LifeFlow®

An Evidence-Based Approach Improves Prehospital Care for Sepsis Patients

A Virginia fire department takes an innovative approach to sepsis care and rapid fluid administration.

About Alexandria Fire Department

Population Served: 159,428

About 13,000 patient contacts per year and 9,800 transports

Ambulances: 6 24-hour ALS units

THE PROBLEM

- Alexandria Fire Department paramedics and EMTs receive calls for many sepsis patients—the agency estimates five or more each week.

THE SOLUTION

- In 2019, Alexandria's team decided to try a new approach. They began using LifeFlow, a novel hand-held rapid infuser, instead of pressure bags, for fluid resuscitation.
- LifeFlow allowed the paramedics to administer a bolus of fluid more quickly, even through a peripheral IV line, and it also gave them more control.

THE RESULTS

- With LifeFlow, the Alexandria paramedics administered an average of a little more than 1,000 mLs of normal saline to each patient, with 21 of the patients receiving a full two liters.
- In the first 117 AFD LifeFlow sepsis patients, they saw average increases of nearly 10 mmHg in their systolic blood pressures and 5 mmHg in their diastolic pressures, which signal an improvement in perfusion that may give patients the extra time they need until the hospital can provide more definitive treatment. [1]

Although the Alexandria Fire Department might be one of the oldest emergency responder organizations in the nation—it claims George Washington as one of its early members—it also considers itself one of the most-forward-thinking. The northern Virginia city's EMS clinicians and leaders have long pushed the agency to adopt innovations that improve care, from evidence-based protocols to advanced technologies. The agency is also heavily data-driven, which is one of the reasons its medical providers recognized sepsis as a critical area of focus to provide the best possible care to the Washington, DC, suburb's 159,000-plus residents and hundreds of thousands of annual visitors.

The Problem

Like clinicians in most urban EMS systems, Alexandria Fire Department paramedics and EMTs receive calls for many sepsis patients—the agency estimates five or more each week, which is a significant percentage of the patients transported by their six ambulances. For many years, it was assumed little could be done for these patients in the prehospital setting. But over the past decade or two, prehospital sepsis research has shown that early recognition and treatment can have a positive impact on patient outcomes. Specifically, several studies have found a correlation between prehospital administration of intravenous fluids and reduced mortality in patients with severe sepsis and hypotension.[2,3,4]

Recognizing the potential to make a positive difference for so many people, several years ago Alexandria implemented a new sepsis protocol. It codified what they'd already been practicing, an emphasis on early sepsis recognition, notification of the hospital team, and aggressive, controlled fluid resuscitation. They took a systems approach, looking for ways to improve training, equipment, communication and other factors that could lead to better outcomes for these critically ill but treatable patients.

The Solution

Alexandria's sepsis protocol reinforces the importance of a thorough assessment, early detection of sepsis and rapid alerting of the hospital to a "Code Sepsis." They are treating sepsis as a time-sensitive emergency similar to ST-elevation myocardial infarctions, acute strokes and multi-system traumas. The protocol also emphasizes the critical areas Alexandria paramedics can address, such as avoiding hypothermia and rapidly restoring perfusion by administering normal saline.

It's that last piece that was often a challenge, and something many members of the department felt wasn't even possible given the typically short transport times in the 15-square-mile city. Initially, medics would use a pressure bag, hoping to squeeze in a few hundred milliliters on the way to the hospital. (One study of a large EMS system found that the median amount of fluid given to septic patients was only 400 mL.[2])

In 2019, Alexandria's team decided to try a new approach. They began using LifeFlow, a novel hand-held rapid infuser, instead of pressure bags, for fluid resuscitation. LifeFlow allowed the paramedics to administer a bolus of fluid more quickly, even through a peripheral IV line, and it also gave them more control.

"With pressure bags you are just checking for the green and red indicators periodically," explained Barbara Tharpe, NRP, who oversees EMS supplies for Alexandria.

> "With LifeFlow you stay on top of it and are more aware of the patient's status, you aren't as distracted by other things."
> **- Barbara Tharpe, NRP**

Instead of just "leaving the bag open" and calculating how much they had given when they transferred care, the LifeFlow allows them to more deliberately administer a specified amount of fluid on the scene and during transport to the hospital.

"You can get so much more volume in during a short period of time," said Joseph Marfori, MD, FACEP, FAEMS, the department's medical director and an emergency physician at Inova Alexandria Hospital, where the vast majority of the department's sepsis patients are transported. "With LifeFlow, you actually know, every time, how much you're giving—and how quickly."

The Results

Since they started carrying LifeFlow, Alexandria's medics have used it to treat more than 300 patients, including many with suspected sepsis. Even with short

run times - the mean total time from scene arrival to hospital arrival was only 30.6 minutes - with LifeFlow, the Alexandria paramedics administered an average of a little more than 1,000 mLs of normal saline to each patient, with twenty-one of the patients receiving a full two liters. And because a 500mL bolus can be completed in as few as 4 minutes with LifeFlow, the medics have plenty of time to reassess the patient and perform other vital tasks. Although the department has not analyzed data from before implementing the new sepsis protocol, anecdotally they often struggled to administer more than a few hundred milliliters of fluid using a pressure bag—and often didn't know how much they had given until they arrived at the hospital and checked the bag. It was a much more passive process than it is now.

Most important, they were able to volume resuscitate safely. Alexandria's medical director explained that the hospital emergency department staff's initial concerns—that the aggressive prehospital treatment would cause fluid overload or worsen heart failure—disappeared after seeing the results. Alexandria hasn't seen a single case where a patient's conditions appeared to be worsened after using LifeFlow. Instead, now that they're able to resolve hypotension more quickly, they're seeing patients who were initially unresponsive and decompensating, recovering to such an extent that upon arrival at the hospital the emergency department clinicians barely believed the patients had ever been in extremis.

In the first 117 AFD LifeFlow sepsis patients (documented suspected sepsis or infection), they saw average increases of nearly 10 mmHg in their systolic blood pressures and 5 mmHg in their diastolic pressures.[1] Those numbers might not seem like a lot, but they can signal an improvement in perfusion that may just give that patient the extra time until the hospital can provide more definitive treatments. And in many cases, the change in vitals was much more significant.

> "It got our paramedics psyched up, knowing they could make even more of a difference for our patients."
>
> **- Dr. Joseph Marfori**
> **Medical Director, Alexandria FD**

The Future

Alexandria Fire Department's EMS clinicians' drive to improve outcomes in patients with shock and hypotension doesn't end with sepsis. They also see the potential that rapid infusion could have for other patients, including victims of cardiac arrest and trauma. Of course, while some trauma patients may be aided by a bolus of normal saline, blood would be preferred. Alexandria is looking at establishing a prehospital blood program, and their Northern Virginia neighbors in Loudoun County have already seen success using LifeFlow to administer blood to trauma patients. The team in Alexandria, like many EMS systems around the country, know that with the right evidence, resources and tools, prehospital clinicians can make even more of a difference in the lives of their patients.

Alexandria's Experience with LifeFlow

From February 2019 through February 2022, AFD used LifeFlow to administer fluid to 117 potential sepsis patients.[1]

- Mean age = 69.4 years
- Mean Fluid Volume Administered = 1178 mL
- Mean Increase in Systolic BP = 9.5 mmHg
- Mean Increase in Diastolic BP = 5.0 mmHg
- Mean Transport Time = 8.2 minutes
- Mean Total Time with Patient = 30.6 minutes

Two Liters in Two Miles

Alexandria paramedics responded to a call for a man in his 60s at a local skilled nursing facility. When they arrived, it seemed pretty clear that sepsis was likely: the man was slightly hypotensive, his heart rate crept toward 150 beats per minute, his temperature was elevated and his mental status was altered.

While the department's sepsis protocol indicated a 30 mL/kg bolus of normal saline, in the past Alexandria's medics rarely got more than a few hundred milliliters in before arriving at the hospital. But this time was different. Using LifeFlow, the crew administered nearly two full liters during the two-mile transport to the emergency department.

"His pulse went down to the 90s and his blood pressure came up into the 130s," said Lt. Tim Jaffry, one of the paramedics who treated the patient. "He was no longer diaphoretic. His improvement was significant, and the ED doctor was amazed. That is when I was convinced about LifeFlow. I was hooked."

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1. *Results may not apply to all users. Outcomes are not a result of a well-controlled clinical study, do not purport statistical power, and are presented as AFD customer experience only.*
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