Breathe Easy: The Future of Inhalation

Evaluating the future of inhaled products, it is clear that a vastly improved user experience should be in the pipeline.

The pharma industry is under a great deal of pressure to deliver better dividends to shareholders, and to deliver better, more effective treatment to patients at lower cost. Healthcare costs are escalating at an alarming rate and it is well-reported that some of these costs are due to the ineffective usage and wastage of drugs (1). This is particularly true of inhaled products where we know, for example, that a large proportion of patients cannot coordinate breathing with the actuation of a pressurised metered dose inhaler, or do not adequately adhere to treatment which is then less effective than it could be (2).

Furthermore, sometimes patients simply do not do what you expect them to and, for a variety of reasons, do not take their medication when they should. However, we must not lay the blame at the patient's door; indeed, the pharmaceutical and device industry must assume a large proportion of the responsibility if current drug delivery solutions are not as good as they might be.

In the future, advanced technology will clearly be part of the solution, but it is not the total answer in itself. We still need to provide better usability through design, and more patient education, training, liaison, monitoring and support, but these are out of scope for this paper, which concentrates on the technology element and what the future might hold.

Ownership Costs

If we ask ourselves “can we do more?”, the answer will be “yes”, quickly followed by “but who is going to pay?” Here lies the main complication in the current thinking and commercial model. The cost of poor drug delivery, poor compliance and adherence is borne by all; it is an ownership cost. The result of ineffective delivery of inhaled therapy is wasted drugs, more devices than necessary ‘consumed’, more frequent GP visits, increased exacerbations, more emergency room visits, greater hospitalisation, poorer patient health and increased mortality. Yet when we look for solutions in delivery, we just look at the device and drug cost, seek to minimise these and, in doing so, largely fail to address most of the consequential costs of providing an incomplete and, frankly, woefully inadequate solution. A more holistic solution that seeks to have greater impact on this total, consequential cost might require a slightly more expensive device, but it is likely to greatly reduce total healthcare costs.

So can we afford to stay with ‘cheapest is best’, or is there another technology-enabled way? Do we only have the polarised options shown in Figure 1, or are there gradations in between? In some instances, such as in Third World infrastructures, there will be no choice but to stick with low-cost, less effective methods, since the alternative is to go without completely and that is unacceptable. However, the escalating healthcare costs in the developed world cannot continue to rise at the current rate, and more cost-effective solutions to reduce total health costs must be found.

What is Driving Change?

In targeting more effective delivery of drugs and higher value platforms, the industry is considering different commercial models based on a range of drivers, such as the future ‘threat’ of payment by results (PbR). However, many see PbR as an opportunity: a way of differentiating products not just in the eyes of the ‘payers’, but also in the eyes of the patient (or more realistically the consumer). Further evidence that change is happening is seen in new entrants bringing both add-on devices and applications (apps) to the landscape to enhance the user experience, encourage and ensure adherence, and make it easier to monitor and measure treatment effectiveness (diagnostics).

The convergence of technology will require changes in clinical organisation (3).

The technology-enabled route has the potential to significantly reduce total healthcare costs if a more holistic view is taken. Thus, the drivers of PbR and the need to prove or demonstrate efficacy could be one of the elements that, rather than being a threat, actually stimulates companies to invest in technology and real time diagnostics. In this way, future products have the...
potential to provide better drug delivery systems that are demonstrably more efficacious and enable more patients to achieve better treatment and quality of life, both with existing drugs and with new/emerging therapies and chemical entities.

**Future Technology**

At the 2012 Respiratory Drug Delivery Conference in Arizona, a survey was carried out to establish where inhalation professionals think technology might be heading with respect to inhalation. It asked the question: “Where will inhalation technology be in 10 years?”

To stimulate discussion and tease out views on the factors affecting the uptake of technology, the survey provided reference levels of technology one might expect in the future. Participants were asked to vote for the level of technology they believed would be on the market, within an inhaler, in 2022. The technology levels were selected based on examples of technology that already exist or are in development in other sectors of healthcare. The technology levels used are shown in Table 1.

**Results and Discussion**

Respondents included representatives from pharmaceutical and device companies, suppliers, regulators and academics. Views were wide ranging, however, the spread was skewed towards more inclusive technology rather than basic user aids, and opinion was that technology will play a stronger role in inhalation in the next decade. Analysis of respondents’ views and PA’s current experience reveals a range of benefits, drivers and barriers to technology evolution.

Increased technology in inhalation products has the potential to have positive impact and provide benefits in a number of areas:

- **Reduced healthcare cost through:**
  - Improved adherence – to reduce wastage and the large consequential costs of non-adherence
  - Improved effectiveness of generic drugs – getting more out of the existing portfolio of lower cost drugs
  - Improved effectiveness of new drugs (screen and treat – personalised medicine)

- **Improved quality of healthcare, providing:**
  - Improved clinical outcomes, fewer exacerbations and fewer hospital visits/relapses
  - Improved patient services – better remote support in disease management
  - ‘De-hospitalisation’ of treatment, allowing higher levels of care at home

- **Increased revenues for pharmaceutical companies:**
  - Providing wider levels of service and support to increase revenues and shareholder value
  - Additional IP protection and increased potential for line extensions
  - Improved approval of new products through better clinical data and secured revenue in PbR scenarios

In addition, a range of drivers are influencing the consideration of inclusive technology:

**Clinical Outcomes**

Improving patient adherence through intervention can potentially reduce the significant cost of non-adherence or ineffective delivery (1,4). Compliance monitors and reminders are clinically

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**Table 1: Future technology levels**

<table>
<thead>
<tr>
<th>Level</th>
<th>Device Capability</th>
<th>Description of Technology</th>
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<tbody>
<tr>
<td>1 User aids</td>
<td>Breath actuation; dose counter (the past)</td>
<td></td>
</tr>
<tr>
<td>2 Adherence</td>
<td>Dose reminders; actuation sensors; adherence apps; web-based data transfer (the present)</td>
<td></td>
</tr>
<tr>
<td>3 Successful device use</td>
<td>Combined user feedback (BAI/flow rate etc); event capture; transmission to HCP</td>
<td></td>
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<tr>
<td>4 Successful drug delivery</td>
<td>Device verifies that the drug was successfully delivered, and indicates or transmits confirmation that the dose was in the chamber, left the device, entered the patient, and that the flow rate used was appropriate</td>
<td></td>
</tr>
<tr>
<td>5 Diagnostic device</td>
<td>Device diagnoses some aspect of disease state through, for example, measurement of biomarker</td>
<td></td>
</tr>
<tr>
<td>6 Device management</td>
<td>Fully, or partially, closed loop system that monitors condition and adjusts/recommends dose accordingly</td>
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proven to help in this regard. Feedback from advanced devices enables better estimation of what is being delivered to the lung, providing better design inputs to next generation inhalers. Improved technique through better feedback (from awareness of poor adherence) results in improved response to therapy.

**Legislation**

The inability of regulatory bodies to keep up with technological development was cited by many respondents in the survey as the main barrier to approval of technology-enhanced products. In development now are combinations of drugs, medical device hardware and software, diagnostics and even consumer products that quickly reach the limit of experienced regulators’ ability to define the optimum regulatory pathway. An example here is that Ford, working with Medtronic, has developed a prototype system that allows Ford SYNC to connect via Bluetooth to a Medtronic continuous glucose monitoring device and share glucose levels and trends through audio alerts and visual displays. It can also be linked to an iPhone asthma management system (6).

Furthermore, the spread of liability across healthcare networks implicates a regulatory landscape beyond that of the Food and Drug Administration (FDA) and the European Medicines Agency. Recent research has found that the main challenge lies in finding the right balance between very different regulatory motivations and the resulting dynamics of the communications and healthcare industries (7). Medical approaches to regulation result in closed integrated solutions where the provider has control of the architecture. To support innovation and serve a mass consumer market, mobile health needs the sort of common standards and interoperable approaches that allowed the telecommunications industry to thrive.

**Cost of Development**

The cost of developing a technology-laden product and its associated service is inevitably high. However, the extension to providing a service-based product requires a larger leap of faith so that the downstream value (savings) created can be shared upstream through initial cost increases. The value chain is likely to involve a number of new players in strategic partnerships and their margins must form part of the proposition. It is likely that currently only Big Pharma can afford integrated healthcare solutions, and undoubtedly some already have inhaled telehealth solutions in development.

**Payers and Reimbursement**

While many products can have technology applied, the business case for doing so in a manner that satisfies healthcare payers is complex. This is particularly true when the case rests on ‘managing’ a condition rather than real prevention or cure. In many cases, business propositions where healthcare providers need to pay more for increased benefit will not be acceptable if the providers do not share some
of those downstream benefits. However, technology-enhanced products could initially be available to users who are prepared to pay for it themselves, risking that this will initially result in a two-tier system. A recent positive move has been that in the UK the National Institute for Clinical Excellence (NICE) is considering offering advice to venture capital firms on the type of evidence needed for NICE technology assessments.

**Competencies**
The multidisciplinary nature of combination product development is already experienced by pharmaceutical companies that develop drug-device combinations, even if they are purely mechanical solutions. However, the development of the technology described in the survey levels ventures well outside the core competency of pharmaceutical companies and even traditional drug delivery device developers. Partnerships will be essential.

**Conclusion**
Examining the patient care cycle and mapping onto this the emerging technology levels used in the survey demonstrates that, by adding technology to inhalation therapy, control over the whole cycle of care can be achieved (see Figure 2).

Through the use of technology, pharmaceutical companies, whether knowingly or not, are moving from a product-based to a disease management and service-based model. They will need to assume more responsibility (some already are) for the clinical outcomes, beyond those proven in traditional clinical trials. Payers are moving to assessment of drug products not only on their clinical results but on the value they bring to the whole care pathway (savings in total healthcare costs) and the quality of life.

Developers of inhaled products are in a unique position in that, while it is a drug that is prescribed, the patient is actually presented with a device. Future products must move beyond that of a drug delivery device to being service-based, incorporating features such as user-preferred settings, dose and adherence monitoring, condition-related lifestyle aids, integrated diagnosis and web-based disease management. Once we see the device in this system context, all manner of new possibilities emerge.

**References**
3. Smith BD, Megatrends that will impact the future of Medtech, Clinica Medtech Intelligence, November 2012

**Figure 2:** Patient care cycle with technology levels
Source: PA Consulting Group

Phil Seeney, a mechanical engineer with a DIC (ICSTM) and MDes (RCA), obtained his BSc in 1975. He developed strong engineering skills in industry, transitioning to product design and medical device development after studying at Imperial College and the Royal College of Art. With 40 years’ development experience – FMCG, consumer product and healthcare – and 20 years specialising in drug delivery, he is no stranger to innovation. Phil’s experience extends beyond the development of innovative products. He has conducted numerous technology identification and due diligence projects for blue chip pharmaceutical clients and developed low-cost product manufacturing strategies. Email: phil.seeney@paconsulting.com