Lost in publication: Half of all renal practice evidence is published in non-renal journals

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Physicians often scan a select number of journals to keep up to date with practice evidence for patients with kidney conditions. This raises the question of where relevant studies are published. We performed a bibliometric analysis using 195 renal systematic reviews. Each review used a comprehensive method to identify all primary studies for a focused clinical question relevant to patient care. We compiled all the primary studies included in these reviews, and considered where each study was published. Of the 2779 studies, 1351 (49%) were published in the top 20 journals. Predictably, this list included *Transplantation Proceedings* (5.9% of studies), *Kidney International* (5.3%), *American Journal of Kidney Diseases* (4.7%), *Nephrology Dialysis Transplantation* (4.3%), *Transplantation* (4.2%), and *Journal of the American Society of Nephrology* (2.4%). Ten non-renal journals were also on this list, including *New England Journal of Medicine* (2.4%), *Lancet* (2.3%), and *Diabetes Care* (2.2%). The remaining 1428 (51%) studies were published across other 446 journals. When the disciplines of all journals were considered, 59 were classified as renal or transplant journals (42% of articles). Other specialties included general and internal medicine (16%), endocrinology (diabetes) and metabolism (6.5%), surgery (6.2%), cardiovascular diseases (6.1%), pediatrics (4.3%), and radiology (3.3%). About half of all renal practice evidence is published in non-renal journals. Browsing the top journals is important. However, relevant studies are also scattered across a large range of journals that may not be routinely scanned by busy physicians, and keeping up with this literature requires other continuing education strategies.

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Physicians make better clinical decisions when they understand the circumstances and preferences of their patients, and the clinical evidence underlying the available options.[1] The public also expects that physicians are taking up new research findings in a timely way.[2] To keep up to date, clinicians employ a number of continuing education strategies.[3] A common technique is to regularly browse a set of journals that are perceived as relevant to clinical care.[4,5] This raises the question of where relevant studies are published. By its very nature, nephrology draws on, and contributes to, many other disciplines including endocrinology, cardiology, and rheumatology. It is possible that a substantial portion of renal practice evidence is published in non-renal journals. To help inform continuing physician education, we performed a bibliometric analysis to map the degree to which various journals publish clinical evidence relevant to renal patient care. Our primary aim was to identify the nucleus of top journals, and to determine the degree to which clinical studies are scattered across journals of other disciplines. We also characterized the features of these journals, including the language of publication and whether they were indexed in major bibliographic databases.

RESULTS

We compiled a total of 2779 unique primary renal studies that were published from the years 1961 to 2005. Studies most often addressed questions of treatment (71%), followed by prognosis (13.7%), etiology (8%), diagnosis (6.5%), and economics (0.3%).

The 2779 studies were published across 466 journals (Figure 1). Of the 2779 studies, 1351 (49%) were published in the top 20 journals ranked by publication frequency, whereas the remaining 1428 (51%) studies were published across another 446 journals. The scatter of studies across journals was consistent with Bradford's distribution. When we divided all the studies into three zones with a roughly equal number of studies (zone 1 – the first set consisting of the top 10 journals, zone 2 – the second set of 55 journals, and zone 3 – the third set of 401 journals), the observed ratio of journal number among these three zones was 1:6:40 which was quite close to the predicted distribution of $1:6:6^2$ (i.e. 36). Stated in

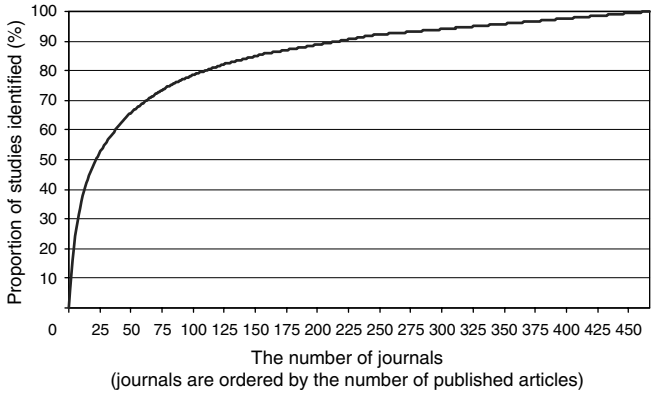

Figure 1 | Studies relevant to the care of patients with kidney conditions appeared in 466 different journals. Of the 2779 studies, 1351 (49%) were published in the top 20 journals ranked by publication frequency*, whereas the remaining 1428 (51%) studies were published across another 446 journals. *The journals which published the highest number of studies are presented in Table 1.

another way, of the 466 journals, 12% published 10 or more studies, 10% five to nine studies, 5% four studies, 7% three studies, 19% two studies, and 47% one study.

A list of the top 50 journals which published studies relevant to the care of renal patients is presented in Table 1. Predictably, this list included renal and transplant journals such as *Transplant Proceedings* (5.9% of the studies), *Kidney International* (5.3%), *American Journal of Kidney Diseases* (4.7%), *Nephrology Dialysis Transplantation* (4.3%), *Transplantation* (4.2%), and *Journal of the American Society of Nephrology* (2.4%). For the topics within nephrology, the top journals were dependent on the content area considered (Table 2, Figure 2). For example, for the topic of acute kidney injury, the journals *Critical Care Medicine* and *Intensive Care Medicine* featured prominently. Conversely for the topic of chronic kidney disease, the journal *Diabetes Care* was important. The degree of scatter across journals was also dependent on the content area considered (Table 2). For example, 82% of studies published in the topic area of transplantation were concentrated in the top 10 journals, compared to only 32% of studies published in the topic area of acute kidney injury. The visual map depicts journals which published the highest number of studies relevant to each renal topic area, as well as a cluster of journals which published studies relevant to a variety of topic areas (Figure 2).

When the disciplines of all 466 journals were considered, 59 journals or about 13% were classified as renal or transplant journals which contributed 42% of the all articles. Other specialties were common and included general and internal medicine (16% of articles), endocrinology (diabetes) and metabolism (6.5%), surgery (6.2%), cardiovascular diseases (6.1%), pediatrics (4.3%), and radiology (3.3%) (Table 3). Renal or transplant journals contributed 47% of all treatment studies, 35% of all etiology studies, 28% of all articles pertaining to prognostic questions, and 13% of all diagnostic studies. Of all the 466 journals, 2% were not indexed in Medline, 7% were not indexed in EMBASE, and 0.6% were not indexed in either database. Nine percent of the journals were published in languages other than English.

DISCUSSION

We live in the information age where the practice of medicine is becoming increasingly complex and specialized. Medline currently indexes over 4800 different journal titles with over 13 million citations.[6] Here, we emphasized the journals which renal practitioners can scan to keep abreast with clinical evidence in their discipline. Physicians can anticipate that scanning the top 20 journals will identify about half the new practice evidence as it becomes available. Unfortunately, the remaining studies are published across a large range of journals, many of which are classified as non-renal. This characteristic scattering of published evidence poses a problem when trying to stay abreast of existing information on a topic. It becomes increasingly less efficient for the busy nephrologist to scan peripheral journals, where the potential for finding relevant studies is low.

Strengths and limitations of this research

To our knowledge, this study represents the first time the degree to which different journals publish research directly relevant to renal patient management has been considered. We provided different core journal sets for those nephrologists who review literature to support specialized practices in transplantation, dialysis, chronic kidney disease, or pediatric nephrology (Table 2).

We used systematic reviews to identify representative clinical studies for this analysis. This sampling approach was more comprehensive and objective than approaches used in other bibliometric studies[7,8] and similar to the approach taken by Birken.[9] This helped reduce the chance that possible selection biases influenced the results. However, as with any sampling method, there is always the potential concern that the results do not generalize perfectly to the 'universe' of available articles. Thus, the numbers provided in this report should not be viewed as absolute. Studies published in languages other than English may be underrepresented because such studies are less likely to be cited by systematic reviews.[10,11] We also recognize that not all clinically relevant studies in nephrology have been subsequently cited in a systematic review. However, these results were very similar when we performed the same type of analysis using primary high-quality clinical studies identified from the Cochrane database on renal content (data not shown). Furthermore, systematic reviews tend to focus on areas where controversy or uncertainty exists – which would be of interest to the target audience of practicing nephrologists.

We did not consider the efficiency of scanning, rather in the current analysis we ranked journals according to publication frequency, that is, the largest number of clinically relevant studies published within each journal. Clearly, the oldest journals that publish the greatest number of articles per year were favored by such an approach. All the primary

Table 1 | Top 50 journals that published the highest number of studies relevant to renal care

Rank	Journal	Percent of relevant studies (*n*=2779)	Cumulative percent
1	*Transplantation Proceedings*	5.9	5.9
2	*Kidney International*	5.3	11.2
3	*American Journal of Kidney Diseases*	4.7	15.8
4	*Nephrology, Dialysis, and Transplantation*	4.3	20.1
5	*Transplantation*	4.2	24.4
6	*New England Journal of Medicine*	2.4	26.8
7	*Journal of the American Society of Nephrology*	2.4	29.1
8	*Lancet*	2.3	31.5
9	*Nephron*	2.2	33.7
10	*Diabetes Care*	2.2	35.9
11	*Clinical Nephrology*	1.8	37.6
12	*Annals of Internal Medicine*	1.7	39.3
13	*BMJ*	1.6	40.9
14	*Journal of Vascular Surgery*	1.3	42.2
15	*Pediatric Nephrology*	1.2	43.4
16	*Journal of Pediatrics*	1.1	44.5
17	*Journal of Urology*	1.1	45.6
18	*Peritoneal Dialysis International*	1.1	46.7
19	*Archives of Disease in Childhood*	1.0	47.6
20	*Radiology*	1.0	48.6
21	*American Journal of Medicine*	0.9	49.5
22	*Diabetic Medicine*	0.8	50.3
23	*JAMA : the journal of the American Medical Association*	0.8	51.1
24	*Diabetologia*	0.8	51.9
25	*American Journal of Nephrology*	0.8	52.7
26	*Diabetes Research and Clinical Practice*	0.7	53.4
27	*AJR. American Journal of Roentgenology*	0.7	54.1
28	*Archives of Internal Medicine*	0.6	54.7
29	*Arthritis and Rheumatism*	0.6	55.4
30	*Clinical transplantation*	0.6	56.0
31	*Journal of the American College of Cardiology*	0.6	56.6
32	*Critical Care Medicine*	0.6	57.2
33	*Intensive Care Medicine*	0.6	57.8
34	*QJM : monthly journal of the Association of Physicians*	0.6	58.3
35	*Contributions to Nephrology*	0.6	58.9
36	*American Journal of Cardiology*	0.5	59.4
37	*Diabetes*	0.5	60.0
38	*Transplant International*	0.5	60.5
39	*Circulation*	0.5	61.1
40	*Journal of Renal Nutrition*	0.5	61.6
41	*Renal Failure*	0.5	62.1
42	*European Journal of Vascular and Endovascular Surgery*	0.5	62.6
43	*Journal of Hypertension*	0.5	63.1
44	*Advances in Peritoneal Dialysis*	0.5	63.5
45	*British Journal of Surgery*	0.5	64.0
46	*American Journal of Hypertension*	0.5	64.5
47	*Journal of Diabetes and its Complications*	0.4	64.9
48	*European Journal of Clinical Pharmacology*	0.4	65.3
49	*Archives of Surgery*	0.4	65.7
50	*American Journal of Surgery*	0.4	66.1

studies included in this analysis were deemed to be sufficiently important, and of high enough quality, to be cited by the authors of the systematic reviews. Although some journals may publish more meritorious studies than others, it is somewhat subjective to assess the impact of any given study for changing a standard of care.

Utility of the study

Better characterization of the top journals in nephrology has a number of additional benefits besides focusing the attention of busy physicians. A number of services already exist to increase physician awareness of new relevant research. These include local libraries, e-mail alerts, and journals and subscription services which summarize primary research results.[6,12–14] Such service providers can use these results to develop systems of information retrieval, to maximize the coverage of relevant studies across journals.

Science Citation Index Journal Impact Factors are a measure of the frequency with which the 'average article' in a journal has been cited in a particular year or period of time. However, impact factors do not highlight which journals publish the largest amount of clinical practice evidence.

Table 2 | The 20 journals which published the highest number of studies relevant to various renal topic areas

	Acute kidney injury (*n*=388)		Chronic kidney disease and glomerulonephritis (*n*=1062)		Chronic hemodialysis or peritoneal dialysis (*n*=585)		Kidney transplantation (*n*=446)		Pediatric nephrology (*n*=186)	
	Journal	%	Journal	%	Journal	%	Journal	%	Journal	%
1	*Kidney Int*	4.6	*Kidney Int*	6.1	*Am J Kidney Dis*	12.0	*Transplant Proc*	34.0	*Pediatr Nephrol*	11.0
2	*Am J Kidney Dis*	3.9	*Diabetes Care*	5.5	*Nephrol Dial Transplant*	8.5	*Transplantation*	26.0	*J Pediatr*	11.0
3	*Crit Care Med*	3.6	*Nephrol Dial Transplant*	3.6	*Kidney Int*	7.2	*Nephrol Dial Transplant*	3.8	*Arch Dis Child*	9.7
4	*Intensive Care Med*	3.6	*N Engl J Med*	3.4	*Nephron*	4.8	*J Am Soc Nephrol*	3.6	*J Urol*	9.7
5	*Lancet*	3.4	*Am J Kidney Dis*	3.0	*Perit Dial Int*	4.6	*Transpl Int*	3.4	*Lancet*	5.4
6	*Am J Med*	3.1	*Ann Intern Med*	2.9	*Clin Nephrol*	3.4	*Clin Transplant*	3.1	*Eur J Pediatr*	3.2
7	*N Engl J Med*	2.8	*BMJ*	2.8	*J Am Soc Nephrol*	3.2	*Am J Transplant*	2.2	*Kidney Int*	3.2
8	*Nephrol Dial Transplant*	2.6	*Lancet*	2.4	*J Vasc Surg*	2.6	*Kidney Int*	2.2	*BMJ*	2.2
9	*Antimicrob Agents Chemother*	2.3	*Clin Nephrol*	2.2	*Adv Perit Dial*	2.2	*Lancet*	2.2	*J Med Assoc Thai*	2.2
10	*J Clin Oncol*	2.1	*Diabet Med*	2.2	*J Ren Nutr*	2.1	*Am J Kidney Dis*	1.6	*Pediatrics*	2.2
11	*Nephron*	2.1	*Diabetologia*	2.1	*Am J Nephrol*	1.4	*N Engl J Med*	1.6	*N Engl J Med*	2.2
12	*Anesth Analg*	1.8	*Radiology*	2.0	*Int J Artif Organs*	1.4	*Arch Surg*	0.9	*Acta Paediatr*	1.6
13	*Ann Intern Med*	1.8	*Diabetes Res Clin Pract*	1.9	*Artif Organs*	1.2	*J Urol*	0.9	*Nippon Hinyokika Gakkai Zasshi*	1.6
14	*J Am Coll Cardiol*	1.8	*Nephron*	1.9	*Scand J Urol Nephrol*	1.2	*Ann Intern Med*	0.7	*Am J Dis Child*	1.1
15	*QJM*	1.8	*J Am Soc Nephrol*	1.8	*N Engl J Med*	1.2	*J Heart Lung Transplant*	0.7	*BJU Int*	1.1
16	*Br J Anaesth*	1.5	*J Vasc Surg*	1.8	*Blood Purif*	1.0	*Br J Surg*	0.7	*Child Nephrol Urol*	1.1
17	*Ren Fail*	1.5	*Arthritis Rheum*	1.7	*Dial Transplant*	1.0	*J Infect Dis*	0.7	*Clin Nephrol*	1.1
18	*Am J Nephrol*	1.3	*AJR Am J Roentgenol*	1.4	*Clin Chem*	0.9	*Am J Nephrol*	0.4	*Clin Pediatr Endocrinol*	1.1
19	*Anaesth Intensive Care*	1.3	*Diabetes*	1.4	*Trans Am Soc Artif Intern Organs*	0.9	*Ann Surg*	0.4	*Contrib Nephrol*	1.1
20	*Arch Intern Med*	1.3	*Am J Hypertens*	1.2	*Am J Surg*	0.7	*BMJ*	0.4	*J Am Soc Nephrol*	1.1
	Total for top 20 journals	48.2	Total for top 20 journals	51.2	Total for top 20 journals	61.3	Total for top 20 journals	89.9	Total for top 20 journals	72.0

The percentage of all renal studies published in each journal appears with the journal name.

The information presented here can be used by authors to highlight which journals may be receptive to publishing clinical research in various renal topic areas, or where to publish their research to achieve maximal impact.

Knowledge of the journals which publish evidence relevant to a renal practice can also improve the precision of bibliographic search strategies to reduce extraneous citations identified in such searches. Specifically, the strategy can be restricted to search only those journals which publish relevant studies.[15] Improving the precision of searches would benefit all types of users including the public, physicians, researchers, and policy makers.

Future research

The affinity of various journals to publish studies relevant to clinical practice is continually changing. Indeed, some journals are discontinued while new journals are started (e.g., *American Journal of Transplantation*, *Clinical Journal of the American Society of Nephrology*). These results should be replicated in the future to characterize any secular changes in the ranked journal list.

There could be a systematic difference in the types of studies and conclusions published in top journals, compared to those published in more peripheral journals. If new evidence published in peripheral journals does not change current treatment paradigms, then reviewing such journals may be less important.

Finally, the real daunting issue remains that we need better methods to improve the timely translation of new health-care knowledge into patient care. Unfortunately, increasingly larger efforts are needed to keep current with the literature.[16,17] Research into best methods for continuing medical education remains a priority for the profession.

MATERIALS AND METHODS

Bibliometrics is the scientific study of publication patterns.[18] Previous bibliometric research in nephrology has examined the growth in published clinical trials,[19] the failure of many conference abstracts to be subsequently published as full text articles,[20] and the scientific productivity of a group of investigators.[21] Although studies of evidence dispersion across journals have been performed in other disciplines,[7,8] to our knowledge no such analysis has been performed for renal content. To conduct this analysis, we first compiled a representative set of renal clinical studies, and then considered the journals where such studies were published.

A set of clinical studies derived from renal systematic reviews

The method of assembling studies is a critical first step in any bibliometric mapping project. To avoid selection biases, we elected

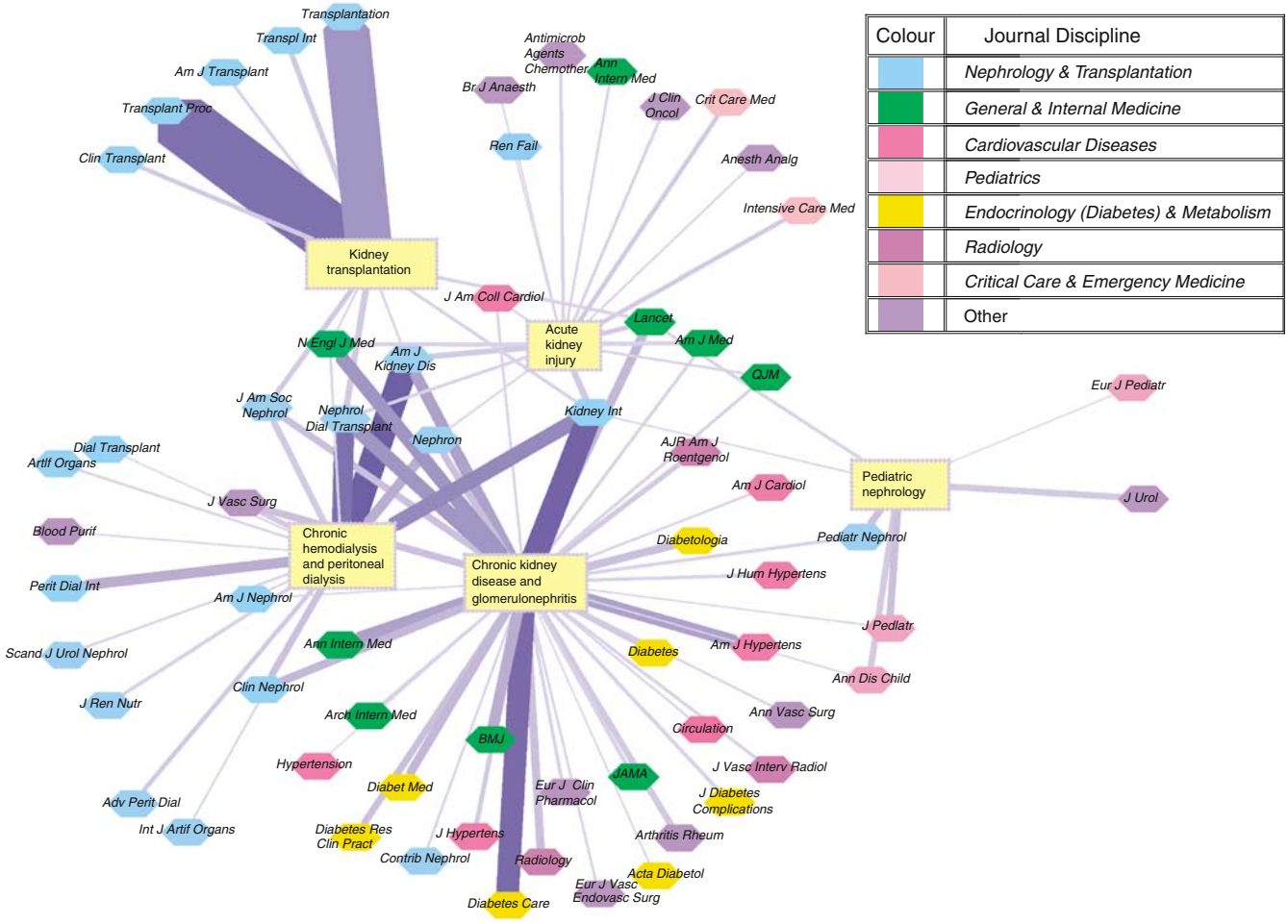

Figure 2 | A visual map presenting journals which published studies in five renal topic areas – acute kidney injury, kidney transplantation, chronic hemodialysis or peritoneal dialysis, chronic kidney disease and glomerulonephritis, and pediatric nephrology. The thickness of each line is the proportional to the number of studies published in each journal. A journal had to contribute more than five articles to atleast one renal topic to be presented in the map.

not to search bibliographic databases (i.e., Medline or EMBASE) with kidney terms as the initial method to identify primary studies of interest.[8] Such an approach would have only emphasized articles published in those journals indexed in each database. It is also well recognized that even the most comprehensive search strategy often fails to identify a number of relevant studies.[22,23]

Rather, we used renal systematic reviews as the source of primary clinical studies. A well-conducted systematic review is one which asks a focused question, uses comprehensive methods to identify all high-quality primary studies for that question, and appraises the methodological quality of the primary studies. Such studies often focus on whether to use a therapy (treatment), how patients fare (prognosis), how to best use a diagnostic test (diagnosis), or the cause of certain conditions (etiology). Certainly, there are other important articles in the literature which describe biology and pathophysiology, or epidemiology other than randomized trials, prognosis, diagnostic, and etiology studies. Some articles are also commentaries or case reports. These latter types of articles are not usually cited in systematic reviews. Thus, this analysis focused on those types of study designs best suited to provide high-quality clinical practice evidence for patients with kidney conditions.

We identified the renal systematic reviews from a detailed search of Medline for the years 2001–2005, the Cochrane Database of Systematic Reviews, Cochrane Renal group records of non-Cochrane meta-analyses, and the McMaster University Health Information Research Unit Premium LiteratUre Service (PLUS) database (articles published in the years 2002–2005).[12] Two nephrologists used a standardized checklist to independently confirm whether each review was pertinent to renal care. Pairs of reviewers also independently confirmed that each review met specified methodological criteria for quality. Methodologic criteria were met if the following were described in the text of the review: a statement of the clinical topic; explicit statements of the inclusion and exclusion criteria applied for selecting primary studies for detailed review; and methods used to identify primary studies for inclusion in the review (i.e., which bibliographic databases or reference lists were searched).

A total of 195 relevant unique systematic reviews, which included meta-analyses, were identified.[24–218] The reviews examined a broad range of questions relevant to the practice of nephrology such as whether acetylcysteine is beneficial for the prevention of acute kidney injury, the value of fish oil for immunoglobulin A nephropathy, proteinuria as a prognostic factor for progressive

Table 3 | Renal practice evidence was published across journals from many disciplines

Primary discipline	No. of journals (*n*=466)	No. of articles (*n*=2779)	% of articles
Nephrology and Transplantation	59	1155	42.0
General and Internal Medicine	74	432	16.0
Endocrinology (Diabetes) and Metabolism	18	182	6.5
Surgery	39	171	6.2
Cardiovascular Diseases	41	170	6.1
Pediatrics	30	120	4.3
Radiology	21	91	3.3
Pharmacology	21	68	2.4
Critical Care and Emergency Medicine	11	53	1.9
Urology	7	49	1.8
Anesthesiology	14	43	1.5
Oncology	16	32	1.2
Rheumatology	8	31	1.1
Infectious diseases	9	26	0.9
Hematology	12	20	0.7
Nutrition	5	11	0.4
Obstetrics and gynecology	5	9	0.3
Gastroenterology	6	8	0.3

An additional 70 journals that contributed 108 articles were scattered across other disciplines.

renal disease, and magnetic resonance angiography for the diagnosis of renal artery stenosis. The average number of primary studies cited per review was 17 (range 1–136). All primary studies that were published in journals were compiled. Primary studies that were cited in multiple systematic reviews were only counted once. Studies published in the form of an abstract, book, or thesis were not considered further as the purpose of this study was to characterize journals which published renal practice evidence.

Abstracting data on studies and journals

We abstracted data both on the primary studies, and on the journals in which they were published. For each primary study, the date of publication, language of publication, and journal title were abstracted. Each study was further classified by a nephrologist according to the following five renal topics: acute kidney injury, chronic kidney disease or glomerulonephritis, chronic hemodialysis or peritoneal dialysis, kidney transplantation, and pediatric nephrology. Each study was also classified according to the type of question posed: treatment, diagnosis, prognosis, etiology, or economics.

For each journal that published at least one primary study, we abstracted the language of publication and whether it was indexed in two major bibliographic databases (i.e., Medline and EMBASE). Each journal was classified according to its primary discipline using the US National Library of Medicine Medline journal subject terms as a guide. Primary disciplines included nephrology and kidney transplantation, general and internal medicine, endocrinology and metabolism (including diabetes), cardiovascular diseases, surgery, pediatrics, radiology, pharmacology, critical care and emergency medicine, urology, anesthesiology, oncology, rheumatology, infectious diseases, hematology, nutrition, obstetrics and gynecology, and gastroenterology. When the title of a journal had changed, or when two journals merged, we summed all studies under the more recent journal name. Studies in journal supplements were also considered to be from the originating journal. All identified journals were ranked by publication frequency: journals that published the largest number of relevant articles were ranked the highest, and journals that published the lowest number of relevant articles were ranked the lowest.

Analysis

All studies were counted and analyzed using Reference Manager version 10.0 (ISI ResearchSoft, Philadelphia, PA, USA) and Excel version 11.0 (Microsoft Corporation, Redmond, WA, USA) software. Each journal which published at least one study relevant to nephrology was ranked according to the number of renal studies published. We hypothesized that the dispersion of renal studies across journals would follow Bradford's distribution. Bradford suggested that for any given discipline, if scientific journals are ranked in order of a decreasing number of published studies, then the journal scatter can be characterized into a nucleus of a small number of journals particularly devoted to the subject, and then subsequent circumferential zones containing the same number of studies as the nucleus, but published over an increasing larger number of journals.[18,219,220] For example, when a ranked journal list is divided into three zones with an equal number of studies in each zone, the number of journals in the nucleus (first zone) and two succeeding zones (second and third zone) follows a distribution of $1:n:n^2$. We used aiSee 2.2.05 graph visualization software (AbsInt Angewandte Informatik GmbH, Germany) to depict the relationships between top journals for various renal topics. In the visual map, each journal was linked to a renal topic by a line, where the thickness of a line increased with the number of published studies. The journal had to contribute more than 5 articles to at least one renal topic to be represented in the visual map.

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