

By Sylvia Wrobel

A nursing professor finds a solution to the sleep problems that plague up to 85% of dialysis patients

Turning Down the Heat for a Better Night's Sleep

As you drift into sleep, your body's core temperature begins dropping rapidly, while heat escapes through the skin surface and extremities. Toward morning, as the core temperature naturally rises, you begin to wake up.

These fluctuations are barely noticeable on a thermometer, a fraction of 1% on either side of the average body temperature of 98.6 F, but they can have a big impact. Anything that interferes with the body's ability to dissipate heat from the core to the surface interferes with the amount and quality of sleep. Icy feet, for example. Too many blankets on the bed. Or, as recently reported by nursing professor Kathy Parker, very slight differences in the temperature of the dialysis fluids used to filter the blood of patients whose own kidneys are no longer able to do the job.

Parker, the Edith F. Honeycutt Professor who also serves as co-director of the Emory Sleep Center, has been a pioneer in understanding the notoriously bad sleep problems experienced by dialysis patients. Starting in the 1970s, she saw these problems firsthand as a nurse practitioner in the dialysis and nephrology units at the

Atlanta Veterans Affairs Medical Center. Patients submitted without complaint to hours of being hooked to life-saving dialysis machines, but almost all complained about how poor sleep was affecting their quality of life and ability to function. No one understood why. In the mid-1980s, Parker decided to return to graduate school in nursing at Georgia State University to find out.

Her earliest studies confirmed that dialysis patients did indeed have cause to complain, that their sleep problems differed from those experienced by chronic kidney disease patients not on dialysis. Something about dialysis itself was causing disturbances in sleep.

Parker documented the excessive daytime sleepiness of patients, even on dialysis-free days. Before her work, published in the *American Journal of Kidney Disease*, patients' tendency to fall asleep during dialysis often had been attributed to simple boredom. Parker showed it also occurred the day after dialysis and that the amount of sleepiness depended on when dialysis took place. She and other scientists suggested ways that dialysis might adversely affect sleep, such as rapid changes in fluid/electrolytes and acid/base balance, cytokine production, or

treatment-induced changes in melatonin levels. A study in the *Journal of the American Medical Association* (co-authored with sleep center colleague Donald Bliwise and epidemiologist Nancy Kutner) reported that patients who received dialysis in the morning lived longer on average than those who were dialyzed in the afternoon; the research team suggested this too might have something to do with the quality of sleep, a factor known to be related to mortality. Perhaps people who got their dialysis over with early in the morning simply had better sleep?

As Parker (and indeed, the emerging field of sleep medicine) learned more and more about the mechanisms of sleep and waking, she began to wonder if dialysis might be causing sleep problems, at least in part, through its impact on body core temperature.

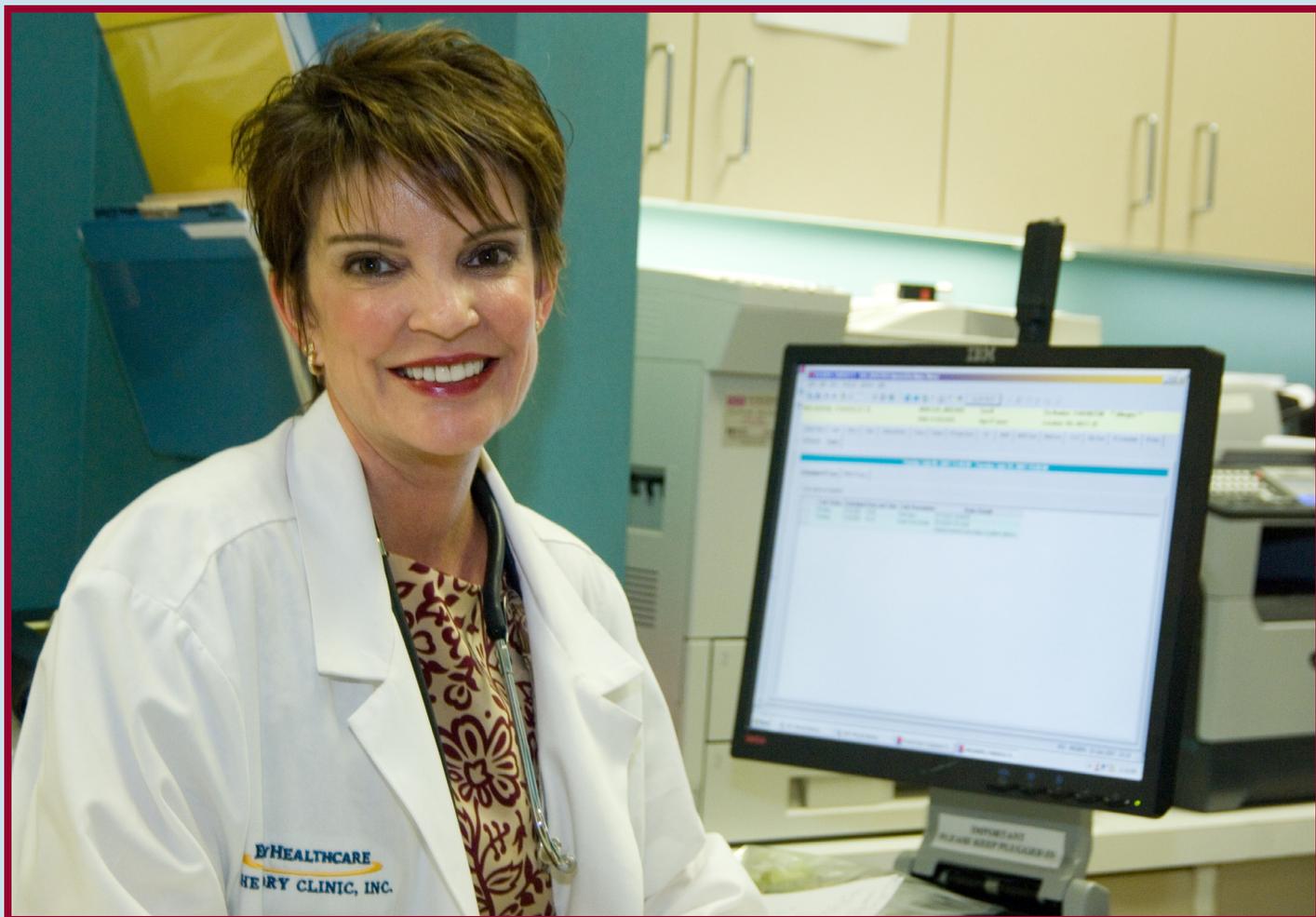
The study published this past March in the *Journal of Sleep Research* is the first to establish the dialysis core temperature sleep connection as

well as the first to suggest a simple solution: just lower the temperature of the dialysis bath flowing through the blood vessels from 37 C (98.6 F) to 35 C.

Parker coauthored the study with nephrologists James Bailey and Eus J. Van Someren, David Rye (director of the Emory Sleep Center), and neurology colleague Donald Bliwise.

The seven patients participating in the pilot study (four women, three men) were stable dialysis patients. They each initially spent one night in the sleep laboratory in the clinical research center at Emory University Hospital, giving them a chance to acclimate to the place. The next morning, these patients received their usual dialysis with dialysis fluid at the usual temperature and were then sent home.

The patients then returned to the sleep laboratory on two different occasions, a week apart, each time spending two nights. On day 1, the patient was admitted at 6 PM. The following



Kathy Parker has confirmed that dialysis causes sleep problems through its impact on body core temperature.



More than half a million people in the United States are undergoing dialysis. That figure is expected to increase substantially in the near future.

morning, day 2, he or she was given dialysis with fluid at either the standard 37 C temperature or the cooler 35 C temperature, in a sequence selected at random. (The exact degree of the cooler liquid was determined separately for each patient, adjusted to his or her individual average body temperature.) After dialysis, patients were allowed to walk around and have visitors but were not permitted to leave the sleep laboratory until noon on day 3. During these 42

hours, patients both asleep or awake, had their skin temperature measured and recorded minute by minute with a small sensor worn under the armpit. Both nights, patients went to bed at a set “lights-out” time, and standard measures of sleep—onset, stages, wakening—were collected every half hour until “lights-on.”

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When patients received dialysis with fluid at the usual temperature, they experienced a markedly greater drop of skin temperature the next morning than that seen in either the baseline (the morning after a night in the lab during which no dialysis had been given) or the morning after the day in which dialysis was given using the cooler fluid. On the morning after having received the cooler fluid in dialysis, patients sustained the normally elevated skin temperature until later in the morning hours.

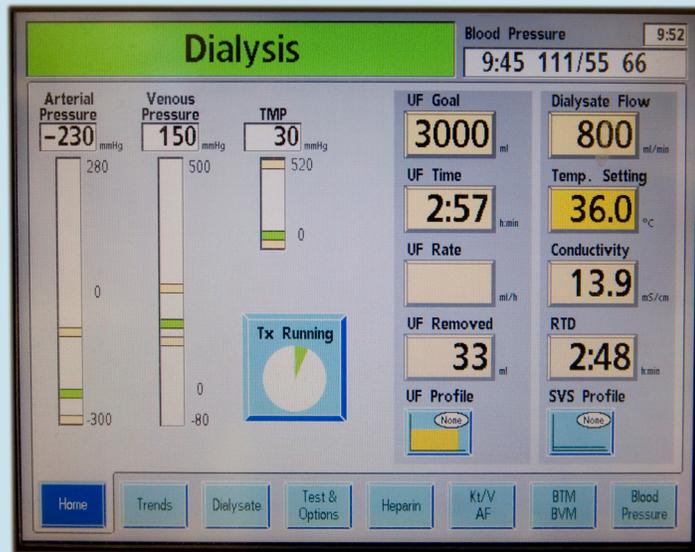
That appeared to make a significant difference in sleep. Patients who had received the cooler dialysis liquid fell asleep earlier, more quickly moved into deep sleep as measured by rapid-eye-movement, and tended to sleep longer.

It makes physiologic sense, explains Parker. During dialysis, significant quantities of blood are removed from the body to be cleaned. To maintain a constant blood pressure in the face of this change, the body compensates by constricting vessels in the skin and extremities, keeping blood closer to the center of the body and the major organs. This causes an increase in the core body temperature, but the vessels closer to the surface are so constricted that they are unable to dissipate the heat. It requires several hours for the body to return to equilibration.

“We actually already knew that lowering the temperature of the dialysis fluid could help keep blood circulating to the skin surface,” says Parker. The technique has been used for years, without negative side effects, in people who experience dangerously low hypotension during dialysis. But nobody, before Parker, thought to look at it in terms of the sleep problems dialysis patients report.

Parker and colleagues are now conducting a clinical trial involving 60 dialysis patients, men and women, 30 to 70 years old. During the nine-month study, slated to conclude this fall, patients are undergoing three months of dialysis using either the warmer or cooler dialysis fluid, with half of them then changing to the other temperature for three months. During the final three months, all patients receive warm fluid. In addition to measuring skin temperature and sleep, the researchers also are measuring daytime sleepiness (nap studies) and performance (response time to digital signals).

If the results turn out as Parker expects, nephrologists will have access to a new intervention. Nothing could be simpler. Already tested



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Lowering dialysis fluid temperature would be inadvisable for patients with peripheral vessel disease, says Parker, but for the great majority of patients undergoing dialysis—700,000 in the United States alone, a figure expected to grow substantially in coming years—this innovation may be one way to decrease sleep problems and increase quality of life.

“Emory is all about changing how medical care is practiced and delivered to optimize outcomes for our patients,” Rye says. “This clinical translation of basic science concepts is a huge step forward, a keystone for the development of new procedures.” ^{EN}

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