

In this feature, Neonatal Intensive Care interviews clinicians and healthcare providers about the actual application of specific products and therapies. This interview is with Bert Bunnell, ScD, of Bunnell Incorporated.

Neonatal Intensive Care: After a lifetime dedicated to helping premature babies, what defines your success?

Bert Bunnell: I am most pleased that we have helped save about 150,000 infants with HFJV over the past 30 years. Our Jet is now being used to treat around 10,000 babies a year, which means that some baby somewhere is being connected to one of our ventilators every 53 minutes.

NIC: What is HFJV and after more than 30 years of clinical application, why hasn't it been universally accepted?

BB: HFJV (high-frequency jet ventilation) is a gentle and efficient way to facilitate gas exchange in the lungs. It works by squirting tiny spurts of air and oxygen into the patient's endotracheal tube (ETT) through a little jet nozzle built into the ETT adapter at rates up to 11 "breaths" per second. The closest thing to HFJV in the natural world is panting.

HFJV is a "disruptive technology;" it changes the way people ventilate patients. Other examples of disruptive technologies are personal computers, cell phones, the internet, etc. People resist change, so disruptive technologies are typically slow to be adopted, have limited appeal, and take time to demonstrate practical applications. Such is the case with HFJV. However, I am heartened to know that HFJV use has been slowly and steadily rising while overall use of mechanical ventilation has been going down every year for the past several years.

Until HFV came along, every ventilator tried to mimic normal breathing for patients that were anything but normal. While that approach works a great deal better than nothing, it certainly has its drawbacks, which are exemplified by bronchopulmonary dysplasia (BPD) in the case of surviving preterm infants. Despite better prenatal care, surfactant administration, and better understanding of the hazards of mechanical ventilation and excess oxygen, BPD remains the most common severe complication of preterm birth.

NIC: Describe the history of HFJV and how you developed the technology.

Bert Bunnell, ScD, began searching for a better way of breathing for premature babies in 1972. His hard work and dedication led to the development of the Life Pulse® High Frequency Ventilator and Bunnell Incorporated. Input on questions was provided by Neonatal Intensive Care. If you would like to participate in this feature, as a company or healthcare provider, please contact Steve Goldstein at s.gold4@verizon.net.

BB: My personal history of HFJV is illustrative of how sometimes the worst things that happen to you become the best things that happen to you. At age 21 and a senior in engineering school in 1968, I was diagnosed with malignant melanoma, which prompted immediate surgery but also exempted me from military service during the Viet Nam war, and enabled me to attend graduate school.

Accepted by MIT's Department of Chemical Engineering, I moved to Boston where my melanoma metastasized, requiring another radical surgery just before school started. At that point, it was obvious that my cancer was tracking the lymph system from my neck toward my lungs, which heightened my interest in medicine in general and lungs in particular.

As luck would have it, once I qualified for the doctoral program a thesis topic related to aerosolizing artificial surfactant for premature infants became available. It immediately caught my interest, because it had something to do with lungs.

I received my doctorate of science degree in 1972 after demonstrating that I could deposit artificial surfactant in newborn lamb alveoli. I then pursued a fellowship in pediatric pulmonology at the Massachusetts General Hospital (MGH) to determine if this therapy would work in human infants.

This aerosol therapy ultimately failed due to the inadequate surfactant then available, but its pursuit, my engineering background, and wonderful mentorship from Dr. Dan Shannon at MGH led us to high-frequency ventilation in 1974.

NIC: What happened with your melanoma?

BB: All I had were the two radical surgeries — no chemo, no radiation. I never even met an oncologist until 1975 when I decided to pursue commercial development of HFJV by taking a job in industry.

One year earlier, five years after my last surgery, I discovered this statistic in Chest: only 10% of patients were alive one year after diagnosis of metastatic malignant melanoma. When the oncologist examined me in 1975, he wanted to start me on chemotherapy immediately. I declined, stating the obvious: I had no signs of cancer at that point.

The doctor said: "But, you should be dead!" I said: "But, I'm not." So, he made me promise to see him every 3 months after that as a condition for him to give me a clean bill of health for my new

job. I had no problem making that pledge, and the melanoma never reappeared.

NIC: So, you went to work for a company?

BB: I pursued commercial development of HFV with two major corporations for five years. The time frame for my project was far longer than their attention spans, so I founded Bunnell Inc. out of desperation in 1980.

NIC: Why would a baby need HFJV?

BB: Two reasons: rescue when babies are dying of complications that conventional therapies can't handle, and prevention of those complications after premature birth.

NIC: Which patient had the biggest impact on your life and why?

BB: Three patients immediately come to mind. The first patient was an infant I unexpectedly resuscitated while left in a room alone with a baby at MGH when I was a graduate student. I just did what I had learned to do with rabbits in cardiac arrest during my early experiments with HFJV, and it worked. The baby survived, it was no big deal, and it gave me confidence that I could save babies.

The second patient was an adult. In 2000, I was recruited to use our prototype Jet for larger patients in extremis to rescue the former dean of nursing at Baylor University in Dallas when her trachea fell apart during the late phase of ALS (amyotrophic lateral sclerosis). She was the only patient I ever treated who told me how it felt to be on HFJV. She said it felt "funny."

After so many people had expressed their concerns that HFJV would somehow hurt the babies we were treating in the early days of its application, I welcomed the feedback that it just felt funny.

The third patient was a heart breaker — a baby girl born full-term, Apgars of 9 and 9, who then turned purple. Kelli had a rare defective surfactant syndrome, which up to then, was always fatal. As was typical in the Phoenix hospital where she was transferred, she was rescued by HFJV. But even though she was fine on the Jet, there was no possibility of weaning. After several weeks, it became apparent that her only chance of survival was to procure a new set of lungs. Thus, the hospital requested our help in transporting this baby on a Jet via jet to St. Louis where she might be able to get a double lung transplant.

The transport went well, and we taught the hospital in St. Louis how to keep her alive on HFJV while the family waited for a donor. It took over three months before another family's disaster became the Arizona family's salvation, and Kelli received a working set of lungs.

Kelli led a short (11 years) but spectacular life that left everyone who met her in awe. She and her family became avid organ donor advocates. She was active in sports, Girl Scouts, and played the piano. She had her own website (www.kelligar.com) that she would eagerly show people as she got old enough to coach them on how to find it on their cell phones. She brought joy to everyone she met.

Kelli's life continues to inspire me to this day, as it demonstrated that we can do more than we know we can do, and that we must constantly push the limits of what we know now to even approach the potential of everything we can do.

NIC: What is the role of small companies in health care, how do they survive, and why is it important that they do?

BB: Most innovation comes from small companies. They take risks, because compared to large companies, they have little to lose and a lot to gain — not just monetary gains, but true advancements in medicine. When an innovation pans out, small companies are typically acquired by big companies who can market new products quickly and effectively. However, it doesn't always work out that way, especially with products that serve small markets like neonatal medical devices.

There are easily 10 times as many adult patients as newborns, and the ratio of adult patients to children age 1-17 is probably 5 times greater than that, because, fortunately, most children are healthy. It takes just as much money to market a product for babies as it does one for adults, so why not go for the product with the biggest financial upside?

Some big companies try to cover the markets for smaller people by designing "cradle to grave" products. After all, aren't babies just like adults, only smaller? Some big companies acquire small companies only to discover that their products aren't so easy to sell or don't produce the return on investment that they hoped for, so they just shut them down. (Remember Infrasonics?)

So, small companies matter, and one way to keep them prosperous is to make them employee-owned.

NIC: How does employee ownership improve small company prosperity?

BB: Besides the obvious incentive that employee ownership provides every worker (a stake in the company), employee ownership perpetuates jobs. No large company can acquire an employee-owned corporation without approval of its employees, and most employees want to maintain their jobs until they decide to retire, when their companies have an obligation to buy out their shares of ownership. We converted Bunnell Inc. to an employee-owned company in 2008 after spending the previous five years buying back all outstanding shares from our investors. Since then, we've had several employees retire, everyone still with us is working hard, and it's working great for all.

NIC: So, what does the future hold for Bert Bunnell and Bunnell Inc.?

BB: I'm mostly retired now and living the dream, as the saying goes. Over the past 10 years we've added a collection of bright young people to our 40+ employee firm, and the Company just got FDA approval for a new model of our Jet. So, its future is bright.

I enjoy teaching, so I volunteer my time as an adjunct associate professor of bioengineering at the University of Utah, and I stay involved with Bunnell Inc. as Chairman Emeritus. I'm writing up the 37-year history of the Company, and I still accept speaking engagements at hospitals and medical conferences whenever those opportunities arise.

I also love rock climbing and skiing, so it will be interesting to see which goes first, the body or the mind. If it's the body, I'll have to do more reading and writing. If it's the mind, it will make my climbing and skiing even more exciting!