



## Chronic Kidney Disease, End-Stage Renal Disease, and Heat Providers

Individuals with chronic kidney disease (CKD) and end-stage renal disease (ESRD) may be among the most vulnerable people to heat exposure.<sup>1</sup> They are far more likely to visit emergency departments, need hospitalization, and die during heatwaves than healthy individuals.<sup>2</sup> When CKD patients progress to dialysis dependence, risks of harm increase further.<sup>3</sup>

### Heat Exposure Risks for People with CKD and ESRD

Several studies have identified that emergency department (ED) visits, hospitalizations, and deaths during heat waves often result from kidney diseases.<sup>4</sup> A meta-analysis of more than 24 studies found a temperature increase of 1°C (~0.6°F) increased risks of kidney failure by 1.1% (95% CI: 0.9-1.3) and mortality from kidney disease, including kidney failure, urolithiasis, acute kidney injury (AKI), and urinary tract infection, by 3.1% (95% CI: 0.5-5.8).<sup>5</sup>

#### Hydration Status

Dehydration has been associated with AKI and chronic declines in renal function.<sup>6</sup> Heat promotes dehydration which puts renal blood flow at risk. In individuals with CKD, over-hydration may also worsen outcomes.

#### Age

Renal function generally declines with age. About 45% of adults ≥70 years old have CKD, compared to only about 4% of adults between 20 and 39 years old,<sup>8</sup> and 30% of adults over 65 never recover from an AKI.<sup>9</sup> Older individuals may have less plasma volume,<sup>10</sup> decreased thirst,<sup>11</sup> and reduced urine concentrating ability,<sup>12</sup> among other physiological changes that promote dehydration and increase risk for AKI. Age-related declines in hormonal control of diuresis and blood pressure also play a role in renal injury.<sup>13,14</sup>

#### Comorbidities

CKD's most common comorbidities include cardiovascular disease, hypertension, and diabetes mellitus (both type 1 and 2) with as many as 3 in 10 Americans over 65 affected by one or more of these conditions.<sup>15</sup> These comorbidities increase morbidity and mortality from heat exposure in patients with CKD and especially those on dialysis with ESRD.<sup>3</sup> In a review of heat-related deaths in the United States between 2004-2018, nearly half were attributable to underlying cardiovascular disease.<sup>16</sup>

### Medication Considerations

Dehydration potentiates kidney injury from nephrotoxic medications, especially in patients with compromised renal function.

Medications to manage CKD comorbidities, including ACE inhibitors/ARBs and beta blockers, may substantially increase hospitalization during warmer months.<sup>17</sup> While more research is needed, several studies have found the following classes of medications to increase risk of hospitalization: ACEIs, ARBs, beta blockers, diuretics, antipsychotics, and SSRIs.<sup>17,21,22</sup> No trials have been conducted to guide clinical decision making considering these increased risks.

Limited research has found that statins may be protective against heat exposure.<sup>23</sup>

## Temperatures of Concern

The temperatures that increase risk of harm for patients with CKD and ESRD may be far lower than those considered dangerous to many people. For most cities in the United States, the minimum mortality temperature (the temperature above which mortality rates increase) is often just below the 80th percentile of the annual temperature range for American cities.<sup>18</sup>

Temperatures tend to peak in mid to late afternoon. The time of day with the highest temperatures for your location can be found at [weatherspark.com](http://weatherspark.com).<sup>19</sup>

The National Weather Service (NWS) issues heat advisories, excessive heat watches, and excessive heat warnings. To see if a heat alert has been issued for your location, check the weather app on your smart phone, or go to [weather.gov](http://weather.gov) and select your county or enter your zipcode. For more details on how to access NWS alerts for heat (and other weather extremes), as well as the differences between heat watches and warning, see the accompanying toolkit document titled “Accessing Weather Alerts”.

### Built Environment

The forecast temperature available to patients may not accurately represent the temperature they are exposed to in their home or community. The upper levels of multi-story buildings, especially those without air conditioning, may be much warmer than lower levels.

Urban heat islands can result in temperatures more than 4°F higher than reported due to factors such as fewer trees and parks, more asphalt and concrete, and more traffic. Black American, Hispanic, and lower-wealth communities often live in neighborhoods with greater heat island effects.<sup>20</sup> Homeless individuals are at particularly high risk of heat exposure.

## Heat Action Plans for Patients with CKD and ESRD

Appropriate guidance for people with CKD and ESRD should be based upon an assessment of the severity of their disease, comorbidities, occupation (especially if outdoors), access to air conditioning at home, and excess heat exposure from an urban heat island or the home environment.

Prior to a heat event, you can work with a patient’s primary nephrologist or care team to develop a plan. We recommend that you familiarize yourself with the “Heat Action Plan” provided in the toolkit and review it with any patient at risk from excessive heat exposure. The action plan can be provided during care visits with adolescents and adults and can be the basis for a discussion around safety planning and care management in the event of a heat event. Action plans should be completed in advance of heat season in your locale.

For additional guidance, see the accompanying toolkit document titled “Establishing a Heat Action Plan”.

## Anticipatory Guidance for Providers to Give Patients

Anticipatory guidance for hot days may contribute to improved health outcomes. The strategies and resources below may be helpful for you to provide to patients who are at risk from excessive heat and reflect the “Heat Tip Sheet – CKD, ESRD” available in the toolkit, which we encourage you to share with patients.

1. Before going outside, check the weather forecast on your phone, television, radio, or online (e.g., at [weather.gov](http://weather.gov) or [weather.com](http://weather.com)).

2. If a patient does not have a thermostat or thermometer that measures room temperature in their home, they can be bought for a few dollars at hardware stores or online. Consider having inexpensive thermometers available in your clinic to distribute.
  - a. Indoor temperatures in the patient’s home should ideally remain <80°F. If they cannot keep the temperature below 80°F, they should use a fan or consider moving to an air-conditioned space until the temperature cools.
3. When a heat advisory or heat alert has been announced by the NWS (see “Accessing Weather Alerts” for more information), advise patients to:
  - a. Follow their heat action plan (see “Establishing a Heat Action Plan” for guidance)
  - b. If a heat advisory is issued, patients with CKD/ESRD should preferably stay indoors in an air-conditioned space. If going outside is necessary, limit outdoor activities especially during the hottest part of the day (typically 11AM to 3 PM).
  - c. If an excessive heat warning is issued, patients with CKD and ESRD should remain in air-conditioned spaces until the warning expires.
4. For more tips on how patients with CKD/ESRD can stay safe in the heat, see “Heat Tip Sheet – CKD, ESRD”.

## References

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