Original Article

Citation classics: ranking of the top 100 most cited articles in nephrology

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ABSTRACT

Background. The number of citations of a scientific article is considered a weight of that work in the field of interest. Bibliometric analysis of the most cited articles conducted in some medical disciplines has identified the most relevant scientific contributions that pushed forward knowledge and clinical practice of that discipline.

Methods. We conducted a bibliometric analysis of the most cited articles in nephrology, by extracting relevant words that identify issues of nephrological interest and querying the Google Scholar database. A rank with the 100 most cited articles was obtained, based on the absolute number of citations. Articles were clustered in different areas of interest.

Results. Word(s) extracted from the Google Scholar database that restituted at least 100 000 hits were 50. The extracted 100 most cited articles collected cumulatively >285 000 citations. Nine subcategories were identified and the most populated one was ‘Renal function assessment’ (16 articles and 68 000 citations, 24% of total). The other relevant group of articles (16, with 46 652 citations) belonged to the category ‘Randomized trials and pharmacology’. Almost 70% of the articles in the top 100 were published by eight major international journals. The top 100 list included 62 articles generated from USA scientists and the author with higher number of articles was A.S. Levey (10).

Conclusions. The top 100 list of articles in nephrology helps delineate the major interests of this medical discipline. Assessment of renal functions, probably for its multidisciplinary relevance, is the heaviest topic, based on number of citations.

Keywords: bibliometric analysis, citations, Google Scholar, nephrology, top 100 most cited articles

INTRODUCTION

Nephrology is a medical discipline that gained autonomy in the mid-1950s, when the eminent clinician Jean Hamburger in Paris proposed this term to define the branch of internal medicine that would study kidney diseases [1, 2]. In the preceding decades, mainly experimental studies and clinical observations had enriched the knowledge on specific physiological aspects of renal function [3], while at the time of Hamburger, a spectrum of glomerulonephritides and renal diseases with a defined pathogenesis were identified [4, 5]. Also, the introduction of the Kolff
artificial kidney occurred a decade before, and laid the foundations for this novel branch of medicine. In recognition of the rapidly growing new discipline, prominent specialists worldwide founded the International Society of Nephrology in 1960 [1]. The development of areas of interest in nephrology and its specific clinical and research topics can be analysed from the research contributions summing up about 795,000 items in the PubMed database under the heading 'kidney'. We were interested in assessing the most relevant scientific articles that influenced the nephrological practice and shaped the discipline, by focusing on specific topics of the research in kidney diseases. In recent years, efforts have been made to define relevant articles in some medical specialty areas (anaesthesiology, dermatology, general surgery, urology, chronobiology and neurosciences) by identifying the 100 most cited articles [6–11], and some journals have analysed the ‘classic’ articles published by impact on readership [12, 13]. No such investigation has been conducted in nephrology. We therefore employed a bibliometric analysis aimed at identifying the top 100 most cited scientific articles on specific nephrological issues.

MATERIALS AND METHODS

The Google Scholar tool, which restitutes for each article the number of citations, was used to search for the most cited articles of nephrological interest. Compared with other instruments (such as Scopus, and Web of Science by Thomson Reuters), Google Scholar is able to capture a broader spectrum of citing sources, including books, conference publications, other citations, etc. The search was conducted by introducing in the field ‘with at least one of the words’ general terms that could capture all relevant articles dealing with kidney function, pathology, renal pathophysiology, renal diseases, principal drugs used for kidney diseases, common comorbidities of kidney diseases, principal metabolites handled by the kidney, dialysis and transplantation. We selected all index word(s) that constituted at least 100,000 items in Google Scholar. Also, a combination of terms was used to probe the search engine and to make sure that all relevant publications could be identified.

Selected articles were original articles, meta-analyses, consensus articles and guidelines. Narrative reviews were not considered. The top most cited 100 articles were identified. A preliminary analysis of number of citations allowed us to set a cut-off of 1000 citations, so all articles that received a higher number of citations were extracted and listed to generate a rank based on absolute number of citations received by each article as of 7 February 2018. Concerning the country origin of the articles, individual countries have been listed if the authors derived from up to three countries, otherwise, the origin was deemed as global, if the countries of author origin were four or more.

Since most recent articles have a lifespan shorter than older articles, the number of citations per year was also calculated. Articles were categorized according to the topic in one of nine subfields.

RESULTS

In Table 1, all terms used for searching the Google Scholar database are listed. A total of 50 terms were identified that produced more than 100,000 hits in Google Scholar search. The database was then probed with each individual term listed and all publications with at least 1000 citations were extracted. Top most cited 100 articles collected cumulatively >285,000 citations. The nine subcategories of the top 100 articles are indicated in Table 2. The most populated category was ‘Renal function assessment’, which included 16 articles that collectively accumulated nearly 68,000 citations (almost 24% of all citations). The second most abundant group of articles belonged to the subcategory ‘Randomized trials and pharmacology’ (16 articles, 46,652 citations, 16.4% of all citations). Subcategories ‘Diagnosis/Transplantation’, ‘Epidemiological studies’, ‘Pathophysiology’ and ‘Acute Kidney Injury’ individually accounted for about 10% of all citations and each category contained between 9 and 14 articles (Table 2).

The top 10 most cited articles include 3 articles (rank number 1, 2 and 4) on modality of estimating renal function, 3 more articles (rank number 6, 7 and 8) describing results from randomized trials on the utility of Renin-Angiotensin-Aldosterone System (RAAS) blockade in diabetic nephropathy and 2 articles that dealt with definition and classification of acute kidney injury (AKI) (rank number 9 and 10); the last two were: one article on the predictive value of chronic kidney disease (CKD) on mortality and cardiovascular disease (rank number 3) and, finally, a >50-year-old article by Graham and Karnovsky on a new method of ultrastructural cytochemistry demonstrating the reabsorption of peroxidase by the proximal tubular cells, after glomerular filtration (rank number 5) (Table 3). Among the top 10 cited articles the most rapidly growing in citations per year is the article of Levey and the Chronic Kidney Disease - Epidemiology Collaboration (CKD-EPI) consortium on glomerular filtration rate (GFR) estimation that accumulated >1087 citations per year (Table 3).

The first most cited article dealing with issues relevant to the haemodialysis field is at the 15th position, by Wolfe et al., concerning the mortality risk in patients on dialysis compared with that in transplanted patients. This article collected 3698 citations (Table 3). There are 11 other articles dealing with specific issues related to chronic dialysis (at the 24th, 28th, 34th, 45th, 46th, 53rd, 58th, 62nd, 82nd, 83rd and 90th position) and these concern risk factors for mortality, atherosclerosis, mineral metabolism, aluminium intoxication, vascular access, effects of dialysis membrane type and inflammation. All the 12 articles were globally cited 27,481 times (9.6% of the total citations of the top 100 articles).

Another relevant aspect is represented by epidemiological studies on the classification and incidence of CKD in the US population (two articles by Levey and Coresh et al., respectively, at rank number 12 and 13). Other articles of epidemiological interest are found at position 21st, 30th, 37th, 54th and 55th, and collectively have been cited 20,555 times (7.2% of the global citations).

A total of four studies on anaemia correction by erythropoiesis-stimulating agents are present in the top 100 list. The four articles allocate to the 35th, 36th, 57th and 60th position. Cumulative citations of these studies were 8968 (3.1% of total citations) (Table 3).

Basic sciences or mechanism of diseases were addressed in some articles, namely at rank 11th [genetic polymorphism at the angiotensin-converting enzyme (ACE) gene, regulating plasma levels of the enzyme], 18th [nephrotic syndrome caused by shunt operation for hydrocephalus], 23rd [tyrosine kinase and endothelial dysfunction in pre-eclampsia], 43rd [nitric oxide accumulation in renal failure], 50th [urinary antimicrobial effects of hepcidin], 69th [kidney development], 74th (mutated nephrin and nephrotic syndrome), 84th [cellular function of polycystin 1 and 2], 86th [von Willebrand factor and thrombotic thrombocytopenic purpura (TTP)] and 92nd (tyrosine kinase receptor and kidney development); the number of citations for each of these articles ranged from 4225 to 1583 (Table 3).

Epidemiology, classification and management of acute renal failure and AKI has received proper attention: besides the 9th and 10th article by the AKI Network, we find articles at 22nd,
Table 1. Terms used to extract relevant articles with highest citations, and number of items indexed in the Google Scholar search engine for each term

| Number | Term                  | Number of items (approx.) | Number | Term                  | Number of items (approx.) |
|--------|-----------------------|---------------------------|--------|-----------------------|---------------------------|
| 1      | Clearance             | 3 450 000                 | 26     | Nephrology            | 838 000                   |
| 2      | Urine                 | 3 190 000                 | 27     | ACE inhibitor         | 753 000                   |
| 3      | Urea                  | 3 040 000                 | 28     | Haemodialysis         | 762 000                   |
| 4      | Kidney                | 3 000 000                 | 29     | Nephropathy           | 717 000                   |
| 5      | Renal                 | 2 900 000                 | 30     | Renin                 | 698 000                   |
| 6      | Urinary               | 2 770 000                 | 31     | Nephritis             | 467 000                   |
| 7      | Hypertension          | 2 710 000                 | 32     | Tubular secretion     | 458 000                   |
| 8      | Low-protein diet      | 2 690 000                 | 33     | Metabolic acidosis    | 401 000                   |
| 9      | CKD                   | 2 670 000                 | 34     | Kidney stones         | 393 000                   |
| 10     | Chronic renal failure | 2 390 000                 | 35     | Glomerulonephritis    | 389 000                   |
| 11     | End stage renal disease | 2 390 000              | 36     | Proteinuria           | 389 000                   |
| 12     | Renal insufficiency   | 2 060 000                 | 37     | Diuretic              | 373 000                   |
| 13     | Acid base balance     | 2 000 000                 | 38     | Nephron               | 355 000                   |
| 14     | Dialysis              | 1 990 000                 | 39     | Tubular necrosis      | 340 000                   |
| 15     | End stage kidney disease | 1 800 000               | 40     | Renal cysts           | 307 000                   |
| 16     | Kidney transplant     | 1 760 000                 | 41     | Eclampsia             | 278 000                   |
| 17     | Renal failure         | 1 740 000                 | 42     | Nephrotic             | 259 000                   |
| 18     | Renal transplant      | 1 740 000                 | 43     | Renal glomerulus      | 251 000                   |
| 19     | AKI                   | 1 730 000                 | 44     | Uraemic               | 244 000                   |
| 20     | Renal tubular         | 1 640 000                 | 45     | Haematuria            | 199 000                   |
| 21     | Kidney transplantation | 1 640 000                | 46     | Pyelonephritis        | 184 000                   |
| 22     | Renal transplantation | 1 600 000                 | 47     | Diuresis              | 183 000                   |
| 23     | Creatinine            | 1 330 000                 | 48     | Furosemide            | 176 000                   |
| 24     | Angiotensin           | 1 320 000                 | 49     | Uraemia               | 160 000                   |
| 25     | Glomerular            | 948 000                   | 50     | Albuminuria           | 123 000                   |

Total 285 094 100.0

Table 2. Subcategories of the top 100 most cited articles

| Number | Article group         | Description                                                                 | Abbreviation | Number of articles | Article number | Number of citations (total) | % total |
|--------|-----------------------|------------------------------------------------------------------------------|--------------|--------------------|----------------|-----------------------------|---------|
| 1      | Renal function assessment | Studies on modalities of renal function assessment and laboratory methods | RF           | 16                 | 1, 2, 4, 17, 19, 26, 27, 31–33, 39, 52, 56, 78, 81, 95 | 67 938  | 23.8 |
| 2      | Randomized trials/ pharmacology | Randomized clinical trials and pharmacology of relevant kidney diseases | RT           | 16                 | 6–8, 14, 35, 36, 44, 46, 51, 57, 60, 72, 73, 87, 98, 100 | 46 652  | 16.4 |
| 3      | Dialysis transplantation | Studies involving uraemic patients treated by dialysis or transplantation | DT           | 14                 | 24, 28, 34, 41, 45, 53, 58, 59, 62, 70, 82, 83, 88, 90 | 29 424  | 10.3 |
| 4      | Epidemiological studies | Studies on prevalence of renal diseases, outcomes, guidelines | ES           | 9                  | 12, 13, 15, 16, 21, 30, 37, 54, 55 | 27 791  | 9.7  |
| 5      | Pathophysiology       | Mechanisms of kidney diseases                                                | PP           | 12                 | 18, 23, 25, 29, 43, 48, 50, 63, 68, 71, 86, 93 | 27 613  | 9.7  |
| 6      | AKI                   | Pathogenic factors, biomarkers, classification and interventions in AKI     | A            | 10                 | 9, 10, 22, 38, 66, 67, 75–77, 89 | 27 115  | 9.5  |
| 7      | Kidney structure and function | Studies on structural, functional aspect, development of kidney and genetics | SF           | 7                  | 5, 11, 69, 74, 84, 92, 94 | 20 201  | 7.1  |
| 8      | CKD/pathology         | Pathogenic and predictive factors of CKD evolution/pathology of renal diseases | CK           | 6                  | 3, 20, 42, 65, 85, 99 | 19 469  | 6.9  |
| 9      | Comorbidities of renal disease | Studies on mechanisms of diabetic nephropathy and hypertension | DH           | 10                 | 40, 47, 49, 61, 64, 79, 80, 91, 96, 97 | 18 891  | 6.6  |

Total 285 094 100.0
Table 3. Top 100 most cited articles in nephrology, ranked by number of citations

| Number | Year | Authors | Title | Journal | Country | Cit. n | Cit. norm | Cat. |
|--------|------|---------|-------|---------|---------|--------|----------|------|
| 1      | 1976 | Cockcroft DW, Gault MH. | Prediction of creatinine clearance from serum creatinine. | Nephron 1976; 16: 31–41. PubMed PMID: 1244564. | Canada | 14499 | 353.6 | RF   |
| 2      | 1999 | Levey AS, Bosch JP, Lewis JB et al. | A more accurate method to estimate glomerular filtration rate from serum creatinine: a new prediction equation. Modification of Diet in Renal Disease Study Group. | Ann Intern Med 1999; 130: 461–470. PubMed PMID: 10075613. | USA | 13186 | 732.5 | RF   |
| 3      | 2004 | Go AS, Chertow GM, Fan D et al. | Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. | N Engl J Med 2004; 351: 1296–1305. PubMed PMID: 15385656. | USA | 18679 | 732.5 | CK   |
| 4      | 2009 | Levey AS, Stevens LA, Schmid CH et al. | A new equation to estimate glomerular filtration rate. | Ann Intern Med 2009; 150: 604–612. PubMed PMID: 19414839. | USA | 8699 | 1087.4 | RF   |
| 5      | 1966 | Graham RCJr, Kamovsky MJ. | The early stages of absorption of injected horseradish peroxidase in the proximal tubules of mouse kidney: ultrastructural cytochemistry by a new technique. | J Histochem Cytochem 1966; 14: 291–302. PubMed PMID: 5962951. | USA | 7414 | 145.4 | SF   |
| 6      | 2001 | Brenner BM, Cooper ME, de Zeeuw D et al. | Effects of losartan on renal and cardiovascular outcomes in patients with type 2 diabetes and nephropathy. | N Engl J Med 2001; 345: 851–860. PubMed PMID: 11565518. | Global | 7219 | 451.2 | RT   |
| 7      | 2001 | Lewis EJ, Hunsicker LG, Clarke WR et al. | Renoprotective effect of the angiotensin-receptor antagonist losartan in patients with nephropathy due to type 2 diabetes. | N Engl J Med 2001; 345: 851–860. PubMed PMID: 11565518. | Global | 6085 | 380.3 | RT   |
| 8      | 1993 | Lewis EJ, Hunsicker LG, Bain RP et al. | The effect of angiotensin-converting-enzyme inhibition on diabetic nephropathy. | N Engl J Med 1993; 329: 1456–1462. PubMed PMID: 8413456. | USA | 5622 | 234.2 | RT   |
| 9      | 2004 | Bellomo R, Ronco C, Kellum JA et al. | Acute renal failure - definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. | Crit Care 2004; 8: R204–R212. PubMed PMID: 15312219. | Global | 5523 | 424.8 | A    |
| 10     | 2007 | Mehta RL, Kellum JA, Shah SV et al. | Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. | Crit Care 2007; 11: R31. PubMed PMID: 17331245. | Global | 5217 | 521.7 | A    |
| 11     | 1990 | Rigat B, Hubert C, Alhenc-Gelas F et al. | An insertion/deletion polymorphism in the angiotensin I-converting enzyme gene accounting for half the variance of serum enzyme levels. | J Clin Invest 1990; 86: 1343–1346. PubMed PMID: 1976655; PubMed Central PMCID: PMC296868. | France | 4225 | 156.5 | SF   |
| 12     | 2007 | Coresh J, Selvin E, Stevens LA et al. | Prevalence of chronic kidney disease in the United States. | JAMA 2007; 298: 2038–2047. PubMed PMID: 17986697. | USA | 4174 | 417.4 | ES   |
| 13     | 2003 | Levey AS, Coresh J, Balk E et al. | National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. | Ann Intern Med 2003; 139: 137–147. PubMed PMID: 12859163. | USA/Canada | 3980 | 284.3 | ES   |
| 14     | 2001 | Parving HH, Lehnert H, Bröchner-Mortensen J et al. | The effect of irbesartan on the development of diabetic nephropathy in patients with type 2 diabetes. | N Engl J Med 2001; 345: 870–878. PubMed PMID: 11565619. | Global | 3712 | 232.0 | RT   |
| 15     | 1999 | Wolfe RA, Ashby VB, Milford EL et al. | Comparison of mortality in all patients on dialysis, patients on dialysis awaiting transplantation, and recipients of a first cadaveric transplant. | N Engl J Med 1999; 341: 1725–1730. PubMed PMID: 10580071. | USA | 3698 | 205.4 | ES   |

(continued)
| Number | Year | Authors | Title | Journal | Country | Cit. n | Cit. norm | Cat. |
|--------|------|---------|-------|---------|---------|--------|-----------|------|
| 16     | 1995 | Burt VL, Whelton P, Roccella EJ et al. | Prevalence of hypertension in the US adult population. Results from the Third National Health and Nutrition Examination Survey, 1988-1991. Modified reagents for determination of urea and ammonia. Nephrotic syndrome associated with bacteremia after shunt operations for hydrocephalus. Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. | Hypertension 1995; 25: 305–313. PubMed PMID: 7875754. | USA | 3538 | 160.8 | ES |
| 17     | 1962 | Chaney AL, Marbach EP. | | Clin Chem 1962; 8: 130–132. PubMed PMID: 13878063. Lancet 1965; 2: 921–924. PubMed PMID: 4165274. | USA | 3431 | 62.4 | RF |
| 18     | 1965 | Black JA, Challacombe DN, Ockenden BG. | | | UK | 3368 | 64.8 | PP |
| 19     | 2006 | Levey AS, Coresh J, Greene T et al. | | | USA | 3242 | 294.7 | RF |
| 20     | 1999 | Racusen LC, Solez K, Colvin RB et al. | The Banff 97 working classification of renal allograft pathology. Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third National Health and Nutrition Examination Survey. | Kidney Int 1999; 55: 713–723. PubMed PMID: 9987096. | Global | 3161 | 175.6 | CK |
| 21     | 2003 | Coresh J, Astor BC, Greene T et al. | | | USA | 3151 | 225.1 | ES |
| 22     | 2005 | Uchino S, Kellum JA, Bellomo R et al. | Acute renal failure in critically ill patients: a multinational, multicenter study. Excess placental soluble fms-like tyrosine kinase 1 (sFlt1) may contribute to endothelial dysfunction, hypertension, and proteinuria in preeclampsia | JAMA 2005; 294: 813–818. PubMed PMID: 16106006. J Clin Invest 2003; 111: 649–658. PubMed PMID: 12681519. | Global | 3113 | 259.4 | A |
| 23     | 2003 | Maynard SE, Min JY, Merchant J et al. | | | USA | 3100 | 221.4 | PP |
| 24     | 2000 | Goodman WG, Goldin J, Kuizon BD et al. | Coronary-artery calcification in young adults with end-stage renal disease who are undergoing dialysis. | N Engl J Med 2000; 342: 1478–1483. PubMed PMID: 10816185. | USA | 2953 | 173.7 | DT |
| 25     | 1969 | Haber E, Koerner T, Page LB et al. | Application of a radioimmunoassay for angiotensin I to the physiologic measurements of plasma renin activity in normal human subjects. | J Clin Endocrinol Metab 1969; 29: 1349–1355. PubMed PMID: 4311082. | USA | 2832 | 59.0 | PP |
| 26     | 2009 | Matsuo S, Imai E, Horio M et al. | Revised equations for estimated GFR from serum creatinine in Japan. | Am J Kidney Dis 2009; 53: 982–992. PubMed PMID: 19339088. | Japan | 2793 | 349.1 | RF |
| 27     | 2000 | Levey AS, Greene T, Kusek JW et al. | A simplified equation to predict glomerular filtration rate from serum creatinine. | J Am Soc Nephrol 2000; 11: 155A. abstract. Am J Kidney Dis 1998; 31: 607–617. PubMed PMID: 9531176. | USA | 2681 | 157.7 | RF |
| 28     | 1998 | Block GA, Hubert-Shearson TE, Levin NW et al. | Association of serum phosphorus and calcium x phosphate product with mortality risk in chronic hemodialysis patients: a national study. | | USA | 2632 | 138.5 | DT |
| 29     | 1994 | Goldblatt H, Lynch J, Hanzal RF et al. | Studies on experimental hypertension: I. The production of persistent elevation of systolic blood pressure by means of renal ischemia. | J Exp Med 1994; 180: 347–379. PubMed PMID: 19870251; PubMed Central PMCID: PMC2132360. | USA | 2632 | 31.7 | PP |

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| Number | Year | Authors | Title | Journal | Country | Cit. n | Cit. norm | Cat. |
|--------|------|---------|-------|---------|---------|-------|----------|------|
| 30 | 2005 | Levey AS, Eckardt KU, Tsukamoto Y et al. | Definition and classification of chronic kidney disease: a position statement from Kidney Disease: Improving Global Outcomes (KDIGO). | Kidney Int | Global | 2625 | 218.7 | ES |
| 31 | 2007 | Choi HS, Liu W, Misra P et al. | Renal clearance of quantum dots. | Nat Biotechnol | USA | 2607 | 206.7 | RF |
| 32 | 1986 | Pace CN. | Determination and analysis of urea and guanidine hydrochloride denaturation curves. | Methods Enzymol | USA | 2589 | 83.5 | RF |
| 33 | 1945 | Bonsnes RW, Taussky HH. | On the colorimetric determination of creatinine by the Jaffe reaction. | J Biol Chem | USA | 2583 | 35.9 | RF |
| 34 | 2004 | Block GA, Klassen PS, Lazarus JM et al. | Mineral metabolism, mortality and morbidity in maintenance hemodialysis. | J Am Soc Nephrol | USA | 2512 | 193.2 | DT |
| 35 | 2006 | Singh AK, Szczech L, Tang KL et al. | Correction of anemia with epoetin alfa in chronic kidney disease. | N Engl J Med | USA | 2473 | 224.8 | RT |
| 36 | 1987 | Eschbach JW, Egrie JC, Downing MR et al. | Correction of the anemia of end-stage renal disease with recombinant human erythropoietin. Results of a combined phase I and II clinical trial. | N Engl J Med | USA | 2426 | 80.9 | RT |
| 37 | 2001 | Gerstein HC, Mann JF, Yi Q et al. | Albuminuria and risk of cardiovascular events, death, and heart failure in diabetic and Non diabetic individuals. | JAMA | USA | 2392 | 149.5 | ES |
| 38 | 2005 | Chertow GM, Burdick E, Honour M et al. | Acute kidney injury, mortality, length of stay, and costs in hospitalized patients. | J Am Soc Nephrol | USA | 2391 | 199.2 | A |
| 39 | 1960 | Fawcett JK, Scott J. | A rapid and precise method for the determination of urea. | J Clin Pathol | UK | 2340 | 41.0 | RF |
| 40 | 1984 | Mogensen CE. | Microalbuminuria predicts clinical proteinuria and early mortality in maturity-onset diabetes. | N Engl J Med | Denmark | 2333 | 70.7 | DH |
| 41 | 1999 | Blacher J, Guerin AP, Pannier B et al. | Impact of aortic stiffness on survival in end-stage renal disease. | Circulation | France | 2329 | 129.4 | DT |
| 42 | 2004 | Weening JJ, D’Agati VD, Schwartz MM et al. | The classification of glomerulonephritis in systemic lupus erythematosus revisited. | Kidney Int | Global | 2324 | 178.8 | CK |
| 43 | 1992 | Leone A, Moncada S, Vallance Pet al. | Accumulation of an endogenous inhibitor of nitric oxide synthesis in chronic renal failure. | Lancet | UK | 2312 | 92.5 | PP |
| 44 | 1994 | Klahr S, Levey AS, Beck GJ et al. | The effects of dietary protein restriction and blood-pressure control on the progression of chronic renal disease. Modification of Diet in Renal Disease Study Group. | N Engl J Med | USA | 2245 | 97.6 | RT |
| 45 | 1990 | Lowrie EG, Lew NL. | Death risk in hemodialysis patients: the predictive value of commonly measured variables and an evaluation of death rate differences between facilities. | Am J Kidney Dis | USA | 2231 | 82.6 | DT |
| 46 | 2005 | Wanner C, Krane V, März W et al. | Atorvastatin in patients with type 2 diabetes mellitus undergoing hemodialysis. | N Engl J Med | Germany | 2229 | 185.7 | RT |

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| Number | Year | Authors | Title | Journal | Country | Cit. n | Cit. norm | Cat. |
|--------|------|---------|-------|---------|---------|--------|-----------|------|
| 47     | 2009 | Krum H, Schlaich M, Whitboim R et al. | Catheter-based renal sympathetic denervation for resistant hypertension: a multicentre safety and proof-of-principle cohort study. | Lancet 2009; 373: 1275–1281. | Australia | 2205 | 275.6 | DH |
| 48     | 2005 | Mishra J, Dent C, Tarabishi R et al. | Neutrophil gelatinase-associated lipocalin (NGAL) as a biomarker for acute renal injury after cardiac surgery. | Lancet 2005; 365: 1231–1238. | USA | 2185 | 182.1 | PP |
| 49     | 2010 | Simplicity HTN-2 Investigators, Esler MD, Krum H et al. | Renal sympathetic denervation in patients with treatment-resistant hypertension (The Simplicity HTN-2 Trial): a randomized controlled trial. | Lancet 2010; 376: 1903–1909. | Global | 2176 | 310.8 | DH |
| 50     | 2001 | Park CH, Valore EV, Waring AJ et al. | Heparin, a urinary antimicrobial peptide synthesized in the liver. | J Biol Chem 2001; 276: 7806–7810. | USA | 2166 | 135.3 | PP |
| 51     | 1977 | Schwartz GJ, Haycock GB, Edelmann CM Jr et al. | A simple estimate of glomerular filtration rate in children derived from body length and plasma creatinine. | Pediatrics 1976; 58: 259–263. | USA | 2152 | 52.5 | RF |
| 52     | 1974 | Lindner A, Charras B, Sherrard DJ et al. | Accelerated atherosclerosis in prolonged maintenance hemodialysis. | N Engl J Med 1974; 290: 697–701. | USA | 2139 | 49.7 | DT |
| 53     | 2008 | Collins AJ, Foley R, Hezaocq C et al. | Excerpts from the United States Renal Data System 2007 annual data report. | Am J Kidney Dis 2008; 51 (1 Suppl 1): S1–S320 | USA | 2125 | 236.1 | ES |
| 54     | 2010 | Chronic Kidney Disease Prognosis Consortium. | Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality in general population cohorts: a collaborative meta-analysis | J Clin Invest 1945; 24: 388–404. | Global | 2108 | 301.1 | ES |
| 55     | 1945 | Smith HW, Finkelstein N, Aliminoza L et al. | The renal clearances of substituted hippuric acid derivatives and other aromatic acids in dog and man. | J Clin Invest 1945; 24: 388–404. | USA | 2059 | 28.6 | RF |
| 56     | 1998 | Besarab A, Bolton WK, Browne JK et al. | The effects of normal as compared with low hematocrit values in patients with cardiac disease who are receiving hemodialysis and epoetin. | N Engl J Med 1998; 339: 584–590. | USA/Canada/UK | 2058 | 108.3 | RT |
| 57     | 1976 | Alfrey AC, LeGendre GR, Kaehny WD. | The dialysis encephalopathy syndrome. Possible aluminum intoxication. | J Clin Invest 1945; 24: 388–404. | USA | 2045 | 49.9 | DT |
| 58     | 2000 | Harlan J, Johnson CP, Bresnahan B et al. | Improved graft survival after renal transplantation in the United States, 1988 to 1996. | N Engl J Med 1976; 294: 184–188. | USA | 2059 | 28.6 | RF |
| 59     | 2006 | Dnieke TB, Locatelli F, Clyne N et al. | Normalization of hemoglobin level in patients with chronic kidney disease and anemia. | N Engl J Med 2006; 355: 2071–2084. | Global | 2011 | 182.8 | RT |
| 60     | 1982 | Viberti GC, Hill RD, Jarrett RJ et al. | Microalbuminuria as a predictor of clinical nephropathy in insulin-dependent diabetes mellitus. | Lancet 1982; 1: 1430–1432. | UK | 2005 | 57.3 | DH |

(continued)
| Number | Year | Authors | Title | Journal | Country | Cit. n | Cit. norm | Cat. |
|--------|------|---------|-------|---------|---------|-------|-----------|------|
| 62 | 1966 | Brescia MJ, Cimino JE, Appel K et al. | Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula. | N Engl J Med 1966; 275: 1089–1092. PubMed PMID: 5923023. | USA | 2004 | 39.3 | DT |
| 63 | 1981 | Hostetter TH, Olson JL, Rennke HG et al. | Hyperfiltration in remnant nephrons: a potentially adverse response to renal ablation. | Am J Physiol 1981; 241: F85–F93. PubMed PMID: 7246778. | USA | 1999 | 55.5 | PP |
| 64 | 1984 | Mogensen CE, Christensen GK. | Predicting diabetic nephropathy in insulin-dependent patients. | N Engl J Med 1984; 311: 89–93. PubMed PMID: 6738599. Kidney Int 1999; 55: 1899–1911. PubMed PMID: 10231453. | Denmark | 1959 | 59.4 | DH |
| 65 | 1999 | Stenvinkel P, Heimbürger O, Paultre F et al. | Strong association between malnutrition, inflammation, and atherosclerosis in chronic renal failure. | | | | | |
| 66 | 2002 | Nash K, Haeez A, Hou S. | Hospital-acquired renal insufficiency. | Am J Kidney Dis 2002; 39: 930–936. | USA | 1926 | 128.4 | A |
| 67 | 2000 | Ronco C, Bellomo R, Homel P et al. | Effects of different doses in continuous venovenous haemofiltration on outcomes of acute renal failure: a prospective randomised trial. | Kidney Int 1999; 55: 1899–1911. | | | | |
| 68 | 2004 | Anavekar NS, McMurray JJ, Velazquez EJ et al. | Relation between renal dysfunction and cardiovascular outcomes after myocardial infarction. | N Engl J Med 2004; 351: 1285–1295. PubMed PMID: 15385655. | | 1881 | 144.7 | PP |
| 69 | 1993 | Kreidberg JA, Sariola H, Loring JM et al. | WT-1 is required for early kidney development. | Cell 1993; 74: 679–691. | | 1877 | 74.2 | SF |
| 70 | 2003 | Nankivell BJ, Borrows RJ, Fung CL et al. | The natural history of chronic allograft nephropathy. | N Engl J Med 2003; 349: 2326–2333. PubMed PMID: 14668458. | | 1873 | 133.8 | DT |
| 71 | 2002 | Li YC, Kong J, Wei M et al. | 1,25-Dihydroxyvitamin D(3) is a negative endocrine regulator of the renin-angiotensin system. | J Clin Invest 2002; 110: 229–238. PubMed PMID: 12122115. | | 1847 | 123.1 | PP |
| 72 | 2000 | Tepel M, van der Giet M, Schwarztfeld C et al. | Prevention of radiographic-contrast-agent-induced reductions in renal function by acetylsalicylate. | N Engl J Med 2000; 343: 180–184. PubMed PMID: 10900277. | | 1842 | 108.3 | RT |
| 73 | 1996 | Maschio G, Alberti D, Janin G et al. | Effect of the angiotensin-converting-enzyme inhibitor benazepril on the progression of chronic renal insufficiency. The Angiotensin-Converting-Enzyme Inhibition in Progressive Renal Insufficiency Study Group. | N Engl J Med 1996; 334: 939–945. PubMed PMID: 8596594. | | 1817 | 86.5 | RT |
| 74 | 1998 | Kestilä M, Lenkkeri U, Männikkö M et al. | Positionally cloned gene for a novel glomerular protein—nephrin is mutated in congenital nephrotic syndrome. | Mol Cell 1998; 1: 575–582. PubMed PMID: 9660941. | Finland | 1814 | 95.5 | SF |
| 75 | 2002 | Rihal CS, Textor SC, Grill DE et al. | Incidence and prognostic importance of acute renal failure after percutaneous coronary intervention. | Circulation 2002; 105: 2259–2264. PubMed PMID: 12010907. | | 1808 | 120.5 | A |
| 76 | 2004 | Mehran R, Aymong ED, Nikolsky E et al. | A simple risk score for prediction of contrast-induced nephropathy after percutaneous coronary intervention: development and initial validation. | J Am Coll Cardiol 2004; 44: 1393–1399. PubMed PMID: 15464318. | | 1803 | 138.7 | A |
| 77 | 1997 | McCullough PA, Wolny R, Rocher LL et al. | Acute renal failure after coronary intervention: incidence, risk factors, and relationship to mortality | Am J Med 1997; 103: 368–375. PubMed PMID: 9375704. | | 1794 | 89.7 | A |

(continued)
| Number | Year | Authors | Title | Journal | Country | Cit. n | Cit. norm | Cat. |
|--------|------|---------|-------|---------|---------|-------|----------|------|
| 78     | 1988 | Intersalt cooperative research group. | Intersalt: an international study on electrolyte excretion and blood pressure. Results from 24 hour urinary sodium and potassium excretion. | BMJ 1988; 297: 319–328. PubMed PMID: 3416162; PubMed Central PMCID: PMC1834069. | Global | 1772 | 61.1 | RF |
| 79     | 1996 | Klag MJ, Whelton PK, Randall BL et al. | Blood pressure and end-stage renal disease in men. | N Engl J Med 1996; 334: 13–18. PubMed PMID: 9375704. | USA | 1753 | 83.5 | DH |
| 80     | 2002 | Wright JT Jr, Bakris G, Greene T et al. | Effect of blood pressure lowering and antihypertensive drug class on progression of hypertensive kidney disease: results from the AASK trial. | JAMA 2002; 288: 2421–2431. PubMed PMID: 12435255. | USA | 1752 | 116.8 | DH |
| 81     | 2002 | Dharnidharka VR, Kwon C, Stevens G. | Serum cystatin C is superior to serum creatinine as a marker of kidney function: a meta-analysis. | Am J Kidney Dis 2002; 40: 221–226. PubMed PMID: 12148093. | USA | 1747 | 116.5 | RF |
| 82     | 2002 | Eknayan G, Beck GJ, Cheung AK et al. | Effect of dialysis dose and membrane flux in maintenance hemodialysis | Kidney Int 1999; 55: 648–658. PubMed PMID: 9987089. | Germany | 1695 | 94.2 | DT |
| 83     | 1999 | Zimmermann J, Herrlinger S, Pruy A et al. | Inflammation enhances cardiovascular risk and mortality in hemodialysis patients. | Kidney Int 2002; 62: 245–252. PubMed PMID: 12081584. | Global | 1712 | 90.1 | PP |
| 84     | 2003 | Nauli SM, Alenghat FJ, Luo Y et al. | Polycystins 1 and 2 mediate mechanosensation in the primary cilia of kidney cells. | Nat Genet 2003; 33: 129–137. PubMed PMID: 12514735. | USA | 1717 | 122.6 | SF |
| 85     | 2003 | Ojo AO, Held PJ, Port FK et al. | Chronic renal failure after transplantation of a nonrenal organ. | N Engl J Med 2003; 349: 391–3940. PubMed PMID: 12954741. | USA | 1682 | 120.1 | CK |
| 86     | 1998 | Fulin M, Robles R, Galbusera M et al. | von Willebrand factor-cleaving protease in thrombotic thrombocytopenic purpura and the hemolytic-uremic syndrome. | Kidney Int 1999; 55: 648–658. PubMed PMID: 12081584. | Global | 1712 | 90.1 | PP |
| 87     | 2003 | Baigent C, Landray MJ, Reith C et al. | The effects of lowering LDL cholesterol with simvastatin plus ezetimibe in patients with chronic kidney disease (Study of Heart and Renal Protection): a randomised placebo-controlled trial. | Lancet 2011; 377: 2181–2192. PubMed PMID: 21663949; PubMed Central PMCID: PMC3145073. | Global | 1679 | 279.8 | RT |
| 88     | 2003 | London GM, Guérin AP, Marchais SJ et al. | Arterial media calcification in end-stage renal disease: impact on all-cause and cardiovascular mortality. | Nephrol Dial Transplant 2003; 18: 1731–1740. PubMed PMID: 12937218. | France | 1650 | 117.8 | DT |
| 89     | 1996 | Levy EM, Viscoli CM, Horwitz RI. | The effect of acute renal failure on mortality. A cohort analysis. | JAMA 1996; 275: 1489–1494. PubMed PMID: 9375704. | USA | 1628 | 77.5 | A |
| 90     | 2002 | Chertow GM, Burke SK, Raggi P et al. | Sevelamer attenuates the progression of coronary and aortic calcification in hemodialysis patients. | Kidney Int 2002; 62: 245–252. PubMed PMID: 12081584. | USA/ Germany/ Austria | 1610 | 107.3 | DT |
| 91     | 2003 | Adler AI, Stevens RJ, Manley SE et al. | Development and progression of nephropathy in type 2 diabetes: the United Kingdom Prospective Diabetes Study (UKPDS 64). | Kidney Int 2003; 63: 225–232. PubMed PMID: 12472787. | UK | 1605 | 114.6 | DH |
| 92     | 1994 | Schuchardt A, D’Agati V, Larsson-Blomberg L et al. | Defects in the kidney and enteric nervous system of mice lacking the tyrosine kinase receptor Ret. | Nature 1994; 367: 380–383. PubMed PMID: 9375704. | USA | 1583 | 68.8 | SF |

(continued)
| Number | Year | Authors | Title | Journal | Country | Cit. n | Cit. norm | Cat. |
|--------|------|---------|-------|---------|---------|--------|----------|------|
| 93     | 2003 | Mishra J, Ma Q, Prada A et al. | Identification of neutrophil gelatinase-associated lipocalin as a novel early urinary biomarker for ischemic renal injury. | J Am Soc Nephrol 2003; 14: 2534–2543. | USA | 1579 | 112.8 | PP |
| 94     | 1957 | Margoshes M, Vallee BL. | A cadmium protein from equine kidney cortex. | J Am Chem Soc 1957; 79: 4813–4814. | USA | 1571 | 26.2 | SF |
| 95     | 1987 | Schwartz GJ, Brion LP, Spitzer A. | The use of plasma creatinine concentration for estimating glomerular filtration rate in infants, children and adolescents. | Pediatr Clin North Am 1987; 34: 571–590. | USA | 1558 | 51.9 | RF |
| 96     | 2007 | Bellamy L, Casas JP, Hingoran AD et al. | Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. | BMJ 2007; 335: 974. | UK | 1552 | 155.2 | DH |
| 97     | 1993 | Dyck PJ, Kratz KM, Kames JL et al. | The prevalence by staged severity of various types of diabetic neuropathy, retinopathy, and nephropathy in a population-based cohort: the Rochester Diabetic Neuropathy Study. | Neurology 1993; 43: 817–824. | USA | 1551 | 64.6 | DH |
| 98     | 2001 | Mann JF, Gerstein HC, Pogue J et al. | Renal insufficiency as a predictor of cardiovascular outcomes and the impact of ramipril: the HOPE randomized trial. | Ann Intern Med 2001; 134: 629–636 | Germany, Canada | 1548 | 96.7 | RT |
| 99     | 2004 | Keith DS, Nicholls GA, Gullion CM et al. | Longitudinal follow-up and outcomes among a population with chronic kidney disease in a large managed care organization. | Arch Intern Med 2004; 164: 659-663. | USA | 1542 | 118.6 | CK |
| 100    | 2008 | Mann JF, Schmieder RE, McQueen M et al. | Renal outcomes with telmisartan, ramipril, or both, in people at high vascular risk (the ONTARGET study): a multicentre, randomised, double-blind, controlled trial. | Lancet 2008; 372: 547–553. | Global | 1531 | 170.1 | RT |

A, AKI, Cat., subcategory as indicated by abbreviations in Table 2; Cit. n, total number of citations; Cit. norm, number of citations per year, since publication; CK, chronic kidney disease/pathology; DH, comorbidities of renal disease; DT, dialysis transplantation; ES, epidemiological studies; PP, pathophysiology; RF, renal function assessment; RT, randomized trials/pharmacology; SF, kidney structure and function.
Table 4. Number of articles for the different scientific journals that contributed to the top 100 most cited articles in nephrology

| Journal                        | Number of articles |
|--------------------------------|--------------------|
| N Engl J Med                  | 27                 |
| Lancet                        | 10                 |
| Am J Kidney Dis               | 7                  |
| Kidney Int                    | 7                  |
| Ann Intern Med                | 5                  |
| JAMA                           | 5                  |
| J Clin Invest                  | 4                  |
| J Am Soc Nephrol              | 4                  |
| Crit Care                     | 2                  |
| J Biol Chem                   | 2                  |
| Circulation                   | 2                  |
| Br Med J                      | 2                  |
| Clin Chem                     | 1                  |
| Hypertension                  | 1                  |
| Nephron                       | 1                  |
| J Histochem Cytochem          | 1                  |
| J Clin Endocrinol Metab       | 1                  |
| Nephrol Dial Transpl          | 1                  |
| J Exp Med                     | 1                  |
| Nat Biotechnol                | 1                  |
| Methods Enzymol               | 1                  |
| J Clin Pathol                 | 1                  |
| Science                       | 1                  |
| Pediatrics                    | 1                  |
| Am J Physiol                  | 1                  |
| Cell                          | 1                  |
| Mol Cell                      | 1                  |
| J Am Coll Cardiol             | 1                  |
| Am J Med                      | 1                  |
| Nat Genet                     | 1                  |
| Nature                        | 1                  |
| J Am Chem Soc                 | 1                  |
| Pediatr Clin North Am        | 1                  |
| Neurology                     | 1                  |
| Arch Intern Med               | 1                  |
| Total                         | 100                |

38th, 66th, 67th, 75th, 76th, 77th and 89th rank. Cumulative citations of this subcategory are 27 115 (9.5% of total) (Table 2).

Common comorbidities of CKD, such as diabetes and hypertension, relative to their potential to cause renal diseases were topics covered in 10 out of the top 100 articles (rank number 40, 47, 49, 61, 64, 79, 80, 91, 96 and 97): half of them focused on hypertension and half on predictive factors of diabetic nephropathy in patients affected by diabetes mellitus (Table 3); all 10 articles received 6.6% of total citations (Table 2).

Among the top 100 articles there were 9 ‘classic’ articles, which were published more than 50 years ago (rank number 5, 17, 18, 29, 33, 39, 56, 62 and 94), and spanned across four categories (Kidney structure and function, Renal function assessment, Pathophysiology and Dialysis transplantation). The oldest article included in the top 100 was the 1934 article by Goldblatt in the Journal of Experimental Medicine describing the effect on systemic blood pressure consequent to renal ischaemia, that has been cited 2632 times since then, with a mean rate of 31.7 citations/year for a period of 83 years.

A total of 35 scientific journals had published the top 100 most cited articles in nephrology, of which eight included almost 70% of all contributions (The New England Journal of Medicine, The Lancet, American Journal of Kidney Diseases, Kidney International, Annals of Internal Medicine, JAMA, Journal of Clinical Investigation and Journal of the American Society of Nephrology) (Table 4).

The principal author or co-author with higher number of articles in the top 100 is AS Levey with 10 articles (rank number 2, 4, 12, 13, 19, 21, 27, 30, 44 and 82) accounting for a total of 45 716 citations (16.0% of all citations).

Concerning the country of origin of the articles included in the top 100 list, the great majority of studies were contributed by USA scientists (total 62 articles), while 16 articles were contributed by authors from four or more countries (defined as global). The UK contributed seven articles and other countries (Germany, Canada, France, Australia, Italy, Denmark, Sweden and Finland) with a lower number (Figure 1). Plotting all the 100 top cited articles in a timeline graph by number of articles published and the year of publication shows that the maximum number of articles were published in 2003 (nine articles), there is a large skewness towards the old articles going back to 1934, while the most recent article was published in 2011 (Figure 2).

DISCUSSION

In this study, we have evaluated the top 100 articles that had a high impact on the practice of nephrology, by assessing the number of times these articles were cited. Therefore, by analysing the topics that were covered by the set of articles, one can draw the contours of the discipline and, potentially, its evolution over time since its establishment about 60 years ago. Through this analysis, one can also obtain information on the major source of articles that contributed to the most cited and assess their country of origin.

We decided to use an approach based on Google Scholar search, which is more comprehensive of all citing sources of an article. One has to consider, however, that the cumulative number of citations in each subcategory does not reflect the global interest of the nephrology community for that specific field; instead it represents an estimation of the weight of single publications that have been produced in that specific subfield.

It is not possible to comment on each individual article included in the top 100 list; however, we can draw some considerations that help understand the major interests of the nephrological professionals worldwide.

The first two most cited articles are: (i) the 1976 article on Cockcroft–Gault formula for estimating creatinine clearance and (ii) Levey’s 1999 article on estimating GFR by the Modification of Diet in Renal Disease (MDRD) formula. Both of them accumulated >27 600 citations (9.7% of the total citations of the top 100 articles). Therefore, the highest interest of nephrologists in the last three to four decades has been related to estimating GFR in a more accurate way. As a matter of fact, at the fourth position we find the article by Levey et al. describing the new CKD-EPI formula for estimating GFR, while at the 27th position of most cited articles there is a 2000 abstract by Levey et al. on a modification of the original MDRD formula to calculate estimated GFR, which is worth of 2681 citations. Also, at the 19th rank we find the article by Levey and the CKD-EPI consortium on the expression of the MDRD formula by standardized creatinine measurement. Finally, another article by Schwartz et al. on estimating GFR in children, collected 2152 citations and ranked 52nd. In total, 10 articles concerned measurement of serum creatinine, and different formulas to estimate GFR by different methods or in different ethnic groups, and cumulatively they were cited 53 140 times (18.6% of total citations of the top 100 articles).
articles). This result can be, at least partially, explained by the interdisciplinary relevance of this topic.

Another relevant field of interest in nephrological research is the pharmacological intervention aimed at slowing the progression rate of CKD. At the 6th position we find a clinical trial from Brenner et al. about the Reduction of Endpoints in NIDDM with the Angiotensin II Antagonist Losartan (RENAAL) study with 7219 citations. While on the 7th and 8th positions, we find two
studies from Ed Lewis’s group on the renoprotective effects of RAAS blockade in diabetic nephropathy, which cumulatively were cited 11707 times. It is noteworthy that a good proportion of articles describing randomized controlled trials with drugs involve antagonists of the renin-angiotensin system that have a broader organ protection in common chronic conditions such as diabetes, hypertension and cardiovascular diseases and, therefore, have a multidisciplinary interest. Even though the pharmacological intervention and randomized controlled studies do not have the proper weight in the nephrological literature, compared with other medical specialties, since ‘only’ 13 articles among the top 100 concerned randomized controlled trials, and the paucity of controlled studies in nephrology has been emphasized in a previous report by the Cochrane investigators [14].

Among the first 10 most cited articles, 4 were published <15 years ago, and this aspect may represent a sign of acceleration of the nephrological community on specific research topics (epidemiology of CKD, exact estimation of GFR and classification of AKI).

Correction of anaemia in uraemic patients after the introduction of erythropoiesis-stimulating agents in the late 1980s has represented a classic topic of the nephrological research. Among the top 100 articles, we find four contributions describing intervention studies evaluating the effects of recombinant human erythropoetin on correction of anaemia in end-stage renal disease patients. Aside from the original pilot study in 25 haemodialysis patients by Eschbach et al., the other three studies that received significant citations in this field, addressed the issue of different targets of haemoglobin on mortality and quality of life in dialysis patients with or without cardiovascular disease, and in patients Stage 3–4 CKD.

The large prevalence of articles published in the USA among the top 100 list is not surprising, since the scientific and medical research core, starting at the beginning of the 20th century, shifted its gravitational centre from Europe to Northern America, supported by a rapid growth of public and private universities in the USA [15]. Perhaps, American authors tend to cite other articles produced in that country. Also, relevant journals that are based in the USA, tend to prefer American reviewers [7].

The number of citations cannot be considered the unique criterion to establish the absolute relevance of a scientific article. It perhaps reflects a measure of recognition or the way that specific contribution intersects with relevant, even though practical, issues; the number of citations is by no way a measure of the scientific or clinical quality of a specific study. Associated to this concept is the finding that, when the journal Nature commissioned a search from the Thomson Reuters Institute to identify the top 100 most cited scientific articles ever [16], in first position was an article of practical impact in lab experiments: that is, the method for protein microassay in fluids, described by Oliver Lowry in 1951, which accumulated 305 000 citations. On the other side, the 1953 Watson and Crick article published in Nature about the discovery of the DNA structure, was cited, at the time of the Nature article was published, ‘only’ 5307 times [16].

In conclusion, this analysis allows identification of major fields of interest in the nephrological clinical and basic research. Most relevant aspects that have been explored in the top 100 most cited articles deal with the modality of evaluation of renal function, controlled trials with pharmacologic agents useful for delaying the progression of CKDs and the epidemiological assessment of prevalence of CKDs in the general population. Specific issues pertaining to morbidity of the uraemic status and definition and management of AKI are also relevant aspects of the nephrological investigation. The relevant nephrological literature comes from English-based journals and is produced in the USA. Information from this analysis may help guide the process of scientific updating required for a proper clinical practice of the modern nephrologist.

CONFLICT OF INTEREST STATEMENT

None declared. The results presented in this article have not been published previously in whole or in part, neither in abstract format.

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