kidney and dialysis

Editorial

Green Nephrology

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The greenhouse effect of carbon dioxide, nitrous oxide, and methane release resulted in an exponential rise of land temperatures over the last decades. The parallel warming of the ocean surfaces and the melting of the polar icecap offset the natural buffer against land heating. Global warming results in an unstable climate and many extreme conditions across the globe, with progressively more heatwaves, droughts and forest fires, as well as hurricanes and floods. Drastically lowering greenhouse gas emission is the only option for a sustained effect on this human-caused climate change.

Moreover, the unmanaged worldwide buildup of discarded waste generates tons of plastic ending up in rivers and oceans and, ultimately, in the food chain after ingestion by fish and shellfish. This devastating evolution can be stopped only by measures leading to a circular economy.

Kidney disease occupies a significant place in the environmental challenge: environmental problems aggravate kidney diseases, whereas dialysis especially leaves a huge environmental footprint with regard to water consumption and greenhouse gas and waste production [1–5] (Figure 1). However, the response to this by the nephrological community has remained unenthused, similar to a number of other, be it not all, areas of economic activity.

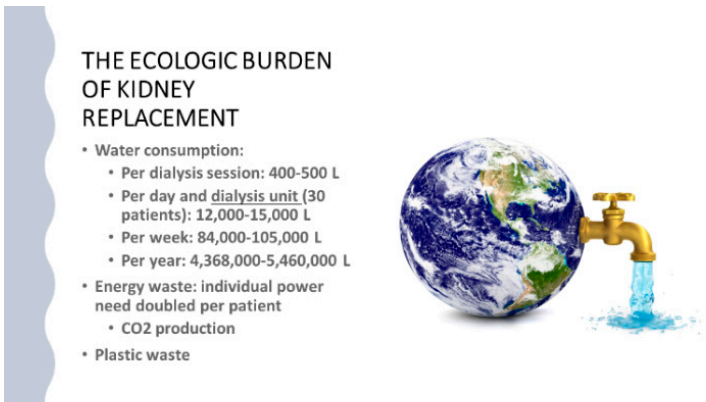

Figure 1. Summary of the main environmental problems related to hemodialysis. Graphic reprinted with permission from Depositphotos™, 2022 (https://depositphotos.com, accessed on 8 July 2022).

A recent policy paper by the European Kidney Health Alliance (EKHA) was drafted by a group of concerned physicians, patients, nurses, engineers and chemists [1]. This text, next to other publications by the EKHA, intends to create awareness among European policy makers of the dimensions of the environmental burden of nephrology [1,6]. It also wants to motivate the nephrological community, both from the manufacturer and provider sides, to take this problem to heart and avoid European nephrology lagging behind compared to other European economic sectors or to the nephrology field in other continents. The publication was written considering the significant boost in environmental action and ample

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opportunities created by the European Commission with the Green Deal, an overarching plan aiming at a 55% reduction in greenhouse gas emission versus 1990 in the European Union by 2030 and at an energy-neutral Europe by 2050 [7].

Green innovation of nephrology is also the main thematic of EKHA in 2022, and one of the focus points of EKHA's annual European Kidney Forum, held in the European Parliament [8]. Hopefully, these initiatives by EKHA will generate a boost in environmental considerations among professionals involved with kidney care and result in more transparency about undertaken actions. Although the activities mentioned above are essentially aimed at Europe and European policy, the intent of the present editorial is to broaden the scope to a worldwide setting because of the many parallels that can be made with other countries and continents, both regarding desired policy engagement and stakeholder action.

The EKHA publication referred to above [1] contains several tables with recommendations and suggestions on how to cope with the environmental problem in nephrology. Some action points refer to general attention points that are re-emphasizing viewpoints already expressed in previous publications, but the text also contains several suggestions that are novel and should be considered as out-of-the-box. Some suggestions are also specifically directed at policy making, since several action points may be accelerated by transnational coordination and guidance from an overarching level. The most compelling points are summarized in Table 1 of the present publication. Traditional and broadly recognized solutions that are insufficiently applied in nephrology, policy actions, and out-of-the-box thinking should all be combined on a large scale if we want to avoid that kidney care misses the boat of environmental innovation.

Table 1. Main solutions for environmental problems of dialysis [1].

- Established but not systematically applied solutions
    - Decrease water consumption
        - Dialysate regeneration
        - Decrease of dialysate flow
    - Energy neutral practices
        - Solar and wind energy
        - Heat pumps
        - Heat exchangers
    - Waste handling
        - Waste triage
        - Biodegradable plastic
        - Bio-based polymers
        - More durable dialysis machines and electronics
- Less established (out-of-box) solutions
    - Decrease water consumption
        - Water distillation
        - Repurposing of reverse osmosis water
        - Household use (bathing, toilet flush, laundry)
        - Drinking water
        - Spent dialysate as fertilizer
    - Energy neutral practices
        - Spent dialysate as fertilizer
        - Urea fuel cells
    - Waste handling
        - Biodegradable disinfection products
        - Repurposing plastic waste (e.g., to reinforce concrete)
        - Develop safe reuse techniques
- Policy changes
    - Facilitate screening and prevention of CKD and transplantation
    - Facilitate registries and stimulate transparency on environmental burden
    - Promote exchange of best practices
    - Adapt regulations to facilitate recycling of medical material

One of the most important hurdles for the facilitation of green nephrology is the lack of awareness among the general public and policy makers of the ecological burden of nephrology that is further aggravated by the deficient familiarity with kidney health and kidney disease at large. Advocacy efforts by all stakeholders are necessary at all levels (international, national, regional) to increase the knowledge of the humanistic, economical, and social burden of kidney disease. By joining the Decade of the Kidney™ initiative [9], the EKHA, since 2020, further geared up its awareness campaigns on burden of kidney disease, emanating in several initiatives, including a comprehensive review written in language understandable for a lay public and policy makers summarizing all concerns linked to deficient kidney health [6].

The primary step to reduce the environmental burden of kidney care is by the prevention of advanced kidney failure, thus obviating the need for kidney replacement therapies. This implies more streamlined screening, primary and secondary prevention, and more investment in innovative approaches refraining the progression of kidney disease [10]. Of note, heathy lifestyle as primary prevention measure is also eco-friendly [11], e.g., by reducing red meat and processed food consumption and by promoting organic farming products and travel by one's own physical means rather than by fuel-consuming devices.

Among kidney replacement therapies, transplantation causes the lowest environmental burden [12]. Therefore, actions to increase uptake of transplantation are also of the utmost importance [13]. However, less than 40% of Europeans on kidney replacement therapy live with a functioning graft, and the degrees of uptake of transplantation per individual European country differ substantially, suggesting ample room for improvement [14].

With the majority of kidney failure patients on dialysis, especially an environmental optimization of this therapeutic option is imperative and should be pursued from production, transport, and delivery up to the therapeutic application itself and its waste management. Several industrial stakeholders have taken planet-friendly measures [15–17], which, however, seem focused on manufacturing rather than on clinical application. Corrections have been introduced in packaging, transport, and delivery processes, and some of the packaging material is recycled. However, production secrecy seems often an obstacle for a detailed reporting of specific ecologic measures. Along the same line, transnational mapping processes of the exact ecologic burden of clinical dialysis as a whole and per center remains fragmentary [18,19]. Significant quantities of reverse osmosis reject water that usually ends in the drain could easily be used for every-day purposes such as toilet flushes, laundry or bathing [20], and even as drinking water. This should certainly be a primary aim for newly built units but is feasible as well in existing units if an approach that has been well-organized in advance is followed [21].

Dialysate regeneration is another option to reduce water consumption [22–25]. Several compact dialysis systems are currently in use or developed, which next to ecologic benefit due to less water consumption might also allow more flexibility, user-friendliness, and lower cost for individuals and countries or regions adhering to those methods [24,26].

The generation of greenhouse gases [4,20] needs solutions by both manufacturers and providers to make dialysis energy neutral, e.g., by a shift to solar or wind energy, heat pumps, heat exchangers, or dialysate regeneration [27]. Energy consumption can further be reduced by simple actions, such as turning off lights and computers after the end of daily activities [4]. Home dialysis reduces the environmental burden of travel and uses ambient temperature regulation on a small domestic scale, which is usually less energy-consuming than hospital-based or unit-based climatization.

The dialysis concept should be refurbished into a circular model, involving biodegradable or recyclable materials or their repeated use. The current dialysis machines are usually built to be disassembled after a limited lifespan, which interferes with the cradle-to-cradle (circular) concept [19]. Dialysis waste originates from packages, non-contaminated and contaminated disposables, and hardware (electrical and electronic equipment). Corrective actions are indicated, from reduction in used material and careful triage of components before recycling, up to recycling per se, of both contaminated and non-contaminated disposables. However, international, national, and regional regulations often impede the disposal of biohazardous or toxic materials as well as of recycling.

Peritoneal dialysis might be conceived as more environment-friendly in view of the lower water need and (mainly for Continuous Ambulatory Peritoneal Dialysis (CAPD)) lower energy consumption for the dialysis procedure per se. However, this benefit is at least in part offset by a higher need for plastic used for the bags and packaging, which results in more waste, while the production process consumes more water, and more energy is used for production and transport than what is spent for the generation of hemodialysis filters [4].

Out of a conservative reflex, some people may think that most ideas formulated in this and the other referred articles are remote theory. However, these papers contain a large number of practical solutions which are easy to accomplish or could be made possible with some organization, constructive thinking, or research. Initiatives in France [21] and the UK [28,29] mentioned in the referred EKHA publication are real-life initiatives which are currently operational and beyond the stage of theory. If we, as individuals, modify our lifestyle to become energy-neutral and to avoid that life becomes hell for the next generations, we believe such initiatives should also be possible for dialysis units.

Others may suggest that the environmental impact of CKD has already repeatedly been cooked and served in various sauces. However, if one looks for the literature on environment and kidney health, one barely finds papers on this topic and only part of them propose solutions. So, it is fair to propose that there are many areas in nephrology that have been more frequently cooked than green nephrology. It is important to stress that all co-authors were specifically asked to come up with novel ideas, and all of those were included. As a consequence, it is reasonable to state that at least 30% of the entire text and more than half of the section with solutions contain novel ideas [1]. However, even if the publication would be entirely repetitive, the text still collects a large number of proposals for modification, allowing to design a roadmap on how to make progress in the immediate future. The intention of EKHA is to use this text for advocacy purposes with policy makers and major stakeholders on how to support/organize this environmental transition.

In conclusion, in view of the bidirectional relationship between environment and kidneys, it is necessary that the nephrological community takes action without delay. This implies profound shifts in structures, planning, targets and actions of industry, hospitals, medical professionals, and patients alike. Professionals, patients, and insurers as main end-product consumers have a responsibility to enforce this move upon manufacturers and providers. Only with a shift in mentality, it will be possible to overcome the current status quo by finding planet-friendly solutions, which is the only way to forestall the growing environmental burden of kidney care.

Conflicts of Interest: The author declares no conflict of interest.

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