Green Nephrology

Masoud Khosravi, M.D.

Nephrologist

Faculty of Guilan University of Medical Sciences

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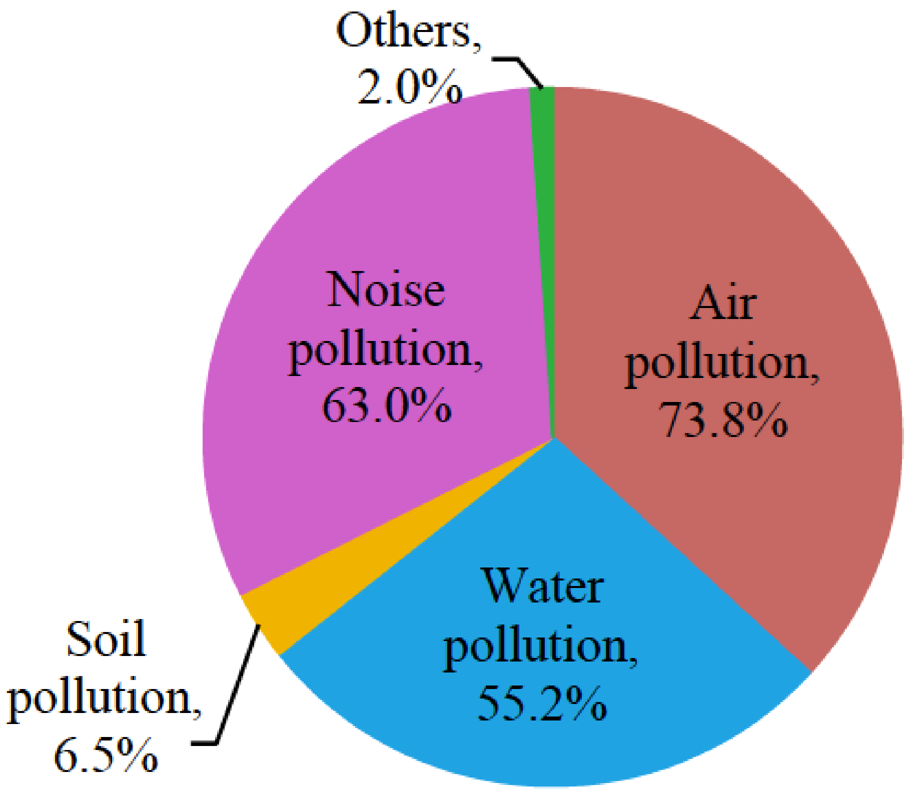

Figure 4. Types of environmental pollution identified by the respondents

earth
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Article

The Severity of Environmental Pollution in the Developing Countries and Its Remedial Measures

Najmun Nahar [1,2,*], Sanjia Mahiuddin [1] and Zakaria Hossain [2]

Earth **2021**, *2*, 124–139. https://doi.org/10.3390/earth2010008

Table 3. Major causes of environmental pollution identified by the respondents.

Causes of Environmental Pollution	Percentage
Rapid population growth	40.3
Unplanned and ill-planned urbanization	88.3
Deforestation	69.5
Improper waste disposal and management	85.0
Emissions from industries and automobiles	74.8
Emissions of fossil fuels	48.8
Chemical effluents from industries	88.3
Landfills by wastes	87.6
Construction works	76.5
Indiscriminate use of loudspeakers	59.0

Source: Field survey, 2018 (Multiple responses).

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The Severity of Environmental Pollution in the Developing Countries and Its Remedial Measures

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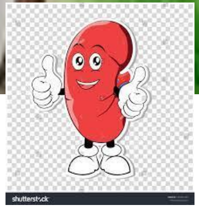
Pollution is Slow Poison, Acts Slowly but Lethally.

Clear evidence indicates that the health of the natural world is declining globally at rates that are unprecedented in human history.

Environmental change, particularly climate change, is already having and will increasingly have an impact on the incidence and distribution of kidney diseases.



Air pollution is a complex mixture of different gaseous and particulate components and can cause several health effects. Both long- and short-term exposure to air pollution can cause cardiovascular, respiratory diseases (e.g., asthma, chronic obstructive pulmonary disease, lung cancer) and mortality . In addition to the diseases listed above air pollution ($PM_{2.5}$) can also cause some physiological changes as blood pressure .

PLOS | ONE

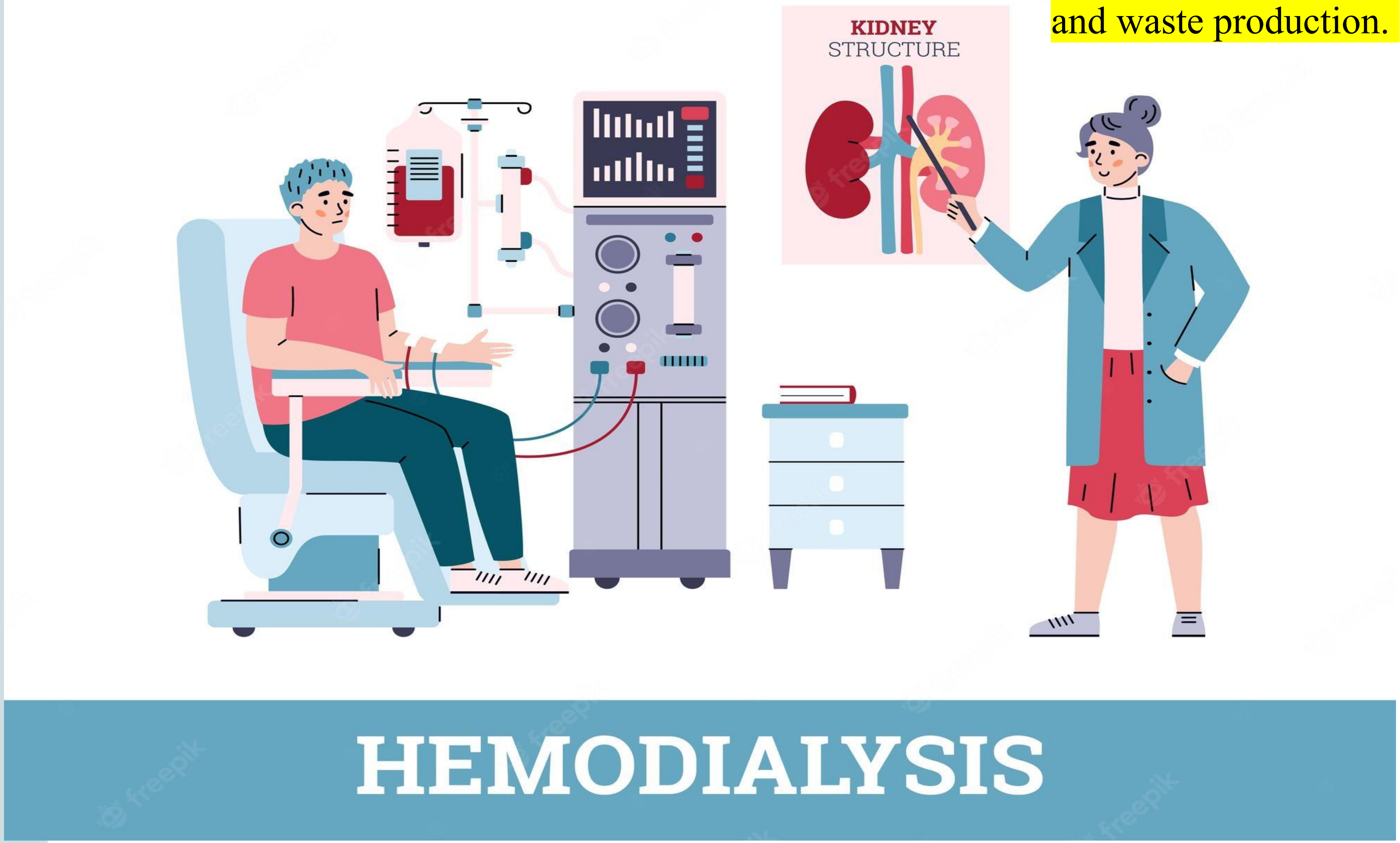
RESEARCH ARTICLE

The mediating role of risk perception in the association between industry-related air pollution and health

Arnold D. Bergstra[1,2]*, Bert Brunekreef[3,4], Alex Burdorf[1]

PLOS ONE | https://doi.org/10.1371/journal.pone.0196783 May 3, 2018

Dialysis especially leaves a huge ***environmental footprint*** with regard to water consumption and greenhouse gas and waste production.



Three main waste disposal streams exist in health care:
hazardous (infectious) waste,
General waste and waste for recycling.

In addition, organic waste in landfill emits methane, a greenhouse gas that is 21 times more potent in terms of global warming than carbon dioxide (CO_2).

phthalates (found in many medical plastics) can leach into the soil and groundwater and become environmental and health hazards for many years.

A dialysis facility from the UK reported the generation of 2.5 kg of hazardous waste per haemodialysis treatment, of which 38% was plastic.

NATURE REVIEWS | NEPHROLOGY
https://doi.org/10.1038/s41581-019-0245-1

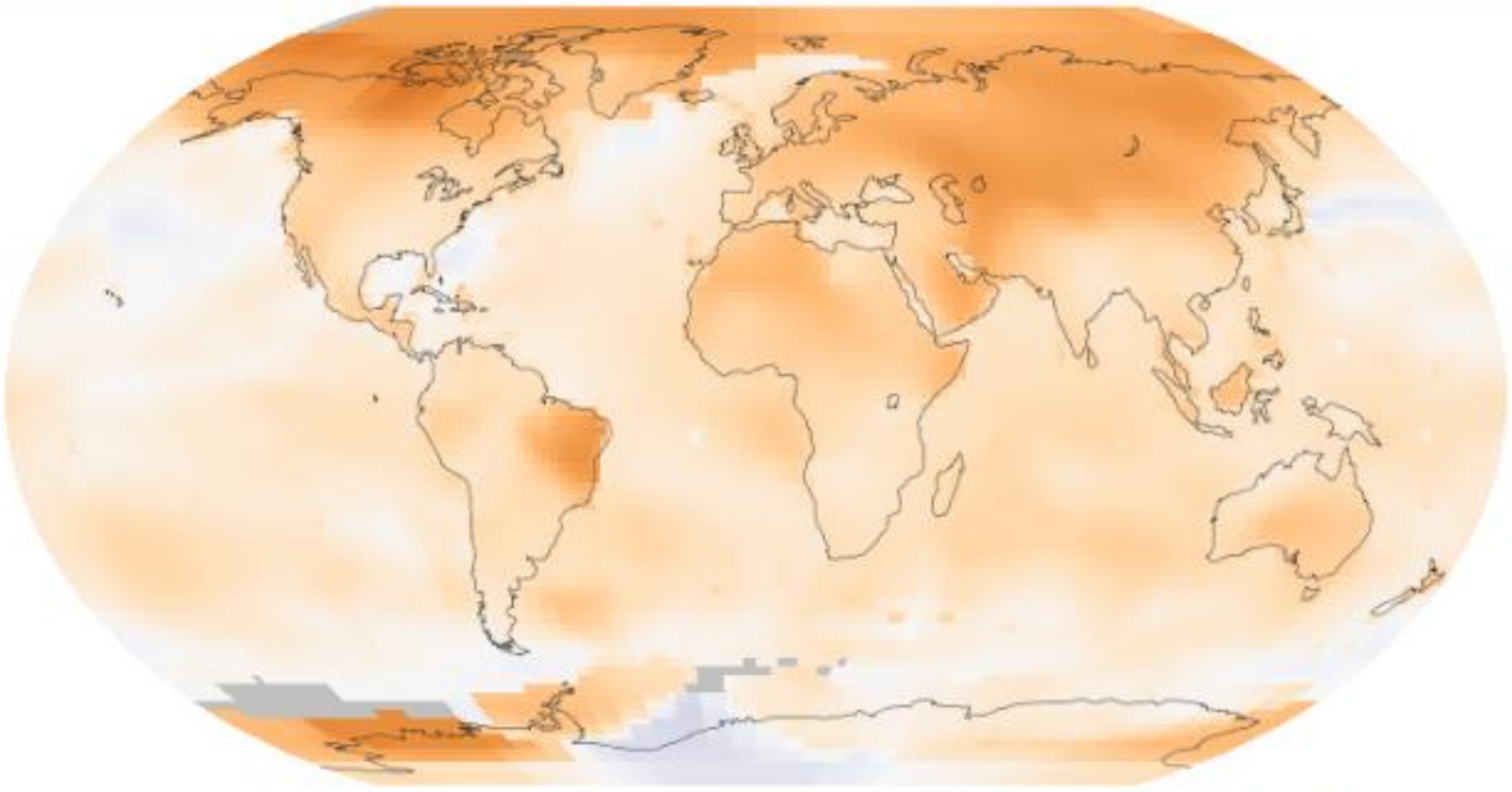
REVIEWS

Check for updates

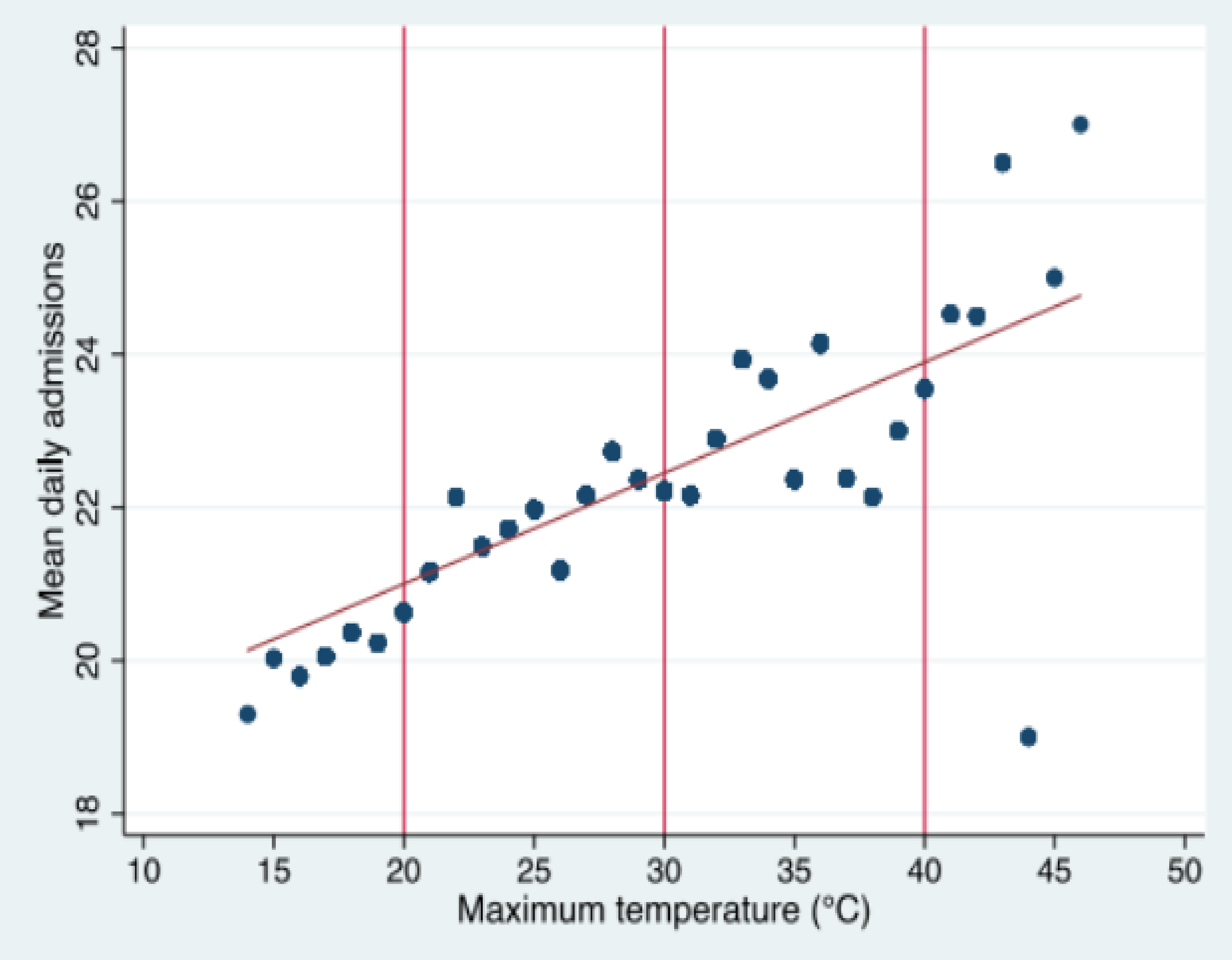
Green nephrology

Katherine A. Barraclough[1]✉ *and John W. M. Agar*[2]

Over the past 50 years, the mean global temperature has increased by 0.8° C.



World map showing surface temperature trends between 1950 and 2014. NASA/GSFC/Earth Observatory, NASA/GISS / Public domain.



Daily maximum temperature during the warm season (October – March) and mean hospital emergency department total renal disease admissions in Adelaide from 1 Jul 2003 to 31 March 2014. Figure 2A from Borg et al (CC BY 4.0), *Environmental Health.*

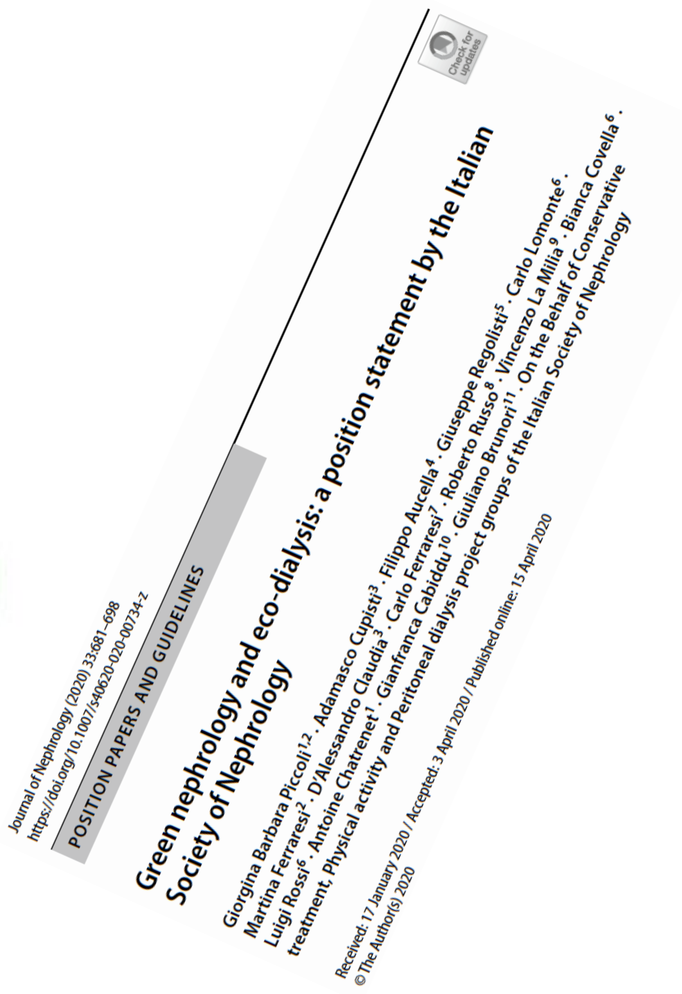
Rhabdomyolysis injury is related to direct acute tubular injury, while other forms of heat related acute kidney injury are thought to be related to ischemia and oxidative stress. Heat also brings increased incidence of nephrolithiasis. In the southeastern United States (US), there is a 50% higher prevalence of kidney stones than in the northwest, with a mean annual temperature difference of 8°C between the two climates. Poor hydration habits exacerbate hypovolemia, resulting in concentration of stone forming salts and, according to some estimates, by 2050, the US may see an increase of 1.6-2.2 million lifetime urolithiasis cases.

During a heat wave in July of 1995 in Chicago, there was a 388% increase in admissions for AKI in patients 65 years and older when compared to non-heat wave weeks.

AJKDblog

https://ajkdblog.org/2020/03/13/nephmadness-2020-green-nephrology-region/#prettyPhoto

Fig. 1 The "R" cycle, and its potential application to dialysis treatment


Journal of Nephrology (2020) 33:681–698
https://doi.org/10.1007/s40620-020-00734-z

POSITION PAPERS AND GUIDELINES

Green nephrology and eco-dialysis: a position statement by the Italian Society of Nephrology

Giorgina Barbara Piccoli[1,2] · Adamasco Cupisti[3] · Filippo Aucella[4] · Giuseppe Regolisti[5] · Carlo Lomonte[6] · Martina Ferraresi[2] · D'Alessandro Claudia[3] · Carlo Ferraresi[7] · Roberto Russo[8] · Vincenzo La Milia[9] · Bianca Covella[6] · Luigi Rossi[6] · Antoine Chatrenet[1] · Gianfranca Cabiddu[10] · Giuliano Brunori[11] · On the Behalf of Conservative treatment, Physical activity and Peritoneal dialysis project groups of the Italian Society of Nephrology

Received: 17 January 2020 / Accepted: 3 April 2020 / Published online: 15 April 2020

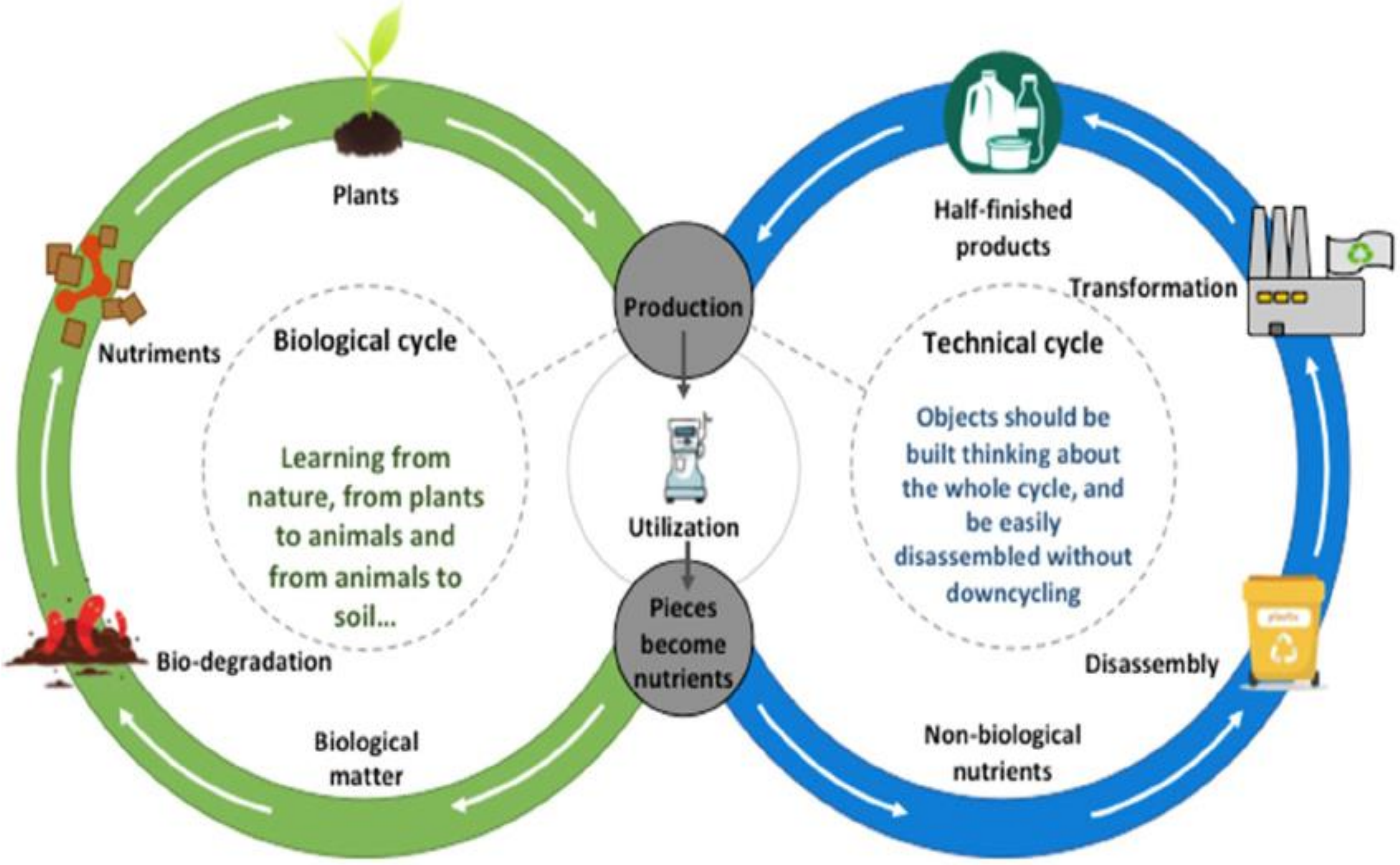


Fig. 2 The circular "cradle to cradle" model: technical waste should nourish the technical cycle, similar to organic waste, nourishing plants and being continously recycled in the biosphere

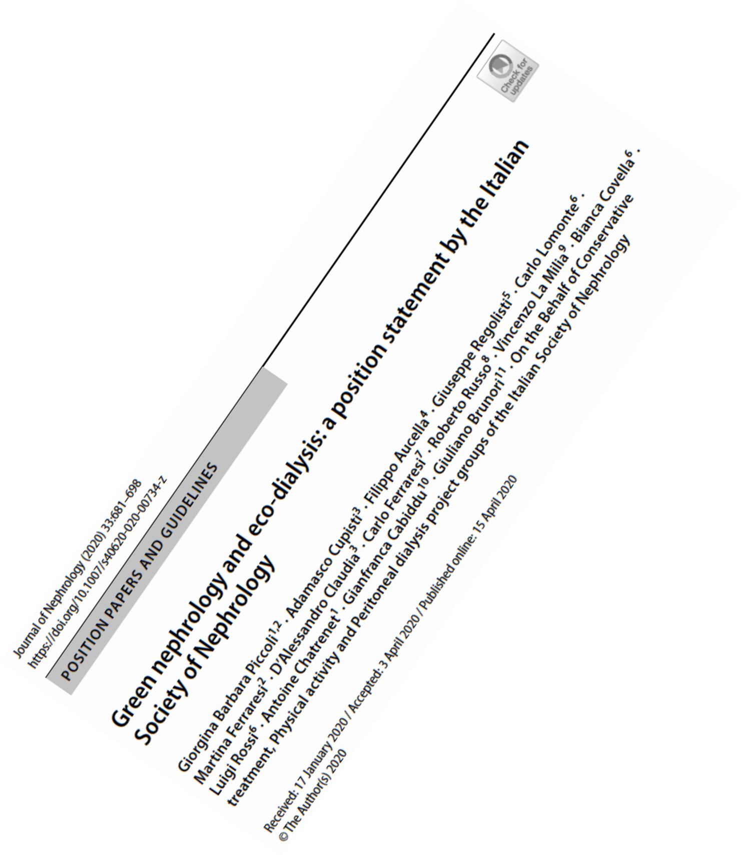

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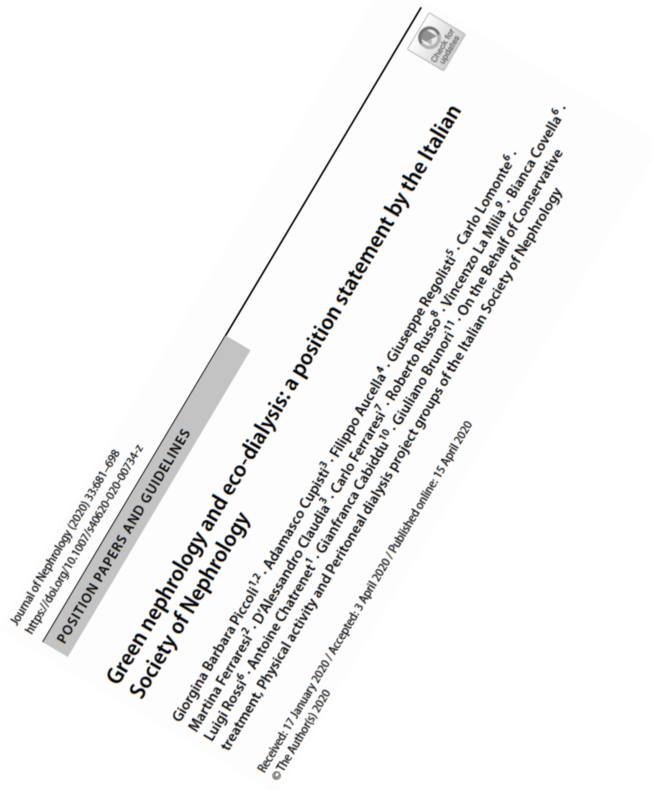
Fig. 3 The issues regarding ecology and nephrology are like Russian dolls: the smaller ones, regarding eco-dialysis and waste management, lead to reconsider dialysis prescriptions, predialysis care, and eventually education and prevention of kidney diseases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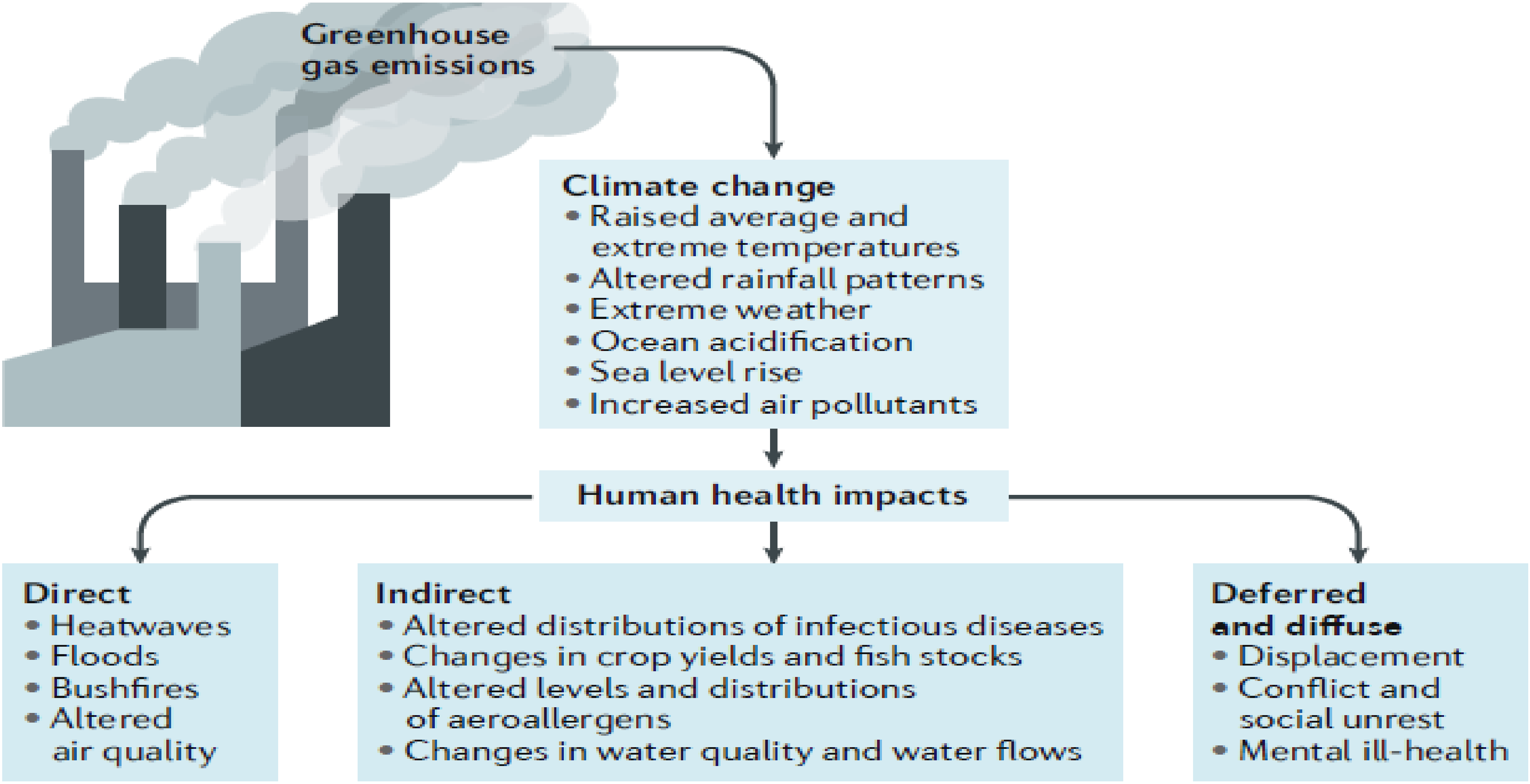

Fig. 1 | **Greenhouse gas emissions, climate change and human health.** Climate change owing to high levels of greenhouse gas emissions poses a broad range of threats to human health and survival[11]. The impacts of climate change on human health can be direct (for example, heatwaves cause heat stress and other heat-related illnesses), indirect (for example, warmer temperatures lead to an increased range of mosquitoes and alterations in the incidence and distribution of mosquito-borne diseases), or deferred and diffuse (for example, water shortages can lead to conflict and forced migration with associated ill-health).

Barraclough KA, Agar JW. Green nephrology. Nature Reviews Nephrology. 2020;16(5):257-68.

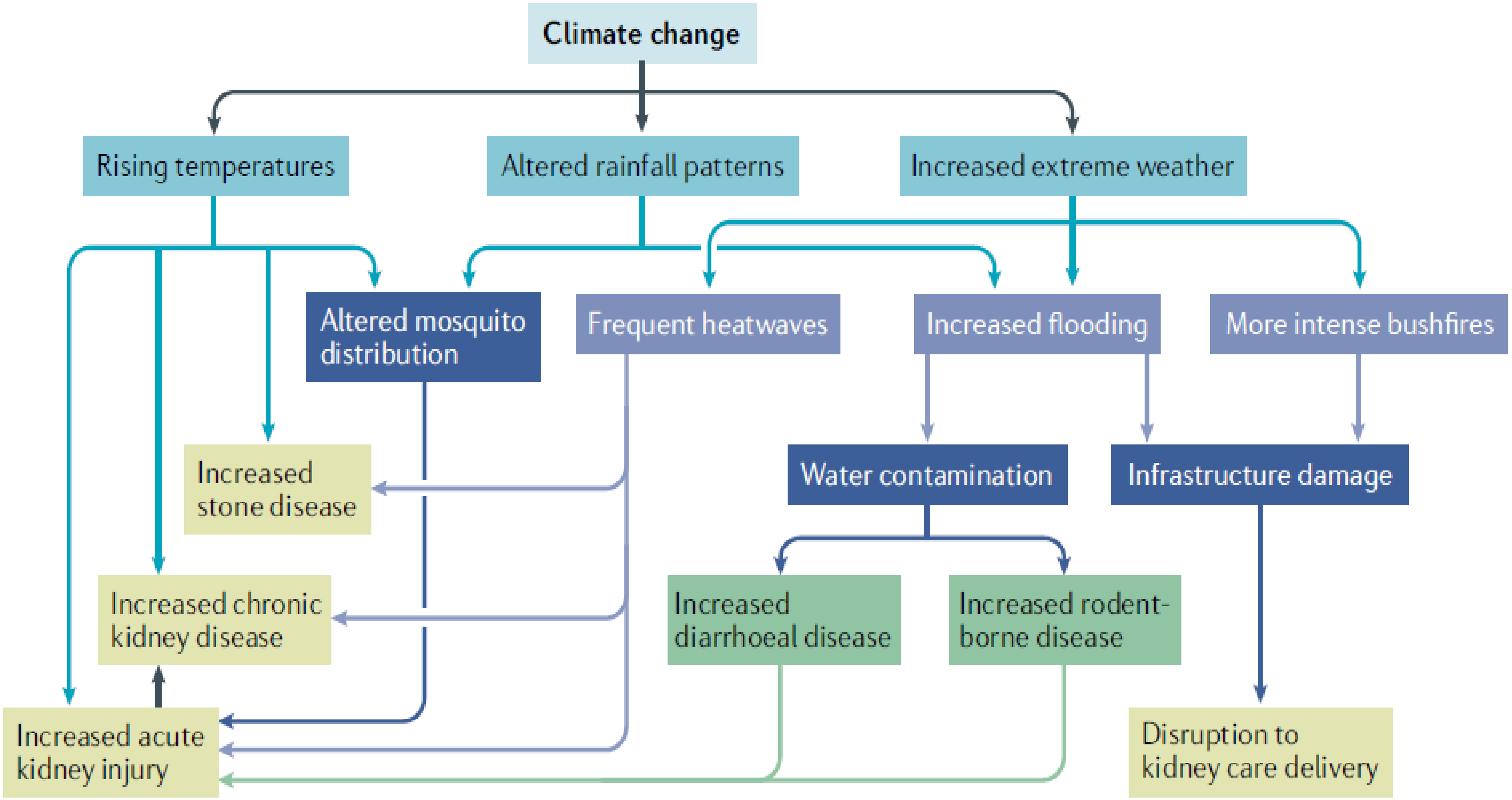

Fig. 2 | **The relationship between climate change and kidney diseases.** Climate change has the potential to have an impact on the incidence and distribution of acute and chronic kidney diseases through a variety of pathways. In addition, extreme weather events related to climate change are likely to have an increasingly disruptive influence on the delivery of health care to patients with kidney diseases.

Barraclough KA, Agar JW. Green nephrology. Nature Reviews Nephrology. 2020;16(5):257-68.

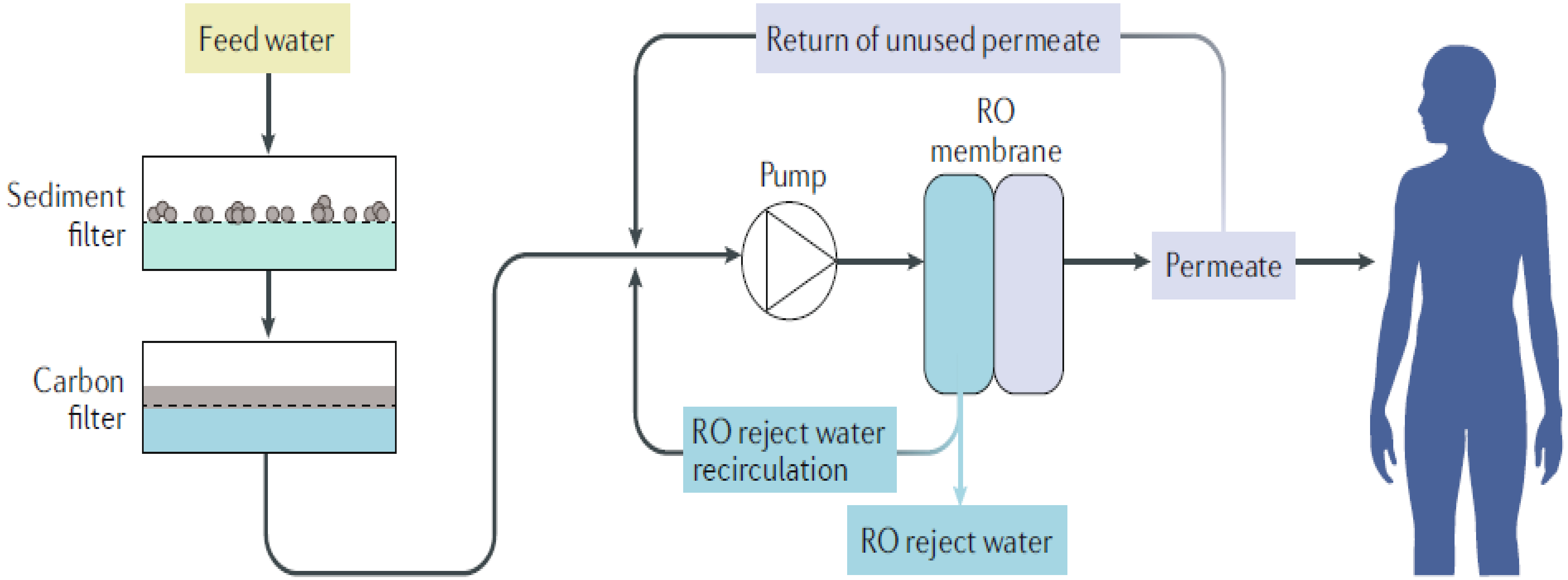

Fig. 3 | **Water treatment in haemodialysis.** Feed water is passed through a sediment filter to remove suspended solids and then a carbon filter to remove chlorine, chloramines and organic matter by absorption. The water is then pumped across a semi-permeable membrane that removes any remaining dissolved ions and salts via reverse osmosis (RO). This treatment produces water of a quality suitable for haemodialysis. The by-product is a similar volume of RO 'reject' water. Modern RO systems have the ability to recirculate a proportion of the reject water along with any unused permeate back to the inlet to be passed again through the RO membrane, thereby reducing water wastage.

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Haemodialysis programmes have a particularly large carbon footprint, with a recurrent, per capita resource consumption and waste generation profile that seems to be disproportionately high compared with most other medical therapies

Table 1 | Cumulative savings from UK Green Innovations[98]

Type of innovation	Initiatives undertaken by individual kidney care facilities	Environmental and financial savings	Potential financial savings to the UK health system
Infrastructure projects	Reverse osmosis reject water reuse; installation of baling machines for plastic and cardboard recycling; lighting upgrades; central delivery of acid for haemodialysis; retrofitting of heat exchangers to dialysis machines; upgrade to water treatment plant	The six projects had capital investment costs of £121,000, but generated annual savings of £57,000, 84 tonnes of greenhouse gases and 12 million litres of water	Estimated savings of £7 million (US$10.64 million), 11,000 tonnes of greenhouse gases and ~470 million litres of water if infrastructure innovations were replicated by 30% and process innovations by 60% of UK kidney care units; model-of-care estimates were not included in the total savings projections
Process innovations	Paperless laboratory reporting; waste reductions in food, linen and dialysis consumables; improved waste segregation	No investment costs were incurred; annual savings of £186,000 and 183 tonnes of greenhouse gases	
Model of care innovations	Improved use of telecommunications	Financial savings were not quantified owing to the complexity, but savings of 6 tonnes of greenhouse gases were estimated from three specific projects in their pilot phase	

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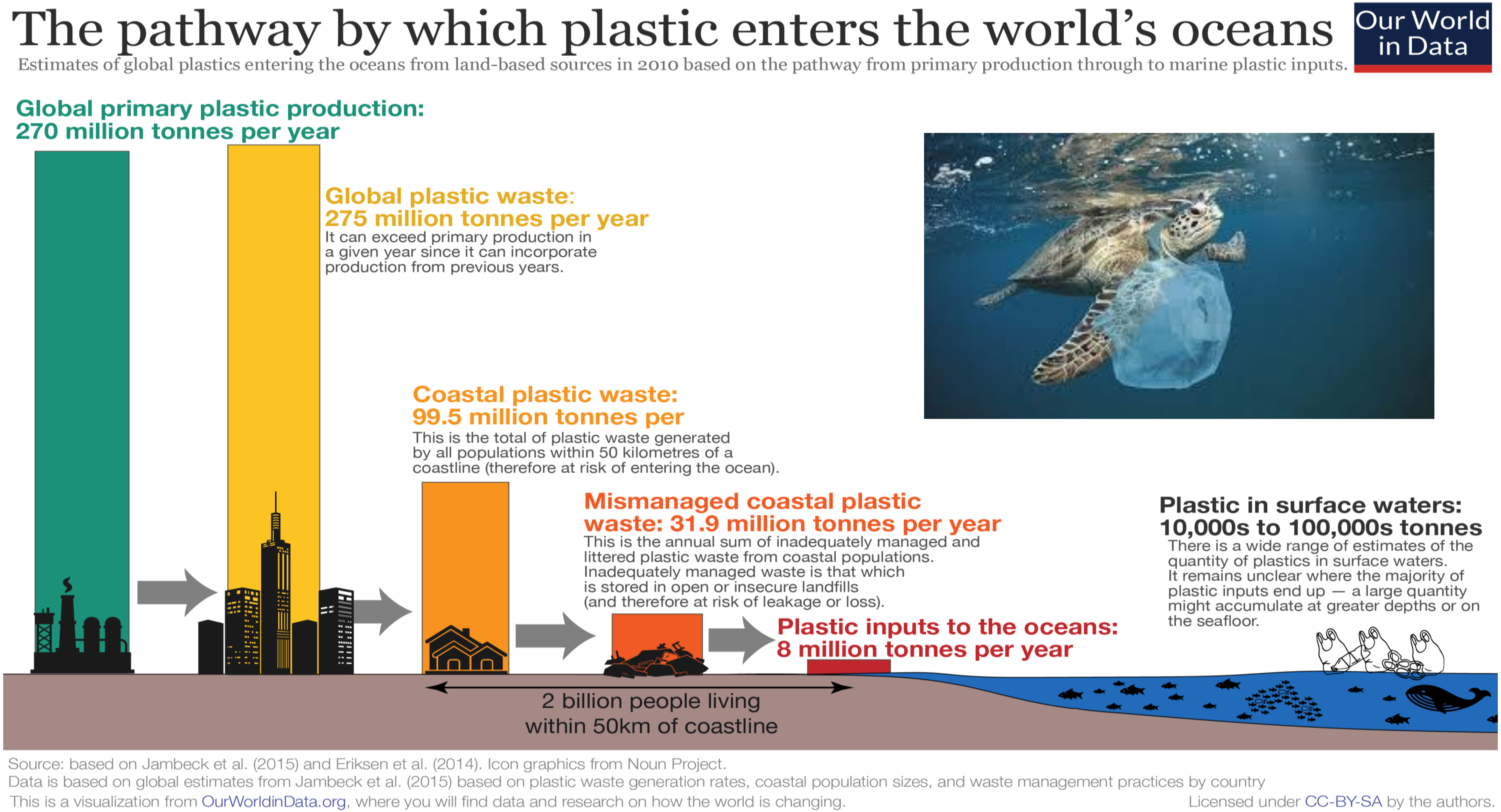
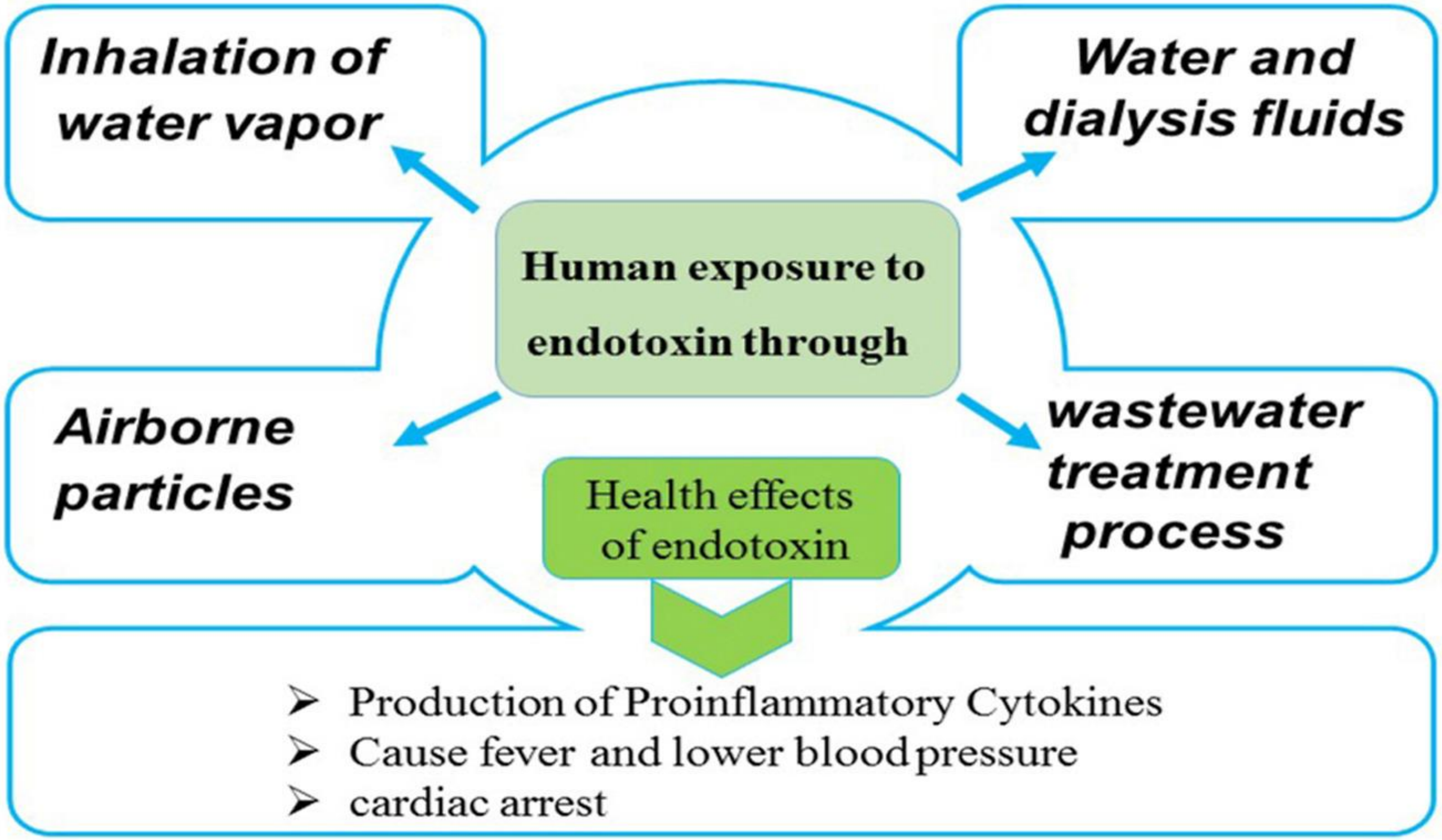
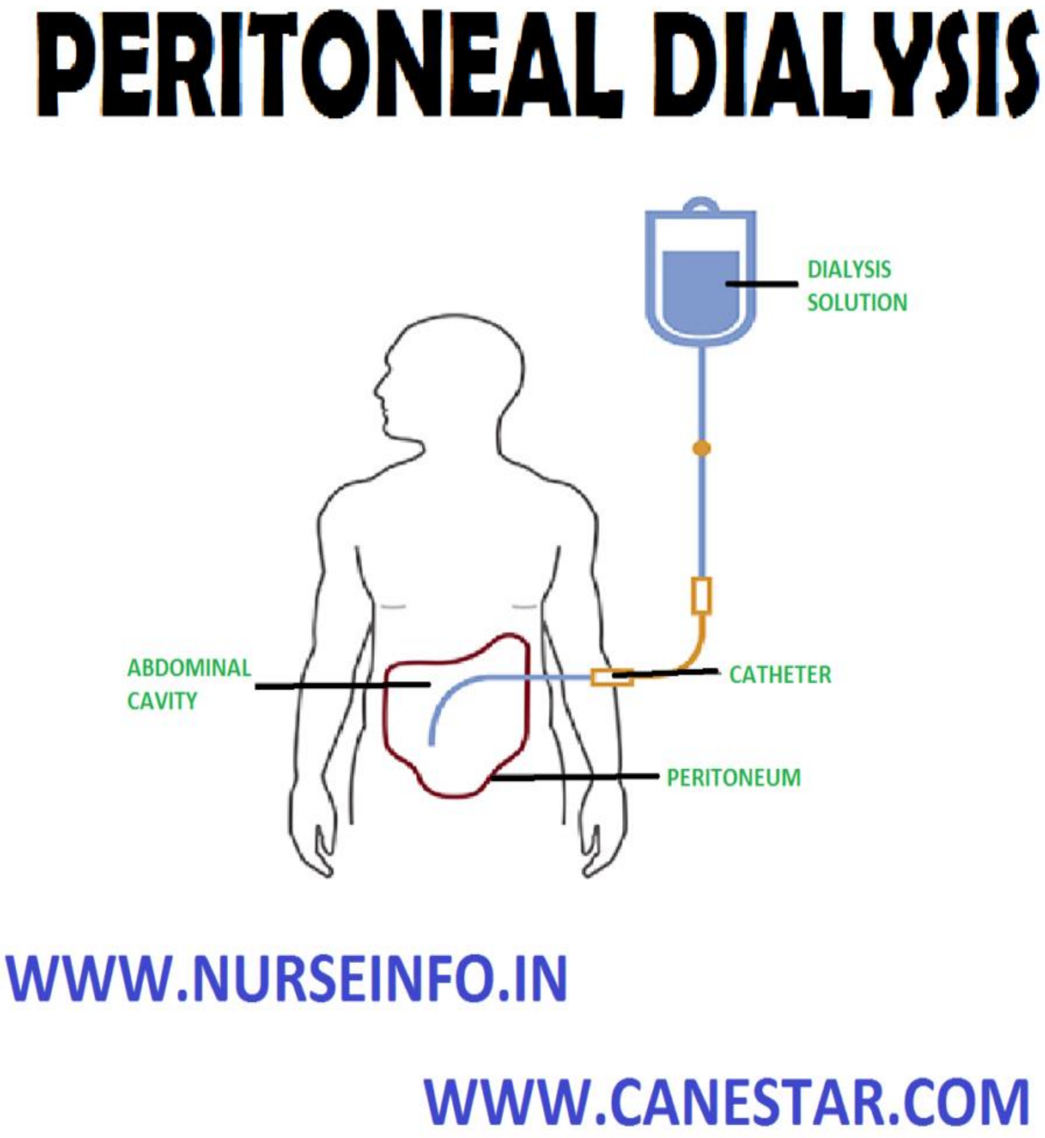


The pathway by which plastic enters the world's oceans
Estimates of global plastics entering the oceans from land-based sources in 2010 based on the pathway from primary production through to marine plastic inputs.
Our World in Data
Global primary plastic production: 270 million tonnes per year
Global plastic waste: 275 million tonnes per year
It can exceed primary production in a given year since it can incorporate production from previous years.
Coastal plastic waste: 99.5 million tonnes per
This is the total of plastic waste generated by all populations within 50 kilometres of a coastline (therefore at risk of entering the ocean).
Mismanaged coastal plastic waste: 31.9 million tonnes per year
This is the annual sum of inadequately managed and littered plastic waste from coastal populations. Inadequately managed waste is that which is stored in open or insecure landfills (and therefore at risk of leakage or loss).
Plastic inputs to the oceans: 8 million tonnes per year
Plastic in surface waters: 10,000s to 100,000s tonnes
There is a wide range of estimates of the quantity of plastics in surface waters. It remains unclear where the majority of plastic inputs end up — a large quantity might accumulate at greater depths or on the seafloor.
2 billion people living within 50km of coastline
Source: based on Jambeck et al. (2015) and Eriksen et al. (2014). Icon graphics from Noun Project.
Data is based on global estimates from Jambeck et al. (2015) based on plastic waste generation rates, coastal population sizes, and waste management practices by country
This is a visualization from OurWorldinData.org, where you will find data and research on how the world is changing.
Licensed under CC-BY-SA by the authors.

Each year, 4.8–12.7 million metric tonnes of plastic and 300–400 million tons of heavy metals, solvents, toxic sludge and other wastes from industrial facilities are allowed to enter the oceans.



https://doi.org/10.1016/j.chemosphere.2022.135089



PD uses far less dialysate than haemodialysis, in the order of 6–12 l per patient per day depending on the dialysis prescription.

An empty 2-l PD dialysate bag weighs 155 g, suggesting water usage during manufacture of around 28 l per bag.

A report from the UK described the generation of 1.69 kg of solid waste per day from patients receiving continuous ambulatory PD performing four daytime exchanges. Of this waste, 0.94 kg or 56% was PVC.

The annual waste generation per patient on
PD 617 kg because of the daily nature of PD therapy.
HD 390 kg

carbon footprint of PD totalled 1.4 t CO_2-eq per annum.

PD is more environmentally friendly than HD.

In 2018, 3,362,000 people were estimated to be receiving dialysis worldwide, with 2,993,000 (89%) receiving haemodialysis
and 369,000 (11%) receiving PD

https://www.freseniusmedicalcare.com

THE ECOLOGIC BURDEN OF KIDNEY REPLACEMENT

- Water consumption:
  - Per dialysis session: 400-500 L
  - Per day and dialysis unit (30 patients): 12,000-15,000 L
  - Per week: 84,000-105,000 L
  - Per year: 4,368,000-5,460,000 L
- Energy waste: individual power need doubled per patient
  - CO2 production
- Plastic waste

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).

kidney and dialysis

MDPI

Editorial

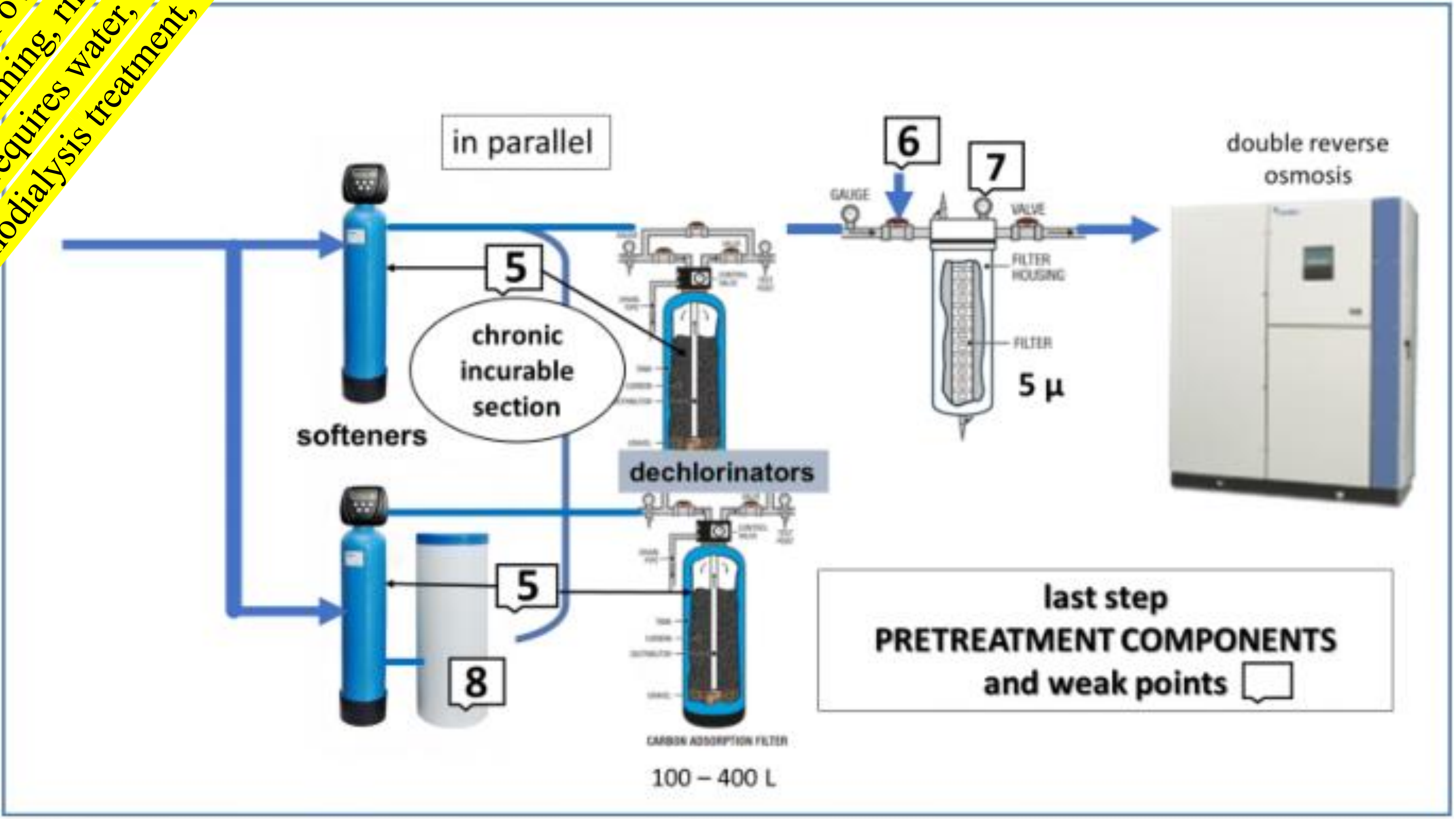
Green Nephrology

Raymond Vanholder [1,2]

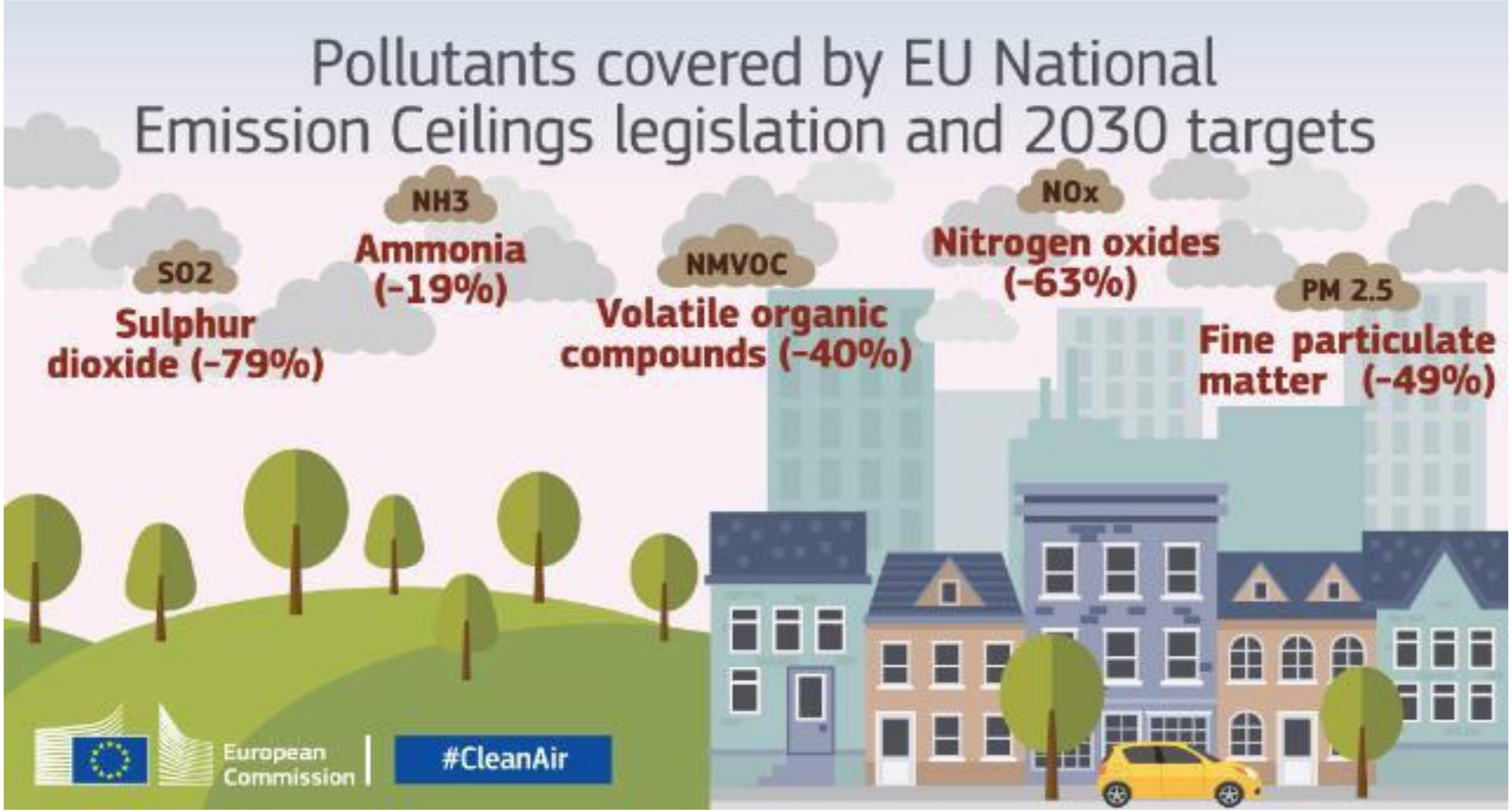
1 Nephrology Section, Department of Internal Medicine and Pediatrics, University Hospital, Corneel Heymanslaan 10, 9000 Ghent, Belgium; raymond.vanholder@ugent.be; Tel.: +32-4-75612751
2 European Kidney Health Alliance (EKHA), Luxemburgstraat 22, 1000 Brussels, Belgium

Many of the RO systems currently in use are inefficient, rejecting between half and two- thirds of the source water at the RO membrane

for a dialysate flow rate of 500 ml/min, 1 l or more of source water per minute is required to prepare the dialysate, or 240 l over a 4-h dialysis session. As pretreatment priming, rinsing and sterilization of the system also requires water, total water draw per patient, per haemodialysis treatment, can reach 500 l.



Weak points identifiable in the test with {n}


Pollutants covered by EU National
Emission Ceilings legislation and 2030 targets
SO2
Sulphur
dioxide (-79%)
NH3
Ammonia
(-19%)
NMVOC
Volatile organic
compounds (-40%)
NOx
Nitrogen oxides
(-63%)
PM 2.5
Fine particulate
matter (-49%)
European
Commission
#CleanAir

Haemodialysis systems are also very
power- hungry.

A study from Australia reported the average power draw of a Fresenius 4008B haemodialysis machine in combination with an individual Gambro WRO 10-1 RO unit to be 6.2 kWh per session.

Carbon Footprint:

In a study of thrice- weekly in- centre haemodialysis in the UK, emissions of 3.8 t CO_2-eq were reported per patient, per annum.

Opportunities for improvement

1-RO reject water recycling.

With recurrent savings of up to 4,492,000 l of water and £10,558 per year thereafter.

2-Reduced dialysate flow rates

Treatment with a Qd of 500 ml/min used 24 l more dialysate per 4-h session than treatment with a Qd of 400 ml/min, whereas further increasing Qd to 700 ml/min used an additional 48 l.

A randomized crossover study in patients with body weights <65 kg reported that reducing Qd from 500 ml/min to 400 ml/min had no impact on Kt/V, interdialytic weight gain, blood pressure or electrolytes, but did decrease per- treatment dialysate consumption from 120 l to 96 l.

3-Renewable power generation

18.6% of total dialysis emissions were attributable to electricity

4-Sorbent haemodialysis

5-Waste segregation, recycling and minimization

management of waste across dialysis facilities worldwide could save €3 billion (US$4 billion) annually.

Dialysis reuse   Echo-friendly dialysis disposables

6-Carbon accounting for pharmaceuticals and devices

7- TX

8- Green nephrology initiatives

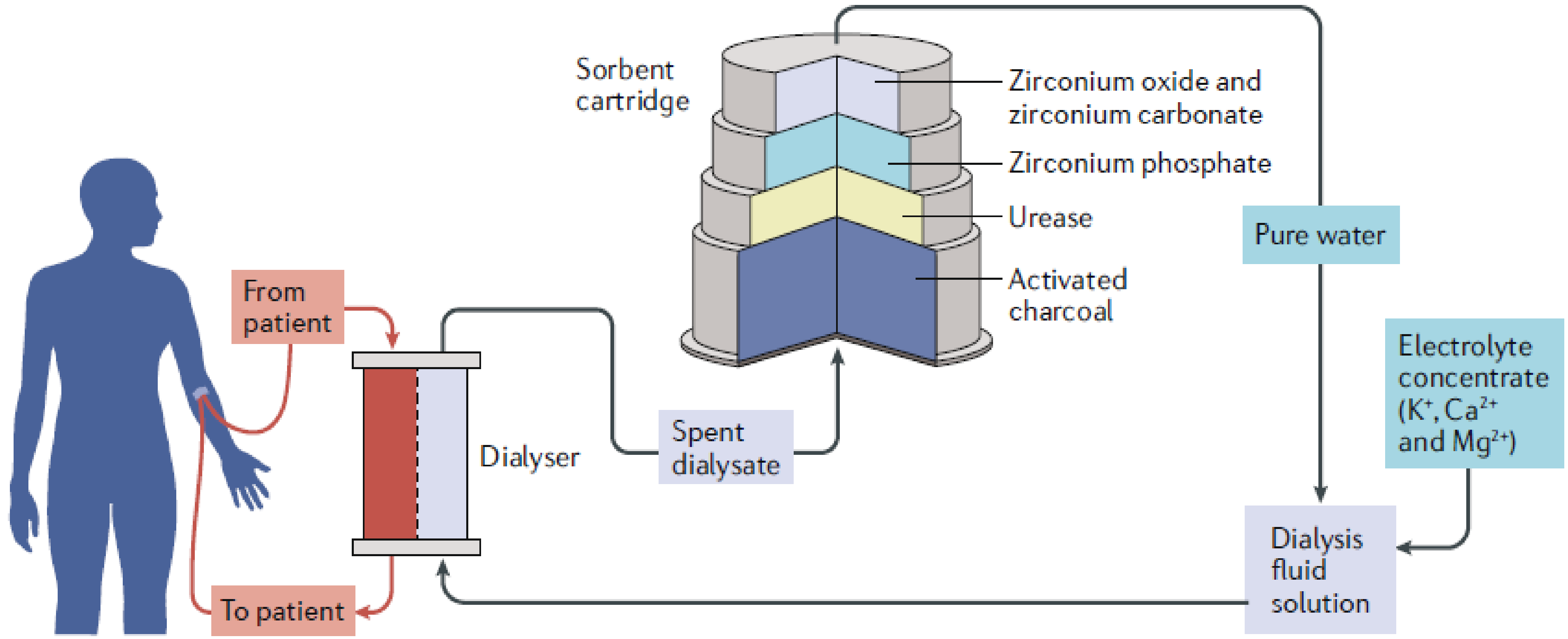


Fig. 4 | **Schematic of a sorbent dialysis system.** Sorbent dialysis systems recirculate and reconstitute spent (effluent) dialysate rather than sending it to the drain. The spent dialysate exits the dialyser then passes through a multilayered sorbent cartridge. The first layer contains activated charcoal, which adsorbs heavy metals, chloramines, creatinine, a range of middle-molecular-weight molecules and other organic matter. The second layer contains urease, which converts urea into carbon dioxide and ammonia. The third layer contains zirconium phosphate, which releases sodium and hydrogen while binding ammonium, calcium, magnesium, potassium, other cations and metals. The final layer contains zirconium oxide and zirconium carbonate, which release sodium, bicarbonate and acetate in exchange for phosphate, fluoride and metals. The pure water that emerges from the cartridge is mixed with an electrolyte concentrate before being returned to the dialyser.

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Box 1 | Green initiatives that can be undertaken in dialysis facilities

Low- or no-cost initiatives

- Identify ‘green champions’ or establish a ‘green team’ within the facility
- Include environmental sustainability as a standing agenda item for departmental meetings
- Incorporate ‘green’ education into departmental meetings
- Encourage staff to turn off lights when not in use
- Ensure that computers and photocopiers are auto-configured to enter hibernation, sleep or standby mode when not in use
- Encourage staff to log off and switch off computers when not in use
- Ensure that thermostats are set at appropriate temperatures
- Ensure that heating and cooling are turned off when the unit is not in use
- Ensure that general and hazardous waste and recycling bins are available and appropriately sited and signed
- Incorporate waste education in staff induction and ongoing education programmes
- Explore local recycling opportunities (for instance, polyvinyl chloride or single-use metal instruments recycling)
- Request that dialysis product suppliers retrieve pallets, cardboard boxes and other packaging on delivery
- Explore opportunities to introduce or raise the weighting of environmental criteria in procurement contracts
- Discourage, monitor and/or restrict printing and photocopying
- Set printers and photocopiers to double-sided printing
- Explore opportunities for electronic record keeping and communications
- Promote the health benefits of active transport to patients and staff
- Provide incentives to those engaging in active transport (e.g. ‘ride-to-work’ breakfasts)
- Investigate and encourage shared transport options
- Explore opportunities to expand the use of telehealth

Initiatives involving an initial capital outlay

- Explore opportunities for renewable energy generation
- Explore the feasibility of recovering and reusing reverse osmosis reject water
- Investigate the installation of water-saving taps and toilets
- Upgrade lighting to low-energy light bulbs
- Install motion sensors to control lighting in low-traffic areas

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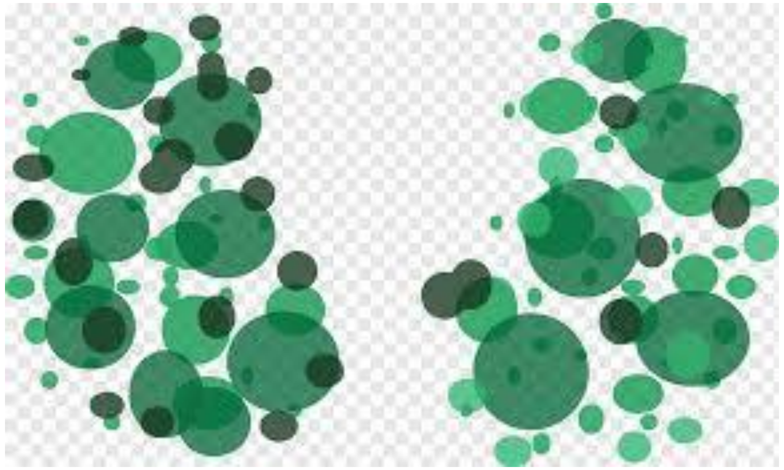
GNC

Green Nephrology Committee

Green Dialysis



Environmental pollution has a great impact on human health, ecosystems, and financial development.

*Waste management is also one of the main sources of the air pollutants.

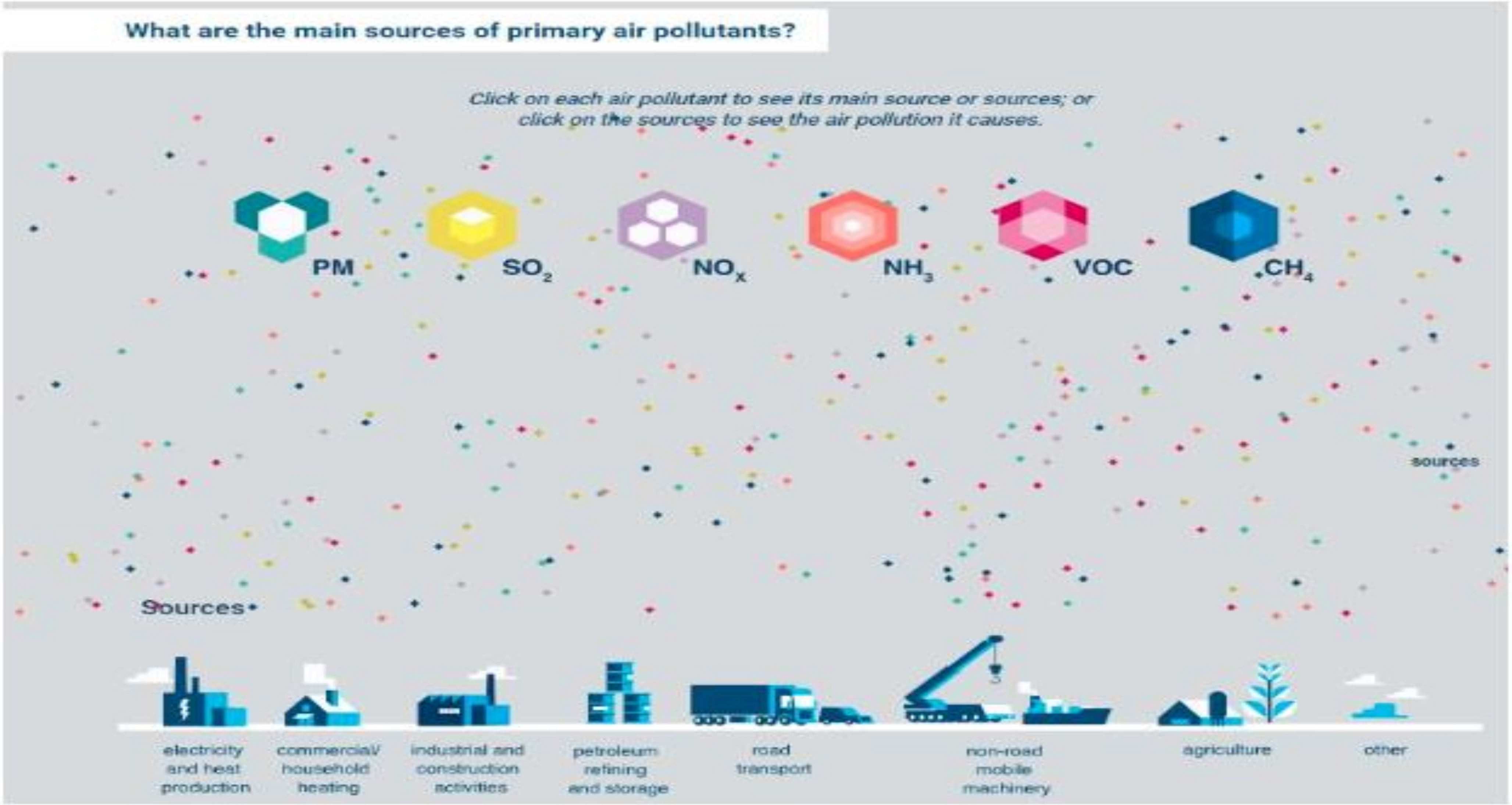
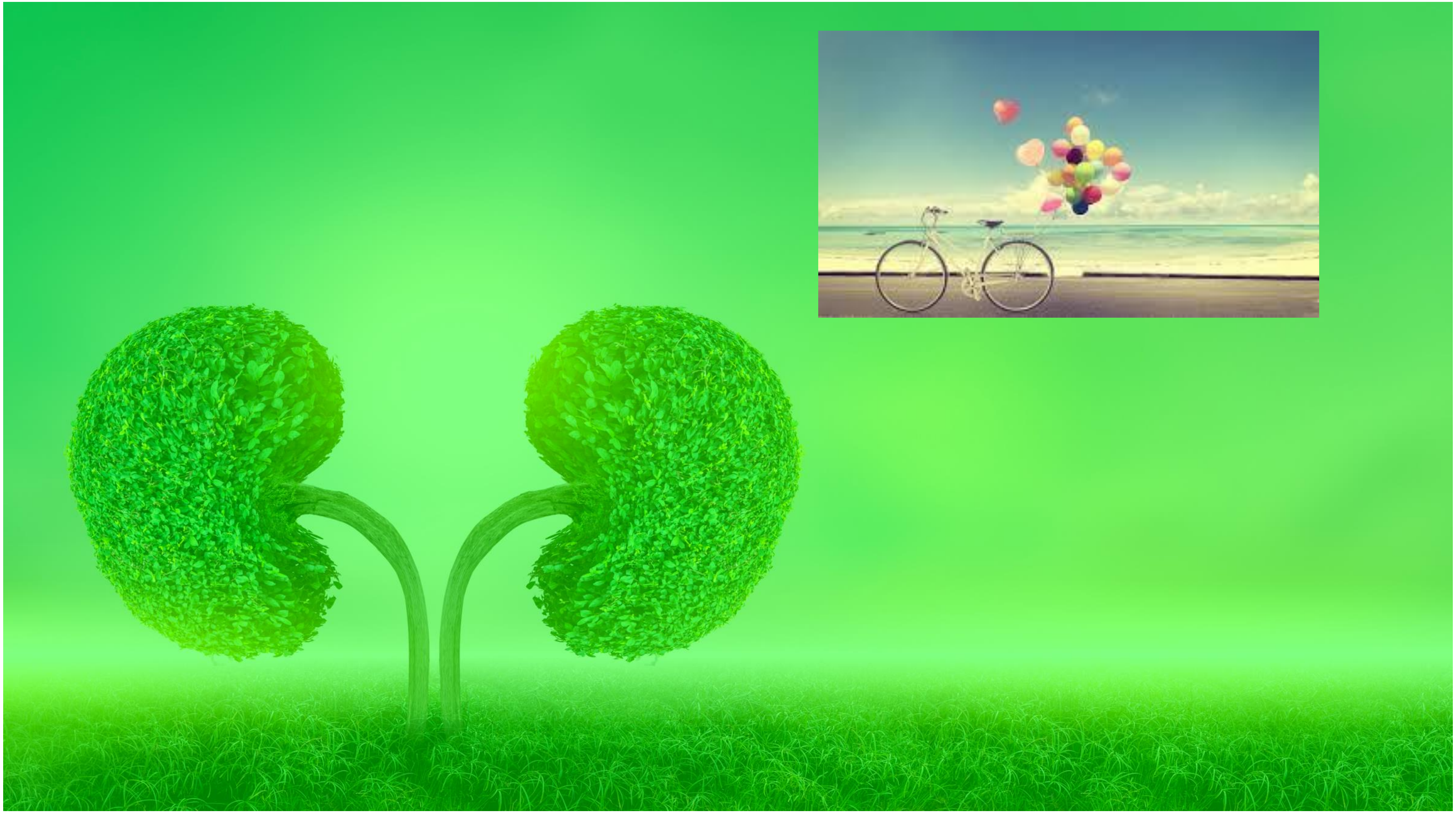


Photo: European Commission/Environment/Cleaner air for all

https://balkangreenenergynews.com/clean-air-for-all-what-are-the-main-sources-of-air-pollutants/




سپاس بسیار