Rescuing survivors buried by Wednesday’s earthquake in central Italy will require more than shovels, backhoes, and sweat: First responders will also rely on a complex bit of chemistry involving baking soda and salt water. That’s because this kind of tragedy creates a cascade of medical issues well beyond broken bones and internal bleeding. One of the most dangerous is kidney failure..

“This is a major, major complication,” said Dr. Dan Hanfling, a contributing scholar at the UPMC Center for Health Security in Baltimore, who has helped manage response teams after earthquakes in Turkey, Haiti, and Nepal. “That’s why many of these patients in events like in Italy … end up requiring dial

Crush syndrome, as disaster relief experts call the set of complications suffered by buried survivors, can affect close to 15 percent of hospitalized earthquake victims. “This is one of the most important causes of death for those who survive the earthquake,” said Dr. Yitshak Kreiss, director general of the Sheba Medical Center in Tel Aviv, who helped run a field hospital after the disastrous 2010 quake in Haiti.

The problem is worrisome enough that in some cases rescuers start trying to prevent kidney failure even before they have fully extricated a survivor from the rubble. They use a fluid containing sodium bicarbonate — a.k.a. baking soda — as one of their primary tools. “People who are now on the scene can start treating patients while they are still trapped,” said Dr. Mark Pearlmutter, chair of emergency medicine for Steward Health Care Network in the Boston area, and another veteran of the Haiti quake. “They may have an arm that they have access to, and can start giving the patient fluid, and they can proactively give bicarbonate.”

An arm or a leg crushed by a collapsed building may seem unrelated to anything that would require dialysis. But during the London Blitz in World War II, a doctor found that four patients who had been trapped by falling debris had urine floating with mysterious dark brown bits. Some of the molecules contained within our muscles, it turns out, can prevent the kidneys from doing their job of filtering toxins from the blood.

Myoglobin is one of them. Normally, this protein is essential for transporting oxygen in the muscles. Small quantities of it end up in the bloodstream, but other proteins stick onto it, making it too big to fit into the tiny tubes that form the kidney’s filtration system. When a muscle gets crushed, though, its cells explode, releasing a flood of myoglobin into the blood. Without enough proteins to glom onto all these bits of myoglobin, a lot of it ends up accumulating in the kidney’s tubules and blocking them. For trapped earthquake survivors, that blockage is made worse by the fact that the person can’t get any water, which would help dilute the buildup in the kidneys. “It’s really a double whammy,” said Hanfling.Top of Form

Bottom of Form

And that one-two punch on the kidneys throws the body’s chemistry completely out of whack. The kidneys can no longer filter out acid, and so the blood becomes highly acidic and potassium pours out of cells into the veins. The kidneys can’t filter that out either, and too much potassium throws off the electrical currents that keep the heart beating regularly.

That’s why an emergency responder might squeeze the contents of an IV bag into an exposed limb before going at the fallen cinderblock with picks, shovels, or diamond-tip concrete saws. They want to make sure the patient’s heart and kidneys don’t give out while the rescue is taking place.

Sodium bicarbonate is an important part of the cocktail that can help re-establish order inside the body: It reduces the acidity in the blood and helps to dissolve the myoglobin that’s built up in the kidneys. A flood of intravenous saline solution also dilutes the buildup while combatting dehydration.

Along with these, the medical team will give the patient insulin and glucose, which together drag potassium back into cells so that it stops wreaking havoc on the heart. The patient may still need dialysis, but in the interim won’t be poisoned by his or her inner chemistry.

“These patients are highly medically complicated,” said Dr. Michael VanRooyen, the chairman of emergency medicine at Brigham and Women’s Hospital in Boston, who oversaw a 400-bed field hospital after the Haitian quake. “They involve checking electrolyte levels and potassium levels, and administering bicarbonate and maybe dialysis.”

The Italian earthquake was not as deadly as the one in Haiti six years ago. And Italy has solid medical infrastructure to treat those chemical complications — and deliver the countless surgical, orthopedic, and antibacterial procedures that are needed — long before towns such as Amatrice and Accumoli can start to rebuild.

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