

## Mobile technology battles HIV

By Victoria Gill  
Science reporter, BBC News

**"When I arrived here, I saw people with HIV being carried all day to get to the clinic," Paul Williams recalls.**

"There were no testing services, no education, no treatment and certainly no monitoring of treatment. People just died."

That was the situation in Bwindi, Uganda, three years ago. Dr Williams, formerly a GP in North-East England, has since transformed a tiny and very basic health centre on the edge of the Impenetrable Forest into an efficient community hospital.

And for the past five months, thanks to a small but important piece of equipment, Dr Williams' medical team has been able to monitor the health of patients with HIV from a clinic that fits into the back of their four-wheel-drive "community ambulance".

Bwindi Community Hospital now provides health care for about 40,000 people.

It has a dedicated maternity programme and a children's ward that deals with many cases of malnutrition, as well as other common diseases including malaria and HIV. In total, the hospital takes care of 1,000 HIV positive patients.

Dr Williams describes the environment in which he works: "We're a mile away from the rainforest where there are mountain gorillas, right on the border between Uganda and the Democratic Republic of Congo.

"There aren't any tarmac roads here, there isn't any public transport, and lots of the patients live a day's walk from the hospital. Many of them live a subsistence existence and they can't afford to get here."

So his team packs an "HIV outreach clinic" into its vehicle, and takes it out to remote communities.

Along with the rest of the equipment loaded into the back and strapped on to the roof of the ambulance, there is one modest-looking grey box.

This piece of equipment is a PointCare NOW machine. It was donated to the hospital last year, and has since transformed the care Dr Williams can offer HIV patients.

The machine is a portable blood-testing device - pop in a blood sample and, within 10 minutes, it gives a print-out detailing the condition of a patient's immune system.

It counts CD4 positive T cells. These are the white blood cells that the HIV virus latches on to - attacking and destroying them.

"When we say someone has a weak immune system because of HIV, we mean their number of CD4 cells is low," explains Dr Williams.

"During the course of infection, the number of these cells gets less and less - so you have to count them to see how advanced the HIV is."

### The quest

The machine was developed by PointCare, a company based in the US that specialises in diagnostic equipment for the developing world.

It's an organisation with an impressive pedigree. Petra Krauledat, and her long-time business partner Peter Hansen, founded the company in 2003, having both already had long and successful careers in HIV research.

**" What people needed was a test that could be used in a little shack of a clinic, transported to remote areas, and that could withstand the heat "**

Petra Krauledat PointCare

"Peter invented the first automated CD4 test in the late 1970s, and I led the group in 1982, in Germany, that launched the first HIV screening test in Europe," explains Dr Krauledat.

In the 1990s they were approached by former colleagues who asked them to turn their attention to developing a much-needed, cheap CD4 test for the developing world.

"So we went to Southern Africa to talk to the [medics] actually working there," she says.

What they found surprised them both. "People showed us tonnes of donated instruments just sat in storage. The reagents [or chemicals needed to run the tests] had simply perished in the heat," she relates.

"So 'cheap' wasn't people's biggest concern. What they needed was a test that could be used in a little shack of a clinic, transported to remote areas, and that could withstand the high temperatures.

"We've fulfilled that quest."

### **Surviving the heat**

Dr Hansen invented a test that uses chemical reagent that can be freeze-dried and stored in temperatures of over 40C.

CD4 screening tests use antibodies - molecular tags that recognise and latch onto a chemical marker on the surface of the cell. By attaching to the cells, they act as flags distinguishing CD4 cells from other white blood cells.

But these antibodies need to be "labelled", so they can be detected by a machine.

Traditionally, antibodies are labelled using fluorescent markers, but these fluorescent chemicals perish if they are not kept refrigerated. So they're useless for a medical team operating from a temporary clinic in the heat of an African summer.

Dr Hansen developed a new label. "We use colloidal gold," explains Dr Krauledat. "It's true nanotechnology - extremely tiny gold particles attached to the anti-CD4 antibody."

The gold-bound antibodies are very heat-stable - they can be stored at over 42C for an entire year.

### **Immediate result**

Inside the PointCare machine, the freeze-dried, gold-labelled antibody is liquefied and combined with the blood sample, and with a chemical accelerator that speeds up the attachment of the antibody to the cells. "How the accelerator works is a trade secret, but it allows us to complete the test within eight minutes," says Dr Krauledat.

"Before we had this machine, we'd see somebody in the clinic, then we'd have to see them on another day to collect a blood sample," recalls Dr Williams.

"We had a system of motorcycle riders that went round all of our outreach sites on a particular day to collect samples. They would have to ride for four hours along a muddy road through the Impenetrable Forest, to a laboratory on the other side, where we could get them tested.

"It took us three days to get the result, and we couldn't get it back to the patient until we saw them again two weeks later.

"Now, with this simple piece of technology, we can deal with problems immediately."

The machine is also far cheaper to run than traditional instruments. It is powered via a battery pack. "Because we use colloidal gold, we have an instrument that doesn't consume a lot of power," explains Dr Krauledat.

"Fluorescently labelled antibodies have to be detected with a laser, and those systems are quite fragile

and consume more power. We use a [light-emitting diode] detector. It's technology with a lifetime of 180,000 days, doesn't break and it uses almost no power."

### 'Productive lives'

As well as a CD4 count, the device also counts five other subtypes of white blood cell.

This gives a complete picture of the patient's immune system.

The results provide a physician with a good indication of whether an HIV positive patient might have tuberculosis, give a warning sign of other opportunistic infections, and find out if the patient has anaemia - a debilitating condition that is fairly common in the latter stages of HIV.

**" We've been able to change HIV from being a death sentence to being something that people can live with and lead productive lives "**

Paul Williams Bwindi Community Hospital

It also means that a patient's treatment can be monitored. "HIV treatment is great - anti-retroviral drugs can add up to 30 years to a person's life," says Dr Williams.

"But there are some people who develop resistance to the drugs, or in whom the drugs fail, and we can spot that early on to take action to be able to stop them from getting sick."

In three years, Dr Williams and his team have transformed the lives of their HIV positive patients.

"I started a testing centre in the hospital, then the mobile testing services, and then, once we had access to drugs, developed a treatment programme.

"Now our death rates from HIV are very low. We're able to diagnose it early, manage it early and keep people living with HIV fit and well.

"Over a reasonably short period of time, we've been able to change HIV from being a death sentence into something that people can live with and lead productive lives."

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