



Charles Potter, Glide Pharma's founder and chief executive

Delivering drugs in Southern England: Glide Pharma (Abingdon, UK)

No More Jabs?

There are two types of people: those who are afraid of needles and those who pretend they aren't. A new needle-free injection technology brings hope to the faint-hearted.

When Charles Potter, an engineer with a close interest in medicine, earned his PhD at the engineering department of the University of Cambridge in 1989, he sometimes perplexed his advisors. From the beginning, he was interested in applying new engineering approaches to medical problems. For his PhD, Potter looked at the heart's pumping mechanism from an engineering perspective. At the Transplant Unit of Papworth Hospital, he developed a technique for rapidly measuring the performance of donated hearts – a job where time is of the essence.

"It meant lots of midnight dashes to all parts of the country to get hold of hearts as soon as they became available," reminisces Potter, "but it was well worth it." He is sure that this early exposure to the hospital environment has meant that the needs and concerns of patients, doctors and nurses have played a major role in his thinking.

A lack of career opportunities

Potter was frustrated with what he saw as the lack of career structure in the National Health Service (NHS), but an opening was destined to come from an unexpected source. Brian Bellhouse, a mathematics lecturer at Oxford University, had formed a company called Oxford Bioscience, later to become Powderject. Bellhouse developed a device that uses the explosive release of helium to fire tiny particles of powder into cells. When Powder-

ject advertised for a technician they got more than they expected, when the enterprising Potter told them, "you don't want a technician, you want a PhD with experience in engineering, someone who can do his own research, someone who understands the needs of patients, doctors and nurses."

Potter got the job.

Everything he has created in the following 15 years can probably be traced back to this watershed. The Powderject technology looked like a powerful alternative to the old choice of needles and syringes, and the technology has been acquired by Pfizer for the delivery of vaccines. Over the course of time, Powderject changed direction and became more interested in developing vaccines, and was bought by Chiron (now Novartis Vaccines) in 2003 for €782 million.

Leaving Powderject

But in the meantime, Potter had gained valuable experience in the solid delivery field. Three years at another company, Oxford Biosignals, followed. But he continuously chewed over the challenges and opportunities for drug delivery, puzzling out new and better ways of getting drugs into patients.

"I saw the opportunities for ballistic drug delivery, but the technology was too complex," Potter believes. Ballistic delivery, like the kind envisaged by Powderject, is a bit like shooting someone with a very, very small shotgun. Perfectly safe and very effec-

The drug pellet, delivered into the patient's skin with Glide's solid dose injector, is smaller than a match head and almost invisible. Note its pointed shape, which eases penetration!



Photo: Glide Pharma

tive – but there is a huge problem that neutralises these advantages. “The depth of penetration of a small projectile depends on which tissue it hits,” Potter soon reasoned. As a consequence, needle-free injection technologies never took off. Their cost and complexity hindered uptake in the health care system.

To realise his own concepts, Potter decided to found a company. “The key difference with our technology is that, with our trick, the drug is pushed to the same depth in the tissue in every injection, rather than being fired,” he asserts.

Really? Is Glide Pharma, Potter's small Oxfordshire company of 12 employees about to revolutionise drug delivery?

No more scary needles?

Well, he hopes so. Glide Pharma's technology is a simplification of the powder injection system, and this simplicity is its very strength. Firstly, the drug is lyophilised and bound to a scaffolding polymer to form a solid; then the tiny pellet is loaded into a disposable cartridge and a small device then drives a tiny, pointed solid stick of material under the skin. It is a matter of push, rather than fire, Potter explains.

Operation by the end user is simple: attach the cartridge to the applicator, push the head of the cartridge against the skin, and press the button. When the user has applied the pre-set force, the applicator drives the pointed pellet into the skin to a predetermined depth. The discomfort is no more than a traditional needle, and an indicator in the cartridge reassures the user that the drug has gone in. Job done. Throw the cartridge into the nearest bin and put the applicator away ready for the next time. No more scary needles, no more needlestick injuries, no more accidental cross contamination (think of accidental AIDS contamination), and none of the problems associated with disposing of those needles and syringes.

But that is not all, as Potter enthusiastically tells your *Lab Times* reporter. Behind the simplicity lies a host of possibilities for controlling drug release. The nature of the polymer with which the drug is bound up – the excipient – determines the timing of its release. If the polymer is a sugar, release is almost as rapid as a needle injection. Alternatively, a more slowly dissolving excipient gives a gradual longer lasting release. So, the potential for combining different therapeutic molecules with carefully designed excipients opens the way for complex regimes of drug release that go beyond what could be reasonably achieved, even with a series of traditional injections.

Potter seems to be convinced of the technology. But why isn't it already used in hospitals, nine long years after his company's foundation? Why has Glide just twelve employees, while syringe-manufacturers still turn over many millions of euros?

One-person-company for three years

To answer these obvious questions, let's go back in time. After finishing at Powderject, Potter joined Oxford Biosignals and it was during this period that he set about turning his own idea into a product. He worked alone for a couple of years to prove to himself that the technology could work. In late 2001 he formed a

company, Caretek Medical, and in January of 2005 he hired his first employee. By now he had secured seed funding, largely with the help of Oxford Technology Venture Capital Trust, for his first clinical trial. Armed with the data from this trial, and having secured the interest of doctors and pharmaceutical companies, he rebranded the company as Glide Pharma. Glide's first fundraising campaign in February 2005 had its €600,000 target oversubscribed to nearly twice that amount. Since that time, Glide has raised about €12 million, mostly from business individuals, and so boasts a large shareholder base.

Glide's device is not just about fear of needles. “The needle-free aspect is low on our list,” says Potter, “much more important is simplicity. Think of an elderly patient, having to self-administer at home alone. Or a child at school developing an allergic reaction to a bee sting, the teacher faced with the choice of giving a needle-injection or waiting until the ambulance arrives.”

Not just fear

Then, aside from the drug delivery question, there are the advantages associated with using solid formulations rather than liquids. Solids have longer shelf life, whereas many liquid presentations need to be dissolved immediately before injection, entailing inconvenience and the danger of error. Most solid formulations do not need cold storage, an important advantage in developing countries where not only is cold storage in the field a problem, but the whole chain of supply, from air freight to road delivery, needs refrigeration.

But will it sell? There is no question that the technology works: non-clinical studies have confirmed the bioequivalence for a range of drugs, such as Sumatripan, a triptan drug including a sulfonamide group for the treatment of migraine headaches. And patients liked it, according to the results: 88% of volun- ▶▶



Wait, wait!
Just let me put on a clean lab coat...

►► teers in a Phase I human sensation study said they preferred it to needles.

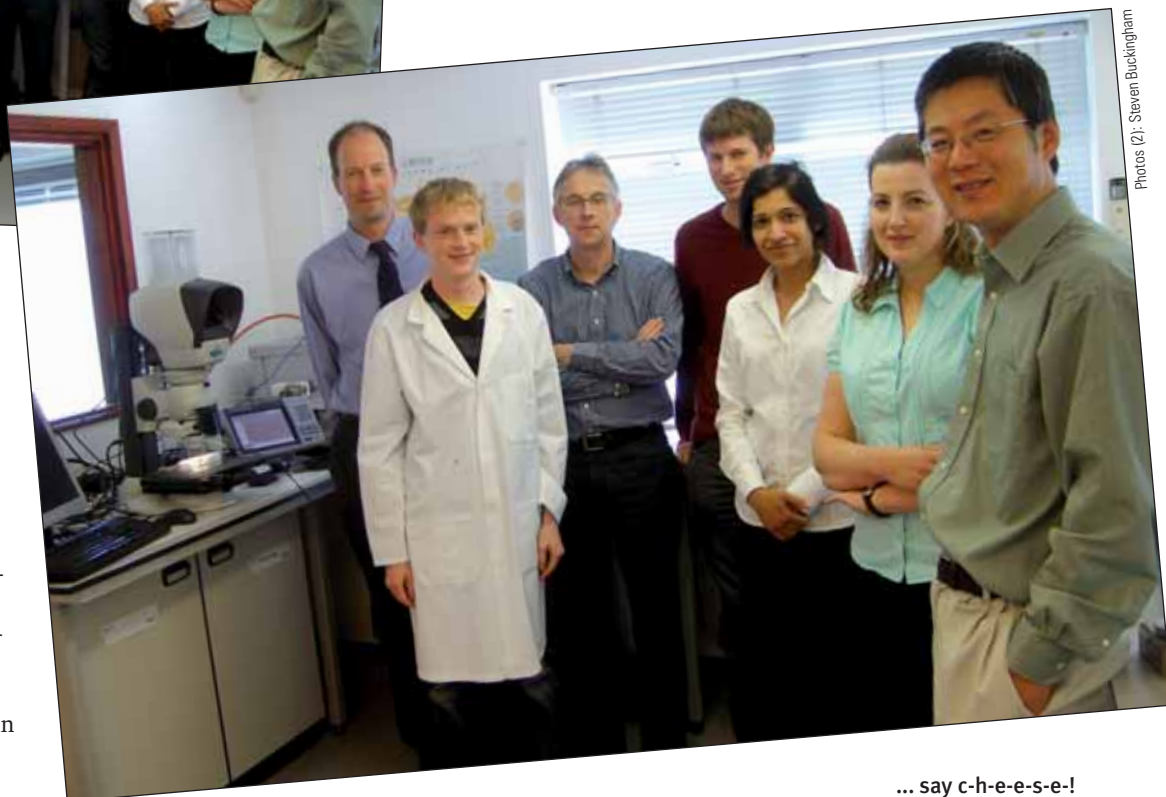
But what about the cost? Can Glide persuade pharmaceutical companies to part with the familiar (and cheap) needle-and-syringe? "Right now, the Glide device is relatively expensive because it is in development," admits Potter, "but we are confident we can get the price down to near-syringe levels when we are manufacturing at high volumes". Indeed, the device is mechanically very simple – no electronics, no complicated control mechanisms – so economies of scale are likely to do just that.

The industry's aversion to risk

Potter is targeting his technology primarily at the home-administration (where simplicity of use is a key factor) and vaccine markets. Vaccines are a lucrative market and have a huge impact on health and well-being in developing countries. Vaccination programmes in developing countries often fall down because many patients just don't turn up for their boosters, with potential consequences for themselves and possibly the whole vaccination programme.

In a solid-state formulation, on the other hand, the primer and the booster could be administered in one, single dose. On top of that, solid-state delivery has actually proved to be even more effective than traditional injections, Potter says, although to date no-one knows quite why.

Aware that pharma's proverbial aversion to risk is only going to get worse, given the current economic climate, the company's strategy is to de-risk as far as possible in the early stages of business development. Potter is concentrating on working up a few of their own products at first, and two of these are already in clinical studies. In Potter's words, "we need to have a product or two on the market to show there is no unmanageable risk and commer-



... say c-h-e-e-s-e-!
6 out of 12 Glide Pharma employees
smile into the camera, with company founder
Charles Potter on the far left.

cial viability for the technology has been demonstrated. The internal products will be taken through to the pivotal clinical studies and marketing authorization will be sought."

Clinical proof-of-concept

That derisking is already happening, with the recent successful clinical proof-of-concept of the solid dose injector, conducted in 18 subjects with a solid dose formulation of the analgesic fentanyl.

However, it should be noted that it's highly debatable whether a serious, randomised double-blind trial is at all feasible, if one seeks to compare a conventional skin damaging injection with Glide's needle-free drug delivery system.

Anyway, according to Potter, the device safely and quickly delivered accurate doses into systemic circulation – suggesting that the €1.6 billion per annum breakthrough pain market could potentially open up to Glide's technology without the bruising and bleeding associated with needle-and-syringe delivery. In the 2-3 years it will take to get these products developed, Glide Pharma will try to get as many pharma companies as they can interested in licensing the technology for their own products.

STEVEN BUCKINGHAM