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REVIEW

Privatization and Oligopolies of the Renal Replacement Therapy Sector on Contemporary Capitalism: A Systematic Review and the Brazilian Scenario

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Abstract: Worldwide the assistance on renal replacement therapy (RRT) is carried out mainly by private for-profit services and in a market with increase in mergers and acquisitions. The aim of this study was to conduct an integrative systematic review on privatization and oligopolies in the RRT sector in the context of contemporary capitalism. The inclusion criteria were scientific articles without language restrictions and that addressed the themes of oligopoly or privatization of RRT market. Studies published before 1990 were excluded. The exploratory search for publications was carried out on February 13, 2024 on the Virtual Health Library Regional Portal (VHL). Using the step-by-step of PRISMA flowchart, 34 articles were retrieved, of which 31 addressed the RRT sector in the United States and 26 compared for-profit dialysis units or those belonging to large organizations with non-profit or public ones. The main effects of privatization and oligopolies, evaluated by the studies, were: mortality, hospitalization, use of peritoneal dialysis and registration for kidney transplantation. When considering these outcomes, 19 (73%) articles showed worse results in private units or those belonging to large organizations, six (23%) studies were in favor of privatization or oligopolies and one study was neutral (4%). In summary, most of the articles included in this systematic review showed deleterious effects of oligopolization and privatization of the RRT sector on the patients served. Possible explanations for this result could be the presence of conflicts of interest in the RRT sector and the lack of incentive to implement the chronic kidney disease care line. The predominance of articles from a single nation may suggest that few countries have transparent mechanisms to monitor the quality of care and outcomes of patients on chronic dialysis.

Keywords: renal dialysis, chronic kidney failure, health facility merger, private sector, capitalism, review

Introduction

Chronic kidney disease (CKD) is a worldwide public health problem. Its prevalence has increased globally, mainly due to the ageing of the population and the obesity epidemic. These factors lead to an increase in the prevalence of hypertension and diabetes, which are the main causes of CKD.[1] As a consequence of the increase in the prevalence of CKD, the estimated number of people currently receiving renal replacement therapy (RRT) worldwide has doubled in the last 20 years, also driven by the increase in the supply of this treatment.[2]

CKD is divided into five stages of increasing severity. It is agreed to call the treatment for patients with stages 1–4 of CKD "medication-based", since RRT is not indicated and measures to delay the disease progression must be adopted. In stage 5 of CKD, kidney function is so impaired that the patient requires some form of renal function replacement. Therefore, RRT is a life-sustaining treatment for patients with the most advanced stage of CKD. The RRT methods are hemodialysis (HD), peritoneal dialysis (PD) and kidney transplantation.[3] Among these three methods, transplantation is recognized as being the

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one associated with better quality of life and greater patient survival.[4] Despite this, more than 70% of people with kidney failure are on HD or PD worldwide, mainly due to the unavailability of organs for everyone, and to a lesser extent, due to contraindications for kidney transplantation.[5]

In nations where RRT is funded with public resources or health insurance, there has naturally been a significant increase in the number of RRT services to meet the increase in demand in recent decades.[6] In these places, around 0.1% of people on RRT consume 5–7% of their country's entire healthcare budget.[7,8] Although RRT assistance can be carried out by public or non-profit providers, a significant volume of these financial resources has been captured by for-profit providers.[9]

In Brazil, RRT is funded by the Unified Health System (Sistema Único de Saúde [SUS]) for more than 85% of patients, who undergo treatment in health units, whose legal nature is 55% private for-profit.[10,11] Factors that contribute to maximizing the profit of the private RRT sector in Brazil are also highlighted, namely, the form of remuneration for the production of services, with no limit on the volume of procedures and from a specific financing source, named Strategic Actions and Compensation Fund.[12]

In addition to the predominance of for-profit RRT services, the RRT market (and the healthcare market in general) has seen an increase in the number of mergers and acquisitions.[13] In each country, the magnitude of this phenomenon is related to the permissiveness of health systems to for-profit companies and the entry of foreign capital.[14] Studies suggest that the concentration of ownership of health services, as well as an increase in the percentage of for-profit services, could have a negative impact on patient outcomes.[15,16]

The process of acquiring RRT units by large business conglomerates is well established in the United States (USA), where more than 70% of dialysis units are owned by two multinational companies.[17] In Brazil, this movement began in the last decade and nowadays a small number of companies control the production of RRT inputs and equipment and own services that provide direct assistance to patients.[14] In addition to gaining scale in their operations, the large dialysis organizations (LDO) have more power to determine prices and exert pressure for adjustments vis-à-vis the public sector, in the case of RRT. The market dominance of these companies could become even greater in the Brazilian scenario, since more than 70% of dialysis services are under municipal management, which is the most fragile entity in terms of financial resources and negotiating power with the private sector.[11]

The impact of privatization and oligopolization in the RRT sector has been described over the last three decades. Studies have indicated that these phenomena, when associated with payment-for-production models, may be associated with lower chance of referral for transplantation by dialysis services, higher hospitalization rates and higher mortality.[18–20] In this context, the aim of this study was to conduct an integrative systematic review on privatization and oligopolies in the RRT sector in the context of contemporary capitalism.

Materials and Methods

The present study used the integrative review methodology for the systematic collection of data.[21] This methodology consists of constructing a broad analysis of the literature, which was based on the following research question:

> What does the scientific literature present about the relationship between the renal replacement therapy sector and the phenomena of privatization and oligopolies in contemporary capitalism?

Data Source and Search Strategy

Based on the research question, the design of this review was structured in three stages: identification of the descriptors, exploratory search of the material in the literature and systematic reading of the titles, abstracts and full texts of the publications.

Identifying Descriptors

When using the acronym Phenomena-Population-Context, the following key items were identified: renal replacement therapy, oligopolies and contemporary capitalism, respectively. Thus, the descriptors were then identified, using the controlled vocabulary of terms from the electronic portal Health Sciences Descriptors – DeCS.[22] The descriptors identified were: "renal dialysis", "chronic kidney failure", "renal insufficiency, chronic" and "renal replacement therapy" (phenomena pole); "value-based purchasing", "associated health institutions", "health facility merger", "privatization", "ownership" and "private sector" (population pole), and "capitalism" (context pole).

Exploratory Search for Material in the Literature

The exploratory search for publications was carried out on February 13, 2024 on the Virtual Health Library Regional Portal (VHL). The VHL Portal was chosen because it is a large database of bibliographical data on health, produced by networks such as LILACS (Latin American and Caribbean Health Sciences Literature) and Medline and by open educational publications, scientific events and internet sites.

Firstly, the Boolean operator "OR" was used between the descriptors of each pole of this review and, later, the operator "AND" was used between the poles. The number of publications in each pole was: 203,798 (phenomena), 29,969 (population) and 1062 (context). Next, a combined search for the three poles was carried out, using the following syntax: (mh:((mh:("Renal Replacement Therapy")) OR (mh:("Renal Dialysis")) OR (mh:("Chronic Kidney Failure")) OR (mh:("Renal Insufficiency, Chronic")))) AND (mh:((mh:("Privatization")) OR (mh:("Private Sector")) OR (mh:("Health Facility Merger")) OR (mh:("Ownership")) OR (mh:("Associated Health Institutions")) OR (mh:("Value-Based Purchasing")))) AND (mh:(mh:("capitalism")))). Due to the fact that this syntax did not result in any publications, we excluded the "capitalism" pole, since it was the pole with the lowest recovery of publications in an isolated way.

Therefore, the final syntax used in this review was: (mh:((mh:("Renal Replacement Therapy"))) OR (mh:("Renal Dialysis")) OR (mh:("Chronic Kidney Failure")) OR (mh:("Renal Insufficiency, Chronic")))) AND (mh:((mh:("Privatization")) OR (mh:("Private Sector")) OR (mh:("Health Facility Merger")) OR (mh:("Ownership")) OR (mh:("Associated Health Institutions")) OR (mh:("Value-Based Purchasing")))). The syntax resulted in 162 publications (Table 1).

Systematized Reading of Titles and Abstracts of Publications

For the systematic search for publications, the four general stages of the preferred reporting items for systematic reviews and meta-analysis (PRISMA) flowchart were carried out (Figure 1).[23] The inclusion criteria were scientific articles without language restrictions and that addressed the themes of oligopoly or privatization of RRT market. Studies published before 1990 were excluded. Firstly, of the 162 publications identified by the final syntax, 3 repeated studies were excluded, obtaining a total of 159 publications. From then on, publications that did not refer to scientific articles were removed. Therefore, the following were excluded: a) reports (40); b) reviews (30), c) editorials (10) and d) guideline (1). This process corresponded to a total of 81 publications removed. Thus, 78 scientific articles remained. Furthermore, in the tracking stage, the titles of the articles were read, based on the inclusion criteria referring to studies that addressed: a) human beings; b) the RRT sector; c) oligopolization and/or privatization; and, d) contemporary capitalism, considering the period after 1990. In this way, 6 articles were excluded, resulting in 72.

The abstracts of the articles were then read. At this stage, the inclusion criteria were the same as those used when reading the titles. Thus, 30 articles were removed and, subsequently, 5 were removed because they were prior to the 1990s. Therefore, 37 articles remained for reading the full text. Of these, 3 articles were excluded because they did not meet the inclusion criteria, thus leaving 34 articles included in this review.

Results

The main characteristics of the articles included in this review are described in Table 2. As for the country of origin, 91% of the studies addressed the RRT sector in the USA (31) and the others in Italy (1), Romania (1) and Taiwan (1). Six articles (18%) addressed only the oligopolization phenomenon, 16 (47%) only privatization and 12 articles (35%) both phenomena. As for the study design, 26 studies (76%) were comparative, that is, they used at least two groups of dialysis units to evaluate the impact of one or both phenomena (oligopolization and privatization) on the patients assisted. Five articles (15%) were descriptive, there

Table 1 Exploratory Search for Publications Carried Out on February 13, 2024

Source of Information	Search Term	Result
Virtual Health Library Regional Portal (VHL)	(mh:((mh:("Renal Replacement Therapy"))) OR (mh:("Renal Dialysis")) OR (mh:("Chronic Kidney Failure")) OR (mh:("Renal Insufficiency, Chronic")))) AND (mh:((mh:("Privatization")) OR (mh:("Private Sector")) OR (mh:("Health Facility Merger")) OR (mh:("Ownership")) OR (mh:("Associated Health Institutions")) OR (mh:("Value-Based Purchasing"))))	162

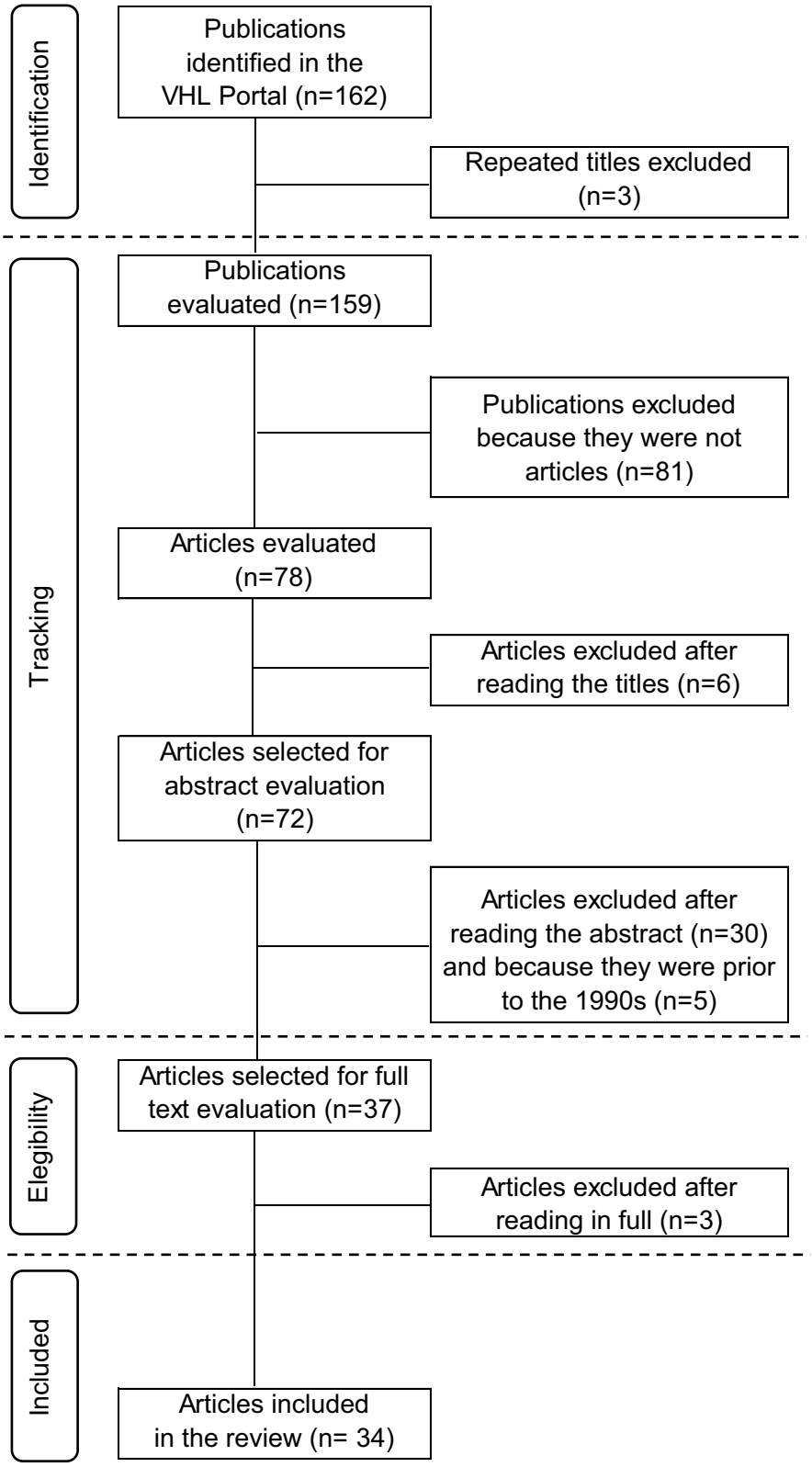

Figure 1 Flowchart of the selection process of articles included in the review.
Abbreviation: VHL, Virtual Health Library.

Table 2 Characteristics of Studies Included in the Systematic Review

Author, year	Country	Addressed Privatization	Addressed Oligopoly	Study Design	Variable Assessed								
					Hospitalization	Mortality	Transplantation	Use of PD	Use of EPO	Quality	Market Competition	Costs	Efficiency
Amaral et al,[24] 2022	USA	Yes	No	Retrospective, comparative	No	No	Yes	No	No	No	No	No	No
Liu et al,[25] 2021	Taiwan	Yes	No	Retrospective, comparative	No	Yes	No	No	No	No	No	No	No
Dickman et al,[26] 2020	USA	Yes	No	Systematic review and meta-analysis	No	Yes	No	No	No	No	No	No	No
Gander et al,[27] 2019	USA	Yes	No	Retrospective, comparative	Yes	No	Yes	No	No	No	No	No	No
Erickson et al,[20] 2019	USA	No	Yes	Retrospective, comparative	Yes	Yes	No	No	No	No	No	No	No
Erickson et al,[20] 2019	USA	No	Yes	Retrospective, comparative	No	Yes	No	No	No	No	No	No	No
Erickson et al,[28] 2017	USA	No	Yes	Retrospective, descriptive	No	No	No	No	No	No	Yes	No	No
Wilson,[29] 2016	USA	Yes	Yes	Retrospective, descriptive	No	No	No	No	No	No	No	No	No
Stefan et al,[30] 2015	Romania	Yes	Yes	Retrospective, comparative	No	Yes	No	No	No	No	No	No	No
Brunelli et al,[31] 2014	USA	Yes	Yes	Retrospective, comparative	Yes	Yes	No	No	No	No	No	No	No
Zhang et al,[32] 2014	USA	Yes	Yes	Retrospective, comparative	No	No	Yes	No	No	No	No	No	No
Dalrymple et al,[33] 2014	USA	Yes	No	Retrospective, comparative	Yes	No	No	No	No	No	No	No	No
Ishida et al,[34] 2013	USA	Yes	No	Retrospective, comparative	No	No	No	No	Yes	No	No	No	No

(*Continued*)

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Table 2 (Continued).

Author, year	Country	Addressed Privatization	Addressed Oligopoly	Study Design	Variable Assessed								
					Hospitalization	Mortality	Transplantation	Use of PD	Use of EPO	Quality	Market Competition	Costs	Efficiency
Zhang et al,[35] 2013	USA	Yes	Yes	Retrospective, comparative	No	Yes	No	No	Yes	No	No	No	No
Balhara et al,[36] 2012	USA	Yes	No	Cross-sectional, questionnaire-based	No	No	Yes	No	No	No	No	No	No
Hynes et al,[37] 2012	USA	Yes	No	Prospective, comparative	Yes	No	No	No	Yes	Yes	No	Yes	No
Zhang et al,[38] 2011	USA	Yes	Yes	Retrospective, comparative	No	Yes	No	No	No	No	No	No	No
Hirth et al,[39] 2010	USA	Yes	Yes	Retrospective, comparative	No	No	No	No	Yes	Yes	No	Yes	No
Lee et al,[40] 2010	USA	Yes	Yes	Retrospective, comparative	Yes	No	No	No	No	No	No	No	No
Posniak et al,[41] 2010	USA	No	Yes	Retrospective, descriptive	No	No	No	No	No	No	No	No	No
Wick et al,[42] 2010	USA	No	Yes	Retrospective, comparative	No	Yes	No	No	No	Yes	No	No	No
Mehrotra et al,[43] 2009	USA	No	Yes	Retrospective, comparative	No	Yes	No	Yes	No	No	No	No	No
Foley et al,[44] 2008	USA	Yes	No	Retrospective, comparative	No	Yes	Yes	No	Yes	Yes	No	No	No
Thamer et al,[45] 2007	USA	Yes	Yes	Retrospective, comparative	No	No	No	No	Yes	No	No	No	No
Gitto et al,[46] 2006	Italy	Yes	No	Retrospective, comparative	No	No	No	Yes	No	No	Yes	No	No
Thamer et al,[47] 2006	USA	Yes	Yes	Retrospective, descriptive	No	No	No	No	Yes	No	No	No	No

Szczech et al,[48] 2006	USA	Yes	No	Retrospective, comparative	No	Yes	No	No	No	Yes	No	No	No
Devereaux et al,[49] 2002	USA	Yes	No	Systematic review and meta-analysis	No	Yes	No	No	No	No	No	No	No
Ozgen et al,[50] 2002	USA	Yes	Yes	Retrospective, descriptive	No	No	No	No	No	No	No	Yes	Yes
Irvin,[51] 2000	USA	Yes	No	Retrospective, comparative	No	Yes	No	No	No	No	No	No	No
Garg et al,[52] 1999	USA	Yes	No	Retrospective, comparative	No	Yes	Yes	No	No	No	No	No	No
Furth et al,[53] 1999	USA	Yes	No	Retrospective, comparative	No	No	No	Yes	No	No	No	No	No
Griffiths et al,[54] 1994	USA	Yes	Yes	Retrospective, comparative	No	No	No	No	No	No	No	Yes	Yes
Lissovoy et al,[55] 1994	USA	Yes	No	Retrospective, comparative	No	No	No	No	Yes	No	No	No	No

Abbreviations: PD, peritoneal dialysis; EPO, erythropoietin; USA, United States of America.

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were two systematic reviews with meta-analysis (6%) and one cross-sectional study based on a questionnaire (3%). The effects of the privatization and oligopoly processes evaluated by the articles were: mortality of patients treated (15 studies), use of high-cost reimbursable medications (8 studies), hospitalization rate (6 studies), referral for kidney transplantation (6 studies), quality of care (5 studies), costs of RRT (4 studies), use of PD (3 studies), efficiency (2 studies) and market competition (2 studies).

The PRISMA 2020 checklist and the PRISMA checklist for abstracts are completed in Supplementary Material. The methods and approaches to privatization and oligopolies of the studies included in this review are summarized in Table 3. Based on the methodology used, the articles were classified into comparative studies, descriptive studies, systematic reviews and questionnaire-based studies.

Table 3 Results of the Articles Included in the Review According to Author, Year of Publication, Methods and Approaches to Privatization and Oligopolies

Author, Year	Study Methods	Approach to Privatization	Approach to Oligopolies
Amaral et al,[24] 2022	Retrospective, comparative based on 2000–2018 USRDS.	21% less registration on the transplant list in for-profit dialysis facilities than in non-profit ones.	Not addressed.
Liu et al,[25] 2021	Retrospective, comparative. Based on 2005–2012 Taiwan Renal Registry Data System.	5–11% higher risk of death patients in for-profit dialysis facilities than in non-profit ones.	Not addressed.
Dickman et al,[26] 2020	Systematic review with meta-analysis of nine studies between 2001 and 2019.	7% higher risk of death patients in for-profit dialysis facilities than in non-profit ones.	Not addressed.
Gander et al,[27] 2019	Retrospective, quantitative, comparative, based on 2000–2016 USRDS.	13% fewer registrations on the transplant list in for-profit dialysis facilities, 18% fewer living donor kidney transplants and 17% fewer deceased donor transplants than in non-profit ones.	Not addressed.
Erickson et al,[20] 2019	Retrospective, quantitative, comparative, based on 2001–2015 USRDS. It used the differences-in-differences model.	Not addressed.	• Mortality in acquired units fell by 8%, while in non-acquired units, the drop was 20%. • Hospitalization remained stable in acquired units and fell by 2.6 days per patient-year in non-acquired units.
Erickson et al,[20] 2019	Retrospective, quantitative, comparative study based on 2001–2009 USRDS. The differences-in-differences model was used.	Not addressed.	In the regions with the greatest market consolidation, there was an 8% increase in HD patient mortality.
Erickson et al,[28] 2017	Retrospective, quantitative, descriptive. Market competition was assessed between 2001 and 2011 using the HHI.	Not addressed.	• The average number of providers available for patients to choose increase from 6.9 to 7.6 in each area. • Average HHI maintained at 0.46. • The number of dialysis providers with only one service unit reduces from 1322 to 1214

(*Continued*)

Table 3 (Continued).

Author, Year	Study Methods	Approach to Privatization	Approach to Oligopolies
Wilson,[29] 2016	Retrospective, quali-quantitative, descriptive. It covered the period between 1990 and 2015.	• The number of non-profit dialysis facilities remained stable, while the number of for-profit units quadrupled. • For-profit dialysis facilities are less likely to receive charitable donations, lower human resource costs, and greater unnecessary use of reimbursable medications and laboratory tests.	• LDO can negotiate better prices with their suppliers. • The representation of two large organizations in the total number of for-profit dialysis facilities rose from 33% to 74% between 1995 and 2008.
Stefan et al,[30] 2015	Retrospective, quantitative, comparative. It assessed patients on HD in 2011.	• In 2004, 100% of Romania's dialysis facilities were public, until a privatization process began with support from the World Bank. • Privatization has allowed more patients to have access to RRT.	• Three of the four LDO had a higher SMR than the national reference (1.30–1.58). • The other dialysis organizations had an SMR similar to the national reference (SMR=1.07).
Brunelli et al,[31] 2014	Retrospective, quantitative, comparative, based on 2010 USRDS.	• For-profit dialysis facilities serve a higher proportion of patients who started RRT without pre-dialysis care, with a venous catheter and from rural and poorer areas. • After adjusting for these and other confounding factors, there was no significant difference between mortality and hospitalization rates.	• According to the authors, LDO in the USA serve disproportionately more rural and poor areas compared to other providers, which could account for worse mortality and hospitalization rates in previous studies. • This data is in disagreement with that described in reference 33.
Zhang et al,[32] 2014	Retrospective, quantitative, comparative study, based on 2006–2009 USRDS.	• For-profit dialysis facilities have a 13% lower rate of registration on the transplant list. • For-profit dialysis facilities and large organizations serve more metropolitan and economically developed areas than non-profit units, which would even enable greater referral for transplantation.	• LDO have an 8% lower rate of registration on the transplant list. • Possible explanations: less social control, greater profit in reducing patient outflow and lower number of employees/patient, which would reduce the opportunity for patient education about transplantation.
Dalrymple et al,[33] 2014	Retrospective, quantitative, comparative, based on 2005–2008 USRDS.	Patients who started RRT in for-profit dialysis facilities had higher rates of hospitalization for all causes (RR 1.15), fluid overload (RR 1.37) and vascular access complications (RR 1.15)	Not addressed.
Ishida et al,[34] 2013	Retrospective, quantitative, comparative, based on 2007–2008 USRDS.	• The EPO dose and mean hemoglobin level of patients on RRT in for-profit dialysis facilities was higher. • The percentage of patients with anemia control did not differ, suggesting unnecessary use in for-profit units.	Not addressed.

(*Continued*)

Table 3 (Continued).

Author, Year	Study Methods	Approach to Privatization	Approach to Oligopolies
Zhang et al,[35] 2013	Retrospective, quantitative, comparative, based on 2006 USRDS.	The use of injectable medications (EPO, iron and vitamin D) was greater in for-profit dialysis facilities compared to non-profit ones.	The use of injectable medications was higher in large and medium dialysis organizations (>100 units) than in small organizations.
Balhara et al,[36] 2012	Cross-sectional, comparative study based on a questionnaire in 2010.	• For-profit dialysis unit providers were less likely to spend >20 minutes talking to their patients about kidney transplantation. • In these places, patients' families were less frequently involved in the conversation about kidney transplantation.	Not addressed.
Hynes et al,[37] 2012	Prospective, carried out in 2002. It compared the costs of 170 Department of Veterans Affairs patients with the costs of 164 patients in private facilities.	Patients in private dialysis facilities had lower costs, fewer emergency visits, a lower average number of hospital stays, a higher urea reduction ratio and greater use of EPO.	Not addressed.
Zhang et al,[38] 2011	Retrospective, comparative, based on 2004 USRDS.	Patients treated in for-profit dialysis facilities had 13% higher mortality over two years of follow-up.	Patients treated in dialysis facilities of two LDO had 19% and 24% higher mortality over two years of follow-up.
Hirth et al,[39] 2010	Retrospective, comparative, based on 2004 Medicare database.	Compared to non-profit dialysis facilities, for-profit units used more EPO and had higher rates of anemia control and dialysis efficiency.	Compared to independent dialysis facilities, three of the four largest dialysis chains used more EPO and had higher rates of anemia control and dialysis efficiency.
Lee et al,[40] 2010	Retrospective, comparative, based on 2003 USRDS.	The adjusted number of hospitalization days per year was 17% higher among patients in for-profit dialysis facilities.	There was no difference in the indicator between independent dialysis facilities and those belonging to large organization
Posniak et al,[41] 2010	Retrospective, quantitative, based on 1997–2003 Medicare database.	Not addressed.	• Among the acquisitions, 166 (40%) were carried out by small/medium dialysis organizations and 245 (60%) by large organizations. • Factors related to acquisition were higher HD cost/session, higher average hematocrit of patients and larger size of the dialysis market.
Wick et al,[42] 2010	Retrospective, comparative, carried out by the company DaVita. Control group: 606 dialysis facilities owned by DaVita and acquired before 2004. Evaluated group: 504 units acquired in 2005.	Not addressed.	• Acquired clinics had worse quality indicators both at baseline and two years after acquisition. • The performance of the acquired units improved in most of the indicators evaluated. • Mortality in the acquired units was higher than in DaVita units at baseline and lower two years after acquisition. In both groups, there was a significant reduction in mortality.

(*Continued*)

Table 3 (Continued).

Author, Year	Study Methods	Approach to Privatization	Approach to Oligopolies
Mehrotra et al,[43] 2009	Retrospective, comparative, based on 1996–2004 USRDS.	Not addressed.	• The use of PD fell in all the dialysis facilities evaluated. • Three of the five largest dialysis organizations had lower PD utilization than independent organizations throughout all years of the study.
Foley et al,[44] 2008	Retrospective, comparative, based on 1998–2003 USRDS.	Patients treated in for-profit dialysis facilities showed greater dialysis efficiency, better control of anemia, greater use of intravenous EPO and iron, less need for blood transfusion, lower enrollment on the kidney transplant list and similar mortality rates.	Not addressed.
Thamer et al,[45] 2007	Retrospective, comparative, based on 2004 USRDS.	• Before 1990, when Medicare payment for EPO was fixed, for-profit units used lower average doses than non-profit units. • After this period, reimbursement began to be based on the prescribed dose, and for-profit dialysis facilities began to use higher doses.	After 1990, regardless of the anemia control rate, the units of large organizations used higher doses of EPO, increased the EPO dose for patients without anemia and had a higher percentage of patients with a hematocrit above the recommended level.
Gitto et al,[46] 2006	Retrospective, comparative, based on 1996–2000 Sicilian Dialysis and Transplant Registry.	• Private dialysis facilities in Sicily accounted for 75% of the total and offered practically only the HD method. • Compared to HD, PD has lower costs and profit margins. • Patients who opted for HD were more likely to have chosen public dialysis facilities than private ones.	Not addressed.
Thamer et al,[47] 2006	Retrospective, descriptive, based on information from Medicare & Medicaid in 1999 and 2000.	Intravenous use is more profitable and indifferent in terms of clinical outcome. The use of subcutaneous EPO was 43% higher in non-profit dialysis facilities.	The use of subcutaneous EPO was 38% higher in independent dialysis facilities than in those belonging to large organizations.
Szczech et al,[48] 2006	Retrospective, descriptive, based on information from the USRDS and the Medicare & Medicaid database between 1995 and 2000.	Patients in for-profit dialysis facilities had higher albumin concentrations and urea reduction ratios, better control of hematocrit and ferritin and similar mortality rates to patients in public services.	Not addressed.
Devereaux et al,[49] 2002	Systematic review with meta-analysis that included eight studies. The search included publications between 1984 e 2001.	The risk of death was 8% higher in HD patients in for-profit units compared to non-profit units.	Not addressed.

(*Continued*)

Table 3 (Continued).

Author, Year	Study Methods	Approach to Privatization	Approach to Oligopolies
Ozgen et al,[50] 2002	Retrospective, descriptive, based on 1997 Medicare information.	For-profit dialysis facilities were more efficient than non-profit ones.	Independent dialysis facilities and small organizations were more efficient than those from large organizations.
Irvin,[51] 2000	Retrospective, comparative, based on 1996 USRDS.	The risk of death was 1 to 2% higher in HD patients in for-profit units.	Not addressed.
Garg et al,[52] 1999	Retrospective, comparative, based on 1990–1996 USRDS.	Patients treated in for-profit dialysis facilities had a 20% higher mortality rate and a 26% lower chance of being placed on the kidney transplant waiting list.	Not addressed.
Furth et al,[53] 1999	Retrospective, comparative, based on 1994 Medicare information.	Patients treated in for-profit dialysis facilities were 2.2 times less likely to be in PD.	Not addressed.
Griffiths et al,[54] 1994	Retrospective, descriptive, based on Medicare information from 1990. Efficiency was estimated by the ratio between the production of dialysis sessions and the number of professionals and equipment.	For-profit dialysis facilities were 13–21% more efficient.	Dialysis facilities belonging to LDO were 13% more efficient.
Lissovoy et al,[55] 1994	Retrospective, comparative, based on 1990 Medicare information.	For-profit dialysis facilities used a lower dose of EPO.	Not addressed.

Abbreviations: USA, United States of America; USRDS, United States Renal Data System; HD, hemodialysis; HHI, Herfindahl-Hirschman Index; RRT, renal replacement therapy; SMR, standard mortality ratio; RR, relative risk; EPO, erythropoietin; PD, peritoneal dialysis; LDO, large dialysis organizations.

Comparative Studies

When considering the effect of consolidation and/or privatization of the RRT sector, among the 26 comparative studies, 19 (73%) were in favor of non-profit dialysis facilities or independent ones, that is, these units showed better results for patients than private centers or those belonging to dialysis organizations.[20,24,25,27,30,32–35,38,40,43,45,46,51–53,55] Independent dialysis facilities are those whose owner has only one dialysis unit. Six studies (23%) were favorable to for-profit dialysis facilities or dialysis organizations[37,39,42,44,48,54] and one study (4%) was neutral.[31]

Descriptive Studies

Erickson et al[28] showed that there was an 8% reduction in the number of independent dialysis facilities in the 2000s. Furthermore, due to the increase in the population on RRT and, consequently, the number of dialysis facilities, the number of providers per geographic area evaluated increased from 6.9 to 7.6 in the same period.[28] A study by Wilson[29] showed that the dominance of the North American RRT market by two multinational companies increased from 33% to 74% between 1990 and 2015. Posniak et al[41] showed that 60% of dialysis facilities acquisitions in the USA, between 1997 and 2003, were carried out by LDO (those that own >1000 dialysis facilities each) and 40%, by medium-sized ones (ownership of 10–1000 dialysis facilities) or small organizations (<10 dialysis facilities).[41] Furthermore, the study showed that the factors predicting the acquisition of dialysis facilities were the larger size of the local market, higher average serum hematocrit of patients and higher cost per HD session.

Thamer et al[45] analyzed the factors related to the subcutaneous use of erythropoietin (versus intravenous use) between 1990 and 2000, observing that for-profit dialysis facilities used this route of administration 43% less compared to non-profit facilities. Similarly, units belonging to LDO used 38% less subcutaneous erythropoietin than independent facilities. Ozgen et al,[50] when evaluating factors related to the efficiency of dialysis facilities in the USA in 1997, found that for-profit units had lower

expenditure on human resources, operating with smaller numbers of professionals and qualified professionals per patient, compared with non-profit units, and thus achieved greater efficiency.

Systematic Reviews

This integrative review included two systematic reviews. Both aimed to evaluate the effect of the profit status of dialysis facilities on patient mortality. In the first, Devereaux et al[49] analyzed the results of eight articles published between 1984 and 2000, finding, in the meta-analysis carried out, that mortality in for-profit dialysis facilities was 8% higher than in non-profit ones (RR=1.08, 95% CI=1.04 to 1.13). Dickman et al,[26] in turn, by evaluating nine articles between 2011 and 2019, showed a similar result, that is, a 7% increase in the risk of death of patients in for-profit versus non-profit dialysis facilities (RR=1.07, CI95%=1.04 to 1.11).

Questionnaire-Based Survey

Balhara et al[36] aimed to evaluate the approach to kidney transplantation carried out by physicians from HD centers in the USA in 2010. Compared to professionals from non-profit facilities, those from for-profit facilities were 11% less likely to spend more of 20 minutes talking to their patients about kidney transplants, 43% less chance of involving family members in this conversation, and 55% less chance of considering patients eligible for the procedure. In the same study, the lack of specific reimbursement to talk to patients about kidney transplantation was mentioned as one of the barriers to the transplantation process by 30% of physicians in for-profit units versus 18% of those in non-profit facilities.[15]

Discussion

This integrative review showed that most of the articles included dealt with the RRT sector in a single country (USA). There was a predominance of studies highlighting the deleterious effects of privatization and oligopolization phenomena on patients. Among these effects, the studies showed higher rates of hospitalization and death, adverse selection of one RRT method over another and lower referral to kidney transplantation. Some of these results were attributed to conflicts of interest in the RRT sector. The studies that were favorable to private for-profit units or those belonging to LDO showed, above all, lower costs, greater economic efficiency and better performance in the anemia control indicator for patients. As such, this discussion was structured into four dimensions: 1) Hospitalization and death of dialysis patients; 2) Conflicts of interest in the RRT sector; 3) PD utilization; and 4) Economic efficiency and quality of care in RRT.

Hospitalization and Death of Dialysis Patients

The causes of hospitalization and death in the dialysis population are multifactorial and difficult to prevent,[56–58] nevertheless the studies included in this review have repeatedly shown greater morbidity[20,33,40] and mortality in patients treated in facilities for profitable than non-profit or public ones, even after adjustment for several confounding factors.[20,25,26,30,31,35,38,43,49,51,52]

There are some explanations that could justify these results. Studies by Ozgen[50] and Griffiths[54] showed that for-profit dialysis units used fewer employees per patient and fewer qualified professionals than non-profit dialysis units. Lee et al[40] showed that private dialysis centers or those belong to LDO carry out HD sessions of shorter duration than non-profit RRT services, which is known to be associated with a higher risk of intra-dialysis complications.[59,60] Another hypothesis could be the greater resources diverted, by for-profit dialysis facilities, to pay for amenities used for market competition, such as hospitality, decoration, more comfortable seats and entertainment.[61,62] In the private dialysis sector, there is greater profit from in-hospital dialysis sessions than from outpatient ones, which could represent a commercial stimulus for hospitalizations.[40,63] On the other hand, public or non-profit facilities could have a lower hospitalization rate due to the need to reduce the occupancy of public beds, as they are linked to universities and receive donations and tax exemptions, thus being able to make greater investments in human and direct patient care.[25,63]

Brazil is an upper-middle-income Latin American country that has the third largest dialysis population in the world and is one of the ten nations with the greatest incidence of advanced CKD.[10,64,65] To date, there are no Brazilian studies that directly compared the performance of for-profit and non-profit dialysis units. Brazil has a dual health system in which the public and universal system coexists with the private supplementary one. There are profound differences in the

determinants of health and illness between people with and without private health insurance (hygiene and housing conditions, security, public transportation, income, education, social support and access to complementary exams and specialized treatments).[66–69] This is probably the main explanation for the higher mortality of dialysis patients who do not have private health insurance, as shown in recent Brazilian studies.[70,71]

Conflicts of Interest in the RRT Sector

Compared to the general population, the RRT population is highly vulnerable due to their greater age and burden of comorbidities, lower income and schooling and, therefore, higher rates of hospitalization and death.[72] Among people on dialysis, racial minority and low-income groups have less access to specialized treatments and worse clinical outcomes.[73] The variety of therapeutic options is an additional complexity, as they are dependent on local incentives and availability, patient characteristics and knowledge of the services and health professionals involved.[74,75] Therefore, decision-making centered on patients with advanced chronic kidney disease becomes a challenge.

The studies carried out by Amaral,[24] Gander,[27] Zhang,[32] Balhara,[36] Foley[44] and Garg[52] showed that the enrollment rate of patients on the transplant list was lower in for-profit dialysis units and those belonging to LDO than in non-profit clinics. Possible explanation for these results could be the payment model for production of HD sessions, as it may constitute commercial disadvantage for reducing the number of patients on dialysis, whether through kidney transplantation or longer stays in conservative management of kidney function.[76] Between 2008 and 2022, the estimated number of people on dialysis funded by the Brazilian Public Health System increased from 69,675 to 110,924, while the number of new kidney transplants increased from 3426 to just 4218 in the same period, thus causing a progressive increase in demand for organs for transplantation.[64] A survey by the Brazilian Society of Nephrology showed that only 22% of dialysis patients are on the wait-list for kidney transplantation.[65] There are no Brazilian studies comparing the wait-listing rate for kidney transplantation in for-profit dialysis facilities or LDO with the rate in their own or independent public facilities.

Erythropoietin derivatives (EPO) are essential medications for treating anemia in dialysis patients. It is well known that excessive doses can be harmful and the dose of EPO should be titrated according to the serum hemoglobin level.[3,77] Studies by Zhang,[35] Ishida,[34] Thamer[45] and Lissovoy[55] showed that the use of EPO by patients undergoing HD before 2011 in for-profit clinics was greater than in non-profit ones, regardless of the rate of patients reaching the hemoglobin target or the change in this parameter that occurred from the mid-2000s.[3] A possible justification for these results could be government reimbursement for the use and application of these drugs in dialysis clinics, which was in force in the USA until 2011.[78] After the implementation of the bundle payment system, for-profit dialysis units and those belonging to LDO reduced the average dose of EPO for their patients by 38%.[78] This new system, named Prospective Payment System (PPS), incorporated erstwhile separately billable services, including EPO, into a single bundled payment.[79]

PD Utilization

Mehrota[43] and Furth[53]'s studies showed that north-American for-profit dialysis facilities or those belonging to LDO had lower PD utilization than non-for-profit ones. The lower profitability of the PD compared to HD may be one of the explanations for these results.[80,81] In many countries, the use of PD remains low despite arguments that support its greater use, including outcomes similar to HD, home-based therapy, avoidance of central venous catheters and potential health economic advantages.[80] Luijtgaarden et al[81] evaluated 36 countries around the world with the aim of determining macroeconomic factors and population characteristics related to PD use. They found that lower PD utilization was independently associated to higher prevalence of diabetes, higher per capita health expenditure, greater participation of private for-profit centers, and higher costs of PD consumables relative to personnel.

The increase in the absolute number of people on dialysis in Brazil mentioned above corresponded to an increase in prevalence from 36.4 to 51.7 per 100,000 inhabitants in the last two decades, which occurred exclusively at the expense of the HD method, since the prevalence of people on PD fell from 2.9 to 2.3 per 100,000.[64] Unfortunately, there are no Brazilian studies that analyzed the use of PD in private dialysis facilities or LDO, comparing it with the use in their own or independent public facilities. In countries of continental dimensions such as Brazil, greater use of PD could improve the quality of life of thousands of people who have to travel three times a week to perform HD in dialysis facilities, most of which are located in large urban centers.[82–85]

Economic Efficiency and Quality of Care in RRT

This review showed greater economic efficiency and better-quality care indicators in for-profit dialysis facilities and LDO compared to non-profit ones. As described previously, the studies by Ozgen[50] and Griffiths[54] showed that for-profit dialysis units could reduce their per HD session costs by using fewer employees per patient and fewer qualified professionals.[54] The quality indicator whose performance was superior in private services than in public ones was mainly the better control of patients' anemia as showed by Foley,[44] Hirth[39] and Hynes.[37] Possible explanations for this result could be the greater use of EPO, which was a high-cost reimbursable medication at the time the studies were carried out.[55,62]

Few countries in the world have dialysis registries robust enough to collect dialysis quality information systemically.[86] In the USA, the United States Renal Data System (USRDS) has for decades provided grouped information on quality indicators, hospitalization and death of patients undergoing RRT, among others.[87] Furthermore, information with a greater level of detail can be obtained upon request from the USRDS coordination and was the source of data for many of the studies included in this review (Table 3).

Despite this great availability of information, a key factor for the efficiency of hemodialysis, that is, the type of vascular access, was not addressed by the studies included in this review. Compared to venous catheters, the use of arteriovenous fistula is associated with greater dialysis efficiency and survival.[88] A recent study carried out in Brazil showed that patients with private health insurance have a lower rate of arteriovenous fistula use than patients with exclusive coverage from the public system.[89] On the other hand, SUS patients have a higher rate of use of non-tunneled catheters than patients with private insurance, with the former devices being associated with greater risks of infection and death.[89]

In the Brazilian case, Ordinance number 1675 of 2018 determines that public managers must monitor a series of quality indicators in dialysis facilities.[90] However, this is unfulfilled monitoring and information on the quality of RRT in Brazil comes mainly from surveys carried out by the Brazilian Society of Nephrology, in which the participation of dialysis facilities is voluntary and the percentage of adherence has been only 25–30%.[11,72,91]

Study's Limitation

The limitations of this review must be acknowledged. Firstly, the results presented here cannot be generalized, since more than 90% of the studies addressed the RRT sector of a single country. Nevertheless, a recent scoping review also showed that the origin of the retrieved articles was predominantly from high- and upper-middle-income countries, especially the USA.[92] In the case of Brazil, there is an unproven possibility that private RRT services perform as well as or better than public services, considering the progressive de-funding of the SUS[93–95] and the supplementary health income that private services obtain in addition to the amounts paid by the SUS, since more than 70% of dialysis services in Brazil are mixed in terms of the type of public served.[64,65] Secondly, many studies used the USRDS database in overlapping periods, which could lead to partial duplication of results. However, the differences in objectives, data extraction methods and number of variables included in multiple models remained present between these studies. Thirdly, important outcomes such as mortality and hospitalization must be analyzed with caution due to the large number of confounding factors.[49] Fourthly the use of only one search source (VHL Portal) may have interfered with the number and characteristics of the publications evaluated. Finally, the lack of uniformity and use of scientific descriptors in the areas of economics and health policy may have resulted in the non-inclusion of relevant studies.

Conclusion

This integrative review showed possible deleterious effects of privatization and oligopolies in the RRT sector. Among these effects, the studies have shown higher rates of hospitalization and mortality, and lower rates of referral for kidney transplantation and PD utilization in for-profit dialysis units and those belonging to large organizations, compared to public or non-profit ones. Carrying out these studies was only possible due to a robust, nationwide information system. In this sense, the absence of studies from different nations, with the exception of the USA, was worrying. When considering the example of Brazil, attention should be drawn to the progressive oligopolization of the RRT sector, the progressive reduction in the PD utilization, the low referral rate for kidney transplantation and the failure to comply with the Ministry of Health's Ordinance, which requires public managers to monitor the quality of RRT care. In countries with a universal

health system and a rapid increase in the prevalence of people undergoing RRT, the significant volume of public resources that are consumed by multinational and profit-making companies has pointed to the need to evaluate the care provided in RRT in a systemic and transparent way.

Abbreviations

CKD, chronic kidney disease; EPO, erythropoietin; HD, hemodialysis; HHI, Herfindahl-Hirschman Index; LDO, large dialysis organizations; PD, peritoneal dialysis; RR, relative risk.; RRT, renal replacement therapy; SMR, standard mortality ratio; SUS, Sistema Único de Saúde (Brazilian Unified Health System); USA, United States of America; USRDS, United States Renal Data System; VHL, Health Library Regional Portal.

Data Sharing Statement

The data used to support the findings of this study are included in the article.

Author Contributions

All authors contribute equally in the conception, study design, execution, acquisition of data, analysis and interpretation, drafting, revising and critically reviewing the article. All authors gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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