

claimed that this could slow the growth of biotechnology in Europe. By contrast, I suggest that withholding patents on genes could encourage the expansion, in Europe, of pharmaceutical R&D that is free of gene patents that could limit the choice of drug targets in the USA.

Society is entitled to see maximal benefit from the public funding of the Human Genome Project. Although some situations might require a much-reduced level of patenting, ideally, genes should be patent-free. [For a more extensive discussion of gene patenting from this author, see Ref. 1.]

## Reference

- 1 Williamson, A.R. (2001) Gene patents: socially acceptable monopolies or an unnecessary hindrance to research? *Trends Genet.* 17, 670–673

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## Pills and pumps: the future of insulin therapies ▼

In a recent issue of *Drug Discovery Today*, Pillai and Panchagnula provide an insightful review of the history and current research into insulin therapies<sup>1</sup>. Much of the research involves alternative delivery methods to injection that maintain the current safety and efficacy of the drug. Most diabetics would gladly give up syringes and needles for a pill, or something else more comfortable and convenient. However, the Pillai and Panchagnula review tends to overemphasize developments toward better insulin pumps, and gives short

shrift to exciting new alternative delivery methods that avoid needles, including oral and inhaled delivery.

Insulin pumps have been around for some time, and in a small proportion of the diabetic population (particularly infants and teenagers) they have proven advantageous. However, the use of an insulin pump does not avoid needles, and actually requires closer monitoring of insulin levels throughout the day than a regimen involving multiple injections does ([http://www.childrenwithdiabetes.com/d\\_06\\_f00.htm](http://www.childrenwithdiabetes.com/d_06_f00.htm)). As Pillai and Panchagnula point out, these pumps are a long way from acting as an artificial pancreas; the glucose sensing technology is simply not yet up to the task. For a majority of diabetics, the advantages will not outweigh the inconveniences until that time.

Several versions of inhaled insulin are in clinical trials, and one version recently completed Phase III trials. However, this version is currently delayed from submission to the FDA, causing some speculation about its safety ([www.inhale.com](http://www.inhale.com)). Although it is true that the lungs provide a large surface area for absorption that is relatively free of proteolytic enzymes, it is not yet clear whether this needle-free approach will pass regulatory approval.

Among the alternative delivery routes being explored, the oral route of administration is the most preferred. In addition to the convenience and higher compliance with oral administration, oral insulin administration would place the drug in the portal circulation first, thus mimicking the physiological pathway of insulin delivery, providing a direct route to the active site (liver), and would avoid some of the undesirable peripheral effects observed when insulin is injected. Of the peroral delivery methods for insulin mentioned by Pillai and Panchagnula, one involves polymer conjugates of insulin, essentially a prodrug approach (<http://www.infinitypoint.com/Articles/Horizon/>

993756633). Another is actually based on buccal delivery, using the large number of blood vessels in the cheek tissues (<http://www.pharmaceuticalonline.com>). Only one, to my knowledge, has shown successful delivery of therapeutic levels of unaltered insulin through the gastrointestinal tract (<http://www.hadassah.org.il/news/OralInsulinDov0701.htm>). All of these peroral delivery methods are currently in Phase II clinical trials.

The dream of many diabetics is to throw away their needles and simply take a pill to get their insulin. Beyond the added comfort and convenience over needles, oral insulin would have therapeutic advantages, avoiding some of the side effects caused by delivery into the peripheral circulation. Two more phases of clinical trials are necessary, but in a few years, oral insulin could be available in some pill form. An artificial pancreas would be better still, but for the moment it appears that pills are winning the race over pumps.

## Reference

- 1 Pillai, O. and Panchagnula, R. (2001) Insulin therapies – past, present and future. *Drug Discov. Today* 6, 1056–1061

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