See also the study selection flow chart in Appendix A, study evidence tables in Appendix D, forest plots in Appendix E and GRADE tables.

2.1.4.2. Excluded studies

See the excluded studies list in Appendix I.

2.1.5. Summary of studies included in the prognostic evidence

Table 6: Summary of studies included in the evidence review

Study	Risk factor	Population	Outcomes (including definitions)	No. of event (n)
Buratti 2021 (Buratti, Crimi, Somaschini, Cornara, Camporotondo, Cosentino, Moltrasio, Rubino, De Metrio, Marana, De Servi, Marenzi and De Ferrari, 2021)	eGFR • <60	N=1954 Consecutive STEMI patients undergoing PCI Mean age (SD): 62.48 (12.14) years Italy	Contrast-induced AKI, defined as: an absolute serum creatinine increase ≥0.5 mg/dl in the first 72 hours	93 (4.8%)
Caspi 2017 (Caspi, Habib, Cohen, Kerner, Roguin, Abergel, Boulos, Kapeliovich, Beyar, Nikolsky and Aronson, 2017)	eGFR: • <30 • 30-59	N=2025 Patients admitted with STEMI undergoing PCI Mean age (SD): 59.72 (12.93) years Israel	Increase in serum creatinine concentration ≥0.5 mg/dL compared with admission value or a >25% relative rise during the first 72 hours after the procedure	209 (10.3%)
Liu 2015 (Liu, He, Tan, Chen, Liu, Yang, Huang, Ye, Li, Ran, Duan, Chen, Zhou and Chen, 2015)	eGFR: • <60	N=2248 Consecutive patients undergoing coronary angiography or PCI Mean age (SD): 63.48 (10.72) years China	Increase in serum creatinine of >0.5 mg/ dL over the baseline value within 48 to 72 hours after the administration of contrast medium	50 (2.2%)
Lunyera 2021 (Lunyera, Clare, Chiswell, Scialla, Pun, Thomas, Starks and Diamantidis, 2021)	eGFR: • <15 • 15-29 • 30-59	N=9422 Patients undergoing cardiac catheterization and cardiac surgery Mean age (IQR): 62 (54-72)	KDIGO criteria: a 1.5-fold or greater relative elevation in serum creatinine from the reference value to the highest value within 7 days after the date and time of PCI, or a 0.3 mg/dl absolute	865 (9%)

Study	Risk factor	Population	Outcomes (including definitions)	No. of event (n)
		USA	increase in serum creatinine from the reference value within 48 hours after the date and time of PCI	
Mohebi 2022 (Mohebi, Karimi Galougahi, Garcia, Horst, Ben-Yehuda, Radhakrishnan, Chertow, Jeremias, Cohen, Cohen, Maehara, Mintz, Chen, Redfors, Leon, Stuckey, Rinaldi, Weisz, Witzenbichler, Kirtane, Mehran, Dangas, Stone and Ali, 2022)	eGFR: • <60	N=7287 Consecutive patients successfully treated with drug-eluting stents Mean age (SD): 63.84 (10.85) years USA and Germany	European Society of Urogenital Radiology definition: absolute increase of ≥0.5 mg/dL or ≥25% relative increase in serum creatinine after PCI compared with the pre-PCI serum creatinine level occurring within 3 days of the intravascular administration of contrast medium when no alternative aetiology for AKI was identified	476 (6.5%)
Shacham 2016 (Shacham, Gal-Oz, Flint, Keren and Arbel, 2016)	eGFR: • ≤60	N=1372 Consecutive patients referred with STEMI undergoing primary PCI Mean age (SD): 61.50 (12.83) years Israel	AKI network criteria - a rise in serum creatinine >0.3 mg/dl, compared with the admission value	153 (11%)

See Appendix D for full evidence tables.

2.1.6. Summary of the prognostic evidence

Table 7: Clinical evidence profile: eGFR for the prediction of contrast-associated acute kidney injury in adults receiving iodine-based contrast media

Cut-off and referent value	No of studies	n	Risk of bias	Inconsistency	Indirectness	Imprecision	Effect size (95%CI)	Quality
<15 vs ≥90	1	9422	Some concerns[1]	Not serious	Not serious	Not serious	OR: 15.71 (9.97-24.77)	MODERATE
15-29 vs ≥90	1	9422	Some concerns[1]	Not serious	Not serious	Not serious	OR: 5.77 (3.96-8.41)	MODERATE
<30 vs ≥60	1	2025	Not serious	Not serious	Not serious	Not serious	OR: 6.27 (3.15-12.49)	HIGH
30-59 vs ≥90	1	9422	Some concerns[1]	Not serious	Not serious	Not serious	OR: 2.29 (1.77-2.97)	MODERATE
30-59 vs ≥60	1	2025	Not serious	Not serious	Not serious	Not serious	OR: 1.71 (1.17-2.50)	HIGH
<60 vs ≥60	3	2248	Not serious	Very serious[2]	Not serious	Not serious	OR: 5.12 (2.27-11.54)	LOW
		1954	Some concerns[1]	Very serious[2]	Not serious	Not serious	OR: 5.04 (3.05-8.32)	VERY LOW
		7287	Some concerns[1]	Very serious[2]	Not serious	Not serious	OR: 1.65 (1.21-2.21)	VERY LOW
≤60 vs >60	1	1372	Some concerns[1]	Not serious	Not serious	Not serious	OR: 1.67 (1.02-2.75)	MODERATE

1. *Downgraded by one increment due to concerns arising from statistical analysis and reporting (unclear how the confounding variables included in the multivariate model were identified)*
2. *Downgraded by two increments due to substantial differences between the point estimates and 95%CIs reported in studies examining the same threshold*

See **Error! Reference source not found.** for full GRADE tables.

2.1.7. Economic evidence

A literature search was carried out for both review questions (i.e. risk prediction tools and eGFR evidence) to identify relevant published economic studies. In total, 244 records were retrieved from database. After title and abstract screening, no relevant studies were found for this review question.

2.1.7.1. Included studies

No health economic studies were included.

2.1.7.2. Excluded studies

Not applicable.

2.1.8. Summary of included economic evidence

No economic evidence was identified for this review question.

2.1.9. Economic model

No original economic model was developed for this review question

3. The committee's discussion and interpretation of the evidence

3.1. The outcomes that matter most

The committee included three clinical outcomes in the evidence reviews: acute kidney injury, dialysis, and mortality. Sensitivity and specificity were prioritised as measures of discrimination, with minimum clinically important difference thresholds set as 0.60 and 0.80 for which a test would be deemed clinically useless, and 0.80 and 0.90 for which a test would be recommended for sensitivity and specificity, respectively. Positive and negative predictive values, positive and negative likelihood ratios and area under the receiver operating curve were also included as measures of discrimination, with a lower emphasis placed on the latter due to its limited clinical applicability. Odds, risk and hazard ratios were included for dialysis and mortality outcomes. Hosmer-Lemeshow was included as a measure of calibration for all clinical outcomes. Mortality was considered the most important outcome, followed by dialysis, then acute kidney injury. Mortality and dialysis are patient centred outcomes, hence the committee agreed that additional care should be taken to avoid these outcomes when administering contrast media due to the negative outcomes experienced by patients. Acute kidney injury was considered less important, as this reflects a diagnosis based on an increase in creatinine that is not necessarily felt by the patient. However, acute kidney injury is still a relevant outcome as it increases the likelihood of dialysis and mortality and is more frequently reported in papers.

3.2. Risk prediction tools

3.2.1. The quality of the evidence

The quality of the evidence ranged from moderate to very low quality, although the majority was very low quality. The most common reason for downgrading was due to risk of bias, with all evidence downgraded by at least one increment. The reasons for downgrading were varied, although there were regular occurrences of unclear measurement of predictors where either definitions or timings were not clear, incomplete outcome reporting where discrimination was reported without calibration, and inadequate sample size where the number of events was less than 100 or fewer than 10 per predictor, depending on the study design. Inconsistency was largely not applicable due to a given risk prediction tool only being reported in a single study. Pooling of AUC values was was possible in ten risk prediction tools, albeit without meta analysis, with downgrading for inconsistency occurring on five occasions where there were significant differences in the model performance reported between studies. Meta analysis was conducted on one occasion where sensitivity and specificity of a risk tool at a specified threshold were reported in three separate studies. Indirectness was only seen where risk prediction tools included procedural variables, usually contrast volume and intra-aortic balloon pump, which limited the applicability of the tool as a pre-procedural tool to determine risk prior to administering contrast media. Finally, imprecision was seen across most of the risk prediction tools, mostly due to overlapping a single 95% CI threshold, but also due to overlapping both the upper and lower threshold on six occasions. These limitations and subsequent uncertainty of the evidence were highlighted to the committee. Due to the generally very low quality of the data, the committee struggled to make recommendations based on the evidence presented alone.

3.2.2. Clinically effective tools

Acute kidney injury

Twenty-eight different risk tools were reported in the nineteen studies included in this evidence review. All evidence identified was in participants undergoing percutaneous coronary intervention or coronary angiography. Twelve of these risk prediction tools met the pre-specified threshold of 0.7 for AUC, indicating good discrimination. These tools were:

- Mehran risk tool: 11 studies, 8374 participants, **median AUC= 0.780** (upper and lower range of confidence interval of 0.480-0.912), very low quality
- Ando risk score: 2 studies, 1373 participants, **mean AUC= 0.70** (upper and lower confidence interval of 0.50-0.92), very low quality
- Inohara risk score: 2 studies, 2272 participants, **mean AUC= 0.705** (upper and lower confidence interval of 0.600-0.770), very low quality
- ACEF score: 2 studies, 1522 participants, **mean AUC= 0.791** (upper and lower confidence interval of 0.656-0.850)
- GRACE score, 1 study, 216 participants, **AUC= 0.828** (95%CI 0.724-0.932), low quality
- de Ferrari risk score: 1 study, 1782 participants, **AUC= 0.838** (95%CI 0.802-0.874), low quality
- CH2DS2-VASc score: 1 study, 300 participants, **AUC= 0.81** (95%CI 0.73-0.90), moderate quality
- Gurm (full model) risk score: 1 study, 20,572 participants, **AUC= 0.852** (95%CI 0.835-0.869), very low quality
- Zwolle risk score: 1 study, 314 participants, **AUC= 0.85** (95%CI 0.78-0.92), very low quality
- Lei risk score: 1 study, 643 participants, **AUC= 0.78** (95%CI 0.73-0.83), low quality
- Liu full risk score: 1 study, 1041 participants, **AUC= 0.858** (95%CI 0.794-0.923), low quality
- Liu reduced risk score: 1 study, 1041 participants, **AUC= 0.854** (95%CI 0.796-0.913), low quality

Ten studies reported a cut-off value for the included risk tools and reported sensitivity and specificity values. Cut-off values for risk tools that met the pre-specified sensitivity threshold for predicting CA-AKI were:

- Victor risk score, cut off >10%: 1 study, 300 participants, **sensitivity= 92.3%** (95%CI 75-99), very low quality (specificity did not meet the threshold (82.1%)
- GRACE score, cut-off >142: 1 study, 216 participants, **sensitivity= 81%** (95%CI 58-95), very low quality (specificity did not meet the threshold (71%))
- CH2DS2-VASc risk score, cut-off ≥4: 1 study, 300 participants, **sensitivity= 90.2%** (95%CI 77-97), low quality (specificity did not meet the threshold (62.9%))
- Lei risk score, cut-off >129: 1 study, 643 participants, **sensitivity= 81.2%** (95%CI 72-88), very low quality (specificity did not meet the threshold (63.3%))

No evidence reported a risk prediction tool that met the pre-specified specificity threshold of 90%.

The committee's attention was drawn to the 2020 study by Serif et al., which included seventeen previously developed risk tools. This paper summarised the general inadequacy of risk prediction tools for CA-AKI, with AUC's ranging from 0.48-0.58, indicating poor discrimination. However, this study also reported positive and negative predictive values (PPV and NPV), with PPV ranging from 17.0-30.2% and NPV ranging from 84.0-94.0%. Reporting of these predictive values highlighted that any risk prediction tool is unlikely to identify patients who will go on to have an AKI but may have some utility as a screening tool to identify those that won't have an AKI. Nonetheless, no single risk prediction tool was deemed to be supported by enough evidence to warrant a recommendation based off these predictive values.

All but three risk prediction tools (Tsai, Liu, Chen) showed non-significant Hosmer-Lemeshow (H-L) test results. The calibration of the Ando risk score was reported in two studies, one of which showed a significant H-L statistic and the other showing a non-significant result. The non-significant H-L seen in the majority of risk prediction tools indicates they are suitable for correctly identifying participants who did or did not go on to have a CA-AKI. Nonetheless, the committee noted that calibration was infrequently reported and agreed that the p-values reported offered little in terms of clinical applicability.

Despite some evidence showing that risk prediction tools can accurately predict CA-AKI, the committee agreed that the evidence was lacking in both quantity and quality. The majority of the included risk prediction tools were included in a small number of studies, limiting the certainty of their accuracy beyond the small number of participants included. Furthermore, the majority of evidence was of very low quality, further reinforcing the uncertainty of the estimates presented. The committee reiterated the specific clinical scenario presented in the identified evidence, with PCI representing a very small portion of the contrast enhanced scans and procedures regularly conducted in the NHS. It was noted that the average population age in the identified evidence was in the 50-60 years range, representing a population that is younger than those typically undergoing contrast enhanced procedures. The committee agreed that recommending any specific risk prediction tool would require extrapolation of the evidence due to the procedures and populations represented in the evidence. As a result, the committee agreed that none of the reported risk tools were supported by adequate evidence to be recommended.

Dialysis

Both the full and reduced Gurm risk tools reported an AUC that exceeded the threshold for predicting dialysis in 22,572 participants. Both tools reported an AUC of 0.875 (95%CI of the full model: 0.819-0.931, reduced model: 0.823-0.931), although this was very low quality evidence for both. The committee noted the impracticality of both tools, which contained procedural variables that limited their utility as a pre-contrast screening tool. Furthermore, the full tool contained 46 variables and the reduced tool contained 15, both of which are unlikely to be used routinely in practice. One study reported the accuracy of the GRACE score, a risk prediction score developed for predicting acute coronary syndrome, not AKI, at four thresholds, none of which resulted in a sensitivity or specificity exceeding the pre-specified threshold. The committee agreed that none of the reported risk tools were supported by adequate evidence to be recommended. The lack of data on the association between dialysis and contrast use was noted and potentially an area to make a research recommendation.

Mortality

The Mehran risk score was the only risk prediction tool that showed an AUC exceeding the threshold for predicting mortality with an AUC of 0.74 (95%CI 0.59-0.79) reported by a single study containing 891 participants but with very low certainty of the estimate. The same study reported hazard ratios for different levels of the risk score, which categorises patients into low, medium, high and very high risk. Data from this study showed a HR of 3.61 (95%CI 2.19-5.98) with a medium score, a HR of 8.00 (95%CI 4.53-14.13) with a high score, and a HR of 15.29 (95%CI 8.11-28.83) with a very high score, all compared to a low score. This data suggests that applying the author-defined categories of the Mehran risk tool can predict mortality in patients, showing a clear relationship between increasing risk levels and incidence of mortality. However, it was raised to the committee that in the study reporting this, none of the participants that died had CA-AKI, limiting the strength of the conclusion that this risk tool can predict mortality in the context of CA-AKI. Furthermore, the committee noted that the Mehran risk score contains contrast volume and IABP, limiting both its utility as a pre-procedural risk score and as a tool that can be used across multiple contrast-requiring conditions. One study reported the accuracy of the GRACE score at four levels, none of which resulted in a sensitivity or specificity exceeding the pre-specified threshold in our protocol. The committee agreed by informal consensus that none of the reported risk tools were supported by adequate evidence to be recommended.

3.3. eGFR

3.3.1. The quality of the evidence

The quality of the evidence ranged from high to very low quality, with the majority being moderate quality. The majority of the evidence was downgraded by one increment due to concerns arising from risk of bias, namely due to incomplete reporting of how confounders were identified for inclusion in the multivariate model. Very serious inconsistency was noted at one threshold where three studies reported the same cut-off. All other evidence was from individual studies reporting a cut-off value, meaning inconsistency could not be assessed. No indirectness or imprecision was present at any threshold.

3.3.2. Clinically important differences

Acute kidney injury

The committee did not pre-specify thresholds for eGFR cut-offs. The evidence showed that a lower eGFR is associated with an increased risk of CA-AKI. The most useful data identified compared an eGFR of 30-59 vs ≥60, <60 vs ≥60, and ≤60 vs >60 mL/min/1.73m^2, with all other comparisons being made between non-adjacent categories (e.g., <15 vs ≥90). High quality evidence from a single study reported an OR of 1.71 (95%CI 1.17-2.50) when comparing 30-59 vs ≥60. Low to very low quality evidence from three studies compared <60 vs ≥60, reporting ORs of 5.12 (2.27-11.54), 5.04 (3.05-8.32) and 1.65 (1.21-2.21), with the latter containing 7287 participants, compared to 2248 and 1954 in the former estimates. Moderate quality evidence from one study compared ≤60 vs >60, reporting an OR of 1.67 (95%CI 1.02-2.75). Whilst this evidence suggests that there is an increased risk at a cut-off around 60 mL/min/1.73m^2, this was not a threshold that was considered by the committee to indicate any significant risk of CA-AKI in practice. No evidence was identified that compared a cut-off of 30 mL/min/1.73m^2 to the currently recommended threshold of 40 mL/min/1.73m^2, resulting in a consensus recommendation. The committee noted that in current practice, clinicians use a threshold of 30 mL/min/1.73m^2 rather than the previously recommended threshold of 40 mL/min/1.73m^2. As a result, the committee agreed that a research recommendation was not necessary in this area as this threshold has, in their experience, been shown to be acceptable for mitigating AKI risk.

Dialysis

No evidence was identified that investigated the prognostic accuracy of any eGFR threshold for the incidence of dialysis.

Mortality

No evidence was identified that investigated the prognostic accuracy of any eGFR threshold for the incidence of mortality.

3.4. Cost effectiveness and resource use

Risk assessment tools

No health economic evaluation was identified from the literature review. Due to the low quality of clinical evidence, no original economic modelling was developed either. The committee felt that all the included risk assessment tools/questionnaires from clinical evidence were of very low quality. Therefore, the committee agreed that none of the reported risk assessment tools were supported by adequate evidence to be recommended for predicting the occurrence of AKI following the administration of iodine-based contrast media.

The committee acknowledged that risk factors of developing CA-AKI should be included in the routine discussion of risks and benefits before offering iodine-based contrast media for CT imaging to adults. The committee noted that there are variations in clinical practice in the NHS; some trusts need a recent eGFR result from all patients before doing a contrast associated CT scan, while other trusts will do a contrast associated CT scan without a recent eGFR result if there is a low risk of CA-AKI. The committee also noted that risk factor-based screening should identify people at higher risk of CA-AKI.

The committee came to a consensus that if no eGFR is available within the last 6 months for a non-emergency outpatient, but a risk assessment tool indicates a history of kidney disease, then the requestor should consider requesting an eGFR test to support decision making. This is likely to affect only a small number of people because someone known to have kidney disease should already have an eGFR result from the past 6 months. No significant resource impact is expected for this in practice because any small increase in cost associated with the increase in eGFR testing at an early stage is likely to be offset by the reduced long-term costs of managing AKI, especially since the eGFR testing is likely to be provided at some point in the treatment pathway anyway.

This change in clinical practice is also likely to reduce either delayed scans or scan cancellations at short notice since an eGFR test result from the past 6 months instead of 3 months (which is used in current practice) will be able to support decisions on the contrast media scan as well as release the burden on multiple blood tests. The committee concluded that risk factor screening is an appropriate first step for people who are thought of as being at increased risk of CA-AKI needing non-emergency contrast associated CT imaging and who present without an eGFR measurement within 6 months.

Estimated glomerular filtration rate (eGFR)

No health economic evaluation was identified from the literature review. Due to the poor quality of clinical evidence, no original economic modelling was developed either. No clinical evidence was identified that compared an eGFR threshold of 30 mL/min/1.73m^2 to the currently recommended threshold of 40 mL/min/1.73m^2, but the committee reached a consensus that an increased risk is associated with an eGFR less than 30 mL/min/1.73m^2 that is commonly used in clinical practice to indicate the prospect of poor kidney function. The committee noted that this updated threshold is also in line with international guidelines. This new threshold of 30 ml/min/1.73 m^2 may ensure that only people with the greatest risk would need an eGFR test, hence, it would be cost saving to the NHS due to the reduced number of eGFR testing.

3.5. Other factors the committee took into account

The committee agreed that in the life-threatening or emergency situations, risk prediction tools should not be applied, and contrast should be administered without delay. The example repeatedly used by the committee was a patient in the emergency department with acute coronary syndrome, indicating a life threating scenario if not treated. In situations like this, the committee agreed that using contrast, regardless of the risk of CA-AKI, is necessary in order to treat the more severe issue that has more significant implications if not acted on. The committee strongly agreed that this should be included as a separate recommendation.

The committee were aware that there is widespread concern surrounding contrast use due to antecedent data suggesting an association between contrast use and AKI. The committee noted that these associations were typically drawn from high osmolar contrast media studies, which was the standard medium used prior to the year 2000. More contemporary research suggests that the risk of CA-AKI with modern low or iso-osmolar contrast media is significantly reduced compared to high osmolar, indicating a reduced risk in current practice. Furthermore, the majority of research has been conducted in emergency settings where participants are in a state of poor acute health. A poor acute health state increases the risk of AKI, independent of contrast administration. That is not to say that contrast is safe in all situations, but that the risks are not as high as typically perceived. The evidence identified in this review was all in patients undergoing percutaneous coronary intervention (PCI), which represents an acute poor health state that mandates intra-arterial contrast administration, associated with an increased with of CA-AKI. AKI can also occasionally be associated with cholesterol embolization associated with PCI. The committee agreed that from the evidence identified it is therefore very difficult to determine the risk of CA-AKI for less invasive procedures, although based on clinical experience there was consensus that the risk of AKI is lesser in non-emergency situations. The committee noted that risks of developing AKI would be discussed with patients as part of the routine discussion of the risks and benefits before carrying our CT imaging. The committee agreed that the list of risk factors for AKI outlined in recommendation 1.1.6 of the previous NICE guidance on this topic should be removed from this section of the guideline. This decision was made on the basis that they are not specific to the risk of developing CA-AKI, but rather represent general risk factors for AKI. The committee agreed that eGFR is the most important consideration when administering contrast media, and whilst clinicians should be aware of these other risk factors, they are not necessarily additive to the risk of developing CA-AKI.

The committee concluded that that further research is needed to develop or validate a suitable risk assessment tool for use across the NHS to predict the occurrence of CI-AKI following the administration of iodine-based contrast media. A research recommendation specific to intravenous contrast administration, for which no evidence was identified, was made to address this gap in the literature.

eGFR

The committee were aware of the problem in current practice whereby a patient is required to have an eGFR within 3 months prior to undergoing contrast media-enhanced scans. This often results in delayed scans and increases the burden on patients and clinicians to conduct blood tests that may not be necessary. Due to the previously outlined lower risk of CA-AKI in non-emergency settings, the committee agreed that screening questions could be used to assess risk. By including initial questions on pre-existing kidney disease, if they have had a kidney transplant, or been seen by a kidney specialist, a large proportion of patients will not then be required to undergo blood tests, which could unnecessarily increase patient and clinician test burden whilst delaying time-sensitive diagnostic scans or treatments. The decision to include an eGFR assessment within 6 months for patients with a history of CKD was based on elevated general risk of AKI in patients with a history of CKD. The committee agreed that patients known to have kidney disease should have an eGFR result within 6 months of contrast use, unless such patients are acutely unwell at the time of contrast use (in which case, an up-to-date blood test would be expected as part of normal practice regardless). The committee also noted that people with a chronic illness are more likely to have regular routine blood tests and therefore a recent eGFR should be available.

The committee were aware that the previous NICE guidance on this topic recommended an eGFR threshold of 40 mL/min/1.73m^2 should be considered high risk for CA-AKI. However, this evidence was based on the risk prediction tools identified at the time, which included eGFR at this threshold. The committee agreed that whilst this was based on the best available evidence at the time, this was now outdated and did not represent what is currently done in practice. The clinical review of eGFR thresholds did not identify any evidence investigating the increase in AKI risk at a cut off of 30 vs 40 mL/min/1.73m^2. Nonetheless, the committee also noted that the risk prediction tools identified in both this, and the previous guideline were in patients undergoing PCI and coronary angiography, representing a high-risk group of patients. Due to the aforementioned reasons pertaining to increased risk in cardiac interventions, the committee agreed that the eGFR threshold that indicates an increased risk of AKI in non-emergency patients is likely to be lower, despite there being no evidence to support this. Furthermore, the committee agreed that a cut-off of 30 mL/min/1.73m^2 made practical sense, with clinicians using this threshold to indicate stage 3 CKD, as opposed to 40 mL/min/1.73m^2 which has no other clinical relevance. The committee were also aware of guidelines published by external international bodies, which despite not being evidence based largely supported the use of 30 mL/min/1.73m^2 as a threshold.

3.6. Recommendations supported by this evidence review

[To be completed once editorially complete version of the guideline is available for submission to NICE for quality assurance, consultation and publication]

This evidence review supports recommendations [add recommendation numbers] and the recommendation for research on [add topic of research recommendation]. Other evidence supporting these recommendations can be found in the evidence reviews on [add topic of evidence review and review letter (A, B, C, etc)]. OR No recommendations were made from this evidence review. Amend as needed

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1 # Appendices

2 ## Appendix A Review protocols

3 ### A.1 Review protocol for risk prediction tools

ID	Field	Content
0.	PROSPERO registration number	
1.	Review title	How effective are risk assessment tools/questionnaires for identifying adults at risk of iodine-based contrast media-associated acute kidney injury (AKI)
2.	Review question	What is the prognostic accuracy of risk assessment tools/questionnaires to predict the occurrence of AKI following the administration of iodine-based contrast media?
3.	Objective	To determine if any of the validated tools/questionnaires for AKI accurately predict AKI in adults receiving iodine-based contrast media
4.	Searches	The following databases (from 2013) will be searched: • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE • Epistemonikos Searches will be restricted by: Date limitations – from original 2013 guideline English language studies

		Human studies Prognostic studies The searches may be re-run 6 weeks before the final committee meeting and further studies retrieved for inclusion if relevant. The full search strategies will be published in the final review. Medline search strategy to be quality assured using the PRESS evidence-based checklist (see methods chapter for full details). Key paper: Bell, S., James, M. T., Farmer, C. K. T., Tan, Z., de Souza, N., & Witham, M. D. (2020). Development and external validation of an acute kidney injury risk score for use in the general population. Clinical kidney journal, 13(3), 402–412. https://doi.org/10.1093/ckj/sfaa072
5.	Condition or domain being studied	Iodine-based contrast media-associated acute kidney injury
6.	Population	Adults receiving iodine-based contrast media Strata: • Intravenous vs intra-arterial media administration Exclusion: • High osmolar contrast media
7.	Risk predictors	Validated risk assessment tools/questionnaires for acute kidney injury
8.	Reference standard	Diagnosis of an acute kidney injury using any study definition

		Timeframe • Within 7 days of contrast administration
9.	Types of study to be included	• Prospective cohort studies • Systematic reviews of prognostic cohort studies
10.	Other exclusion criteria	Non-English language studies. Conference abstracts will be excluded as it is expected there will be sufficient full text published studies available.
11.	Context	
12.	Primary outcomes (critical outcomes)	Primary outcomes: • Sensitivity and specificity • Positive and negative predictive values • Positive and negative likelihood ratios • Area under the receiver operator curve (AUC) • Calibration (Hosmer-Lemeshow test) Minimal important difference (MID): • Sensitivity: upper= 80%, lower= 60% • Specificity: upper= 90%, lower= 80% • AUC: upper= 0.7, lower= 0.5 • Hosmer-Lemeshow: p-value >0.05 Secondary Outcomes (include only if reported in papers reporting primary outcomes):

		• Mortality (risk ratio, odds ratio or hazard ratio) • Dialysis (risk ratio, odds ratio or hazard ratio)
13.	Data extraction (selection and coding)	EndNote will be used for reference management, sifting, citations and bibliographies. All references identified by the searches and from other sources will be uploaded into EPPI reviewer and de-duplicated. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. A standardised form will be used to extract data from studies (see Developing NICE guidelines: the manual section 6.4). 10% of all evidence reviews are quality assured by a senior research fellow. This includes checking: • papers were included /excluded appropriately • a sample of the data extractions • correct methods are used to synthesise data • a sample of the risk of bias assessments Disagreements between the review authors over the risk of bias in particular studies will be resolved by discussion, with involvement of a third review author where necessary.
14.	Risk of bias (quality) assessment	Risk of bias will be assessed using the PROBAST checklist as described in Developing NICE guidelines: the manual.

15.	Strategy for data synthesis	Heterogeneity between the studies in effect measures will be assessed using the I^2 statistic and visually inspected. An I^2 value greater than 50% will be considered indicative of substantial heterogeneity. Sensitivity analyses will be conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented pooled using random-effects.		
16.	Analysis of sub-groups			
17.	Type and method of review	☐	Intervention	
		☐	Diagnostic	
		☒	Prognostic	
		☐	Qualitative	
		☐	Epidemiologic	
		☐	Service Delivery	
		☐	Other (please specify)	
18.	Language	English		
19.	Country	England		
20.	Anticipated or actual start date			
21.	Anticipated completion date			
22.	Stage of review at time of this submission	Review stage	Started	Completed

		Preliminary searches	☐	☐
		Piloting of the study selection process	☐	☐
		Formal screening of search results against eligibility criteria	☐	☐
		Data extraction	☐	☐
		Risk of bias (quality) assessment	☐	☐
		Data analysis	☐	☐
23.	Named contact	5a. Named contact Guideline Development Team NGC 5b. Organisational affiliation of the review National Institute for Health and Care Excellence (NICE)		
24.	Review team members	From NICE: Guideline lead: Gill Ritchie Systematic reviewer: Toby Sands Health economist: Syed Mohiuddin, Yuanyuan Zhang Information specialist: Elizabeth Barrett Project Manager: Kate Ashmore		
25.	Funding sources/sponsor	Development of this systematic review is being funded by NICE.		
26.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for		

		declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
27.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of [Developing NICE guidelines: the manual](). Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/ng148
28.	Other registration details	
29.	Reference/URL for published protocol	
30.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.
31.	Keywords	
32.	Details of existing review of same topic by same authors	
33.	Current review status	☐ Ongoing ☐ Completed but not published ☐ Completed and published

		☐	Completed, published and being updated
		☐	Discontinued
34.	Additional information		
35.	Details of final publication	www.nice.org.uk	

A.2 Review protocol for eGFR

ID	Field	Content
0.	PROSPERO registration number	
1.	Review title	Can estimated glomerular filtration rate (eGFR) predict iodine-based contrast media-associated acute kidney injury (AKI)?
2.	Review question	What is the prognostic accuracy of eGFR for iodine-based contrast media-associated AKI?
3.	Objective	To determine the prognostic accuracy and optimal threshold of eGFR for predicting iodine-based contrast media-associated AKI
4.	Searches	The following databases (from inception) will be searched: • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE • Epistemonikos

		Searches will be restricted by: • Date limitations –from searches for original guideline (2013) • English language studies • Human studies • Prognostic studies The searches may be re-run 6 weeks before the final committee meeting and further studies retrieved for inclusion if relevant. The full search strategies will be published in the final review. Medline search strategy to be quality assured using the PRESS evidence-based checklist (see methods chapter for full details). Key papers: Obed, M., Gabriel, M. M., Dumann, E., Vollmer Barbosa, C., Weißenborn, K., & Schmidt, B. M. W. (2022). Risk of acute kidney injury after contrast-enhanced computerized tomography: a systematic review and meta-analysis of 21 propensity score-matched cohort studies. *European radiology*, *32*(12), 8432–8442. https://doi.org/10.1007/s00330-022-08916-y Bell, S., James, M. T., Farmer, C. K. T., Tan, Z., de Souza, N., & Witham, M. D. (2020). Development and external validation of an acute kidney injury risk score for use in the general population. Clinical kidney journal, 13(3), 402–412. https://doi.org/10.1093/ckj/sfaa072
5.	Condition or domain being studied	iodine-based contrast media-associated acute kidney injury
6.	Population	Adults receiving iodine-based contrast media

		Strata: • Intravenous vs intra-arterial media administration Key confounding variables: (excluded unless all accounted for) • Diabetes (previous diagnosis) • Heart failure (ICD-10 code I50) • Age Additional confounder: (included if not accounted for, but recorded) • Hypertension Exclusion: • High osmolar contrast media

7.	Prognostic factor	Estimated glomerular filtration rate (eGFR)
		• Cut-offs pooled depending on stage of chronic kidney disease indicated:
		    ○ 45-60 (stage 3a)
		    ○ 44-30 (stage 3b)
		    ○ 29-15 (stage 4)
		    ○ <15 (stage 5)
		
		Recorded within 3 months of contrast-media administration

8.	Outcomes	Occurrence of an event following intravenous administration of iodine-based contrast media. • Study defined AKI • Mortality • Dialysis

		Timeframe: • Within 7 days
9.	Types of study to be included	• Prognostic cohort studies • Case control studies • Systematic reviews of prognostic cohort studies Prognostic: studies will only be included if all of the key confounders have been accounted for in a multivariate analysis. In the absence of multivariate analysis, studies that account for key confounders with univariate analysis or matched groups will be considered.
10.	Other exclusion criteria	Non-English language studies. Conference abstracts will be excluded as it is expected there will be sufficient full text published studies available.
11.	Context	
12.	Primary outcomes (critical outcomes)	Risk of mortality, dialysis, or an AKI occurring: • Adjusted relative risk (RR) • Adjusted odds ratio (OR) • Adjusted hazard ratio (HR)
13.	Data extraction (selection and coding)	EndNote will be used for reference management, sifting, citations and bibliographies. All references identified by the searches and from other sources will be uploaded into EPPI reviewer and de-duplicated. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer.

		The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. A standardised form will be used to extract data from studies (see [Developing NICE guidelines: the manual](#) section 6.4). 10% of all evidence reviews are quality assured by a senior research fellow. This includes checking: • papers were included /excluded appropriately • a sample of the data extractions • correct methods are used to synthesise data • a sample of the risk of bias assessments Disagreements between the review authors over the risk of bias in particular studies will be resolved by discussion, with involvement of a third review author where necessary.
14.	Risk of bias (quality) assessment	Risk of bias will be assessed using the QUIPS checklists as described in Developing NICE guidelines: the manual.
15.	Strategy for data synthesis	Heterogeneity between the studies in effect measures will be assessed using the I^2 statistic and visually inspected. An I^2 value greater than 50% will be considered indicative of substantial heterogeneity. Sensitivity analyses will be conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented pooled using random-effects. GRADEpro will be used to assess the quality of evidence for each outcome, taking into account individual study quality and the meta-analysis results. The 4 main quality elements (risk of bias, indirectness, inconsistency and imprecision) will be appraised for each outcome. Publication bias will be considered with the guideline committee, and if suspected will be tested for when there are more than 5 studies for that outcome.

		The risk of bias across all available evidence was evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group http://www.gradeworkinggroup.org/ Where meta-analysis is not possible, data will be presented and quality assessed individually per outcome.		
16.	Analysis of sub-groups			
17.	Type and method of review	☐	Intervention	
		☐	Diagnostic	
		☒	Prognostic	
		☐	Qualitative	
		☐	Epidemiologic	
		☐	Service Delivery	
		☐	Other (please specify)	
18.	Language	English		
19.	Country	England		
20.	Anticipated or actual start date			
21.	Anticipated completion date			
22.	Stage of review at time of this submission	Review stage	Started	Completed

		Preliminary searches	☐	☐
		Piloting of the study selection process	☐	☐
		Formal screening of search results against eligibility criteria	☐	☐
		Data extraction	☐	☐
		Risk of bias (quality) assessment	☐	☐
		Data analysis	☐	☐
23.	Named contact	5a. Named contact Guideline Development Team NGC 5b. Organisational affiliation of the review National Institute for Health and Care Excellence (NICE)		
24.	Review team members	From NICE: Guideline lead: Gill Ritchie Systematic reviewer: Toby Sands Health economist: Syed Mohiuddin, Yuanyuan Zhang Information specialist: Elizabeth Barrett Project Manager: Kate Ashmore		
25.	Funding sources/sponsor	Development of this systematic review is being funded by NICE.		
26.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for		

		declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.	
27.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of [Developing NICE guidelines: the manual](). Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/ng148	
28.	Other registration details		
29.	Reference/URL for published protocol		
30.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.	
31.	Keywords		
32.	Details of existing review of same topic by same authors		
33.	Current review status	☐	Ongoing
		☐	Completed but not published

		☐	Completed and published
		☐	Completed, published and being updated
		☐	Discontinued
34.	Additional information		
35.	Details of final publication	www.nice.org.uk	

Appendix B Literature search strategies

The literature searches for this review are detailed below and complied with the methodology outlined in Developing NICE guidelines: the manual (2014)

For more information, please see the Methodology review published as part of the accompanying documents for this guideline.

B.1 Clinical search literature search strategy

Searches were constructed using a PICO framework where population (P) terms were combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are rarely used in search strategies as these concepts may not be indexed or described in the title or abstract and are therefore difficult to retrieve. Search filters were applied to the search where appropriate.

Table 8: Database parameters, filters and limits applied

Database	Dates searched	Search filter used
Medline (OVID) Medline in process (OVID) Medline e pubs	**01-01-2013 -09-02-2024** **01-01-2013 -09-02-2024** **Searched 09-02-2024**	Prognostic studies Exclusions (animal studies, letters, comments, editorials, case studies/reports) English language
Embase (OVID)	**01-01-2013 -09-02-2024**	Prognostic studies Exclusions (animal studies, letters, comments, editorials, case studies/reports, conference abstracts) English language
The Cochrane Library (Wiley)	Cochrane Reviews 2013 to 2024 Issue 2 of 12	
Epistemonikos (The Epistemonikos Foundation)	No date limits applied (searched 09/02/2024)	

Medline (Ovid) search terms

1.	exp Acute Kidney Injury/
2.	((acute or early) adj1 (kidney or renal) adj2 (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).tw.
3.	((acute or early) and (kidney or renal) and (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).kf.
4.	or/1-3
5.	exp Contrast Media/
6.	Iodine/
7.	5 and 6

8.	((contrast or radio* or media or intraven* or intraart* or intra-art*) adj4 iodin*).tw.
9.	((contrast or radio* or media or intraven* or intraart* or intra-art*) and iodin*).kf.
10.	or/7-9
11.	glomerular filtration rate/
12.	(glomerular adj1 filtrat*).tw.
13.	(glomerular and filtrat*).kf.
14.	(egfr or gfr).tw,kf.
15.	or/11-14
16.	4 and (10 or 15)
17.	letter/ or editorial/ or news/ or exp historical article/ or anecdotes as topic/ or comment/ or case reports/
18.	(letter or comment*).ti.
19.	17 or 18
20.	randomized controlled trial/ or random*.ti,ab.
21.	19 not 20
22.	animals/ not humans/
23.	exp Animals, Laboratory/
24.	exp Animal Experimentation/
25.	exp Models, Animal/
26.	exp Rodentia/
27.	(rat or rats or mouse or mice or rodent*).ti.
28.	or/21-27
29.	16 not 28
30.	predict.ti.
31.	(validat* or rule*).ti,ab.
32.	(predict* and (outcome* or risk* or model*)).ti,ab.
33.	((history or variable* or criteria or scor* or characteristic* or finding* or factor*) and (predict* or model* or decision* or identif* or prognos*)).ti,ab.
34.	decision*.ti,ab. and Logistic models/
35.	(decision* and (model* or clinical*)).ti,ab.
36.	(prognostic and (history or variable* or criteria or scor* or characteristic* or finding* or factor* or model*)).ti,ab.
37.	(stratification or discrimination or discriminate or c statistic or "area under the curve" or AUC or calibration or indices or algorithm or multivariable).ti,ab.
38.	ROC curve/
39.	or/30-38
40.	29 and 39
41.	limit 40 to english language/

Embase (Ovid) search terms

1.	exp acute kidney failure/
2.	((acute or early) adj1 (kidney or renal) adj2 (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).tw.
3.	((acute or early) and (kidney or renal) and (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).kf.
4.	or/1-3
5.	iodinated contrast medium/
6.	((contrast or radio* or media or intraven* or intraart* or intra-art*) adj4 iodin*).tw.

7.	((contrast or radio* or media or intraven* or intraart* or intra-art*) and iodin*).kf.
8.	or/5-7
9.	exp glomerulus filtration rate/
10.	(glomerular adj1 filtrat*).tw.
11.	(glomerular and filtrat*).kf.
12.	(egfr or gfr).tw,kf.
13.	or/9-12
14.	4 and (8 or 13)
15.	letter.pt. or letter/
16.	note.pt.
17.	editorial.pt.
18.	case report/ or case study/
19.	(letter or comment*).ti.
20.	(conference abstract* or conference review or conference paper or conference proceeding).db,pt,su.
21.	or/15-20
22.	randomized controlled trial/ or random*.ti,ab.
23.	21 not 22
24.	animal/ not human/
25.	nonhuman/
26.	exp Animal Experiment/
27.	exp Experimental Animal/
28.	animal model/
29.	exp Rodent/
30.	(rat or rats or mouse or mice or rodent*).ti.
31.	or/23-30
32.	14 not 31
33.	predict.ti.
34.	(validat* or rule*).ti,ab.
35.	(predict* and (outcome* or risk* or model*)).ti,ab.
36.	((history or variable* or criteria or scor* or characteristic* or finding* or factor*) and (predict* or model* or decision* or identif* or prognos*)).ti,ab.
37.	decision*.ti,ab. and statistical model/
38.	(decision* and (model* or clinical*)).ti,ab.
39.	(prognostic and (history or variable* or criteria or scor* or characteristic* or finding* or factor* or model*)).ti,ab.
40.	(stratification or discrimination or discriminate or c statistic or "area under the curve" or AUC or calibration or indices or algorithm or multivariable).ti,ab.
41.	receiver operating characteristic/
42.	or/33-41
43.	32 and 42
44.	limit 43 to english language/

Cochrane Library (Wiley) search terms

#1.	MeSH descriptor: [Acute Kidney Injury] explode all trees
#2.	((acute or early) near/1 (kidney or renal) near/2 (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)):ti,ab,kw
#3.	#1 or #2

#4.	MeSH descriptor: [Contrast Media] explode all trees
#5.	MeSH descriptor: [Iodine] explode all trees
#6.	#4 and #5
#7.	(((contrast or radio* or media or intraven* or intraart* or intra art*) near/4 iodin*)):ti,ab,kw
#8.	#6 or #7
#9.	MeSH descriptor: [Glomerular Filtration Rate] this term only
#10.	((glomerular near/1 filtrat*)):ti,ab,kw
#11.	((egfr or gfr)):ti,ab,kw
#12.	#9 or #10 or #11
#13.	#8 or #12
#14.	#3 and #13

Epistemonikos search terms

1.	(title:((title:((contrast OR radio* OR media OR intraven* OR intraart* OR intra-art*) AND iodin*) OR abstract:((contrast OR radio* OR media OR intraven* OR intraart* OR intra-art*) AND iodin*))) OR abstract:((title:((contrast OR radio* OR media OR intraven* OR intraart* OR intra-art*) AND iodin*) OR abstract:((contrast OR radio* OR media OR intraven* OR intraart* OR intra-art*) AND iodin*)))) OR (title:(glomerular AND filtrat*) OR abstract:(glomerular AND filtrat*)) OR (title:(egfr OR gfr) OR abstract:(egfr OR gfr)) AND (title:((acute OR early) AND (kidney OR renal) AND (failure* OR injur* OR insufficien* OR dysfunction* OR impair* OR damag* OR trauma* OR necrosis)) OR abstract:((acute OR early) AND (kidney OR renal) AND (failure* OR injur* OR insufficien* OR dysfunction* OR impair* OR damag* OR trauma* OR necrosis)))

B.2 Health Economics literature search strategy

Health economic evidence was identified by applying filters to the clinical literature search strategy in Medline and Embase. The following databases were also searched: Econlit (Ovid) NHS Economic Evaluation Database (NHS EED - this ceased to be updated after 31st March 2015), Health Technology Assessment database (HTA - this ceased to be updated from 31st March 2018) and The International Network of Agencies for Health Technology Assessment (INAHTA

Table 9: Database parameters, filters and limits applied

Database	Dates searched	Search filters and limits applied
Medline (OVID)	Health Economics 1 January 2013–19 February 2024	Health economics studies Exclusions (animal studies, letters, comments, editorials, case studies/reports,) English language
Embase (OVID)	Health Economics 1 January 2014 – 19 February 2024	Health economics studies Exclusions (animal studies, letters, comments, editorials,

Database	Dates searched	Search filters and limits applied
		case studies/reports, conference abstracts) English language
NHS Economic Evaluation Database (NHS EED) (Centre for Research and Dissemination - CRD)	Inception –31st March 2015	
Health Technology Assessment Database (HTA) (Centre for Research and Dissemination – CRD)	Inception – 31st March 2018	
The International Network of Agencies for Health Technology Assessment (INAHTA)	Inception - 19 February 2024	English language
Econlit (Ovid)	Inception - 19 February 2024	

Medline (Ovid) search terms

1.	exp Acute Kidney Injury/
2.	((acute or early) adj1 (kidney or renal) adj2 (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).tw.
3.	((acute or early) and (kidney or renal) and (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).kf.
4.	or/1-3
5.	exp Contrast Media/
6.	Iodine/
7.	5 and 6
8.	((contrast or radio* or media or intraven* or intraart* or intra-art*) adj4 iodin*).tw.
9.	((contrast or radio* or media or intraven* or intraart* or intra-art*) and iodin*).kf.
10.	or/7-9
11.	glomerular filtration rate/
12.	(glomerular adj1 filtrat*).tw.
13.	(glomerular and filtrat*).kf.
14.	(egfr or gfr).tw,kf.
15.	or/11-14
16.	4 and (10 or 15)
17.	letter/ or editorial/ or news/ or exp historical article/ or anecdotes as topic/ or comment/ or case reports/
18.	(letter or comment*).ti.
19.	17 or 18
20.	randomized controlled trial/ or random*.ti,ab.
21.	19 not 20
22.	animals/ not humans/
23.	exp Animals, Laboratory/
24.	exp Animal Experimentation/
25.	exp Models, Animal/
26.	exp Rodentia/
27.	(rat or rats or mouse or mice or rodent*).ti.
28.	or/21-27
29.	16 not 28
30.	Economics/

31.	Value of life/
32.	exp "Costs and Cost Analysis"/
33.	exp Economics, Hospital/
34.	exp Economics, Medical/
35.	Economics, Nursing/
36.	Economics, Pharmaceutical/
37.	exp "Fees and Charges"/
38.	exp Budgets/
39.	budget*.ti,ab.
40.	cost*.ti.
41.	(economic* or pharmaco?economic*).ti.
42.	(price* or pricing*).ti,ab.
43.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
44.	(financ* or fee or fees).ti,ab.
45.	(value adj2 (money or monetary)).ti,ab.
46.	or/30-45
47.	exp Models, Economic/
48.	*Models, Theoretical/
49.	*Models, Organizational/
50.	markov chains/
51.	monte carlo method/
52.	exp Decision Theory/
53.	(markov* or monte carlo).ti,ab.
54.	econom* model*.ti,ab.
55.	(decision* adj2 (tree* or analy* or model*)).ti,ab.
56.	Or/47-55
57.	46 or 56
58.	29 and 57
59.	limit 58 to english language/

Embase (Ovid) search terms

1.	exp acute kidney failure/
2.	((acute or early) adj1 (kidney or renal) adj2 (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).tw.
3.	((acute or early) and (kidney or renal) and (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).kf.
4.	or/1-3
5.	iodinated contrast medium/
6.	((contrast or radio* or media or intraven* or intraart* or intra-art*) adj4 iodin*).tw.
7.	((contrast or radio* or media or intraven* or intraart* or intra-art*) and iodin*).kf.
8.	or/5-7
9.	exp glomerulus filtration rate/
10.	(glomerular adj1 filtrat*).tw.
11.	(glomerular and filtrat*).kf.
12.	(egfr or gfr).tw,kf.
13.	or/9-12
14.	4 and (8 or 13)
15.	letter.pt. or letter/
16.	note.pt.
17.	editorial.pt.
18.	case report/ or case study/
19.	(letter or comment*).ti.
20.	(conference abstract* or conference review or conference paper or conference proceeding).db,pt,su.
21.	or/15-20
22.	randomized controlled trial/ or random*.ti,ab.
23.	21 not 22

24.	animal/ not human/
25.	nonhuman/
26.	exp Animal Experiment/
27.	exp Experimental Animal/
28.	animal model/
29.	exp Rodent/
30.	(rat or rats or mouse or mice or rodent*).ti.
31.	or/23-30
32.	14 not 31
33.	Health economics/
34.	exp health care cost/
35.	exp Fee/
36.	exp Budget/
37.	Funding/
38.	budget*.ti,ab.
39.	cost*.ti.
40.	(economic* or pharmaco?economic*).ti.
41.	(price* or pricing*).ti,ab.
42.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
43.	(financ* or fee or fees).ti,ab.
44.	(value adj2 (money or monetary)).ti,ab.
45.	or/33-44
46.	statistical model/
47.	exp economic aspect/
48.	14 and 15
49.	*theoretical model/
50.	*nonbiological model/
51.	stochastic model/
52.	decision theory/
53.	decision tree/
54.	monte carlo method/
55.	(markov* or monte carlo).ti,ab.
56.	econom* model*.ti,ab.
57.	(decision* adj2 (tree* or analy* or model*)).ti,ab.
58.	or/46-58
59.	45 or 58
60.	limit 59 to english language/

NHS EED and HTA (CRD) search terms

#1.	MeSH DESCRIPTOR Acute Kidney Injury EXPLODE ALL TREES
#2.	(((acute or early) adj1 (kidney or renal) adj2 (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)))
#3.	#1 OR #2
#4.	MeSH DESCRIPTOR Contrast Media EXPLODE ALL TREES
#5.	MeSH DESCRIPTOR Iodine EXPLODE ALL TREES
#6.	#4 AND #5
#7.	(((contrast or radio* or media or intraven* or intraart* or intra-art*) adj4 iodin*))
#8.	#6 OR #7
#9.	MeSH DESCRIPTOR Glomerular Filtration Rate EXPLODE ALL TREES
#10.	((glomerular adj1 filtrat*))
#11.	(egfr or gfr)
#12.	#9 OR #10 OR #11
#13.	#8 OR #12

#14.	#3 and #13

INAHTA search terms

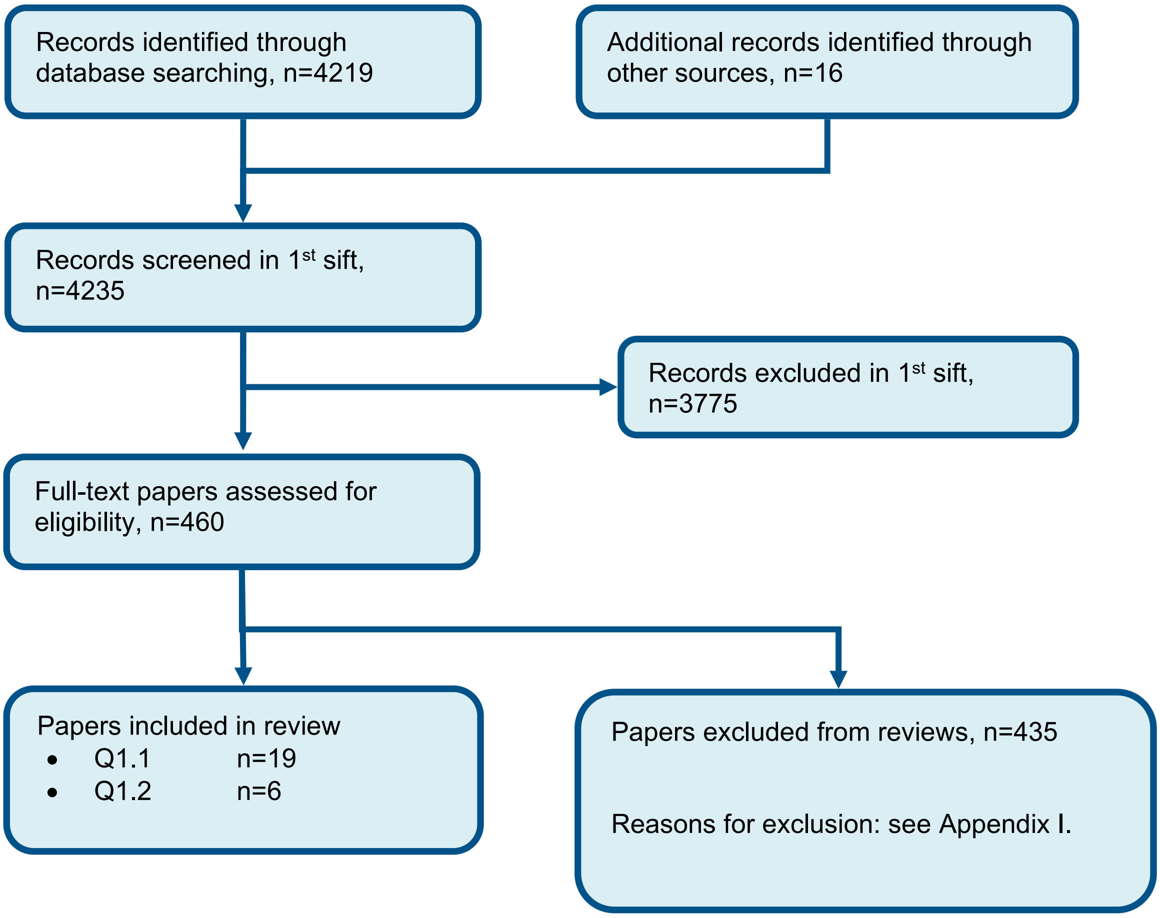
#1.	"Acute Kidney Injury"[mhe]
#2.	((acute or early) and (kidney or renal) and (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis))[Title] OR ((acute or early) and (kidney or renal) and (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis))[abs]
#3.	#1 OR #2
#4.	"Contrast Media"[mhe]
#5.	"Iodine"[mhe]
#6.	#4 AND #5
#7.	((contrast or radio* or media or intraven* or intraart* or intra-art*) and iodin*)[Title] OR ((contrast or radio* or media or intraven* or intraart* or intra-art*) and iodin*)[abs]
#8.	#6 or #7
#9.	"Glomerular Filtration Rate"[mhe]
#10.	(glomerular and filtrat*)[Title] OR (glomerular and filtrat*)[abs]
#11.	(egfr or gfr)[Title] OR (egfr or gfr)[abs]
#12.	#9 OR #10 OR #11
#13.	#8 OR #12
#14.	#3 AND #13

Econlit (Ovid)search terms

1.	((acute or early) adj1 (kidney or renal) adj2 (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).tw.
2.	[((acute or early) and (kidney or renal) and (failure* or injur* or insufficien* or dysfunction* or impair* or damag* or trauma* or necrosis)).kf.]
3.	or/1-2
4.	(contrast or radio* or media or intraven* or intraart* or intra-art*) adj4 iodin*).tw.
5.	[((contrast or radio* or media or intraven* or intraart* or intra-art*) and iodin*).kf.]
6.	or/4-5
7.	(glomerular adj1 filtrat*).tw.
8.	[(glomerular and filtrat*).kf.]
9.	[(egfr or gfr).tw,kf.]
10.	or/7-9
11.	(6 or 10) and 3

Appendix C Prognostic evidence study selection

Figure 1: Flow chart of clinical study selection for the review of risk assessment tools and eGFR as a risk factor for iodine-based contrast media-associated acute kidney injury



Appendix D Prognostic evidence

4.1.1. Risk prediction tools

Alan, 2019

Bibliographic Reference	Alan, Guillaume; Guenancia, Charles; Arnould, Louis; Azemar, Arthur; Pitois, Stephane; Maza, Maud; Bichat, Florence; Zeller, Marianne; Gabrielle, Pierre-Henri; Bron, Alain Marie; Creuzot-Garcher, Catherine; Cottin, Yves; Retinal Vascular Density as A Novel Biomarker of Acute Renal Injury after Acute Coronary Syndrome.; Scientific reports; 2019; vol. 9 (no. 1); 8060

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	France
Study setting	Cardiology intensive care unit
Study dates	September 2016 - March 2017
Sources of funding	Supported by the Dijon University Hospital, the Association de Cardiologie de Bourgogne, and by grants from the Agence Régionale de Santé de Bourgogne, French Ministry of Research, Institut National de la Santé et de la Recherche Médicale, Fédération Française de Cardiologie, Société Française de Cardiologie and the Regional Council of Burgundy

Study sample	Patients' medical records from the obseRvatoire des Infarctus de Côte d'Or - a regional survey set up to collect data for patients hospitalised with acute coronary syndrome
Inclusion criteria	Underwent coronary angiography whilst hospitalised and were eligible for optical coherence tomography angiography
Exclusion criteria	History of an eye disease (diabetic and vascular retinopathy, age-related macular degeneration, vitreoretinal abnormality) On dialysis, Not affiliated to national health insurance
Intervention details	No additional information
Population subgroups	
Risk tool(s)	**Mehran Risk Score** Includes eight weighted variables: hypotension, intra-aortic balloon pump, congestive heart failure, chronic kidney disease, diabetes, age >75 years, anaemia, and volume of contrast **GRACE Score** The GRACE admission score assesses the patient's individual ischemic risk and prognosis with calculation of the probability of in-hospital and 6-month mortality
Model development and validation	Both risk scores were externally created. Optimal cut-off values for each were determined using ROC curves from this study population.
Outcome	Acute kidney injury, referred to in the paper as acute renal failure - according to KDIGO criteria, with an increase in serum creatinine of at least 26.5 μmol/L at 48h after injection or >50% compared to the initial dosage within 7 days after injection of ICA
Duration of follow-up	7 days

Indirectness	None
Additional comments	None

Study arms

Mehran Risk Score (cut-off: 5) (N = 216)

GRACE Score (cut-off: 142) (N = 216)

Characteristics

Study-level characteristics

Characteristic	**Study (N = 216)**
Mean age (SD) Mean (SD)	62.68 (12.38)
% Female Sample size	n = 46 ; % = 21.3
Ethnicity Nominal	NR

Characteristic	Study (N = 216)
Diabetes Sample size	n = 51 ; % = 23.6
Heart failure Sample size	n = 30 ; % = 13.9
Hypertension Sample size	n = 112 ; % = 51.9
Contrast volume mL Mean (SD)	147.56 (64.44)
Number of AKI events Sample size	n = 21 ; % = 10

Outcomes

Acute kidney injury

Outcome	Mehran Risk Score (cut-off: 5), , N = 216	GRACE Score (cut-off: 142), , N = 216
AUC Mean (95% CI)	0.8 (0.7 to 0.91)	0.83 (0.72 to 0.93)
Sensitivity	76	81

Outcome	Mehran Risk Score (cut-off: 5), , N = 216	GRACE Score (cut-off: 142), , N = 216
Nominal		
Specificity % Nominal	69	71

Ando, 2014

Bibliographic Reference	Ando, Giuseppe; de Gregorio, Cesare; Morabito, Gaetano; Trio, Olimpia; Saporito, Francesco; Oreto, Giuseppe; Renal function-adjusted contrast volume redefines the baseline estimation of contrast-induced acute kidney injury risk in patients undergoing primary percutaneous coronary intervention.; Circulation. Cardiovascular interventions; 2014; vol. 7 (no. 4); 465-72

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	Same population as 2013 study by the same author: Age, Glomerular Filtration Rate, Ejection Fraction, and the AGEF Score Predict Contrast-Induced Nephropathy in Patients With Acute Myocardial Infarction Undergoing Primary Percutaneous Coronary Intervention. https://doi.org/10.1002/ccd.25023 Prognostic accuracy data of model 1 is reported in the details of the 2013 study. The details outlined here focus on model 2 only, which was validated in a subset of the whole population.
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Italy
Study setting	Intensive and interventional cardiology department
Study dates	2012-2013

Sources of funding	Funded by the University of Messina
Study sample	Non-consecutive patients undergoing primary PCI
Inclusion criteria	Admitted within 12 hours of STEMI symptom onset
Exclusion criteria	Known tumour or chronic inflammatory disease Chronic kidney failure on haemodialysis at admission Monoclonal gammopathy Recipient of transplants History of adverse reaction to contrast dye or exposure within the last 7 days Undergoing emergency cardiac surgery for coronary revascularization or STEMI-related mechanical complications Died within 12 hr after the procedure.
Intervention details	Primary PCI was performed by an interventional team, using femoral approach and according to standard clinical practice. Pharmacological therapy, as well as the indication to intra-aortic balloon pump support, was left to the discretion of the attending cardiologists. Hydration was initiated during the diagnostic procedure and was continued for ≥48 hours. Saline solution (0.9%) was given intravenously at a rate of 1 mL/ kg per hour; hydration rate was reduced to 0.5 mL/kg per hour in patients with severe left ventricular dysfunction or overt heart failure. Non-ionic low-osmolar contrast media were used in all cases. Blood samples were collected for measurement of serum creatinine concentration on hospital admission, 6 hours after the procedure, every day for the following 3 days, and at discharge from the coronary care unit. Baseline eGFR was calculated using the modification of diet in renal disease equation.
Risk tool(s)	**AGEF Score (including renal function-adjusted contrast volume)** Modified version of the ACEF score, including the following variables: Age

	eGFR LVEF Contrast volume : eGFR ratio
Model development and validation	A logistic regression model was fitted to the database, with the occurrence of CI-AKI as the outcome. The model (model 2) included AGEF score and CV/eGFR. First, the accuracy of each model was assessed in terms of discrimination and calibration: ROC curves analysis was performed to assess discrimination, as measured by the AUC
Outcome	Contrast-induced acute kidney injury, defined as an absolute increase in serum creatinine concentration ≥0.5 mg/dL or ≥25% from baseline within 72 hours after the administration of contrast medium, without any other plausible cause
Duration of follow-up	72 hours
Indirectness	None
Additional comments	None

Study arms

Study-developed risk score (N = 126)

Characteristics

Study-level characteristics

Characteristic	Study (N = 126)
Mean age (SD) Mean (SD)	64.3 (14.1)
% Female Sample size	n = 27 ; % = 21.4
Ethnicity Nominal	NR
Diabetes Sample size	n = 36 ; % = 28.6
Heart failure Nominal	NR
Hypertension Sample size	n = 75 ; % = 59.5
Contrast volume (ml) Mean (SD)	176.7 (44.4)
Number of AKI events Sample size	n = 12 ; % = 9.5

Outcomes

Acute kidney injury

Outcome	Study-developed risk score, , N = 126
AUC Mean (95% CI)	0.86 (0.8 to 0.92)
Hosmer-Lemeshow Mean (p value)	59.9 (<0.001)

Andò, 2013

Bibliographic Reference	Andò, Giuseppe; Morabito, Gaetano; de Gregorio, Cesare; Trio, Olimpia; Saporito, Francesco; Oreto, Giuseppe; Age, glomerular filtration rate, ejection fraction, and the AGEF score predict contrast-induced nephropathy in patients with acute myocardial infarction undergoing primary percutaneous coronary intervention; Catheterization and Cardiovascular Interventions; 2013; vol. 82 (no. 6); 878-885

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Italy
Study setting	Coronary care unit
Study dates	January 2008 - June 2011
Sources of funding	Grant received from Azienda Ospedaliera Universitaria Policlinico “Gaetano Martino”, University of Messina, Italy

Study sample	Consecutive patients referred to the unit for primary percutaneous coronary intervention in the course of ST-segment elevation myocardial infarction
Inclusion criteria	Admitted within 12 hours of symptom onset
Exclusion criteria	Known tumour or chronic inflammatory disease Chronic kidney failure on haemodialysis at admission Monoclonal gammopathy Recipient of transplants History of adverse reaction to contrast dye or exposure within the last 7 days Undergoing emergency cardiac surgery for coronary revascularization or STEMI-related mechanical complications Died within 12 hours of the procedure
Intervention details	Primary PCI was performed from the transfemoral approach according to standard clinical practice. The indication to intra-aortic balloon pump support was left to the discretion of the attending cardiologists. Saline solution (0.9%) was given intravenously at a rate of 1 mL/kg/hr; hydration rate was reduced to 0.5 mL/ kg/hr in patients with severe left ventricular dysfunction or overt heart failure. Hydration was initiated during the diagnostic procedure and was continued for at least 48 hours. Non-ionic low-osmolar contrast media was used in all cases
Risk tool(s)	**ACEF score** Model previously developed by Ranucci et al., (2009) to predict mortality in cardiac surgery patients using the following variables: Age Ejection fraction Serum creatinine

	Mehran risk score Previously established model. No additional information on use other than it was applied at the end of the PCI procedure
Model development and validation	Both models were previously established in other papers
Outcome	Contrast-induced nephropathy, defined as an absolute increase in serum creatinine ≥0.5 mg/dL or an increase ≥25% from baseline within 72 hours of contrast administration, without any other plausible aetiology
Duration of follow-up	Duration of hospital stay (mean (SD)) 7 (3) days
Indirectness	None
Additional comments	None

Study arms

ACEF score (N = 481)

Mehran risk score (cut-off: 5) (N = 481)

Characteristics

Study-level characteristics

Characteristic	Study (N = 481)
Mean age (SD) Mean (SD)	62 (12)
% Female Sample size	n = 128 ; % = 27
Ethnicity Nominal	NR
Diabetes Sample size	n = 143 ; % = 30
Heart failure Killip class Mean (SD)	1.1 (0.5)
Hypertension Sample size	n = 285 ; % = 59
Contrast volume (ml) Mean (SD)	164 (63)
Number of AKI events Sample size	n = 25 ; % = 5.2

Outcomes

Acute kidney injury

Outcome	ACEF score, , N = 481	Mehran risk score (cut-off: 5), , N = 481
AUC Mean (95% CI)	0.82 (0.78 to 0.85)	0.8 (0.77 to 0.84)
Sensitivity Nominal	NR	72
Specificity Nominal	NR	73.5
Hosmer-Lemeshow Mean (p value)	NR (NR)	3.33 (0.77)

Buratti, 2021

Bibliographic Reference	Buratti, Stefano; Crimi, Gabriele; Somaschini, Alberto; Cornara, Stefano; Camporotondo, Rita; Cosentino, Nicola; Moltrasio, Marco; Rubino, Mara; De Metrio, Monica; Marana, Ivana; De Servi, Stefano; Marenzi, Giancarlo; De Ferrari, Gaetano M; A preprocedural risk score predicts acute kidney injury following primary percutaneous coronary intervention.; Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions; 2021; vol. 98 (no. 2); 197-205

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Italy
Study setting	Two hospitals
Study dates	2004 - 2015
Sources of funding	None reported

Study sample	Consecutive ST-elevated myocardial infarction patients admitted to two hospitals
Inclusion criteria	Undergoing percutaneous coronary intervention
Exclusion criteria	On haemodialysis Undergoing rescue PCI or urgent cardiac surgery Died during procedure or before consecutive creatinine measurements could be taken
Intervention details	Primary PCI was performed by interventional cardiologists, according to standard clinical practice. Iso-osmolar contrast agents were used.
Risk tool(s)	**Study developed risk tool (referred to as De Ferrari)** Model based on five variables (score for each indicated in brackets, with a maximum score of 17): Killip class II or III (2) Killip class IV (4) Diabetes (2) Anterior STEMI (3) Age >75 years (3) eGFR <60 (5) **Mehran, Marenzi and Inohara risk scores** No details provided

Model development and validation	Candidate predictors of CI-AKI included variables known at baseline and serum creatinine. Independent predictors were identified by fitting a multivariable logistic regression model in which all significant variables at univariate tests were included. Collinearity between covariates was assessed with a Spearman p test. Each significant variable that was included in the final model was allocated a score based on the nearest whole integer number to the OR identified. ROC curves were computed and c-statistic was used to assess discrimination. Model calibration was assessed with the Hosmer-Lemeshow $\chi 2$ test. The Risk Score performance was then evaluated in the separate validation cohort
Outcome	Contrast-induced acute kidney injury, defined as: an absolute serum creatinine increase ≥0.5 mg/dl in the first 72 hours
Duration of follow-up	Unclear
Indirectness	None
Additional comments	None

Study arms

Study developed risk tool (N = 1782)

Mehran risk score (N = 1782)

Marenzi risk score (N = 1782)

Inohara risk score (N = 1782)

Characteristics

Study-level characteristics

Characteristic	Study (N = 1782)
Mean age (SD) Mean (SD)	63.7 (12.2)
% Female Sample size	n = 387 ; % = 21.7
Ethnicity Nominal	NR
Diabetes Sample size	n = 281 ; % = 15.8
Heart failure Sample size	n = NA ; % = NA
Killip Class II-III Sample size	n = 163 ; % = 9.1
Killip class IV Sample size	n = 158 ; % = 8.7
Hypertension Sample size	n = 914 ; % = 51.2

Characteristic	Study (N = 1782)
No CI-AKI 1646 participants Median (IQR)	209 (156 to 353)
CI-AKI 136 participants Median (IQR)	262 (182 to 470)
Number of AKI events No of events	n = 136 ; % = 7.6

Outcomes

Acute kidney injury

Outcome	Study developed risk tool, , N = 1782	Mehran risk score, , N = 1782	Marenzi risk score, , N = 1782	Inohara risk score, , N = 1782
AUC Mean (SE)	0.84 (0.0183)	0.81 (0.0144)	0.79 (0.0205)	0.73 (0.021)
AUC Mean (95% CI)	0.84 (0.8 to 0.87)	0.81 (0.78 to 0.84)	0.79 (0.75 to 0.83)	0.73 (0.69 to 0.77)

95%CI calculated by analyst from SE reported in paper

Chaudhary, 2019

Bibliographic Reference	Chaudhary, Abhay Kumar; Pathak, Vijay; Kunal, Shekhar; Shukla, Shubhra; Pathak, Pooja; CHA2DS2-VASc score as a novel predictor for contrast-induced nephropathy after percutaneous coronary intervention in acute coronary syndrome.; Indian heart journal; 2019; vol. 71 (no. 4); 303-308

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	India
Study setting	Cardiology department
Study dates	March 2017 - October 2018
Sources of funding	None reported
Study sample	Consecutive patients attending the Department of Cardiology presenting with acute coronary syndrome (ST-elevated myocardial infarction and non-ST-elevated) and undergoing percutaneous coronary intervention (PCI)

Inclusion criteria	None reported
Exclusion criteria	None reported
Intervention details	All PCI procedures were performed by interventional cardiologists either through the transfemoral or transradial approach. Non-ionic, low-osmolar contrast medium or non-ionic, iso-osmolar dimeric contrast medium were used during the PCI. Iodixanol was used in patients with a baseline eGFR <60 mL/min who were also hydrated with intravenous 0.9%, isotonic saline before the procedure, except for patients with frank congestive cardiac failure. Rate of intravenous hydration consisted of 1 mL/kg of body weight/hour or 0.5 mL/kg/ hr for 12 h in patients with LVEF <40%. It was started 3-12 h before contrast agent injection and continued for 12 h after PCI. Nephrotoxic drugs such as metformin and nonsteroidal anti-inflammatory drugs were withdrawn before PCI. All patients were pre-treated with aspirin (300 mg) and a P2Y12 antagonist before PCI. In addition, unfractionated heparin was administered during the procedure. The use of glycoprotein IIb/IIIa inhibitors during PCI was at the operator's discretion
Population subgroups	
Risk tool(s)	**CHA2DS2-VASc** CHA2DS2-VASc score was calculated for each patient by giving a score of 1 to each of these variables: Congestive heart failure or left ventricular systolic dysfunction (ejection fraction ≤40%) Hypertension Age 65-74 years Diabetes mellitus Vascular disease Female gender

	points were allocated for the following variables: Aged ≥75 years Previous stroke or transient ischemic attack A minimum score of 1 was assigned to every patient as they had an episode of coronary artery disease, hence the need for PCI
Model development and validation	Externally developed risk prediction tool typically used for predicting stroke in patients with atrial fibrillation
Outcome	Contrast induced nephropathy, defined as the elevation of serum creatinine ≥0.5 mg/dL or ≥25% increase in the baseline serum creatinine levels within 48 hrs after PCI
Duration of follow-up	Unclear
Indirectness	None
Additional comments	None

Study arms

CHA2DS2-VASc score (cut-off: ≥4) (N = 300)

Characteristics

Study-level characteristics

Characteristic	Study (N = 300)
Mean age (SD) Mean (SD)	55.03 (9.56)
% Female Sample size	n = 85 ; % = 28.3
Ethnicity Nominal	NR
Diabetes Sample size	n = 62 ; % = 20.7
Heart failure Killip class ≥2 Sample size	n = 54 ; % = 18
Hypertension Sample size	n = 120 ; % = 40
Contrast volume (ml) Mean (SD)	145.37 (50.84)
Number of AKI events Sample size	n = 41 ; % = 13.7

Outcomes

Contrast induced nephropathy

Outcome	CHA2DS2-VASc score (cut-off: ≥4), , N = 300
AUC Mean (95% CI)	0.81 (0.73 to 0.9)
Sensitivity Nominal	90.2
Specificity Nominal	62.9

Connolly, 2018

Bibliographic Reference	Connolly, M; Kinnin, M; McEneaney, D; Menown, I; Kurth, M; Lamont, J; Morgan, N; Harbinson, M; Prediction of contrast induced acute kidney injury using novel biomarkers following contrast coronary angiography.; QJM : monthly journal of the Association of Physicians; 2018; vol. 111 (no. 2); 103-110

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	UK
Study setting	Cardiology centre
Study dates	Not reported
Sources of funding	Supported by Randox Laboratories Ltd and the Research and Development fund Northern Ireland Health and Social Care
Study sample	Patients at high risk of AKI attending a cardiology centre who were assessed prior to cardiac catheterisation
Inclusion criteria	Baseline GFR ≤60 mls/min

Exclusion criteria	Recent myocardial infarction Hospitalisation or heart failure within 6 weeks
Intervention details	Pre-procedural CI-AKI prophylaxis with 0.9% saline was adminis-tered to all patients with a GFR <40 mls/min, and patients with a GFR of 40–59 mls/min if their Mehran score was ≥10. Low-osmolar contrast was used for all patients in the form of Iohexol, which contained 350mg of organic iodine per ml.
Population subgroups	
Risk tool(s)	**Mehran risk score (cut-off: ≥10)** No information other than risk factors which contributed to the risk score: Chronic kidney disease stage Cardiac failure Age >75 years Anaemia Diabetes Contrast volume Cut-off based on literature
Model development and validation	Externally developed risk tool

Outcome	Contrast induced acute kidney injury, defined as per KDIGO guidelines: absolute delta rise in creatinine of ≥26.5 mmol/l or a 50% relative rise from baseline at 48 h following contrast
Duration of follow-up	One-year
Indirectness	None
Additional comments	None

Study arms

Mehran risk score (cut-off: ≥10) (N = 301)

Characteristics

Study-level characteristics

Characteristic	Study (N = 301)
Mean age (SD) Mean (SD)	73.53 (8.3)
% Female Sample size	n = 131
Ethnicity Nominal	NR

Characteristic	Study (N = 301)
Diabetes Sample size	n = 85 ; % = 28.2
Heart failure Sample size	n = 67 ; % = 22.3
Hypertension Sample size	n = 297 ; % = 98.7
Contrast volume (ml) Mean (SD)	70.04 (44.24)
Number of AKI events Sample size	n = 28 ; % = 9.3

Outcomes

Acute kidney injury

Outcome	Mehran risk score (cut-off: ≥10), , N = 301
AUC Nominal	0.65
Sensitivity Nominal	64

Outcome	Mehran risk score (cut-off: ≥10), , N = 301
Specificity Nominal	62
PPV Nominal	10
NPV Nominal	94

Gurm, 2013

Bibliographic Reference	Gurm, Hitinder S; Seth, Milan; Kooiman, Judith; Share, David; A novel tool for reliable and accurate prediction of renal complications in patients undergoing percutaneous coronary intervention.; Journal of the American College of Cardiology; 2013; vol. 61 (no. 22); 2242-8

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	USA
Study setting	All non-federal hospitals in Michigan
Study dates	January 2010 - June 2012
Sources of funding	Funded by Blue Cross Blue Shield of Michigan
Study sample	Consecutive patients who underwent percutaneous coronary intervention (PCI)
Inclusion criteria	None reported

Exclusion criteria	Already on dialysis Missing serum creatinine levels (pre or post procedure)
Intervention details	The type of contrast media and hydration protocols used were as per operator preference guided by institutional policy and practice
Population subgroups	
Risk tool(s)	**Study-developed risk tool (full model)** The full model contained 46 parameters: Pre-procedural therapy Beta-blockers Antianginal medication within 2 weeks Calcium channel blockers Long-acting nitrates Other antianginal agent Ranolazine Thrombolytics Pre-procedural vasopressors Clinical history

	GI bleeding Heparin-induced thrombocytopenia Surgery within 7 days pre-procedure Hypertension Cerebrovascular disease Prior heart failure Prior MI Peripheral arterial disease Prior PCI Dyslipidaemia Family history of premature CAD History of atrial fibrillation Cardiac transplant Prior valve surgery Cardiomyopathy or left ventricular systolic dysfunction Chronic lung disease

	Diabetes mellitus Prior CABG Prior ICD implant Patient characteristics Race - black or African American Sex Current/recent smoker (within a year) Age Weight Height Patient presentation PCI indication PCI status CAD presentation Pre-operative evaluation prior to noncardiac surgery Pre-PCI LVEF

	Cardiogenic shock Heart failure within 2 weeks Cardiac arrest within 24 hours Pre-procedural laboratory assessments Creatine-kinase MB Creatinine Haemoglobin Troponin I and II **Study-developed risk tool (reduced model)** To create an easy-to-use bedside tool, a reduced model was also trained using only the 15 most important predictors as assessed in the full model: Patient presentation PCI indication PCI status CAD presentation Cardiogenic shock

	Heart failure within 2 weeks Pre-PCI LVEF Clinical history Diabetes mellitus Patient characteristics Age Weight Height Pre-procedural laboratory assessments Creatine kinase MB Serum creatinine Haemoglobin Troponin I and II
Model development and validation	The full and reduced models were evaluated in terms of discrimination and predictive power in the validation data set. Overall diagnostic accuracy was estimated using the AUC.
Outcome	Contrast-induced nephropathy, defined as: impairment in renal function resulting in ≥0.5 mg/dl absolute increase in serum creatinine level from baseline
Duration of follow-up	Unclear

Indirectness	None
Additional comments	None

Study arms

Study-developed risk tool (full model) (N = 20572)

Study-developed risk tool (reduced model) (N = 20572)

Characteristics

Study-level characteristics

Characteristic	Study (N = 20572)
Mean age (SD) Mean (SD)	65 (12.2)
% Female Sample size	n = 6915 ; % = 34
Ethnicity Black or African American Sample size	n = 2192 ; % = 11

Characteristic	Study (N = 20572)
Diabetes Sample size	n = 7533 ; % = 37
Heart failure Sample size	n = 3196 ; % = 16
Hypertension Sample size	n = 17495 ; % = 85
Contrast volume Nominal	NR
Number of AKI events Sample size	n = 505 ; % = 2.5

Outcomes

Acute kidney injury

Outcome	Study-developed risk tool (full model), , N = 20572	Study-developed risk tool (reduced model), , N = 20572
AUC Mean (95% CI)	0.85 (0.84 to 0.87)	0.84 (0.82 to 0.86)

Dialysis

Outcome	Study-developed risk tool (full model), , N = 20572	Study-developed risk tool (reduced model), , N = 20572
AUC Mean (95% CI)	0.88 (0.82 to 0.93)	0.88 (0.82 to 0.93)

Kul, 2015

Bibliographic Reference	Kul, S; Uyarel, H; Kucukdagli, O T; Turfan, M; Vatankulu, M A; Tasal, A; Erdogan, E; Asoglu, E; Sahin, M; Guvenc, T S; Goktekin, O; Zwolle risk score predicts contrast-induced acute kidney injury in STEMI patients undergoing PCI.; Herz; 2015; vol. 40 (no. 1); 109-15

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Germany
Study setting	Hospital
Study dates	May 2011 - September 2012
Sources of funding	None reported
Study sample	Consecutive patients admitted with ST-elevated myocardial infarction, undergoing urgent cardiac catheterisation

Inclusion criteria	Inclusion based on STEMI criteria: Presented within 12 h from the onset of typical chest pain (24 h for persistent symptoms and/or ST elevation) New ST elevation at the J point in two contiguous leads with the cut-off points of ≥0.1 mV in all leads other than leads V2–V3 where the following cut-off points applied: ≥0.2 mV in men ≥40 years; ≥0.25 mV in men <40 years, or ≥0.15 mV in women New onset of complete left bundle-branch block Had primary PCI (angioplasty and/or stent deployment)
Exclusion criteria	Scheduled for coronary artery bypass graft surgery On medical treatment Chronic kidney disease (eGFR <30 ml/min/1.73m3) and/or on dialysis Prior CABG Died within 48 hours of hospital admission Exposed to contrast medium within 7 days of PCI
Intervention details	All patients received 300 mg aspirin and a 600 mg loading dose of clopidogrel before coronary angiography. Emergency coronary angiography was performed by the percutaneous femoral approach using a non-ionic low-osmolality contrast medium. Heparin (100 U/kg) was administered when the coronary anatomy was first assessed. The usage of tirofiban was left to the discretion of the operator.
Population subgroups	
Risk tool(s)	**Mehran risk score**

	Mehran risk score was calculated using: Hypotension (5 points, if systolic blood pressure <80 mmHg for at least 1 h requiring inotropic support) Use of intra-aortic balloon pump (5 points) Congestive heart failure (5 points, if class III/IV by New York Heart Association classification or history of pulmonary edema) Age (4 points, if >75 years), anaemia (3 points, if haematocrit <39% for men and <36% for women) Diabetes mellitus (3 points) Contrast media volume (1 point per 100 ml) Serum creatinine (4 points if >1.5 mg d/l) **Zwolle risk score** Zwolle risk score was calculated using: Killip class (1, 0 point; 2, 4 points; 3–4, 9 points) Post-TIMI flow grade (3, 0 point; 2, 1 point; 1, 2 points) Age (≥60, 2 points) Three-vessel disease (1 point) Anterior MI (1 point)

	Ischemic time >4 h (1 point)
Model development and validation	Mehran risk score was previously established for the assessment of post-contrast AKI risk. Zwolle risk score is used to identify patients low risk patients with STEMI undergoing PCI.
Outcome	Contrast-induced acute kidney injury, defined as: a relative increase in baseline serum creatinine of >25% and/or an absolute increase of 0.5 mg/ dl within 72 h after contrast administration
Duration of follow-up	Duration of hospital stay
Indirectness	None
Additional comments	None

Study arms

Mehran risk score (cut-off: >5) (N = 314)

Zwolle score (cut-off: >2) (N = 314)

Characteristics

Study-level characteristics

Characteristic	Study (N = 314)
Mean age (SD)	56.33 (11.41)

Characteristic	Study (N = 314)
Mean (SD)	
% Female Sample size	n = 59 ; % = 18.8
Ethnicity Nominal	NR
Diabetes Sample size	n = 71 ; % = 22.6
Heart failure Killip >1 Sample size	n = 20 ; % = 6.4
Hypertension Sample size	n = 136 ; % = 43.3
Contrast volume (ml) Mean (SD)	274.2 (114.1)
Number of AKI events Sample size	n = 38 ; % = 12.1

Outcomes

Acute kidney injury

Outcome	Mehran risk score (cut-off: >5), , N = 314	Zwolle score (cut-off: >2), , N = 314
Sensitivity Mean (95% CI)	71.1 (63 to 81)	76.3 (68 to 84)
Specificity Mean (95% CI)	73 (65 to 84)	75.4 (66 to 83)
AUC Mean (95% CI)	0.79 (0.7 to 0.88)	0.85 (0.78 to 0.92)
PPV Mean (95% CI)	27 (8 to 46)	30 (10 to 43)
NPV Mean (95% CI)	94 (88 to 97)	96 (90 to 99)

Lei, 2020

Bibliographic Reference	Lei, Li; Xue, Yan; Guo, Zhaodong; Liu, Bowen; He, Yibo; Liu, Jin; Nie, Zhiqiang; Chen, Liling; Chen, Kaihong; Huang, Zhidong; Liang, Min; Chen, Shiqun; Liu, Yong; Chen, Jiyan; Nomogram for contrast-induced acute kidney injury in patients with chronic kidney disease undergoing coronary angiography in China: a cohort study.; BMJ open; 2020; vol. 10 (no. 5); e037256

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	China
Study setting	Hospital
Study dates	January 2010 - October 2012
Sources of funding	Supported by the Beijing Lisheng Cardiovascular Pilot Foundation, the 'Lixin Yangfan' Optimised Anti-thrombus Research Fund, the Progress in Science and Technology Project of Guangzhou, the Access Research Fund, and the China Youth Clinical Research Fund

Study sample	Consecutive patients who underwent coronary angiography (CAG) / percutaneous coronary intervention (PCI)
Inclusion criteria	Aged ≥18 years eGFR <60 mL/min/1.73 mm2
Exclusion criteria	Pregnant or lactating Contrast exposure within 7 days of CAG/PCI, or 3 days after Cardiovascular surgery No use of contrast media during procedure Undergoing haemodialysis Missing preoperative or postoperative creatinine Malignancy No use of isotonic saline for hydration
Intervention details	Procedures were performed by interventional cardiologists according to routine practice
Population subgroups	
Risk tool(s)	**Mehran risk score** Original 2004 paper referenced **Study-developed nomogram**

	Nomogram with point scoring system (0-220, with probability of an AKI occurring on a logarithmic scale, starting at ~80 points with a probability of 0.01 through to a score of ~210 representing a probability of 0.8) based on: Age Heart rate Weight Hypotension PCI Beta blocker use
Model development and validation	Variables that were imbalanced between groups or clinically important were candidates for univariable logistic analysis. Significant predictors from the univariable analysis were included in the multivariable logistic analysis to fit a prediction model. A backward stepwise approach was performed to create a reduced model by successively removing non-significant covariates ($p>0.1$) until all the remaining predictors were statistically significant. Collinearity between variables was also evaluated. A nomogram was then formulated based on the results. To form the nomogram, each regression coefficient in the multivariable logistic regression was proportionally converted into a 0–100-point scale. Variables with the highest β coefficient were assigned 100 points. The points are added across each variable to calculate the total points, which are finally converted to predicted probabilities. The performance of the nomogram was assessed using the area under the ROC curve and concordance C-statistic for discriminative ability and calibration with 1000 bootstrap samples. Calibration was assessed using the Hosmer-Lemeshow test. The cut-off score to identified patients at risk of CI-AKI was then derived from the ROC curve.
Outcome	Contrast-induced acute kidney injury, defined as: serum creatinine elevation ≥0.5mg/dL or 25% from baseline within the first 48–72 hours following contrast exposure
Duration of follow-up	Ongoing from enrolment until 2019 (maximum of 9 years)
Indirectness	None
Additional comments	None

Study arms

Mehran risk score (N = 643)

Study-developed nomogram (cut-off: 129) (N = 643)

Characteristics

Study-level characteristics

Characteristic	Study (N = 643)
Mean age (SD) Mean (SD)	69.88 (9.67)
% Female Sample size	n = 181 ; % = 28.2
Ethnicity Nominal	NR
Diabetes Sample size	n = 207 ; % = 32.2

Characteristic	Study (N = 643)
Heart failure Sample size	n = 468 ; % = 73
Hypertension Sample size	n = 475 ; % = 73.9
Contrast volume (ml) Mean (SD)	136.1 (64.72)
Number of AKI events Sample size	n = 96 ; % = 14.9

Outcomes

Acute kidney injury

Outcome	Mehran risk score , , N = 634	Study-developed nomogram (cut-off: 129), , N = 634
Sensitivity Nominal	NR	81.2
Specificity Nominal	NR	62.3
AUC Mean (95% CI)	0.71 (NR to NR)	0.78 (0.73 to 0.83)

Liang, 2023

Bibliographic Reference	Liang, L.; Li, D.; Zeng, R.; Zhang, H.; Lv, L.; Wei, W.; Wan, Z.; Long- and very long-chain ceramides are predictors of acute kidney injury in patients with acute coronary syndrome: the PEACP study; Cardiovascular Diabetology; 2023; vol. 22 (no. 1); 92

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	NCT04122573
Study type	Prospective cohort study
Study location	China
Study setting	Tertiary hospitals
Study dates	November 2019 - April 2020
Sources of funding	Supported by grants from the National Key Research and Development Program of China, Sichuan Science and Technology Program, Sichuan Provincial Health Commission, Sichuan University West China Nursing Discipline Development Special Fund Project

Study sample	Patients admitted with chest pain onset <24 hours who were diagnosed with acute coronary syndrome and underwent percutaneous coronary intervention (PCI)
Inclusion criteria	Diagnosed with acute coronary syndrome Aged >18 years Onset time <24 hours
Exclusion criteria	Received thrombolysis Unqualified ceramide data Missing creatinine measurements Requiring chronic haemodialysis
Intervention details	No additional information
Population subgroups	
Risk tool(s)	**Mehran risk score** Mehran risk score includes the following components: Use of intra-aortic balloon pump Age Anaemia Diabetes mellitus

	Congestive heart failure Contrast media volume Hypotension eGFR
Model development and validation	Previously developed model
Outcome	Acute kidney injury, defined as per KDIGO standard: Stage 1: elevated serum creatinine level >0.3 mg/dL (26.5 mmol/L) less than 2 days; serum creatinine increase to 1.5–1.9-fold from the baseline level; urine output<0.5 mL/kg/h for 6–12 h. Stage 2: serum creatinine increase to 2.0–2.9-fold from the baseline level; urine output<0.5 mL/kg/h for 12 h Stage 3: serum creatinine concentration >4.0 mg/dL (353.6 mmol/L); serum creatinine increased to>3.0-fold from the baseline level; urine output<0.3 mL/kg/h for 24 h; anuria for 12 h
Duration of follow-up	Unclear
Indirectness	None
Additional comments	None

Study arms

Mehran risk score (N = 842)

Characteristics

Study-level characteristics

Characteristic	Study (N = 842)
Mean age (SD) Mean (SD)	66.9 (13)
% Female Sample size	n = 222 ; % = 26.4
Ethnicity Nominal	NR
Diabetes Sample size	n = 258 ; % = 30.6
Heart failure Killip class ≥1 Sample size	n = 398 ; % = 47.3
Hypertension Sample size	n = 487 ; % = 57.8
Contrast volume (ml) Mean (SD)	103.2 (18.71)
Number of AKI events Sample size	n = 139 ; % = 16.5

Outcomes

Acute kidney injury

Outcome	Mehran risk score, , N = 842
AUC Mean (95% CI)	0.78 (0.74 to 0.82)

Liu, 2014

Bibliographic Reference	Liu YH; Liu Y; Tan N; Chen JY; Chen J; Chen SH; He YT; Ran P; Ye P; Li Y; Predictive value of GRACE risk scores for contrast-induced acute kidney injury in patients with ST-segment elevation myocardial infarction before undergoing primary percutaneous coronary intervention.; International urology and nephrology; 2014; vol. 46 (no. 2)

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	China
Study setting	General hospital
Study dates	March 2010 - October 2011
Sources of funding	None reported
Study sample	Consecutive patients with ST-elevated myocardial infarction undergoing primary percutaneous coronary intervention
Inclusion criteria	Presented within 12 hours of symptom onset

Exclusion criteria	Pregnancy Allergy to contrast media Exposure to contrast media within 7 days Treatment with nephroprotective or nephrotoxic drugs Severe hepatic insufficiency Severe chronic disease
Intervention details	An interventional team performed primary PCI according to standard clinical practice using standard techniques. Non-ionic low osmolar contrast media (370 mg I/mL) was used in all cases. Intravenous hydration with an isotonic saline solution (1 or 0.5 ml/kg/h if LVEF was <40% was initiated 6–12 hours before and after exposure to contrast. Use of anti-platelet agents (aspirin/clopidogrel), beta-adrenergic blocking agents, diuretics, angiotensin-converting enzyme inhibitors, or inotropic drug support was directed by the coronary care unit cardiologists in accordance with clinical protocols
Contrast administration route	Intra-arterial
Risk tool(s)	**GRACE risk score** Previously established 9-variable risk score for the prediction of mortality in patients with STEMI **Mehran risk score** Previously established 8-variable risk score for contrast associated AKI
Model development and validation	Both previously established models

Outcome	Contrast-associated AKI, defined as an absolute increase in serum creatinine of ≥0.3 or ≥0.5 mg/dL, or a 50% increase within 48–72 hours after contrast exposure
Duration of follow-up	Unclear
Indirectness	None
Additional comments	None

Study arms

GRACE risk score (cut-off: >160) (N = 251)

GRACE risk score (<136) (N = 251)

GRACE risk score (136-158) (N = 251)

GRACE risk score (159-180) (N = 251)

GRACE risk score (>180) (N = 251)

Mehran risk score (N = 251)

Characteristics

Study-level characteristics

Characteristic	Study (N = 251)
Mean age (SD) Mean (SD)	62.74 (12.27)
% Female Sample size	n = 44 ; % = 17.5
Ethnicity Nominal	NR
Diabetes Sample size	n = 54 ; % = 21.5
Heart failure Nominal	NR
Hypertension Sample size	n = 134 ; % = 53.4
Contrast volume (ml) Mean (SD)	134.4 (49.1)

Characteristic	Study (N = 251)
≥0.3 definition Sample size	n = 43 ; % = 17.1
≥0.5 definition Sample size	n = 22 ; % = 8.8
≥50% definition Sample size	n = 19 ; % = 7.6

Outcomes

Acute kidney injury

Outcome	GRACE risk score (cut-off: >160), , N = 251	GRACE risk score (<136), , N = 251	GRACE risk score (136-158), , N = 251	GRACE risk score (159-180), , N = 251	GRACE risk score (>180), , N = 251	Mehran risk score, , N = 251
Sensitivity Nominal	79.1	NR	NR	NR	NR	NR
Specificity Nominal	61	NR	NR	NR	NR	NR
≥0.3 definition Nominal	0.72	NA	NA	NA	NA	0.78

Outcome	GRACE risk score (cut-off: >160), , N = 251	GRACE risk score (<136), , N = 251	GRACE risk score (136-158), , N = 251	GRACE risk score (159-180), , N = 251	GRACE risk score (>180), , N = 251	Mehran risk score, , N = 251
≥0.5 definition Nominal	0.79	NA	NA	NA	NA	0.84
≥50% definition Nominal	0.69	NA	NA	NA	NA	0.69

Study defines AKI based on three cut-offs in serum creatinine: ≥0.3, ≥0.5 mg/dL, or ≥50%
Sensitivity and specificity for ≥0.3 mg/dL definition

Dialysis (renal replacement therapy)

Outcome	GRACE risk score (cut-off: >160), , N = 251	GRACE risk score (<136), , N = 61	GRACE risk score (136-158), , N = 63	GRACE risk score (159-180), , N = 64	GRACE risk score (>180), , N = 63	Mehran risk score, , N = 251
Number of events No of events	n = NA ; % = NA	n = 0 ; % = 0	n = 0 ; % = 0	n = 2 ; % = 3.1	n = 4 ; % = 6.3	n = NA ; % = NA

In-hospital mortality

Outcome	GRACE risk score (cut-off: >160), , N = 251	GRACE risk score (<136), , N = 61	GRACE risk score (136-158), , N = 63	GRACE risk score (159-180), , N = 64	GRACE risk score (>180), , N = 63	Mehran risk score, , N = 251
Number of events No of events	n = NA ; % = NA	n = 0 ; % = 0	n = 2 ; % = 3.2	n = 2 ; % = 3.1	n = 6 ; % = 9.5	n = NA ; % = NA

Liu, 2020

Bibliographic Reference	Liu, Liwei; Liu, Jin; Lei, Li; Wang, Bo; Sun, Guoli; Guo, Zhaodong; He, Yibo; Song, Feier; Lun, Zhubin; Liu, Bowen; Chen, Guanzhong; Chen, Shiqun; Yang, Yongquan; Liu, Yong; Chen, Jiyan; A prediction model of contrast-associated acute kidney injury in patients with hypoalbuminemia undergoing coronary angiography.; BMC cardiovascular disorders; 2020; vol. 20 (no. 1); 399

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	China
Study setting	Provincial People's Hospital
Study dates	January 2010 - October 2012
Sources of funding	Supported by the Beijing Lisheng Cardiovascular Pilot Foundation and the National Science Foundation of China
Study sample	Patients with hypoalbuminemia who were were undergoing coronary angiography or percutaneous coronary intervention

Inclusion criteria	Aged ≥18 years Hypoalbuminemia (serum albumin <3.5 g/L)
Exclusion criteria	Lactating or pregnant Intravascular injection of contrast agents within 7 days, or 3 days post procedure No use of isotonic saline for hydration No use of low-osmolarity contrast Cardiac surgery or endovascular repair therapy End-stage kidney disease On renal replacement therapy Malignancy Missing pre-operative creatinine measurement
Intervention details	During the operation, standard guidewires, catheters, and stents and the dose of contrast were used and determined by the interventional cardiologist. All procedures were performed according to the guidelines of the American Heart Association/American College of Cardiology Foundation. Each patient received intravenous hydration of isotonic saline with a rate of 1 mL/kg per hour for at least 2 to 12 hours before and 6 to 24 hours after the procedure, while 0.5 mL/kg per hour was used in cases of severe congestive heart failure or left ventricular ejection fraction <40%
Risk tool(s)	**Study-developed nomogram** Study-developed model containing the following variables (score range from 0-300, with risk of AKI occurring increasing on a logarithmic scale from 0.01 at 50 points, to 0.8 at ~275 points): eGFR

	Age Albumin IABP **Mehran risk score** Previously developed model containing 8 variables: Age >75 years Hypotension IABP CKD (eGFR <60) CHF Diabetes Anaemia Contrast volume
Model development and validation	The associations between contrast associated-AKI and variables in the development cohort were assessed by univariable logistic analysis. Collinearity between variables was evaluated. Variables were included in the multivariable analysis using a cut-off of P <0.05 in univariate logistics regression. Backward stepwise regression was conducted to select factors and develop the final model. The regression coefficient of each variable in the model was transformed into a 0 to 100 point scale. The total points were calculated by adding points of each variable and then turned into predicted probabilities. An

	ROC curve and AUC were used to assess the discrimination of the nomogram in both the development and validation cohorts compared to the Mehran score. Internal validation was analyzed using 1000 bootstrap samples.
Outcome	Contrast associated AKI, defined as: increase of ≥0.3 mg/dL or 50% in serum creatinine compared to baseline in the 48 to 72 hours post procedure
Duration of follow-up	Yearly follow-up until 2019 (maximum of 9 years)
Indirectness	None
Additional comments	None

Study arms

Study-developed nomogram (N = 428)

Mehran risk score (N = 428)

Characteristics

Study-level characteristics

Characteristic	Study (N = 428)
Mean age (SD) Mean (SD)	65.96 (11.02)

Characteristic	Study (N = 428)
% Female Sample size	n = 82 ; % = 19.2
Ethnicity Nominal	NR
Diabetes Sample size	n = 96 ; % = 22.5
Heart failure Sample size	n = 87 ; % = 20.4
Hypertension Sample size	n = 250 ; % = 58.5
Contrast volume (ml) Mean (SD)	131.97 (63.4)
Number of AKI events Sample size	n = 48 ; % = 11.2

Outcomes

Acute kidney injury

Outcome	Study-developed nomogram , , N = 428	Mehran risk score , , N = 428
AUC Mean (95% CI)	0.76 (0.69 to 0.83)	0.69 (0.61 to 0.78)
Hosmer-Lemeshow Mean (p value)	11.27 (0.19)	NR (NR)

Liu, 2020

Bibliographic Reference	Liu, Yong; Chen, Shiqun; Ye, Jianfeng; Xian, Ying; Wang, Xia; Xuan, Jianwei; Tan, Ning; Li, Qiang; Chen, Jiyan; Ni, Zhonghan; Random forest for prediction of contrast-induced nephropathy following coronary angiography.; The international journal of cardiovascular imaging; 2020; vol. 36 (no. 6); 983-991

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	NCT01400295
Study type	Prospective cohort study
Study location	China
Study setting	Cardiovascular institute of a hospital
Study dates	January 2010 - December 2013
Sources of funding	Funded by The Guangdong Provincial Cardiovascular Clinical Medicine Research Fund, Science and Technology Planning Project of Guangdong Province, and Cardiovascular Research Foundation Project of the Chinese Medical Doctor Association

Study sample	Consecutive patients undergoing percutaneous coronary intervention (PCI) or coronary angiogram (CAG)
Inclusion criteria	Aged ≥18 years
Exclusion criteria	Pregnant or lactating Intravascular administration of contrast within 7 days, or 3 days post-operatively Did not receive contrast media Underwent cardiovascular surgery or endovascular repair End stage renal disease or on renal replacement therapy Missing creatinine or weight data Malignancy Did not receive isotonic saline for hydration
Intervention details	CAG or PCI was performed as per operator preference. The type of contrast media (Iopamiron or Ultravist), contrast dose, and hydration protocols were also decided by the interventional cardiologist
Population subgroups	
Risk tool(s)	**Study-developed model** The full model contained the following parameters: Pre-procedural therapy Thrombolysis Cardio-pulmonary resuscitation

	Medical history Prior myocardial infarction Diabetes mellitus Prior CABG Hypertension Hyperlipidaemia Anaemia Patient characteristics Age Sex Weight Smoking status Patient presentation Acute myocardial infarction NYHA class LVEF

	Heart rate Systolic BP Diastolic BP IABP Hypotension Emergent PCI Pre-procedural laboratory assessments Serum creatinine Creatine kinase MB B-type natriuretic peptide HS-CRP HDL-C Cholesterol Triglycerides LDL-C Calcium

	Sodium Potassium Fasting plasma glucose HbA1c Uric acid Urine pH Serum albumin Hb Haematocrit Serum urea nitrogen **Study-developed reduced model** The reduced model contained the following parameters: Age LVEF Heart rate

	Systolic BP Serum creatinine Creatine kinase MB B-type natriuretic peptide Potassium Uric acid Serum albumin Hb Haematocrit Serum urea nitrogen **Mehran risk score** No information reported
Model development and validation	Models were developed using a random forest method. The study cohort was randomly divided into training (70%, n=2428) and validation datasets (30%, n=1041). A random forest regression model was trained to predict CIN using the 40 pre-procedural baseline clinical variables. To facilitate the development of an easy-to-use bedside tool, a reduced model was trained using only the 13 most important predictors as assessed by an incremental decrease in node impurity
Outcome	Contrast induced nephropathy, defined as: increase in serum creatinine ≥0.5 mg/dL
Duration of follow-up	Unclear

Indirectness	None
Additional comments	None

Study arms

Study-developed model (N = 1041)

Study-developed reduced model (N = 1041)

Mehran risk score (N = 1041)

ACEF score (N = 1041)

Characteristics

Study-level characteristics

Characteristic	Study (N = 2428)
Mean age (SD) Mean (SD)	62.82 (11.24)

Characteristic	Study (N = 2428)
% Female Nominal	NR
Ethnicity Nominal	NR
Diabetes Nominal	NR
Heart failure Nominal	NR
Hypertension (mmHg) Systolic BP Mean (SD)	128.87 (20.6)
Contrast volume Nominal	NR
Number of AKI events Sample size	n = 37 ; % = 3.5

Characteristics of the training cohort - data not reported for the validation cohort

Outcomes

Acute kidney injury

Outcome	Study-developed model, , N = 1041	Study-developed reduced model, , N = 1041	Mehran risk score , , N = 1041	ACEF score, , N = 1041
AUC Mean (95% CI)	0.86 (0.79 to 0.92)	0.85 (0.8 to 0.91)	0.79 (0.72 to 0.86)	0.76 (0.68 to 0.85)

Lu, 2016

Bibliographic Reference	Lu, T.-M.; Hsu, C.-P.; Chang, C.-F.; Lin, C.-C.; Lee, T.-S.; Lin, S.-J.; Chan, W.-L.; Asymmetric dimethylarginine predicts the risk of contrast-induced acute kidney injury in patients undergoing cardiac catheterization; Atherosclerosis; 2016; vol. 254; 161-166

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Taipei
Study setting	Hospital
Study dates	Not reported
Sources of funding	Supported by grants from the National Science Council
Study sample	Consecutive patients referred for coronary angiography for investigation of chest pain and/or suspected coronary artery disease

Inclusion criteria	None specified
Exclusion criteria	Severe liver disease Sepsis/active infectious disease Malignancy with life expectancy ≤1 year Hyperthyroidism Unstable haemodynamic status Renal artery stenosis Exposure to contrast medium within 2 days
Intervention details	Patients were pre-treated with intravenous infusion of 0.9% saline hydration (1.0 ml/kg per hour for 12 h before the procedure) and oral administration of N-acetylcysteine (600 mg twice a day, administered the day before and on the day of contrast medium exposure). Diagnostic coronary angiography, left ventriculography and percutaneous coronary intervention were performed by a standard procedure using low-osmolar contrast media (iopromide or iohexol) or iso-osmolar contrast medium (iodixanol) at the discretion of operators and/or patients. Revascularization procedures including percutaneous coronary intervention and coronary artery bypass surgery, were performed successfully in all patients with significant CAD (≥50% stenosis in at least one major coronary artery)
Population subgroups	
Risk tool(s)	**Mehran risk score** The Mehran score for predicting CI-AKI was calculated according to the following algorithm: Hypotension (integer score, 5) Support with intra-aortic balloon pump (integer score, 5)

	Congestive heart failure (integer score, 5) Age >75 years (integer score, 4) Pre-existing anaemia (baseline haematocrit <39% for men and <36% for women, integer score, 3 Diabetes (integer score, 3) Contrast medium volume (integer score 1 for every 100 ml) eGFR <60 ml/min per 1.73 m2 (integer score, 2 to 6)
Model development and validation	Previously established model
Outcome	Contrast-induced acute kidney injury was defined as: increase of serum creatinine concentration of ≥0.3 mg/dl or a 25% increase from the baseline value measured at 48 h after exposure to contrast media
Duration of follow-up	Monthly follow-up with unclear duration
Indirectness	None
Additional comments	None

Study arms

Mehran risk score (cut-off: >7) (N = 664)

Characteristics

Study-level characteristics

Characteristic	Study (N = 664)
Mean age (SD) Mean (SD)	67 (12)
% Female Sample size	n = 119 ; % = 20.9
Ethnicity Nominal	NR
Diabetes Sample size	n = 240 ; % = 36.1
Heart failure Sample size	n = 157 ; % = 24.4
Hypertension Sample size	n = 490 ; % = 76.1
Contrast volume (ml) Mean (SD)	182.6 (115.6)
Number of AKI events Sample size	n = 78 ; % = 11.7

Outcomes

Acute kidney injury

Outcome	Mehran risk score (cut-off: >7), , N = 644
Sensitivity Nominal	64.1
Specificity Nominal	54.9
AUC Mean (95% CI)	0.62 (0.58 to 0.65)
PPV Nominal	15.9
NPV Nominal	92

Seibert, 2020

Bibliographic Reference	Seibert, Felix S; Heringhaus, Anja; Pagonas, Nikolaos; Rudolf, Henrik; Rohn, Benjamin; Bauer, Frederic; Timmesfeld, Nina; Trappe, Hans-Joachim; Babel, Nina; Westhoff, Timm H; Biomarkers in the prediction of contrast media induced nephropathy - the BITCOIN study.; PloS one; 2020; vol. 15 (no. 7); e0234921

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	The BITCOIN study
Study type	Prospective cohort study
Study location	Germany
Study setting	Hospital
Study dates	No additional information
Sources of funding	Funded by the German Research Foundation
Study sample	Patients with an indication for a coronary angiography
Inclusion criteria	None specified

Exclusion criteria	Acute hemodynamic shock, Obstructive uropathy Urothelial carcinoma Metastatic cancer Leukocyturia in semi-quantitative dipstick examination >1
Intervention details	Coronary angiographies were performed via radial or femoral arteries. Preventive plasma expansion was performed according to physicians' assessment
Population subgroups	
Risk tool(s)	**Inohara risk model** Previously developed model that contains the following variables (score for each in brackets): Age ≤50 (0) 51-59 (1) 60-69 (2) 70-79 (3) 80-89 (4) 90-99 (5)

	NYHA III or IV (3) Diabetes mellitus (2) Previous PCI (-3) Hypertension (2) Pre-creatinine >1.0 mg/dL (4) Acute coronary syndrome (5) **Ghani risk model** Previously developed model that contains the following variables (score for each in brackets): Basal creatinine ≥115 micromol/L (7) Shock (3) Female gender (2) Multiple vessel stenting (2) Diabetes mellitus (2)
Model development and validation	Previously developed models
Outcome	Acute kidney injury defined as per AKIN criteria

Duration of follow-up	48-72 hours
Indirectness	None
Additional comments	None

Study arms

Inohara risk model (N = 490)

Ghani risk model (N = 490)

Characteristics

Study-level characteristics

Characteristic	Study (N = 490)
Mean age (SD) Median (IQR)	66 (57 to 73)
% Female Sample size	n = 127 ; % = 25.9
Ethnicity	NR

Characteristic	Study (N = 490)
Nominal	
Diabetes Sample size	n = 126 ; % = 25.7
Heart failure Nominal	NR
Hypertension Sample size	n = 386 ; % = 78.8
Contrast volume (ml) Median (IQR)	80 (60 to 120)
Number of AKI events Sample size	n = 30 ; % = 6.1

Outcomes

Acute kidney injury

Outcome	Inohara risk model, , N = 490	Ghani risk model, , N = 490
AUC Mean (95% CI)	0.68 (0.6 to 0.76)	0.57 (0.46 to 0.67)

Serif, 2020

Bibliographic Reference	Serif, L.; Chalikias, G.; Didagelos, M.; Stakos, D.; Kikas, P.; Thomaidis, A.; Lantzouraki, A.; Ziakas, A.; Tziakas, D.; Application of 17 Contrast-Induced Acute Kidney Injury Risk Prediction Models; CardioRenal Medicine; 2020; vol. 10 (no. 3); 162-174

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	Includes risk scores from the following papers (not all included in the present review, mainly due to being retrospective cohort study designs): Brown et al., (2015) Acute Kidney Injury Risk Prediction in Patients Undergoing Coronary Angiography in a National Veterans Health Administration Cohort With External Validation. https://doi.org/10.1161/JAHA.115.002136 Tsai et al., (2014) Validated contemporary risk model of acute kidney injury in patients undergoing percutaneous coronary interventions: insights from the National Cardiovascular Data Registry Cath-PCI Registry. https://doi.org/10.1161/JAHA.114.001380 Gurm et al., (2013) A Novel Tool for Reliable and Accurate Prediction of Renal Complications in Patients Undergoing Percutaneous Coronary Intervention. https://doi.org/10.1016/j.jacc.2013.03.026. Caspi et al., (2017) Acute Kidney Injury After Primary Angioplasty: Is Contrast-Induced Nephropathy the Culprit? https://doi.org/10.1161/JAHA.117.005715

	Victor et al., (2014) Risk scoring system to predict contrast induced nephropathy following percutaneous coronary intervention. https://doi.org/10.1016/j.ihj.2014.05.025 Maioli et al., (2010) Preprocedural score for risk of contrast-induced nephropathy in elective coronary angiography and intervention. DOI: 10.2459/JCM.0b013e328335227c Marenzi et al., (2004) Contrast-induced nephropathy in patients undergoing primary angioplasty for acute myocardial infarction. https://doi.org/10.1016/j.jacc.2004.07.043 Liu et al., (2015) Preprocedural N-Terminal Pro-Brain Natriuretic Peptide (NT-proBNP) Is Similar to the Mehran Contrast-Induced Nephropathy (CIN) Score in Predicting CIN Following Elective Coronary Angiography. https://doi.org/10.1161/JAHA.114.001410 Gao et al., (2014) Derivation and validation of a risk score for contrast-induced nephropathy after cardiac catheterization in Chinese patients. DOI: 10.1007/s10157-014-0942-9 Fu et al., (2012) Risk Score for the Prediction of Contrast-Induced Nephropathy in Elderly Patients Undergoing Percutaneous Coronary Intervention. https://doi.org/10.1177/0003319712467224 Chen et al., (2014) A simple preprocedural score for risk of contrast-induced acute kidney injury after percutaneous coronary intervention. DOI: 10.1002/ccd.25109 Ghani et al., (2009) Risk score for contrast induced nephropathy following percutaneous coronary intervention. Bartholomew et al., (2004) Impact of nephropathy after percutaneous coronary intervention and a method for risk stratification. https://doi.org/10.1016/j.amjcard.2004.03.008 Mehran et al., (2004) A simple risk score for prediction of contrast-induced nephropathy after percutaneous coronary intervention: Development and initial validation. https://doi.org/10.1016/j.jacc.2004.06.068

	Tziakas et al., (2013) Development of an easily applicable risk score model for contrast-induced nephropathy prediction after percutaneous coronary intervention. A novel approach tailored to current practice. https://doi.org/10.1016/j.ijcard.2011.05.079 Ando et al., (2013) Age, glomerular filtration rate, ejection fraction, and the AGEF score predict contrast-induced nephropathy in patients with acute myocardial infarction undergoing primary percutaneous coronary intervention. https://doi.org/10.1002/ccd.25023 McCullough et al., (1997) Acute Renal Failure After Coronary Intervention. Incidence, Risk Factors, and Relationship to Mortality. https://doi.org/10.1016/S0002-9343(97)00150-2
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Greece
Study setting	Cardiac catheterisation laboratory
Study dates	January 2015 - August 2018
Sources of funding	None
Study sample	Consecutive patients treated with percutaneous coronary intervention on an elective or emergency basis
Inclusion criteria	None specified
Exclusion criteria	Chronic peritoneal or haemodialytic treatment Died during hospitalisation Undergoing coronary artery bypass grafting

Intervention details	No additional information
Risk tool(s)	This study compared 17 previously developed risk prediction tools. The number of predictors in each tool varied from 3 to 15.: **McCullough** Impaired renal function Diabetes mellitus Contrast volume **Bartholomew** Impaired renal function Diabetes mellitus Hypertension Heart failure Peripheral vascular disease Use of IABP Procedure urgent/emergent Contrast volume **Marenzi**

	Age Use of IABP Anterior MI Time to reperfusion Contrast volume **Mehran** Age Impaired renal function Anaemia Diabetes mellitus Heart failure Hypotension Use of IABP Contrast volume **Ghani** Female sex

	Impaired renal function Diabetes mellitus Shock Multivessel PCI **Maioli** Age Impaired renal function Diabetes mellitus Impaired LVEF Recent cardiac procedure/PCI One procedure in past 72 hours Pre-procedure creatinine > baseline creatinine **Fu** Age Impaired renal function Anaemia

	Diabetes mellitus Impaired LVEF Previous MI Hypotension Procedure urgent/emergent Contrast volume **Gurm** Age Height Weight Impaired renal function Diabetes mellitus Heart failure Shock CAD presentation Procedure urgent/emergent

	PCI indication HDL <1 mmol/L CK-MB Haemoglobin Troponin I Troponin II **Tsiakas** Impaired renal function Recent cardiac procedure/PCI Peripheral vascular disease Metformin use Contrast volume **Ando** Age Impaired LVEF Pre-procedure creatinine > baseline creatinine

	Chen Age Impaired renal function Anaemia Diabetes mellitus Impaired LVEF Previous MI Hypotension Procedure urgent/emergent HDL <1 mmol/L **Victor** Impaired renal function Diabetes mellitus Peripheral vascular disease Hypotension Contrast volume

	Albuminuria Haemoglobin **Gao** Age Impaired renal function Hypertension Heart failure Previous MI Use of IABP Contrast volume **Tsai** Age Impaired renal function Anaemia Diabetes mellitus Heart failure

	Stroke Cardiac arrest Shock CAD presentation Use of IABP Killip class **Liu** Age Impaired renal function Impaired LVEF **Brown** Age Race Impaired renal function Anaemia Diabetes mellitus

	Hypertension Heart failure Impaired LVEF Recent cardiac procedure/PCI Peripheral vascular disease Smoking Shock CAD presentation Procedure urgent/emergent **Caspi** Age Impaired renal function Diabetes mellitus Impaired LVEF Anterior MI Killip class Diuretic therapy

Model development and validation	All models were previously developed in other studies
Outcome	Contrast-induced acute kidney injury was given two definitions: Liberal criterion: increase of ≥25% or ≥0.5 mg/dl in pre-PCI serum creatinine at 48 h to 72 h post PCI Strict criterion: increase of ≥0.5 mg/dl in pre-PCI serum creatinine at 48 h to 72 h post PCI
Duration of follow-up	72 hours
Indirectness	None
Additional comments	None

Study arms

Brown risk score (N = 1247)

Tsai risk score (N = 1247)

Gurm risk score (N = 1247)

Caspi risk score (N = 1247)

Victor risk score (N = 1247)

Maioli risk score (N = 1247)

Marenzi risk score (N = 1247)

Liu risk score (N = 1247)

Gao risk score (N = 1247)

Fu risk score (N = 1247)

Chen risk score (N = 1247)

Ghani risk score (N = 1247)

Bartholomew risk score (N = 1247)

Mehran risk score (N = 1247)

Tziakas risk score (N = 1247)

Ando risk score (N = 1247)

McCullough risk score (N = 1247)

Characteristics

Study-level characteristics

Characteristic	Study (N = 1247)
Mean age (SD) Mean (SD)	62 (10)
% Female Sample size	n = 238 ; % = 19

Characteristic	Study (N = 1247)
Ethnicity Nominal	NR
Diabetes Sample size	n = 400 ; % = 32
Class I Sample size	n = 1060 ; % = 85
Class II Sample size	n = 133 ; % = 10.5
Class III Sample size	n = 49 ; % = 4
Class IV Sample size	n = 5 ; % = 0.5
Hypertension Sample size	n = 678 ; % = 54
Contrast volume (ml) Mean (SD)	332 (165)
Liberal definition Sample size	n = 206 ; % = 16.5

Characteristic	Study (N = 1247)
Strict definition Sample size	n = 24 ; % = 1.9

Outcomes

Acute kidney injury (liberal definition)

Outcome	Brown risk score, , N = 1247	Tsai risk score, , N = 1247	Gurm risk score, , N = 1247	Caspi risk score, , N = 1247	Victor risk score, , N = 1247	Maioli risk score, , N = 1247	Marenzi risk score, , N = 1247	Liu risk score, , N = 1247	Gao risk score, , N = 1247	Fu risk score, , N = 1247	Chen risk score, , N = 1247	Ghani risk score, , N = 1247	Bartholomew risk score, , N = 1247	Mehran risk score, , N = 1247	Tziakas risk score, , N = 1247	Ando risk score, , N = 1247	McCullough risk score, , N = 1247
AUC Mean (95% CI)	0.52 (0.47 to 0.56)	0.51 (0.49 to 0.54)	0.54 (0.51 to 0.57)	0.53 (0.51 to 0.56)	0.54 (0.5 to 0.59)	0.58 (0.56 to 0.61)	0.55 (0.51 to 0.59)	0.52 (0.48 to 0.57)	0.49 (0.45 to 0.53)	0.5 (0.46 to 0.54)	0.48 (0.43 to 0.52)	0.51 (0.47 to 0.55)	0.49 (0.45 to 0.54)	0.53 (0.48 to 0.57)	0.5 (0.46 to 0.55)	0.54 (0.5 to 0.59)	0.58 (0.54 to 0.62)
PPV Nominal	18.8	22.8	19.1	18.8	20.5	30.2	18.8	19.1	18.2	17.1	21.5	20.1	17	18.9	17.5	20	20.4
NPV Nominal	85.1	84.7	85.8	85.6	85.2	85.7	85.9	84.5	84.8	94	84.8	84	85.7	84.6	83.9	85.4	88.1

Outcome	Brown risk score, , N = 1247	Tsai risk score, , N = 1247	Gurm risk score, , N = 1247	Caspi risk score, , N = 1247	Victor risk score, , N = 1247	Maioli risk score, , N = 1247	Marenzi risk score, , N = 1247	Liu risk score, , N = 1247	Gao risk score, , N = 1247	Fu risk score, , N = 1247	Chen risk score, , N = 1247	Ghani risk score, , N = 1247	Bartholomew risk score, , N = 1247	Mehran risk score, , N = 1247	Tziakas risk score, , N = 1247	Ando risk score, , N = 1247	McCullough risk score, , N = 1247
Hosmer-Lemeshow Mean (p value)	0.35 (0.31)	17.07 (0.029)	11.76 (0.16)	3.16 (0.53)	3.72 (0.16)	6.05 (0.11)	0.13 (0.94)	7.19 (0.007)	9.04 (0.17)	1.08 (0.96)	19.81 (0.011)	1.36 (0.24)	2.37 (0.67)	2.98 (0.89)	3.15 (0.37)	15.68 (0.047)	6.41 (0.6)
Calibration slope Nominal	0.39	0.25	0.11	0.99	0.98	0.97	1	0.99	0.94	0.99	0.75	0.99	1	0.96	0.99	0.62	0.9

Acute kidney injury (strict definition)

Outcome	Brown risk score, , N = 1247	Tsai risk score, , N = 1247	Gurm risk score, , N = 1247	Caspi risk score, , N = 1247	Victor risk score, , N = 1247	Maioli risk score, , N = 1247	Marenzi risk score, , N = 1247	Liu risk score, , N = 1247	Gao risk score, , N = 1247	Fu risk score, , N = 1247	Chen risk score, , N = 1247	Ghani risk score, , N = 1247	Bartholomew risk score, , N = 1247	Mehran risk score, , N = 1247	Tziakas risk score, , N = 1247	Ando risk score, , N = 1247	McCullough risk score, , N = 1247
AUC Mean (95% CI)	0.7 (0.67 to 0.72)	0.63 (0.61 to 0.66)	0.51 (0.48 to 0.54)	0.65 (0.62 to 0.68)	0.6 (0.49 to 0.72)	0.74 (0.71 to 0.76)	0.57 (0.47 to 0.68)	0.6 (0.49 to 0.72)	0.6 (0.5 to 0.69)	0.63 (0.52 to 0.73)	0.55 (0.44 to 0.65)	0.53 (0.41 to 0.65)	0.6 (0.47 to 0.72)	0.6 (0.51 to 0.7)	0.55 (0.43 to 0.67)	0.62 (0.48 to 0.75)	0.58 (0.47 to 0.69)

Outcome	Brown risk score, , N = 1247	Tsai risk score, , N = 1247	Gurm risk score, , N = 1247	Caspi risk score, , N = 1247	Victor risk score, , N = 1247	Maioli risk score, , N = 1247	Marenzi risk score, , N = 1247	Liu risk score, , N = 1247	Gao risk score, , N = 1247	Fu risk score, , N = 1247	Chen risk score, , N = 1247	Ghani risk score, , N = 1247	Bartholomew risk score, , N = 1247	Mehran risk score, , N = 1247	Tziakas risk score, , N = 1247	Ando risk score, , N = 1247	McCullough risk score, , N = 1247
PPV Nominal	3.5	3.8	1.1	3	2.2	3.3	2.5	3.3	2.6	3.1	2.3	3.6	2.8	2.9	3	4.8	2.5
NPV Nominal	99.2	99.2	97.5	99.3	98.9	99.7	98.7	98.6	100	98.7	98.9	98.3	98.7	99.3	98.3	98.8	99.5
Hosmer-Lemeshow Mean (p value)	16.19 (0.04)	20.01 (0.006)	26.6 (0.001)	9.47 (0.05)	1.59 (0.45)	4.15 (0.25)	1.07 (0.59)	1.45 (0.23)	20.69 (0.004)	13.41 (0.063)	14.13 (0.078)	1.99 (0.16)	3.27 (0.51)	12.98 (0.072)	1.51 (0.68)	20.48 (0.009)	5.68 (0.68)
Calibration slope Nominal	0.54	0.84	0.09	0.12	0.77	0.87	1	0.91	0.61	0.82	0.45	0.79	0.73	0.56	0.96	0.69	0.47

Sgura, 2010

Bibliographic Reference	Sgura, Fabio A.; Bertelli, Luca; Monopoli, Daniel; Leuzzi, Chiara; Guerri, Elisa; Spartà, Ilaria; Politi, Luigi; Aprile, Alessandro; Amato, Andrea; Rossi, Rosario; Biondi-Zoccai, Giuseppe; Sangiorgi, Giuseppe M.; Modena, Maria G.; Mehran Contrast-Induced Nephropathy Risk Score Predicts Short- and Long-Term Clinical Outcomes in Patients With ST-Elevation–Myocardial Infarction; Circulation: Cardiovascular Interventions; 2010; vol. 3 (no. 5); 491-498

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Italy
Study setting	Outpatient clinic of the cardiology department
Study dates	2002 - 2008
Sources of funding	None reported

Study sample	Consecutive patients admitted to a coronary care unit for ST-elevation myocardial infarction who were treated with percutaneous coronary intervention (PCI)
Inclusion criteria	Presented within 12 hours of symptom onset
Exclusion criteria	Chronic peritoneal or haemodialysis treatment Cardiogenic shock
Intervention details	Hydration was not routinely performed by the ambulance, helicopter, or emergency room medical staff before arrival in the catheterization laboratory. After contrast exposure, all patients underwent the following hydration protocol: physiological (0.9%) saline was given intravenously at a rate of 1 mL/kg per hour for 12 hours in patients with left ventricular dysfunction (ejection fraction ≤30%) or overt heart failure; hydration rate was reduced to 0.5 mL/kg per hour. A combination prophylaxis with N-acetylcysteine and NaHCO3 was administered from the beginning of the procedure, according to the ejection fraction values and Killip class. The use of beta-adrenergic– blocking agents, angiotensin-converting enzyme inhibitors, diuretics, or the indication to intra-aortic balloon pump or inotropic drugs support was left to the discretion of the interventional and coronary care unit cardiologists, An echocardiographic evaluation was performed in all patients before the procedure to assess wall motion abnormalities and ejection fraction. Primary PCI was performed by an interventional team, according to standard clinical practice. All patients received a loading dose of 300 mg of clopidogrel, in combination with 100 mg of acetylsalicylic acid. After sheath insertion, a heparin bolus at a dose of 70 U/kg, followed by an additional bolus during the procedure to maintain activated clotting time >300 seconds if deemed necessary, and an intravenous bolus and an infusion of platelet glycoprotein IIb/IIIa receptor inhibitors were administered. Contrast type and dose and supportive pharmacological therapies were left to the discretion of the interventional cardiologist
Population subgroups	
Risk tool(s)	**Mehran risk score** The Mehran risk score includes 8 clinical and procedural variables (score per variable in brackets):

	age ≥75 years (4) Hypotension (5) Congestive heart failure (5) Intra-aortic balloon pump (5) eGFR <20 (6) 20-40 (4) 40-60 (2) Diabetes (3) Anaemia (3) Volume of contrast (1 per 100 CC) The risk score can be broken down into four categories, indicating the risk of CA-AKI Low (≤5) Medium (6-10) High (11-16)

	Very high (≥16) **Marenzi risk score** The Marenzi risk score is composed of 5 variables: Age ≥75 years Anterior AMI Time to reperfusion ≥6 hours Contrast agent volume ≥300 mL Use of intra-aortic balloon pump A value of 1 was assigned when a factor was present and 0 when it was absent. For each patient, the score was calculated as the sum of the number of variables (range, 0 to 5)
Model development and validation	Both previously developed models
Outcome	Contrast induced nephropathy was defined as: 0.5 mg/dL (44 mmol/L) increase in serum creatinine or 25% increase compared with baseline values within 48 hours of the procedure
Duration of follow-up	Yearly follow-ups - duration not specified
Indirectness	None
Additional comments	None

Study arms

Mehran risk score (N = 891)

Marenzi risk score (N = 891)

Mehran risk score (medium risk) (N = 217)

Mehran risk score (high risk) (N = 83)

Mehran risk score (very high risk) (N = 29)

Characteristics

Study-level characteristics

Characteristic	Study (N = 891)
Mean age (SD) Mean (SD)	63.9 (13.1)

Characteristic	Study (N = 891)
% Female Sample size	n = 369 ; % = 22.4
Ethnicity Nominal	NR
Diabetes Sample size	n = 128 ; % = 14.4
Killip class 2 Sample size	n = 123 ; % = 13.8
Killip class 3 Sample size	n = 41 ; % = 4.6
Hypertension Sample size	n = 408 ; % = 45.8
Contrast volume (ml) Mean (SD)	216.1 (88.5)
Number of AKI events Sample size	n = 126 ; % = 14.1

Outcomes

Acute kidney injury

Outcome	Mehran risk score, , N = 891	Marenzi risk score, , N = 891	Mehran risk score (medium risk), , N = NA	Mehran risk score (high risk), , N = NA	Mehran risk score (very high risk), , N = NA
AUC Mean (95% CI)	0.57 (0.52 to 0.62)	0.57 (0.51 to 0.62)	NA (NA to NA)	NA (NA to NA)	NA (NA to NA)

Mortality

Outcome	Mehran risk score, , N = 891	Marenzi risk score, , N = 891	Mehran risk score (medium risk), , N = 217	Mehran risk score (high risk), , N = 83	Mehran risk score (very high risk), , N = 29
AUC Mean (95% CI)	0.74 (0.59 to 0.79)	0.6 (0.55 to 0.65)	NA (NA to NA)	NA (NA to NA)	NA (NA to NA)
Hazard ratio Low risk used as referent value Mean (95% CI)	NA (NA to NA)	NA (NA to NA)	3.61 (2.19 to 5.98)	8 (4.53 to 14.13)	15.29 (8.11 to 28.83)

Hazard ratio - Polarity - Lower values are better

Tziakas, 2013

Bibliographic Reference	Tziakas, Dimitrios; Chalikias, Georgios; Stakos, Dimitrios; Apostolakis, Stavros; Adina, Thomaidi; Kikas, Petros; Alexoudis, Apostolos; Passadakis, Ploumis; Thodis, Elias; Vargemezis, Vassilis; Konstantinides, Stavros; Development of an easily applicable risk score model for contrast-induced nephropathy prediction after percutaneous coronary intervention: A novel approach tailored to current practice; International Journal of Cardiology; 2013; vol. 163 (no. 1); 46-55

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Greece
Study setting	Cardiac catheterisation laboratory
Study dates	September 2008 - January 2010
Sources of funding	No additional information
Study sample	Consecutive patients treated with percutaneous coronary intervention on an elective or emergency basis

Inclusion criteria	None reported
Exclusion criteria	On chronic peritoneal or haemodialytic treatment Died during hospitalisation Undergoing coronary artery bypass grafting Treated with repeated PCI within a week of the initial procedure End-stage renal disease
Intervention details	Patients underwent PCI according to current guidelines. Routine hydration was performed with 1 ml/kg/h of normal (0.9%) saline for 18–24 hours before PCI and 18 to 24 hours post procedure. In patients with reduced left ventricular ejection fraction (<40%), presence of significant valvular disease or overt heart failure upon presentation, the hydration rate was reduced to 0.5 ml/kg/h. Metformin was withheld for 48 hours prior to the procedure (for elective cases) and for 48 hours post PCI (all cases). The use of N-acetylcysteine, platelet glycoprotein IIb/IIIa receptor inhibitors, and the indication to intra-aortic balloon pump or intravenous inotropic support, was left to the discretion of the interventional cardiologists. . A non-ionic, low-osmolarity contrast agent, ioversol, was used for all procedures.
Risk tool(s)	**Mehran risk score** Risk score comprised of the following variables (score range from 0-35): Hypotension IABP Chronic heart failure Age >75 years Anaemia

	Diabetes mellitus Volume of contrast Baseline serum creatinine >1.5 mg/dL **Bartholomew risk score** Risk score comprised of the following variables (score range from 0-11): eGFR <60 ml/min IABP Urgent/emergency procedure Diabetes mellitus Congestive heart failure Hypertension Peripheral vascular disease Contrast volume >260 mL **Study-developed risk score**

	Risk score comprised of the following variables (score range from 0-8, score per variable in brackets): Pre-existing renal disease (2) Metformin (2) History of previous PCI (1) Peripheral artery disease (1) Contrast volume ≥300 mL (1)
Model development and validation	**Mehran risk score** Previously developed model **Bartholomew risk score** Previously developed risk score **Study-developed risk score** Fifty-seven demographic, clinical, angiographic and procedural variables were examined in univariate analysis. Thirteen variables with a significant association with contrast induced nephropathy were incorporated in a multivariate model. Using the significant variables on multivariate analysis, a risk scoring system was developed. An integer score of 1 was assigned per 1.000 beta value, resulting in a weighted scoring system containing the variables listed above. This model was initially validated through bootstrapping of 1000 samples, then validated externally using 200 patients undergoing PCI.
Outcome	Contrast induced nephropathy, defined as an increase of ≥25% or ≥0.5 mg/dl in pre-PCI serum creatinine at 48 hours post procedure

Duration of follow-up	7 days
Indirectness	None
Additional comments	None

Study arms

Mehran risk score (N = 488)

Bartholomew risk score (N = 488)

Study-developed risk score (cut-off: >3) (N = 200)

Characteristics

Study-level characteristics

Characteristic	Study (N = 200)
Number of AKI events Sample size	n = 28 ; % = 14

Arm-level characteristics

Characteristic	Mehran risk score (N = 488)	Bartholomew risk score (N = 488)	Study-developed risk score (cut-off: >3) (N = 200)
Mean age (SD) Mean (SD)	64 (11)	64 (11)	61 (12)
% Female Sample size	n = 128 ; % = 26	n = 128 ; % = 26	n = 36 ; % = 18
Ethnicity Nominal	NR	NR	NR
Diabetes Sample size	n = 154 ; % = 32	n = 154 ; % = 32	n = 75 ; % = 38
Heart failure Sample size	n = 58 ; % = 12	n = 58 ; % = 12	n = 32 ; % = 16
Hypertension Sample size	n = 282 ; % = 58	n = 282 ; % = 58	n = 148 ; % = 74
Contrast volume (ml) Mean (SD)	277 (118)	277 (118)	272 (91)

Characteristics of the validation cohort (n=200) and development cohort (n=488)

Outcomes

Acute kidney injury

Outcome	Mehran risk score, , N = 488	Bartholomew risk score, , N = 488	Study-developed risk score (cut-off: >3), , N = 200
AUC Mean (95% CI)	0.59 (0.55 to 0.64)	0.58 (0.54 to 0.63)	0.86 (0.8 to 0.93)
PPV Nominal	NR	NR	83
NPV Nominal	NR	NR	92
Calibration slope Optimism corrected based on 1000 bootstrap sample of the development cohort Nominal	NR	NR	0.88

Victor, 2014

Bibliographic Reference	Victor, Suma M.; Gnanaraj, Anand; S., VijayaKumar; Deshmukh, Rajendra; Kandasamy, Mani; Janakiraman, Ezhilan; Pandurangi, Ulhas M.; Latchumanadhas, K.; Abraham, Georgi; Mullasari, Ajit S.; Risk scoring system to predict contrast induced nephropathy following percutaneous coronary intervention; Indian Heart Journal; 2014; vol. 66 (no. 5); 517-524

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	India
Study setting	Tertiary cardiac referral centre
Study dates	March 2008 - December 2011
Sources of funding	None reported
Study sample	Consecutive patients undergoing PCI
Inclusion criteria	Indian

Exclusion criteria	PCI performed within 2 weeks of coronary angiogram (exposed to contrast within 2 weeks) On regular dialysis Acute renal failure before PCI Cardiogenic shock Required IABP support Developed PCI-related complications
Intervention details	All patients underwent PCI using non-ionic contrast media. All patients with raised creatinine levels were given hydration with half normal saline (1 ml/kg/h starting from 4 hours before and continued till 24 hours after the exposure to contrast media) and N-acetylcysteine (600 mg twice daily 1 day before and for 2 days post procedure). All patients received dual anti platelets and a statin in recommended doses.
Contrast administration route	Intra-arterial
Risk tool(s)	**Study-developed risk score** Equation that predicts the likelihood of contrast induced nephropathy, containing the following variables: GFR Amount of contrast Haemoglobin Diabetic microangiography

	Hypotension Albuminuria Peripheral vascular disease
Model development and validation	The baseline clinical, laboratory and procedural characteristics of the patients in the development set (n=900) were studied using univariate analysis to identify individual risk factors. Significant individual risk factors were used as independent variables and CIN as the dependent variable in the final multivariate logistic regression. Forward step wise logistic regression analysis was used to elucidate the final risk factors with the strongest prediction of CIN. The obtained logistic regression equation was: A A= the sum of (logistic regression coefficient)(independent variable) both to the nearest integer. The probability of CIN was estimated with eA/(1 + eA) where e = exponential Chi square goodness of fit test was used to assess the final model accuracy for prediction of CIN and AUC of the ROC was used to evaluate the model discrimination between patients with and without CIN. The final estimate for CIN probability was evaluated using sensitivity and specificity analysis at various cut off levels. The final risk score system was then substantiated in the validation data set (n=300) and its predictive accuracy was assessed using the c-statistic
Outcome	Contrast-induced nephropathy was defined as: an increase of ≥25% and/or ≥0.5 mg/dl in serum creatinine at 48 hours after PCI when compared to baseline value
Duration of follow-up	Unclear
Indirectness	None
Additional comments	None

Study arms

Study-developed risk score (cut-off: 10%) (N = 300)

Characteristics

Study-level characteristics

Characteristic	Study (N = 900)
Mean age (SD) Mean (SD)	57.3 (10.2)
% Female Sample size	n = 148 ; % = 16.4
Ethnicity Nominal	NR
Diabetes Sample size	n = 477 ; % = 53
Heart failure Sample size	n = 20 ; % = 2.2
Hypertension	n = 470 ; % = 52.2

Characteristic	Study (N = 900)
Sample size	
Contrast volume Mean (SD)	114.9 (37.9)
Number of AKI events In the validation cohort (n=300) Sample size	n = 26 ; % = 8.7

Characteristics of the development set, validation (n=300) not reported

Outcomes

Acute kidney injury

Outcome	Study-developed risk score (cut-off: 10%), , N = 300
Sensitivity Nominal	92.3
Specificity Nominal	82.1

4.1.2. eGFR

Buratti, 2021

Bibliographic Reference	Buratti, Stefano; Crimi, Gabriele; Somaschini, Alberto; Cornara, Stefano; Camporotondo, Rita; Cosentino, Nicola; Moltrasio, Marco; Rubino, Mara; De Metrio, Monica; Marana, Ivana; De Servi, Stefano; Marenzi, Giancarlo; De Ferrari, Gaetano M; A preprocedural risk score predicts acute kidney injury following primary percutaneous coronary intervention.; Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions; 2021; vol. 98 (no. 2); 197-205

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Italy
Study setting	Two hospitals
Study dates	2004 - 2015
Sources of funding	None reported

Recruitment / selection of participants	Consecutive ST-elevated myocardial infarction patients admitted to two hospitals
Inclusion criteria	Undergoing percutaneous coronary intervention
Exclusion criteria	On haemodialysis Undergoing rescue PCI or urgent cardiac surgery Died during procedure or before consecutive creatinine measurements could be taken
Intervention details	Primary PCI was performed by interventional cardiologists, according to standard clinical practice. Iso-osmolar contrast agents were used.
Contrast administration route	Intra-arterial
Prognostic variable(s)	eGFR
Acute kidney injury definition	Contrast-induced acute kidney injury, defined as: an absolute serum creatinine increase ≥0.5 mg/dl in the first 72 hours
Confounders OR Stratifiction strategy	Multivariate logistic regression model that included all variables shown to be significant in univariate analysis: Age >75 years Diabetes Anterior myocardial infarction Killip class at admission

Duration of follow-up	Unclear
Indirectness	None
Additional comments	None

Study arms

eGFR <60 (N = 1954)

Characteristics

Study-level characteristics

Characteristic	Study (N = 1954)
Mean age (SD) Mean (SD)	62.48 (12.14)
% Female Sample size	n = 427 ; % = 21.9
Ethnicity Nominal	NR
Diabetes Sample size	n = 311 ; % = 15.9

Characteristic	Study (N = 1954)
Killip Class II-III Sample size	n = 290 ; % = 14.8
Killip class IV Sample size	n = 100 ; % = 5.1
Hypertension Sample size	n = 1039 ; % = 53.2
Contrast volume Nominal	NR
Number of AKI events Sample size	n = 93 ; % = 4.8

Outcomes

Acute kidney injury

Outcome	eGFR <60, , N = 1954
Adjusted OR Mean (95% CI)	5.04 (3.05 to 8.32)

Referent value: ≥60

Caspi, 2017

Bibliographic Reference	Caspi, Oren; Habib, Manhal; Cohen, Yuval; Kerner, Arthur; Roguin, Ariel; Abergel, Eitan; Boulos, Monther; Kapeliovich, Michael R; Beyar, Rafael; Nikolsky, Eugenia; Aronson, Doron; Acute Kidney Injury After Primary Angioplasty: Is Contrast-Induced Nephropathy the Culprit?.; Journal of the American Heart Association; 2017; vol. 6 (no. 6)

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	Israel
Study setting	Intensive care unit
Study dates	January 2000 to September 2015
Sources of funding	None reported

Recruitment / selection of participants	All patients admitted to intensive care with ST-segment-elevation myocardial infarction (STEMI) receiving percutaneous coronary intervention (PCI) *Study also included people who did not undergo PCI - excluded from this review*
Inclusion criteria	Admitted with STEMI and undergoing PCI
Exclusion criteria	None specified
Intervention details	All participants with STEMI underwent PCI with non-ionic, low-osmolar, iodinated contrast agents
Contrast administration route	Intra-arterial
Prognostic variable(s)	eGFR
Acute kidney injury definition	Increase in serum creatinine concentration ≥0.5 mg/dL compared with admission value or a >25% relative rise during the first 72 hours after the procedure
Confounders OR Stratifiction strategy	All factors found to be significant in the univariate analysis were included in the multivariate model: Age ≥70 years Hypertension Diabetes Anterior infarction Haemoglobin Killip class

	Left ventricular ejection fraction <45% Diuretic therapy
Duration of follow-up	One year
Indirectness	None
Additional comments	None

Study arms

eGFR <30 (N = 2025)

eGFR 30-59 (N = 2025)

Characteristics

Study-level characteristics

Characteristic	Study (N = 2025)
Mean age (SD) Mean (SD)	59.72 (12.93)
% Female	n = 375 ; % = 18.5

Characteristic	Study (N = 2025)
Sample size	
Ethnicity Nominal	NR
Diabetes Sample size	n = 92 ; % = 4.5
Killip Class II-III Sample size	n = 238 ; % = 11.8
Killip Class IV or IABP use Sample size	n = 139 ; % = 6.7
Contrast volume Nominal	NR
Number of AKI events Sample size	n = 209 ; % = 10.3

Outcomes

Study timepoints
72 hour

Acute kidney injury

Outcome	eGFR <30, 72 hour, N = 2025	eGFR 30-59, 72 hour, N = 2025
Adjusted OR Mean (95% CI)	6.27 (3.15 to 12.49)	1.71 (1.17 to 2.5)

Referent value: ≥60

Liu, 2015

Bibliographic Reference	Liu, Yong; He, Yi-ting; Tan, Ning; Chen, Ji-yan; Liu, Yuan-hui; Yang, Da-hao; Huang, Shui-jin; Ye, Piao; Li, Hua-long; Ran, Peng; Duan, Chong-yang; Chen, Shi-qun; Zhou, Ying-ling; Chen, Ping-yan; Preprocedural N-terminal pro-brain natriuretic peptide (NT-proBNP) is similar to the Mehran contrast-induced nephropathy (CIN) score in predicting CIN following elective coronary angiography.; Journal of the American Heart Association; 2015; vol. 4 (no. 4)

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Prospective cohort study
Study location	China
Study setting	Cardiovascular institute of a general hospital
Study dates	October 2008 - December 2012
Sources of funding	Supported by Science and Technology Planning Project of Guangdong Province, Guangdong Cardiovascular Institute; and Guangdong Provincial Cardiovascular Clinical Medicine Research Fund

Recruitment / selection of participants	Consecutive patients undergoing coronary angiography or percutaneous coronary intervention
Inclusion criteria	Aged >18 years Underwent coronary angiography or percutaneous coronary intervention
Exclusion criteria	Pregnant or lactating Intravascular administration of contrast within 7 days, or 3 days post operation Cardiovascular surgery or endovascular repair End-stage renal disease or on renal replacement Missing pre-operative or post-operate creatinine values Malignancy Emergent coronary intervention No pre-procedural evaluation of NT-proBNP
Intervention details	Coronary angiography or PCI was performed using standard techniques. The contrast type and dose were left to the discretion of the interventional cardiologist, according to the patient's need. The use of adrenergic blocking agents, angiotensin-converting enzyme inhibitors, diuretics, intra-aortic balloon pump support, or inotropic drugs was left to the discretion of the interventional cardiologist and the physicians responsible for the patients. Patients received intravenous normal (0.9%) saline at a rate of 1 mL/kg per hour, 2 to 12 hours before and 6 to 24 hours after the administration of contrast medium. In patients with a left ventricular ejection fraction (LVEF) <40% or overt heart failure, the hydration rate was reduced to 0.5 mL/kg per hour
Contrast administration route	Intra-arterial

Prognostic variable(s)	eGFR - evaluated using the level-modified Modification of Diet in Renal Disease equation.
Acute kidney injury definition	Increase in serum creatinine of >0.5 mg/ dL over the baseline value within 48 to 72 hours after the administration of contrast medium
Confounders OR Stratifiction strategy	Logistic regression analysis was performed to identify the independent risk factors for CIN, which were included in the multivariate model: Higher NT-proBNP group Congestive heart failure Age >75 years Diabetes mellitus Contrast dose >200 mL
Duration of follow-up	Two years
Indirectness	None
Additional comments	None

Study arms

eGFR <60 (N = 2248)

Characteristics

Study-level characteristics

Characteristic	Study (N = 2248)
Mean age (SD) Mean (SD)	63.48 (10.72)
% Female Sample size	n = 571 ; % = 25.4
Ethnicity Nominal	NR
Diabetes Sample size	n = 565 ; % = 25.1
Heart failure Sample size	n = 324 ; % = 14.4
Hypertension Sample size	n = 909 ; % = 40.4
Contrast volume mL Mean (SD)	124.09 (68.24)
Number of AKI events Sample size	n = 50 ; % = 2.2

Outcomes

Acute kidney injury

Outcome	eGFR <60, , N = 2248
Adjusted OR OR (95%CI) Mean (95% CI)	5.12 (2.27 to 11.54)

Referent value: ≥60

Lunyera, 2021

Bibliographic Reference	Lunyera, Joseph; Clare, Robert M; Chiswell, Karen; Scialla, Julia J; Pun, Patrick H; Thomas, Kevin L; Starks, Monique A; Diamantidis, Clarissa J; Racial Differences in AKI Incidence Following Percutaneous Coronary Intervention.; Journal of the American Society of Nephrology : JASN; 2021; vol. 32 (no. 3); 654-662

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Retrospective cohort study
Study location	USA
Study setting	University medical centre
Study dates	January 2003 - December 2013
Sources of funding	Supported by Research, Education, and Training Subcore Research Voucher from the Duke Center for Research to Advance Health Equity

Recruitment / selection of participants	All patients undergoing cardiac catheterization and cardiac surgery
Inclusion criteria	Underwent percutaneous coronary intervention (PCI) Had data for assessment of race and AKI incidence post-PCI First PCI procedure in the study period
Exclusion criteria	<18 years of age On chronic dialysis at the time of PCI Subsequent repeat PCI procedures for participants who underwent multiple PCI procedures during the study period
Intervention details	No additional information
Contrast administration route	Intra-arterial
Prognostic variable(s)	eGFR, split into five categories: >90 60 to <90 30 to <60 15 to <30 <15

	Only values <60 were included in this review, as per the protocol specification
Acute kidney injury definition	Kidney Disease Improving Global Outcomes (KDIGO) criteria: a 1.5-fold or greater relative elevation in serum creatinine from the reference value to the highest value within 7 days after the date and time of PCI, or a 0.3 mg/dl absolute increase in serum creatinine from the reference value within 48 hours after the date and time of PCI
Confounders OR Stratifiction strategy	Year of index PCI Sex Age Tobacco use PCI setting (elective versus nonelective) Number of stents placed Contrast volume Systolic and diastolic BP RAAS inhibitors Diuretics Nonsteroidal anti-inflammatory drugs Administration of intravascular fluid and N-acetylcysteine BMI

	Acute coronary status pre-CATH (ST-elevation myocardial infarction (STEMI), non-STEMI, MI unspecified, unstable angina) Pre-existing cardiovascular disease (prior MI, prior PCI, prior coronary artery bypass grafting, history of angina, congestive heart failure, cerebrovascular disease, peripheral vascular disease, carotid bruits) History of hyperlipidaemia Diabetes and diabetes with end organ damage Marital status Median household income
Duration of follow-up	14 days
Indirectness	None
Additional comments	None

Study arms

eGFR 30-59 (N = 9422)

eGFR 15-29 (N = 9422)

eGFR <15 (N = 9422)

Characteristics

Study-level characteristics

Characteristic	Study (N = 9422)
Mean age (SD) Median (IQR)	63 (54 to 72)
% Female Sample size	n = 3097 ; % = 33
White Sample size	n = NR ; % = 75
Black Sample size	n = NR ; % = 20
Other Sample size	n = NR ; % = 5
Diabetes Sample size	n = 2804 ; % = 30
Heart failure Sample size	n = 1592 ; % = 17
SBP Median (IQR)	141 (127 to 160)

Characteristic	Study (N = 9422)
DBP Median (IQR)	81 (72 to 90)
Contrast volume (ml) Median (IQR)	250 (190 to 335)
Number of AKI events Sample size	n = 865 ; % = 9

Outcomes

Acute kidney injury

Outcome	eGFR 30-59, , N = 9422	eGFR 15-29, , N = 9422	eGFR <15, , N = 9422
Adjusted OR OR (95%CI) Nominal	2.29	5.77	15.71
Adjusted OR OR (95%CI) Range	1.77 to 2.97	3.96 to 8.41	9.97 to 24.77

Referent value: ≥90

Mohebi, 2022

Bibliographic Reference	Mohebi, Reza; Karimi Galougahi, Keyvan; Garcia, Javier Jas; Horst, Jennifer; Ben-Yehuda, Ori; Radhakrishnan, Jai; Chertow, Glenn M; Jeremias, Allen; Cohen, David J; Cohen, David J; Maehara, Akiko; Mintz, Gary S; Chen, Shmuel; Redfors, Bjorn; Leon, Martin B; Stuckey, Thomas D; Rinaldi, Michael J; Weisz, Giora; Witzenbichler, Bernhard; Kirtane, Ajay J; Mehran, Roxana; Dangas, George D; Stone, Gregg W; Ali, Ziad A; Long-Term Clinical Impact of Contrast-Associated Acute Kidney Injury Following PCI: An ADAPT-DES Substudy.; JACC. Cardiovascular interventions; 2022; vol. 15 (no. 7); 753-766

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Retrospective cohort study
Study location	USA and Germany
Study setting	No additional information
Study dates	January 2008 - January 2013
Sources of funding	Sponsored by the Cardiovascular Research Foundation, with funding provided by Boston Scientific, Abbott Vascular, Medtronic, Cordis, Biosensors, The Medicines Company, Daiichi Sankyo, Eli Lilly, Volcano, and Accumetrics

Recruitment / selection of participants	Consecutive patients successfully treated with drug-eluting stents
Inclusion criteria	Treated with drug-eluting stents Loaded with aspirin and clopidogrel
Exclusion criteria	Major complication during the procedure, or before platelet function testing Planned bypass surgery after PCI
Intervention details	No details, other than that all participants were treated with aspirin indefinitely, and clopidogrel was recommended for at least 1 year
Contrast administration route	Intra-arterial
Prognostic variable(s)	eGFR
Acute kidney injury definition	European Society of Urogenital Radiology definition: absolute increase of ≥0.5 mg/dL or ≥25% relative increase in serum creatinine after PCI compared with the pre-PCI serum creatinine level occurring within 3 days of the intravascular administration of contrast medium when no alternative etiology for AKI was identified
Confounders OR Stratifiction strategy	Multivariate model adjusted for: Age Sex Self-reported race BMI Peripheral arterial disease

	Congenital heart failure Diabetes mellitus Hypertension Hyperlipidaemia CKD Smoking Anaemia ST-elevation myocardial infarction Killip class Cardiogenic shock Hypotension Intra-aortic balloon pump use Baseline TIMI flow grade Number of stents
Duration of follow-up	2 years
Indirectness	None
Additional comments	None

Study arms

eGFR <60 (N = 7287)

Characteristics

Study-level characteristics

Characteristic	Study (N = 7287)
Mean age (SD) Mean (SD)	63.84 (10.85)
% Female Sample size	n = 1852 ; % = 25.4
Ethnicity Nominal	NR
Diabetes Sample size	n = 2350 ; % = 32.2
Heart failure Sample size	n = 612 ; % = 8.4
Hypertension	n = 5783 ; % = 79.4

Characteristic	Study (N = 7287)
Sample size	
Contrast volume Nominal	NR
Number of AKI events Sample size	n = 476 ; % = 6.5

Outcomes

Acute kidney injury

Outcome	eGFR <60, , N = 7287
Adjusted OR OR (95%CI) Mean (95% CI)	1.65 (1.21 to 2.21)

Paper reports OR for CKD, defined as an eGFR <60 mL/kg/min
Referent value: ≥60

Shacham, 2016

Bibliographic Reference	Shacham, Y.; Gal-Oz, A.; Flint, N.; Keren, G.; Arbel, Y.; Serum uric acid levels and renal impairment among st-segment elevation myocardial infarction patients undergoing primary percutaneous intervention; CardioRenal Medicine; 2016; vol. 6 (no. 3); 191-197

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	No additional information
Trial name / registration number	No additional information
Study type	Retrospective cohort study
Study location	Israel
Study setting	Tertiary referral hospital
Study dates	January 2008 - February 2015
Sources of funding	None reported

Recruitment / selection of participants	Consecutive patients referred with ST-elevated myocardial infarction (STEMI) undergoing primary PCI
Inclusion criteria	None specified
Exclusion criteria	Treated either conservatively or by thrombolysis Final diagnosis on discharge was other than STEMI (e.g. myocarditis or Takotsubo cardiomyopathy) Died within 24 h of admission Required chronic peritoneal dialysis or haemodialysis treatment No information regarding serum uric acid levels
Intervention details	Primary percutaneous coronary intervention (PCI) was performed on patients with symptoms lasting for ≤12 hours as well as in patients with symptoms lasting for 12–24 hours if the symptoms persisted at the time of admission. Following coronary interventional procedures, physiologic (0.9%) saline was given intravenously at a rate of 1 ml/kg/h for 12 h after contrast exposure. In patients with overt heart failure, the hydration rate was reduced at the discretion of the attending physician. The contrast medium used in the procedures was iodixanol or iohexol
Contrast administration route	Intra-arterial
Prognostic variable(s)	eGFR - estimated using the abbreviated Modification of Diet in Renal Disease equation
Acute kidney injury definition	AKI was determined using the AKI network criteria - a rise in serum creatinine >0.3 mg/dl, compared with the admission value
Confounders OR Stratifiction strategy	Independent predictors of AKI were identified by logistic regression model, adjusted for: Age Gender

	Diabetes mellitus Hypertension Heart failure Left ventricular ejection fraction Serum uric acid levels
Duration of follow-up	Unclear
Indirectness	None
Additional comments	None

Study arms

eGFR ≤60 (N = 1372)

Characteristics

Study-level characteristics

Characteristic	**Study (N = 1372)**
Mean age (SD) Mean (SD)	61.5 (12.83)

Characteristic	Study (N = 1372)
% Female Sample size	n = 271 ; % = 19.8
Ethnicity Nominal	NR
Diabetes Sample size	n = 302 ; % = 22
Heart failure Nominal	NR
Hypertension Sample size	n = 587 ; % = 42.8
Contrast volume (ml) Mean (SD)	139.12 (31.44)
Number of AKI events Sample size	n = 153 ; % = 11

Outcomes

Acute kidney injury

Outcome	eGFR ≤60, , N = 1372
Adjusted OR OR (95%CI) Mean (95% CI)	1.67 (1.02 to 2.75)

Referent value: >60

Appendix E Forest plots and AUC and ROC curves

4.1.3. Risk prediction tools

4.1.4. Contrast-induced acute kidney injury

Figure 2: Mehran risk score (cut-off: >5) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Alan 2019	17	56	4	138	0.81 [0.58, 0.95]	0.71 [0.64, 0.77]
Ando 2013	18	121	7	335	0.72 [0.51, 0.88]	0.73 [0.69, 0.77]
Kul 2015	18	45	7	144	0.72 [0.51, 0.88]	0.76 [0.69, 0.82]

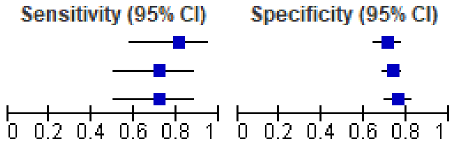


Figure 3: Mehran risk score (cut-off: >7) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Lu 2016	50	264	28	322	0.64 [0.52, 0.75]	0.55 [0.51, 0.59]

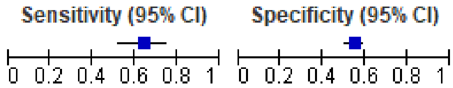


Figure 4: Mehran risk score (cut-off: ≥10) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Connolly 2018	18	104	10	169	0.64 [0.44, 0.81]	0.62 [0.56, 0.68]

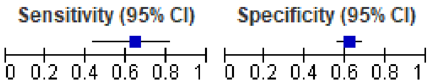


Figure 5: Victor risk score (cut-off: 10%) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Victor 2014	24	49	2	225	0.92 [0.75, 0.99]	0.82 [0.77, 0.86]

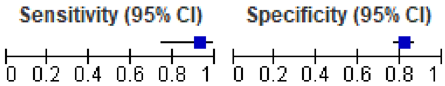


Figure 6: GRACE score (cut-off: >142) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Alan 2019	17	55	4	134	0.81 [0.58, 0.95]	0.71 [0.64, 0.77]

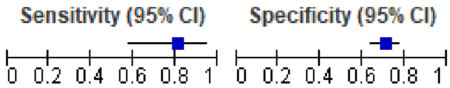


Figure 7: GRACE score (cut-off: >160) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Liu 2014	34	81	9	127	0.79 [0.64, 0.90]	0.61 [0.54, 0.68]

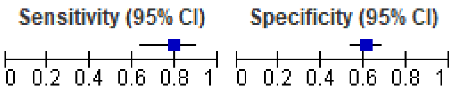


Figure 8: CH2DS2-VASc score (cut-off: ≥4) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Chaudhary 2019	37	96	4	163	0.90 [0.77, 0.97]	0.63 [0.57, 0.69]

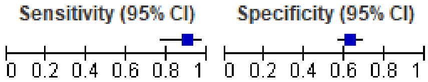


Figure 9: Zwolle score (cut off: >2) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Kul 2015	29	68	9	208	0.76 [0.60, 0.89]	0.75 [0.70, 0.80]

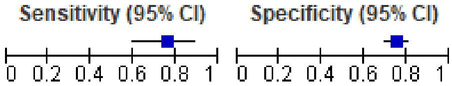


Figure 10: Lei risk score (cut-off: >129) for the prediction of CA-AKI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Lei 2020	78	206	18	341	0.81 [0.72, 0.88]	0.62 [0.58, 0.66]

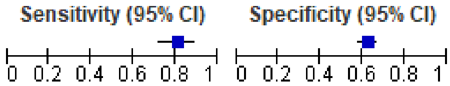


Figure 11: Mehran risk score (cut-off: >5) for the prediction of CA-AKI

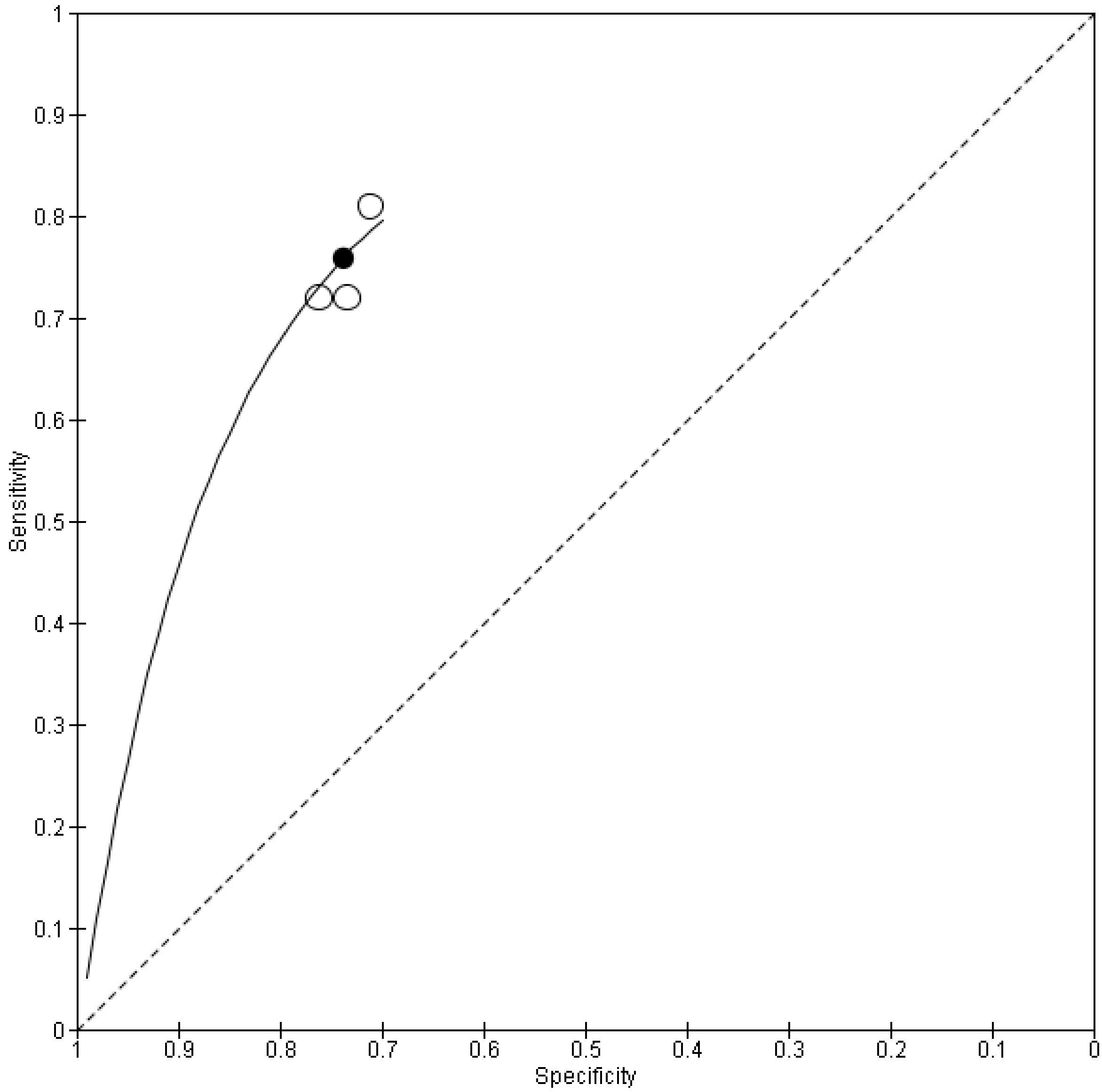


Figure 12: AUC (95%CI) of the Mehran risk score

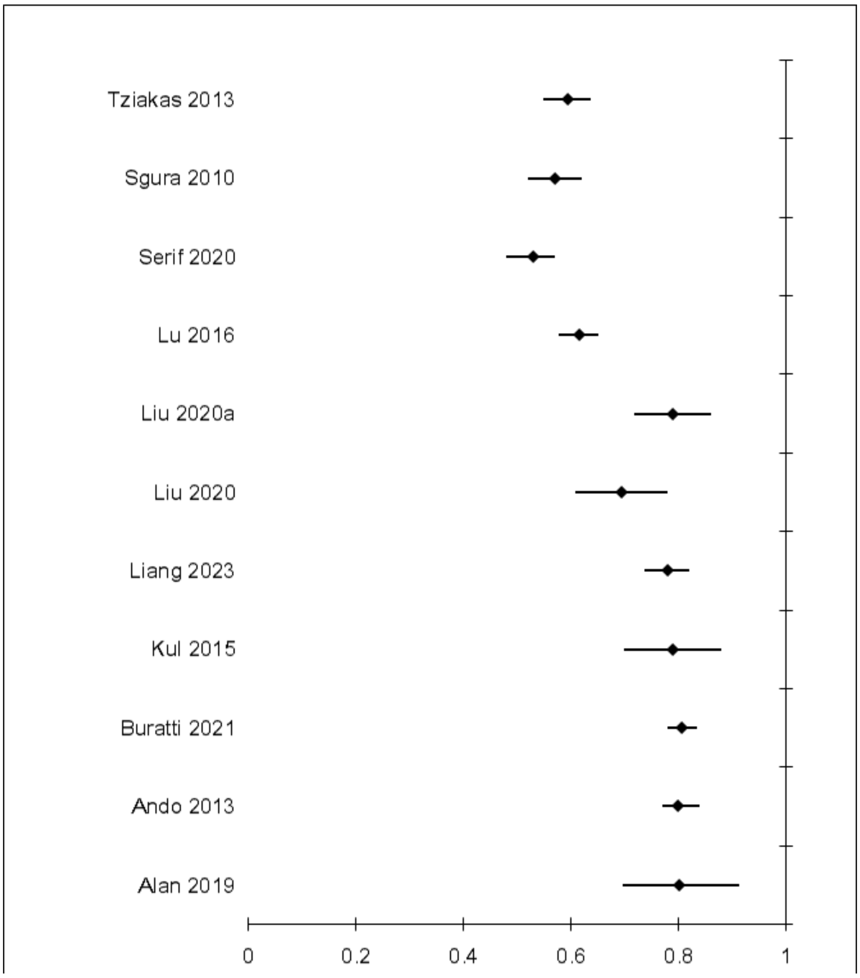


Figure 13: AUC (95%CI) of the Marenzi risk score

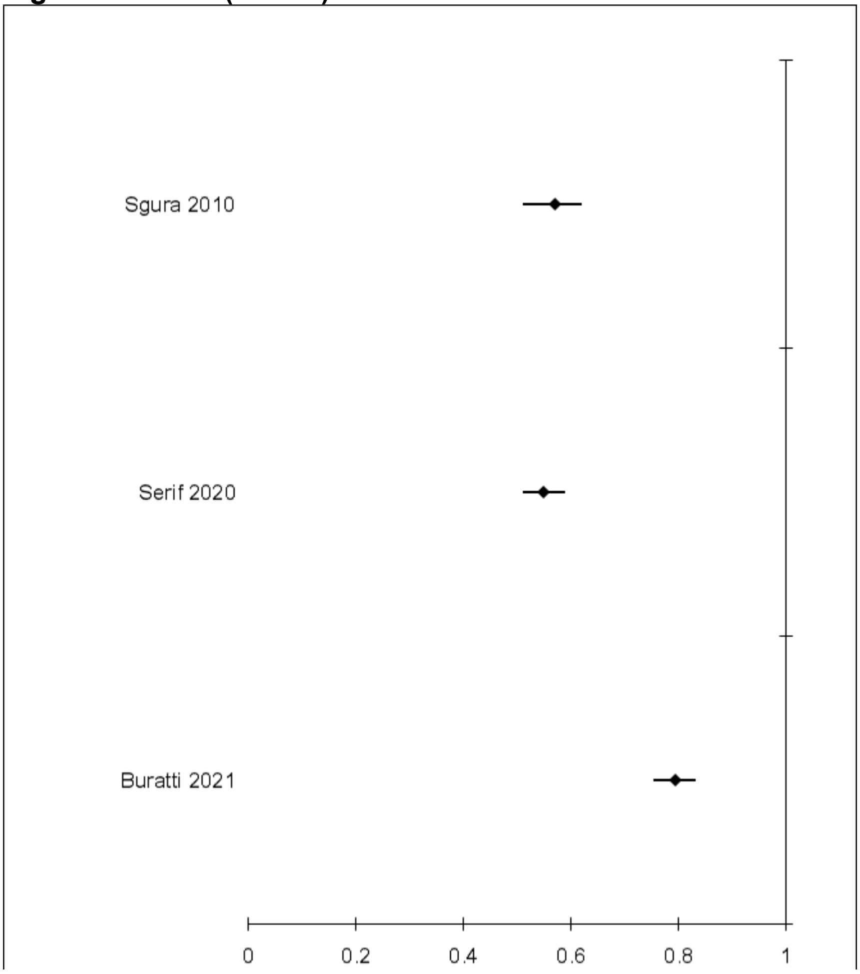


Figure 14: AUC (95%CI) of the Bartholomew risk score

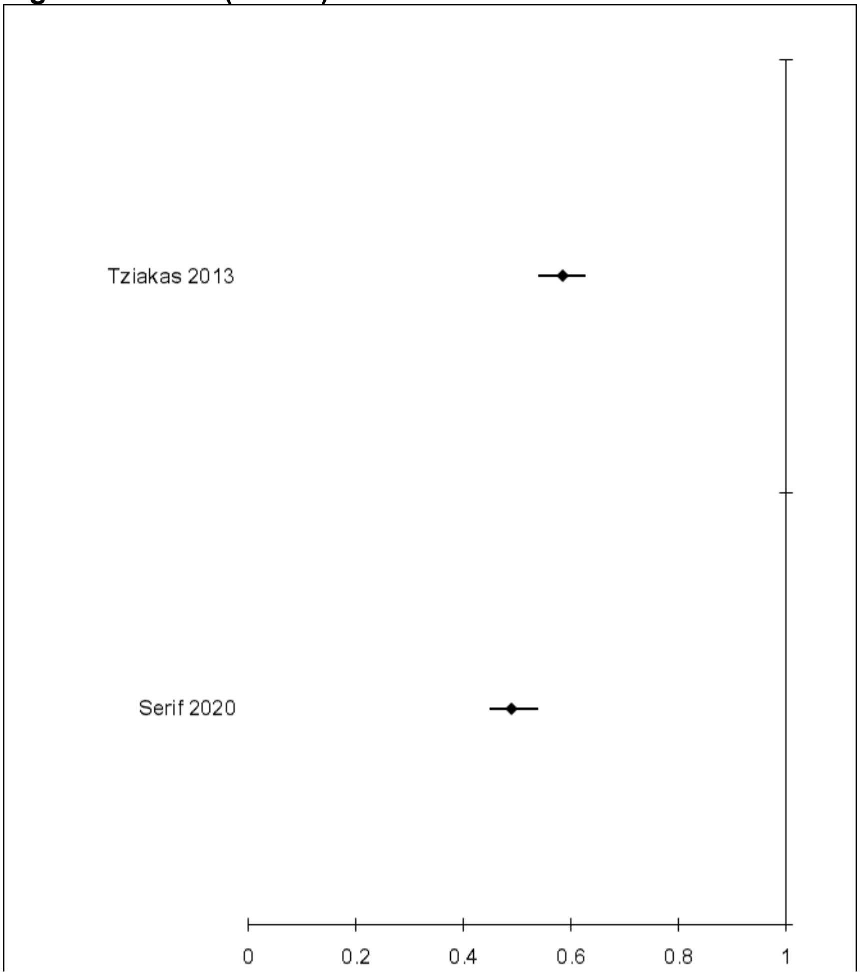


Figure 15: AUC (95%CI) of the Ghani risk score

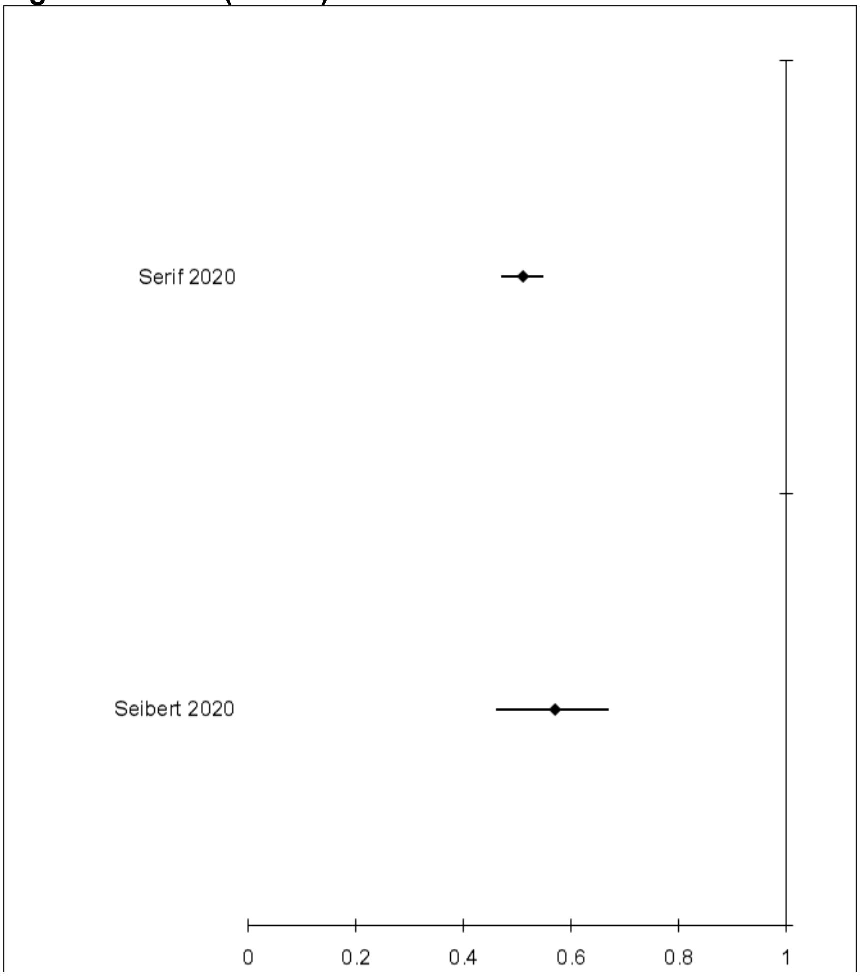


Figure 16: AUC (95%CI) of the Ando risk score

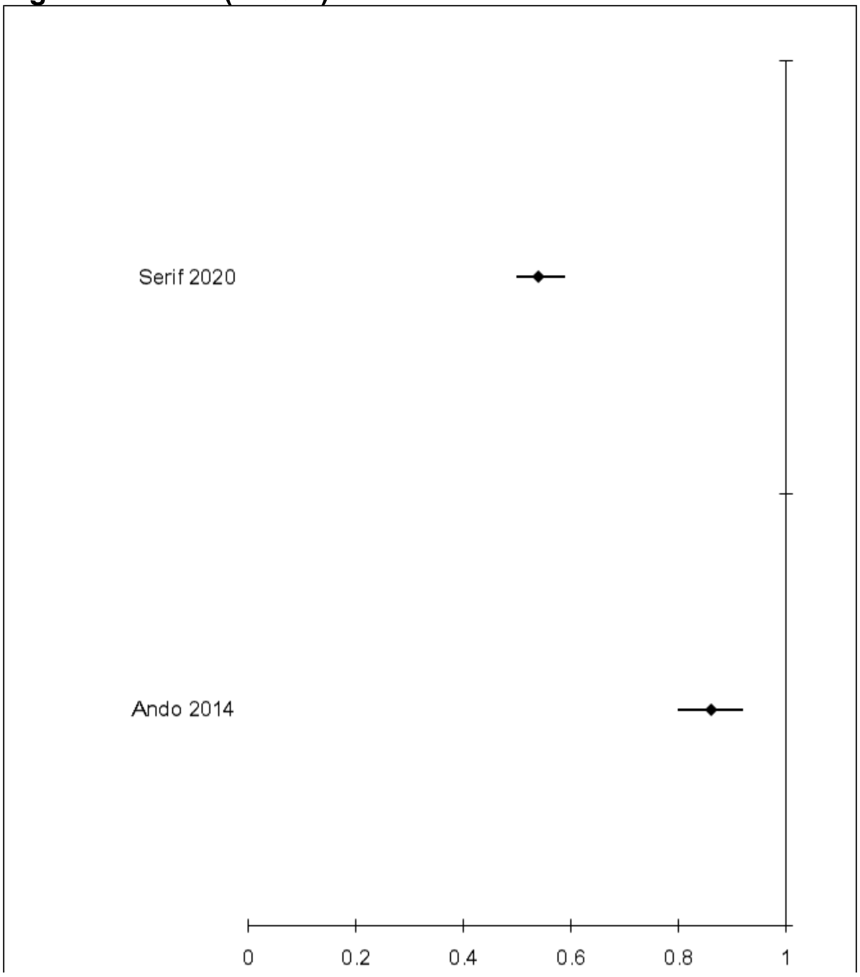


Figure 17: AUC (95%CI) of the Gurm (reduced model) risk score

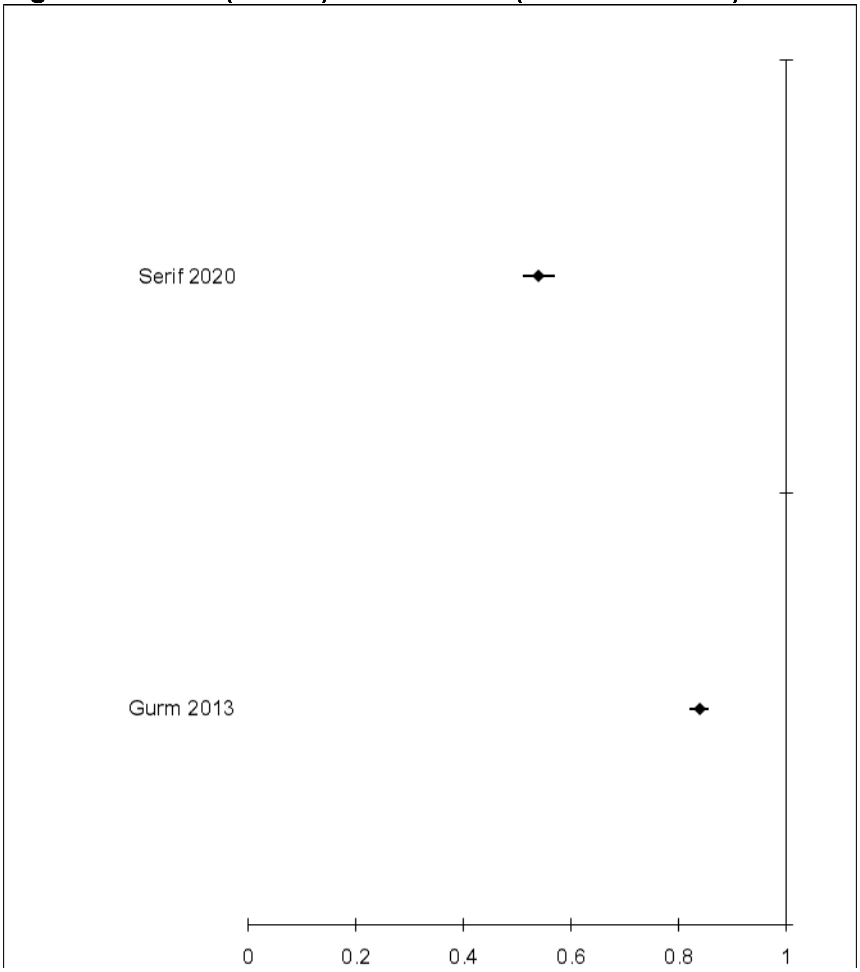


Figure 18: AUC (95%CI) of the Inohara risk score

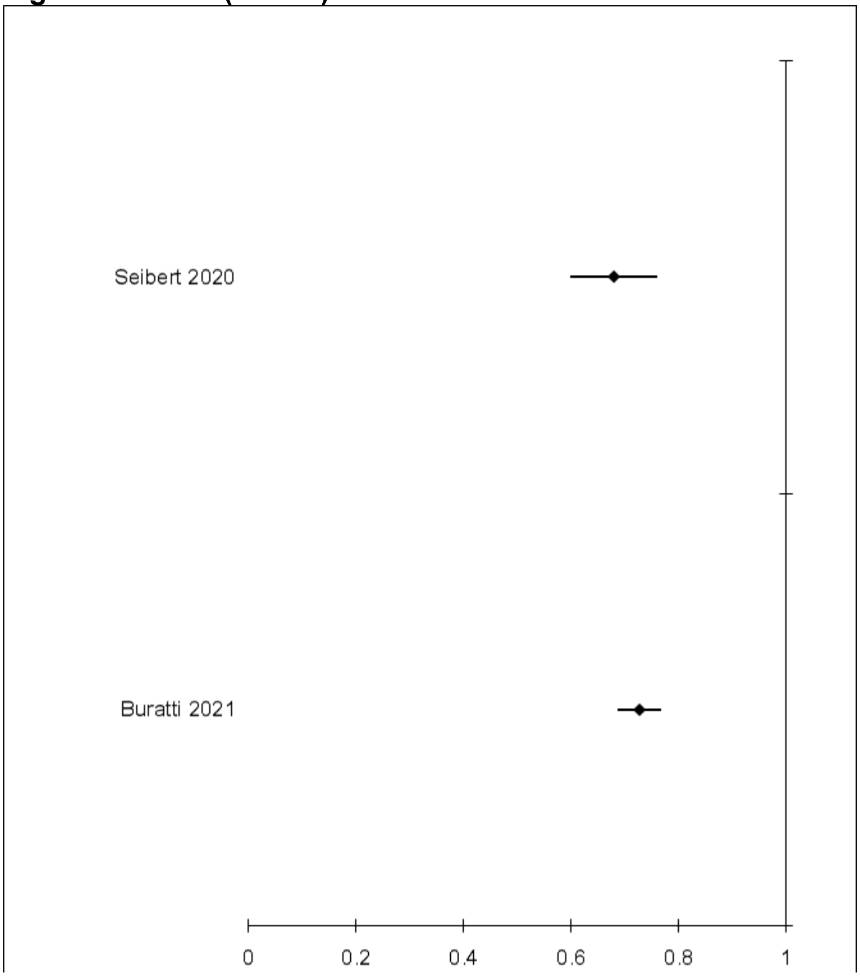


Figure 19: AUC (95%CI) of the Tziakas risk score

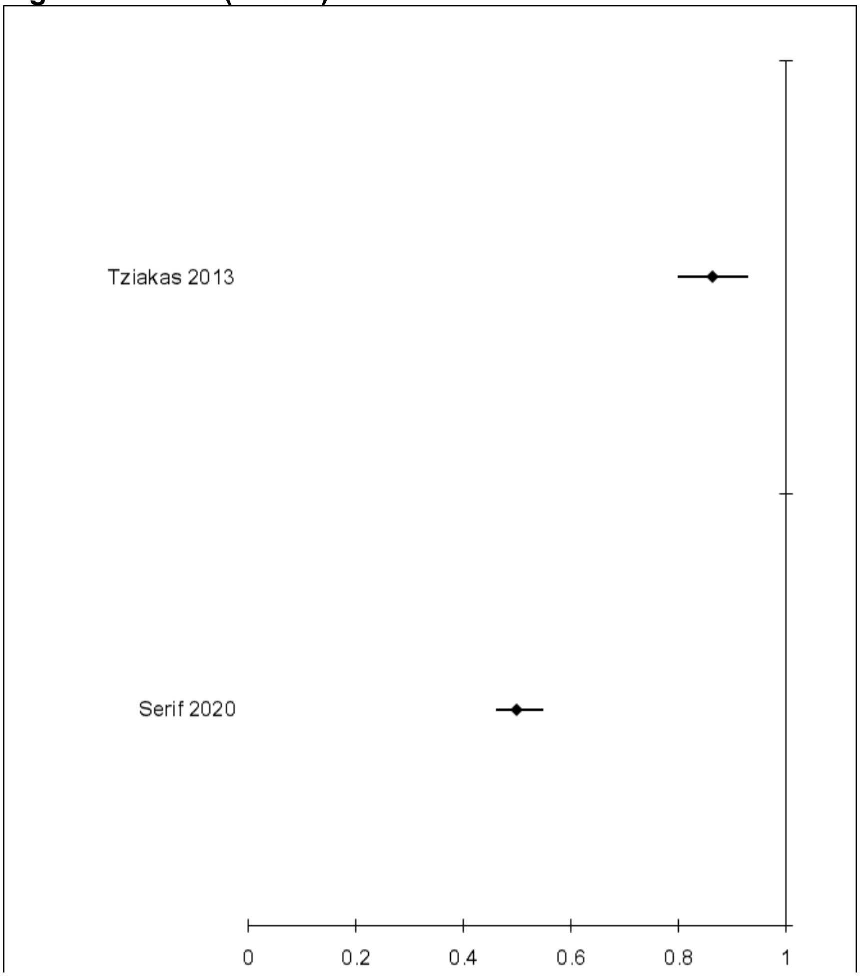
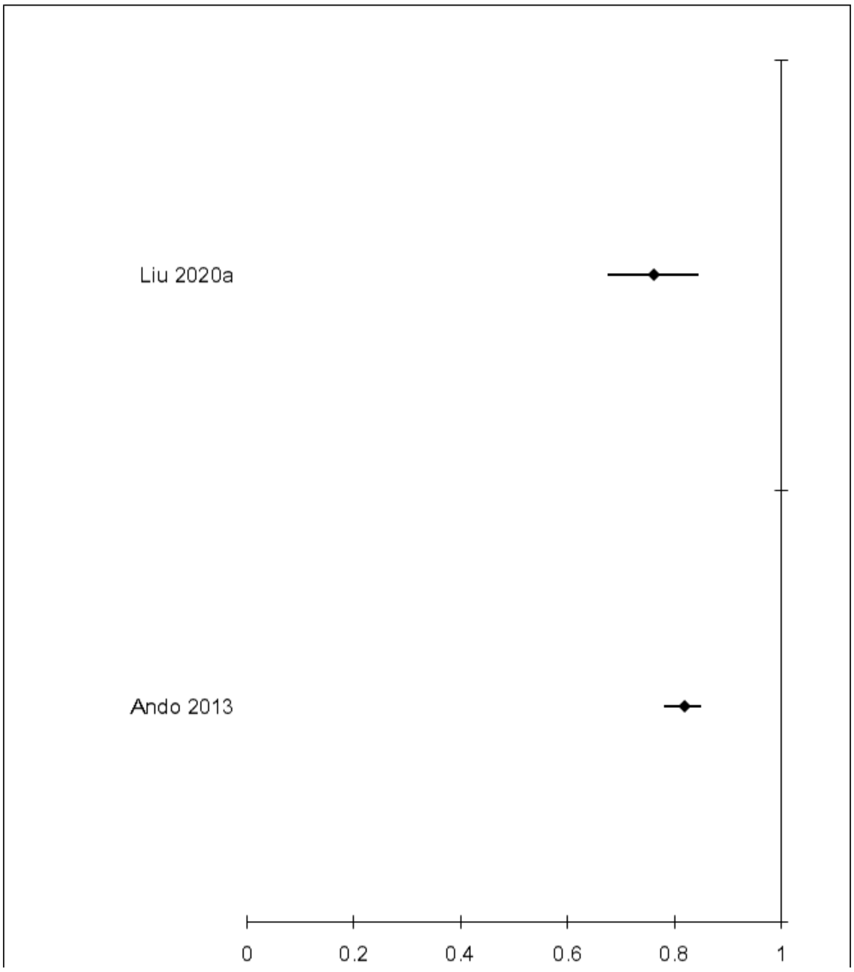


Figure 20: AUC (95%CI) of the ACEF risk score



4.1.5. Dialysis

Figure 21: GRACE score (<136) for the prediction of dialysis

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Liu 2014	0	61	6	184	0.00 [0.00, 0.46]	0.75 [0.69, 0.80]

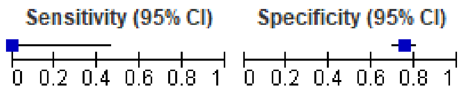


Figure 22: GRACE score (136-158) for the prediction of dialysis

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Liu 2014	0	63	6	182	0.00 [0.00, 0.46]	0.74 [0.68, 0.80]

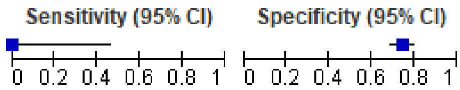


Figure 23: GRACE score (159-180) for the prediction of dialysis

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Liu 2014	2	62	4	183	0.33 [0.04, 0.78]	0.75 [0.69, 0.80]

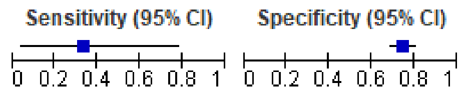
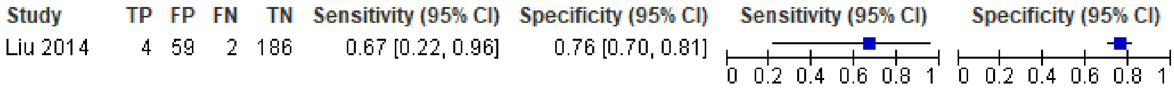


Figure 24: GRACE score (>180) for the prediction of dialysis



4.1.6. Mortality

Figure 25: GRACE score (<136) for the prediction of mortality

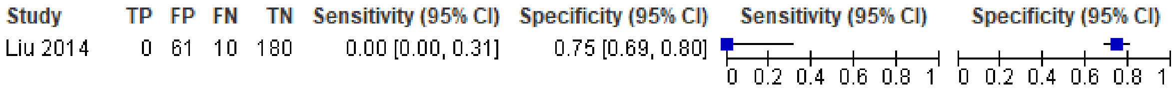


Figure 26: GRACE score (136-158) for the prediction of mortality

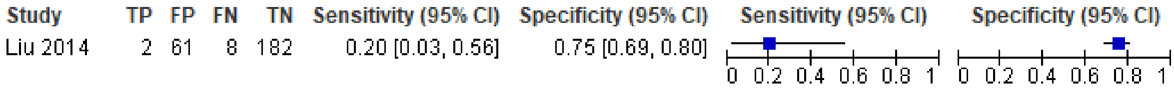


Figure 27: GRACE score (159-180) for the prediction of mortality

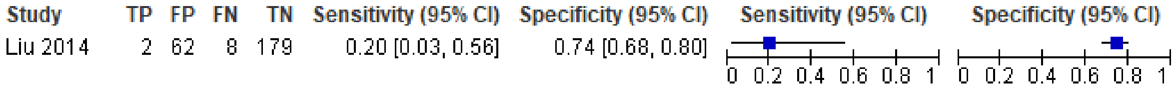
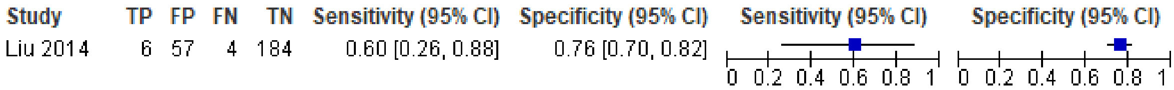


Figure 28: GRACE score (>180) for the prediction of mortality

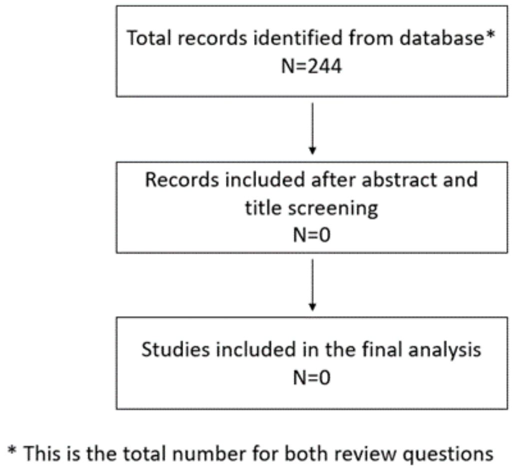


4.1.7. eGFR risk factor

No plots produced due to review type.

Appendix F Economic evidence study selection

Figure 29: PRISMA flow chart for risk prediction tools and eGFR evidence



Appendix G Economic evidence tables

No health economic evidence was identified.

Appendix H Health economic model

No original health economic model was developed.

Appendix I Excluded studies

I.1 Clinical studies

Table 10: Studies excluded from the clinical reviews

Note: this table contains the studies excluded from both reviews 1.1 and 1.2 as the search and sifting process for each was conducted simultaneously.

Study	Code [Reason]
McLean, K.A., Ahmed, W.U.R., English, C. et al. (2020) Perioperative intravenous contrast administration and the incidence of acute kidney injury after major gastrointestinal surgery: prospective, multicentre cohort study. British Journal of Surgery 107(8): 1023-1032	- Population not relevant to this review protocol *Not all participants received iodinated contrast media, and no subgroup analysis data for those that did receive it*
Aalaei-Andabili, Seyed Hossein, Pourafshar, Negiin, Bavry, Anthony A et al. (2016) Acute Kidney Injury After Transcatheter Aortic Valve Replacement. Journal of cardiac surgery 31(7): 416-22	- Review article but not a systematic review
Abbasi, Nooshin, Glazer, Daniel I, Saini, Sanjay et al. (2022) Utility of Patient-Reported Risk Factors for Identifying Advanced Chronic Kidney Disease Before Outpatient CT: Comparison With Recent ACR/NKF Consensus Criteria. AJR. American journal of roentgenology 219(3): 462-470	- Inappropriate analysis method *Study aimed to identify prognostic values for an eGFR threshold and did not include a multivariate model assessing the risk of AKI with a given eGFR*
Abe, Daisuke, Sato, Akira, Hoshi, Tomoya et al. (2014) Clinical predictors of contrast-induced acute kidney injury in patients undergoing emergency versus elective percutaneous coronary intervention. Circulation journal : official journal of the Japanese Circulation Society 78(1): 85-91	- eGFR not included in multivariate model
Abellas-Sequeiros, R.A., Raposeiras-Roubin, S., Abu-Assi, E. et al. (2016) Mehran contrast nephropathy risk score: Is it still useful 10 years later?. Journal of Cardiology 67(3): 262-267	- Retrospective cohort study
Abramavicius, S., Galaune, V., Tunaityte, A. et al. (2021) The glomerular filtration rate estimators in the pharmacokinetic modelling in acute kidney injury: An observational study. Antibiotics 10(2): 1-13	- Population not relevant to this review protocol *Participants had not received iodinated contrast media*

Study	Code [Reason]
Abusaada, Khalid, Yuan, Cai, Sabzwari, Rafay et al. (2017) Development of a novel score to predict the risk of acute kidney injury in patient with acute myocardial infarction. Journal of nephrology 30(3): 419-425	- Population not relevant to this review protocol *Not all participants received iodine based contrast media*
Adamo, Marianna, Provini, Martino, Fiorina, Claudia et al. (2020) Interaction between severe chronic kidney disease and acute kidney injury in predicting mortality after transcatheter aortic valve implantation: Insights from the Italian Clinical Service Project. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions 96(7): 1500-1508	- eGFR not included in multivariate model
Agarwal, S., Kareem, H., Devasia, T. et al. (2018) Baseline nt-probnp level as a risk predictor of contrast induced-acute kidney injury in acute coronary syndrome patients undergoing primary angioplasty. Journal of Clinical and Diagnostic Research 12(3): oc11-oc14	- Inappropriate analysis method *No multivariate analysis reported*
Ahmed, M., Ibrahim, G.H., Adel, M. et al. (2021) Midkine as an early biomarker of contrast-induced acute kidney injury in chronic kidney disease patients undergoing percutaneous coronary intervention foracute coronary syndrome: A single-center prospective study. Open Access Macedonian Journal of Medical Sciences 9: 983-989	- eGFR not included in multivariate model
Aijaz, Saba, Ahmed, Naseer, Akhter, Zohaib et al. (2019) Clinical characteristics and in-hospital outcome in percutaneous coronary interventions with ST elevation myocardial infarction patients developing acute kidney injury. JPMA. The Journal of the Pakistan Medical Association 69(12): 1827-1833	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Akin, Fatih, Celik, Omer, Altun, Ibrahim et al. (2015) Relation of red cell distribution width to contrast-induced acute kidney injury in patients undergoing a primary percutaneous coronary intervention. Coronary artery disease 26(4): 289-95	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Akrawinthawong, Krittapoom, Ricci, Jason, Cannon, Louis et al. (2015) Subclinical and clinical contrast-induced acute kidney injury:	- Data not reported in an extractable format or a format that can be analysed *Multivariate model results not reported*

Study	Code [Reason]
data from a novel blood marker for determining the risk of developing contrast-induced nephropathy (ENCINO), a prospective study. Renal failure 37(2): 187-91	
Al Adas, Ziad, Lodewyk, Kevin, Robinson, David et al. (2019) Contrast-induced nephropathy after peripheral vascular intervention: Long-term renal outcome and risk factors for progressive renal dysfunction. Journal of vascular surgery 69(3): 913-920	- Study not investigating AKI *Study investigates predictors of long-term renal dysfunction, not occurrence of AKI*
Alhozali, H.M., Qutub, M., Alharbi, N.M. et al. (2023) THE RISK OF ACUTE KIDNEY INJURY IN PATIENTS UNDERGOING CORONARY ANGIOGRAPHY. Journal of Population Therapeutics and Clinical Pharmacology 30(18): 1202-1212	- Full text paper not available
Amiri, Ali, Ghanavati, Reza, Riahi Beni, Hassan et al. (2018) Metabolic Syndrome and the Iodine-Dose/Creatinine Clearance Ratio as Determinants of Contrast-Induced Acute Kidney Injury. Cardiorenal medicine 8(3): 217-227	- eGFR not included in multivariate model
An, Jung Nam, Yoo, Kyung Don, Hwang, Jin Ho et al. (2015) Circulating tumour necrosis factor receptors 1 and 2 predict contrast-induced nephropathy and progressive renal dysfunction: a prospective cohort study. Nephrology (Carlton, Vic.) 20(8): 552-9	- eGFR not included in multivariate model
An, Xiuping, Guo, Xi, Ye, Nan et al. (2021) Risk factors of acute kidney injury in patients with Stanford type B aortic dissection involving the renal artery who underwent thoracic endovascular aortic repair. Renal failure 43(1): 1130-1136	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Andreis, Alessandro, Budano, Carlo, Levis, Mario et al. (2017) Contrast-induced kidney injury: how does it affect long-term cardiac mortality?. Journal of cardiovascular medicine (Hagerstown, Md.) 18(11): 908-915	- Data not reported in an extractable format or a format that can be analysed *Risk of AKI with Mehran risk score reported using RR*
Andreucci, Michele; Solomon, Richard; Tasanarong, Adis (2014) Side effects of radiographic contrast media: pathogenesis, risk factors, and prevention. BioMed research international 2014: 741018	- Review article but not a systematic review

Study	Code [Reason]
Andujar, A.M., Lucas, A., Escudero, V.J. et al. (2022) Risk Factors for Acute Kidney Injury Following Cardiac Surgery and Performance of Leicester Score in a Spanish Cohort. Journal of Clinical Medicine 11(4): 904	- Population not relevant to this review protocol *Unclear if participants had received iodinated contrast media*
Anton, B.; Nazarewski, S.; Malyszko, J. (2023) Kidney Function, Male Gender, and Aneurysm Diameter Are Predictors of Acute Kidney Injury in Patients with Abdominal Aortic Aneurysms Treated Endovascularly. Toxins 15(2): 130	- Inappropriate analysis method *Unclear what confounders are included in the multivariate model, and what eGFR threshold CKD was defined at*
Araujo, Gustavo N, Pivatto Junior, Fernando, Fuhr, Bruno et al. (2018) Simplifying contrast-induced acute kidney injury prediction after primary percutaneous coronary intervention: the age, creatinine and ejection fraction score. Cardiovascular intervention and therapeutics 33(3): 224-231	- Retrospective cohort study
Arrotti, S., Sgura, F.A., Monopoli, D.E. et al. (2023) The Importance of Mehran Score to Predict Acute Kidney Injury in Patients with TAVI: A Large Multicenter Cohort Study. Journal of Cardiovascular Development and Disease 10(6): 228	- Retrospective cohort study
Aubry, P., Brillet, G., Catella, L. et al. (2016) Outcomes, risk factors and health burden of contrast-induced acute kidney injury: an observational study of one million hospitalizations with image-guided cardiovascular procedures. BMC Nephrology 17(1): 1-17	- Inappropriate analysis method *Multivariate model did not include all protocol specified confounders*
Augene, E., Lareyre, F., Chikande, J. et al. (2022) Incidence of contrast-induced acute kidney injury in patients with acute mesenteric ischemia and identification of potential predictive factors. Vascular 30(6): 1097-1106	- Population not relevant to this review protocol *Majority of participants did not receive iodine based contrast media*
Avci, Y., Demir, A.R., Guler, A. et al. (2023) A simplified acute kidney injury predictor following endovascular aortic repair: ACEF score. Vascular 31(1): 26-32	- Inappropriate analysis method *Risk tool not validated within study and eGFR not included in multivariate analysis*
Aykut, A., Zengin, E.N., Akkaya, B.B. et al. (2023) Systemic Immune-inflammation Index Predicts Acute Kidney Injury after Cardiac Surgery: A Retrospective Observational Study.	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
Gogus-Kalp-Damar Anestezi ve Yogun Bakim Dernegi Dergisi 29(1): 7-14	
Azzalini, L., Vilca, L.M., Lombardo, F. et al. (2018) Incidence of contrast-induced acute kidney injury in a large cohort of all-comers undergoing percutaneous coronary intervention: Comparison of five contrast media. International Journal of Cardiology 273: 69-73	- Data not reported in an extractable format or a format that can be analysed *eGFR included in multivariate model, but no prognostic cut-off reported*
Azzalini, Lorenzo, Poletti, Enrico, Lombardo, Francesca et al. (2019) Risk of contrast-induced nephropathy in patients undergoing complex percutaneous coronary intervention. International journal of cardiology 290: 59-63	- Data not reported in an extractable format or a format that can be analysed *Prognostic accuracy of Mehran risk score not reported, and eGFR not included in multivariate model*
Baek, Seung Don, Kim, So Mi, Kang, Jae-Young et al. (2019) A risk scoring model to predict renal progression associated with postcontrast acute kidney injury in chronic kidney disease patients. Medicine 98(5): e14377	- Retrospective cohort study
Baldasseroni, Samuele, Bari, Mauro Di, Pratesi, Alessandra et al. (2023) Prediction of worsening postoperative renal function in older candidates to elective cardiac surgery: Choosing the best eGFR formula may not be enough. Heart & lung : the journal of critical care 62: 28-34	- eGFR cut-off outside protocol-defined range *No eGFR cut-off specified for prediction of AKI*
Banda, J., Duarte, R., Dickens, C. et al. (2016) Risk factors and outcomes of contrast-induced nephropathy in hospitalised South Africans. South African Medical Journal 106(7): 699-703	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Barbu, M., Hjarpe, A., Martinsson, A. et al. (2023) Cardiopulmonary bypass management and acute kidney injury in cardiac surgery patients. Acta Anaesthesiologica Scandinavica	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Bartholomew, Beth A, Harjai, Kishore J, Dukkipati, Srinivas et al. (2004) Impact of nephropathy after percutaneous coronary intervention and a method for risk stratification. American Journal of Cardiology 93(12): 1515-1519	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Bell, S., James, M.T., Farmer, C.K.T. et al. (2020) Development and external validation of an acute kidney injury risk score for use in the	- Population not relevant to this review protocol

Study	Code [Reason]
general population. Clinical Kidney Journal 13(3): 402-412	*Participants had not received iodine based contrast media*
Bell, Samira, Dekker, Friedo W, Vadiveloo, Thenmalar et al. (2015) Risk of postoperative acute kidney injury in patients undergoing orthopaedic surgery--development and validation of a risk score and effect of acute kidney injury on survival: observational cohort study. BMJ (Clinical research ed.) 351: h5639	- Population not relevant to this review protocol *Participants had not received iodinated contrast media*
Benaicha, K, Aldroubi, B, Yousuf, P et al. (2023) Factors Associated With Acute Kidney Injury in Patients Undergoing Transcatheter Aortic Valve Implantation: A Systematic Review and Meta-Analysis. Cureus 15(9): e45131	- eGFR not included in multivariate model *Systematic review did not report eGFR as a prognostic marker for AKI*
Berg, Kristin S, Stenseth, Roar, Wahba, Alexander et al. (2013) How can we best predict acute kidney injury following cardiac surgery?: a prospective observational study. European journal of anaesthesiology 30(11): 704-12	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Berglund, F., Eilertz, E., Nimmersjo, F. et al. (2023) Acute and long-term renal effects after iodine contrast media-enhanced computerised tomography in the critically ill-a retrospective bi-centre cohort study. European Radiology	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Blanco, A., Rahim, F., Nguyen, M. et al. (2021) Performance of a pre-procedural Mehran score to predict acute kidney injury after percutaneous coronary intervention. Nephrology 26(1): 23-29	- Retrospective cohort study
Boyer, N., Eldridge, J., Prowle, J.R. et al. (2022) Postoperative Acute Kidney Injury. Clinical Journal of the American Society of Nephrology 17(10): 1535-1545	- Review article but not a systematic review
Braet, Drew J, Graham, Nathan J, Albright, Jeremy et al. (2023) A Novel Preoperative Risk Assessment Tool to Identify Patients at Risk of Contrast-Associated Acute Kidney Injury After Endovascular Abdominal Aortic Aneurysm Repair. Annals of vascular surgery 93: 79-91	- Retrospective cohort study
Brito, C., Falcao, L., Raimundo, M. et al. (2018) Contrast induced acute kidney injury in patients with acute stroke. Neuroradiology 60(supplement2): 433	- Population not relevant to this review protocol

Study	Code [Reason]
	Not all participants received iodine based contrast media, and results stratified by exposure were not usable
Brito, C., Falcao, L., Raimundo, M. et al. (2020) Contrast-induced acute kidney injury in acute ischaemic stroke patients. Neuroradiology Journal	- Duplicate reference
Brown, J.R., MacKenzie, T.A., Maddox, T.M. et al. (2015) Acute kidney injury risk prediction in patients undergoing coronary angiography in a national veterans health administration cohort with external validation. Journal of the American Heart Association 4(12): e002136	- Retrospective cohort study
Buelow, Matthew W, Dall, Aaron, Regner, Kevin et al. (2012) Urinary interleukin-18 and urinary neutrophil gelatinase-associated lipocalin predict acute kidney injury following pulmonary valve replacement prior to serum creatinine. Congenital heart disease 7(5): 441-7	- Population not relevant to this review protocol *Unclear if participants received iodine based contrast media*
Butala, A.D., Nanayakkara, S., Navani, R.V. et al. (2024) Acute Kidney Injury Following Transcatheter Aortic Valve Implantation-A Contemporary Perspective of Incidence, Predictors, and Outcomes. Heart Lung and Circulation	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Caixeta, Adriano, Nikolsky, Eugenia, Leon, Selene et al. (2010) VALIDATION OF A RISK SCORE TO PREDICT CONTRAST-INDUCED ACUTE KIDNEY INJURY AFTER PERCUTANEOUS CORONARY INTERVENTION IN PATIENTS WITH ACS: RESULTS FROM THE ACUITY TRIAL. Journal of The American College of Cardiology - J AMER COLL CARDIOL 55	- Conference abstract
Candela-Toha, Angel, Pardo, Maria Carmen, Perez, Teresa et al. (2018) Estimated glomerular filtration rate is an early biomarker of cardiac surgery-associated acute kidney injury. Nefrologia 38(6): 596-605	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Carlqvist, Jeanette, Nyman, Ulf, Sterner, Gunnar et al. (2021) Minimal risk of contrast-induced kidney injury in a randomly selected cohort with mildly reduced GFR. European radiology 31(5): 3248-3257	- eGFR not included in multivariate model

Study	Code [Reason]
Carpio, J.D., Marco, M.P., Martin, M.L. et al. (2021) Development and validation of a model to predict severe hospital-acquired acute kidney injury in non-critically ill patients. Journal of Clinical Medicine 10(17): 3959	- Population not relevant to this review protocol *Majority of participants had not received iodine based contrast media*
Carrascal, Yolanda, Laguna, Gregorio, Blanco, Miriam et al. (2021) Acute Kidney Injury after Heart Valve Surgery in Elderly Patients: any Risk Factors to Modify?. Brazilian journal of cardiovascular surgery 36(1): 1-9	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Casanova, A.G., Sancho-Martinez, S.M., Vicente-Vicente, L. et al. (2022) Diagnosis of Cardiac Surgery-Associated Acute Kidney Injury: State of the Art and Perspectives. Journal of Clinical Medicine 11(15): 4576	- Review article but not a systematic review
Castaldo, Pasqualina, Frasca, Giovanni M, Brigante, Fabiana et al. (2019) Low incidence of nephrotoxicity following intravenous administration of iodinated contrast media: a prospective study. European radiology 29(7): 3927-3934	- Inappropriate analysis method *Multivariate analysis not reported*
Chandrasekhar, J., Sartori, S., Mehran, R. et al. (2021) Incidence, predictors, and outcomes associated with acute kidney injury in patients undergoing transcatheter aortic valve replacement: from the BRAVO-3 randomized trial. Clinical Research in Cardiology 110(5): 649-657	- Population not relevant to this review protocol *Participants did not receive iodine based contrast media*
Chaudery, Hannan, MacDonald, Neil, Ahmad, Tahania et al. (2019) Acute Kidney Injury and Risk of Death After Elective Surgery: Prospective Analysis of Data From an International Cohort Study. Anesthesia and analgesia 128(5): 1022-1029	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Chaudhury, P., Armanyous, S., Harb, S.C. et al. (2019) Intra-Arterial versus Intravenous Contrast and Renal Injury in Chronic Kidney Disease: A Propensity-Matched Analysis. Nephron 141(1): 31-40	- Population not relevant to this review protocol *Not all participants received iodine based contrast media, and reported risks of AKI stratified by exposure are not usable*
Chen, Hanchuan, He, Chen, You, Zhebin et al. (2021) Association between urine pH and risk of contrast-associated acute kidney injury among patients after emergency percutaneous coronary intervention: a V-shape relationship?.	- eGFR not included in multivariate model *Included in model, but OR not reported*

Study	Code [Reason]
Clinical and experimental nephrology 25(5): 554-561	
Chen, JW; Lin, CH; Hsu, RB (2015) Malignant ventricular arrhythmias after off-pump coronary artery bypass. Journal of the Formosan Medical Association = Taiwan yi zhi 114(10): 936-42	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Chen, Yen-Yu, Liu, Chung-Feng, Shen, Yu-Ting et al. (2023) Development of real-time individualized risk prediction models for contrast associated acute kidney injury and 30-day dialysis after contrast enhanced computed tomography. European journal of radiology 167: 111034	- Retrospective cohort study
Chen, Yi-Ting, Chan, Chieh-Kai, Li, Wen-Yi et al. (2021) Renin-angiotensin-aldosterone system inhibition decreased contrast-associated acute kidney injury in chronic kidney disease patients. Journal of the Formosan Medical Association = Taiwan yi zhi 120(1pt3): 641-650	- Data not reported in an extractable format or a format that can be analysed *No prognostic cut-off value for eGFR provided*
Chen, Zaiyan, Mao, Qi, Xiang, Li et al. (2023) Iodixanol-associated acute kidney injury and prognosis in patients undergoing elective percutaneous coronary intervention: a prospective, multi-center study. European radiology 33(12): 9444-9454	- Retrospective cohort study
Cheng, E.L., Hong, Q., Yong, E. et al. (2020) Validating the use of contrast-induced nephropathy prediction models in endovascular aneurysm repairs. Journal of Vascular Surgery 71(5): 1546-1553	- Retrospective cohort study
Chikata, Y., Iwata, H., Doi, S. et al. (2020) Simultaneous estimation of gender male and atrial fibrillation as risk factors for adverse outcomes following transcatheter aortic valve implantation. Journal of Clinical Medicine 9(12): 1-15	- Study not investigating AKI
Cho, Ara, Kim, Min Joung, You, Je Sung et al. (2019) Postcontrast Acute Kidney Injury After Computed Tomography Pulmonary Angiography for Acute Pulmonary Embolism. The Journal of emergency medicine 57(6): 798-804	- Inappropriate analysis method *Multivariate model did not include all protocol specified confounders*

Study	Code [Reason]
Chua, Horng-Ruey, Horrigan, Mark, Mcintosh, Elizabeth et al. (2014) Extended renal outcomes with use of iodixanol versus iohexol after coronary angiography. BioMed research international 2014: 506479	- Data not reported in an extractable format or a format that can be analysed *Adjusted OR or RR not reported*
Chuang, Y.-C., Tung, T.-H., Chen, J.-Y. et al. (2021) Exploration of the Relationship Among Key Risk Factors of Acute Kidney Injury for Elderly Patients Considering Covid-19. Frontiers in Medicine 8: 639250	- Population not relevant to this review protocol *Participants had not received iodinated contrast media*
Cicek, O.F., Akyurek, F., Akbayrak, H. et al. (2023) Can preoperative neopterin levels predict acute kidney injury in patients undergoing on-pump cardiac surgery?. Turkish Journal of Biochemistry 48(5): 531-540	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Cinar, T., Karabag, Y., Ozan Tanik, V. et al. (2020) The investigation of TIMI risk index for prediction of contrast-induced acute kidney injury in patients with ST elevation myocardial infarction. Acta Cardiologica 75(1): 77-84	- Retrospective cohort study
Coca, S.G., Jammalamadaka, D., Sint, K. et al. (2012) Preoperative proteinuria predicts acute kidney injury in patients undergoing cardiac surgery. The Journal of thoracic and cardiovascular surgery 143(2): 495-502	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Colacchio, E.C., Berton, M., Grego, F. et al. (2023) Post-Operative and Mid-Term Renal Function Impairment Following Elective Fenestrated Endovascular Aortic Repair for Complex Aortic Aneurysms: Incidence and Risk Factors Analysis. Diagnostics 13(11): 1955	- eGFR not included in multivariate model
Comoglu, M., Acehan, F., Katipoglu, B. et al. (2023) Is eGFR >=60 mL/min/1.73 m2 in Patients Undergoing Coronary Angiography Really Safe for Contrast Nephropathy?. Angiology	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Corbett, Mark, Duarte, Ana, Llewellyn, Alexis et al. (2020) Point-of-care creatinine tests to assess kidney function for outpatients requiring contrast-enhanced CT imaging: systematic reviews and economic evaluation. Health technology assessment (Winchester, England) 24(39): 1-248	- Study design not relevant to this review protocol *Systematic review of studies comparing diagnostic accuracy of PoC devices*

Study	Code [Reason]
Coser, T.A., Leitao, J.S.V., Beltrame, B.M. et al. (2021) Intravenous contrast use and acute kidney injury: A retrospective study of 1,238 inpatients undergoing computed tomography. Radiologia Brasileira 54(2): 77-82	- Data not reported in an extractable format or a format that can be analysed *Multivariate analysis results for AKI not reported*
Crawford, Todd C, Magruder, J Trent, Grimm, Joshua C et al. (2017) Renal Failure After Cardiac Operations: Not All Acute Kidney Injury Is the Same. The Annals of thoracic surgery 104(3): 760-766	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Crimi, G., De Marzo, V., De Marco, F. et al. (2022) Acute Kidney Injury After Transcatheter Aortic Valve Replacement Mediates the Effect of Chronic Kidney Disease. Journal of the American Heart Association 11(19): e024589	- Inappropriate analysis method *Multivariate model not adjusted for protocol-specified covariates*
Crowhurst, James A, Savage, Michael, Subban, Vijayakumar et al. (2016) Factors Contributing to Acute Kidney Injury and the Impact on Mortality in Patients Undergoing Transcatheter Aortic Valve Replacement. Heart, lung & circulation 25(3): 282-9	- eGFR not included in multivariate model
Crowley, M.P.; Prabhakaran, V.N.; Gilligan, O.M. (2018) Incidence of Contrast-Induced Nephropathy in Patients with Multiple Myeloma Undergoing Contrast-Enhanced Procedures. Pathology and Oncology Research 24(4): 915-919	- Inappropriate analysis method *No multivariate analysis reported*
D'Oria, Mario, Wanhainen, Anders, Lindstrom, David et al. (2021) Editor's Choice - Pre-Operative Moderate to Severe Chronic Kidney Disease is Associated with Worse Short-Term and Mid-Term Outcomes in Patients Undergoing Fenestrated-Branched Endovascular Aortic Repair. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery 62(6): 859-868	- Study not investigating AKI *Study assessed outcomes at <30 days and 36 months, not reporting AKI incidence within 7 days*
Dagar, S., Emektar, E., Uzunosmanoglu, H. et al. (2022) Risk of acute kidney injury after contrast-enhanced computed tomography in emergency department. Hong Kong Journal of Emergency Medicine 29(5): 305-311	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Dasli, T. and Turan, B. (2023) Is the transradial approach associated with decreased acute	- Inappropriate analysis method

Study	Code [Reason]
kidney injury following percutaneous coronary intervention in patients not complicated by major bleeding and haemodynamic disturbance?. Cardiovascular journal of Africa 34: 1-6	*Multivariate model did not include all protocol-specified confounders*
Davenport, Matthew S, Khalatbari, Shokoufeh, Cohan, Richard H et al. (2013) Contrast material-induced nephrotoxicity and intravenous low-osmolality iodinated contrast material: risk stratification by using estimated glomerular filtration rate. Radiology 268(3): 719-28	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Davenport, Matthew S, Khalatbari, Shokoufeh, Dillman, Jonathan R et al. (2013) Contrast material-induced nephrotoxicity and intravenous low-osmolality iodinated contrast material. Radiology 267(1): 94-105	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
De Filippo, O., D'Ascenzo, F., Piroli, F. et al. (2019) Sometimes neither water nor fire are more useful than friendship - A new risk score for prediction of contrast-induced nephropathy (CIN) and long-term adverse outcomes in patients undergoing coronary angiography. Journal of Thoracic Disease 11(7): 2675-2679	- Review article but not a systematic review
De Rosa, R., Morici, N., De Servi, S. et al. (2020) Impact of renal dysfunction and acute kidney injury on outcome in elderly patients with acute coronary syndrome undergoing percutaneous coronary intervention. European heart journal. Acute cardiovascular care	- Study not investigating AKI *Outcomes reported at 12 months*
Dedemoglu, M. and Tuysuz, M.E. (2020) Risk estimation model for acute kidney injury defined by KDIGO classification after heart valve replacement surgery. General Thoracic and Cardiovascular Surgery 68(9): 922-931	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Dimopoulos, S., Zagkotsis, G., Kinti, C. et al. (2023) Incidence and peri-operative risk factors for development of acute kidney injury in patients after cardiac surgery: A prospective observational study. World Journal of Clinical Cases 11(16): 3791-3801	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Ding, Feng Hua, Lu, Lin, Zhang, Rui Yan et al. (2013) Impact of elevated serum glycated albumin levels on contrast-induced acute kidney injury in diabetic patients with moderate to	- eGFR not included in multivariate model

Study	Code [Reason]
severe renal insufficiency undergoing coronary angiography. International journal of cardiology 167(2): 369-73	
Diprose, William K, Sutherland, Luke J, Wang, Michael T M et al. (2019) Contrast-Associated Acute Kidney Injury in Endovascular Thrombectomy Patients With and Without Baseline Renal Impairment. Stroke 50(12): 3527-3531	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Doulamis, Ilias P, Tzani, Aspasia, Kampaktsis, Polydoros N et al. (2022) Acute Kidney Injury Following Transcatheter Edge-to-Edge Mitral Valve Repair: A Systematic Review and Meta-Analysis. Cardiovascular revascularization medicine : including molecular interventions 38: 29-35	- Population not relevant to this review protocol *Procedure not typically associated with contrast use*
Drazic, Obren D, Zarate, Cristian F, Valdes, Jose F et al. (2020) Juxtarenal Abdominal Aortic Aneurysm: Results of Open Surgery in an Academic Center. Annals of vascular surgery 66: 28-34	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Drosos, George, Ampatzidou, Fotini, Sarafidis, Pantelis et al. (2018) Serum Creatinine and Chronic Kidney Disease-Epidemiology Estimated Glomerular Filtration Rate: Independent Predictors of Renal Replacement Therapy following Cardiac Surgery. American journal of nephrology 48(2): 108-117	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Du, Y., Wang, X.-Z., Wu, W.-D. et al. (2021) Predicting the risk of acute kidney injury in patients after percutaneous coronary intervention (PCI) or cardiopulmonary bypass (CPB) surgery: Development and assessment of a nomogram prediction model. Medical Science Monitor 27: e929791	- Retrospective cohort study
Duceppe, Emmanuelle, Studzinska, Dorota, Devereaux, P J et al. (2019) Incidence and predictors of myocardial and kidney injury following endovascular aortic repair: a retrospective cohort study. Canadian journal of anaesthesia = Journal canadien d'anesthesie 66(11): 1338-1346	- Inappropriate analysis method *Multivariate model did not account for all protocol-specified confounders*
Duzel, Baris; Emren, Sadik Volkan; Berilgen, Rida (2017) Effect of Atrial Fibrillation on	- Data not reported in an extractable format or a format that can be analysed

Study	Code [Reason]
Contrast-Induced Nephropathy Development in Patients With Non-ST-Segment Elevation Myocardial Infarction. Angiology 68(10): 871-876	*Risk of an AKI with a given Mehran risk score reported as RR, and eGFR cut-off not provided in multivariate model*
Dziewierz, A., Tokarek, T., Kleczynski, P. et al. (2018) Impact of chronic obstructive pulmonary disease and frailty on long-term outcomes and quality of life after transcatheter aortic valve implantation. Aging Clinical and Experimental Research 30(9): 1033-1040	- eGFR not included in multivariate model
Efe, S.C., Keskin, M., Toprak, E. et al. (2021) A Novel Risk Assessment Model Using Urinary System Contrast Blush Grading to Predict Contrast-Induced Acute Kidney Injury in Low-Risk Profile Patients. Angiology 72(6): 524-532	- Inappropriate analysis method *Risk prediction tool developed in study, but not validated*
Ehmann, M.R., Mitchell, J., Levin, S. et al. (2023) Renal outcomes following intravenous contrast administration in patients with acute kidney injury: a multi-site retrospective propensity-adjusted analysis. Intensive Care Medicine 49(2): 205-215	- Population not relevant to this review protocol *Participants presented with AKI*
Elias, A. and Aronson, D. (2021) Risk of Acute Kidney Injury after Intravenous Contrast Media Administration in Patients with Suspected Pulmonary Embolism: A Propensity-Matched Study. Thrombosis and Haemostasis 121(6): 800-807	- Population not relevant to this review protocol *Not all participants received iodine based contrast media, and risk of AKI not reported for those that were exposed*
Ellis, James H, Khalatbari, Shokoufeh, Yosef, Matheos et al. (2019) Influence of Clinical Factors on Risk of Contrast-Induced Nephrotoxicity From IV Iodinated Low-Osmolality Contrast Material in Patients With a Low Estimated Glomerular Filtration Rate. AJR. American journal of roentgenology 213(5): w188-w193	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Elmariah, Sammy, Farrell, Laurie A, Daher, Maureen et al. (2016) Metabolite Profiles Predict Acute Kidney Injury and Mortality in Patients Undergoing Transcatheter Aortic Valve Replacement. Journal of the American Heart Association 5(3): e002712	- Inappropriate analysis method *Unclear multivariate analysis confounders*
Falcao, L., Brito, C., Raimundo, M. et al. (2018) Contrast-induced acute kidney injury in patients	- Conference abstract

Study	Code [Reason]
with suspected acute stroke. Nephrology Dialysis Transplantation 33(supplement1): i117	
Fandler-Hofler, Simon, Odler, Balazs, Kneihsl, Markus et al. (2021) Acute and Chronic Kidney Dysfunction and Outcome After Stroke Thrombectomy. Translational stroke research 12(5): 791-798	- Study not investigating AKI *Study reports AKI during hospital stay, but not necessarily within 7 days of contrast administration*
Fathala, A., Almehemeid, S., Alkharji, I. et al. (2021) A conservative screening approach to kidney disease before contrast-enhanced computed tomography in outpatient population. European Review for Medical and Pharmacological Sciences 25(6): 2503-2510	- Inappropriate analysis method *No risk prediction tools or multivariate analysis including eGFR reported*
Ferro, C.J., Law, J.P., Doshi, S.N. et al. (2017) Dialysis Following Transcatheter Aortic Valve Replacement: Risk Factors and Outcomes: An Analysis From the UK TAVI (Transcatheter Aortic Valve Implantation) Registry. JACC: Cardiovascular Interventions 10(20): 2040-2047	- Study not investigating AKI
Flaherty, Michael P, Moses, Jeffrey W, Westenfeld, Ralf et al. (2020) Impella support and acute kidney injury during high-risk percutaneous coronary intervention: The Global cVAD Renal Protection Study. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions 95(6): 1111-1121	- Data not reported in an extractable format or a format that can be analysed *No prognostic accuracy data reported for Mehran risk score, and eGFR not reported in multivariate model*
Fortrie, Gijs, Manintveld, Olivier C, Caliskan, Kadir et al. (2016) Acute Kidney Injury as a Complication of Cardiac Transplantation: Incidence, Risk Factors, and Impact on 1-year Mortality and Renal Function. Transplantation 100(8): 1740-9	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Frank, B., Escola, J.K., Biermann-Ratjen, L. et al. (2021) Post-contrast acute kidney injury after acute stroke-insights from a german tertiary care center. Journal of Clinical Medicine 10(23): 5684	- eGFR not included in multivariate model *Study did not report a multivariate model*
Frydman, S., Freund, O., Banai, A. et al. (2022) Relation of Gender to the Occurrence of AKI in STEMI Patients. Journal of Clinical Medicine 11(21): 6565	- eGFR not included in multivariate model

Study	Code [Reason]
Fu, Naikuan, Li, Ximing, Yang, Shicheng et al. (2012) Risk Score for the Prediction of Contrast-Induced Nephropathy in Elderly Patients Undergoing Percutaneous Coronary Intervention. Angiology 64(3): 188-194	- Retrospective cohort study
Fukushima, Yasuhiro, Miyazawa, Hitomi, Nakamura, Junpei et al. (2017) Contrast-induced nephropathy (CIN) of patients with renal dysfunction in CT examination. Japanese journal of radiology 35(8): 427-431	- eGFR not included in multivariate model
Funamoto, Masaki, Osho, Asishana A, Li, Selena S et al. (2021) Factors Related to Survival in Low-Glomerular Filtration Rate Cohorts Undergoing Lung Transplant. The Annals of thoracic surgery 112(6): 1797-1804	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Gao, Y., Wang, C., Dong, W. et al. (2023) An Explainable Machine Learning Model to Predict Acute Kidney Injury After Cardiac Surgery: A Retrospective Cohort Study. Clinical Epidemiology 15: 1145-1157	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Gao, Yu-mei, Li, Di, Cheng, Hong et al. (2014) Derivation and validation of a risk score for contrast-induced nephropathy after cardiac catheterization in Chinese patients. Clinical and experimental nephrology 18(6): 892-8	- Retrospective cohort study
Geng, Chen-Yu, Wang, Fang-Ze, Zhang, Rui et al. (2023) The predictive value of eGFR combined with BNP detection in acute kidney injury after acute myocardial infarction. African health sciences 23(2): 537-542	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Ghani AA and Tohamy KY (2009) Risk score for contrast induced nephropathy following percutaneous coronary intervention. Saudi journal of kidney diseases and transplantation : an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia 20(2): 240-245	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Giannini, Francesco, Latib, Azeem, Jabbour, Richard J et al. (2017) The ratio of contrast volume to glomerular filtration rate predicts acute kidney injury and mortality after transcatheter aortic valve implantation. Cardiovascular revascularization medicine : including molecular interventions 18(5): 349-355	- eGFR not included in multivariate model

Study	Code [Reason]
Goriki, Y., Tanaka, A., Nishihira, K. et al. (2021) A Novel Prediction Model of Acute Kidney Injury Based on Combined Blood Variables in STEMI. JACC: Asia 1(3): 372-381	- Retrospective cohort study
Goto, M., Odab, E., Matsushita, H. et al. (2012) Renal dysfunction was an independent predictor of in-hospital death and ventricular rupture in patients with acute myocardial infarction. Cardiology Research 3(3): 123-132	- Population not relevant to this review protocol *Not all participants received iodine based contrast media*
Goussot, Samuel, Mousson, Christiane, Guenancia, Charles et al. (2015) N-Terminal Fragment of Pro B-type Natriuretic Peptide as a Marker of Contrast-Induced Nephropathy After Primary Percutaneous Coronary Intervention for ST-Segment Elevation Myocardial Infarction. The American journal of cardiology 116(6): 865-71	- Inappropriate analysis method *Multivariate analysis did not adjust for all protocol-specified confounders*
Grynberg, Keren, Polkinghorne, Kevan R, Ford, Sharon et al. (2017) Early serum creatinine accurately predicts acute kidney injury post cardiac surgery. BMC nephrology 18(1): 93	- Population not relevant to this review protocol *Participants did not receive iodine based contrast media*
Guan, Chen, Li, Chenyu, Xu, Lingyu et al. (2019) Risk factors of cardiac surgery-associated acute kidney injury: development and validation of a perioperative predictive nomogram. Journal of nephrology 32(6): 937-945	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Guan, X.-L., Li, L., Li, H.-Y. et al. (2023) Risk factor prediction of severe postoperative acute kidney injury at stage 3 in patients with acute type A aortic dissection using thromboelastography. Frontiers in Cardiovascular Medicine 10: 1109620	- eGFR not included in multivariate model
Gucun, M., Kahyaoglu, M., Celik, M. et al. (2022) Predictive value of post-procedural hyponatremia on contrast-induced nephropathy in patients who underwent coronary angiography or percutaneous coronary intervention. Acta Cardiologica 77(3): 215-221	- eGFR not included in multivariate model
Guenancia, Charles, Kahli, Abdelkader, Laurent, Gabriel et al. (2015) Pre-operative growth differentiation factor 15 as a novel biomarker of acute kidney injury after cardiac	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
bypass surgery. International journal of cardiology 197: 66-71	
Guillon, Benoit, Ecarnot, Fiona, Marcucci, Charles et al. (2018) Incidence, Predictors, and Impact on Six-Month Mortality of Three Different Definitions of Contrast-Induced Acute Kidney Injury After Coronary Angiography. The American journal of cardiology 121(7): 818-824	- eGFR not included in multivariate model
Gunduz, E (2023) Acute kidney injury early after left ventricular assist device implantation: incidence, risk factors and clinical consequences. European review for medical and pharmacological sciences 27(8): 3336-3343	- Population not relevant to this review protocol *Participants did not receive iodine based contrast media*
Guo, W., Liu, Y., Chen, J.-Y. et al. (2015) Hyperuricemia Is an Independent Predictor of Contrast-Induced Acute Kidney Injury and Mortality in Patients Undergoing Percutaneous Coronary Intervention. Angiology 66(8): 721-726	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Guo, Y., Xu, X., Xue, Y. et al. (2022) Mehran 2 Contrast-Associated Acute Kidney Injury Risk Score: Is it Applicable to the Asian Percutaneous Coronary Intervention Population?. Clinical and Applied Thrombosis/Hemostasis 28	- Retrospective cohort study
Gupta, Shruti, Motwani, Shveta S, Seitter, Robert H et al. (2023) Development and Validation of a Risk Model for Predicting Contrast-Associated Acute Kidney Injury in Patients With Cancer: Evaluation in Over 46,000 CT Examinations. AJR. American journal of roentgenology 221(4): 486-501	- Retrospective cohort study
Haldenwang, Peter, Trampisch, Matthias, Schlomicher, Markus et al. (2014) Risk factors for acute kidney injury following TA-TAVI or minimally invasive aortic valve replacement: which procedure is less kidney damaging in elderly patients?. The Thoracic and cardiovascular surgeon 62(6): 482-8	- Data not reported in an extractable format or a format that can be analysed *Prognostic value of EUROSCORE not reported, and eGFR not included in multivariate model*
Hansen, Malene Kaerslund, Gammelager, Henrik, Mikkelsen, Martin Majlund et al. (2013) Post-operative acute kidney injury and five-year risk of death, myocardial infarction, and stroke among elective cardiac surgical patients: a	- Study not investigating AKI *Study investigated long term outcomes of cardiac surgery*

Study	Code [Reason]
cohort study. Critical care (London, England) 17(6): r292	
Hao, J F, Zhang, L W, Bai, J X et al. (2015) Incidence, risk factors, and prognosis of acute kidney injury following transarterial chemoembolization in patients with hepatocellular carcinoma: a prospective cohort study. Indian journal of cancer 51suppl2: e3-8	- eGFR not included in multivariate model
Hasan, A.M.; Riyad, A.M.; Ahmed, M.A.R. (2024) Predictors of acute kidney injury after percutaneous nephrolithotomy in adult patients: prospective observational study. International Urology and Nephrology	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Hassan, K. and Fadi, H. (2014) Is hypoalbuminemia a prognostic risk factor for contrast-induced nephropathy in peritoneal dialysis patients?. Therapeutics and Clinical Risk Management 10: 787-795	- eGFR not included in multivariate model
Hattar, L., Assaker, J.-P., Aoun, J. et al. (2021) Revising the Maximal Contrast Dose for Predicting Acute Kidney Injury following Coronary Intervention. American Journal of Nephrology 52(4): 328-335	- eGFR not included in multivariate model
Hayiroglu, M.I.; Cinar, T.; Tekkesin, A.I. (2020) The prognostic value of the GRACE score for acute kidney injury in patients with ST elevation myocardial infarction complicated with cardiogenic shock. Erciyes Medical Journal 42(1): 44-49	- Retrospective cohort study
He, H.-M., He, C., You, Z.-B. et al. (2022) Association Between Different Versions of the Model for End-Stage Liver Disease Score and Contrast-Associated Acute Kidney Injury in Patients Undergoing Elective Percutaneous Coronary Intervention. Circulation Journal 86(5): 821-830	- Retrospective cohort study
He, Huan, Chen, Xiao-Rui, Chen, Yun-Qing et al. (2019) Prevalence and Predictors of Contrast-Induced Nephropathy (CIN) in Patients with ST-Segment Elevation Myocardial Infarction (STEMI) Undergoing Percutaneous Coronary Intervention (PCI): A Meta-Analysis. Journal of interventional cardiology 2019: 2750173	- Systematic review used as source of primary studies

Study	Code [Reason]
Hernando, Lorenzo, Canovas, Ester, Freites, Alfonso et al. (2015) Prevalence and prognosis of percutaneous coronary intervention-associated nephropathy in patients with acute coronary syndrome and normal kidney function. Revista espanola de cardiologia (English ed.) 68(4): 310-6	- eGFR not included in multivariate model
Hu, Diane, Blitzer, David, Zhao, Yanling et al. (2023) Quantifying the effects of circulatory arrest on acute kidney injury in aortic surgery. The Journal of thoracic and cardiovascular surgery 166(6): 1707-1716e6	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Hu, Y., Li, Z., Chen, J. et al. (2013) Risk factors for acute kidney injury in patients undergoing same admission coronary angiography and valve replacement. Journal of Cardiac Surgery 28(6): 627-631	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Hu, Yue, Wang, Xiaotong, Xiao, Shengjue et al. (2022) A Clinical Nomogram Based on the Triglyceride-Glucose Index to Predict Contrast-Induced Acute Kidney Injury after Percutaneous Intervention in Patients with Acute Coronary Syndrome with Diabetes Mellitus. Cardiovascular therapeutics 2022: 5443880	- Retrospective cohort study
Hu, Zicheng, Shang, Tingting, Huang, Rongzhong et al. (2019) Renal Safety of Intra-Arterial Treatment after Acute Ischemic Stroke with Multimodal CT Imaging selection. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 28(7): 2031-2037	- eGFR not included in multivariate model
Hua, R., Ding, N., Guo, H. et al. (2022) Contrast-Induced Acute Kidney Injury in Patients on SGLT2 Inhibitors Undergoing Percutaneous Coronary Interventions: A Propensity-Matched Analysis. Frontiers in Cardiovascular Medicine 9: 918167	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders, and no cut-off for eGFR reported*
Huang, C., Murugiah, K., Li, X. et al. (2023) Effect of the New Glomerular Filtration Rate Estimation Equation on Risk Predicting Models for Acute Kidney Injury after Percutaneous Coronary Intervention. Circulation: Cardiovascular Interventions 16(4): e012831	- eGFR not included in multivariate model *Study investigates eGFR prediction equations, not it's prognostic value*

Study	Code [Reason]
Huang, S.-S., Huang, P.-H., Leu, H.-B. et al. (2021) Significance of serum FGF-23 for risk assessment of contrast-associated acute kidney injury and clinical outcomes in patients undergoing coronary angiography. PLoS ONE 16(july): e0254835	- eGFR not included in multivariate model
Husain-Syed, F., Quattrone, M.G., Ferrari, F. et al. (2020) Clinical and Operative Determinants of Acute Kidney Injury after Cardiac Surgery. CardioRenal Medicine 10(5): 340-352	- Population not relevant to this review protocol *Majority of participants had not received iodine based contrast media*
Husain-Syed, Faeq, Ferrari, Fiorenza, Sharma, Aashish et al. (2018) Preoperative Renal Functional Reserve Predicts Risk of Acute Kidney Injury After Cardiac Operation. The Annals of thoracic surgery 105(4): 1094-1101	- Population not relevant to this review protocol *Unclear if participants received iodine based contrast media*
Iacovelli, F., Pignatelli, A., Cafaro, A. et al. (2021) Impact of contrast medium osmolality on the risk of acute kidney injury after transcatheter aortic valve implantation: insights from the Magna Graecia TAVI registry. International Journal of Cardiology 329: 56-62	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Ibrahim, N.E., McCarthy, C.P., Shrestha, S. et al. (2019) A clinical, proteomics, and artificial intelligence-driven model to predict acute kidney injury in patients undergoing coronary angiography. Clinical Cardiology 42(2): 292-298	- Study design not relevant to this review protocol *No validation cohort included in model analysis*
Ifedili, Ikechukwu A, Bolorunduro, Oluwaseyi, Bob-Manuel, Tamunoinemi et al. (2017) Impact of Pre-existing Kidney Dysfunction on Outcomes Following Transcatheter Aortic Valve Replacement. Current cardiology reviews 13(4): 283-292	- Study not investigating AKI
Ince, Orhan, Gulsen, Kamil, Ozcan, Sevgi et al. (2024) Positive blood pressure response may predict the recovery of renal function after transcatheter aortic valve implantation. Blood pressure monitoring 29(1): 1-8	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Infante, B., Conserva, F., Pontrelli, P. et al. (2023) Recent advances in molecular mechanisms of acute kidney injury in patients with diabetes mellitus. Frontiers in Endocrinology 13: 903970	- Review article but not a systematic review

Study	Code [Reason]
Inohara T, Kohsaka S, Abe T et al. (2015) Development and validation of a pre-percutaneous coronary intervention risk model of contrast-induced acute kidney injury with an integer scoring system. The American journal of cardiology 115(12): 1636-1642	- Retrospective cohort study
Isobe, Satoshi, Yuba, Miyuki, Mori, Hiroaki et al. (2017) Increased pre-procedural urinary microalbumin is associated with a risk for renal functional deterioration after coronary computed tomography angiography. International journal of cardiology 230: 599-603	- eGFR not included in multivariate model
Ivey-Miranda, J.B., Almeida-Gutierrez, E., Borrayo-Sanchez, G. et al. (2019) Right ventricular longitudinal strain predicts acute kidney injury and short-term prognosis in patients with right ventricular myocardial infarction. International Journal of Cardiovascular Imaging 35(1): 107-116	- eGFR not included in multivariate model
Jain, Tarun, Shah, Sunay, Shah, Jainil et al. (2018) Contrast-Induced Nephropathy in STEMI Patients With and Without Chronic Kidney Disease. Critical pathways in cardiology 17(1): 25-31	- Data not reported in an extractable format or a format that can be analysed *Prognostic accuracy of Mehran risk score not reported, and eGFR not included in multivariate model*
Jeon, J., Kim, S., Yoo, H. et al. (2019) Risk Prediction for Contrast-Induced Nephropathy in Cancer Patients Undergoing Computed Tomography under Preventive Measures. Journal of Oncology 2019: 8736163	- Retrospective cohort study
Jhaveri, K.D., Saratzis, A.N., Wanchoo, R. et al. (2017) Endovascular aneurysm repair (EVAR)- and transcatheter aortic valve replacement (TAVR)-associated acute kidney injury. Kidney International 91(6): 1312-1323	- Review article but not a systematic review
Ji, Yuchen, Zhou, Yiran, Shen, Ziyun et al. (2023) Risk factors for and prognostic values of postoperative acute kidney injury after pancreaticoduodenectomy for pancreatic ductal adenocarcinoma: A retrospective, propensity score-matched cohort study of 1312 patients. Cancer medicine 12(7): 7823-7834	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Jiang, F., Su, L., Xiang, H. et al. (2019) Incidence, risk factors, and biomarkers	- Population not relevant to this review protocol

Study	Code [Reason]
predicting ischemic or hemorrhagic stroke associated acute kidney injury and outcome: A retrospective study in a general intensive care unit. Blood Purification 47(4): 317-326	*Participants had not received iodine based contrast media*
Jiang, Jie, Ji, Hong-Yan, Xie, Wei-Ming et al. (2019) Could platelet-to-lymphocyte ratio be a predictor for contrast-induced nephropathy in patients with acute coronary syndrome?: A systematic review and meta-analysis. Medicine 98(32): e16801	- Systematic review used as source of primary studies *No relevant papers identified*
Jiang, M.-Y. (2020) Impact of acute kidney injury and baseline renal impairment on prognosis among patients undergoing percutaneous coronary intervention. Acta Cardiologica Sinica 36(3): 223-232	- Inappropriate analysis method *Multivariate analysis did not include all protocol-specified confounders*
Jiang, Wuhua, Yu, Jiawei, Xu, Jiarui et al. (2018) Impact of cardiac catheterization timing and contrast media dose on acute kidney injury after cardiac surgery. BMC cardiovascular disorders 18(1): 191	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Jin, L., Shan, L., Yu, K. et al. (2023) Postoperative acute kidney injury increases short- and long-term death risks in elderly patients (>= 75 years old) undergoing coronary artery bypass graft surgery. International Urology and Nephrology	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Jo, Jun-Young, Ryu, Seung Ah, Kim, Jong-Il et al. (2019) Comparison of five glomerular filtration rate estimating equations as predictors of acute kidney injury after cardiovascular surgery. Scientific reports 9(1): 11072	- Inappropriate analysis method *Multivariate analysis did not adjust for all protocol-specified confounders*
Jochheim, D, Schneider, V-S, Schwarz, F et al. (2014) Contrast-induced acute kidney injury after computed tomography prior to transcatheter aortic valve implantation. Clinical radiology 69(10): 1034-8	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Jung, Su-Young, Park, Jung Tak, Kwon, Young Eun et al. (2016) Preoperative Low Serum Bicarbonate Levels Predict Acute Kidney Injury After Cardiac Surgery. Medicine 95(13): e3216	- Population not relevant to this review protocol *Not all participants received iodine based contrast media*
Kajimoto, Katsuya, Sato, Naoki, Takano, Teruo et al. (2016) Association of anemia and renal dysfunction with in-hospital mortality among	- Population not relevant to this review protocol

Study	Code [Reason]
patients hospitalized for acute heart failure syndromes with preserved or reduced ejection fraction. European heart journal. Acute cardiovascular care 5(7): 89-99	*Participants had not received iodine based contrast media*
Kanchi, Muralidhar, Sudheshna, Karanam D, Damodaran, Srinath et al. (2023) Single value of NephroCheck TM performed at 4 hours after surgery does not predict acute kidney injury in off-pump coronary artery bypass surgery. Annals of cardiac anaesthesia 26(1): 57-62	- Population not relevant to this review protocol *Unclear if participants received iodine based contrast media*
Kandathil, A, Mills, R A, Hanna, M et al. (2020) Abdominal adiposity assessed using CT angiography associates with acute kidney injury after trans-catheter aortic valve replacement. Clinical radiology 75(12): 921-926	- eGFR not included in multivariate model
Karaaslan, H., Uyar, N., Gocer, E.G. et al. (2023) An Analysis of the Prevalence and Risk Factors of Contrast-Associated Acute Kidney Injury in Patients With Diabetic Foot Ulcer. Angiology 74(7): 624-630	- Population not relevant to this review protocol *Half of the participants had not received iodine based contrast media, and results stratified by exposure were not usable*
Kashani, Kianoush, Steuernagle, Jon H 4th, Akhoundi, Abbasali et al. (2015) Vascular Surgery Kidney Injury Predictive Score: A Historical Cohort Study. Journal of cardiothoracic and vascular anesthesia 29(6): 1588-95	- Population not relevant to this review protocol *Majority of participants had not received iodine based contrast media*
Katoh, Hiromasa, Nozue, Tsuyoshi, Kimura, Yuya et al. (2014) Elevation of urinary liver-type fatty acid-binding protein as predicting factor for occurrence of contrast-induced acute kidney injury and its reduction by hemodiafiltration with blood suction from right atrium. Heart and vessels 29(2): 191-7	- eGFR not included in multivariate model
Katsogridakis, E, Lea, T, Yap, T et al. (2021) Acute kidney injury following endovascular intervention for peripheral artery disease. The British journal of surgery 108(2): 152-159	- eGFR not included in multivariate model
Kene, Mamata, Arasu, Vignesh A, Mahapatra, Ajit K et al. (2021) Acute Kidney Injury After CT in Emergency Patients with Chronic Kidney Disease: A Propensity Score-matched Analysis. The western journal of emergency medicine 22(3): 614-622	- Inappropriate analysis method *eGFR reported in univariate analysis*

Study	Code [Reason]
Khademi, S., Mehr, L.S., Janati, M. et al. (2023) Association of urine output during cardiopulmonary bypass and postoperative acute kidney injury in patients undergoing coronary artery bypass graft. Perfusion (United Kingdom) 38(3): 567-573	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Khandy, Aashaq Hussain, Shiekh, Rayees, Nabi, Tauseef et al. (2023) Incidence, Determinants, and Outcome of Contrast-induced Acute Kidney Injury following Percutaneous Coronary Intervention at a Tertiary Care Hospital. Saudi journal of kidney diseases and transplantation : an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia 34(3): 214-223	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Kim, Myoung Hwa, Koh, Shin Ok, Kim, Eun Jung et al. (2015) Incidence and outcome of contrast-associated acute kidney injury assessed with Risk, Injury, Failure, Loss, and End-stage kidney disease (RIFLE) criteria in critically ill patients of medical and surgical intensive care units: a retrospective study. BMC anesthesiology 15: 23	- Retrospective cohort study
Kim, Won Ho, Lee, Sangmin M, Choi, Ji Won et al. (2013) Simplified clinical risk score to predict acute kidney injury after aortic surgery. Journal of cardiothoracic and vascular anesthesia 27(6): 1158-66	- Retrospective cohort study *Retrospective, so not relevant study design for risk tools, and multivariate analysis of eGFR did not include all protocol specified confounders*
Kim, Won Ho, Park, Mi Hye, Kim, Hyo-Jin et al. (2015) Potentially modifiable risk factors for acute kidney injury after surgery on the thoracic aorta: a propensity score matched case-control study. Medicine 94(2): e273	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Kiser, Kelsie A, Tanaka, Akiko, Sandhu, Harleen K et al. (2022) Extensive cell salvage and postoperative outcomes following thoracoabdominal and descending aortic repair. The Journal of thoracic and cardiovascular surgery 163(3): 914-921e1	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Kliuk-Ben Bassat, O., Sadon, S., Sirota, S. et al. (2021) Assessment of Kidney Function After Transcatheter Aortic Valve Replacement. Canadian Journal of Kidney Health and Disease 8	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*

Study	Code [Reason]
Koifman, Edward, Segev, Amit, Fefer, Paul et al. (2016) Comparison of acute kidney injury classifications in patients undergoing transcatheter aortic valve implantation: Predictors and long-term outcomes. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions 87(3): 523-31	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Koo, Hyang Mo, Doh, Fa Mee, Ko, Kwang Il et al. (2013) Diastolic dysfunction is associated with an increased risk of contrast-induced nephropathy: a retrospective cohort study. BMC nephrology 14: 146	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Kooiman, J. and Gurm, H.S. (2014) Predicting Contrast-induced Renal Complications in the Catheterization Laboratory. Interventional Cardiology Clinics 3(3): 369-377	- Review article but not a systematic review
Kopolovic, Ilana, Simmonds, Kim, Duggan, Shelley et al. (2013) Risk factors and outcomes associated with acute kidney injury following ruptured abdominal aortic aneurysm. BMC nephrology 14: 99	- Population not relevant to this review protocol *Majority of participants did not receive iodine based contrast media*
Kowalczyk, J., Lenarczyk, R., Kowalski, O. et al. (2014) Contrast-induced acute kidney injury in patients undergoing cardiac resynchronization therapy-incidence and prognostic importance. Sub-analysis of data from randomized TRUST CRT trial. European Heart Journal 35(suppl1): 163	- eGFR not included in multivariate model
Koyner, Jay L, Coca, Steven G, Thiessen-Philbrook, Heather et al. (2015) Urine Biomarkers and Perioperative Acute Kidney Injury: The Impact of Preoperative Estimated GFR. American journal of kidney diseases : the official journal of the National Kidney Foundation 66(6): 1006-14	- Predictive model included variables not measured pre-contrast administration *Predictors measured after surgery*
Kucukosmanoglu, M., Icen, Y.K., Sumbul, H.E. et al. (2020) Residual SYNTAX Score Is Associated With Contrast-Induced Nephropathy in Patients With Non-ST Segment Elevation Myocardial Infarction With Preserved LVEF. Angiology 71(9): 799-803	- Retrospective cohort study
Kume, Kiyoshi, Yasuoka, Yoshinori, Adachi, Hidenori et al. (2013) Impact of contrast-induced	- eGFR not included in multivariate model

Study	Code [Reason]
acute kidney injury on outcomes in patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. Cardiovascular revascularization medicine : including molecular interventions 14(5): 253-7	
Kuno, Toshiki, Mikami, Takahisa, Sahashi, Yuki et al. (2022) Machine learning prediction model of acute kidney injury after percutaneous coronary intervention. Scientific reports 12(1): 749	- Retrospective cohort study
Kurtul, Alparslan, Murat, Sani Namik, Yarlioglues, Mikail et al. (2015) Procalcitonin as an Early Predictor of Contrast-Induced Acute Kidney Injury in Patients With Acute Coronary Syndromes Who Underwent Percutaneous Coronary Intervention. Angiology 66(10): 957-63	- Data not reported in an extractable format or a format that can be analysed *No eGFR or SYNTAX risk score cut-off reported*
Kuwatsuru, Yoshiki, Hirano, Takahiro, Wakabayashi, Ryozo et al. (2023) Changes in renal function over time in outpatients with eGFR >= 30 mL/min/1.73 m2: implication for timing of renal function testing before contrast-enhanced CT imaging. Japanese journal of radiology 41(9): 994-1006	- Study not investigating AKI *Study investigates long-term loss of renal function*
Kwon, J.-T.; Jung, T.-E.; Lee, D.-H. (2019) Predictive risk factors of acute kidney injury after on-pump coronary artery bypass grafting. Annals of Translational Medicine 7(3): 44	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Landi, A., Chiarito, M., Branca, M. et al. (2023) Validation of a Contemporary Acute Kidney Injury Risk Score in Patients With Acute Coronary Syndrome. JACC: Cardiovascular Interventions 16(15): 1873-1886	- Retrospective cohort study
Lang, J., Patyna, S., Buttner, S. et al. (2020) Incidence, risk factors and prognostic impact of acute kidney injury after coronary angiography and intervention in kidney transplant recipients: A single-center retrospective analysis. Postepy w Kardiologii Interwencyjnej 16(1): 58-64	- eGFR not included in multivariate model
Langfritz, Melina, Shahin, Mohammady, Nietlispach, Fabian et al. (2019) Baseline Predictors of Renal Failure in Transcatheter	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*

Study	Code [Reason]
Aortic Valve Implantation. The Journal of invasive cardiology 31(10): e289-e297	
Leballo, Gontse, Moutlana, Hlamatsi Jacob, Muteba, Michel Kasongo et al. (2021) Factors associated with acute kidney injury and mortality during cardiac surgery. Cardiovascular journal of Africa 32(6): 308-313	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Ledwoch, J., Bertog, S., Wunderlich, N. et al. (2014) Predictors for prolonged hospital stay after transcatheter mitral valve repair with the MitraClip. Catheterization and Cardiovascular Interventions 84(4): 599-605	- eGFR not included in multivariate model
Lee, Cheng-Chia, Chan, Yi-Ling, Wong, Yon-Cheong et al. (2023) Contrast-enhanced CT and Acute Kidney Injury: Risk Stratification by Diabetic Status and Kidney Function. Radiology 307(5): e222321	- Population not relevant to this review protocol *Propensity matched analysis and no risk outcomes for exposed participants only*
Lee, Ji Hwan, Chung, Byunghoon, Lee, Sung Chul et al. (2017) Lower incidence of contrast-induced nephropathy in patients undergoing fluorescent angiography. BMC ophthalmology 17(1): 46	- Data not reported in an extractable format or a format that can be analysed *No multivariate model reported*
Lee, S.-R.; Dardik, A.; Ochoa Chaar, C.I. (2020) Postcontrast Acute Kidney Injury after Peripheral Vascular Interventions in Kidney Transplant Recipients. Annals of Vascular Surgery 68: 8-14	- Inappropriate analysis method *Unclear what confounders were included in multivariate model*
Lee, Shin-Rong, Zhuo, Haoran, Zhang, Yawei et al. (2020) Risk factors and safe contrast volume thresholds for postcontrast acute kidney injury after peripheral vascular interventions. Journal of vascular surgery 72(2): 603-610e1	- Inappropriate analysis method *Unclear if all protocol-specified confounders were included in the multivariate model*
Lee, WC, Wu, PJ, Fang, CY et al. (2021) Impact of Chronic Kidney Disease on Chronic Total Occlusion Revascularization Outcomes: A Meta-Analysis. Journal of clinical medicine 10(3): 1-9	- Study design not relevant to this review protocol *Meta analysis of studies comparing contrast-enhanced to non-enhanced surgical methods*
Lee, Yen-Chien, Hsieh, Chung-Cheng, Chang, Ting-Tsung et al. (2019) Contrast-Induced Acute Kidney Injury Among Patients With Chronic Kidney Disease Undergoing Imaging Studies: A Meta-Analysis. AJR. American journal of roentgenology 213(4): 728-735	- Inappropriate analysis method

Study	Code [Reason]
Legrand, Matthieu, Pirracchio, Romain, Rosa, Anne et al. (2013) Incidence, risk factors and prediction of post-operative acute kidney injury following cardiac surgery for active infective endocarditis: an observational study. Critical care (London, England) 17(5): r220	- Population not relevant to this review protocol *Majority of participants did not receive iodine based contrast media*
Li, J., Gong, M., Joshi, Y. et al. (2022) Machine Learning Prediction Model for Acute Renal Failure After Acute Aortic Syndrome Surgery. Frontiers in Medicine 8: 728521	- Population not relevant to this review protocol *Unclear if participants received iodinated contrast media*
Li, Jing, Li, Yi, Wang, Xiaozeng et al. (2014) Age, estimated glomerular filtration rate and ejection fraction score predicts contrast-induced acute kidney injury in patients with diabetes and chronic kidney disease: insight from the TRACK-D study. Chinese medical journal 127(12): 2332-6	- Retrospective cohort study
Li, Q., Lin, M., Huang, H. et al. (2022) Prevalence and mortality of transient acute kidney injury within 48 h, as new subtype, following coronary angiography: a cohort study. Clinical and Experimental Nephrology 26(4): 333-340	- eGFR not included in multivariate model
Li, Shengnan, Liu, Ming, Liu, Xiang et al. (2022) Associated factors and short-term mortality of early versus late acute kidney injury following on-pump cardiac surgery. Interactive cardiovascular and thoracic surgery 35(3)	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Li, Shengnan, Wang, Shu, Priyanka, Priyanka et al. (2019) Acute Kidney Injury in Critically Ill Patients After Noncardiac Major Surgery: Early Versus Late Onset. Critical care medicine 47(6): e437-e444	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Li, Siqian, Ren, Weifu, Ye, Xiaofei et al. (2023) An online-predictive model of acute kidney injury after pancreatic surgery. American journal of surgery	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Li, Tingyu, Yang, Yuelong, Huang, Jinsong et al. (2022) Machine learning to predict post-operative acute kidney injury stage 3 after heart transplantation. BMC cardiovascular disorders 22(1): 288	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
Li, Wen-hua, Li, Dong-ye, Han, Fei et al. (2013) Impact of anemia on contrast-induced nephropathy (CIN) in patients undergoing percutaneous coronary interventions. International urology and nephrology 45(4): 1065-70	- Inappropriate analysis method *Multivariate analysis did not include all protocol-specified confounders*
Li, Y., Hou, X.-J., Liu, T.-S. et al. (2021) Risk factors for acute kidney injury following coronary artery bypass graft surgery in a Chinese population and development of a prediction model. Journal of Geriatric Cardiology 18(9): 711-719	- Retrospective cohort study
Li, Yang, Chen, Xiaohong, Wang, Yimei et al. (2020) Application of group LASSO regression based Bayesian networks in risk factors exploration and disease prediction for acute kidney injury in hospitalized patients with hematologic malignancies. BMC nephrology 21(1): 162	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Li, You-Qi, Shi, Yongjun, Deng, Wen-Feng et al. (2022) A novel risk factor of contrast associated acute kidney injury in patients after enhanced computed tomography: a retrospective study. PeerJ 10: e14224	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders, and did not specify a cut-off for eGFR*
Li, Yuhan, Ma, Kai, Shen, Guoqi et al. (2021) Impact of small and dense low-density lipoprotein (sd-LDL)on contrast-induced acute kidney injury in patients with acute ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. International urology and nephrology 53(12): 2611-2617	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders, and no eGFR threshold specified*
Liebetrau, Christoph, Gaede, Luise, Doerr, Oliver et al. (2014) Neutrophil gelatinase-associated lipocalin (NGAL) for the early detection of contrast-induced nephropathy after percutaneous coronary intervention. Scandinavian journal of clinical and laboratory investigation 74(2): 81-8	- eGFR not included in multivariate model
Liu, Kathleen D, Yang, Jingrong, Tan, Thida C et al. (2019) Risk Factors for Recurrent Acute Kidney Injury in a Large Population-Based Cohort. American journal of kidney diseases : the official journal of the National Kidney Foundation 73(2): 163-173	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
Liu, Tao, Jian, Xinwen, Li, Li et al. (2023) The Association between Dapagliflozin Use and the Risk of Post-Contrast Acute Kidney Injury in Patients with Type 2 Diabetes and Chronic Kidney Disease: A Propensity-Matched Analysis. Kidney & blood pressure research 48(1): 752-760	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Liu, W.T., Liu, X.Q., Jiang, T.T. et al. (2022) Using a machine learning model to predict the development of acute kidney injury in patients with heart failure. Frontiers in Cardiovascular Medicine 9: 911987	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Liu, Xing, Ye, Yongkai, Mi, Qi et al. (2016) A Predictive Model for Assessing Surgery-Related Acute Kidney Injury Risk in Hypertensive Patients: A Retrospective Cohort Study. PloS one 11(11): e0165280	- Retrospective cohort study
Liu, Yong, He, Yi-ting, Tan, Ning et al. (2015) Preprocedural N-terminal pro-brain natriuretic peptide (NT-proBNP) is similar to the Mehran contrast-induced nephropathy (CIN) score in predicting CIN following elective coronary angiography. Journal of the American Heart Association 4(4)	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Liu, Yong, Liu, Yuan-hui, Chen, Ji-yan et al. (2015) A simple pre-procedural risk score for contrast-induced nephropathy among patients with chronic total occlusion undergoing percutaneous coronary intervention. International Journal of Cardiology 180: 69-71	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Liu, Zhenjie, Shang, Aijun, Chen, Zexin et al. (2020) Neutrophil gelatinase-associated lipocalin as an early predictor of contrast-induced nephropathy following endovascular therapy for arteriosclerosis obliterans. Medicine 99(37): e21386	- eGFR not included in multivariate model *eGFR not reported*
Lo, Kevin Bryan, Penalver, Jorge, Mostafavi Toroghi, Hesam et al. (2019) Invasive Hemodynamic Predictors of Renal Outcomes after Percutaneous Coronary Interventions. Cardiorenal medicine 9(6): 382-390	- Inappropriate analysis method *Multivariate analysis did not adjust for all protocol specified confounders*
Locham, S., Rodriguez, A., Balceniuk, M.D. et al. (2023) Contrast-Associated Acute Kidney Injury in High-Risk Patients Undergoing	- eGFR not included in multivariate model

Study	Code [Reason]
Peripheral Vascular Interventions. Vascular and Endovascular Surgery 57(6): 583-591	
Loizzi, F., Burattini, O., Cafaro, A. et al. (2023) Early acute kidney injury after transcatheter aortic valve implantation: predictive value of currently available risk scores. Hellenic Journal of Cardiology 70: 19-27	- Retrospective cohort study
Luders, Florian, Meyborg, Matthias, Malyar, Nasser et al. (2015) The Preinterventional Cystatin-Creatinine-Ratio: A Prognostic Marker for Contrast Medium-Induced Acute Kidney Injury and Long-Term All-Cause Mortality. Nephron 131(1): 59-65	- eGFR not included in multivariate model
Lunyera, Joseph, Clare, Robert M, Chiswell, Karen et al. (2023) Association of Acute Kidney Injury and Cardiovascular Disease Following Percutaneous Coronary Intervention: Assessment of Interactions by Race, Diabetes, and Kidney Function. American journal of kidney diseases : the official journal of the National Kidney Foundation 81(6): 707-716	- Study not investigating AKI *Study reports risk of adverse events after an AKI, but doesn't report risk of an AKI with a given eGFR threshold*
Ma, B., Allen, D.W., Graham, M.M. et al. (2019) Comparative performance of prediction models for contrast-associated acute kidney injury after percutaneous coronary intervention. Circulation: Cardiovascular Quality and Outcomes 12(11): e005854	- Retrospective cohort study
Ma, K., Li, J., Shen, G. et al. (2022) Development and Validation of a Risk Nomogram Model for Predicting Contrast-Induced Acute Kidney Injury in Patients with Non-ST-Elevation Acute Coronary Syndrome Undergoing Primary Percutaneous Coronary Intervention. Clinical Interventions in Aging 17: 65-77	- Retrospective cohort study
Madhavan, Mahesh V, Genereux, Philippe, Rubin, Jonah et al. (2014) Usefulness of the SYNTAX score to predict acute kidney injury after percutaneous coronary intervention (from the Acute Catheterization and Urgent Intervention Triage Strategy Trial). The American journal of cardiology 113(8): 1331-7	- Retrospective cohort study
Mahmud, Nadim, Asrani, Sumeet K, Reese, Peter P et al. (2022) Race Adjustment in eGFR	- Population not relevant to this review protocol

Study	Code [Reason]
Equations Does Not Improve Estimation of Acute Kidney Injury Events in Patients with Cirrhosis. Digestive diseases and sciences 67(4): 1399-1408	*Participants had not received iodine based contrast media*
Maioli, Mauro, Toso, Anna, Gallopin, Michela et al. (2010) Preprocedural score for risk of contrast-induced nephropathy in elective coronary angiography and intervention. Journal of Cardiovascular Medicine 11(6)	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Maioli, Mauro, Toso, Anna, Leoncini, Mario et al. (2008) Sodium Bicarbonate Versus Saline for the Prevention of Contrast-Induced Nephropathy in Patients With Renal Dysfunction Undergoing Coronary Angiography or Intervention. Journal of the American College of Cardiology 52(8): 599-604	- Study design not relevant to this review protocol *RCT comparing prophylaxis methods and no risk prediction tools or adjusted eGFR values reported*
Majka, J., Varvarovsky, I., Rozsival, V. et al. (2016) Heart failure is the strongest predictor of acute kidney injury in patients undergoing primary percutaneous coronary intervention for ST-elevation myocardial infarction. Kardiologia Polska 74(1): 18-24	- eGFR not included in multivariate model
Malik, Ali O, Amin, Amit, Kennedy, Kevin et al. (2021) Patient-centered contrast thresholds to reduce acute kidney injury in high-risk patients undergoing percutaneous coronary intervention. American heart journal 234: 51-59	- Retrospective cohort study
Malyszko, Jolanta, Bachorzewska-Gajewska, Hanna, Malyszko, Jacek S et al. (2019) Hepcidin - Potential biomarker of contrast-induced acute kidney injury in patients undergoing percutaneous coronary interventions. Advances in medical sciences 64(2): 211-215	- eGFR not included in multivariate model
Mandurino-Mirizzi, A., Kajana, V., Cornara, S. et al. (2021) Elevated serum uric acid is a predictor of contrast associated acute kidney injury in patient with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. Nutrition, Metabolism and Cardiovascular Diseases 31(7): 2140-2143	- eGFR not included in multivariate model

Study	Code [Reason]
Mandurino-Mirizzi, A.; Munafo, A.; Crimi, G. (2022) Contrast-Associated Acute Kidney Injury. Journal of Clinical Medicine 11(8): 2167	- Review article but not a systematic review
Mankerious, Nader, Hemetsberger, Rayyan, Samy, Mohamed et al. (2023) The Target Vessel SYNTAX Score: A Novel Pre-Procedural Predictor for Contrast-Induced Acute Kidney Injury After Rotational Atherectomy. Cardiovascular revascularization medicine : including molecular interventions 47: 18-24	- Retrospective cohort study
Marbach, Jeffrey A, Feder, Joshua, Yousef, Altayyeb et al. (2017) Predicting Acute Kidney Injury following Transcatheter Aortic Valve Replacement. Clinical and investigative medicine. Medecine clinique et experimentale 40(6): e243-e251	- eGFR not included in multivariate model
Marenzi, Giancarlo, Lauri, Gianfranco, Assanelli, Emilio et al. (2004) Contrast-induced nephropathy in patients undergoing primary angioplasty for acute myocardial infarction. Journal of the American College of Cardiology 44(9): 1780-1785	- Inappropriate analysis method *Study developed a risk prediction tool, but did not validate it*
Margolis, G., Gal-Oz, A., Letourneau-Shesaf, S. et al. (2018) Acute kidney injury based on the KDIGO criteria among ST elevation myocardial infarction patients treated by primary percutaneous intervention. Journal of Nephrology 31(3): 423-428	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Marschall, A., Del Castillo Carnevalli, H., De la Flor Merino, J.C. et al. (2020) Clinical risk factors for the prediction of acute kidney injury post cardiac resynchronization therapy in an elderly population. IJC Heart and Vasculature 30: 100594	- eGFR not included in multivariate model
Mathis, Michael R, Naik, Bhiken I, Freundlich, Robert E et al. (2020) Preoperative Risk and the Association between Hypotension and Postoperative Acute Kidney Injury. Anesthesiology 132(3): 461-475	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
McCullough, Peter A, MD, MPH, Wolyn, Robert, MD et al. (1997) Acute Renal Failure After Coronary Intervention: Incidence, Risk Factors, and Relationship to Mortality. The American Journal of Medicine 103(5): 368-375	- Data not reported in an extractable format or a format that can be analysed *No prognostic accuracy data reported (reported as OR for an AKI)*

Study	Code [Reason]
McCullough, Peter, Ng, Chaan S, Ryan, Michael et al. (2021) Major Adverse Renal and Cardiovascular Events following Intra-Arterial Contrast Media Administration in Hospitalized Patients with Comorbid Conditions. Cardiorenal medicine 11(4): 193-199	- Inappropriate analysis method *No multivariate analysis or risk prediction model reported*
McDonald, J.S., Katzberg, R.W., McDonald, R.J. et al. (2016) Is the presence of a solitary kidney an independent risk factor for acute kidney injury after contrast-enhanced CT?. Radiology 278(1): 74-81	- eGFR not included in multivariate model
McDonald, J.S. and McDonald, R.J. (2023) Risk of Acute Kidney Injury Following IV Iodinated Contrast Media Exposure: 2023 Update, From the AJR Special Series on Contrast Media. AJR. American journal of roentgenology	- Full text paper not available
McDonald, Jennifer S, Leake, Caleb B, McDonald, Robert J et al. (2016) Acute Kidney Injury After Intravenous Versus Intra-Arterial Contrast Material Administration in a Paired Cohort. Investigative radiology 51(12): 804-809	- eGFR not included in multivariate model
McDonald, Jennifer S, McDonald, Robert J, Carter, Rickey E et al. (2014) Risk of intravenous contrast material-mediated acute kidney injury: a propensity score-matched study stratified by baseline-estimated glomerular filtration rate. Radiology 271(1): 65-73	- Population not relevant to this review protocol *Propensity score matched study comparing contrast to non-contrast exposed patients. No risk prediction data reported for those exposed.*
McDonald, Jennifer S, McDonald, Robert J, Comin, Jules et al. (2013) Frequency of acute kidney injury following intravenous contrast medium administration: a systematic review and meta-analysis. Radiology 267(1): 119-28	- Population not relevant to this review protocol *SR of controlled trials comparing risk of AKI in contrast to non-contrast exposed patients*
McDonald, Jennifer S, McDonald, Robert J, Lieske, John C et al. (2015) Risk of Acute Kidney Injury, Dialysis, and Mortality in Patients With Chronic Kidney Disease After Intravenous Contrast Material Exposure. Mayo Clinic proceedings 90(8): 1046-53	- Inappropriate analysis method *No multivariate model reported*
McDonald, Jennifer S, McDonald, Robert J, Williamson, Eric E et al. (2017) Is Intravenous Administration of Iodixanol Associated with Increased Risk of Acute Kidney Injury, Dialysis, or Mortality? A Propensity Score-adjusted Study. Radiology 285(2): 414-424	- Population not relevant to this review protocol *Propensity score matched study comparing contrast to non-contrast exposed patients. No risk prediction data reported for those exposed.*

Study	Code [Reason]
McDonald, Jennifer S, McDonald, Robert J, Williamson, Eric E et al. (2017) Post-contrast acute kidney injury in intensive care unit patients: a propensity score-adjusted study. Intensive care medicine 43(6): 774-784	- Population not relevant to this review protocol *Propensity score matched study comparing contrast to non-contrast exposed patients. No risk prediction data reported for those exposed.*
McDonald, Robert J, McDonald, Jennifer S, Bida, John P et al. (2013) Intravenous contrast material-induced nephropathy: causal or coincident phenomenon?. Radiology 267(1): 106-18	- Conference abstract
McInerney, A., Tirado-Conte, G., Rodes-Cabau, J. et al. (2021) Impact of morbid obesity and obesity phenotype on outcomes after transcatheter aortic valve replacement. Journal of the American Heart Association 10(12): e019051	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Meersch, M.; Schmidt, C.; Zarbock, A. (2017) Perioperative Acute Kidney Injury: An Under-Recognized Problem. Anesthesia and Analgesia 125(4): 1223-1232	- Review article but not a systematic review
Mehran, R.; Dangas, G.D.; Weisbord, S.D. (2019) Contrast-associated acute kidney injury. New England Journal of Medicine 380(22): 2146-2155	- Review article but not a systematic review
Mehran, Roxana, Aymong, Eve D., Nikolsky, Eugenia et al. (2004) A simple risk score for prediction of contrast-induced nephropathy after percutaneous coronary intervention: Development and initial validation. Journal of the American College of Cardiology 44(7): 1393-1399	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Mehran, Roxana, Owen, Ruth, Chiarito, Mauro et al. (2021) A contemporary simple risk score for prediction of contrast-associated acute kidney injury after percutaneous coronary intervention: derivation and validation from an observational registry. Lancet (London, England) 398(10315): 1974-1983	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Meng, Z., Zhao, Y., Zheng, X. et al. (2021) The Relationship Between AKI in Patients With STEMI and Short-Term Mortality: A Propensity Score Matching Analysis. Angiology 72(8): 733-739	- Population not relevant to this review protocol *Not all participants had received iodine based contrast media*

Study	Code [Reason]
Mezhonov, Evgeny Mikhailovich, Vialkina, Iuliia Aleksandrovna, Vakulchik, Kristina Aleksandrovna et al. (2021) Acute kidney injury in patients with ST-segment elevation acute myocardial infarction: Predictors and outcomes. Saudi journal of kidney diseases and transplantation : an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia 32(2): 318-327	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Minakata, Kenji, Bando, Ko, Tanaka, Shiro et al. (2014) Preoperative chronic kidney disease as a strong predictor of postoperative infection and mortality after coronary artery bypass grafting. Circulation journal : official journal of the Japanese Circulation Society 78(9): 2225-31	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Mithiran, Harish, Kunnath Bonney, Glenn, Bose, Saideep et al. (2016) A Score for Predicting Acute Kidney Injury After Coronary Artery Bypass Graft Surgery in an Asian Population. Journal of cardiothoracic and vascular anesthesia 30(5): 1296-301	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Mo, Changhua, Ma, Xiao, Jian, Wen et al. (2022) High mobility group box 1 and homocysteine as preprocedural predictors for contrast-induced acute kidney injury after percutaneous coronary artery intervention. International urology and nephrology 54(7): 1663-1671	- eGFR not included in multivariate model
Mokhtar, Ahmed T, Tennankore, Karthik, Doucette, Steve et al. (2021) Predicting acute kidney injury following nonemergent cardiac surgery: A preoperative scorecard. Journal of cardiac surgery 36(7): 2204-2212	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Mooney, John F, Ranasinghe, Isuru, Chow, Clara K et al. (2013) Preoperative estimates of glomerular filtration rate as predictors of outcome after surgery: a systematic review and meta-analysis. Anesthesiology 118(4): 809-24	- Population not relevant to this review protocol *Meta analysis of events following surgery, not specifically following surgery with iodine based contrast media administration*
Moos, S.I., Stoker, J., Nagan, G. et al. (2014) Prediction of presence of kidney disease in a general patient population undergoing intravenous iodinated contrast enhanced computed tomography. European Radiology 24(6): 1266-1275	- Inappropriate analysis method *Prediction models were not validated and eGFR was not reported in a multivariate analysis*

Study	Code [Reason]
Moriyama, Noriaki, Laakso, Teemu, Raivio, Peter et al. (2021) Acute Kidney Injury Following Aortic Valve Replacement in Patients Without Chronic Kidney Disease. The Canadian journal of cardiology 37(1): 37-46	- Population not relevant to this review protocol *Not all participants received iodine based contrast media*
Mosa, O.F. (2018) Prognostic Significance of Serum NGAL and Troponin i against Acute Kidney Injury in Egyptian ICU Patients after Open Heart Surgery: A Pilot Study. Kidney Diseases 4(4): 246-254	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Mrzljak, A., Franusic, L., Pavicic-Saric, J. et al. (2020) Pre-and intraoperative predictors of acute kidney injury after liver transplantation. World Journal of Clinical Cases 8(18): 4034-4042	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Mujtaba, A., Taher, M.A., Alrubay, H.K. et al. (2020) The incidence of contrast induced nephropathy-acute kidney injury after cardiac catheterization in basra cardiac catheterization center. A prospective cohort study. Indian Journal of Forensic Medicine and Toxicology 14(1): 557-563	- Data not reported in an extractable format or a format that can be analysed *Risk of AKI per Mehran risk score category reported as RR*
Murakami, Ryusuke, Kumita, Shin-ichiro, Hayashi, Hiromitsu et al. (2013) Anemia and the risk of contrast-induced nephropathy in patients with renal insufficiency undergoing contrast-enhanced MDCT. European journal of radiology 82(10): e521-4	- eGFR not included in multivariate model
Murat, Sani Namik; Kurtul, Alparslan; Yarlioglues, Mikail (2015) Impact of Serum Albumin Levels on Contrast-Induced Acute Kidney Injury in Patients With Acute Coronary Syndromes Treated With Percutaneous Coronary Intervention. Angiology 66(8): 732-7	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Muslem, Rahatullah, Caliskan, Kadir, Akin, Sakir et al. (2018) Acute kidney injury and 1-year mortality after left ventricular assist device implantation. The Journal of heart and lung transplantation : the official publication of the International Society for Heart Transplantation 37(1): 116-123	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Nadziakiewicz, Pawel, Grochla, Marek, Krauchuk, Alena et al. (2020) Prognostic Value of Creatinine Concentration and Glomerular	- Population not relevant to this review protocol

Study	Code [Reason]
Filtration Rate in Acute Kidney Injury Development in the Early Postoperative Period After Heart Transplantation. Transplantation proceedings 52(7): 2091-2093	*Participants had not received iodine based contrast media*
Nagore, D., Candela, A., Burge, M. et al. (2021) Hydroxyethyl starch and acute kidney injury in high-risk patients undergoing cardiac surgery: A prospective multicenter study. Journal of Clinical Anesthesia 73: 110367	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Nah, Chung Wei, Ti, Lian Kah, Liu, Weiling et al. (2016) A clinical score to predict acute kidney injury after cardiac surgery in a Southeast-Asian population. Interactive cardiovascular and thoracic surgery 23(5): 757-761	- Predictive model included variables not measured pre-contrast administration
Najjar, M.; Salna, M.; George, I. (2015) Acute kidney injury after aortic valve replacement: Incidence, risk factors and outcomes. Expert Review of Cardiovascular Therapy 13(3): 301-316	- Conference abstract
Najjar, M., Yerebakan, H., Sorabella, R.A. et al. (2015) Acute kidney injury following surgical aortic valve replacement. Journal of Cardiac Surgery 30(8): 631-639	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Nemoto, Teruyoshi, Minami, Yoshiyasu, Sato, Toshimitsu et al. (2019) Contrast Volume and Decline in Kidney Function in Optical Coherence Tomography-Guided Percutaneous Coronary Intervention. International heart journal 60(5): 1022-1029	- Data not reported in an extractable format or a format that can be analysed *Multivariate analysis results for AKI not reported*
Neyra, Javier A, Shah, Sunay, Mooney, Roberta et al. (2013) Contrast-induced acute kidney injury following coronary angiography: a cohort study of hospitalized patients with or without chronic kidney disease. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association 28(6): 1463-71	- Inappropriate analysis method *Multivariate analysis did not adjust for all protocol-specified confounders*
Ng, Chaan S, Kalva, Sanjeeva P, Gunnarsson, Candace et al. (2018) Risk of renal events following intravenous iodinated contrast material administration among inpatients admitted with cancer a retrospective hospital claims analysis. Cancer imaging : the official publication of the International Cancer Imaging Society 18(1): 30	- Inappropriate analysis method *Multivariate model did not include all protocol-specified covariates*

Study	Code [Reason]
Nombela-Franco, Luis, Rodes-Cabau, Josep, Cruz-Gonzalez, Ignacio et al. (2018) Incidence, Predictors, and Prognostic Value of Acute Kidney Injury Among Patients Undergoing Left Atrial Appendage Closure. JACC. Cardiovascular interventions 11(11): 1074-1083	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Nough, H., Eghbal, F., Soltani, M. et al. (2013) Incidence and main determinants of contrast-induced nephropathy following coronary angiography or subsequent balloon angioplasty. CardioRenal Medicine 3(2): 128-135	- Inappropriate analysis method *Multivariate analysis did not include all protocol-specified confounders*
Nusca, A., Mangiacapra, F., Sticchi, A. et al. (2021) Usefulness of Adding Pre-procedural Glycemia to the Mehran Score to Enhance Its Ability to Predict Contrast-induced Kidney Injury in Patients Undergoing Percutaneous Coronary Intervention Development and Validation of a Predictive Model. American Journal of Cardiology 155: 16-22	- Retrospective cohort study
Nyman, Ulf, Leander, Peter, Liss, Per et al. (2024) Absolute and relative GFR and contrast medium dose/GFR ratio: cornerstones when predicting the risk of acute kidney injury. European radiology 34(1): 612-621	- Review article but not a systematic review
Obed, Mikal, Gabriel, Maria Magdalena, Dumann, Eva et al. (2022) Risk of acute kidney injury after contrast-enhanced computerized tomography: a systematic review and meta-analysis of 21 propensity score-matched cohort studies. European radiology 32(12): 8432-8442	- Population not relevant to this review protocol *SR of propensity score matched studies, with risk of AKI in contrast-exposed patients not reported separately*
Oezkur, Mehmet, Wagner, Martin, Weismann, Dirk et al. (2015) Chronic hyperglycemia is associated with acute kidney injury in patients undergoing CABG surgery--a cohort study. BMC cardiovascular disorders 15: 41	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Okoye, O., Ojogwu, L., Unuigbe, E. et al. (2013) Frequency and risk factors of contrast-induced nephropathy after contrast procedures in a Nigerian tertiary centre. West African Journal of Medicine 32(1): 19-25	- Inappropriate analysis method *Unclear what confounders were included in the multivariate model*
Ortega-Loubon, Christian, Fernandez-Molina, Manuel, Paneda-Delgado, Lucia et al. (2018) Predictors of Postoperative Acute Kidney Injury after Coronary Artery Bypass Graft Surgery.	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
Brazilian journal of cardiovascular surgery 33(4): 323-329	
Osken, Altug, Oz, Ahmet, Keskin, Muhammed et al. (2021) The association between neutrophil-to-lymphocyte ratio and contrast-induced acute kidney injury in patients with carotid artery stenting. Vascular 29(4): 550-555	- eGFR not included in multivariate model
Osugi, Naohiro, Suzuki, Susumu, Shibata, Yohei et al. (2017) Coronary artery calcification scores improve contrast-induced nephropathy risk assessment in chronic kidney disease patients. Clinical and experimental nephrology 21(3): 391-397	- Data not reported in an extractable format or a format that can be analysed *AUC the only protocol-specified statistic reported, but without variance data*
Oweis, A.O., Alshelleh, S.A., Daoud, A.K. et al. (2018) Inflammatory milieu in contrast-induced nephropathy: A prospective single-center study. International Journal of Nephrology and Renovascular Disease 11: 211-215	- eGFR not included in multivariate model
Pacini, Davide, Pantaleo, Antonio, Di Marco, Luca et al. (2015) Risk factors for acute kidney injury after surgery of the thoracic aorta using antegrade selective cerebral perfusion and moderate hypothermia. The Journal of thoracic and cardiovascular surgery 150(1): 127-33e1	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Pan, Hui-Chao, Wu, Xian-Hao, Wan, Qian-Li et al. (2018) Analysis of the risk factors for contrast-induced nephropathy in over-aged patients receiving coronary intervention. Experimental biology and medicine (Maywood, N.J.) 243(12): 970-975	- Inappropriate analysis method *No multivariate model included*
Pannu, Neesh, Graham, Michelle, Klarenbach, Scott et al. (2016) A new model to predict acute kidney injury requiring renal replacement therapy after cardiac surgery. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 188(15): 1076-1083	- Population not relevant to this review protocol *Unclear if participants received iodine based contrast media*
Park, H.S., Kim, C.J., Yi, J.-E. et al. (2015) Contrast volume/raw eGFR ratio for predicting contrast-induced acute kidney injury in patients undergoing percutaneous coronary intervention for myocardial infarction. CardioRenal Medicine 5(1): 61-68	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*

Study	Code [Reason]
Park, Jin Ha, Ihn, Kyong, Han, Seok Joo et al. (2020) Incidence and Risk Factors of Acute Kidney Injury after Kasai Operation for Biliary Atresia: A Retrospective Study. International journal of medical sciences 17(8): 1023-1029	- Population not relevant to this review protocol *Study conducted in infants*
Park, Sehoon, Cho, Hyunjeong, Park, Seokwoo et al. (2019) Simple Postoperative AKI Risk (SPARK) Classification before Noncardiac Surgery: A Prediction Index Development Study with External Validation. Journal of the American Society of Nephrology : JASN 30(1): 170-181	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Park, Sehoon, Kim, Myoung-Hee, Kang, Eunjeong et al. (2016) Contrast-Induced Nephropathy After Computed Tomography in Stable CKD Patients With Proper Prophylaxis: 8-Year Experience of Outpatient Prophylaxis Program. Medicine 95(18): e3560	- Data not reported in an extractable format or a format that can be analysed *No prognostic cut-off for eGFR reported*
Park, Sin-Youl and Lee, Kyung-Woo (2017) Renal assessment using CKD-EPI equation is useful as an early predictor of contrast- induced nephropathy in elderly patients with cancer. Journal of geriatric oncology 8(1): 44-49	- eGFR not included in multivariate model
Peillex, M., Marchandot, B., Bayer, S. et al. (2020) Bedside renal doppler ultrasonography and acute kidney injury after TAVR. Journal of Clinical Medicine 9(4): 905	- Data not reported in an extractable format or a format that can be analysed *Mehran risk tool included, but reported as a HR of AKI occurring, not prognostic accuracy*
Peillex, Marilou, Marchandot, Benjamin, Matsushita, Kensuke et al. (2021) Acute kidney injury and acute kidney recovery following Transcatheter Aortic Valve Replacement. PloS one 16(8): e0255806	- Data not reported in an extractable format or a format that can be analysed *No prognostic accuracy data reported*
Perez, Teresa, Candela-Toha, Angel M, Khalifi, Loubna et al. (2022) Individualized prediction for the occurrence of acute kidney injury during the first postoperative week following cardiac surgery. Journal of clinical anesthesia 77: 110596	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Piasecki, P, Zabkowski, T, Brzozowski, K et al. (2018) The Assessment of the Risk of Acute Kidney Injury in Patients Undergoing an Urgent Endovascular Treatment Due to Severe Renal	- Retrospective cohort study

Study	Code [Reason]
Bleeding. Cardiovascular and interventional radiology 41(3): 398-405	
Piffaretti, Gabriele, Mariscalco, Giovanni, Bonardelli, Stefano et al. (2012) Predictors and outcomes of acute kidney injury after thoracic aortic endograft repair. Journal of vascular surgery 56(6): 1527-34	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Pighi, Michele, Fezzi, Simone, Pesarini, Gabriele et al. (2021) Extravalvular Cardiac Damage and Renal Function Following Transcatheter Aortic Valve Implantation for Severe Aortic Stenosis. The Canadian journal of cardiology 37(6): 904-912	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Pistolesi, V., Di Napoli, A., Fiaccadori, E. et al. (2016) Severe acute kidney injury following cardiac surgery: short-term outcomes in patients undergoing continuous renal replacement therapy (CRRT). Journal of Nephrology 29(2): 229-239	- eGFR not included in multivariate model
Pistolesi, Valentina, Regolisti, Giuseppe, Morabito, Santo et al. (2018) Contrast medium induced acute kidney injury: a narrative review. Journal of nephrology 31(6): 797-812	- Review article but not a systematic review
Poh, W.-Y.; Omar, M.S.; Tan, H.-P. (2018) Predictive factors for contrast-induced acute kidney injury in high-risk patients given N-acetylcysteine prophylaxis. Annals of Saudi Medicine 38(4): 269-276	- eGFR not included in multivariate model
Prasad, A., Ortiz-Lopez, C., Khan, A. et al. (2016) Acute kidney injury following peripheral angiography and endovascular therapy: A systematic review of the literature. Catheterization and Cardiovascular Interventions 88(2): 264-273	- eGFR not included in multivariate model *SR reports incidence of AKI, but doesn't mention any prognostic factors or risk tools*
Prowle, John Richard, Calzavacca, Paolo, Licari, Elisa et al. (2015) Combination of biomarkers for diagnosis of acute kidney injury after cardiopulmonary bypass. Renal failure 37(3): 408-16	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Qiao, Yong, Li, Mingkang, Li, Linqing et al. (2022) Fibrinogen-to-Albumin Ratio Predicts Postcontrast Acute Kidney Injury in Patients with Non-ST Elevation Acute Coronary	- Retrospective cohort study

Study	Code [Reason]
Syndrome after Implantation of Drug-Eluting Stents. Journal of the renin-angiotensin-aldosterone system : JRAAS 2022: 9833509	
Qin, Y., Qiao, Y., Wang, D. et al. (2021) The predictive value of soluble urokinase-type plasminogen activator receptor in contrast-induced acute kidney injury in patients undergoing percutaneous coronary intervention. International Journal of General Medicine 14: 6497-6504	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders, and no eGFR cut-off reported*
Qin, Y., Tang, H., Yan, G. et al. (2020) A High Triglyceride-Glucose Index Is Associated With Contrast-Induced Acute Kidney Injury in Chinese Patients With Type 2 Diabetes Mellitus. Frontiers in Endocrinology 11: 522883	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Rafiq Abbasi, Muhammad Sajid, Sultan, Khawar, Manzoor, Rukhsana et al. (2023) Assessment of renal function and prevalence of acute kidney injury following coronary artery bypass graft surgery and associated risk factors: A retrospective cohort study at a tertiary care hospital in Islamabad, Pakistan. Medicine 102(42): e35482	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Rahman, M.S.; Sharma, R.; Brecker, S.J.D. (2015) Transcatheter aortic valve implantation in patients with pre-existing chronic kidney disease. IJC Heart and Vasculature 8: 9-18	- eGFR not included in multivariate model
Rahul, A. and Kumar, S. (2023) A Tertiary Hospital Based Study of the Clinical Profile, Outcome, and Prognostic Factors of Acute Kidney Injury. International Journal of Pharmaceutical and Clinical Research 15(10): 873-879	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Ranucci, Marco, Aloisio, Tommaso, Cazzaniga, Anna et al. (2018) Validation of renal-risk models for the prediction of non-renal replacement therapy cardiac surgery-associated acute kidney injury. International journal of cardiology 272: 49-53	- Retrospective cohort study
Ray, Bappaditya, Rickert, Kim L, Welch, Babu G et al. (2013) Development of contrast-induced nephropathy in subarachnoid hemorrhage: a single center perspective. Neurocritical care 19(2): 150-6	- Data not reported in an extractable format or a format that can be analysed *No relevant models or analyses included*

Study	Code [Reason]
Reazaul Karim, Habib Md; Yunus, Md; Dey, Samarjit (2020) A retrospective comparison of preoperative estimated glomerular filtration rate as a predictor of postoperative cardiac surgery associated acute kidney injury. Annals of cardiac anaesthesia 23(1): 53-58	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Reuter, John E., Rao, Mohan, Ramkumar, Bhuvaneswari et al. (2011) i2.Summit (Interventional Cardiology). Journal of the American College of Cardiology 57(14s): e1891	- Conference abstract
Ribeiro, A.L., Sousa, F.B., Juchem, B.C. et al. (2023) Incidence of contrast-associated acute kidney injury: a prospective cohort. Jornal brasileiro de nefrologia	- Inappropriate analysis method *Study compared contrast-enhanced to non-enhanced scans, with no reporting of risk of AKI with eGFR or any risk prediction tools*
Ribitsch, Werner, Horina, Joerg H, Quehenberger, Franz et al. (2019) Contrast Induced Acute Kidney Injury and its Impact on Mid-Term Kidney Function, Cardiovascular Events and Mortality. Scientific reports 9(1): 16896	- Data not reported in an extractable format or a format that can be analysed *Multivariate analysis not conducted*
Rivera, Frederick Berro, Al-Abcha, Abdullah, Ansay, Marie Francesca Mapua et al. (2023) Transcatheter Aortic Valve Replacement-Associated Acute Kidney Injury: An Update. Cardiorenal medicine 13(1): 143-157	- Review article but not a systematic review
Rosa, V.E.E., Campos, C.M., Bacelar, A. et al. (2021) Performance of prediction models for contrast-induced acute kidney injury after transcutaneous aortic valve replacement. CardioRenal Medicine 11(4): 166-173	- Retrospective cohort study
Rossouw, E. and Chetty, S. (2023) Acute kidney injury after major non-cardiac surgery: Incidence and risk factors. South African Medical Journal 113(3): 135-140	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Rudnick, Michael R, Leonberg-Yoo, Amanda K, Litt, Harold I et al. (2020) The Controversy of Contrast-Induced Nephropathy With Intravenous Contrast: What Is the Risk?. American journal of kidney diseases : the official journal of the National Kidney Foundation 75(1): 105-113	- Review article but not a systematic review

Study	Code [Reason]
Ryden, L., Sartipy, U., Evans, M. et al. (2014) Acute kidney injury after coronary artery bypass grafting and long-term risk of end-stage renal disease. Circulation 130(23): 2005-2011	- Population not relevant to this review protocol *Unclear if participants received iodine based contrast media*
Safley, David M, Salisbury, Adam C, Tsai, Thomas T et al. (2021) Acute Kidney Injury Following In-Patient Lower Extremity Vascular Intervention: From the National Cardiovascular Data Registry. JACC. Cardiovascular interventions 14(3): 333-341	- Retrospective cohort study
Sahu, A., Goel, P., Khanna, R. et al. (2022) Neutrophil gelatinase-associated lipocalin as a marker for contrast-induced nephropathy in patients undergoing percutaneous coronary intervention: A prospective observational analysis. Indian Journal of Nephrology 32(3): 247-255	- Data not reported in an extractable format or a format that can be analysed *Cut-off for eGFR not reported*
Saia, Francesco, Ciuca, Cristina, Taglieri, Nevio et al. (2013) Acute kidney injury following transcatheter aortic valve implantation: incidence, predictors and clinical outcome. International journal of cardiology 168(2): 1034-40	- Data not reported in an extractable format or a format that can be analysed *Prognostic accuracy of EuroSCORE not reported, and no eGFR cut-off reported*
Sakan, S., Povsic-cevra, Z., Brusich, K.T. et al. (2017) A single center retrospective study of cardiac surgery associated acute kidney injury - incidence and outcomes. Acta Medica Croatica 71: 285-291	- Population not relevant to this review protocol *Unclear if participants received iodine based contrast media*
Salem, Karim M, Saadeddin, Zein, Go, Catherine et al. (2021) Risk factors for acute kidney injury after pharmacomechanical thrombolysis for acute deep vein thrombosis. Journal of vascular surgery. Venous and lymphatic disorders 9(4): 868-873	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Sany, Dawlat, Refaat, Hany, Elshahawy, Yasser et al. (2014) Frequency and risk factors of contrast-induced nephropathy after cardiac catheterization in type II diabetic patients: a study among Egyptian patients. Renal failure 36(2): 191-7	- eGFR not included in multivariate model
Saratzis, Athanasios, Joshi, Shivam, Benson, Ruth A et al. (2020) Editor's Choice - Acute Kidney Injury (AKI) in Aortic Intervention: Findings From the Midlands Aortic Renal Injury	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*

Study	Code [Reason]
(MARI) Cohort Study. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery 59(6): 899-909	
Saratzis, Athanasios, Nduwayo, Sarah, Sarafidis, Pantelis et al. (2016) Renal Function is the Main Predictor of Acute Kidney Injury after Endovascular Abdominal Aortic Aneurysm Repair. Annals of vascular surgery 31: 52-9	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Saylik, Faysal, Cinar, Tufan, Akbulut, Tayyar et al. (2023) Serum Uric Acid to Albumin Ratio Can Predict Contrast-Induced Nephropathy in ST-Elevation Myocardial Infarction Patients Undergoing Primary Percutaneous Coronary Intervention. Angiology 74(1): 70-78	- eGFR not included in multivariate model
Schewel, Dimitry, Zavareh, Milad, Schewel, Jury et al. (2017) Impact of interaction of diabetes mellitus and impaired renal function on prognosis and the incidence of acute kidney injury in patients undergoing transcatheter aortic valve replacement (TAVR). International journal of cardiology 232: 147-154	- eGFR not included in multivariate model
Schmucker, Johannes, Fach, Andreas, Becker, Matthias et al. (2018) Predictors of acute kidney injury in patients admitted with ST-elevation myocardial infarction - results from the Bremen STEMI-Registry. European heart journal. Acute cardiovascular care 7(8): 710-722	- Data not reported in an extractable format or a format that can be analysed *Multivariate model including appropriate confounders, but no adjusted OR or RR reported*
Schnabel, Renate B, Seiffert, Moritz, Wilde, Sandra et al. (2015) Kidney injury and mortality after transcatheter aortic valve implantation in a routine clinical cohort. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions 85(3): 440-7	- Data not reported in an extractable format or a format that can be analysed *Risk of an AKI with increasing EuroSCORE reported, but no prognostic accuracy data*
Schneider, C, Brumberg, A, Roller, F C et al. (2018) Multimodality imaging evaluation before transcatheter aortic valve implantation: incidence of contrast medium-induced acute kidney injury, risk factors and prognosis. Clinical radiology 73(5): 502e1-502e8	- eGFR not included in multivariate model
Schreuder, Sanne M; Stoker, Jaap; Bipat, Shandra (2017) Prediction of presence of kidney disease in patients undergoing	- Study not investigating AKI

Study	Code [Reason]
intravenous iodinated contrast enhanced computed tomography: a validation study. European radiology 27(4): 1613-1621	*Study assessed the diagnostic accuracy of prediction tools to identify people with low eGFR values*
Schweitzer, Julian, Horn, Patrick, Voss, Fabian et al. (2022) Incidence of Acute Kidney Injury Is Lower in High-Risk Patients Undergoing Percutaneous Coronary Intervention Supported with Impella Compared to ECMO. Journal of cardiovascular translational research 15(2): 239-248	- Data not reported in an extractable format or a format that can be analysed *No prognostic accuracy data reported*
Sedaghat, Alexander, Vij, Vivian, Streit, Samuel R et al. (2020) Incidence, predictors, and relevance of acute kidney injury in patients undergoing left atrial appendage closure with Amplatzer occluders: a multicentre observational study. Clinical research in cardiology : official journal of the German Cardiac Society 109(4): 444-453	- Population not relevant to this review protocol *Not all participants received iodine based contrast media, and results not stratified by those who did / did not*
Sedaghat, Farzad, Vadvala, Harshna V, Shan, Alan et al. (2022) Incidence of Contrast-Associated Acute Kidney Injury in Renal-Competent COVID-19 Patients Undergoing Computed Chest Angiography. Journal of computer assisted tomography 46(5): 701-706	- Inappropriate analysis method *Unclear what confounders were included in the multivariate model*
Serraino, Giuseppe Filiberto, Provenzano, Michele, Jiritano, Federica et al. (2021) Risk factors for acute kidney injury and mortality in high risk patients undergoing cardiac surgery. PloS one 16(5): e0252209	- Population not relevant to this review protocol *Participants did not receive iodine based contrast media*
Sholy, H., Zukermann, R., Soni, A. et al. (2012) Contrast induced nephropathy: An update on diagnosis, predictors, implications and preventive strategies. Minerva Medica 103(6): 465-486	- Review article but not a systematic review
Sigirci, Serhat, Keskin, Kudret, Yildiz, Suleyman Sezai et al. (2019) Can Thrombus Burden Predict Contrast-Induced Nephropathy in Patients With ST-Segment Elevation Myocardial Infarction?. Angiology 70(7): 642-648	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Silvain, Johanne, Nguyen, Lee S, Spagnoli, Vincent et al. (2018) Contrast-induced acute kidney injury and mortality in ST elevation myocardial infarction treated with primary	- Data not reported in an extractable format or a format that can be analysed *Paper does not report multivariate analysis of predictors for AKI*

Study	Code [Reason]
percutaneous coronary intervention. Heart (British Cardiac Society) 104(9): 767-772	
Simsek, Baris, Cinar, Tufan, Inan, Duygu et al. (2022) C-Reactive Protein/Albumin Ratio Predicts Acute Kidney Injury in Patients With Moderate to Severe Chronic Kidney Disease and Non-ST-Segment Elevation Myocardial Infarction. Angiology 73(2): 132-138	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Singh, M., Gulati, R., Lewis, B.R. et al. (2022) Multimorbidity and Mortality Models to Predict Complications Following Percutaneous Coronary Interventions. Circulation: Cardiovascular Interventions 15(7): 577-586	- Inappropriate analysis method *Risk prediction tool development and validation carried out on the same data set*
Snaith, Beverly, Harris, Martine A, Shinkins, Bethany et al. (2018) Point-of-care creatinine testing for kidney function measurement prior to contrast-enhanced diagnostic imaging: evaluation of the performance of three systems for clinical utility. Clinical chemistry and laboratory medicine 56(8): 1269-1276	- Study design not relevant to this review protocol *Study does not reported occurrence of AKI*
Spieker, Maximilian, Hellhammer, Katharina, Katsianos, Stratis et al. (2018) Effect of Acute Kidney Injury After Percutaneous Mitral Valve Repair on Outcome. The American journal of cardiology 122(2): 316-322	- eGFR not included in multivariate model
Statius van Eps, Randolph G, Nemeth, Banne, Mairuhu, Ronne T A et al. (2017) Determinants of Acute Kidney Injury and Renal Function Decline After Endovascular Abdominal Aortic Aneurysm Repair. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery 54(6): 712-720	- eGFR not included in multivariate model
Su, Tse-Hsuan, Hsieh, Chih-Huang, Chan, Yi-Ling et al. (2021) Intravenous CT Contrast Media and Acute Kidney Injury: A Multicenter Emergency Department-based Study. Radiology 301(3): 571-581	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Sudarsky, D., Drutin, Y., Kusniec, F. et al. (2022) Acute Kidney Injury Following Transcatheter Aortic Valve Implantation: Association with Contrast Media Dosage and Contrast Media Based Risk Predication Models. Journal of Clinical Medicine 11(5): 1181	- Retrospective cohort study

Study	Code [Reason]
Sutheechai, S.; Lailakdamrong, K.; Sudchada, P. (2022) Performance of contrast-associated acute kidney injury predictive risk models in Thai cardiac angiography or angioplasty patients. Pharmaceutical Sciences Asia 49(5): 518-525	- Retrospective cohort study
Takahashi, Edwin A, Kallmes, David F, Fleming, Chad J et al. (2017) Predictors and Outcomes of Postcontrast Acute Kidney Injury after Endovascular Renal Artery Intervention. Journal of vascular and interventional radiology : JVIR 28(12): 1687-1692	- Inappropriate analysis method *No multivariate model reported*
Tan, J., Zhang, Y.-H., Si, J. et al. (2023) Incidence, predictors and prognosis of acute kidney injury in acute ST-segment elevation myocardial infarction patients undergoing emergent coronary angiography/primary percutaneous coronary intervention. Journal of Geriatric Cardiology 20(2): 139-149	- eGFR not included in multivariate model
Tanaka, Tetsu, Kavsur, Refik, Sugiura, Atsushi et al. (2022) Acute Kidney Injury Following Tricuspid Transcatheter Edge-to-Edge Repair. JACC. Cardiovascular interventions 15(19): 1936-1945	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Tang, Ying, Chen, Junzhe, Huang, Kai et al. (2017) The incidence, risk factors and in-hospital mortality of acute kidney injury in patients after abdominal aortic aneurysm repair surgery. BMC nephrology 18(1): 184	- Population not relevant to this review protocol *Not all participants received iodine based contrast media, and results were not stratified by those who did / did not*
Tao, Shu Min, Kong, Xiang, Schoepf, U Joseph et al. (2018) Acute kidney injury in patients with nephrotic syndrome undergoing contrast-enhanced CT for suspected venous thromboembolism: a propensity score-matched retrospective cohort study. European radiology 28(4): 1585-1593	- Inappropriate analysis method *All analyses focussed on contrast-enhanced vs non-enhanced imaging - no data on predictors of AKI in contrast group*
Thongprayoon, Charat, Cheungpasitporn, Wisit, Mao, Michael A et al. (2017) Persistent acute kidney injury following transcatheter aortic valve replacement. Journal of cardiac surgery 32(9): 550-555	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Thongprayoon, Charat, Cheungpasitporn, Wisit, Srivali, Narat et al. (2016) AKI after Transcatheter or Surgical Aortic Valve	- Population not relevant to this review protocol

Study	Code [Reason]
Replacement. Journal of the American Society of Nephrology : JASN 27(6): 1854-60	*Not all participants received iodine based contrast media*
Thongprayoon, Charat, Cheungpasitporn, Wisit, Srivali, Narat et al. (2016) Incidence and risk factors of acute kidney injury following transcatheter aortic valve replacement. Nephrology (Carlton, Vic.) 21(12): 1041-1046	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Tinica, G., Brinza, C., Covic, A. et al. (2020) Determinants of acute kidney injury after cardiac surgery: A systematic review. Reviews in Cardiovascular Medicine 21(4): 601-610	- Study not investigating AKI
Tirado-Conte, Gabriela, Rodes-Cabau, Josep, Rodriguez-Olivares, Ramon et al. (2018) Clinical Outcomes and Prognosis Markers of Patients With Liver Disease Undergoing Transcatheter Aortic Valve Replacement: A Propensity Score-Matched Analysis. Circulation. Cardiovascular interventions 11(3): e005727	- Data not reported in an extractable format or a format that can be analysed *Risk of AKI reported between liver disease state, not based on eGFR or any risk prediction tool*
Tonchev, Ivaylo, Heberman, Dan, Peretz, Alona et al. (2021) Acute kidney injury after MitraClip implantation in patients with severe mitral regurgitation. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions 97(6): e868-e874	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Traub, Stephen J, Kellum, John A, Tang, Aimee et al. (2013) Risk factors for radiocontrast nephropathy after emergency department contrast-enhanced computerized tomography. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine 20(1): 40-5	- Retrospective cohort study
Tsai, Thomas T, Patel, Uptal D, Chang, Tara I et al. (2014) Contemporary incidence, predictors, and outcomes of acute kidney injury in patients undergoing percutaneous coronary interventions: insights from the NCDR Cath-PCI registry. JACC. Cardiovascular interventions 7(1): 1-9	- Inappropriate analysis method *Multivariate analysis not reported*
Tsai, Thomas T, Patel, Uptal D, Chang, Tara I et al. (2014) Validated contemporary risk model of acute kidney injury in patients undergoing percutaneous coronary interventions: insights from the National Cardiovascular Data Registry	- Retrospective cohort study

Study	Code [Reason]
Cath-PCI Registry. Journal of the American Heart Association 3(6): e001380	
Tung, Ying-Chang, Chang, Chih-Hsiang, Chen, Yung-Chang et al. (2015) Combined biomarker analysis for risk of acute kidney injury in patients with ST-segment elevation myocardial infarction. PloS one 10(4): e0125282	- Inappropriate analysis method *Multivariate analysis results not reported*
Uzendu, Anezi, Kennedy, Kevin, Chertow, Glenn et al. (2023) Implications of a Race Term in GFR Estimates Used to Predict AKI After Coronary Intervention. JACC. Cardiovascular interventions 16(18): 2309-2320	- Retrospective cohort study
van der Molen, Aart J, Reimer, Peter, Dekkers, Ilona A et al. (2018) Post-contrast acute kidney injury. Part 2: risk stratification, role of hydration and other prophylactic measures, patients taking metformin and chronic dialysis patients : Recommendations for updated ESUR Contrast Medium Safety Committee guidelines. European radiology 28(7): 2856-2869	- Review article but not a systematic review
Vavalle, John P, van Diepen, Sean, Clare, Robert M et al. (2016) Renal failure in patients with ST-segment elevation acute myocardial infarction treated with primary percutaneous coronary intervention: Predictors, clinical and angiographic features, and outcomes. American heart journal 173: 57-66	- eGFR not included in multivariate model
Vavilis, G., Evans, M., Jernberg, T. et al. (2017) Risk factors for worsening renal function and their association with long-term mortality following transcatheter aortic valve implantation: Data from the SWEDEHEART registry. Open Heart 4(2): e000554	- Study not investigating AKI *Study investigating persistent AKI that exceeded the 7-day threshold specified in this review protocol*
Venturi, Gabriele, Scarsini, Roberto, Pighi, Michele et al. (2022) Volume of contrast to creatinine clearance ratio predicts early mortality and AKI after TAVI. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions 99(6): 1925-1934	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Vives, Marc, Candela, Angel, Monedero, Pablo et al. (2023) Improving the performance of the Cleveland Clinic Score for predicting acute kidney injury after cardiac surgery: a	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
prospective multicenter cohort study. Minerva anestesiologica	
Wang, Can, Li, Gaoye, Liang, Xiaomei et al. (2020) Predictive Value of Fibrinogen-to-Albumin Ratio for Post-Contrast Acute Kidney Injury in Patients Undergoing Elective Percutaneous Coronary Intervention. Medical science monitor : international medical journal of experimental and clinical research 26: e924498	- Retrospective cohort study
Wang, Rui, Wang, Xian, Zhu, Yifan et al. (2020) Acute kidney injury following on-pump or off-pump coronary artery bypass grafting in elderly patients: a retrospective propensity score matching analysis. Journal of cardiothoracic surgery 15(1): 186	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Wang, X., Guo, N., Chen, Y. et al. (2022) A new model to predict acute kidney injury after cardiac surgery in patients with renal insufficiency. Renal Failure 44(1): 767-776	- Population not relevant to this review protocol *Unclear if participants received iodine based contrast media*
Wang, Xudong, Lin, Xinghui, Xie, Bo et al. (2020) Early serum cystatin C-enhanced risk prediction for acute kidney injury post cardiac surgery: a prospective, observational, cohort study. Biomarkers : biochemical indicators of exposure, response, and susceptibility to chemicals 25(1): 20-26	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Wang, Xun and Fu, Xianghua (2023) Predicting AKI in patients with AMI: Development and assessment of a new predictive nomogram. Medicine 102(24): e33991	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Wang, Yi, Liu, Kaixiang, Xie, Xisheng et al. (2021) Contrast-associated acute kidney injury: An update of risk factors, risk factor scores, and preventive measures. Clinical imaging 69: 354-362	- Review article but not a systematic review
Wang, Ying and Bellomo, Rinaldo (2017) Cardiac surgery-associated acute kidney injury: risk factors, pathophysiology and treatment. Nature reviews. Nephrology 13(11): 697-711	- Review article but not a systematic review
Wang, Zheng-Yu, Wang, Yong-Li, Wei, Jian et al. (2020) Role of serum cystatin C in the prediction of contrast-induced nephropathy after	- eGFR not included in multivariate model

Study	Code [Reason]
intra-arterial interventions. Chinese medical journal 133(4): 408-414	
Watanabe, Makoto, Saito, Yoshihiko, Aonuma, Kazutaka et al. (2016) Prediction of contrast-induced nephropathy by the serum creatinine level on the day following cardiac catheterization. Journal of cardiology 68(5): 412-418	- eGFR not included in multivariate model *Change in eGFR included, but not pre-contrast eGFR*
Werner, Gerald S, Lorenz, Simon, Yaginuma, Kenji et al. (2021) A prospective study on the incidence of contrast-associated acute kidney injury after recanalization of chronic total coronary occlusions with contemporary interventional techniques. International journal of cardiology 337: 38-43	- eGFR not included in multivariate model
Wilson, Todd A, de Koning, Lawrence, Quinn, Robert R et al. (2021) Derivation and External Validation of a Risk Index for Predicting Acute Kidney Injury Requiring Kidney Replacement Therapy After Noncardiac Surgery. JAMA network open 4(8): e2121901	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Wolff, G., Lin, Y., Quade, J. et al. (2020) Validation of National Cardiovascular Data Registry risk models for mortality, bleeding and acute kidney injury in interventional cardiology at a German Heart Center. Clinical Research in Cardiology 109(2): 235-245	- Retrospective cohort study
Wu, M.-J. and Tsai, S.-F. (2022) Patients with Different Stages of Chronic Kidney Disease Undergoing Intravenous Contrast-Enhanced Computed Tomography-The Incidence of Contrast-Associated Acute Kidney Injury. Diagnostics 12(4): 864	- Inappropriate analysis method *Unclear if the multivariate model included all protocol-specified confounders*
Wu, Qin, Yang, Hao, Bo, Hong et al. (2019) Predictive role of estimated glomerular filtration rate prior to surgery in postsurgical acute kidney injury among very elderly patients: a retrospective cohort study. Renal failure 41(1): 866-874	- Population not relevant to this review protocol *Majority of participants had not received iodine based contrast media*
Wu, Xiaoyun, Qiu, Feng, Jin, Xianglan et al. (2022) Evaluation of Four eGFR Calculating Formulae in Predicting Postoperative Acute Kidney Injury in Adult Patients Undergoing Open-Heart Surgery with Cardiopulmonary	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
Bypass. Contrast media & molecular imaging 2022: 6929758	
Wu, Yukun, Chen, Junxing, Luo, Cheng et al. (2021) Predicting the risk of postoperative acute kidney injury: development and assessment of a novel predictive nomogram. The Journal of international medical research 49(8): 3000605211032838	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Xie, B., Fu, L., Wu, Y. et al. (2022) Risk factors of renal replacement therapy after heart transplantation: a retrospective single-center study. Annals of Translational Medicine 10(5): 257	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Xu, Feng-Bo, Cheng, Hong, Yue, Tong et al. (2019) Derivation and validation of a prediction score for acute kidney injury secondary to acute myocardial infarction in Chinese patients. BMC nephrology 20(1): 195	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Yamauchi, Takashi, Miyagawa, Shigeru, Yoshikawa, Yasushi et al. (2017) Risk Index for Postoperative Acute Kidney Injury After Valvular Surgery Using Cardiopulmonary Bypass. The Annals of thoracic surgery 104(3): 868-875	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*
Yan, Ping, Duan, Shao-Bin, Luo, Xiao-Qin et al. (2023) Development and validation of a deep neural network-based model to predict acute kidney injury following intravenous administration of iodinated contrast media in hospitalized patients with chronic kidney disease: a multicohort analysis. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association 38(2): 352-361	- Retrospective cohort study
Yan, Y., Gong, H., Hu, J. et al. (2023) Perioperative parameters-based prediction model for acute kidney injury in Chinese population following valvular surgery. Frontiers in Cardiovascular Medicine 10: 1094997	- Predictive model included variables not measured pre-contrast administration
Yang, C., Hou, P., Wang, D. et al. (2022) Serum Myoglobin Is Associated With Postoperative Acute Kidney Injury in Stanford Type A Aortic Dissection. Frontiers in Medicine 9: 821418	- Population not relevant to this review protocol *Participants had not received iodine based contrast media*

Study	Code [Reason]
Yang, Junqing, He, Yibo, Liu, Yong et al. (2022) A risk score predicting unplanned renal replacement therapy after coronary catheterization. Clinical nephrology 97(1): 28-38	- Study not investigating AKI *Study investigated a risk prediction tool for post-contrast renal replacement therapy, not AKI*
Yarkova, N.A. and Borovkov, N.N. (2017) Algorithm for early diagnosis of contrast-induced nephropathy using biomarkers of renal damage. Sovremennye Tehnologii v Medicine 9(4): 156-161	- Inappropriate analysis method *No multivariate analysis reported*
Yildirim, Erkan; Ermis, Emrah; Cengiz, Mahir (2020) Inflammatory markers of contrast-induced nephropathy in patients with acute coronary syndrome. Coronary artery disease 31(3): 279-283	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Yin, Wen-Jun, Yi, Yi-Hu, Guan, Xiao-Feng et al. (2017) Preprocedural Prediction Model for Contrast-Induced Nephropathy Patients. Journal of the American Heart Association 6(2)	- Retrospective cohort study
You, Je Sung, Cho, Junho, Shin, Hye Jung et al. (2023) Baseline eGFR cutoff for increased risk of post-contrast acute kidney injury in patients undergoing percutaneous coronary intervention for ST-elevation myocardial infarction in the emergency department. PloS one 18(10): e0293598	- eGFR cut-off outside protocol-defined range
Yuan, Y., Qiu, H., Hu, X. et al. (2017) Predictive value of inflammatory factors on contrast-induced acute kidney injury in patients who underwent an emergency percutaneous coronary intervention. Clinical Cardiology 40(9): 719-725	- eGFR not included in multivariate model
Yuan, Y., Qiu, H., Hu, X. et al. (2022) A risk score model of contrast-induced acute kidney injury in patients with emergency percutaneous coronary interventions. Frontiers in Cardiovascular Medicine 9: 989243	- Retrospective cohort study
Yuan, Ying, Qiu, Hong, Hu, Xiao-Ying et al. (2018) Relationship between High Level of Estimated Glomerular Filtration Rate and Contrast-Induced Acute Kidney Injury in Patients who Underwent an Emergency Percutaneous Coronary Intervention. Chinese medical journal 131(17): 2041-2048	- Data not reported in an extractable format or a format that can be analysed *Cut-off value for predictive value of eGFR not reported*

Study	Code [Reason]
Yuan, Ying, Qiu, Hong, Hu, Xiao-Ying et al. (2017) Risk Factors of Contrast-induced Acute Kidney Injury in Patients Undergoing Emergency Percutaneous Coronary Intervention. Chinese medical journal 130(1): 45-50	- Data not reported in an extractable format or a format that can be analysed *No eGFR threshold reported*
Yuan, Ying, Qiu, Hong, Song, Lei et al. (2018) A New Risk Factor Profile for Contrast-Induced Acute Kidney Injury in Patients Who Underwent an Emergency Percutaneous Coronary Intervention. Angiology 69(6): 523-531	- eGFR not included in multivariate model
Yue, J.-N., Luo, Z., Guo, D.-Q. et al. (2013) Evaluation of acute kidney injury as defined by the risk, injury, failure, loss, and end-stage criteria in critically ill patients undergoing abdominal aortic aneurysm repair. Chinese Medical Journal 126(3): 431-436	- eGFR not included in multivariate model
Yue, Zhou; Yan-Meng, Guan; Ji-Zhuang, Lou (2019) Prediction model for acute kidney injury after coronary artery bypass grafting: a retrospective study. International urology and nephrology 51(9): 1605-1611	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Yun, Donghwan, Kim, Dong Ki, Lee, Jung Pyo et al. (2021) Can sodium fluorescein cause contrast-induced nephropathy?. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association 36(5): 819-825	- eGFR not included in multivariate model
Zahler, David, Rozenfeld, Keren-Lee, Merdler, Ilan et al. (2020) Contrast Volume to Glomerular Filtration Ratio and Acute Kidney Injury among ST-Segment Elevation Myocardial Infarction Patients Treated with Primary Percutaneous Coronary Intervention. Cardiorenal medicine 10(2): 108-115	- eGFR not included in multivariate model
Zaleska-Kociecka, M.; Dabrowski, M.; Stepinska, J. (2019) Acute kidney injury after transcatheter aortic valve replacement in the elderly: Outcomes and risk management. Clinical Interventions in Aging 14: 195-201	- Review article but not a systematic review
Zarkowsky, Devin S, Hicks, Caitlin W, Bostock, Ian C et al. (2016) Renal dysfunction and the associated decrease in survival after elective	- Inappropriate analysis method

Study	Code [Reason]
endovascular aneurysm repair. Journal of vascular surgery 64(5): 1278-1285e1	*Multivariate model did not include all protocol-specified confounders*
Zbierska-Rubinkiewicz, Katarzyna, Trebacz, Oksana, Tomala, Marek et al. (2017) Creatine kinase-MB and red cell distribution width as predictors of contrast-induced nephropathy after percutaneous coronary intervention in acute myocardial infarction. Folia medica Cracoviensia 57(3): 87-99	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Zealley, Ian, Wang, Huan, Donnan, Peter T et al. (2018) Exposure to contrast media in the perioperative period confers no additional risk of acute kidney injury in surgical patients. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association 33(10): 1751-1756	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Zhang, Dong, Teng, Jie, Luo, Zhe et al. (2023) Risk Factors and Prognosis of Acute Kidney Injury after Cardiac Surgery in Patients with Chronic Kidney Disease. Blood purification 52(2): 166-173	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Zhang, H., Wang, Z., Tang, Y. et al. (2022) Prediction of acute kidney injury after cardiac surgery: model development using a Chinese electronic health record dataset. Journal of Translational Medicine 20(1): 166	- Population not relevant to this review protocol *Unclear if participants had received iodine based contrast media*
Zhang, L., Xu, J., Li, X. et al. (2022) Risk Factors and Outcomes of AKI after LAAC Operation: A Single-Center Observational Study from Mainland China. Reviews in Cardiovascular Medicine 23(9): 306	- Inappropriate analysis method *Multivariate model did not include all protocol-specified confounders*
Zhao, Ning, Chen, Zaiyan, Zhou, Yinpin et al. (2021) Effects of a High Dose of the Contrast Medium Iodixanol on Renal Function in Patients Following Percutaneous Coronary Intervention. Angiology 72(2): 145-152	- Data not reported in an extractable format or a format that can be analysed *No eGFR cut-off reported*
Zhou, F., Lu, Y., Xu, Y. et al. (2023) Correlation between neutrophil-to-lymphocyte ratio and contrast-induced acute kidney injury and the establishment of machine-learning-based predictive models. Renal Failure 45(2): 2258983	- Inappropriate analysis method *Prediction models not validated and predictive cut-off for eGFR not reported*

Study	Code [Reason]
Zhou, X., He, Y., Hu, L. et al. (2022) Lactate level and lactate clearance for acute kidney injury prediction among patients admitted with ST-segment elevation myocardial infarction: A retrospective cohort study. Frontiers in Cardiovascular Medicine 9: 930202	- Retrospective cohort study
Zhou, Xuejun, Sun, Zhiqin, Zhuang, Yi et al. (2018) Development and Validation of Nomogram to Predict Acute Kidney Injury in Patients with Acute Myocardial Infarction Treated Invasively. Scientific reports 8(1): 9769	- Retrospective cohort study
Zhu, Jian-Cheng, Chen, Shao-Liang, Jin, Guo-Zhen et al. (2014) Acute renal injury after thoracic endovascular aortic repair of Stanford type B aortic dissection: incidence, risk factors, and prognosis. Journal of the Formosan Medical Association = Taiwan yi zhi 113(9): 612-9	- Study not investigating AKI *AKI reported, but no prognostic factors assessed*

I.2 Health economic studies

Not applicable.

Appendix J Recommendations for research – full details

J.1 Recommendation for research

What validated risk assessment tools could be used to predict the occurrence of contrast induced acute kidney injury following the administration of intravenous iodine-based contrast media?

J.1.1 Why this is important

An accurate risk assessment tool may assist clinicians in balancing the diagnostic benefit of contrast media CT-scans against the potential risks of contrast associated acute kidney injury. Currently avoidance in the use of iodine-based contrast media in people perceived to be at higher risk can lead to poorer outcomes resulting from unnecessary delay or cancellation of scans when the risk of post-contrast acute kidney injury is low for most people.

J.1.2 Rationale for the recommendation for research

Importance to 'patients' or the population	Intravenous iodine-based contrast media (ICM) is often required for clinically vital tests and treatments for serious diseases, many of which convey substantial proven benefit for patients. Delayed intravenous ICM use or avoidance risks serious adverse outcomes, especially when test or treatment benefits are time sensitive. Currently, people are often denied timely access to ICM based contrast enhanced CT-scans when their additional risk of developing acute kidney injury (AKI) as a result of intravenous modern ICM use is relatively low.
Relevance to NICE guidance	Risk assessment tools and questionnaires have been considered in this guideline and no evidence was identified that examined risk assessment tools to predict risk of acute kidney injury in the context of intravenous contrast administration.
Relevance to the NHS	There is variation in current practice in when and in whom eGFR measurement is carried out before doing a contrast -enhanced CT scan, and in the interpretation of who is at higher risk of an acute kidney injury. Further research may provide greater clarity on the level of the risk and a reliable tool for identifying risk factors.
National priorities	
Current evidence base	Minimal large-scale data within an older population reflective of those seen in current practice.
Equality considerations	None known

J.1.3 Modified PICO table

Population	Adults receiving intravenous administration of ICM for contrast-enhanced CT scans.
Risk assessment tools	Validated risk assessment tools
Outcomes	• Contrast-associated acute kidney injury (definition to be determined by author (KDIGO, RIFLE, AKIN definition) • Dialysis • Mortality due to acute kidney injury
Study design	Prospective cohort studies
Timeframe	Contrast-associated acute kidney injury (within 7 days of intravenous ICM for a contrast-enhanced CT scan).

Appendix K