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# Use of matching methods in observational studies with critical patients and renal outcomes. Scoping review

## *Utilización de los métodos de emparejamiento en estudios observacionales con pacientes críticos y desenlaces renales. Revisión exploratoria*

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### What do we know about this problem?

In observational studies, matching methods are increasingly being used to control for confounding variables derived from non-random assignment of individuals to exposure groups. Multivariate regression or matching algorithms are the methods most frequently used to address confounding risk.

### What does this new study add?

The use of these methods, such as the propensity score, is not always adequate, as is also the case with the reporting of study findings. A scoping review was conducted in order to assess the use and reporting of these methods, describing the aspects that need to be taken into account in the report.

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## Abstract

### Introduction

Although the use of matching techniques in observational studies has been increasing, it is not always adequate. Clinical trials are not always feasible in critically ill patients with renal outcomes, and observational studies are an important alternative.

### Objective

Through a scoping review, determine the available evidence on the use of matching methods in studies involving critically ill patients and renal outcome assessments.

### Methods

Medline, Embase, and Cochrane databases were used to identify articles published between 1992 and week 10 of 2020. Studies had to assess different exposures in critically ill patients with renal outcomes using propensity score matching.

### Results

Most publications are cohort studies 94 (94.9%), with five (5.1%) reporting cross-sectional studies. The main pharmacological intervention was the use of antibiotics in seven studies (7.1%) and the main risk factor studied was renal injury prior to ICU admission in 10 studies (10.1%). The use of standardized means to assess balance of baseline characteristics was found in only 28 studies (28.2%). Most studies 95 (96%) used logistic regression to calculate the propensity score.

### Conclusion

Major inconsistencies were observed regarding the use of methods and reporting of findings. Considerations related to the use of propensity score matching methods and reporting of findings are summarized.

### Keywords

Critical illness; critical care; renal replacement therapy; acute kidney injury; propensity score.

## Resumen

### Introducción

El uso de técnicas de emparejamiento en estudios observacionales ha ido en aumento y no siempre se usa adecuadamente. Los experimentos clínicos no siempre son factibles en los pacientes críticos con desenlaces renales, por lo que los estudios observacionales son una alternativa importante.

### Objetivo

Mediante una revisión de alcance, determinar la evidencia disponible sobre la utilización de los métodos de emparejamiento en los estudios que incluyen pacientes críticamente enfermos y que evalúan desenlaces renales.

### Métodos

Se utilizaron las bases de datos de Medline, Embase, y Cochrane para identificar artículos publicados entre 1992 y 2020 hasta la semana 10, que estudiaran diferentes exposiciones en el paciente crítico con desenlaces renales y utilizaran métodos de emparejamiento por propensión.

### Resultados

La mayoría de las publicaciones (94) son estudios de Cohorte (94,9 %), cinco estudios (5,1 %) correspondieron a cross-seccional. La principal intervención farmacológica fue el uso de antibióticos en siete estudios (7,1 %) y el principal factor de riesgo estudiado fue la lesión renal previa al ingreso a UCI en diez estudios (10,1 %). El balance entre las características de base evaluado mediante medias estandarizadas se encontró solo en 28 estudios (28,2 %). La mayoría de los estudios 95 (96 %) utilizaron regresión logística para calcular el índice de propensión.

### Conclusiones

Se observaron grandes inconsistencias en la utilización de los métodos y en el informe de los hallazgos. Se hace un resumen de los aspectos por considerar en la utilización de los métodos y reporte de los hallazgos con el emparejamiento por índice de propensión.

### Palabras clave

Enfermedad crítica; cuidados intensivos; terapia de reemplazo renal; lesión renal aguda; puntaje de propensión.

## INTRODUCTION

A clinical trial is the quintessential design to determine, in most cases, causal associations between exposures and the outcomes that it seeks to establish. Random subject assignment, coupled with adequate sample size, allows for homogenous distribution of baseline characteristics among the individuals in the comparison groups. However, controlled clinical trials are not always feasible due to ethical reasons, costs, or other and, therefore, observational studies are an important option in clinical research, despite the higher probability of obtaining biased estimations (1). Hence the need to use methods designed to control for confounding variables.

Causal inference techniques have been developed over the past few years, propensity score matching (PSM) being one of the most frequently used to control confounding variables. The goal of

matching using the propensity index is to achieve a balance of baseline characteristics in the comparison groups (2-6).

Success in achieving adequate balance of baseline variables depends on the correct specification of the propensity score (PS) model. This requires including all potential confounding variables, i.e., those that could modify both the probability of being exposed or receiving the treatment, as well as the occurrence of the outcome (7-9).

The boom of scientific papers that describe the use of these methods requires editors, peer reviewers and researchers in the area of critical medicine to be knowledgeable of how studies that include those methods should be reported. Publications using PSM have been reviewed in other clinical settings. In the urological literature, Nayan found deficient reporting (10) and, more recently, Yao (11) conducted a review of the application of PS methods in treated cancer patients assessing inconsistencies. However, no studies

exploring the use of matching methods in critically ill patients with renal outcomes have been found to date.

In this work, an exploratory systematic review was conducted based on the available evidence in critical medicine of the studies that assessed the effects of different interventions and risk factors in renal outcomes, using matching techniques. The aim is to describe the methods employed and give recommendations regarding their adequate use.

## METHODOLOGY

The protocol followed the PRISMA guidelines for Scoping Reviews.

### Eligibility criteria

The studies included in the review had to assess different exposures in critically ill

patients and to describe renal outcomes. PSM techniques should have been included in the analysis.

The Medline, Embase and Cochrane databases were queried for the period between week 1 of 1990 and week 10 of 2020, using the following search strategy:

**(((renal dysfunction) OR (renal outcomes)) OR (acute renal failure)) AND (((critical care patients) OR (intensive care unit)) OR (critical illness)) OR (critical ill))) AND (((propensity score matched analysis) OR (propensity-matched)) OR (propensity score matching)) OR (propensity score)  
Filters: Adult: 19+ years, Humans.**

### Study selection and classification

All observational cohort and cross-sectional studies were included. Based on titles and abstracts, two reviewers (HO and GB) working independently selected the analytical studies that met the criteria of critically ill patients, use of propensity score matching (PSM) and assessment of renal outcomes. In cases of disagreement, a third reviewer (PC) reviewed the full text in order to settle the discrepancy.

### Study characteristics

The year of publication, journal, country of origin, treatments or exposures, and the criteria to evaluate the methodological quality of the matching methods described by authors like Austin, Nayan and Yao were taken into account (6,10,11):

1. Publication year, author and country
2. Exposures or treatments assessed
3. Study type: cohort, cross-sectional
4. Method used to estimate the propensity score (logistic, probit, Poisson, regression trees, neuronal networks)
5. Description of the covariables

included in the propensity score model

6. Rationale for the use of covariables
7. Matching algorithm description (nearest neighbor, Caliper, Greedy Matching)
8. Description of subject coincidence method
9. Assessment of covariable balance between exposure groups (standardized differences of p value)
10. Description of statistical methods designed to assess exposure effect on outcomes. Need to incorporate standard error adjustments due to matching-originated dependence.

### Summary of the results

The full text of each of the studies was paired-reviewed by the authors (HO and GB) in order to assess the items required be reported in observational studies that use PSM, in accordance with Austin's recommendation. The information contained in the studies was entered into an Excel database according to the list of study characteristics, determining whether the relevant criterion was met or not, or whether it was not reported (Complementary content 1, Table 1).

## RESULTS

The search strategy identified 123 studies (4,5,12-96). Of these, 99 were selected based on title and abstract reviews in accordance with the inclusion criteria (Figure 1).

The first study was published in 2002 and, as shown in Figure 2 and Complementary content 2, the number of published studies has grown since then.

The largest number of publications (35) corresponded to American journals (35.3%) and the journals with the largest number of publications were Critical Care with 13 studies (13.2%), Critical Care Medicine, 11 studies (11.2%) and Intensive Care Medicine, 7 studies (7.14%) (Complementary content 3 and 4).

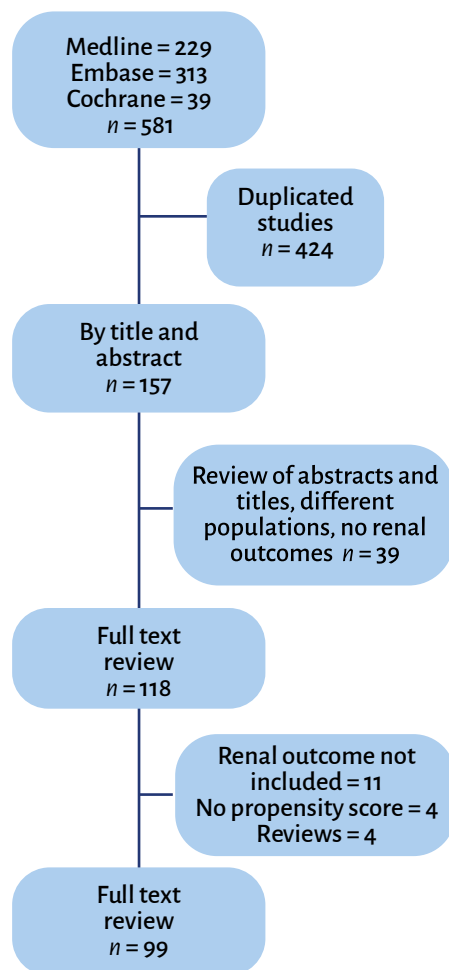
**TABLE 1.** Items that need to be taken into account in observational studies that use PSM methods.

Characteristic	n (%)
<b>Study type</b>	
Cohort	94(94.9)
Cross-sectional	5(5.1)
<b>PS calculation method</b>	
Logistic regression	95(96.0)
Not reported	4(4.0)*
<b>Matching method</b>	
Agreement matching	64(65.7)
Stratification	13(13.1)
Covariable in one model	12(12.1)
IPW (weighting)	3(3.0)
Stratification + covariable	1(1.0)
IPW + stratification	1(1.0)
Not reported	5(5.1) *
<b>Closeness determination</b>	
Nearest neighbor	14(14.1)
Caliper	12(12.1)
Greedy Matching	12(12.1)
Nearest neighbor + caliper	10(10.1)
Not reported	51(51.5)*
<b>Balance assessment</b>	
p value	54(54.5)
Standardized means	21(21.2)
C statistic	9(9.1)
ROC curve	7(7.1)
Standardized means + p value	4(4.0)
Standardized means + C statistic	2(2.0)
Standardized means + ROC value	1(1.0)
Not reported	1(1.0)*
<b>Methods in the analysis</b>	
Student's t test	19(19.2)
Fisher's exact test-Mann-Whitney U test	17(17.2)
Fisher exact test-chi-square test	17(17.2)
chi-square test Wilcoxon rank	14(4.1)
Kaplan Meier-Log rank	7(7.1)
McNemar	3(3.0)
Mann-Whitney rank	3(3.0)
Cochran test-Fisher exact test.	2(2.0)
Cochran test-Fisher exact test.	2(2.0)
Not reported	17(17.2)*
<b>Covariable description</b>	
Yes	97(97.9)
No/Not reported	2(2.0)

\*Number of articles with no reporting of the assessed criterion. IPW: inverse probability weighting.

SOURCE: Authors.

**FIGURE 1.** Flow diagram of the selection of studies assessing critically ill patients with renal injury using matching methods.

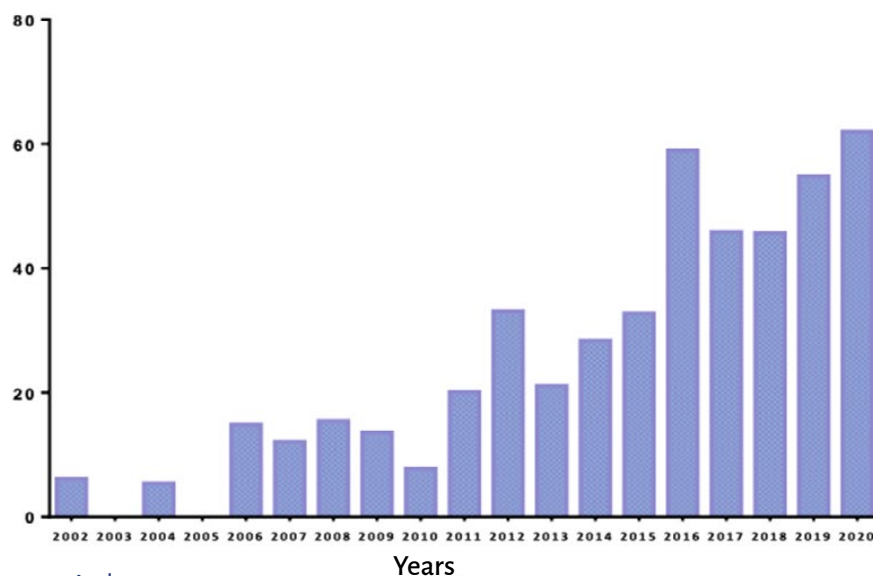


SOURCE: Authors.

In terms of exposures or treatments assessed in the selected publications, pharmacological interventions were the most frequent, in 33 studies (33.3%), followed by assessment of surgical and other invasive procedures in 20 studies (20.4%); risk factors were third, assessed in 19 studies (19.4%); 16 studies with dialysis therapy were fourth (16.3%); and, finally, 11 studies assessed administrative processes and biomarkers (11.2%) (Complementary content 5).

For PS estimations, 95 studies (95.9%) used logistic regression, and the use of covariables in PS calculations was reported

**FIGURE 2.** Number of publications per year with adjusted propensity score for every 1000 publications with and without PS.



SOURCE: Authors.

and justified in the majority of studies. Only two studies (2.0%) did not describe the rationale for the use of covariables.

### Matching methodology reporting

In terms of the type of PSM, the most frequent was matching in 62 studies (64.3%), followed by the stratification method in 13 studies (13.2%). The propensity index was used as covariable in the multivariate analysis in 12 studies (12.2%); and 5% of the studies did not mention the matching algorithm. Regarding the selection of the proximity method in control assignments, it was found that the nearest neighbor method was used in 14 studies (14.2%), followed by caliper, Greedy Matching and nearest neighbor + caliper, with 12 (12.2%), 12 (12.2%) and 9 (9.2%), respectively. The majority of the studies, 51 (52.0%), did not report a particular method. When assessing baseline characteristic balancing through the calculation of standardized mean differences, it was reported only in 27 studies (27.6%). In terms of tests used for analyzing the effect of the exposure on outcome, parametric tests such as Student's

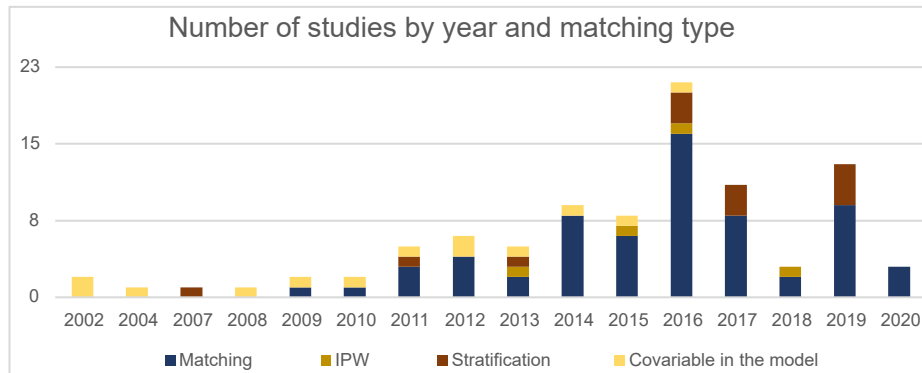
t test for independent samples were used in 18 studies (18.4%). Only 10 of the studies reviewed (10%) reported how standard error calculation was approached.

### Evolution of matching methods

Key to achieving balance of baseline characteristics is the PS method used. Figure 3 shows that matching was the most widely used, followed by stratification and the use of propensity index as a covariable in a multivariate analysis model; change of algorithms over time can also be observed, with initial predominance of the propensity index as a covariable, with incorporation of inverse probability weighting (IPW) having occurred only recently.

## DISCUSSION

This scoping review identified 98 studies published in the past 18 years that used the PSM methodology. It was found that 51 studies (52%) did not report the closeness algorithm used for matching,

**FIGURE 3.** Evolution of the use of matching algorithms.

IPW: inverse probability weighting. SOURCE: Authors.

and the balance of baseline characteristics was inadequately assessed in 54 studies (55%) and consequently, adequate control of confounding variables could not be ascertained in half of the studies. On the other hand, matching was the predominant method, reported in 63 studies (64.3%), while more robust methods such as IPW were used only in 3 studies (3.1%). However, it was found that all studies published in the last three years reported the balance of baseline characteristics in the form of standardized differences; they were all cohort studies with adequate mention of the matching methods, which is evident in the 19 studies published between 2018 and 2020; and only 5 studies did not specify the closeness algorithm.

These findings are consistent with those described by Nayan and Austin (10,97), who assessed studies in urology and cardiovascular surgery. In these areas of medicine, significant inconsistencies are also found in the reports of the procedures used with the PSM methodology. These inconsistencies do not only compromise the estimated validity but could also introduce estimation bias, additional to inconsistencies in variance calculation and residual confounding due to omission of non-observed variables.

In terms of the balance of baseline characteristics, the consensus is that it should be done through comparison of differences in standardized means both

in the exposed as well as the non-exposed groups and it is expected that these differences should not be higher than 10%. Balance assessment by p value only is not appropriate, given sample size influence on these values (Complementary content 6).

### Why is it important to report the matching method employed?

The choice of the matching method can determine the presence of greater or smaller bias, greater or smaller variance.

In matching (98-100) it is unlikely that two subjects in a population will have equal score so, in practice, matching is usually done on the basis of propensity score "closeness" which means that a treated subject with an estimated  $\Pr[T=1|X]$  probability of being treated of 0.67492, can be matched with a not treated subject with an estimated  $\Pr[T=1|X]$  probability of 0.67510. Now then, there are several ways to define closeness, one of them being nearest neighbor distance or the use of a caliper based on 0.2 standard deviations from the logarithmic transformation of the propensity score (99,101). In matching, the definition of closeness implies balance between bias and accuracy: if the closeness criteria are too permissive, individuals with relatively different values will be matched among themselves, giving rise to a variable score distribution between the treated and

the not treated population, and creating estimation risk (101,102); but if closeness criteria are too stringent, matching will exclude many subjects, giving rise to wider 95% confidence intervals and lower accuracy (103).

Additionally, the consequence of probability assumptions different from zero and lower than 1 (1) in the PS, will determine that matching will only be done for scores greater than 0 and lower than 1 that coincide in treated and not treated subjects, restricting the population to the common support region (99). The consequence of limiting to the common support region will be a smaller population size and, therefore, lower accuracy (104) (Figure 4).

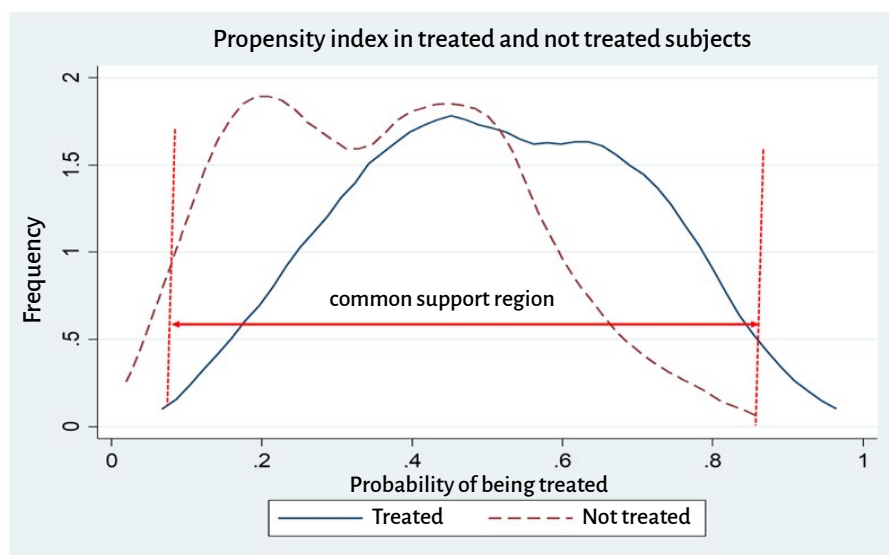
Third, sample restriction may result in a limited causal effect, i.e., a causal estimator being far from the initial study population.

Fourth, when the sample is restricted to the common support region, it could maintain the subjects that benefit the most from the intervention, excluding those who benefit the least, with the obvious result of biased estimates.

As for the matching by stratification method described by Rosebaum and Rubin (1), five strata are created and individuals exhibiting similar but not identical values are matched; they demonstrated up to 90% elimination of bias derived from observed confounding variables. Stratification also has limitations, given that differences in distributions between treated and not treated subjects are found in each of the strata, compromising subject interchangeability with the stratum (2,105). Finally, another method consists of using the propensity score as a continuous covariable together with other covariables in the multivariate analysis (106). With this approach, an indicator variable that shows treatment status and the estimated propensity score is included (6). Hernán and Robins (107) highlight that when the propensity score is included in the regression it is important to include an interaction term between the score and the set of covariables; the new limitation



**FIGURE 4.** Common support region in relation to the PS in treated and not treated subject distributions.



**SOURCE:** Authors.

with the regression is that the parameters cannot be interpreted causality.

In view of the above considerations regarding the variations that may occur with the use of matching methods in terms of standard error calculation and the choice of statistical tests to assess exposure in relation to outcome, there is a need to adhere to the criteria reported in the literature, summarized in [Table 2 \(6,10,97,108\)](#), so that they are considered in the analysis and reporting of the results of studies using PSM.

Not less important than the assessment of the above criteria in matching methods is the criterion used for selecting the variables when building the model for propensity index calculation. This work found that, although 97 studies (97.9%) reported the variables used in PS calculation, none of the studies included a thorough discussion of the relationship of each of the included variables with both the exposure as well as the outcome, considering that exposure-related variables included in the model will not contribute to the estimation but will actually increase the estimator standard error. Something similar can also happen with exposure-associated variables with just a weak association with the outcome,

while variables associated only with the outcomes which are included in the model, would diminish the estimator standard error ([109](#)). Special attention must be paid to variables found in the causal pathway as intermediate variables because they not only do not contribute but, when included, would cancel out the sought effect which, in this case, is estimating the probability of being treated or exposed. Current observational studies aimed at establishing causality include directed acyclic graphs (DAGs) which are a valuable tool to clarify relationships of observed confounding variables and intermediate variables within the causal pathway.

## CONCLUSIONS

Studies of critically ill patients that assess renal function outcomes and apply PS vary significantly in terms of reporting of the methods used for the analysis and treatment of exposure, outcome and confounding variables. Results must be interpreted in the light of the differences in the results derived from the use of matching algorithms, assessment of balance between the groups in terms

in baseline characteristics, and the use of analytical methods for the exposure variable; this will result in the limitations discussed above, consisting mainly of the balance between bias and accuracy. Moreover, clinical judgement will have to be used as a starting point to determine the plausibility of the relationship between the exposures and outcomes under study, taking into account the great limitation imposed by the variables that will not be observed.

The methodological criteria proposed in the literature which establish the correct use of methods when it comes to analyzing and reporting the results of studies that use PSM were applied in this review.

## ETHICAL RESPONSIBILITIES

### Human and animal protection

The authors declare that no human or animal experiments were carried out as part of this research.

### Data confidentiality

The authors declare that the protocols of their center pertaining to patient data were followed.

### Right to privacy and informed consent

The authors declare that no patient data appear in this article.

The authors obtained the informed consent of the patients and/or subjects referred to in this article. This document is kept by the corresponding author.

## ACKNOWLEDGEMENTS

### Authors contributions

HO, GB and PAC participated in question formulation and design conception; review of the articles; data analysis; writing of

**TABLE 2.** Description of methods used in the studies that apply propensity scores in the literature that assesses renal outcomes in critically ill patients.

Section	Description	Alternatives	Interpretation
<b>Title</b>	Identifies type of study and methodology to be used	Cohort, cross-sectional	One of the advantages of the propensity score is that it allows to separate the design from the analysis; cohort designs make PS estimation easier according to the identification of variables found temporarily before the exposure, whereas in cross-sectional and case-control designs establishing this temporality is not possible (1).
<b>Abstract</b>	Provides information on study objective, methods, results and conclusions	Design: 1. Cohort, cross-sectional 2. Participants 3. Sample size 4. Exposure and outcomes 5. Estimates and their accuracy	Failing to provide information in the summary will prevent the study from being adequately selected in preliminary searches.
<b>Introduction</b>	Introduction to the context, data source datos	Highlights the importance of the study, states study objective	Provides information on the topic, states the background for the study, highlights the value and usefulness of the work; provides only the necessary information.
<b>Methods</b>	Describes the method for propensity score estimation	Models: logistic, probit, regression trees, neuronal networks	Describing the method is important for the reproducibility of the of the results; machine learning methods can be more difficult to interpret and do not offer a clear advantage over conventional statistical methods (2).
	Describes how the information was collected	Administrative databases, electronic medical records	Database validation, description of algorithms for diagnosis determinations, approach to missing data.
	Describes the covariables included in the model and inclusion rationale	Exposure-associated confounding variables	Compliance of the conditional independence assumption. Selection bias is assumed to be due only to observable characteristics, requiring the inclusion of all the characteristics that cause selection bias (7,102,107).
	Describes matching algorithm	Matching, weighting, stratification and use of propensity score as covariable	The choice of the matching algorithm is not based on principles and, therefore, it is mainly arbitrary. Most matching algorithms depend on the order of data observation. Non-matched observations are discarded, resulting in loss of accuracy and power. When propensity score is included in a regression, the fact that it can interact with treatment is often forgotten, hence the need to adequately specify the regression model and assess that interaction (6,101).
	Describes closeness methods in exposed and non-exposed subjects according to propensity score	Nearest neighbor, Kernel, caliper, Greedy Matching	Closeness criteria condition a balance between bias and accuracy; therefore, very stringent closeness criteria result in the exclusion of many subjects, increasing variance, while very loose criteria match individuals with somewhat different characteristics, increasing bias (99,101).

Section	Description	Alternatives	Interpretation
<b>Methods</b>	Matching quality: describes methods used to assess balance between groups in terms of baseline characteristics	Use of standardized mean differences, p value, graphic assessment	The p value is independent from sample size; small differences are found as significant in large samples, standardized differences must be preferred for balance assessment (7).
	Mentions the type of statistical analysis	Uses tests such as McNemar, conditional logistic regression log Rank adjusted, Cox proportional risk models, matching-stratified	Measurement dependencies must be taken into account; failure to do so will result in standard error inconsistencies when tests for independent samples are applied (103).
<b>Results</b>	Describes participant population according to the percentage of matched individuals	Common support region, trimming	Limitation to this common support region requires considering that results cannot be interpolated to the study population; any effect of the limitation and trimming on the result must be verified; few verification techniques have been described.
	Describes standard error calculation used to obtain confidence intervals	Use of: 1. Bootstrapping 2. Robust errors 3. Jackknife 4. Analytically	The variance due to propensity score estimation as well as the variance due to the matching method (with or without replacement) must be incorporated.
<b>Discussion</b>	Discusses the limitations of the study	Population proportion	The more the population is restricted, the farther from the study population and other subsequent populations will the causal estimator be.
		Residual confounding	Residual confounding must be expected when confounding variables are not being observed. Confounding variables that may affect the result must be recognized and named; a sensitivity analysis may be included in the best scenario.
		Accuracy	Standard error calculation limitations must be taken into account.

**SOURCE:** Authors.

the manuscript; critical review; and final approval of the manuscript.

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None declared.

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#### Conflict of interest

The authors have no conflict of interest to disclose.

#### Presentaciones

None declared.

#### Appreciation

None declared.

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## COMPLEMENTAR CONTENT

### COMPLEMENTAR CONTENT 1. Study characteristics assessed.

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2002	Ravindra L.	The American Journal of Medicine	United States	Cohort	Timing of nephrology consult in acute renal failure (early vs. late).	Age, sex, urinary output, liver failure, hematological insufficiency, heart rate, and serum creatinine and BUN	Covariable in one model	Not reported	ROC values	Logistic regression	Mortality
2002	Mehta RL	JAMA	United States	Cohort	Association of diuretics with adverse or favorable outcomes in critically ill patients with acute renal failure	Age, nephrotoxic etiology of acute renal failure, BUN, acute respiratory failure and congestive heart failure.	Covariable in one model	Not reported	ROC values	Logistic regression	Mortality
2004	Uchino, S.	Crit Care Med	Australia	Cohort	Determination of the impact of diuretics on mortality rate in critically ill patients with acute renal failure	Patient age, simplified acute physiology score II, creatinine on ICU admissions, need for renal replacement therapy, time between ICU admission and inclusion in the study, central venous pressure, Glasgow coma score, vasopressor use, urine volume during 6 hours prior to inclusion, platelet count, creatinine, arterial pH, septic etiology, low cardiac output etiology and other etiologies	Covariable in one model	Not reported	C statistic	Logistic regression	Mortality
2006	Cho, K. C.	J Am Soc Nephrol	United States	Cohort	Survival by dialysis modality (continuous vs. intermittent) in critically ill patients with acute renal injury	Age, liver failure, sepsis, thrombocytopenia, blood urea nitrogen and serum creatinine	Not reported	Not reported	ROC values	Logistic regression and Cox regression	Survival
2006	Liu, K. D.	Clin J Am Soc Nephrol	United States	Cohort	Association between dialysis initiation (early vs. late) and mortality.	Age, liver failure, sepsis, thrombocytopenia, and serum creatinine and stratification by site and modality of initial dialysis	Not reported	Not reported	ROC values	Logistic regression and Cox regression	Mortality
2007	S. Uchino	The International Journal of Artificial Organs	United States	Cohort	Renal replacement therapy (continuous vs. intermittent) to assess impact on survival and renal recovery	ATrial pH, furosemide dose, creatinine, gastrointestinal medical admission, immunomodulation, use of pulmonary artery catheter, hepatorenal syndrome, mechanical ventilation, mean arterial pressure and Glasgow coma score	Stratification	Not reported	P Value	Logistic regression	Survival
2008	Schortgen, F.	Intensive Care Med	France	Cohort	The risk of renal adverse events in patients with shock resuscitated with hypo-oncotic colloids, artificial hyperoncotic colloids, hyperoncotic albumin or crystalloids	Demographic characteristics, admission category (i.e., planned or unplanned medical, surgical, with the type of surgery), potentially life-threatening underlying disease, immunodeficiency, risk factors for acute renal failure and use of nephrotoxic drugs. Simplified acute physiology score (SAPS II) and the number of organ dysfunction	Covariable in one model	Not reported	P Value	Logistic regression	Renal failure

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2009	Bagshaw, S. M.	Intensive Care Med	Canada	Cohort	In patients with septic shock, describe the association between time of onset of hypotension and effective antimicrobial therapy and onset and severity of early acute renal failure	Age, sex, comorbidity, source of infection, surgical status, need for mechanical ventilation, need for vasopressors, APACHE II score, hospital setting and study year	Covariable in one model	Not reported	ROC values	Logistic regression and Cox regression	Renal failure
2009	Benedetto, U.	The Annals of thoracic surgery	Italy	Cohort	Association between on-pump coronary artery bypass grafting (CABG) vs. mini cardiopulmonary bypass systems (mini-CPB) and reduced incidence of acute renal failure	Age, sex, body mass index (BMI), preoperative GFR, diabetes mellitus, chronic obstructive pulmonary disease requiring treatment, hypertension, peripheral vascular disease, NYHA class III/IV, left ventricular ejection fraction, prior percutaneous coronary intervention, myocardial infarction within 30 days, emergency surgery, preoperative medications including blockers, angiotensin converting enzyme inhibitors or angiotensin receptor blockers, aspirin and clopidogrel within 5 days after surgery; primary surgeon, number of grafts per patient and CPB time; postoperative variables including red blood cell transfusions and low cardiac output incidence	Coincidence matching	Coincidence matching Nearest neighbor	C statistic	Logistic regression	Renal failure
2010	Billings	Journal of Cardiothoracic and Vascular Anesthesia	United States	Cohort	Pre- and postoperative use of statins and incidence of acute renal failure in patients taken to cardiac surgery	Preoperative treatment with statins, baseline creatinine, age, sex, history of diabetes, history of hypertensive disease, BMI, baseline left ventricular ejection fraction, preoperative diuretic, preoperative use of ACEI, valve surgery, use of CBP, time on CBP, aortic cross-clamping time, intraoperative inotropic support, intraoperative coronary catheterization, postoperative surgical re-exploration, postoperative diuretic, and extubation time	Stratification y Covariable in one model	Not reported	P Value	Logistic regression	Renal failure
2010	Chamchad, D.	J Cardiothorac Vasc Anesth	United States	Cohort	Immediate extubation in the operating room after cardiac surgery associated with intensive care and hospital length	Age, sex, BMI, ethnicity, preoperative serum creatinine, NYHA, reoperation, CABG, valve procedure, DM, hypertension, COPD, use of BB, angina, reintubation, bleeding, postoperative renal failure, postoperative atrial fibrillation, time on CPB, priority of the surgery, off-pump operation, surgical priority	Coincidence matching	Greedy matching	Standardized measurements	Logistic regression and Cox regression	Estancia
2010	Engoren, M.	Anesthesiology	United States	Cohort	Red blood cell transfusion vs. no transfusion in patients with acute pulmonary injury for the development of acute renal failure	Not described	Not reported	Not reported	Not reported	Logistic regression	Renal failure

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2011	Chou, Y. H.	Crit Care	Taiwán	Cohort	Impact of early or late initiation of renal replacement therapy in patients with acute renal failure of septic origin	Demographics, comorbidities, septic AKI development after surgery (or not), and indications for TSR. Biochemical data such as complete red blood cell count, blood urea nitrogen (BUN), serum creatinine (sCr), serum glutamate-oxaloacetate transaminase (GOT), total serum bilirubin, serum albumin and serum potassium (sK+) were documented on admission to the ICU and initiation of RRT. Clinical parameters included heart rate, systolic and diastolic blood pressure, central venous pressure (CVP), partial oxygen pressure in arterial blood gases and inspired oxygen fraction. Severity scores included Glasgow Coma Scale (GCS), acute physiology score and chronic health evaluation II (APACHE II), sequence organ failure assessment (SOFA) and simplified acute physiology score III (SOFA III). The use of mechanical ventilation was documented and inotropic equivalent dose was calculated.	Coincidence matching	Not reported	P Value	Logistic regression and Cox regression	Mortality
2011	Kawar, E.	Jaapa	United States	Cohort	Comparison of clinical outcomes between patients admitted to an intensive care unit managed by residents vs. medical assistant	Age, sex, admission diagnoses, patient origin before admission to the ICU and insurance status, tachycardia (heart rate 150 beats per minute), arrhythmia, hypotension, stroke, coma, intracranial mass, gastrointestinal bleeding and need for mechanical ventilation, cardiopulmonary resuscitation (CPR) within 24 hours before admission, liver cirrhosis, serum creatinine or metastatic cancer, readmission to the ICU.	Coincidence matching	Not reported	P Value	Logistic regression and Cox regression	Length of stay and mortality

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2011	Le Manach, Y.	Anesthesiology	France	Cohort	Chronic statin treatment compared to no statin treatment in terms of the main postoperative adverse events in patients undergoing vascular surgery	Age, sex, admission diagnoses, patient origin before admission to the ICU and insurance status, tachycardia (heart rate 150 beats per minute), arrhythmia, hypotension, stroke, coma, intracranial mass, gastrointestinal bleeding and need for mechanical ventilation, cardiopulmonary resuscitation (CPR) within 24 hours before admission, liver cirrhosis, high serum creatinine levels ( $\leq 2$ mg/dL) or metastatic cancer. Physician and staff names and whether the patients was being readmitted to the ICU	Covariable in one model	Not reported	C statistic	Logistic regression	Mortality
2011	Lee, E. H.	J Cardio-thorac Vasc Anesth	Korea	Cohort	Immediate postoperative hypoalbuminemia value as a marker of outcome after off-pump coronary artery bypass grafting (OPCABG)	Sex, age, body mass index (BMI), diabetes mellitus, hypertension, chronic pulmonary disease, renal failure, prior stroke, preoperative ejection fraction, preoperative hematocrit, preoperative albumin, European System for Cardiac Operative Risk (EuroSCORE) and EuroSCORE logistic additive	Coincidence matching	Not reported	P Value	Logistic regression	Renal failure
2011	Shahin, J.	Crit Care	Canada	Cohort	Relationship between inotrope use and hospital mortality and renal dysfunction in patients undergoing cardiac surgery	Parsonnet score and low left ventricular ejection fraction, age, sex, bypass time, procedure type, CABG only or other procedures and the perioperative use of intra-aortic balloon pump	Stratification	Greedy matching	P Value	Logistic regression	Mortality
2012	Attaran	European Journal of Cardio-Thoracic Surgery	UK	Cohort	Radiofrequency ablation for atrial fibrillation in patients undergoing cardiac surgery in relation to a better outcome and postoperative survival rate	Age, BMI, female gender, class IV angina, recent acute MI, current smoker, DM, hypercholesterolemia, hypertension, respiratory disease, cerebrovascular disease, renal dysfunction, three-vessel disease, priority surgery, rheumatic valve disease, euroSCORE, LVEF $< 30\%$	Coincidence matching	Not reported	P Value	Logistic regression	Mortality
2012	Azuma, N.	Eur J Vasc Endovasc Surg	Japan	Cohort	Determination of factors that affect ischemic wound healing and the role of angiosome in bypass surgery	Diabetes, end-stage renal disease, heel ulcer, Rutherford classification, serum albumin and CRP	Coincidence matching	Not reported	P Value	Logistic regression	Survival
2012	Clech, C.	Crit Care	France	Cohort	Association of renal replacement therapy with in-hospital mortality in ICU patients with acute renal failure	Increase in creatinine reflected by the RIFLE score, oliguria reflected in 24-hour urine output and SAPS II score, blood urea nitrogen, serum creatinine and potassium (before RRT initiation), fluid accumulation (reflected by the difference in patient weight when reaching maximum RIFLE class as compared to weight on admission to the ICU) and SAPS II score	Coincidence matching	Not reported	P Value	Logistic regression	Mortality

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2012	Lee, E. H.	Intensive Care Med	Korea	Cohort	Association between preoperative low levels of serum albumin and acute renal injury after off-pump coronary artery bypass	Age, body mass index, baseline renal function, left ventricular ejection fraction, liver disease, diabetes mellitus, occlusive peripheral vascular disease and chronic obstructive pulmonary disease	Coincidence matching	Greedy matching	C statistic	Logistic regression	Renal failure
2012	Vaara, S. T.	Acta Anaesthesiol Scand	Finland	Cohort	Volume of annual cases in an intensive care unit of patients treated with renal replacement therapy due to acute renal injury and its association with in-hospital mortality	Gender, age, BMI, elective surgery, intra-aortic balloon, cardiopulmonary resuscitation, comorbidities, systemic organ failure, among others	Covariable in one model	Not reported	P Value	Logistic regression	Mortality
2012	Wu, V. C.	PLoS One	Taiwan	Cohort	Impact of diuretic use and dose on mortality in critically ill patients with acute renal injury 30 days after dialysis	Gender, age, BMI, elective surgery, intra-aortic balloon, cardiopulmonary resuscitation, comorbidities, systemic organ failure, among others	Covariable in one model	Not reported	P Value	Logistic regression and Cox regression	Mortality
2013	Apel, M.	Crit Care	Germany	Cohort	End-stage renal disease is independently associated with a higher risk of death following major surgical procedures	Age, sex, comorbidities, SAPS II, surgery type and SOFA subitems on admission to the ICU	Coincidence matching	Greedy matching	P Value	Logistic regression	Mortality
2013	Bayer, O.	Critical Care Medicine	Germany	Cohort	Comparison of perioperative fluid management in cardiac surgery patients using colloids vs. crystalloids with dialysis, cardiovascular stabilization, fluid balance and mortality	Age, hypertension, DM, cirrhosis, NYHA IV, acute MI, pulmonary hypertension, bypass time, serum creatinine, use of noradrenaline or adrenaline, NSAIDs, diuretics, ACEi, aminoglycosides, glycopeptides, antifungals, iodinated contrast media, septic shock, SAPSII score	Stratification	Not reported	P Value	Logistic regression	Mortality
2013	Ehrmann	Critical Care Medicine	France	Cohort	Use vs. non use of iodinated contrast medium as related to an increase in the incidence of acute renal injury in ICU patients .	Age, hypertension, creatinine levels, chronic renal failure, diabetes, respiratory failure, coma, trauma, fluid use 12 h before inclusion, use of mechanical ventilation, shock, lactate, Sequential Organ Failure Assessment (SOFA) and sepsis.	Coincidence matching	Not reported	P Value	Logistic regression	Renal failure
2013	Leite, T. T.	Crit Care	Brazil	Cohort	Determination of the association between early vs. late initiation of dialysis after AKIN stage 3 classification and in-hospital mortality in critically ill patients	Demographic, clinical and laboratory data on ICU admission and on the day of renal replacement therapy initiation	IPW (weighting)	Not reported	Standardized measurements + significance	Logistic regression	Mortality
2013	Verônica Torres Costa e Silva	PLOS ONE	Brazil	Cohort	Time of early vs. late nephrology consult and association with prognosis in patients with acute renal failure in the ICU	<b>Late consult:</b> Diuresis, serum creatinine levels, surgical AKI and mechanical ventilation <b>Nephrology consult:</b> SAPS 3, CSA score, diuresis, serum creatinine levels, potassium and bicarbonate levels	Covariable in one model	Not reported	ROC values	Logistic regression	Mortality and Renal failure



Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2014	Brewer, R.	Ann Thorac Surg	United States	Cohort	Comparison between on-pump and off-pump coronary revascularization surgery	Age, gender, race, mortality risk, body surface area, smoker, preoperative creatinine, hypertension, DM, dyslipidemia, dialysis, chronic pulmonary diseases, peripheral vascular disease, cerebrovascular disease, prior stroke, prior acute MI, heart failure, type of surgery, number of compromised vessels, VEF <40%, left trunk stenosis >50%, preoperative intra-aortic balloon	Coincidence matching	Not reported	P Value	Logistic regression	Mortality
2014	Elmestekawy, E	Ann Thorac Surg	Canada	Cohort	Incidence and associated risk factors in mild renal failure and determination of clinical impact following cardiovascular surgery	Acute myocardial infarction, age, angina class, atrial fibrillation, cardiopulmonary bypass, CARE score, central nervous system complications, left ventricular functional class, coronary artery disease, endocarditis, sex, hypertension, intraoperative blood transfusion, hospital length of stay, length of ICU stay, time on ventilation, surgical priority, peripheral vascular disease, preoperative creatinine, preoperative hemoglobin, preoperative intra-aortic balloon pump, pulmonary edema, repeat cardiac surgery, shock, smoking	Coincidence matching	Nearest neighbor	P Value	Logistic regression	Mortality
2014	Iwagami, M.	Crit Care Med	Japan	Cohort	Effect of postoperative polymyxin B hemoperfusion on mortality in patients with abdominal septic shock	Age, sex, surgery-related findings; use of noradrenaline, dopamine and dobutamine; previously defined organ dysfunctions (6), hospital volumes and hospital type (teaching or non-teaching hospital)	Coincidence matching	Nearest neighbor	Cstatistic	Logistic regression	Mortality
2014	Raghunathan	Critical Care Medicine	United States	Cohort	Association between the use of crystalloids and in-hospital mortality in critically ill adult patients with sepsis	Not described	Coincidence matching	Greedy matching	P Value	Logistic regression	Mortality
2014	Linder, A.	Am J Respir Crit Care Med	Canada	Cohort	At least one episode of mild acute renal failure (stage 1) vs. absence of renal failure associated with long-term survival after recovery from critical disease	Sex, age, diabetes, MAP (lower baseline), noradrenaline treatment, lactate level on day 1, chronic heart failure, COPD, chronic liver failure, chronic steroid treatment, malignancy and HIV	Coincidence matching	Caliper	P Value	Regresión	Survival
2014	Oh, H. J.	Crit Care	Korea	Cohort	Benefit of a team that specializes in acute renal injury patients undergoing continuous renal replacement therapy	Age, gender, mean arterial pressure, APACHE II, organ failure, age-adjusted Charlson comorbidity index, RIFLE scale, contributing factors, use of anticoagulation, use of diuretics, laboratory tests (hemoglobin, leukocytes, creatinine, bicarbonate, BUN, total cholesterol, albumin, CRP, arterial pH and total bilirubin)	Coincidence matching	Greedy matching	P Value	Logistic regression and Cox regression	Survival

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2014	Picard, W	Antimicrob Agents Chemother	France	Cohort	Determine the nephrotoxicity risk associated with aminoglycoside treatment	Age, gender, nosocomial sepsis, sepsis origin, sepsis severity, organ failure, rhabdomyolysis, renal graft of single functional kidney, DM, cirrhosis, pre-existing renal failure, nephrotoxic treatments, ACE inhibitors/ARBs, use of diuretics, high osmolarity contrast medium, use of hydroxyethyl starches, NSAIDs, antibiotics	Covariable in one model	Not reported	P Value	Cox regression	Renal failure
2014	Vaara, S. T.	Crit Care Med	Finland	Cohort	Excess mortality attributable to acute renal injury	Excess mortality attributable to acute renal injury	Coincidence matching	Not reported	Standardized measurements + significance	Logistic regression	Mortality
2014	Wald, R.	Crit Care Med	Canada	Cohort	Intermittent vs. continuous dialysis associated with the risk of chronic dialysis	Age, sex, hospitalization year, number of admissions and emergency room visits, number of visits to family physician, nephrologist, internist, cardiologist, geriatrician and psychiatrist; coronary artery, carotid or peripheral artery revascularization, heart valve surgery, coronary angiography, cardiac stress test, echocardiography, 12-lead individual electrocardiography or outpatient 24-hour electrocardiography, pacemaker insertion or carotid Doppler ultrasound within the 5 years prior to hospitalization and ARI diagnosis, major infection, alcoholism, chronic renal disease, liver dysfunction, heart failure, myocardial infarction, diabetes mellitus, cancer, cerebrovascular disease, myocardial infarction or angina and peripheral artery disease within 5 years prior to the date of hospital admission, Charlson comorbidity index, sepsis, non-ruptured aortic aneurysm repair, heart surgery, mechanical ventilation and initiation of dialysis in a teaching hospital	Coincidence matching	Nearest neighbor	Standardized measurements	Logistic regression and Cox regression	Renal failure
2015	Chiang, Y.	J Cardiothorac Vasc Anesth	United States	Cohort	Effect of pulmonary artery catheterization on clinical outcomes after cardiac surgery in high risk patients	Demographic characteristics, preoperative characteristics (hypertension, hypercholesterolemia, diabetes mellitus, obesity, prior stroke, coronary heart disease, endocarditis, chronic obstructive pulmonary disease, pulmonary hypertension, peripheral vascular disease, chronic renal failure, dialysis, liver disease, substance abuse, previous CABG, prior valve surgery), elective surgery, type of cardiac surgery, CABG, single valve CABG surgery, double or triple CABG surgery	Coincidence matching	Not reported	P Value	Logistic regression	Mortality

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2015	Ding, W.	Cardiology	China	Cohort	Intra-aortic balloon pump in relation to early clinical outcome in high risk patients taken to elective off-pump coronary artery bypass grafting (OPCABG)	Age, sex, body mass index, smoker, DM, hypertension, dyslipidemia, renal dysfunction, prior stroke, prior acute MI, prior cardiac surgery, number of compromised coronary arteries, SYNTAX, BNO, euroSOCRE, LVEF, distal anastomosis	Coincidence matching	Not reported	P Value	Logistic regression	Mortality
2015	Horkan, C. M.	Crit Care Med	United States	Cohort	Acute renal injury in patients who survived critical care and association of post-discharge outcomes (readmission beyond 30 days after discharge, post-discharge mortality and progression to end-stage renal disease)	Age, sex, race, Deyo-Charlson index, type of patient and risk classification, injury, failure, loss of renal function or end-stage renal disease	Covariable in one model	Caliper	P Value	Logistic regression and Cox regression	Mortality and Renal failure
2015	Leite, T. T.	Clin J Am Soc Nephrol	Brazil	Cohort	Renal outcomes in critically ill patients receiving propofol or midazolam	Sex, age, non-renal admission, simplified acute physiology score I and sequential organ failure evaluation, main comorbidities, type of ICU admission (medical, surgical or coronary), sepsis diagnosis, admission, Glasgow Coma Scale score, renal function on admission to the ICU (first serum creatinine measurement available), need for vasoactive drugs during the first 48 hours in the ICU and mean arterial pressure median in the first 48 hours in the ICU	Coincidence matching	Nearest neighbor	Standardized measurements + significance	Logistic regression	Renal failure
2015	Alexandre Liborio	Nephrology Dialysis Transplantation	United States	Cohort	Propofol vs. midazolam.	Sex, age, non-renal admission, simplified acute physiology score I and sequential organ failure evaluation, main comorbidities, type of ICU admission (medical, surgical or coronary), sepsis diagnosis, admission, Glasgow Coma Scale score, renal function on admission to the ICU (first serum creatinine measurement available), need for vasoactive drugs during the first 48 hours in the ICU and mean arterial pressure median in the first 48 hours in the ICU	Coincidence matching	Nearest neighbor + caliper	Standardized measurements	Logistic regression	Renal failure
2015	Liborio, A. B.	Clin J Am Soc Nephrol	Brazil	Cohort	Complications of renal failure in critically ill patients associated with mortality and dialysis rates	Age, SAPS-I/SOFA scores on admission, maximum BUN, cumulative fluid balance, minimum bicarbonate, maximum serum potassium and main comorbidities, including heart failure	Coincidence matching	Nearest neighbor	P Value	Logistic regression	Mortality and Renal failure
2015	Sang, B. H.	Crit Care Med	Korea	Cohort	Influence of postoperative albumin level on the prevalence of acute renal injury after live donor liver transplant	Age, sex, BMI, diabetes, hypertension, mean arterial pressure, CHILDPUGH score, model for end-stage liver disease score, hemoglobin, platelets, albumin, sodium, total bilirubin, creatinine, prothrombin time and intraoperative data	IPW (weighting)	Not reported	C statistic	Logistic regression and Cox regression	Renal failure

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2015	Shaw, A. D.	Crit Care	United States	Cohort	Type of intravenous fluid administered to patients with systemic inflammatory response syndrome and association with outcome	Age, sex, race, admission source, admission type, urban, comorbidities	Coincidence matching	Greedy matching	P Value	Logistic regression	Mortality
2015	Shen, T. C.	Medicine (Baltimore)	Japan	Cohort	Risk of septicemia in patients with end-stage renal disease with or without renal transplant	Age, sex, index date, comorbidities (hepatitis B, hepatitis C, Charlson comorbidity index score) and medications (steroids and immunosuppressors [cyclosporine, azathioprine, mycophenolate mofetil and tacrolimus]).	Coincidence matching	Not reported	P Value	Logistic regression and Cox regression	Mortality
2016	Allen, C. J.	Mil Med	United States	Cohort	Risk of acute renal failure or death in patients with penetrating trauma receiving a single bolus of hydroxyethyl starch during initial fluid resuscitation	Age and sex, injury characteristics (injury severity score, initial systolic blood pressure, heart rate, Glasgow scale), excess base, hematocrit, need for blood transfusion, ICU admission and surgery	Coincidence matching	Nearest neighbor	P Value	Logistic regression	Mortality and Renal failure
2016	Bonnet, V.	Medicine (Baltimore)	France	Cohort	Comparison of postoperative complications of mitral valve repair taking into account age under and over 80 years and comorbidities	Age over and under 80 years, sex, BMI, comorbidities, NYHA $\geq 2$ , LVEF $< 45\%$ , pulmonary hypertension, type of surgery, surgical time	Coincidence matching	Not reported	C statistic	Logistic regression	Mortality
2016	Carmona, p	Interact Cardiovasc Thorac Surg	Spain	Cohort	On or off-pump coronary revascularization surgery comparing intraoperative and 30-day postoperative outcomes	Age, sex, EuroSCORE logistic, smoking, obesity BMI $> 30$ , hypertension under treatment, dyslipidemia under treatment, diabetes mellitus under with insulin treatment, past medical history of stroke (stroke or transient ischemic attack), chronic pulmonary disease: pulmonary disease under treatment with bronchodilators or steroids, clinical symptoms of stable or unstable angina, past history of percutaneous coronary intervention, history of acute coronary syndrome within the previous 6 months. Surgery, intra-aortic balloon pump implantation before surgery. Chronic renal disease: defined as preoperative creatinine $> 2$ mg/dL or need for renal replacement therapy, peripheral artery disease with intermittent clinical symptoms. Lower limb claudication, more than 50% carotid artery occlusion, amputation of any limb due to arterial disease, prior aortic or lower limb artery surgery, priority of the surgery: if the case was intervened within the first 24 hours after indication of surgery or later	Coincidence matching	Not reported	ROC values	Logistic regression	Mortality
2016	Chao, p. W.	Crit Care Med	Taiwan	Cohort	Long-term results in critically ill septic patients who received cardiopulmonary resuscitation vs. those who did not receive resuscitation	Age, year of onset, month of onset, sex, urbanization level, hospital level, Charlson comorbidity index score, infection site, use of inotropic agents, dialysis, ventilation, days in the ICU, comorbidities, concomitant medications	Stratification	Nearest neighbor	Standardized measurements	Logistic regression and Cox regression	Survival

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2016	Charat Thongprayoon	BMC Nephrology	United States	Cohort	Effect of several measurement methods to determine baseline creatinine levels on the accuracy of acute renal injury diagnosis in critically ill patients	Age, race, diabetes mellitus, hypertension, coronary heart disease, stroke, peripheral vascular disease, congestive heart failure and APACHE III on admission to the ICU	Not reported	Not reported	Cstatistic	Logistic regression	Renal failure
2016	Cipolle, M. D.	J Trauma Acute Care Surg	United States	Cohort	Differences in results between trauma patients who received care in the trauma hospital program and patients with similar medical complexity trauma who did not receive care in the trauma program	Age, injury severity score and pre-existing diabetes mellitus conditions requiring insulin therapy, hypertension, congestive heart failure and stroke	Coincidence matching	Not reported	P Value	Logistic regression	Mortality
2016	Clark, E.	Intensive Care Med	Canada	Cohort	Clinical characteristics and in-hospital mortality in patients with end-stage chronic renal failure or chronic dialysis with septic shock as compared to patients with septic shock not on chronic dialysis	Age, sex, comorbidities (cancer, immune compromise, ICC, coronary artery disease, elective or emergency surgery, COPD, diabetes) and APACHE II score	Coincidence matching	Nearest neighbor	Standardized measurements and Cstatistic	Logistic regression and Cox regression	Mortality
2016	Hammond, D. A.	Pharmacotherapy	United States	Cohort	Comparison of the incidence of acute renal failure development in critically ill patients who received concomitant vancomycin with piperacillin-tazobactam or cefepime	Age, sex, BMI, initial creatinine, creatinine at the time of antibiotic initiation, SOFA, APACHE IV, septic shock, number of concomitant antibiotics, initial vancomycin levels, number of nephrotoxic medications, length of stay, admission unit, infection-associated length of stay, comorbidities	IPW (weighting)	Not reported	P Value	Logistic regression	Renal failure
2016	Henriikka Mildh	Mildh et al. Ann. Intensive Care	Finland	Cohort	Three-year mortality in survivors of 30 days of critical care with acute renal injury	Age, comorbidities and ICU admission and treatment characteristics	Coincidence matching	Caliper	Standardized measurements	Logistic regression and Cox regression	Mortality
2016	J. Latour-Pérez	Med Intensiva	Spain	Cohort	Assessment of the use and effectiveness of the routine invasive strategy in patients with non-ST elevation acute coronary syndrome with renal dysfunction	Age, sex, mode of access, transport, delays and access to the center, cardiac catheterization availability, coronary risk factors, prior cardiovascular disease, prior treatments (pharmacological and coronary) and baseline clinical status (blood pressure, heart rate, initial EKG, initial Killip, TIMI score, GRACE and CRUSADE).	Stratification	Not reported	Standardized measurements	Not reported	Mortality
2016	Joung, K. W.	Medicine (Baltimore)	Korea	Cohort	Comparison of postoperative acute renal injury in ileal conduit and urinary shunting of the neobladder following radical cystectomy	Sex, years, height, weight, body mass index, history of hypertension, diabetes mellitus, coronary heart disease or cerebrovascular disease, cancer stage and grade, application of neoadjuvant chemotherapy, angiotensin converting enzyme inhibitor, angiotensin receptor II blocker or diuretic medications, albumin, hematocrit, creatinine, uric acid and placement of ureteral stent	Coincidence matching	Not reported	P Value	Logistic regression	Renal failure



Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2016	Jun, I. G. *	Liver Transpl	Korea	Cohort	Incidence of acute renal failure in patients with live donor liver transplant with and without ABO compatibility	ABO compatibility, sex, age, body weight, height, body mass index (BMI), ABO type and end-stage liver disease score model (MELD); comorbidities such as diabetes mellitus, hypertension and coronary artery disease and preoperative laboratory values such as platelet count, prothrombin time, normalized international proportion and hemoglobin, glucose, serum albumin, serum sodium, total serum bilirubin, sCr, serum aspartate aminotransferase, serum alanine aminotransferase, and the highest intraoperative IA titre.	Stratification	Nearest neighbor	Standardized measurements	Logistic regression and Cox regression	Survival
2016	Karamanos, E.	World J Surg	United States	Cohort	Impact of diabetes mellitus on outcomes of patients undergoing emergency laparotomy due to small bowel adhesive obstruction	Age, gender, BMI, comorbidities, wound classification, Charlson index, inflammatory status at the time of admission.	Not reported	Not reported	Cstatistic	Logistic regression	Renal failure
2016	Kerry C. Cho	Clinical Science Articles	United States	Cohort		Age, liver failure, sepsis, thrombocytopenia, blood urea nitrogen and serum creatinine	Covariable in one model	Not reported	P Value	Logistic regression and Cox regression	Survival
2016	Lai, W. H.	Scand J Trauma Resusc Emerg Med	Taiwan	Cross-sectional	Incidence and clinical presentation of post-traumatic acute renal failure in hospitalized adult patients and its association with shock	Sex, years, comorbidity, Glasgow scale, head/neck, chest, abdomen or limb injury according to severity on the abbreviated injury scale for each body region and injury severity score (ISS).	Coincidence matching	Not reported	P Value	Logistic regression	Mortality and Renal failure
2016	Lin, C. Y.	Medicine (Baltimore)	Taiwan	Cohort	Correlation of preoperative renal failure with mortality and morbidity after aortic valve replacement vs. patients without renal failure.	Preoperative demographics, associated comorbidities, surgical procedures and hospital recovery were compared between groups. In-hospital mortality was defined as death occurring during hospitalization. Emergency operations included hemodynamically unstable patients requiring a high dose of inotropic agents, endotracheal intubation or mechanical circulatory support, including intra-aortic balloon pump (IABP) or extracorporeal membrane oxygenation (ECMO) before the surgery.	Coincidence matching	Nearest neighbor	P Value	Logistic regression	Mortality
2016	Mazzeffi, M.	J Anesth	United States	Cohort	Preoperative use of aspirin associated with cardiac surgery patients with massive transfusion.	Type of surgery, urgency of the surgery, year of the surgery, cardiopulmonary bypass time, use of antifibrinolytics, age, sex, weight, height, preoperative platelet count, preoperative hematocrit, preoperative INR, baseline hemodialysis, baseline creatinine, chronic pulmonary disease, hypertension, diabetes, dyslipidemia, peripheral vascular disease, cerebrovascular disease, infectious endocarditis, prior myocardial infarction, prior cardiac intervention, congestive heart failure within the 2 weeks following surgery, use of betablockers, use of statins and use of warfarin	Coincidence matching	Greedy matching	P Value	Logistic regression	Mortality

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2016	Moise, p. A.	J Anesth Clin Ther	United States	Cohort	Comparing the results of early treatment with daptomycin vs. vancomycin for methicillin-resistant Staphylococcus aureus bacteremia	Variables identified for matching were: age (<60 vs. >60), disease severity (ICU status) and type of infection (intravascular, extravascular or catheter). Bacteremia clearing was used to validate the hierarchy for the type of infection.	Coincidence matching	Not reported	P Value	Logistic regression	Mortality
2016	Oscar Peñuelas	Journal of Intensive Care Medicine	Spain	Cross-sectional	Assessment of predictors for ICU-acquired paresis and associated short-term outcomes	Age, SAPS II, chronic obstructive pulmonary disease, sepsis (leading to mechanical ventilation or as a complication during mechanical ventilation), use of neuromuscular blockade, cardiovascular failure, renal failure, hematological insufficiency and days on mechanical ventilation before weaning	Coincidence matching	Nearest neighbor y Caliper	Standardized measurements y ROC values	Logistic regression	Mortality
2016	Park, J. Y.	Crit Care	South Korea	Cohort	Results of early vs. late initiation of renal replacement therapy	Age, sex, CCI, systolic arterial pressure, prothrombin time and total bilirubin level	Coincidence matching	Nearest neighbor y Caliper	Standardized measurements + significance	Logistic regression and Cox regression	Survival
2016	Ruan, S. Y.	Crit Care	Taiwan	Cohort	Risk of acute renal failure associated with inhaled nitric oxide therapy in patients with acute respiratory distress syndrome	Age, sex, year of entry to the cohort, height, body weight, ARDS etiology, simplified acute physiology score II (SAPS II) (15), lung injury score (16), comorbidities, ventilator settings, vital signs, arterial blood gases, complete blood count, creatinine and bilirubin levels, urine output, radiological pattern, and use of vasopressors on the first ARDS day. Creatinine clearance was estimated using the Cockcroft-Gault.	Stratification	Caliper	P Value	Logistic regression and Cox regression	Renal failure
2016	Thongprayoon, C.	J Am Soc Nephrol	United States	Cohort	Assessing the risk of acute renal failure in patients taken to transcatheter aortic valve replacement (TAVR) vs. surgical aortic valve replacement (SAVR)	STS risk score, eGFR, sex, body mass index, type of surgery (elective vs. urgent/emergent), presence of anemia, history of diabetes mellitus, hypertension, congestive heart failure, peripheral vascular disease, cerebrovascular disease, chronic pulmonary disease, NYHA (classes 1 and 2 vs. 3 and 4), preoperative use of angiotensin converting enzyme inhibitor or angiotensin receptor blocker, prior percutaneous cardiac intervention, prior coronary bypass grafting, prior aortic valve surgery, cardiac rhythm during surgery (normal vs other) and aortic valve regurgitation (none or trivial vs, mild, moderate or severe)	Coincidence matching	Caliper	Standardized measurements	Logistic regression	Renal failure
2017	Bentzer, p.	Scand J Trauma Resusc Emerg Med	Sweden	Cohort	Effect of dextran-70 on outcomes in patients with severe sepsis	Age, sex, chronic obstructive pulmonary disease (COPD), renal failure, diabetes, outcome variables (except mortality) and fluid administration data.	Coincidence matching	Greedy matching	Standardized measurements	Logistic regression	Mortality and Renal failure

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2017	Chan, M. J.	Medicine (Baltimore)	Taiwan	Cross-sectional	Effects of 3 different surgical methods for coronary revascularization in renal injury	Age, sex, preoperative creatinine level, cardiac ejection fraction, emergent/urgent intervention, use of intra-aortic balloon pump (IABP), preoperative ventilator use, diabetes mellitus, recent myocardial infarction, shock and chronic obstructive pulmonary disease	Coincidence matching	Not reported	P Value	Logistic regression	Renal failure
2017	Dos Santos, T. O. C.	PLoS One	Brazil	Cross-sectional	Mortality-related factors in patients admitted to the ICU with acute renal failure requiring dialysis who underwent continuous veno-venous hemodiafiltration (CVVHDF)	Age, comorbidities, severity of the disease that caused AKI, metabolic disorders, organ dysfunction and weight gain during the resuscitation phase. Other factors that appear to influence prognosis in these patients are those related with the therapy itself, including type of dialysis modality, time of initiation of the procedure, administered dialysis dose, metabolic control and volume status obtained over the course of treatment	Coincidence matching	Not reported	P Value	Logistic regression and Cox regression	Survival
2017	Dou, L.	Nephron	United States	Cohort	Obstructive sleep apnea associated with the risk of acute renal failure in the intensive care unit	Age, BMI, history of CHF, CKD, CPD, hypertension, diabetes, high risk surgery, exposure to nephrotoxins, mechanical ventilation and APACHE III score	Coincidence matching	Caliper	Standardized measurements	Logistic regression	Renal failure
2017	Hoi-Ping SHUM	Nephrology	China	Cross-sectional	Impact of renal replacement therapy on 90-day mortality in critically ill patients with KDIGO stage 3 renal failure	Age, baseline GFR, worse creatinine/potassium/bilirubin/platelet count level, pH within the first 24 hours of admission to the ICU and APACHE IV score	Coincidence matching	Nearest neighbor y Caliper	Cstatistic	Logistic regression and Cox regression	Mortality
2017	Jennifer S. McDonald	Intensive Care Med	United States	Cohort	Association between intravenous iodinated contrast material administration and later development of post-contrast AKI, emergent dialysis and short-term mortality	Age, serum creatinine before CT (sCr), changes in sCr prior to exploration and SOFA score, comorbidities, use of nephrotoxic drugs, IV fluids used, stability prior to CT	Stratification	Not reported	P Value	Logistic regression	Mortality and Renal failure
2017	Kianoush Kashan	PLOS ONE	United States	Cohort	Effect of bicarbonate concentration in the replacement solution on patients in the ICU that required CRRT for AKI.	pH, bicarbonate, interaction between pH and bicarbonate, presence of sepsis, use of mechanical ventilation, vasopressor administration, intra-aortic balloon pump (IABP) and Charlson comorbidity index	Coincidence matching	Caliper	Standardized measurements	Logistic regression and Cox regression	Mortality
2017	Kovacheva, V. p.	Neurosurgery	United States	Cohort	Determine if AKI in patients after craniectomy is associated with higher 30-day mortality	Age, sex, race (white vs. non-white), Deyo-Charlson index, sepsis and chronic renal disease covariables, severity of the disease, intracranial bleeding, subarachnoid hemorrhage, acute respiratory failure and trauma	Coincidence matching	Caliper	P Value	Logistic regression y Cox	Mortality
2017	Latour-Perez, J	Med Intensiva	Spain	Cohort	Assess the use an effectiveness of the routine invasive strategy in patients with non-ST elevation acute coronary syndrome with renal dysfunction	Age, sex, clinics, mode of access, transportation and delay in accessing the center, availability of cardiac catheterization, coronary risk factors, prior cardiovascular disease, previous treatments (pharmacological and coronary) and baseline clinical status (blood pressure, heart rate, initial EKG, initial Killip, TIMI 24, GRACE and CRUSADE scores	Stratification	Not reported	Standardized measurements + significance	Logistic regression	Mortality

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2017	Legouis, D.	Anesthesiology	France	Cohort	Impact of acute renal injury in patients who experience reversible acute renal injury after cardiac surgery	Age, body mass index, preoperative eGFR, clamping and bypass time, European logistic system for assessing the cardiac surgery risk, left ventricular ejection fraction and type of surgery	Coincidence matching	Nearest neighbor y Caliper	Standardized measurements	Logistic regression and Cox regression	Renal failure
2017	Marik, p. E.	Chest	United States	Cohort	Hydrocortisone, vitamin C and thiamine for the treatment of severe sepsis and septic shock	Age, sex, diagnosis on admission, comorbidities, need for mechanical ventilation, use of vasopressors, daily urine output, fluid balance after 24 and 72 hours, length of stay in the ICU and laboratory values, Immunocompromised patients if they received cytotoxic therapy or if diagnoses with acquired immune deficiency syndrome. Serum creatinine levels, leukocyte counts (WB), platelet count, total bilirubin, PCT and lactate. Acute renal injury (AKI), APACHE II and APACHE IV scores on admission, including foreseen in-hospital mortality in APACHE IV	Not reported	Not reported	P Value	Logistic regression	Survival
2017	Shou-Chun Yu,	World Neurosurgery	Taiwan	Cohort	One-year mortality rate in patients with spinal cord injury with CKD and TRD and comparison in patients with spinal cord injury without CKD	Age, sex, comorbidities, length of stay in the intensive care unit and total length of stay	Stratification	Not reported	P Value	Cox regression	Mortality
218	Etienne Gayat	Intensive Care Med	France	Cohort	Association between the use of ACEi and ARA II in patients with acute renal failure in the ICU with mortality within 1 year	Age, Charlson score, CKD, diabetes mellitus, chronic heart failure, ACEi/ARB administration before ICU admission, vasopressor administration while in the ICU, RRT during ICU stay, systolic blood pressure at discharge from the ICU	Coincidence matching	Nearest neighbor	Standardized measurements	Cox regression	Mortality
2018	Buyun Wu	Scientific Reports	China	Cohort	Impact of low AKI recognition (more than 3 days after onset) on short-term prognosis	Sex, age, setting in which AKI occurred, eGFR on admission, oliguria, history of malignant neoplasm, APACHE II score, SOFA score, risk factors for AKI (hypovolemia, heart failure, sepsis, surgery), AKI stage, blood urea nitrogen and whether RRT was used	IPW (weighting) y Stratification	Caliper	Standardized measurements	Logistic regression	Mortality
2018	Shih-Ting Huang_ nuevo	CMAJ	Taiwan	Cohort	Renal outcomes in patients with no pre-existing renal disease who were admitted due to critical acute disease	Age (5-year periods), sex and index year with control patients, comorbidities	Coincidence matching	Not reported	Standardized measurements	Logistic regression and Cox regression	Mortality and Renal failure
2019	AMANDA Y WANG	Nephrology	Australia	Cohort	HMG-CoA reductase inhibitors (statins) and acute renal injury	Age, sex, sepsis, mechanical ventilation and APACHE III scores at the time of randomization	Coincidence matching	Not reported	P Value	Cox regression	Renal failure
2019	Ana p. A	ccmjournal	Brazil	Cohort	Assessment of in-hospital mortality and mortality risk factors in patients with cancer discharged from the ICU after the decision to refuse vital support therapies	SAPS 3 and SOFA on admission to the ICU, setting prior to admission to the ICU, infection on admission to de ICU, use of non-invasive mechanical ventilation, acute renal injury and delirium during while in the ICU	Coincidence matching	Caliper	P Value	Logistic regression	Mortality

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Close-ness	Balance assessment	Analytical method used	Outcomes
2019	Ian E. McCoy,	Crit Care Expl	United States	Cohort	Estimation of the effects of diuretic use in the first 24 hours in the ICU	Age, sex, race, comorbidities, type of admission, ICU type, serum creatinine on admission, mechanical ventilation and each of the SOFA score items on admission, out of six ICU items	Coincidence matching	Greedy matching	Standardized measurements	Logistic regression	Renal failure
2019	Muhammad Zeeshan	American Association for the Surgery of Trauma	United States	Cohort	Four-factor prothrombin complex plus fresh frozen plasma vs. fresh frozen plasma alone in patients with trauma-related bleeding	Age, sex, race, body mass index, vital signs (systolic blood pressure, heart rate, Glasgow scale), time to therapy initiation, injury mechanisms, injury severity score, abbreviated injury scale (AIS), Head-AIS, chest-AIS, abdominal-AIS, spine-AIS, limb-AIS, comorbidities, use of anti-platelet agents before injury, and trauma center level	Stratification	Nearest neighbor	P Value	Logistic regression	Mortality and Renal failure
2019	Philippe Gaudard	BMC Infectious Diseases	France	Cohort	Acute renal injury during treatment with daptomycin vs. vancomycin in critically ill cardiovascular patients	Severity score such as simplified acute physiology (SAPS II) on admission to the ICU and sequential organ failure assessment (SOFA) upon initiation of treatment, history of chronic renal failure (creatinine clearance under 50 mL/min), creatinine and AKI before initiation of treatment (defined as baseline), sepsis-related or heart-failure related circulatory shock (defined as systolic blood pressure under 90 mmHg and resistant to fluid challenge, with evidence of end-organ hypoperfusion such as oliguria, altered mentation or high plasma lactate level), need for cardiopulmonary bypass for surgery (within 48 h of antibiotic initiation), use of other nephrotoxic agents (iodine contrast, aminoglycosides, cyclosporin), bacteremia documented by CPG	Coincidence matching	Not reported	P Value	Logistic regression	Renal failure
2019	Raphael Donadio Pitta	European Journal of Clinical Microbiology & Infectious Diseases	Brazil	Cross-sectional	Comparison of the incidence of AKI in critically ill patients treated with aminoglycosides or meropenem in the intensive care setting	Age, sex and use of vancomycin, polymyxin, diuretic and amphotericin	Coincidence matching	Nearest neighbor y Caliper	P Value	Logistic regression	Renal failure
2019	Sarah A. Schubert	The Journal of Thoracic and Cardiovascular Surgery	United States	Cohort	Determine the influence of perioperative administration of betablockers before aortic valve replacement	Rates of hypertension, anemia, coronary artery disease, preoperative atrial fibrillation or heart failure, among others	Stratification	Greedy matching	Standardized measurements	Logistic regression	Mortality

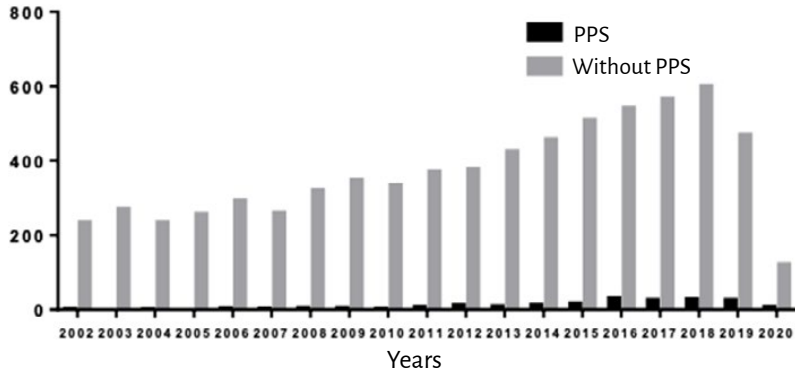


Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2019	Wuhua Jiang	Braz J Cardiovasc Surg	China	Cohort	Discover potentially modifiable perioperative predictors for renal replacement therapy (RRT) in patients with cardiac surgery-associated acute renal injury	Age, comorbidities, history of contrast media exposure, preoperative cardiac function status (NYHA classification), baseline eGFR (CKD-EPI), creatinine levels surgery-related factors (proceduresk urgency, time on cardiopulmonary bypass, red blood cell transfusion) and operative characteristics of central venous pressure and red blood cell transfusion. If >1 cardiac surgery procedures were performed during the same admission, only the data for the first surgery were considered	Coincidence matching	Not reported	P Value	Logistic regression	Renal failure
2019	Yanfei Shen	Critical Care BMC	China	Cohort	Relationship between the use of loop diuretics and in-hospital mortality in critically ill patients with vasopressor support	Age, weight, diabetes mellitus, hypertension, heart disease, AKI, SOFA score on admission to the ICU, white count, fluid volume intake and proportions of various vasopressors	Stratification	Nearest neighbor y Caliper	Standardized measurements	Logistic regression	Mortality and Renal failure
2019	Yoshihisa Miyamoto	Intensive Care Med	Japan	Cohort	Examine the association between the use of intravenous contrast and no recovery from acute renal injury requiring dialysis (AKI-D) and hospital in-hospital mortality in patients with sepsis	Age, sex, CCI, congestive heart failure, diabetic nephropathy, CKD, consciousness level with JCS, discharge year, source of infection, emergency surgery due to infectious source, hospital volume and treatments performed within the next 2 days after discharge	Coincidence matching	Nearest neighbor	Standardized measurements and C statistic	Logistic regression	Mortality and Renal failure
2019	Yu Hsiang Chou	Journal of Nephrology	Taiwan	Cohort	Preoperative continuation of renin-angiotensin system inhibitor and cardiac surgery-associated acute kidney injury	Age, sex, CKD, DM, decompensated heart failure, coronary heart disease, occlusive peripheral artery disease, hypertension, hyperlipidemia, chronic obstructive pulmonary disease, cirrhosis, hyperuricemia, metastatic cancer, smoking, hemoglobin, baseline creatinine, albumin, urinary protein, surgery type, antihypertensives and statins	Coincidence matching	Caliper	P Value	Logistic regression and Cox regression	Renal failure
2019	Yuya Goto	Goto et al. Critical Care	Japan	Cohort	Assess the effect of contrast media on renal function and mortality in patients with sepsis who already had AKI	Age, sex, infection site, history of chronic kidney disease, diabetes mellitus, septic shock, immune compromise, use of aminoglycosides or vancomycin, laboratory data (hemoglobin, Cr, total bilirubin, platelets, lactate), partial oxygen pressure/ inspired oxygen fraction ratio, and Glasgow coma scale on admission to the ICU	Coincidence matching	Not reported	P Value	Logistic regression	Mortality and Renal failure
2019	Lisa-Mae	Chest	United States	Cohort	Association between contrast and acute renal injury in critically ill patients with normal renal function	Age, gender, comorbidities, use of contrast, race, obesity, primary diagnosis, APACHE	Stratification	Nearest neighbor y Caliper	Standardized measurements	Logistic regression	Renal failure

Year	Author	Journal	Country	Study type	Exposure	Variables	Matching algorithm	Closeness	Balance assessment	Analytical method used	Outcomes
2020	Ala Abu-dayyeh	American Journal of Hospice	United States	Cohort	Determine the impact of dialysis on survival of patients admitted to the ICU with stage IV cancer and renal failure	Age, sex, race/ethnicity and vital status (alive vs. dead). Clinical data included type of malignant neoplasm, peripheral vascular disease and/or dementia diagnosis, and consults for dialysis and palliative care. Dementia, peripheral vascular diseases and reduced albumin, length of stay in the ICU, SOFA score and disposition. First albumin level obtained in the first 3 days in the ICU	Coincidence matching	Nearest neighbor	Standardized measurements	Logistic regression and Cox regression	Renal failure
2020	Guang-ju Zhao	Zhao et al. Critical Care BMC	United States	Cohort	Administración de furosemida y los resultados en pacientes críticos con lesión renal aguda.	Edad, género, etnia, tipo de admisión, comorbilidades, puntuación simplificada de fisiología aguda II (SAPSII), puntuación de evaluación de falla orgánica secuencial (SOFA), presión arterial media (MAP), nivel de creatinina en suero, uso de vasopresores e inotrópicos, entrada diaria de líquidos, fluido equilibrio, tipos de líquidos, cirugía cardíaca, TSR y ventilación mecánica.	Coincidence matching	Nearest neighbor y Caliper	Standardized measurements	Logistic regression and Cox regression	Renal failure
2020	Gustavo A. Ospina-Tascón	Critical care	Colombia	Cohort	Effects of very early initiation of noradrenaline in patients with septic shock	Age, APACHE II, comorbidities and patient origin (emergency room, general ward or intensive care unit) were documented. Heart rate and blood pressure were also documented and at 2, 4, 6, 8 and 24 h after vasopressor administration. Multiple organ dysfunction was assessed using the sequential organ failure assessment score (SOFA). Days off ventilation, renal replacement therapy requirement and days without RRT were also calculated. Finally, ICU and hospital length of stay were recorded together with ICU, in-hospital and 28-day mortality	Coincidence matching	Nearest neighbor	P Value	Cox regression	Mortality and Renal failure

**SOURCE.** Authors.

**COMPLEMENTAR CONTENT 2.** Evolution of publications using PPS, adjusted for every 10000 publications.



SOURCE. Authors.

**COMPLEMENTAR CONTENT 3.** Number of publications with propensity score by journal.

Journal	n (%)
Critical Care	13(13.1)
Critical Care Medicine	11(11.1)
Intensive Care Medicine	7(7.1)
Medicine (Baltimore)	5(5.1)
Plos One	4(4.0)
Clinical Journal of the American Society of Nephrology	3(3.0)
The Annals of Thoracic Surgery	3(3.0)
Journal of Cardiothoracic and Vascular Anesthesia	3(3.0)
Anesthesiology	3(3.0)
Journal of the American Society of Nephrology	2(2.0)
Medicina Intensiva	2(2.0)
Scandinavian Journal of Trauma Resuscitation and Emergency Medicine	2(2.0)
Nephrology	2(2.0)
Chest	2(2.0)
The American Journal of medicine	1(1.0)
JAMA	1(1.0)
The International Journal of Artificial Organs	1(1.0)
JAAPA	1(1.0)
European Journal of Cardio-Thoracic Surgery	1(1.0)
European Journal of Vascular and Endovascular Surgery	1(1.0)
Acta Anaesthesiologica Scandinavica	1(1.0)
American Journal of Respiratory and Critical Care Medicine	1(1.0)
Antimicrobial Agents and Chemotherapy	1(1.0)
Cardiology	1(1.0)
Military Medicine	1(1.0)
Interactive Cardiovascular and Thoracic Surgery	1(1.0)
BMC Nephrology	1(1.0)
The Journal of Trauma and Acute Care Surgery	1(1.0)
Pharmacotherapy	1(1.0)
Annals of Intensive Care	1(1.0)
Liver Transplantation	1(1.0)
World Journal of Surgery	1(1.0)
Clinical Science Articles	1(1.0)
Journal of Anesthesia	1(1.0)
Clinical Therapeutics	1(1.0)
Journal of Intensive Care Medicine	1(1.0)
Nephron	1(1.0)
Neurosurgery	1(1.0)
World Neurosurgery	1(1.0)
Canadian Medical Association Journal	1(1.0)
critical care explorations	1(1.0)
American Association for the Surgery of Trauma	1(1.0)
BMC Infectious Diseases	1(1.0)
European Journal of Clinical Microbiology & Infectious Diseases	1(1.0)
The Journal of Thoracic and Cardiovascular Surgery	1(1.0)
Brazilian Journal of Cardiovascular Surgery	1(1.0)
Journal of Nephrology	1(1.0)
American Journal of Hospice	1(1.0)
Scientific Reports	1(1.0)
Nephrology Dialysis Transplantation	1(1.0)

SOURCE. Authors.

**COMPLEMENTAR CONTENT 4.** Number of publications with propensity score by country.

Country	n (%)
United States	35(35.3)
Taiwán	10(10.1)
France	9(9.1)
Brasil	7(7.1)
Canada	6(6.1)
Korea	6(6.1)
Japan	5(5.1)
China	5(5.1)
Spain	4(4.0)
Finland	3(3.0)
Australia	2(2.0)
Germany	2(2.0)
Italy	1(1.0)
UK	1(1.0)
South Korea	1(1.0)
Sweden	1(1.0)
Colombia	1(1.0)

SOURCE. Authors.

**COMPLEMENTAR CONTENT 6.** Fórmula 1.

The difference in standardized measurements is defined as follows:

$$d = \frac{100 \times \bar{X}_{Tratados} - \bar{X}_{Control}}{\frac{\sqrt{S^2_{Tratados} + S^2_{Control}}}{2}}$$

Where  $\bar{X}_{Tratados}$  and  $\bar{X}_{Control}$  represents variable averages between treated and not treated, while  $S^2_{Tratados}$  and  $S^2_{Control}$  corresponds to standard deviations of the covariables between treated and not treated subjects.

SOURCE. Austin (6).

**COMPLEMENTAR CONTENT 5.** Exposures in critically ill patients with renal outcomes.

Exposure	n (%)
<b>Intervención farmacológica</b>	
Antibiotic	7(7.1)
IV fluids	6(6.1)
Diuretics	5(5.1)
Statins	3(3.0)
Midazolam. propofol	2(2.0)
ACEi/ARAI	2(2.0)
Inotropes	1(1.0)
Inhaled nitric oxide	1(1.0)
Hydrocortisone. vitamin C and thiamine	1(1.0)
Prothrombin + fresh frozen plasma vs. fresh plasma	1(1.0)
Betablockers	1(1.0)
Diuretics + vasopressors	1(1.0)
Vasopressors	1(1.0)
Aspirin	1(1.0)
<b>Risk factor</b>	
History of acute renal failure	10(10.1)
End-stage renal disease	2(2.0)
Factors affecting healing. angiosome	1(1.0)
Renal transplant	1(1.0)
Age under or over 80 years	1(1.0)
Diabetes mellitus	1(1.0)
Obstructive sleep apnea	1(1.0)
Critical disease in patient with no past history of acute renal injury	1(1.0)
Post-traumatic acute renal failure	1(1.0)
<b>Dialysis therapy</b>	
Early/late	5(5.1)
Continuous/intermittent	4(4.0)
Renal replacement therapy	4(4.0)
Chronic dialysis	1(1.0)
Continuous veno-venous hemodiafiltration	1(1.0)
Bicarbonate in replacement solution	1(1.0)
<b>Surgical and other invasive procedures</b>	
Iodinated contrast medium	5(5.1)
Coronary revascularization surgery (bypass)	4(4.0)
Invasive techniques in patients with NSTEMI and renal dysfunction	2(2.0)
Immediate postoperative extubation	1(1.0)
Red blood cell transfusion	1(1.0)
Radiofrequency ablation for atrial fibrillation	1(1.0)
Pulmonary artery catheterization	1(1.0)
Intra-aortic balloon pump	1(1.0)
Radical cystectomy	1(1.0)
Liver transplant (ABO compatibility)	1(1.0)
Transcatheter/surgical aortic valve replacement	1(1.0)
Cardiopulmonary resuscitation	1(1.0)
<b>Administrative processes and biomarkers</b>	
Postoperative hypoalbuminemia	3(3.0)
Care by residents/medical assistance/trauma team	2(2.0)
Nephrology consult (early/late)	1(1.0)
Specialized equipment for RRT	1(1.0)
Volume of patients on dialysis in the ICU	1(1.0)
Paresis in ICU	1(1.0)
Refusal of vital support therapies in the ICU	1(1.0)
Creatinine measurement methods	1(1.0)

SOURCE. Authors.