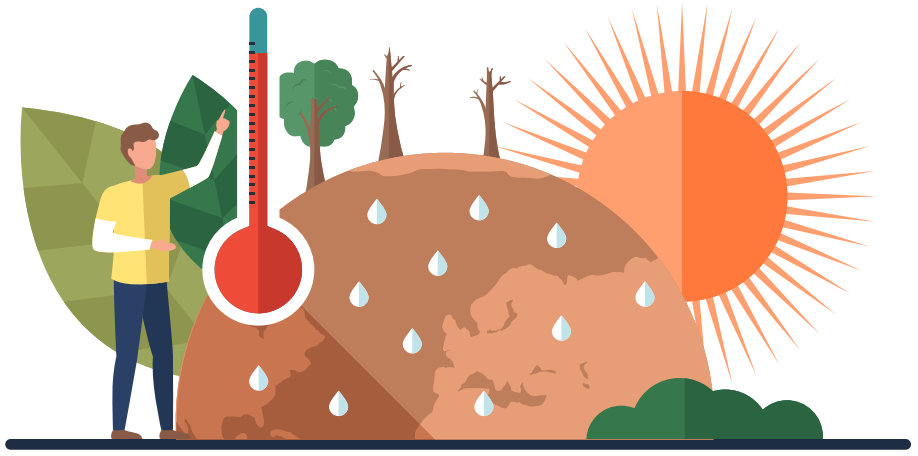
Achieving Kidney Health in a Warming World

By Zachary Kribs



In January 2019, Suraj Thapa Magar, a 28-year-old Nepalese migrant worker, collapsed on his Kuwait job site with what would later be diagnosed as kidney failure. Now waiting for a kidney transplant, Magar is among a growing number of young men with heat-related kidney failure, profiled in a January 2023 article in *The Washington Post*, titled "The world's torrid future is etched in the crippled kidneys of Nepali workers" (1).

Photojournalist Ed Kashi has also recently trained his lens on the impact of climate change on kidney health, including a joint *Time* magazine and Pulitzer Center series profiling the climate-related health conditions facing migrant workers in Qatar preparing for the 2022 World Cup (2).

"Both nephrolithiasis and acute kidney injury (AKI) are associated with higher ambient temperatures," wrote Australian kidney health researchers Matthew Borg and Peng Bi in a 2021 article published in *Nature Reviews Nephrology* (3). Borg and Bi described that "AKI can result not only as a consequence of hypovolemia but also as a consequence of extreme heat exposure through the induction of rhabdomyolysis and inflammation" and that "recurrent episodes of AKI can lead to chronic kidney disease (CKD) and eventual kidney failure, and patients with CKD are at increased risk of future episodes of AKI."

Thinking globally, acting locally

Although the consequences of climate change on kidney health are visible and critical issues to address in international contexts, particularly in developing countries facing extreme temperatures with limited infrastructure, it is vital for U.S. health professionals to recognize the domestic impact of climate change on kidney health and the importance of addressing climate change on a local level. According to a new report from the Intergovernmental Panel on Climate Change (IPCC) (4), a body of global experts assessing climate change-related science: "Human-caused climate change is already affecting many weather and climate extremes in every region across the globe. This has led to widespread adverse impacts and related losses and damages to nature and people."

The IPCC noted that these adverse impacts are most easily observed scientifically in the western areas of the United States, although southern and midwestern areas of the United States, where combined temperature and humidity pose a risk of human mortality, are already experiencing 10–50 days per year with levels of heat that risk human mortality. These figures are only expected to increase in geographic size and severity as global temperatures rise. Research conducted in Brazil suggests that for every 1-degree Celsius increase in daily mean temperature, the risk of hospitalization for kidney diseases increases by 0.9% at a national level (5). Furthermore, the IPCC wrote that "[t]here is a rapidly closing window of opportunity to secure a [livable] and sustainable future for all…. Every increment of global warming will intensify multiple and concurrent hazards." However, if within this decade, "[d]eep, rapid and sustained mitigation" efforts to reduce greenhouse gas emissions are implemented with accelerated "adaptation actions," together, they would "reduce projected losses and damages for humans and ecosystems…and deliver many co-benefits, especially for air quality and health."

ASN action

In April 2022, ASN's Statement on Climate Change (6) articulated that "climate health is kidney health" and called on kidney health professionals across the world to: "Support people with kidney diseases to survive climate change," "Diminish the contribution of kidney care to climate change," and "Advocate for public policy to address climate change as a contributor to kidney health." Since the publication of this statement, interest in climate change and kidney health has rapidly grown in the United States, yet more work is needed to sustain and increase climate health actions to meet the needs of people at risk for or living with kidney diseases in a changing climate.

Building toward climate resilience

As U.S.-based kidney health professionals grapple locally with the consequences of climate change, people living with and at risk for kidney diseases must be empowered with tools and skills that enable resilience and adaptability. "Moving forward, the kidney community must rapidly transform practices to build resilience to the effects of climate change on the care of people with kidney disease," reported Struthers et al. in a 2022 *JASN* perspective (7).

Although there is much work to be done to educate and empower people with kidney diseases to face the challenges of climate change, progress is steadily being made. In 2021, the Biden-Harris administration established the Office of Climate Change and Health Equity, focused on addressing the impact of climate change on health, particularly for communities and populations at risk for the most severe impacts of climate change. As part of its scope of work, the office publishes a Climate and Health Outlook, which includes a monthly forecast of climate risks across the United States (8). Such surveillance tools will become increasingly important for disaster preparation and disease mitigation: During 2017's Hurricane Maria, a majority of the 11,652 people receiving dialysis in Puerto Rico were evacuated from the island ahead of the storm. Because of emergency preparedness efforts by public officials, dialysis providers, and Puerto Rican citizens, there was not a noticeable increase in patient mortality (9). As severe weather incidents increase across the United States, more frequent disaster responses will be needed.

Addressing the impact of kidney care on climate health

Kidney health professionals must also be aware of their own impact on climate change and "urgently develop more climate-friendly methods of managing patients with kidney disease," reported Young and colleagues in a 2023 *CJASN* review (10). The authors noted that dialysis, while lifesaving, "can be associated with marked water usage (up to 600 L per dialysis session), energy usage (with one 4-hour session averaging as much as one fifth of the total energy consumed by a household per day), and large clinical wastes (with hemodialysis accounting for one third of total clinical medicine–associated waste)."

A 2022 study by Sehgal and colleagues (11) of greenhouse gas emissions in 15 dialysis facilities in Ohio found that "[a]nnual emissions per facility averaged 769,374 kg CO_2-eq (95% CI, 709,388 to 848,180 kg CO_2-eq)" with "patient and staff transportation (28.3%), electricity (27.4%), and natural gas (15.2%)" comprising the three largest contributors. This rate of emission per facility is equivalent to the "annual energy use of 93 homes, and emissions per treatment are equivalent to driving an average automobile for 238 km (149 miles)."

Perhaps the greatest opportunity to improve the environmental impact of existing therapies for people with kidney failure is to reduce the water usage in dialysis. Globally, dialysis requires enough medically pure water to fill Lake Tahoe annually. Young and colleagues (10) wrote that "[h]emodialysis is an extremely water-hungry treatment.... Reverse osmosis (RO) machines are at the center of water treatment procedures in hemodialysis units and are very inefficient, often rejecting >50% of the water. This water is never in contact with a patient and does not pose a risk, but it is nonetheless discarded down the sewer...most US citizens use about 310 L of water a day but a patient on dialysis requires one to two times this amount for a single treatment."

Methods to reduce water usage in dialysis are already being implemented internationally, particularly in Australia (12), and could be applied to a U.S. context. Additionally, great possibility exists for innovation in dialysis water-reduction technology to be developed through programs such as The Kidney Innovation Accelerator (KidneyX) (13), the public-private partnership between ASN and the U.S. Department of Health and Human Services to accelerate innovation in the prevention, diagnosis, and treatment of kidney diseases. Furthermore, reduced water usage in dialysis will be beneficial to areas in the United States facing droughts and restrictions on water use, freeing up supply of a scarce resource for other critical uses.

Increasing research and awareness

Finally, increased investment in awareness, research, and public policy to address the impact of climate change on kidney health is needed. Struthers and colleagues (7) wrote that "kidney health professionals must step into this advisory role and advocate for the development of greener kidney care."

Encouraging signs exist that U.S. kidney health professionals are doing just this. In 2023, ASN joined the Medical Society Consortium on Climate and Health (MSCCH) (14), a group of medical professional societies focused on raising awareness about the impact of climate change on health, hosted by the George Mason University Center for Climate Change Communication in collaboration with the Sean N. Parker Center at the Stanford School of Medicine. ASN's membership in MSCCH will allow ASN to raise the profile and scope of its advocacy on climate and kidney health.

Research on climate change and kidney health is also increasing and importantly, in the U.S. health system context. In 2022, the National Institutes of Health (NIH) launched the NIH Climate Change and Health Initiative (15), an "all hands on deck" collaborative effort among multiple NIH investigative centers "to advance the science of climate change and health." Through the initiative, the NIH now provides dedicated funding opportunities, educational programs, and scholarships to improve understanding about the connections between climate change and heath. More can be read on the initiative's website: https://www.nih.gov/climateandhealth.

Climate change is already impacting people in the United States and around the world. Overcoming the challenges posed by climate change, particularly in the context of kidney health, will require deep, rapid, and sustained action. U.S. kidney health professionals must join international colleagues in thinking globally, and simultaneously act locally to create a world without kidney diseases. ■

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Covered Stent Improves PTA Outcomes in Upper Extremity Fistulae

Placement of a covered stent provides better outcomes than percutaneous transluminal angioplasty (PTA) alone in hemodialysis patients with stenosis of upper extremity fistulae, concludes a randomized trial in *Kidney International*.

The multicenter Arteriovenous [AV] Stent Graft in the Treatment of Venous Outflow Stenosis in AV Fistula Access Circuits (AVeNEW) study enrolled 280 patients with stenosis of 50% or greater in an upper extremity AV fistula (AVF). Patients were randomly assigned to PTA alone or PTA followed by placement of the Covera self-expanding covered stent. A 6-month target lesion primary patency (TLPP) rate was compared between groups.

Thirty-day safety outcomes were "significantly non-inferior" between the two procedures. Patients receiving the covered stent had superior patency compared with PTA alone: 78.7% versus 55.8% at 6 months and 47.9% versus 21.2% at 12 months, respectively. Six-month access circuit primary patency was similar between groups.

On secondary outcome analysis at 2 years, TLPP was 40.0% in the covered-stent group versus 11.6% with PTA. Stent placement was associated with fewer target-lesion revascularizations (1.6 versus 2.8) and a longer interval between reinterventions (249.5 versus 217.6 days).

Stenoses of hemodialysis AVFs are commonly treated with PTA, but the restenosis rate is high. The AVeNEW study is the first large, randomized trial, to date, to compare the benefits of covered-stent placement with PTA alone.

The results show improvement in TLPP in the covered stent group at 6 and 12 months, with observational evidence of a continued patency advantage at 24 months. Safety outcomes are similar between groups. The researchers conclude, "Overall, the use of the Covera covered stent...provided a safe alternative to angioplasty with statistically superior TLPP results and modest clinical benefit for patients" [Dolmatch B, et al. Prospective, randomized, multicenter, clinical study comparing a self-expanding covered stent to percutaneous transluminal angioplasty for treatment of upper extremity hemodialysis arteriovenous fistula stenosis. *Kidney Int*, published online ahead of print March 27, 2023. doi: 10.1016/j.kint.2023.03.015; https://www.kidney-international.org/article/S0085-2538(23)00182-5/fulltext].