EDTA: A NEPHROLOGY AND PUBLIC POLICY COMMITTEE (NPPC) PLATFORM CALL FOR MORE EUROPEAN INVOLVEMENT IN AKI

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ABSTRACT

Acute Kidney Injury (AKI) is an often neglected but crucial element of clinical nephrology. The aim of the Nephrology Public Policy Committee (NPPC) of the European Renal Association – European Dialysis and Transplant Association (ERA-EDTA) is to promote several key aspects of European nephrology. One of the targets proposed by NPPC was to advance European nephrology involvement in AKI. We undertook literature analyses to define the current position of European nephrology in the field of AKI compared to other regions, and about how different European countries compare to each other. It appeared that vis-à-vis countries with a comparable socio-economic status (the US, Australia, New Zealand, Canada), the European contribution was almost 50% lower. Within Europe, Central/Eastern Europe and countries with a lower gross domestic product (GDP) showed lower scientific output. Nephrologists contributed to less than half of the output. There was no trend for a change over the last decade. It is concluded that there is room to improve the contribution of European nephrology in the field of AKI. We propose a model on how to promote clinical collaboration on AKI across Europe, the creation of a pan-European nephrology network of interested units is proposed, to improve clinical outcomes, increase nephrologist involvement and awareness outside nephrology, and stimulate research on AKI in Europe. Accordingly, we also propose a list of research priorities and stress the need for more European funding of AKI research.

Keywords: acute kidney injury, AKI, Nephrology and Public Policy Committee, networking, NPPC

KEY LEARNING POINTS

What is already known about this subject?

- Acute Kidney Injury (AKI) is an important kidney problem with high mortality which often receives insufficient attention.
- AKI is one of the key issues proposed for promotion by the Nephrology and Public Policy Committee of ERA-EDTA.
- The contribution of European nephrology to AKI expertise remains unclear.

What this study adds?

- The European contribution to AKI publications is low compared to other regions with similar wealth.
- Between European countries, there is an East-West gradient but also a low/high income gradient.
- There is no trend for a change over time.
- Nephrologists contributed to less than half of the publications.

What impact this may have on practice or policy?

- This is a wake-up call for European nephrology to join efforts combating AKI.
- We propose a pan-European network of interested units participating in multicentric registration and research.
- We recommend a model with variable involvement depending on the interest.
- We also include a list of research priorities.

INTRODUCTION

Until the beginning of this century, at least 30 definitions of Acute Kidney Injury (AKI) were in use^{1,2}. The introduction of classification systems, although not perfect, resulted in a more systematic approach, acknowledging that already minor changes in kidney function are related to worse outcomes³. Nevertheless, AKI is not one disease but an amalgamate concerning many specialties, with a broad spectrum of causes, such as hypovolemia, hypoperfusion, nephrotoxicity, haem-pigments, intravascular coagulation, inflammation, post-renal obstruction⁴, and conditions where several factors coincide, like sepsis^{5,6}. The two most involved specialties are nephrology and intensive care medicine⁷. The nephrologist's role, although considered essential⁸, may vary depending on the local situation.

Traditionally Chronic Kidney Disease (CKD) and AKI were viewed as separate entities, but recent knowledge considers the two conditions as intertwined⁹. If the acute condition evolves into CKD and long-term kidney replacement therapy (KRT), this heavily weighs on prognosis, and even more so in countries with limited resources.

The risk of AKI is increased by the presence of comorbidities, including diabetes mellitus, congestive heart failure, arterial hypertension, cardio-vascular disease, chronic obstructive pulmonary disease, secondary immune deficient states like HIV, chronic liver disease, cancer and CKD^{10,11}. Not coincidentally, the noncommunicable (chronic) diseases (NCDs) in this list are also linked to CKD development¹². The increasing survival with most of these comorbidities also widens the time window over which patients are susceptible to AKI¹³. Also the progressively growing fraction of elderly people¹⁴ is at increased risk of AKI and of needing KRT in case of AKI¹⁵.

Epidemiology and phenotype of AKI patients differ between high income countries (HIC) and low-to-middle income countries (LMIC)^{4,10,16}, which also applies to Europe as European countries belong to both categories¹⁷. Global warming may promote further shifts in epidemiology especially in Southern Europe by increasing the risk of dehydration and infectious diseases such as malaria and dengue^{18,19}.

Current status

The burden of AKI is immense due to its immediate consequences as well as to the increased risk of long-term problems like cardiovascular events in survivors²⁰. Even mild AKI is associated with a reduction in survival which remains present even if kidney function recovers²¹. These problems are associated with a health-economic and societal burden, owing to severity of disease, the multiple comorbidities and complications, the need for highly technological interventions (dialysis, artificial ventilation, close monitoring, hemodynamic support, major surgery, etc.), and lengthy recovery periods^{22,23}. They also raise ethical questions, on who to treat and who not²⁴.

The recent global increase in awareness and action with regards to AKI can to a substantial extent be attributed to the International Society of Nephrology (ISN) which launched in 2015 the ambitious Oby25 initiative (0 preventable deaths due to AKI worldwide by 2025)²⁵. Although this action mainly aimed at improving the situation in LMIC, it regards HIC as well, and AKI was recently identified as an important target for the Western European Nephrology community²⁶.

In the context of its key role in clinical nephrology and research, the European Renal Association – European Dialysis and Transplant Association (ERA-EDTA) convened several stakeholders in the Nephrology and Public Policy Committee (NPPC) to consider future avenues advancing European clinical kidney research. NPPC defined eight topics to stimulate research collaboration and grant applications in Europe, and decided to translate this plan into public policy action²⁷. One of the selected topics was to “extend understanding of AKI progression and complications”. The question arising in this context is where Europe and European academia are positioned in the fight against AKI and its consequences. Some may perceive that Europe is lagging behind, but objective pan-European data on this assumption are lacking.

To answer this question, we reviewed the available literature to assess European involvement in AKI compared to other regions worldwide and especially compared to countries with a similar economic or scientific stature, such as the US, Australia-New Zealand or Canada. Based on these data we propose a model on how to promote clinical collaboration and nephrology networking on AKI across Europe.

Literature analyses - methods

We first undertook an Endnote search for the entire year 2018 with key terms “acute kidney injury” or “acute renal failure” in the title (referred to by the aggregated term “AKI” in what follows). As this analysis was started in 2019, the year 2018 was selected, as it was the most recent year with complete literature data. Experimental and clinical studies and case reports were included. We excluded publications that were not directly on AKI (e.g. papers on acute graft rejection), and letters and comments. Papers were not excluded based on language or quality criteria. We recorded the nationality of the first author as representative for the origin of the publications.

We first performed an analysis of the absolute number of publications on AKI per region, either a continent, part of a continent (Latin-America, Australia-New Zealand), a group of countries (the non-European Mediterranean countries), or an individual country (US, Canada). We then normalized these data per million population (pmp) which we used as a surrogate for the human resource capacity to perform scientific and/or clinical analyses. The non-European Mediterranean countries were considered as a separate geographic entity because their physicians and researchers are eligible for ERA-EDTA membership.

One of the major questions was the relative scientific output of Europe vs. the US, the other large Western entity with vested research interests. To exclude the possibility of a general trend for a different European kidney research endeavour vs. the US, we performed a similar scientific output analysis with as search terms “chronic kidney disease” and on two more restricted nephrology topics where specific European networks are active: “uremic toxins” (EUTox) and “hemolytic uremic syndrome” (ERKNet). The ratio of the number of publications for Europe vs. the US for AKI was compared to that for the three other topics. We also calculated the mean impact factor of the journals in which the analysed publications had appeared.

We then ranked all European countries (except those with < 100,000 inhabitants) for the number of generated AKI publications pmp. We also performed subanalyses comparing Western and Central/Eastern Europe and the highest, middle and lowest tertiles of countries classified based on their GDP pmp. Central/Eastern Europe was defined as the geographic area that formerly was under communist political influence (former Soviet Union, Warsaw

Pact countries and Yugoslavia, and Albania) plus Turkey. GDP was expressed in US Dollars as provided by Worldometer²⁸.

The above comprehensive one year analysis did not permit assessment of the evolution over time. To answer this question, in a second, more restricted, investigation, we assessed the number of publications with the acronym “AKI” in the title (referred to as “AKI in title” in what follows) for the years 2012-2019 and compared the percent share of European contributions to the rest of the world. This examination was also used to assess the contribution of nephrologists vis-à-vis other specialties in Europe and per country. Here also, assessments were based on the nationality of the first author. To analyse specialty involvement, only countries with more than four contributions in the database were included.

RESULTS

The first large scale analysis for the year 2018 comprised 1554 references. When analysing the publication rate in absolute numbers, Asia had the highest production (564 publications), followed by Europe (438) and the US (362) (table 1 and supplemental figure 1). When publication rate was normalized per million population, the list is headed by Australia-New Zealand and the US (both 1.1 publications pmp) and Canada (1.01). The rate for Europe was almost 50% lower (0.59 pmp) than that of the US (table 1 and supplemental figure 1).

These differences could however also be an illustration of a general trend for lower European activity in scientific and clinical nephrology reporting. We therefore also compared European activity to that of the US for uremic toxicity, the hemolytic uremic syndrome and CKD. The ratio of European over US production was higher for these three topics than for AKI (figure 1). The mean journal impact factors for the European and US AKI papers was the same (4.2 ± 7.3 and 4.3 ± 7.7).

Analysis of scientific output per European country normalized pmp showed substantial differences, from 2.5 pmp (Iceland) to 0.05 pmp (Ukraine and the Russian Federation) (table 2), while twelve of the 43 countries (27.9%) produced no publications. Of note, the scientific output list is headed by two countries with a population $\leq 500,000$, so that even one single publication gave high scores. When countries were stratified according to a scientific output of > 1.00 pmp, 0.51-1.00 pmp, 0.01-0.50 pmp and 0 pmp, a definite East/West gradient was

observed, with a lower scientific output in Central/Eastern Europe (figure 2, table 3). This dichotomy, however, was paralleled by marked differences in country wealth. GDP pmp was almost 5 times higher in Western than in Central/Eastern Europe (table 3). Stratification of European countries in tertiles depending on GDP pmp showed a gradient in proportion to GDP (table 3). However, there are exceptions to this trend, essentially corresponding to smaller countries (Slovenia in the middle GDP tertile with a publication rate of 1.43 pmp, and Croatia in the upper part of the lower GDP tertile with 0.98).

The longitudinal analysis based on the inclusion of the acronym AKI in the publication title (2012-2019) included 213 publications. It showed an unmodified share of European contributions vs. the rest of the world in the range of 20-30% over the entire period under consideration (figure 3, supplemental table 1). All data taken together, the share of nephrologists as first author was slightly less than 50% whereas other specialists, mainly intensive care physicians, contributed to the remaining half (figure 4). Considering individual countries with 4 publications or more, there were marked differences in contributions from nephrologists, ranging from the majority of contributions by nephrologists (Germany, Spain, Italy) to only a minority (the Netherlands, France) (supplemental table 2).

DISCUSSION

This study analysed the European contribution to both basic and clinical AKI research as compared to other regions, and made an internal comparison within Europe. The principal findings are:

- 1) Normalized to pmp inhabitants, the European contribution to AKI research is substantially smaller than that of regions with a similar socio-economic status, such as North-America or ANZA.
- 2) The discrepancy vs. the US was not observed for other nephrology research topics, such as the Hemolytic Uremic Syndrome, uremic toxicity or CKD. These differences are not paralleled by the mean of the impact factors of the journals in which the papers appeared.
- 3) A manifest East-West gradient in scientific output exists and this trend parallels disparities in country wealth.

4) The contribution of nephrology to European AKI publications is less than 50%, with intensive care medicine as an almost equivalent contributing specialty.

5) There is no signal of change in European activity over the past decade.

The relatively low contribution of European nephrology to AKI research is worrisome in view of the clinical and health-economic burden of AKI²⁰. In addition, contributing factors to the incidence of this condition will very likely gain in importance in future due to the population aging²⁴ and improved outcomes of other associated conditions such as cardio-vascular disease^{29,30} or cancer³¹. Also related costs are projected to increase²². Hence, research in this field is essential for the medical community, patients and society alike. It would be unfavourable for Europe not to be in the frontline of unravelling the patho-physiology and searching for new cures for AKI, as a backlog in progress would force European nephrology to largely depend on non-European data and therapeutic solutions.

Some may argue that the scanty European contribution in AKI is emblematic for a global lack of European interest in kidney research. However, this assumption is not mirrored for other nephrology topics and especially not for areas where European networks like EUTox or ERKNET are active (figure 1). Likewise, one may argue that if the analysis would have been limited to Western Europe, scientific output would have been closer to that from the US, Canada, or Australia-New Zealand. However, it would be unlikely for scientific output in those countries to be geographically more homogeneous than it is in Europe. In addition, for policy action and improvement initiatives, it is preferable to consider the European Union and Europe as one entity. Finally, even if the first author is not European, Europeans might be further ranked co-authors. However, we thought that the first author is in most cases the most important contributor to a publication, reflecting the place where the analysis, observation or study took place, while they in addition most often are junior staff members, who constitute the future of medical interest in a given topic, in this case AKI.

The essential role of the nephrologist in AKI has repeatedly been emphasized^{9,32,33}. First of all, not all AKI cases are in need of critical care and in those patients the nephrologists may be crucial to timely identify the problem and its causes and for instructing therapy, as well as play an educational role and raise awareness among non-nephrologists and non-AKI physicians. Also in ICU patients, the causes may not be the more usual critical conditions like

sepsis or kidney hypoperfusion, but intrinsic kidney disorders for which nephrologists can be instrumental in diagnosis and management. In addition, nephrologists can advise on correction of electrolyte disorders³², and interpretation of serum creatinine³⁴. Second, nephrologists master a broad spectrum of kidney replacement therapies, including intermittent and extended hemodialysis and peritoneal dialysis³⁵, which may help adapt to overwhelmed healthcare systems like during the ongoing COVID-19 pandemic³⁶. Third, nephrologists may assist in avoiding futile therapy, e.g. in frail AKI patients^{24,32,37}. Fourth, and above all, in view of the frequent link with CKD, the nephrologist can play a role in preventing evolution towards CKD and to steer the approach and follow-up if kidney function does not recover^{9,38,39}. Thus, we call not only for European research activity on AKI, but also for clinical involvement of the nephrologist in AKI outside the nephrology unit. Unfortunately, if the publication activity as illustrated in this study is also representative of the clinical involvement of nephrologists, our data suggests ample room for increasing this participation. Vice versa, more commitment will increase visibility of nephrology in the area of AKI. As the relation with other specialties might differ between countries and hospitals, mapping of the current situation might be of interest.

The representation of ICU-specialists in AKI literature does not reflect the actual epidemiology of AKI in hospitals and is likely biasing understanding of AKI. In a recent European study from a single tertiary hospital, based on an electronic screening of patient records using KDIGO criteria, ICU cases accounted for only 3% of hospital-acquired AKI⁴⁰. Of note, this analysis is based on a single centre and the situation might differ in settings with different healthcare systems or patient mix. In addition, the study contained but was by definition not limited to ICU patients, but in this way exactly stresses that AKI is frequent also outside the ICU.

The recent COVID-19 pandemic illustrates several of the concerns raised above. The frequent presence of cytokine storm suggested a high propensity for AKI⁴¹, and the many negative facets of AKI, such as the high complication rate, mortality and technical demands, emerged in a timewise condensed way, while AKI appeared to be a major complication in many of the most severely affected COVID-19 patients⁴²⁻⁴⁵. However, especially in the early phase of the pandemic, European nephrology needed to rely on epidemiologic data from China⁴⁶ or the US⁴⁷, although the first cases in Europe and the US were reported almost

simultaneously^{48,49}. The ERA-EDTA took the laudable decision to open a registry on COVID-19 and its links to kidney disease (ERACODA)^{50,51}, but to the best of our knowledge this database remained limited to dialysis patients and transplant recipients.

To improve this situation and boost the European contribution to AKI, we propose the development of a European nephrology network of clinicians and researchers with interest in AKI. For each country one or more coordinators are invited to convene interested groups in their regional/national environment. Networks are among the tools to advance interest, knowledge and outcomes of AKI⁵² and exist already in some European countries like the UK⁵³ and France⁵⁴ but should be rolled out at a broad European level, e.g. by applying for a European Cooperation in Science and Technology (COST) action. Once installed, participants will be offered the opportunity to contribute to European registration and research projects and proposals for EU support via Framework Programs like Horizon Europe⁵⁵. Some initiatives may be global and include a broad array of participants; others may be restricted to a few interested parties, applying a model similar to that of the European Uremic Toxin Work Group EUTox^{56,57}. The network could also be instrumental in developing pan-European projects to improve clinical outcomes, such as developing a uniform laboratory AKI alert system, preferably inspired upon existing systems⁵⁸. Networking may however not be the only solution. An additional focus point could be the extension of involvement of the nephrologist in AKI outside nephrology (intensive care but also other specialties like oncology, cardiology, surgery etc). However, a European network could also play a crucial coordinating role in promoting and organizing this evolution.

The group should define its immediate and long-term research priorities. A preliminary, non-exhaustive list of such topics can be found in table 4.

The lower participation in Central/Eastern Europe should not be considered as a symptom of lack of interest or quality care, but the parallelism with GDP is striking. We can only speculate on the reasons but a probable role can be attributed to lower resources for research, lack of time for physicians possibly resulting in less attention to AKI cases, or, since the number of nephrologists is lower in Central/Eastern than in Western Europe⁵⁹, lower specialist numbers. We plead for active involvement of Central/Eastern Europe, especially since differences in epidemiology may lead to interesting observations and a broader patho-physiologic diversity.

Our analysis has a number of drawbacks. The first, most extended, analysis, covered only one year. Countries might have reached a different profile in another year. It is however unlikely that this would have affected the general comparisons between regions or countries. Second, a number of references may have been missed if the title was not containing the pre-defined keywords, but again, this would unlikely affect general trends. Third, the use of the address of the first author, may not always be representative to define the country where the study was executed. Fourth, the long-term analysis with comparisons between specialties was based on a second, smaller database, which might have been biased by the lower number of retrieved papers, while the term AKI in the title might have been used to a different degree dependent on the year, specialty or country of origin. Finally, the lower publication rate in Central/Eastern Europe might be attributable to a number of publications in local language, which may have been missed in our search.

On the other hand, our analysis also has a number of strengths. To our knowledge, this is the first analysis of scientific output on AKI research of the European nephrology community with comparisons of different aspects, such as regional and country activity, evolution over time and involved specialties, and impact of country wealth. In addition, it was broad enough to give useful indications on how to inform future initiatives to modify the situation.

In conclusion, this analysis shows, compared to countries or regions with comparable socio-economic stature, a relative lack of European initiatives to study and to report on clinical observations with regards to AKI. As for other focus areas defined by NPPC, Central/Eastern European and low income countries appear to demand special consideration⁶⁰. The data also underscore that the involvement of the nephrologists in this domain could be improved. The fact that only one author of this paper is a woman suggests that there is also room for more involvement of women. More time could be devoted to AKI in European nephrology conferences (in the recent ERA-EDTA meetings markedly more slots were devoted to CKD than to AKI) and in continuing medical education courses (CMEs), especially in LMIC. Furthermore, increased focus on AKI in European research programs with more funding for AKI studies is another necessity. To cope with these problems, a European nephrology network of researchers and clinicians interested in AKI will be created under the auspices of ERA-EDTA, with the intent to instigate interest in AKI and to develop common research projects.

CONFLICT OF INTEREST STATEMENT

HJ Anders reports personal fees from Secarna; grants and personal fees from Previpharma; personal fees from Novartis, Bayer, GSK, Boehringer and AstraZeneca, outside the submitted work.

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None of the remaining authors declared a conflict of interest.

DATA AVAILABILITY STATEMENT

The data underlying this article are available in the article and in its online supplementary material.

Table 1. Publications on AKI per region in 2018

	Absolute N of publications	Share of total publications (%)	population in millions	publications pmp*	Share of total publications pmp (%)
Africa**	16	1.0	1,216.0	0.01	0.1
ANZ	33	2.1	29.9	1.10	24.9
Asia	564	36.3	4,463.0	0.35	7.9
Canada	38	2.4	37.6	1.01	22.8
Europe	438	28.1	741.4	0.59	13.3
Latin-America	69	4.4	626.0	0.11	2.5
Mediterranean	63	2.2	227.5***	0.15	3.4
US	362	23.3	328.2	1.10	24.9

N: number; pmp: per million population; US: United States; ANZ: Australia-New Zealand

*: ratio = number per million population; **: sub-Saharan Africa; ***: total population of Syria, Lebanon, Israel, Egypt, Libya, Algeria, Tunisia, Morocco.

Table 2. European publication rate on AKI in 2018 per country normalized pmp

Country	N of publications	Population (millions)	N of publications pmp
Iceland	1	0.4	2.50
Malta	1	0.5	2.00
Switzerland	13	8.5	1.53
Slovenia	3	2.1	1.43
Denmark	8	5.8	1.38
The Netherlands	23	17.4	1.32
Belgium	15	11.4	1.32
Finland	6	5.5	1.09
Portugal	11	10.3	1.07
Italy	63	60.4	1.04
Croatia	4	4.1	0.98
Austria	8	8.9	0.90
United Kingdom	59	66.4	0.89
Cyprus	1	1.2	0.83
Sweden	8	10.1	0.79
Greece	8	10.3	0.78
Spain	34	46.7	0.73
Germany	60	82.9	0.72
France	45	67.1	0.67
Ireland	3	4.9	0.61
North-Macedonia	1	2.1	0.48
Poland	15	38.4	0.39
Norway	2	5.3	0.38
Slovak Republic	2	5.4	0.37
Lithuania	1	2.8	0.36
Turkey	29	83.1	0.35
Georgia	1	3.7	0.27
Romania	3	19.5	0.15
Serbia	1	7.0	0.14
Russian Federation	8	145.9	0.05
Ukraine	2	41.7	0.05

N: number; pmp: per million people. Small countries (less than 100,000 inhabitants) like Andorra, Liechtenstein, Monaco, San Marino, Vatican, were not included. No publications for: Albania, Belarus, Bosnia-Herzegovina, Bulgaria, Czech Republic, Estonia, Hungary, Kosovo, Latvia, Luxembourg, Moldova, Montenegro.

Table 3. Relation between scientific output (publications on the topic of AKI in 2018), and geographic location and GDP

Region	West/East (number of countries)	GDP pmp (US dollars) mean±SD)	GDP pmp (US dollars) [median (range)]	Scientific output (mean±SD)	Scientific output [median (range)]
Western Europe	20/0	48640±22256	42229 (105280-18695)	1.03±0.54	0.90 (2.50-0)
Central/Eastern Europe	0/21	9877±6119*	9198 (23488-2002)	0.20±0.36**	0 (1.43-0)
GDP pmp					
Highest tertile	14/0	58513±18561	51436 (105280-39532)	1.01±0.58	0.9 (2.50-0)
Middle tertile	6/8	20720±5345	19692 (32038-13871)	0.64±0.58	0.65 (2.00-0)
Lowest tertile	0/15	6641±3273	5418 (13200-2002)	0.16±0.26***	0.05 (0.98-0)

Scientific output was calculated as number of publications pmp. GDP: gross domestic product. Pmp: per million population.

*: p<0.001 vs. West; **: p<0.01 vs. West; ***: p<0.01 vs. highest tertile.

Table 4. Research priorities

IMMEDIATE
Develop a uniform transnational European alarm system and assess clinical impact
Prospective registry with follow-up at 1, 3, 6 months with epidemiology and outcomes (albuminuria, eGFR, complications, death, dialysis) in different countries – possibly coupled to proteomic/genomic biobank
Impact of cessation or not of RAAS-inhibitors on evolution of AKI
Mechanisms of AKI in cancer patients
Observational study of the different models of AKI care across European healthcare systems i.e. ‘practice patterns’ type of approach
Develop tools that reliably assess the I in AKI, as opposed to current tools that evaluate function
A systems biology approach to AKI diagnosis and categorization enabling evaluation of different therapeutic approaches in uniform buckets of cases
Create a European network of clinical trialists
Explore novel imaging techniques for the diagnosis of AKI
Assess epidemiology and risk factors in vulnerable populations (e.g. the elderly)
Describe primary and secondary preventive measures and their impact on AKI development and severity
LONG-TERM
Prospective registry with follow-up at ≥ 1 year with epidemiology and outcomes (albuminuria, eGFR, complications, death, dialysis) in different countries – possibly coupled to proteomic/genomic biobank – extension of the immediate priority above
Health-economic impact of transition of AKI to CKD
Patho-physiologic studies of target molecules and mechanisms, their receptors and pathways
Interventional trials of prevention or treatment of AKI
Prognostic impact of uremic toxins in AKI
Prognostic impact of outpatient AKI
Monitor the impact of widespread SGLT2 inhibitor uptake on the incidence and outcome implications of AKI
Describe impact of primary and secondary preventive measures on long-term AKI outcomes
Development and evaluation of tools using artificial intelligence to identify patients at risk for AKI and to predict the severity of AKI outcomes

RAAS: renin angiotensin aldosterone system; AKI: acute kidney injury; CKD: chronic kidney disease; SGLT: sodium-glucose transport

Figure 1: Ratio of the number of publications in Europe over the US for acute kidney injury (AKI), Chronic Kidney Disease (CKD), Hemolytic Uremic Syndrome (HUS) and Uremic Toxins (UTox) in 2018.

Figure 2: European publication rate on AKI in 2018 per country normalized pmp. Darkness of shade in proportion to publication rate (darkest for highest rate). Rates were calculated as number of publications on AKI based on AKI in title. Blue colors: publication rate > 1.00 pmp, 0.51-1.00 pmp, 0.01-0.50 pmp. Grey: publication rate 0. There is a marked East-West gradient.

Figure 3: Year by year European contribution to publications on AKI (% publications out of overall worldwide publications, based on AKI in title). There was no significant trend.

Figure 4: Percent contribution of different specialties in European publications with AKI in the title (2012-2019).

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NDT-02044-2020.R1-fig1

66x253mm (300 x 300 DPI)

NDT-02044-2020.R1-fig2

146x254mm (300 x 300 DPI)

NDT-02044-2020.R1-fig3

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NDT-02044-2020.R1-fig4

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