THE gum trees were blooming when Natalie Beohm fell ill, their flowers creamy and feather-like in the breeze that whispered off Queensland’s Moreton Bay.

It was July 2008 and the young woman had the job she had always wanted at the Redlands Veterinary Clinic, looking after horses and working with people who were more like family than colleagues. Looking back, it seems like another life. Her life before Hendra virus.

"I'm still tired all the time," Beohm is saying, nearly five long years later. She has ventured to Melbourne to find herself, such as she can, after contracting a disease that has baffled and horrified scientists and doctors in equal measure. "I still get pain all down my right side. I get night tremors. I can't hear out of my right ear," she explains, the weariness heavy in her voice. "I could keep going on about what this thing has done to me, but what's the point? I just have to live with it."

Beohm, 25, is one of only three known survivors of Hendra virus. Her friend and mentor, Ben Cunneen, a 33-year-old equine vet who was also struck down, died the day after she was released from hospital. Five horses were killed in that outbreak at a time when the disease, which can skip from animals to people, could not be treated. Cunneen was the third of Hendra's four known human victims since the virus was identified 19 years ago.

As she lay in intensive care, her doctors wondering what to do next, Beohm felt lost and helpless. The virus had invaded her brain, making her as sick as a person could be. She would say goodnight to her parents fearing that it was actually goodbye. Yet Beohm was doing more to unlock the secrets of Hendra than she could know.

The blood samples and swabs that were taken from her twice a day would help researchers to explain how the disease was spread by flying foxes to horses and then to people. The Redlands eruption in outer Brisbane proved to be the turning point. It spurred development of a world-first vaccine for horses and a prototype treatment for people. American military scientists working in the shadow of the 9/11 attacks on the US joined the effort,
fearing the virus would be seized upon by terrorists and used as a biological weapon. Millions of dollars were spent on a program that has been hailed as "one of the best success stories" of biodefence-related research in the world.

Only now can the full story be told, as the horse vaccine faces its first test with the onset of Hendra season and a perverse reluctance by some horse owners to use the drug. It is an epic tale of luck, loss and dogged perseverance. Australia gave rise to Hendra virus and, as we will see, only Australians could have confronted the 41 outbreaks to date in Queensland and northern NSW. Like Beohm's recovery, progress has come at a heavy cost. "If I had to go through it again, I couldn't," she says quietly. "I would just roll over and die."

To understand what she went through you need to know not only what the virus is and what it does, but where it came from. So rewind, back to when Beohm was a little girl who lived to ride horses, to the stables of an irascible trainer named Vic Rail, sandwiched between the racecourses of Doomben and Eagle Farm in Brisbane. The suburban streets echo to the clip-clop of horses being walked to track work at dawn. Overhead, the last flying foxes flap to their nesting spots, inky specks against a glimmering sky. The year is 1994; the place is called Hendra.

Not everyone gets to be Bart Cummings in the horseracing game. And while he'd had a measure of success, Rail was one of those battlers the punters love: a knockabout ex-boxer who occasionally got to mix it with the silvertails in the winner's enclosure. His claim to fame was training Vo Rogue, the champion front-runner that amassed more than $3 million in earnings through the 1980s.

In September 1994, he had another prospect on his hands. Starting at 16-1, Quegent had come from nowhere to win the Ascot Vale Stakes at Flemington. Like Vo Rogue, the galloper was schooled to Rail's idiosyncratic dictates: he made his own horse tonic, which he generally administered by hand down the hapless animal's throat.

On September 9, 1994, one of his mares, Drama Series, went berserk at the Hendra stables. The vet found Rail sitting on the horse's head, trying to calm it. There was nothing to do but put it down. Quegent became ill two days later and Rail wasn't feeling too well himself. He told friends that he had been diagnosed with Ross River fever, and it seemed to be playing up again. Ten days later, another nine horses were down and Rail was bed-ridden, too sick to lend a hand. He was looking more like his ailing horses, gripped by uncontrollable shakes and fever, his breathing laboured. Suspecting he had legionnaire's disease, a bacterial infection, doctors at Brisbane's Mater Hospital prescribed massive doses of the antibiotic erythromycin. Nothing worked. Rail slipped into a coma and died on September 27. By then, 14 of his horses had died or been destroyed. (Quegent survived, never to race again.) Virologist Gary Crameri and his colleagues at the CSIRO's high-security Australian Animal Health Laboratory (AAHL) in Geelong soon established it was a novel virus - one not seen before. Alarm bells sounded.

It turned out to be a paramyxovirus, related to those that cause mumps and measles in people and distemper in dogs. Only it behaved differently. Most viruses are species-specific and tend to lose potency if they jump from animals to people. But not Hendra or the other viral nasties spread by bats - Hendra's virological twin, Nipah virus; Ebola; SARS; rabies; and lyssavirus, which killed an eight-year-old north Queensland boy recently, its third victim. "When we did the work on Hendra in the lab it almost didn't matter what cell type we put it into," says Crameri, who joined AAHL in 1995. "It destroyed them all."

A second human Hendra victim was confirmed in October 1995 with the death of Mackay sugarcane farmer Mark Preston, 35, who was found to have contracted the virus 13 months earlier. Preston had fought it off initially - unknown to his doctors, who had no way of diagnosing it at the time - suggesting that the virus can lie dormant in the system and reappear at any time. After his death, Hendra disappeared as abruptly as it had emerged in Queensland. No further episodes involving horses or people occurred until January 1999, by which time the AAHL was on the verge of abandoning its research.

As program director Deborah Middleton tells it, the horse vaccine that was rushed into production last November could have been history there and then. A tall woman with a mop of silvery hair, Middleton has spent countless hours zipped into a positive-pressure suit at biosafety level 4, the air-locked, aseptic setting in which deadly viruses are handled. When she started at the AAHL in 1998, all that was keeping the Hendra research going was the work on flying foxes being done with Hume Field, the Queensland government scientist credited with proving the virus was bat-borne. A veterinarian pathologist by training, Middleton was appalled by Hendra's potency. "It is so destructive, like a really malignant cancer," she says. "You look down the microscope and think, 'Oh, this is wild.'"

Not for the first time, luck would play its part in the Hendra saga. Had the virus emerged in another country, the research simply could not have been done. The AAHL is the only lab in the world capable of accommodating full-grown horses at biosafety level 4; they can be walked into the lab and kept in isolation in railed stalls for up to nine days. When Nipah virus broke out in Malaysia in 1999, infecting thousands of pigs and killing more than 100 people, the scientific world started to take careful note of the work emanating from Geelong.

And then something else, unspeakably shocking, happened. On September 11, 2001, hijacked airliners smashed into the World Trade Centre in New York, the Pentagon in Washington and a field in Pennsylvania. The age of Osama bin Laden and the "asymmetric warfare" of global terrorism had arrived. As the Americans reset the threat matrix, attention focused on Nipah virus, Hendra's close relative. Was it a bioterror weapon waiting to happen? Congress was jolted into action. As it happened, a key figure in the US biodefence program had already been in touch with the Hendra team. In 1999, Christopher Broder, a professor of emerging infectious diseases at the military-backed Uniformed Services University of the Health Sciences in Bethesda, Maryland, had approached the AAHL to join forces to tackle Nipah and Hendra. "I suggested that their ability to work with live virus combined with our expertise in molecular virology and vaccine and therapeutics development would dovetail quite well," Broder recalls.

By then the Australian scientists knew that Hendra could infect just about every animal exposed to it: dogs, cats, ferrets, guinea pigs, pigs and, of course, horses. But why the horse is especially susceptible remains one of the many mysteries. It may be that the animal has an inherent weakness to Hendra. The virus is mostly shed by bats through urine, but viral particles also end up in or on the regurgitated "spats" of their semi-digested food, a treat for a hungry horse. The horse's
elongated nasal and throat passages are ideally contoured for Hendra, scientists believe. Once it takes hold the race is on, in Crameri's words, between the virus and the horse's immune system. "In about 75 per cent of the cases ... Hendra wins," he says.

Small wonder the Americans were concerned by the appearance in Malaysia and subsequently Bangladesh of Nipah virus, which is transmitted from bat to pig to person. A saving grace of Hendra is that it is not known to spread between people - though Crameri cautions it is entirely feasible that it could. In Bangladesh, there are worrying signs that Nipah virus can jump from bats direct to the human population, and there is evidence that person-to-person transmission has happened in Malaysia. "You probably just need a warm garden shed and the right cell cultures and you could grow Nipah," Middleton says. "And, like Hendra, it is available in the environment. It is there, living in bat colonies."

If further evidence were required of the havoc an emergent virus could wreak it was writ large in the 2003 outbreak of SARS (severe acute respiratory syndrome) that started in Asia and threatened to become a pandemic, forcing shutdowns in international travel. Within 12 months, research money from the US National Institutes of Health (NIH) was flowing to Middleton's team. At the direction of US lawmakers, a branch of the NIH had shifted about a third of its extramural funding to counter-terrorism research, with an emphasis on biological threats. More than $2.5 million would find its way to Geelong, according to Middleton.

In Bethesda, Broder and co-researcher Katharine Bossart were picking apart the Hendra genome. Their work with the Australian scientists had identified two key proteins, coded G and F, on the virus's crust. These are critical to Hendra establishing infection, Middleton says. Cleverly, the Americans managed to transfer the gene that produces the G-protein into cell culture and grow it in the lab. "It's the ideal way to make a vaccine antigen because it has no contaminants," says Middleton. "From my perspective, that was the first joining of the dots."

Again, "fate played into our hands a bit," she says. Antibodies to Hendra-G proved to offer better cross-protection against both strains of the virus than those for Nipah-G protein. "So if you vaccinated animals with Hendra-G they produced very strong protection to Hendra as well as Nipah, whereas if you vaccinated with Nipah-G, it was fine against Nipah but not so strong against Hendra."

Middleton made the case to the Americans that they should go with the Hendra vaccine base. "We could defend this from a scientific perspective," she says. "But it was actually terribly fortunate for us because we couldn't have used a Nipah-G vaccine nearly as effectively against the Hendra virus, which of course is the agent of interest to us from our national perspective."

Broder agrees it was a win-win outcome. "Combining our efforts has led to one of the best success stories of biodefence-related, NIH-supported work," he tells The Weekend Australian Magazine. "Basically, we have successfully made an astoundingly efficacious vaccine to both Hendra and Nipah virus infection." More recently, the vaccine has also been shown to completely protect monkeys, paving the way for its possible use in people, Broder says.

In early 2007, laboratory trials involving ferrets proved that the vaccine stopped viral replication cold. None of the animals exposed to Hendra became ill, even those given a low dose of the experimental drug. Still, there was no way at this point that Middleton could see the vaccine progressing to market. True, the know-how was there, but what the CSIRO needed was a commercial partner, and Hendra had gone quiet once more, slipping off the public radar.

Middleton tapped her contacts among the top veterinary medicine-makers, but none was interested. Reluctantly, she resolved to bide her time. CSIRO's vaccine adjuvant, the X-factor that supercharges the immune system's response, was not formulated to an "industrial" standard, and the work would have to be redone. "To me, it was a waste of effort," she remembers. Until, that is, the horse in yard 19 of the Redlands Veterinary Clinic got sick.

They might be called fruit bats, but the preferred fare of the Little Red Flying Fox, the most common species in Australia, is the flowers of native trees. They feast on the nectar and spread the pollen far and wide, seeding the landscape. In the early winter of 2008, the eucalypts surrounding the Redland clinic, bayside in Brisbane's southeast, were full of snowy blossoms. As an added temptation to bats, the hedges around Truly Gifted's corral in yard 19 were thick with bulbs of wild fruit. On Thursday, June 26, the horse's temperature soared.

Beohm had just turned 21, and was finding her feet as a trainee veterinary nurse in the practice. Having grown up with horses in Victoria, she had always wanted to work with them and here she was, doing just that, after moving north with her parents, Andrew and Rhonda. "To get this job, well, it was amazing," she says. In the days leading up to the outbreak she had been helping Cunneen to treat a horse named JD, which had a long-standing nasal inflammation unrelated to Hendra. It was the second to succumb to the virus. By July 8, another two horses were sick and the clinic was under lockdown. Beohm can't remember when Hendra was first mentioned. None of the ailing horses had respiratory symptoms, at that time regarded as telltale of Hendra virus: JD went down after presenting with a head tilt. The others had various neurological signs, suggestive of anything from colic to Japanese encephalitis.

Cunneen became ill over the weekend of July 12-13 and was admitted to the Princess Alexandra (PA) Hospital, where his condition deteriorated rapidly. Beohm was tested for Hendra and cleared, yet what felt at first like a "bit of a cold" got worse. She went to see Cunneen and waved to him through the window of his quarantine room. Later that night, her mobile phone beeped and it was a specialist telling her that she needed to get straight back to the hospital; she was positive to Hendra after all. "I texted Ben saying, 'Hey, I am in here with you,'" she recalls. "But I didn't hear from him; he was too sick by then."

Hendra takes between seven and 21 days to incubate in people - much longer than is the case with horses - but its onslaught is just as terrible. Once established, there is little to be done. "We don't have any compounds that actually work against the virus," says the PA Hospital's director of infectious diseases, Geoffrey Playford, who treated Beohm and Cunneen. The best hope was to keep them alive long enough for their immune systems to kick in. The progression of their symptoms reflected how Hendra attacks the body: first the lungs, then the brain. In time, every organ can be infected. "I can remember Dr Playford coming in and saying, 'I don't know what to do,'" Beohm says.
Cammeen died on August 20, 2008, the day after Beohm left the PA. "I look fine on the outside, but I am broken on the inside and people can't see that," she says, describing how she is yet to recover. "It was not like I had a broken arm that would be right in six months. This is an ongoing thing ... It's in your brain and how do you fix that?"

"Everything changed after Redlands. It was a wake-up call to us all," Deborah Middleton says. The message was hammered home in August 2009 when Debbie Brown's favourite mare, Jackowah's Regal Princess, became ill on the horse stud she managed at Cawarral, near Rockhampton. Pink froth was streaming from the animal's nostrils and Brown could hear it choking. When she inserted a needle to get an IV going, black blood spurted into her hands.

Hendra's fourth human victim was to be her vet, Alister Rodgers. A fortnight earlier he had been called out to the property to treat another horse for what they thought was snakebite. Now, the awful realisation dawned on Brown that it had been Hendra all along. She didn't hesitate. She had helped birth the mare, and she wasn't going to let it down. The horse was too weak to stand so she cradled its head in her arms, to hell with the consequences. "What else could I do?" she asks, all these years later, as another of her horses clumps by. "I'm not stupid. I knew what the symptoms for Hendra were. But she was suffering so terribly, she was choking, gasping for breath, and I had to do something for her."

Brown and three workmates were covered in muck from the stricken horse and ended up in hospital under quarantine, waiting to find out whether they, too, had been infected. She remembers seeing Rodgers there, a few days before he went into a coma and died. The 55-year-old father-of-two was under no illusion about his prospects. "They've already made my bed," he told her.

News of his death - giving Hendra a 60 per cent fatality rate among the seven people known to have contracted it - flashed around the world. Building on their work with Middleton's team at AAHL, Broder and another colleague, Dimitar Dimitrov of the NIH, had pinpointed a human antibody to neutralise Hendra and Nipah. When cloned, this provided the basis of a drug therapy that proved promising in lab trials with ferrets and green monkeys. The treatment was tried on Rodgers, but so little of the experimental drug was available that, according to Playford, only a 10th of the required dose could be given.

In any event, the treatment was known to be most effective when administered prior to the onset of symptoms. Broder had donated the antibody-producing cell line to Queensland Health for what he describes as "compassionate use". At a meeting in Brisbane, he urged that the question of a horse vaccine be revisited to break the transmission chain to people. Most of the animal trials had been performed on ferrets in the AAHL's hermetically sealed labs. Wasn't it time, he asked, for the prototype HeV-sG vaccine to be tried out on horses? "The ball really got moving after this," he remembers.

Shocked by Rodgers' death, Debbie Dekker decided that her organisation, the Queensland Horse Council, had to get involved. She wrote to every politician she could think of, starting with then Queensland premier, Anna Bligh, appealing for funding for the horse vaccine. Middleton had let it slip that the scientific work was complete, and "basically it was sitting there, waiting to be grabbed", Dekker says.

But it took another outbreak of Hendra, this time on the Sunshine Coast, to seal the deal. Rebecca Day and her 12-year-old daughter Mollie were given the unregistered antibody treatment after their horse, Cash, was put down with Hendra virus on May 17, 2010. They had been so heavily exposed to the animal's secretions that it put them in the high-risk category, with a 15-25 per cent chance of being infected. Neither was, and there is no way of knowing whether this was down to good luck or good medicine.

The Queensland and federal governments jointly kicked in $600,000 to fund a final proving trial for the horse vaccine, along with money for the University of Queensland's Australian Institute for Bioengineering and Nanotechnology to formulate a medicine-quality supply of the antibody treatment for people. Four horses were inoculated in a secure compound outside the AAHL complex and brought into the lab to be dosed with the virus. The vaccine did its job in every instance.

The final piece of the jigsaw fell into place when US pharmaceutical giant Pfizer stepped up. Mike van Blommestein, the boss of its 80 per cent-owned animal health division, Zoetis Australia, found himself sitting next to Queensland's chief vet Rick Symons at an industry dinner where they got to talking about the final horse vaccine trials. "I said to him, 'Hell, we can also get involved ... we've got the technology'," van Blommestein says.

"All of a sudden it all came together," Middleton adds. "We had the money to do the horse work here, we could actually use a commercial vaccine formulation through Pfizer which would shorten the path to registration ... and we had access to this huge experience and expertise in vaccine-making."

Given the threat posed by Hendra, you would think that horse owners would be lining up for it. Not so. The take-up has been underwhelming since the vaccine's release on November 1 last year. As of March 1, just 23,947 doses of vaccine had been sold, few of them outside the danger zone in Queensland and northern NSW. Van Blommestein had anticipated that at least 120,000 of the 190,000 horses estimated to be at risk would by this time have been inoculated. "It's frustrating," he admits.

One disincentive, according to Dekker, is that there are strings attached to using the vaccine. Due to its fast-tracked production, it was not conventionally licensed. As an interim measure, the Australian Pesticides and Veterinary Medicines Authority has allowed accredited vets to give the required injections, exactly 21 days apart, under what is known as a Minor Use Permit. This is a recognised pathway to registration, but one not particularly familiar to the equine industry. All up, the cost of vaccination comes in at between $100 and $200 per animal, industry sources say.

Dekker says the owners of "low-value" animals might consider that a stretch. The industry's concerns don't stop there, however. The vaccine's proven effectiveness in the lab doesn't translate to hard, fast guarantees of how it will work in the field. How long does the immunity last? At least six months and probably much longer, Middleton says, but she can't be specific because the data simply does not exist at this point. One persistent rumour involves a purported risk to mares in foal. "The horse industry is full of myths," says Dekker, who dismisses it as unfounded.
Zoetis Australia says a study is under way into the vaccine's use on pregnant mares. Vaccines made from live virus are known to be hazardous to horses in foal, but its Hendra prophylactic, Equivac HeV, is a synthetic sub-unit vaccine with no such downside. "Not having a safety study does not mean the vaccine is unsafe, just that a study has not been completed," the company says. Inevitably, there will be commercial implications unless sales improve, van Blommestein warns. "If it isn't taken up, the commercial interests could kick in here where we simply say it's not worth our while ... I wouldn't want to be putting any threats like that out, because we want to see this thing through. But the fact of the matter is the smaller the production volume, the higher is the cost of your production per unit."

The organisers of the Royal Queensland Show have taken the decision out of the hands of horse owners if they want to be involved in this year's Ekka. All horses entered in the show must be vaccinated. Still, there is no convincing some people. Despite her brush with Hendra, Debbie Brown insists she won't be using the vaccine. "You can't afford to mess around with fertility," she says. "I know that sounds strange, given what we've been through with this thing, but I can tell you a lot of horse people feel the same way. We won't use the vaccine while there is any doubt."

Natalie Beohm went back to Melbourne to "get away from the bats" - and who can blame her? She took the time out to find herself, "to deal with everything in my own way". When she can, she goes to the Yarra Valley where her horse, Vennie, is stabled. To see her with the 10-year-old gelding is deeply moving. "Horses are what get me through being sick," she says. "Hanging with them and not getting spoken to about Hendra or what's happened to my body ... they just make me smile." She is thinking about returning to Queensland and Vennie will be going with her, of course. There's no way she would leave him after all she's been through. Her mother says the horse should be vaccinated but Beohm isn't sure. "I hope they have done enough testing on it and it's safe," she says. "I hope the vets don't try to make money off it."

The need, however, has probably never been greater for action. In 2011, Hendra struck more widely than ever, with a record 18 outbreaks that killed or forced the destruction of 22 horses. Dusty the dog, on a quarantined property southwest of Brisbane, became the first outside a lab to return a positive test result. Eight separate sites of infection emerged in NSW as the virus extended its known reach to Macksville on the state's mid-north coast, the furthest south it had been detected. The federal, NSW and Queensland governments jointly lifted funding to $13 million to find out what was going on.

Hume Field's researchers from the Queensland Centre for Emerging Infectious Diseases established that fruit bats were shedding the virus in unprecedented numbers. Usually, only 10 per cent of them are infectious at any one time. Urine sampling at the height of the outbreak in mid-winter 2011 suggested that up to 70 per cent of the animals in some colonies were excreting the virus. The suspicion was that the devastating floods of the previous summer had stressed the bats, possibly by destroying food sources and habitats, making them more susceptible to the virus.

Field is not so sure. The longer he looks, the more convinced he is that there is no single reason for Hendra to erupt. "You need to have a combination of things happen to have a bad year," he says. Eight outbreaks were recorded in 2012, all north of Rockhampton, and there have been two so far this year. Of the 41 eruptions since 1994, 28 have happened in the cooler months in Queensland - May to October - and that could be linked to the breeding season of bats, he says; antibody levels to the virus have been shown to spike in pregnant and lactating females.

Field also points to the "hungry horse" theory. Pasture tends to die back in winter, possibly impelling horses to eat contaminated bat spats. He says he can't rule out the involvement of a "super-shedder" - a kind of rogue flying fox that excretes vast quantities of virus. And it's still not clear why so many of the cases have occurred in Queensland. As scientists and doctors are learning, there are no convenient answers to Hendra.

Beohm says no one should ever forget how fearsome the price of progress has been. She is still paying it, as is the family of Ben Cunneen, and those of Alister Rodgers, Mark Preston and Vic Rail. "It makes me sad that they had to die for people to take Hendra seriously and do something about it," she says. "I mean, what happened to me could have happened to anyone."

The young woman is trying to look forward, not back, and get on with her life. But the virus is still with her, ever present, ever dangerous.