

Item S1. Search String

1. (Renal Dialysis or Dialysis, Extracorporeal or Dialysis, Renal or Extracorporeal Dialysis or Hemodialysis or Dialysis).kf.
2. (Dialysis Solutions or Dialysates or Dialyzates).af.
3. 1 or 2
4. (Adrenergic beta-Antagonists or Adrenergic beta-Receptor Blockaders or beta-Adrenergic Antagonists or beta-Adrenergic Blockers or beta-Adrenergic Blocking Agents or beta-Adrenergic Receptor Blockaders or beta-Adrenoceptor Antagonists or beta-Blockers, Adrenergic or beta-Blockers or b-Blockers or beta-Blocker or b-Blocker).af.
5. (Metoprolol or Beloc-Duriles or Betaloc or Betaloc-Astra or Betalok or CGP-2175 or H 93-26 or Lopressor or Metoprolol CR-XL or Metoprolol Succinate or Metoprolol Tartrate or Seloken or Spesicor or Spesikor or Toprol or Toprol-XL).tw.
6. (Carvedilol or BM 14190 or BM-14190 or Carvedilol Hydrochloride or Carvedilol, 14C-labeled or Coreg or Coropres or Dilatrend or Eucardic or Kredex or Querto).tw.
7. (Atenolol or ICI-66082 or Tenormin or Tenormine).tw.
8. (Bisoprolol or Bisoprolol Fumarate or Bisoprolol Hydrochloride or Bisoprolol Methanesulfonate Salt or CL-297939 or Concor or EMD-33512).tw.
9. (Propranolol or AY-20694 or Anaprilin or Anapriline or Avlocardyl or Betadren or Dexpropranolol or Dociton or Inderal or Obsidan or Obzidan or Propanolol or Propranolol Hydrochloride or Rexigen).tw.
10. (Acebutolol or Acebutolol Hydrochloride or Acetobutolol or Apo-Acebutolol or Monitan or Neptal or Novo-Acebutolol or Prent or Rhotral or Sectral).tw.
11. (Nadolol or Corgard or SQ-11725 or Solgol).tw.
12. (Nebivolol or Bystolic or Lobivon or Nebilet or Nebivolol Hydrochloride or R 67555 or R-67555 or Silostar).tw.
13. (Labetalol or AH-5158 or Albetol or Apo-Labetalol or Dilevalol or Labetalol Hydrochloride or Labetolol or Normodyne or Presolol or SCH-19927 or Trandate).tw.
14. (Pindolol or LB-46 or Prindolol or Visken).tw.
15. (Timolol or Blocadren or L-714,465 or MK-950 or Optimol or Timacar or Timolol Hemihydrate or Timolol Maleate or Timoptic or Timoptol).tw.
16. (Carteolol or Carteolol Hydrochloride or Carteolol Monohydrochloride or OPC- 1085).tw.
17. (Penbutolol or Betapressin or Hoe-893d or Penbutolol Sulfate).tw.
18. (Betaxolol or ALO-1401-02 or Betaxolol Alcon or Betaxolol Hydrochloride or Betoptic or Betoptima or Kerlon or Kerlone or Oxodal or SL-75212).tw.
19. (esmolol or ASL 8052 or ASL-8052 or Brevibloc or esmolol hydrochloride).tw.

20. (Practolol or Dalzic or Eralzdin Practolol or ICI-50172).tw.
21. (Alprenolol or Alfeprol or Alpheprol or Alprenolol Hydrochloride or Aptin or Aptin-Duriles or Aptina or Aptine or H-56-28).tw.
22. (Oxprenolol or Coretal or Koretal or Oxprenolol Hydrochloride or Slow Trasicor or Tevacor or Trasicor).tw.
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176. 4 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121 or 122 or 123 or 124 or 125 or 126 or 127 or 128 or 129 or 130 or 131 or 132 or 133 or 134 or 135 or 136 or 137 or 138 or 139 or 140 or 141 or 142 or 143 or 144 or 145 or 146 or 147 or 148 or 149 or 150 or 151 or 152 or 153 or 154 or 155 or 156 or 157 or 158 or 159 or 160 or 161 or 162 or 163 or 164 or 165 or 166 or 167 or 168 or 169 or 170 or 171 or 172 or 173 or 174 or 175

177. 3 and 176

178. limit 177 to (systematic reviews or case reports or clinical study or clinical trial, all or clinical trial or comparative study or journal article or meta analysis or observational study or randomized controlled trial or "systematic review")

179. limit 178 to yr="1990 -Current"

180. limit 179 to english language

181. remove duplicates from 180

Table S1. ROBINS I bias assessment tool questions and reviewer responses for each paper used in this systematic review.

	Assimon et al.	Shireman et al.	Weir et al.	Wu et al.
Bias due to confounding				
1.1 Is there potential for confounding of the effect of the intervention of the study? (If N/PN to 1.1: the study can be considered to be at low risk of bias due to confounding and no further signalling questions need be considered)	Y	PY	PY	PY
1.2 Determine if there is a need to assess time varying confounding. (If N/PN, answer questions relating to baseline confounding (1.4 to 1.6). If Y/PY, proceed to question 1.3)	N	N	No	N
1.3 Were intervention discontinuations or switches likely to be related to factors that are prognostic for the outcome (If N/PN, answer questions relating to baseline confounding (1.4 to 1.6). If Y/PY, answer questions relating to both baseline and time-varying confounding (1.7 and 1.8)	skip	skip	skip	skip
1.4 Did authors use an appropriate analysis method that controlled for all the important confounding domains?	PY	PN	PY	PY
1.5 (If Y/PY to 1.4) Were confounding domains that were controlled for measured validly and reliably by variables available in the study?	PY	PN/skip	PY	PY
1.6 Did authors control for any post-intervention variables that could have been affected by the intervention?	NI	PN	NI	PN
1.7 Did the author use an appropriate analysis method that adjusted for all the important time confounding domains and for time varying confounding?	skip	N	PY	skip
1.8 (If Y/PY to 1.7) Were confounding domains that were adjusted for measured validly and reliably by the variables available in the study?	skip	skip	PY	skip
Risk of Bias judgement (Table 1)	Serious	Serious	Moderate	Moderate
Optional: what is the predicted direction of bias due to confounding?				
Bias in Selection of Participants				
2.1 Was selection of participants into the study based on participant characteristics observed after the start of intervention? (If N/PN to 2.1: go to 2.4)	PN	Y	Y	N

2.2 (If YPY to 2.1) Were post intervention variables that influenced selection likely to be associated with intervention?	skip	N	Y	skip
2.3 (If YPY to 2.2) Were post intervention variables that influenced selection likely to be influenced by the outcome or a cause of the outcome?	skip	N/skip	PY	skip
2.4 Do start of follow up and start of intervention coincide for most participants?	Y	Y	Y	Y
2.5.(If Y/PY to 2.2 and 2.3, or N/PN to 2.4) Were adjustment techniques used that are likely to correct for the presence of selection biases?	skip	N/skip	N	skip
Risk of Bias judgement (Table 1)	Moderate	Moderate	Seriou s	Low
Optional: what is the predicted direction of bias due to selection of participants into the study?				

Bias in Classification of Interventions

3.1 Were intervention groups clearly defined?	Y	Y	Y	Y
3.2 Was the information used to define intervention groups recorded at the start of the intervention?	Y	Y	PY	Y
3.3 Could classification of the intervention status have been affected by the outcome or risk of the outcome?	N	N	N	N
Risk of Bias Judgement (Table 1)	Low	Low	Low	Low
Optional: what is the predicted direction of bias due to measurement of outcomes or interventions?				

Bias Due to Deviations from Intended Interventions?

4.1. Were there deviations from the intended intervention beyond what would be expected in usual practice?	N	PN	PN	PN
4.2. If Y/PY to 4.1: Were these deviations from intended intervention unbalanced between groups and likely to have affected the outcome?	skip	skip	skip	skip
4.3. Were important co-interventions balanced across intervention groups?	skip	skip	PY	skip
4.4. Was the intervention implemented successfully for most participants?	skip	skip	PY	skip
4.5. Did study participants adhere to the assigned intervention regimen?	skip	skip	PY	skip
4.6. If N/PN to 4.3, 4.4 or 4.5: Was an appropriate analysis used to estimate the effect of starting and adhering to the intervention?	skip	skip	skip	skip
Risk of Bias judgement (Table 2)	Low	Low	Moder ate	Low
Optional: What is the predicted direction of bias due to deviations from the intended interventions?				

Bias Due to Missing Data

5.1 Were outcome data available for all, or nearly all, participants?	Y	PY	Y	N
5.2 Were participants excluded due to missing data on intervention status?	N	N	N	PY
5.3 Were participants excluded due to missing data on other variables needed for the analysis?	PN	Y	N	PY
5.4 (If PN/N to 5.1, or Y/PY to 5.2 or 5.3) Are the proportion of participants and reasons for missing data similar across interventions?	skip	N	skip	N
5.5 (If PN/N to 5.1, or Y/PY to 5.2 or 5.3) Is there evidence that results were robust to the presence of missing data?	skip	Y	skip	PY
Risk of Bias judgement (Table 2)	Low	Low	Low	Serious
Optional: What is the predicted direction of bias due to missing data?				

Bias in Measurement of Outcomes

6.1 Could the outcome measure have been influenced by knowledge of the intervention received?	PY	PY	PY	PN
6.2 Were outcome assessors aware of the intervention received by study participants?	NI	Y	Y	PY
6.3 Were the methods of outcome assessment comparable across intervention groups?	Y	PY	Y	Y
6.4 Were any systematic errors in measurement of the outcome related to intervention received?	NI	PN	PN	PN
Risk of Bias judgement (Table 2)	Serious	Serious	Moderate	Low
Optional: What is the predicted direction of bias due to measurement of outcomes?				

Bias in Selection of the Reported Result

Is the reported effect estimate likely to be selected, on the basis of the results, from.... 7.1. ... multiple outcome measurements within the outcome domain?	N	PY	PN	PY
7.2 ... multiple analyses of the intervention-outcome relationship?	N	PN	PN	PN
7.3 ... different subgroups?	N	PN	PN	PN
Risk of Bias judgement (Table 2)	Low	Moderate	Moderate	Moderate

For full details on the ROBINS I bias evaluation tool, refer to Sterne et al. in references.

Table S2. Primary outcomes for each paper used, their definitions, and the sources of these definitions.

Paper	Outcome	Definition/Source	Outcome	Definition/Source	Other Major Outcomes	Definition/Source
Assimon et al.	1-year All-cause mortality	Death due to any cause.	1-year Cardiovascular Mortality	Death with any cardiovascular death code 23, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36) listed as the cause of death on the ESRD death notification form. (these codes correspond to acute MI, pericarditis (incl cardiac tamponade), atherosclerotic heart disease, cardiomyopathy, cardiac arrhythmia, cardiac arrest (cause unknown), valvular heart disease, pulmonary edema due to exogenous fluid, CHF, pulmonary embolus and cerebrovascular accident (including	Intradialytic Hypotension	A systolic blood pressure decrease ≥ 20 mm Hg during hemodialysis AND intradialytic saline solution administration, OR intradialytic nadir systolic blood pressure < 90 mm Hg. Source: (Assimon et al. 2018)

				intercranial hemorrhage).		
Shireman et al.	All-cause mortality	USRDS Core CD	Cardiovascular Mortality and Morbidity	Cardiovascular morbidity: Inpatient hospitalization (medicare part A claims) for myocardial infarction, ischemic heart disease, revascularization, CHF, cerebrovascular accident, or peripheral vascular disease. Cardiovascular mortality: USRDS listed cause of death (MI, atherosclerotic heart disease, cardiomyopathy,	N/A	N/A

				cardiac arrhythmia, cardiac arrest, cerebrovascular accidents). Source: (Shireman et al. 2016)		
Weir et al.	All-cause mortality	Ontario Health Insurance Plan (OHIP) Registered Persons Database	Ventricular Arrhythmia (proxy for the risk of sudden cardiac death)	ICD-10 code I490	Cardiovascular Disease	The composite of death, myocardial infarction, or heart failure. Source: (Weir et al. 2015)
Wu et al.	All-cause mortality	N/A	Major Adverse Cardiovascular Events (MACE)	A hospital admission in Taiwan's NHIRD with a primary diagnosis of acute MI, ischemic stroke and heart failure.	N/A	N/A

Wu et al. did not include an official definition for their outcome of all-cause mortality.

Table S3. I^2 values

		I^2 percentages	
		ACM	CVE
Papers	All 4 Included	84%	35%
	Weir et al removed	59%	0%
	Assimon et al removed	88%	48%
	Shireman et al removed	89%	55%
	Wu et al removed	86%	52%

The statistical heterogeneity of the selected studies was explored by removing each of the four studies separately from Review Manager. The table summarizes the resulting I^2 values. Higher values indicate a greater degree of heterogeneity.