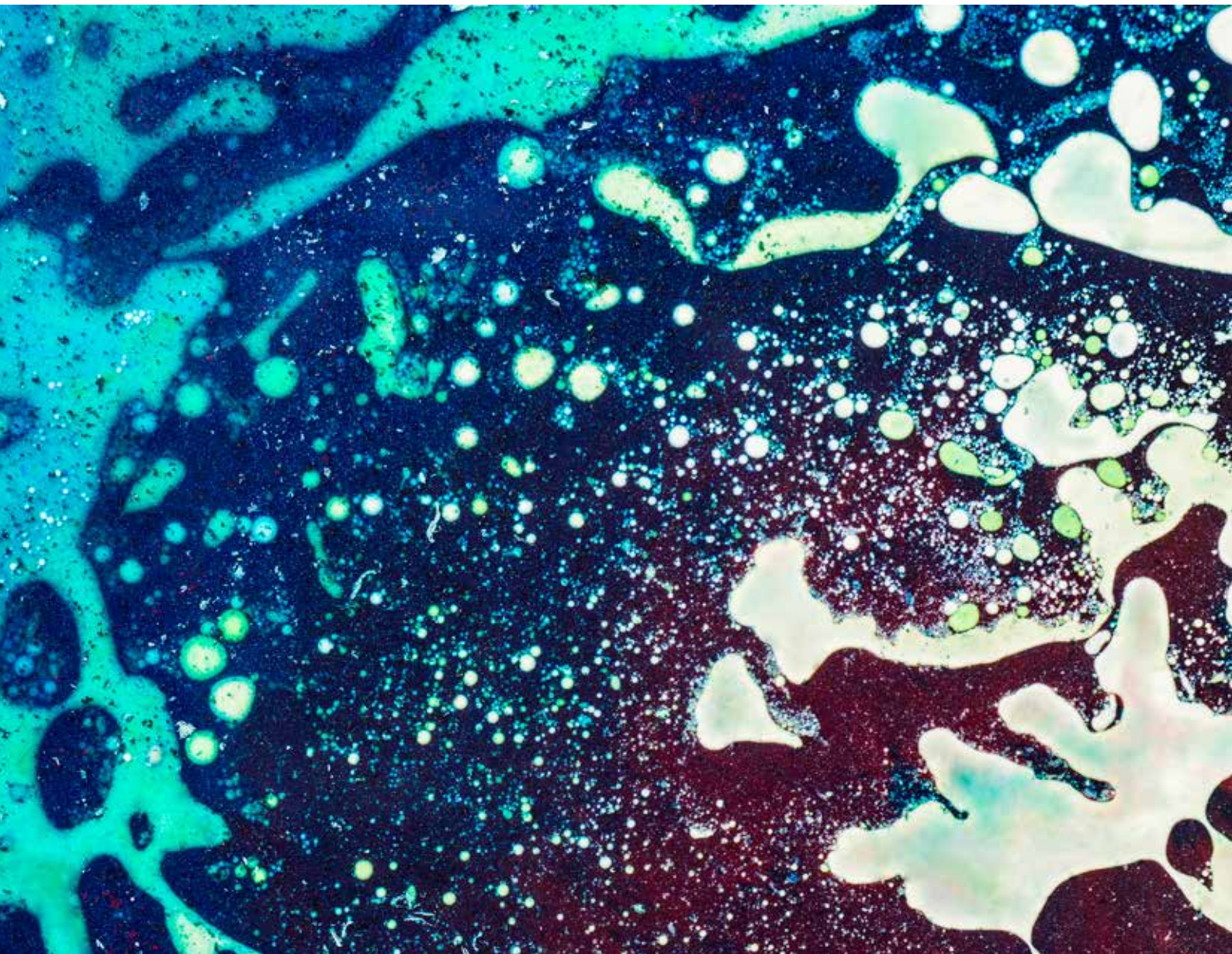


# **The Innovation Imperative:** The Future of Drug Development Part II: Barriers, Enablers and Calls to Action

A report by The Economist Intelligence Unit



**The world leader in global business intelligence**

The Economist Intelligence Unit (The EIU) is the research and analysis division of The Economist Group, the sister company to The Economist newspaper. Created in 1946, we have over 70 years' experience in helping businesses, financial firms and governments to understand how the world is changing and how that creates opportunities to be seized and risks to be managed.

Given that many of the issues facing the world have an international (if not global) dimension, The EIU is ideally positioned to be commentator, interpreter and forecaster on the phenomenon of globalisation as it gathers pace and impact.

**EIU subscription services**

The world's leading organisations rely on our subscription services for data, analysis and forecasts to keep them informed about what is happening around the world. We specialise in:

- **Country Analysis:** Access to regular, detailed country-specific economic and political forecasts, as well as assessments of the business and regulatory environments in different markets.
- **Risk Analysis:** Our risk services identify actual and potential threats around the world and help our clients understand the implications for their organisations.
- **Industry Analysis:** Five year forecasts, analysis of key themes and news analysis for six key industries in 60 major economies. These forecasts are based on the latest data and in-depth analysis of industry trends.

**EIU Consulting**

EIU Consulting is a bespoke service designed to provide solutions specific to our customers' needs. We specialise in these key sectors:

- **Consumer:** Providing data-driven solutions for consumer-facing industries, our management consulting firm, EIU Canback, helps clients to enter new markets and deliver greater success in current markets. **Find out more at: [eiu.com/consumer](http://eiu.com/consumer)**
- **Healthcare:** Together with our two specialised consultancies, Bazian and Clearstate, The EIU helps healthcare organisations build and maintain successful and sustainable businesses across the healthcare ecosystem. **Find out more at: [eiu.com/healthcare](http://eiu.com/healthcare)**
- **Public Policy:** Trusted by the sector's most influential stakeholders, our global public policy practice provides evidence-based research for policy-makers and stakeholders seeking clear and measurable outcomes. **Find out more at: [eiu.com/publicpolicy](http://eiu.com/publicpolicy)**

**The Economist Corporate Network**

The Economist Corporate Network (ECN) is The Economist Group's advisory service for organisational leaders seeking to better understand the economic and business environments of global markets. Delivering independent, thought-provoking content, ECN provides clients with the knowledge, insight, and interaction that support better-informed strategies and decisions.

The Network is part of The Economist Intelligence Unit and is led by experts with in-depth understanding of the geographies and markets they oversee. The Network's membership-based operations cover Asia-Pacific, the Middle East, and Africa. Through a distinctive blend of interactive conferences, specially designed events, C-suite discussions, member briefings, and high-calibre research, The Economist Corporate Network delivers a range of macro (global, regional, national, and territorial) as well as industry-focused analysis on prevailing conditions and forecast trends.

# Contents

<b>Foreword</b>	<b>2</b>
<b>Impetus for the research program</b>	<b>3</b>
<b>Innovations prove impactful but face adoption barriers</b>	<b>6</b>
The data are vast, new—and fragmented	7
The workforce is not large enough or adequately trained	8
Payers and patients have negative perceptions of pharma's approach to innovation	8
Cultural barriers surround drug development and innovation	9
The known unknowns—understanding the true barriers today and in the future	11
<b>Overcoming challenges by enabling future innovations</b>	<b>12</b>
Advanced data and analytics	14
Workforce readiness	15
Collaborative partnerships	17
Early regulator, payer and patient engagement	18
<b>Conclusions and calls to action</b>	<b>23</b>
<b>Appendix</b>	<b>25</b>
Methodology for qualitative analysis	25
<b>References</b>	<b>28</b>



## Foreword

**P**art II of *The Innovation Imperative: The Future of Drug Development* is a call to action. Together with the deep and insightful findings presented in Part I, it lays out a blueprint for reversing one of the most talked-about and worrying trends in healthcare: the unsustainable path of drug development. Encouragingly, it provides evidence that, by and large, the tools required to significantly improve all key performance indicators in this industry already exist, and can be leveraged by eliminating inertia and focusing on the right set of powerful enablers for success.

As part of our organization's heritage, The Economist Intelligence Unit (EIU) has a long history of questioning the status quo through a holistic understanding of the world, fact-driven analysis and thought-provoking conclusions. In the health arena this translates into reinforcing the much-hyped but still not fully implemented shift towards value across the continuum of care, as this is the most logical and in all likelihood, the only way to achieve a sustainable system in the future. Much of our work on this topic over the past decade has sought to educate and guide participants by breaking down issues to their core and building them back up through a combination of real evidence and pragmatic application.

While many (including the EIU) have devoted attention to assessing the demonstrated impact of specific health policies and interventions, little work has been done on how to transform an inefficient drug development system. This is a critical component of the value equation, as the flow to market of timely, safe and accessible new drugs that improve patient outcomes is necessary to combat growing societal health challenges. In this sense, discovering avenues for greater productivity in drug development will in turn help to facilitate a process that is crucial in keeping pace with the promise of medical science.

I was struck by a number of insights arising from our research. While it was not a shock to see that key innovations have a positive impact on improving drug development, it was a revelation to find such a consistent effect across multiple success metrics, geographies and therapeutic areas. It was also immensely valuable to quantify this impact for the first time, as simply assuming it to be true does not act as an impetus for measurable change. At the same time, I was encouraged to see so much recognition by experts around the importance of not just understanding the science of data analytics, but of actively seeking to create a collaborative ecosystem in which data and knowledge could readily flow among the people who want to build upon the learnings of others.

It is also clear that the path forward is not a linear one, or simply a matter of institutionalizing the innovations studied. As this report lays out in detail, there are building blocks that require attention and investment in order to support the innovations to come as well as the ones we have in our toolkit today. And while high-profile topics like big data and collaborative partnerships garner much attention (with good reason), we should not lose sight of less hyped but equally critical issues like the necessity of providing the workforce with the skills needed to adapt to whatever may come in the future.

In the end, our hope is that this research incites not just educated dialogue among stakeholders but, more importantly, collective action with a common purpose: to foster a dynamically innovative and ultimately sustainable approach to developing future drugs that will have a positive impact on patients.

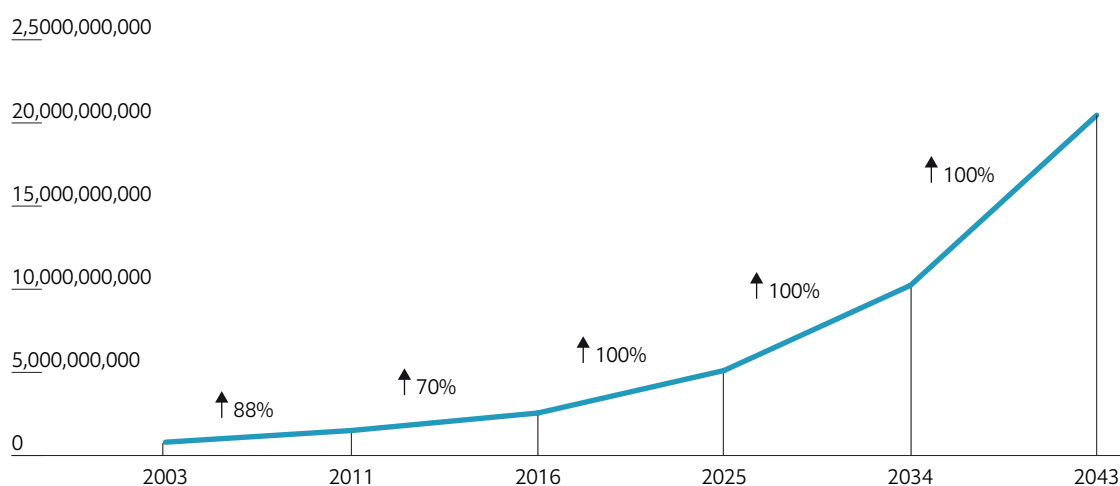
*David Humphreys, Head of Health Policy & Clinical Evidence Practice, EIU Healthcare*

## Impetus for the research program

While innovations across many industries are driving better returns and greater efficiency at lower costs, this is not the case with pharmaceutical drug development. In fact, the research and development (R&D) process has become more expensive over time, exacerbated by the end of the blockbuster drug era, the patent cliff, and increasingly complex trials and regulatory and payer approvals processes.<sup>1,2</sup> This process, known as Eroom's Law (the observation that drug discovery is becoming slower and more costly over time), represents the major challenge facing drug companies in today's development landscape.

**Figure 1: Projecting future R&D costs per drug**

(Eroom's law)



Source: EIU calculations based on Mestre-Ferrandiz J et al and DiMasi JA et al. <sup>7,8</sup>

The urgency around the adoption of innovation in drug development cannot be overstated in an industry with a failure rate that can be as high as 90%, in which the average time to market for a new drug has hovered around 12 years for the past three decades and where the R&D costs of developing a drug more than doubled between 2003 and 2016.<sup>3,4,5,6</sup>

At the same time, the R&D pipeline is obviously a significant expense for pharmaceutical companies (especially given that overall investment in development picked up in 2017).<sup>53</sup> Still, despite the imperative for innovation that this predicament presents, productivity has stagnated or fallen.<sup>53</sup>

So far, the pharmaceutical industry has been slow to react to new innovations in drug development, particularly in comprehensively assessing the impact of new approaches. This has left it without the necessary evidence to prove the effectiveness of drug development innovations to both industry insiders and other stakeholders—notably regulators, payers and patients.

Healthcare systems and patients face the consequences of this uneven performance. The ramifications include higher drug costs and longer times to market—and the access issues arising from these factors. Aging populations, the rising prevalence of chronic diseases and healthcare budgets

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

---

that outstrip inflation all increase the financial burdens of healthcare on governments and families. Ultimately, the costs to society of little or no progress in drug development productivity are both human and economic.

The worrying trends on cost, time to market and patient impact suggest that overcoming entrenched risk aversion and leaning into the opportunities that innovation offers is imperative. With this in mind, PAREXEL commissioned The Economist Intelligence Unit (EIU) to evaluate the dynamics of innovation in drug development and gain an understanding of current perspectives among industry stakeholders. The result was a study that examined measurable innovations in drug development and identified the underlying factors that both hold these innovations back today and will allow them to thrive in the future.

To generate credible and actionable insights on this daunting topic, the EIU carried out a global research program covering two equally important facets. The first centered on examining the role of innovations in improving drug development in key measures of success. Through a literature review and working with a set of experts drawn from across the drug development continuum, the EIU identified four innovations deemed worthy of further assessment for their potential impact on the future of drug development:

- **Adaptive trial designs:** trials that incorporate pre-specified modifications into the protocol, allowing for changes once the trial is in progress based on interim data analysis.
- **Patient-centric trials:** trials that consider and/or include patients in trial design and execution.
- **Precision medicine trials:** trials that test precision medicines, including the use of genotyping and biomarkers to identify patient groups likely to respond to the therapy.
- **Real-world data trials:** trials that include one or more measures of the impact that a therapy has in real-world settings, rather than just in the trial environment.

In the comprehensive data-driven report, *Research Methods and Findings*, the EIU assessed the impact of these four innovations using metrics identified from the literature and endorsed by the expert panel, spanning drug development and market access. Across all three metrics—trial efficiency (total trial time, including recruitment and treatment), likelihood of launch and formulary or market access approval—we found that the selected innovations delivered strong results.

Despite the seemingly clear evidence uncovered by our quantitative study of the four innovations, they are yet to be widely accepted within the drug development landscape. With that in mind, the second part of the EIU's research effort aimed to round out the analysis by seeking explanations for the observed low adoption rates of selected innovations and providing recommendations for future actions to overcome this. To answer these questions, we further probed our experts (and expanded our reach to others), seeking to understand lessons from cases of success from around the globe. This allowed us to highlight potential barriers to the adoption of drug development innovations, and to identify ways in which they can be enabled to thrive.

*Barriers, Enablers and Calls to Action* makes a compelling case for the creation of an environment where such promising tools as real-world data and precision medicine can be leveraged to their full potential. As part of that goal, the study argues for a more robust approach to key issues such

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

---

as workforce training and partnership networks. It also makes clear that, to reap the rewards of innovation, conventional ways of doing things must evolve. Connecting silos—which have traditionally separated competitors, payers, patients and regulators—and instilling a culture of collaboration are vital to successful clinical outcomes.

The culmination of this research is a call to action for all stakeholders involved in drug development. It provides the foundation for debate and discussion on how to lean into change. It raises important questions about the long-term value of established approaches and entrenched organizational behaviors. And it opens the door for some genuinely blue-sky thinking on ways to transform a system characterized by caution and a reliance on established processes. In this sense, the study aims to stimulate broad discussion on how the industry can and will have to evolve, recognizing that no change is not an option.

## Innovations prove impactful but face adoption barriers

**T**he EIU's data-driven analysis of innovations in drug development (adaptive trial designs, patient-centric trials, precision medicine trials and real-world data trials) has produced very encouraging signs for an industry desperately seeking a system-wide improvement in productivity. Consider:

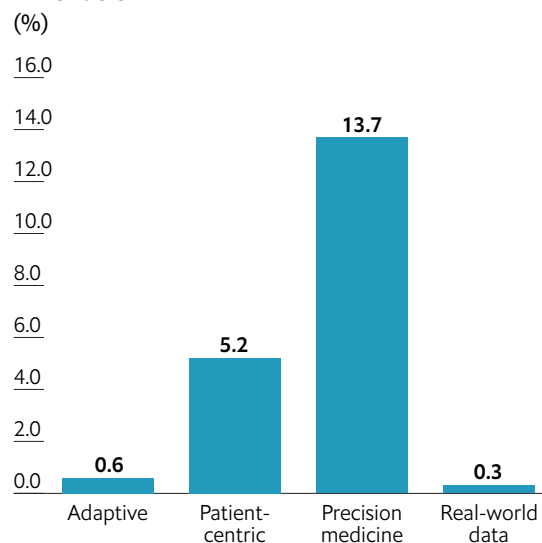
- Trial efficiency demonstrated improvement through the adoption of innovative trial types, with patient recruitment time reduced by at least 37% for all the selected therapy areas studied;
- Drugs developed using innovations were more likely to be launched, with the chances increasing by upwards of 21%; and
- Drugs developed using innovations were also more likely to be added to payer formularies or other national approved-drug lists, with the greatest differences found in US Medicare formularies and some publicly funded European lists.

Nevertheless, although the data on the innovations assessed provide a clear indication that these innovations may prove invaluable to the future of drug development, their success is not guaranteed. Indeed, adoption rates for each innovation are alarmingly low, as shown by the chart below.

On the surface, the reason for this could simply be the newness of the innovations themselves. The application of real-world data has by and large occurred in post-marketing trials; yet other innovations, such as adaptive trial designs, have existed since the late 1990s without being widely adopted. More importantly, the evidence demonstrates the potential for greater adoption, with precision medicine trials in oncology surpassing the average rate of adoption by 5 percentage points, while at the same time collective use of all the innovations studied differed by geography, with the US surprisingly lagging behind.<sup>i</sup>

The message put forward by the experts engaged in our qualitative research also confirms this view: that without the right building blocks in place, the best innovations will encounter significant bottlenecks. From the slow-moving nature and entrenched processes of big pharma to the challenges thrown up by differences in countries' regulatory environments, much action is needed to enable these new and exciting drug development innovations to fulfill their potential on a global scale.

**Figure 2: Adoption rates of the selected innovation \***



\* Innovation adoption rate is defined as the number of phase II & phase III trials indicating use of innovation during the above period, as percentage of trials where innovations were not present from the same period of time.

Source: Trialstrove® | Pharmaintelligence, 2018. Data: 2012-2017.

<sup>i</sup> Based on EIU analysis of geographic distribution of total trials and use of each innovation.



Even bearing this in mind, often what most people would expect to be the greatest obstacles do not prove to be significant—or at least not the most significant—barriers to adopting innovations in drug development. Regulatory bodies are an obvious target as they are the gatekeepers for the adoption of innovations in drug development, but, as demonstrated by the plethora of successful cases highlighted later in this study, regulators are in fact often open to and actively encouraging of innovation. “I get frustrated when people point to regulators as a barrier,” says Craig Lipset, Head of Clinical Innovation at Pfizer. “We’re not operating at a level where they are our limiter. Culture is more of a barrier. There is a lot more capacity to do more with what we have before needing the regulator to do more.”

Digging deeper into the barriers to innovation produces a list of mostly long-standing, deeply entrenched issues. Among the problems raised by our experts were some that are perhaps not that surprising and which were often issues that we had suspected might be slowing innovation. Many companies have made attempts to overcome them, but have failed to systemize well-intentioned but small-scale change initiatives. Other barriers have built up in recent years as systems and human capital have failed to keep pace with advances in science and technology. Nevertheless, as attested to by our research and our panel of experts, it is the collective impact of these impediments that has contributed to stifling the selected innovations studied, as well as other innovations in drug development.

### **The data are vast, new—and fragmented**

*“One of the key changes in today’s world is the fact that we have data along the entire process—and data are fragmented.”*

*Expert during the October 2017 panel event*

Recent years have seen exponential growth in both the sheer amount of data and the types of data used in healthcare research and drug development. This has been characterized by three primary characteristics, the “three Vs” of big data in healthcare: volume, velocity and variety.<sup>7</sup> Old ways of collecting data such as radiology images and personal medical records have been joined by newer methods, ranging from biometric sensors and genomics to social media.<sup>8</sup> The result is a vast quantity of data, gathered by a broader set of sources drawing in more patients and creating billions of data points, which is increasingly available as a steady stream of constant—and constantly accruing—information.

This potentially creates a huge opportunity for drug developers to adopt innovations—but it also presents challenges. A theme returned to repeatedly by our expert panelists was that data are kept in silos, whether held by payers, academic institutions, commercial drug developers or other stakeholders. This is partly because the rapid growth of data use and availability has meant an uneven and uncoordinated approach to data collection and storage, but it is also because—particularly in the commercial sphere—secrecy has dictated that data are not made widely available, nor are methods of data collection shared.<sup>9</sup>

The upshot is a vast array of data fragmented between silos and stored and collected according to the specific structures and methods used within the individual repositories. “The data are in a format that doesn’t talk to each other,” said Dr Roy Auty of Genentech in our panel discussion. Until data silos are bridged, data will be underused and will not be sufficiently exposed to those who can find new ways to take advantage of them across the development spectrum.

Opening up data silos will also enable wider input on how to improve data collection and usage. “We need to improve the quality of the data that we gather, but we also need to connect that data,” says Bernard Munos of FasterCures. The latter will be one way of working towards achieving the former goal.

## The workforce is not large enough or adequately trained

“We have exponential growth in demand for research and patients, but we have linear growth in the people doing the work—and the gap is getting larger.”

*Jim Kremidas, Executive Director, Association of Clinical Research Professionals*

Increased adoption of the four selected innovations studied in our quantitative analysis requires the employment of workers in new roles, as well as the training of existing workers so that they are capable of modifying their practices and adopting new ones. Furthermore, trials utilizing selected innovations are complex and often take place on a larger scale (in terms of both participant numbers and number of data points) than standard clinical trials.

The key workforce deficiency highlighted by our panelists relates to the ability to handle and interpret data. Of the four innovations that we have highlighted as key to creating a more efficient drug development environment, the use of real-world data is the one that is most obviously linked to the vast quantities of data, and the numerous modes of data collection, that are now available. But all four innovations benefit to a significant extent from—and so are reliant on—the ability of drug developers to access and make use of data from differing sources, in different formats and of variable quality.

Alongside this vast quantity of siloed, often hard-to-access data, panelists identified a paucity of knowledge among the workforce about how to handle and interpret medical data. Referring to the rapid increase of data being collected, Mr Munos raises a key question: “What do you do with this data? As an industry, we don’t know what to do with it, because we’ve never had it before.” Part of the solution may be to bring in data specialists, but much will rely on training the existing and future members of the drug development, regulatory and payer workforce.

Moreover, although the gathering, management and analysis of data is key to the innovations that we have highlighted, a more holistic approach to recalibrating the workforce is needed as drug development shifts away from a reliance solely on controlled trials. “There’s a gap in more than just data analytics,” says one expert from our October panel discussion. “How do we build people’s competencies? [...] We need to start thinking about how we build the workforce.” As we will see in subsequent pages, workforce competencies vary regionally, both overall and regarding specific areas, as does the training available.

## Payers and patients have negative perceptions of pharma’s approach to innovation

“Perception means a lot in the payer world,” said Dr David Epstein, a former Medical Director of a large national health plan during our panel discussion. Something described as a pharmaceutical innovation is often received with concern and skepticism in the payer community. The terms innovation, along with similar terms such as novel therapy or unique mechanism of action usually come with very expensive price tags. And these price tags are often additive to current first and second

line therapies despite the often marginal improvements offered by the so-called innovative drugs.” As drug development has become slower, more difficult and more expensive, pharmaceutical firms have sought to find alternative ways to bring products to market and to boost their revenue streams; this has often proved controversial and has given rise to negative perceptions of the drug development process.

“Perception means a lot in the payer world.”

*Dr David Epstein, former Medical Director of a large national health plan*

Panelists highlighted a drive by the pharmaceutical industry to refresh revenue streams by developing treatments for subsets of diseases, thus expanding the orphan drug sector. “As patents have expired, we basically have been replacing drugs that treat millions with drugs that treat thousands,” says Mr Munos. “Pharma then increases the price of these drugs by thousands.”

Pricing and questions over the true value of innovation are perhaps too easy a stick with which to beat an increasingly pressured pharmaceutical sector. But these negative perceptions need to be fought in a way that increases trust in pharmaceutical companies and encourages both payers and patients to engage fully with the drug development process. “How do you have a better understanding of the value proposition for payers?” asks Jim Kremidas, Executive Director at the Association of Clinical Research Professionals. “How do we get drugs to the market faster that are going to truly have an impact on patients?”

Countering negative perceptions is not only about garnering positive sentiment once a drug hits the market; it will also encourage (and further benefit from) early involvement by payers, and may boost patient engagement with trials. This is especially true of two of the innovations that we assessed, namely patient-centric trials and precision medicine trials.

As the market becomes more demanding, drug developers will increasingly need to earn the trust of payers and patients, partly through engaging both sets of stakeholders in trials, and partly through providing increased transparency regarding how the drug development process works and how developers define a drug’s value when determining its price.

Although patients welcome new innovations, they tend to view the pharmaceutical industry as highly profitable and, as the author of one research paper puts it, “faceless.”<sup>14</sup> Conversely, patients are increasingly driven to seek out information about potential new treatments, and able to do so. They are also—either through the advocacy of patient organizations, or simply by spreading the word loudly across the internet and the media—able to make their voices heard.<sup>15</sup> A more transparent, more patient- and payer-conscious pharmaceutical industry would be more likely to gain the trust—and the input—of patients and payers as it works to develop innovative new treatments.

## Cultural barriers surround drug development and innovation

The drug development process is a high-risk one—with high rates of failure throughout the process—and there is only so much that can be done to mitigate that risk.<sup>35</sup> Therefore, all involved in drug development have to live with this high level of risk daily and in the long term. This lack of control over risk can lead to risk aversion in other areas, such as the adoption of innovations. The risk involved

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

---

in current processes is at least known, so what is the incentive to implement innovations where the degree of risk is unknown? It could be lower, but it could also be higher.

Thus, a change in culture – or as one expert panelist describes it a stronghold of clinical trial mentality – all along the drug development pathway, is required if the innovations studied (and others to come) are to be widely adopted. This is as true for those working in regulatory agencies and payer bodies as it is for those developing drugs within commercial and academic settings.

One critical issue is the invisible walls within organizations that prevent much-needed collaboration; just as there are data silos, so there are also “people silos.” It is difficult to connect people to enable them to work effectively together in order to design and deliver innovation, yet such co-operative forms of working can breed innovation.<sup>35</sup> Mergers and acquisitions are popular routes, but even newly acquired companies may remain relatively siloed from developers’ other research operations. The agile approach that made such start-ups attractive can be diluted by companies’ overarching corporate culture. The cultural barrier to implementing innovation in drug development, then, often lies in communicating the value of an innovation in a way that would enable people working in what is already a high-risk industry to feel they can take an additional risk. The implementation of innovation succeeds where it has powerful allies who give it time and space to bed in.

**“The number one obstacle to innovation is our lack of basic understanding of the disease.”**

*Bernard Munos, Senior Fellow, FasterCures*

Another related aspect of cultural deficiencies comes at the earliest stage of the drug development process, and consists of a neglect of basic research. “Basic research is lacking,” says Dr Auty. “The pharmaceutical industry is incentivizing a lot of folks who are doing basic research to do more and more applied research. And so we are actually eroding our basic science base in favor of an applied science base.” Leaving basic research primarily to academia—even if, increasingly, small start-ups are also involved—largely shifts the burden (from a funding and knowledge perspective) from pharmaceutical firms to universities and, even more, to governments.

This also implies that the earliest stages of research towards potential drug innovations are at the mercy of cuts in government spending. US government spending on basic research fell below 50% of overall spend on basic scientific research for the first time in 2013 and dropped to 44% in 2015, and although pharmaceutical industry spending increased rapidly between 2008 and 2014, it provided only US \$8.1bn of the total in the latter year.<sup>16</sup> Similarly, in the UK and the EU, Brexit poses a potential imminent threat to research funding.<sup>17</sup> If government funding remains on shaky ground in such major markets, it remains to be seen to what extent industry will be willing to direct funding towards the long-term, uncertain-reward structure of basic research, especially if this involves reducing funding of later-stage developmental science, where potential commercial gains are more clearly in sight.

Such a separation of basic and later-stage research not only creates a divide with a key cornerstone in drug development, but can also feed back into the silos mentioned previously, whereby those conducting basic research face not being effectively connected with those working on later-stage developmental research. Small start-ups offer one source of potentially ready-made basic research organizations that could be incorporated into the wider research practices of pharmaceutical

companies, but even these remaining risks relatively are cut off from developers' other research operations.

### **The known unknowns—understanding the true barriers today and in the future**

The research points to a multiplicity of factors that have limited broader adoption of the innovations that our study has shown are successful. The natural inference, thus, is that surmounting these hurdles around uptake should lead to higher adoption rates. However, that conclusion makes the false assumption that all the barriers are well defined; as one expert put it, "Clearly, the problem in this whole drug development process is that we don't understand what the problems are."

In this sense, there are still additional issues in drug development to explore and understand in order to identify and overcome the factors that truly hold back innovation. Although the issues discussed above appear to be the most likely set of hurdles based on the past experience of our experts, many of the same people also recognize that there is lack of understanding as to why these selected innovations have not achieved greater penetration. Much as the quantitative results of our work definitively showed the positive impact of specific innovations (thereby confirming what was previously merely assumed to be true), it is critically important to continue to study the obstacles preventing wider use of these innovations, especially as future innovations and their unique barriers have yet to be explored.



## Overcoming challenges by enabling future innovations

**T**he data analysis for the innovations studied presents a promising path towards redefining and empowering drug development and market access. However, if these and other innovative approaches are to thrive in the future, the right building blocks must be put into place to facilitate their success.

Taking a further in-depth look at the panel discussion and the qualitative interviews that we conducted, we identified four enabling factors that will help in overcoming the barriers limiting uptake of the innovations that we assessed. While the list is by no means exhaustive, these factors are emerging as areas of critical importance for industry transformation:

- **Advanced data and analytics**
- **Workforce readiness**
- **Collaborative partnerships**
- **Early regulator, payer and patient engagement**

Collectively, the enabling factors outlined here point to an overarching need for significantly more interoperability and partnership in the industry.

Connecting data silos—such as information fragmented across databases—will allow wider, easier access to data, further facilitating **data analytics**. Combined with this, investment is needed in developing an **appropriately skilled workforce** that can work towards delivering innovative trial design backed by big-data use. Connecting “people silos” through **partnerships** between potential competitors—and perhaps unexpected collaborators—will kick-start innovation and enable leaders to develop a longer-term vision beyond their own specific projects. **Early engagement** with regulators, payers and patients will ensure that innovation is undertaken in a way that is relevant, well executed, cost-effective and most likely to succeed.

In the following pages we look at these enabling factors in more detail, including a clear linkage (see Table 1, at the end of the section) between these factors and selected innovations analyzed.

### Advanced data and analytics

Our findings emphasized the importance of integrating data capture and analytics across the entire drug development and market access continuum. All the experts interviewed agreed that in healthcare there is often not a shortage of data, but rather an issue of connecting data within and across organizations.

**Data sharing and interoperability:** Data are siloed into payer and provider databases that capture individual patient outcomes, organization-level data, disease- and country-focused patient registries, and the data collected by drug developers. Standards, such as those developed by the International Organization for Standardization (ISO), exist to harmonize technical aspects of data. Furthermore, the

China Food and Drug Administration has issued a technical guide for clinical-trial data management, recommending the use of standardized clinical-trial data systems and specifying technical requirements to encourage a move away from paper-based systems and towards interoperable digital systems that can advance drug research and development in China.<sup>28</sup> However, the worldwide environment is still plagued with systems that cannot speak to each other and data that cannot be easily aggregated and compared.

Bridging these data silos could enable greater data sharing and transparency across the industry, potentially driving efficiencies, as suitable data could be shared and reused rather than having to be recreated over and over again. The European Cystic Fibrosis Society Patient Registry (ECFSRP) has been successful in compiling data from 20,000 people with cystic fibrosis across 16 countries.<sup>18</sup> This is a significant feat: such a connected dataset has saved researchers time and money, and has enabled them to secure access to disparate datasets and, ultimately, to accelerate research in this therapeutic area. Panelists pointed out that resistance to this type of approach, driven by a reluctance to share

### **Case study: Connecting researchers and data**

RD-Connect is an EU-funded integrated network that connects databases, registries and biobanks for rare-disease research.<sup>19</sup> It has developed a number of products that seek to address these data issues. The RD-Connect Genome-Phenome Analysis Platform allows scientists and doctors around the globe to evaluate and share next-generation sequencing data for research and diagnosis, free of charge.<sup>20</sup> The company has developed tools relating to multi-omics, an

approach that simultaneously explores the relationships and behavior of molecules within cells across datasets. The resulting big data can be used to provide insight into how particular genetic variants of a disease cause specific symptoms. A better understanding of the genetics behind rare diseases can improve prognosis and the design of bespoke therapies. RD-Connect has also created a set of standards—Findable, Accessible, Interoperable, Reusable (FAIR)—to harmonize data from different sources ranging from archives and health records to biobanks and global directories of rare disease patient registries.<sup>21</sup>

### **The expert panel speaks**

Collecting, analyzing and developing actionable insights from data was a prominent topic in our expert panel session, given its importance for the future of drug development and market access. Two ideas stood out:

- Creating agnostic data platforms where an independent third party facilitates access to data without being a user. This would connect data silos and enable greater data sharing. Rather than chopping data up into proprietary databases,

independent registries and data platforms enable researchers to build larger datasets and draw more meaningful conclusions.

- The panel drew an interesting distinction when discussing AI, as they preferred the definition “augmented intelligence” rather than “artificial intelligence.” So technology could be deployed to complement and augment human capacity rather than to replace it. Using this approach to harness large datasets is already a reality today. Positioning AI as an aid to humans could help to bring sceptics and protectionists on board.

potentially valuable data, is declining as companies and researchers embrace eSource and real-world data (RWD). Researchers can work together, for example, to develop and share digital biomarkers. The victor, in a business sense, is the organization that can bring new knowledge back into the company and use it to contribute to the development of a new treatment.

**Data prioritization:** Managing the quantity of data that exists is also a challenge, particularly as RWD is increasingly being used. Whereas trials might previously have collected data from patients a few times a month, data from wearable technologies (such as fitness trackers and blood pressure monitors) can be collected at shorter intervals or on a continuous basis, creating millions of data points.<sup>22</sup> So the role of data analytics can and will be to define what we need to collect, how we collect it and what we do with it. Commonly agreed standards are needed as we shift from traditional data-gathering to these dynamic and continuous methods, to ensure that we are not overwhelmed by large volumes of theoretically useful data that we do not know how to analyze.

**Integrating alternative data sources:** The research around drug development demonstrates that patient enrollment currently takes up a large proportion of the available time and resources in clinical trials. Thus, there is a great opportunity (not to mention appetite) to streamline this process, with the use of data technology—and particularly patient registries—having the potential to become a mechanism to increase the efficiency of patient enrollment. As an example, the Clinical Trials Matching System (CTMS) searches the CNExT cancer registry using inclusion criteria from [clinicaltrials.gov](http://clinicaltrials.gov) for potentially eligible patients for clinical trials.<sup>23</sup> This tool saves trialists time by reducing the time spent searching [clinicaltrials.gov](http://clinicaltrials.gov). Other benefits of using registries to recruit trial participants include identifying large numbers of participants, geographically diverse participants (especially important for rare diseases), ethnic minorities and people based on characteristics (via “disease-neutral registries”).<sup>24</sup>

**Predictive analytics:** Trials that are forced to terminate early or that produce inadequate outcomes (for example, underpowered sample size) represent a huge opportunity cost to drug developers. For this reason, Pfizer created a risk modeling tool using data analytics to analyze new protocols and predict problems that might arise during a trial.<sup>25</sup> Identifying such issues allows them to adapt the protocol to mitigate this risk and to put preventive measures in place when a trial begins.

### Case study: Drug repurposing driven by data analytics

The field of data analytics is transforming the field of drug repurposing, by allowing the re-analysis of big datasets to discover potential new uses for existing drugs. The financial case for drug repurposing is clear: time can be saved in discovery and development—especially where regulators will accept safety data from previous indications. An extension of marketing authorization from the European Medicines Agency (EMA) costs €86,100

for a minor or major variation, compared with authorization for one pharmaceutical form at one strength for one presentation, which starts at €286,900.<sup>26</sup> A Harvard University research group has launched several databases that harness big data and computational methods to help to identify drug repositioning opportunities.<sup>27</sup> These databases are published open source, meaning that anyone can access the code, adapt it or improve it (via GitHub). The signals that these big data findings provide can then be explored using conventional methods such as clinical trials.

## Workforce readiness

“Training is very much needed in China. Clinical research capability building is key in promoting innovation after regulatory reform in order to move more innovative products into clinical trials in China. There should be more training programs regarding ICH as well – from industry and regulators.”

*Carol Zhu, Senior Vice-President and Managing Director, Drug Information Association, Greater China*

Industry transformation, tightening external conditions and evolving data and technology raise questions about whether the industry has nurtured and maintained appropriately trained data science professionals. Specifically, without sufficient workers involved in drug development who have a deep understanding of data as a science, the possibility of a significant barrier to data use is clear.

**Collecting and managing unconventional data:** RWD is a good example of where inadequacies in the data science workforce can hold back innovation. The collection of RWD, such as data from electronic health records or patients’ wearable technologies, offers great promise for providing insights into the safety and effectiveness of drugs outside of tightly controlled clinical trials. However, properly managing this presents several challenges, including how to collect data (arranging data sharing agreements, anonymization, etc.), how to store these vast datasets<sup>28,29</sup> and how to extract real-world evidence from real-world data.

But by far the biggest obstacle related to data is not how to collect data, but rather how to interpret data in a way that is actionable. There is a need for a data-savvy workforce to bring structure and meaning to these data through complex analytics.<sup>29</sup> For instance, in China there is a lack of academic programs to train new and existing researchers in RWD, and also a lack of training opportunities for doctors, policymakers and industry personnel to improve their understanding and uptake of these methodologies.<sup>28</sup> Technical solutions are central to this, but they require a skilled workforce to implement them, ensuring that analyses are appropriate and accurate.

### The expert panel speaks

In terms of preparing the workforce for a future data-driven world, the panel suggested formalizing partnerships between data science and medicine to better connect these complementary disciplines. Currently, data science is a distinct discipline that intersects with healthcare. However, data science could be better integrated into healthcare through medical curricula, specialist continuing medical education and collaborative working partnerships.

At the same time, throwing money at the workforce is not the sole solution. The panel recommended the compilation of core competencies that would feed into the creation and enforcement of standardized certification for individuals involved in conducting clinical research. Setting such standards would enable drug developers to have greater confidence in individual trialists and centers, as well as giving them scope to hold poorly performing individuals and centers accountable.

**Continual improvement:** Another bottleneck in workforce preparation relates to the quality of existing educational mechanisms. A systematic review of training programs for trial recruiters found

little evidence to indicate that this training improved patient recruitment to trials.<sup>56</sup> An earlier Cochrane review found the same results when looking at all methods (rather than just training) of improving trial recruitment.<sup>30</sup> These reviews highlight the need to evaluate training programs to ensure that their impact justifies any investment required.

Innovations for conducting clinical trials in drug development also require trialists who are familiar with these data and analytical methods. Adaptive trials, for example, can overcome many of the pitfalls of conventional study design but are equally vulnerable to type 1 errors if poorly designed and executed. To enable this innovation to be widely and effectively implemented, there is a clear need for a workforce that can design, execute and analyze the findings of these innovative trials.

Is it possible for a workforce that is so steeped in randomized control trial (RCT) methodologies to manage this? To implement adaptive trials requires people and workforce management to identify gaps in knowledge and experience, determine suitable training solutions and secure funding for training. Capability-building was highlighted by panelists as vitally important, especially as the drug development pathway evolves to incorporate new practices and new technology (particularly in relation to the collection and analysis of data). Both industry and regulators should have a hand in this, but pharmaceutical companies specifically will need to develop multifunctional teams that include workers who understand the technology—that is, who bring in new-technology-related knowledge and skills from outside of the pharmaceutical industry.

Overall, both the experts engaged and literature review findings indicate that inadequate workforce readiness is a key hurdle that must be overcome if drug development seeks to become efficient. The panel highlighted gaps in trial execution, particularly around variation in the competencies of individuals and entire trial centers. This ranged from sites that underperform in trial recruitment due to a lack of effort, to more worrying issues around data accuracy and quality. The panel felt that this was an area that had not received sufficient attention in recent years. Allocating adequate resources

### **Case study: Turning big data into usable knowledge through training**

Training and recruiting a skilled big data workforce is challenging. The Big Data to Knowledge (BD2K) training project is one program that attempted to provide the necessary foundations for big data to flourish. Running in its first phase from 2013 to 2016, BD2K<sup>31</sup> is the US National Institutes of Health's project to train a national workforce in biomedical data science. Launched with an initial US\$200m in grant awards, the program sought to broaden the use of big data by cultivating and circulating methods of analysis and software, by establishing training programs necessary for large-scale data

analysis and by setting up centers of excellence for biomedical big data.

BD2K has issued a range of awards in biomedical big data training in an effort to improve the skills base and increase the numbers of biomedical data scientists. These include grants for training and teaching at Brown University and for enhancing diversity in biomedical data science at Indiana State University and San Francisco State University. They also include funding for programs in crowd-assisted deep learning for the use of digital curation to translate big data into precision medicine at the University of California, San Francisco. In addition, the program has made training resources available to the ERuDite educational resource index.



for training individuals in areas such as clinical trial coordination and execution, as well as standardizing how clinical research is conducted and how study coordinators are trained, could drive better output and improve consistency.

### Collaborative partnerships

*“Every stakeholder has a role to play. There’s no room for everyone to be in the back seat of this car. [...] Innovation will be a story of interesting bedfellows.”*

*Craig Lipset, Head of Clinical Innovation, Pfizer*

Collaboration is increasingly recognized as key to successful drug development and market access—it is no longer a “nice to have,” but rather an essential component of the pharmaceutical business model. When done properly, it can reduce the risk that companies individually take on, and can help to spread the high cost of failure that has overwhelmed the traditional approach—“you are guaranteed to lose your entire book of business every 10 to 12 years,” as a former chief executive of GlaxoSmithKline put it.<sup>32</sup>

Some observers have raised concerns that the trend for mergers and acquisitions in the drug development industry could reduce incentives for innovation as competition is reduced.<sup>33</sup> The consolidation of competition might also make it harder for small, innovative enterprises to enter the marketplace, given the value of economies of scale and the potential for barriers to entry. But mergers—like partnerships—can also breed innovation by bringing people together and enabling a learning environment.<sup>33</sup> Mergers are complex, require access to funding and take time. Thus, this presents an opportunity for well-defined partnerships to step in and help organizations to work together and learn from each other without permanently altering the competitive landscape.

Among pharmaceutical companies there has also been an increase in pre-competitive collaboration to share data and emergent findings early on in the drug discovery and development process. “Co-opetition” is also gaining traction as a way for multiple potential competitors to collaborate. Such a dynamic is a point of focus in initiatives like TransCelerate, a collaboration across 19 pharma companies to make R&D more efficient.<sup>34</sup>

#### The expert panel speaks

The panel concluded that real change comes with multilateral relationships, connecting people in much the same way as connection is needed between data sources.

The concrete benefits of these relationships include:

- Building trust and understanding between stakeholders—fostering further cooperation.
- “Co-opetition” between drug developers that

would otherwise be competitors can shorten time to market as developers work concurrently or complementarily. This benefits drug developers by reducing development times, and enables drugs to be made available to patients more quickly.

The panel acknowledged that there has been progress in establishing multilateral relationships between stakeholders in the drug development process. However, they wanted to see more such relationships, in order to realize more fully the potential benefits.

Precision medicine is an area that is particularly ripe for collaborative partnerships because of the opportunities that it presents to create holistic treatment packages—that is, in developing companion diagnostics alongside drug treatments. This approach is being embraced by established pharma players such as Janssen.<sup>35</sup> These relationships are further complicated by questions of data and intellectual property; in addition, finding effective ways to manage the relationship in cultural terms is an important requirement, as such collaborations require proper alignment and corresponding incentives to drive partners towards common goals.<sup>35</sup>

Ultimately, multilateral relationships between stakeholders that share a common aim—to improve people's health—stand to benefit drug development and market access by connecting previously separated organizations. The key to success is in initiating and managing such partnerships in a way that goes beyond simple pilot cases towards models that are both scalable and impactful. In China, the China Real World Evidence Alliance was recently established to unite stakeholders, increase understanding of RWD/real-world evidence methodologies and provide technical guidance to improve data quality (for example, standardized coding).<sup>28</sup> There is also an opportunity for public-private partnerships to create data infrastructure and develop technologies and methods to improve RWD production and use.<sup>28</sup>

The European Medicines Agency's (EMA) adaptive pathway for licensing similarly aimed to gather key stakeholders around the table at the start of the approval process.<sup>36</sup> Stakeholders included companies, the regulator, health technology assessment (HTA) agencies and patients. It was piloted between March 2014 and August 2016, focusing on areas in which there is high unmet need. This pilot approach was an evolutionary step, rather than a revolutionary change. The success of this multi-stakeholder process is that it has been integrated into the evolving EMA regulatory framework, such as the regulator's Parallel Consultation process.

### **Case study: Collaboration between industry organizations and payers in Japan**

The Japan Medical Association Center for Clinical Trials (JMACCT) supports investigator-initiated clinical trials (IICTs), which are still relatively new in Japan (having been authorized in July 2003).<sup>37</sup> To promote IICTs, the JMACCT provides financial and practical support, such as consultation on trial protocols and informed consent. A specific barrier to IICTs in Japan are the Good Clinical Practice requirements, which make principal investigators

personally liable for trial outcomes. This presents a barrier, given that principal investigators may be unwilling or unable to accept such liability, as the impact would be more difficult for them to absorb than it would be for a drug manufacturing company. The JMACCT worked in partnership with two insurance companies to devise an innovative type of insurance for IICTs to provide principal investigators with greater protection. The role of the JMACCT was instrumental, as the body's scientific and ethical credentials in selecting high-quality trials sufficiently reassured the insurance companies such that they were willing to proceed.

## **Early regulator, payer and patient engagement**

In addition to collaborative partnerships that focus on a shared set of objectives, early regulator, payer and patient engagement is a critical initiative that could have significant impact on the speed and

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

---

success of drug development and market access. Understanding limitations, values and perspectives at the outset helps to bring together stakeholders—which in the past have found themselves in adversarial relationships—to create a collaborative working environment and resolve gaps before they become embedded barriers. Showing a commitment to engagement also builds trust, as it emphasizes to these stakeholders the importance of collaboration with drug developers.

*“Regulator considerations are on a continuum: safety, quality, efficacy, comparative clinical and cost-effectiveness, and market approval. These final two phases are often the most problematic.”*

*Sir Alasdair Breckenridge, former Chair of the UK Medicines and Healthcare Products Regulatory Agency*

There have already been a multitude of successful examples of this type of initiative in Europe. For example, the EMA’s Parallel Consultation process involves drug developers engaging in early discussions with the regulator and HTA bodies.<sup>38</sup> These stakeholders provide drug developers with feedback on evidence-generation plans, with the aim of ensuring that evidence gathered during the development process meets the needs of regulators and HTA organizations/payers. The process also aims for pan-European harmonization, so that developers do not have to contact member states’ HTA bodies individually—potentially making the process more efficient.

In the US, the Prescription Drug User Fee Act (PDUFA) is a good example of early regulator involvement. Now in its sixth iteration (PDUFA VI was signed into law in 2017 and covers 2018-22), PDUFA allows the US Food and Drug Administration (FDA) to collect application fees from drug manufacturers seeking regulatory approval for sale and marketing. Given that inadequate funding of the FDA is a barrier to speedy regulatory assessment and approval of medicines, PDUFA has been vital to changing the funding dynamic—industry now pays 75% of the cost of scientific review of new medicines.<sup>39</sup> This increased funding has allowed the FDA to reach an approval level of 90% for new drugs in the first review cycle, frequently yielding approval in under a year, representing a drastic reduction from previous times.<sup>40</sup> Combined with the 21st Century Cures Act, signed in 2016, PDUFA VI mandates a greater focus on patient involvement in drug approval, as well as the allowance of biomarkers, alternative clinical trials and real-world evidence.<sup>41</sup>

As a broader example of collaboration between the industry and regulators, the International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use (ICH) was founded in 1990 by Europe, Japan and the US to harmonize their drug approval processes, with China

### The expert panel speaks

With regard to early engagement with stakeholders, the panel made the following observations:

- Data remains a key facilitator of collaborative relationships, as it provides incentive to work together, demonstrates trust and offers a

technological platform to facilitate interaction.

- Drug developers can be leaders in initiating conversations with payers and regulators, rather than having to wait for permission to do so.
- Patients can be a key resource in finding a balance between clinical outcomes and those relevant to patients, which need not be in opposition.

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

joining in 2017.<sup>42</sup> The US has often been a priority market for approval for drug developers, which has meant that there has sometimes been a lag of several years until the same drugs have been filed in Japan. The ICH has produced guidance to harmonize regulatory practice in quality, safety, efficacy and technical standards (for example, Medical Dictionary for Regulatory Activities (MedDRA) medical terminology).<sup>43</sup> The US and Japan have also successfully worked to align the medical-device approval processes of the FDA and the Pharmaceuticals and Medical Devices Agency (PMDA).<sup>44</sup> This enables drug developers to create evidence-generation plans suitable for multiple regulatory frameworks, in order to facilitate multiple filings and reduce delays in patient access.

Variations have been observed in how regulatory agencies apply ICH guidance, and aligning the maturing frameworks of non-ICH regulators will be a challenge, but the ICH has been a significant driver of regulatory harmonization among its member agencies.<sup>45,46</sup> China's accession to the ICH represents a major step forward for a country whose regulatory environment has had to develop rapidly in the past two decades as the country has embraced a market-based economy.<sup>47</sup>

Although regulatory harmonization is helpful, early engagement with payers holds greater potential for producing positive results for the industry. Engagement between drug developers and payers has improved greatly in recent years, as collaboration has shown that both benefit from a cooperative, rather than a confrontational, style of interaction. Incorporating the requirements of payers into evidence-generation activities supports the market access aspect of drug development as it can reduce the risk of payers refusing to add drugs to their formularies. Transparency and collaboration also builds trust between developers and payers, further driving market access by facilitating future pricing discussions and negotiations.<sup>48</sup>

A literature review conducted in 2017 identified three broad categories of payer engagement strategies:<sup>48</sup>

Payer consultations	Risk-sharing agreements	Expertise-based partnership
Formal consultations	Financially based scheme <ul style="list-style-type: none"> <li>• Price-volume agreements</li> <li>• Rebates/discounts</li> <li>• Utilization caps</li> </ul>	Joint evidence generation <ul style="list-style-type: none"> <li>• Real-world evidence</li> <li>• Comparative effectiveness</li> </ul>
Advisory board meetings	Outcomes-based scheme <ul style="list-style-type: none"> <li>• Pay-for-performance</li> <li>• Outcomes guarantee</li> <li>• Disease management schemes</li> </ul>	Medication adherence projects <ul style="list-style-type: none"> <li>• Telemedicine</li> <li>• E-pills</li> <li>• M-health</li> <li>• Patient financial incentives</li> <li>• User-friendly delivery devices</li> <li>• Better healthcare delivery</li> </ul>

The final piece of the early engagement puzzle is engagement with patients. Patient engagement can provide insight on what it is like to live with a condition, through providing insights on clinical manifestations of a disease and other, secondary effects (such as mobility or sleep problems) throughout a condition's progression. Patient engagement can also provide drug developers with feedback on treatment options, such as standard of care and effectiveness of existing therapies, as well as improving patient retention in trials.<sup>49</sup>

*"It's now routine to provide findings to patients in plain-language summaries. Patients want to know what happened in the trial in which they took part."*

*Sameer Tandon, Head of Strategic Alliances and Customer Transactions in US Medical Affairs, Novartis*

Recent initiatives, such as the stakeholder engagement model used by the Clinical Trial Transformation Initiative (an FDA collaboration with Duke University), have worked to increase the value that developers associate with patient involvement in trials.<sup>50</sup> And although studies have reported some variation between different stakeholders—especially discrepancies between patient groups on one hand, and industry and academic figures on the other—in perceptions of the value of engaging with patients in trial design, progress is being made.<sup>51</sup> The experts to whom we spoke for this report highlighted the importance of initiatives to improve engagement with patients, including patient advisory boards, sharing findings and data with patients and offering follow-up trials through patient alumni networks.

### **Case study: Training patients as "qualified partners" in health**

The European Patients' Academy (EUPATI) Expert Training Course educates patients and patient advocates in medical R&D, with the aim of helping them become qualified partners in the process.<sup>52</sup> The course combines independent "e-learning" coursework and face-to-face training events over a period of 14 months. The first course launched in October 2014 and the third is currently in progress. The goals of the initiative are not only to help patients understand the aims of R&D, but also to improve the public's access to "objective, patient-friendly information."

The pan-European initiative includes 33 organizations, with partners including patient organizations, universities, non-profit organizations and pharmaceutical companies. Educational material is available in 11 European languages. The EUPATI course focuses on medical development generally, rather than on disease-specific issues or therapies. However, participants have specialized in a wide range of disease areas, from Parkinson's and rheumatoid arthritis to Duchenne muscular dystrophy and Ehlers-Danlos syndrome. EUPATI has also developed separate guidance documents covering patient involvement in industry-led R&D, ethics committees, regulatory authorities and HTAs.



# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

**Table 1: Linking enabling factors with innovations**

<b>1. Advanced data and analytics</b>	<ul style="list-style-type: none"> <li>● <b>Adaptive trials</b> are reliant on analysis of interim data to reduce the use of resources or improve the success of trials. The more sophisticated this process is, the greater the chance that it will be effective.</li> <li>● <b>Patient-centric</b> trials are essentially also data-centric trials. Access to good-quality, standardized data is vital to their success.</li> <li>● Patient data are also essential to <b>precision medicine trials</b>, which rely on patients' genetic codes and health records.</li> <li>● Although collection of <b>real-world data</b> (RWD) is not new, in its most sophisticated form it offers huge possibilities for rapid innovation of drug development processes. However, only when data silos are connected can RWD reach its potential.</li> </ul>
<b>2. Workforce readiness</b>	<ul style="list-style-type: none"> <li>● <b>Adaptive trials</b>, although rooted in traditional clinical-trial methodology, diverge from traditional trial design in ways that create sometimes unexpected complications. The planning stage (which requires complex modelling) and the data analysis are key to ensuring that adaptive trials are conducted effectively. Adaptive trials are not a particularly new innovation, but researchers' wariness of working outside of traditional controlled trial situations has held back their adoption.</li> <li>● The key workforce-related challenge facing all the other three innovations (<b>patient-centric trials</b>, <b>precision medicine trials</b> and <b>RWD trials</b>) relates to the handling and interpretation of data. Comprehensive training is vital, as is the incorporation of data scientists into the process of trial design and execution. In addition, these new trial methods require new skills: those related to bridging the gap between data specialism and trial planning, and also the "soft" skills needed when patients and payers are closely involved.</li> </ul>
<b>3. Collaborative partnerships</b>	<ul style="list-style-type: none"> <li>● Collaboration, for example between drug companies and contract research organizations (CROs) can help to smooth the process of complex <b>adaptive</b> and <b>patient-centric trials</b>, particularly if an individual developer is still moving its workforce toward being ready to conduct new trials. If managed correctly, these relationships can more closely resemble strategic alliances than client-provider transactions.</li> <li>● <b>Precision medicine</b> is a particularly ripe area in which collaborative partnerships can prosper, as it presents opportunities to create holistic treatment packages, such as combined drug treatments and diagnostics.</li> <li>● If <b>RWD</b> is to achieve its potential, data silos will have to be connected. Data are a valuable commodity, and so sharing data will often demand a sharing of risk and reward, through either early pre-competitive collaboration, strategic alliances or "co-opetition."</li> </ul>
<b>4. Early regulator, payer and patient engagement</b>	<ul style="list-style-type: none"> <li>● Understanding limitations, values and perspectives at the outset is vital to the success of new approaches.</li> <li>● For all four innovations (<b>adaptive trial designs</b>, <b>patient-centric trials</b>, <b>precision medicine trials</b> and <b>RWD trials</b>), attending to the considerations of all stakeholders will enable the process to progress more smoothly. Regulators, payers and patients are all vital to the success of a drug development process, and listening to these alternative views at an early stage will help drug developers to anticipate multilateral and trial-specific issues that may arise.</li> </ul>

## Conclusions and calls to action

**M**uch like new medical treatments, drug development innovations will not be effective from the beginning: problems need to be overcome, improvements made, creases ironed out and stakeholders convinced. All of this takes time.

Our quantitative work shows that the innovations selected by our panel would have a significantly beneficial impact on drug innovation if implemented on a wide scale. The EIU's research thus, demonstrates that empirically tested innovations have a place at the center of drug R&D, and for that reason this study has explored the barriers to implementation and the enablers that will support it.

*"Companies are far from helpless in the face of obstacles to health care innovation."<sup>54</sup>  
*Why Innovation in Health Care Is So Hard, Harvard Business Review**

The challenge now is to enable effective innovations to take root among the more established tools used in the development of treatments. The significant positive message that emerged from our quantitative and qualitative assessments of the drug development landscape is that there is widespread recognition of a need to change the way things are done. And, in fact, much work to embrace the innovations that we assessed is already being carried out by all stakeholder groups, often in collaboration.

No one innovation is a silver bullet, but this toolkit of mechanisms that have been shown to be effective and the means to execute them offers a valuable opportunity for the industry to start proving Eroom's Law wrong. To enable these innovations to fulfill their potential, industry, regulators and payers must foster an environment that encourages new ways of thinking. At the heart of this will be a multilateral approach in which stakeholders can work together to achieve clinical breakthroughs, overcome development hurdles and bring treatments to the marketplace as quickly and efficiently as possible.

*"It's clear that collaboration compounds the return on our innovation investments, and our common work has greater impact. We must strengthen this commitment to teamwork across sectors and in public-private partnerships, keeping our eye on the patient—who must always remain at the center of our efforts. The cost of inaction is too high, especially for the most vulnerable. The only way forward is together."<sup>55</sup>*

*John Noseworthy, CEO, Mayo Clinic*

The calls to action presented in Table 2 aim to provide guidance for all those involved in drug development, to help them put in place the institutional and process enablers that will be critical for the continued successful implementation and development of effective innovations. It is not intended to be an exhaustive list; indeed, the research rightly highlighted the need for further probing, to understand why some innovations take hold and others are unable to overcome established barriers.

But the actions detailed offer a clear set of steps that should be initiated straight away, guided by the overarching objective of creating a sustainable future in which all can participate and benefit from

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

impactful drug development. In the words of one expert, framing the consensus of the panel, the goal should be “finding innovations in research and development that ultimately improve the speed at which patients get the drugs that help them.” Our research detailed in the *Innovation Imperative: The Future of Drug Development* demonstrates that this goal is achievable, given the right focus and sense of urgency.

**Table 2: Calls to action; premises and principles; examples of actions and actors**

Call to action	Premises and key principles	Examples of possible actions and corresponding actors
<b>Foster innovation</b> in clinical trial processes and measure impact	<p><b>Premise:</b> The data show that selected innovations can contribute to improved trial efficiency and likelihood of launch.</p> <p><b>Key principle:</b> Selected innovations are imperative to reverse the R&amp;D efficiency slide. Innovations are impactful, but the magnitude of impact varies across geographies and therapy areas. Investment in innovation should be evidence-led.</p>	<ul style="list-style-type: none"> <li>● Drug developers: Define and measure the impact of selected innovations in trials.</li> <li>● Drug developers: Define the trade-offs in outcomes: which are acceptable, which are not.</li> <li>● Payers and regulators: Understand why and how the industry is innovating, and work to understand your role in its search for sustainability.</li> <li>● Drug developers, payers and regulators: Identify new ways to incorporate and actively engage patients within drug development, drug approval and reimbursement processes.</li> </ul>
<b>Invest in the workforce</b> to deliver the promise of big data and innovative trial design	<p><b>Premise:</b> An appropriately skilled workforce is needed to deliver the promise of big data and run the innovative trials that the analysis indicates impact efficiency and success.</p> <p><b>Key principle:</b> Ever more data are being collected, but without an adequate workforce to design, process and analyze the results, there is a danger that disillusionment will set in when benefits fail to materialize.</p>	<ul style="list-style-type: none"> <li>● Drug developers, regulators, payers: Data science and clinical trial design training is needed for the current and future workforce.</li> <li>● Drug developers: Develop a system of practitioner certification and/or an allied syllabus to consolidate shifts in workforce requirements and standardize how people are trained and assessed.</li> <li>● Drug developers, regulators, payers: Need to update their processes to incorporate more sophisticated data analytics and ensure regular updating to keep pace with innovation.</li> <li>● Academic institutions: Explore ways to evolve curricula to prepare individuals for careers in drug trial coordination or data analytics.</li> </ul>
<b>Collaborate to innovate and connect people and data silos</b>	<p><b>Premise:</b> Silos that separate people and data can undermine the promise of innovations like real-world data and big data.</p> <p><b>Key principle:</b> Connecting silos facilitates collaboration and shared learning between individuals and organizations and across datasets.</p>	<ul style="list-style-type: none"> <li>● Drug developers, regulators, payers, researchers, governments: Create environments that foster flexible collaborative endeavors between people. Isolated examples are in place, but implementation needs to be stepped up.</li> <li>● Drug developers, regulators, payers, researchers, governments: Deploy technologies to connect data silos, since open platforms will help to ensure that data do not get locked behind virtual walls.</li> <li>● Drug developers and payers: Establish routine touchpoints, whereby patients are consistently involved in trial design and results-sharing.</li> </ul>
<b>Engage in multi-stakeholder Initiatives</b> earlier and more often	<p><b>Premise:</b> Drug developers need to understand stakeholders' perspectives. Patient-centric trial designs, for example, positively contribute to efficiency and success.</p> <p><b>Key principle:</b> Building trust and understanding between stakeholders can smooth regulatory and market access processes.</p>	<ul style="list-style-type: none"> <li>● Drug developers, regulators, payers and patient associations: Arrange greater and earlier engagement that is structured and well defined.</li> <li>● Drug developers, regulators, payers: Engage in discussion around innovative methods to ensure alignment and understanding.</li> </ul>

## Appendix

### Methodology for qualitative analysis

The barriers and enablers described in this report reflect discussions with experts engaged throughout this project. Originally generated through the day-long panel convened in October 2017, these factors were then further explored through in-depth interviews and relevant literature searches. For the latter, the EIU identified and conducted secondary research on a series of best practices related to the enabling factors that provided practical guidance on solutions. Finally, once the impact and adoption rate of the innovations selected had been determined through the quantitative analysis, the experts were re-engaged to probe for additional insight on the underlying reasons behind the low uptake level.

The findings from these various sources were grouped into themes to facilitate a thematic analysis of the barriers to and enablers of the selected innovations. The barriers and enablers listed specifically reflect the selected innovations, but also speak to wider issues around innovation adoption within the drug development industry.

### Literature review

This following structured approach was used to arrive at the longlist of proposed areas of innovation, metrics and underlying issues influencing their adoption in drug development.

1. Literature search
2. Identifying key R&D challenges
3. Identifying innovations and metrics
4. Constructing R&D innovation landscape map
5. Proposed areas of innovation
6. Proposed metrics

To manage the challenge presented by the diversity of language used and the broad scope of the project, we took advantage of most databases' ability to order "by relevance." Databases were initially searched using a sensitive search strategy, and results were then ordered by relevance.

Using this sensitive approach, we retrieved approximately 15,000 articles when the search was restricted to the last ten years. The results were ordered by "best match," and the first 200 articles were examined for relevant articles. Articles determined to be in scope and of potential interest (that is, likely to describe innovations and/or metrics) were reviewed at full text and relevant information was extracted and subsequently used as pearl articles to inform further searches based on key words, indexing terms and "similar articles" functionality.

In addition to Embase.com and Medline (via PubMed), we used the supplemental searching functionality of Scopus (Elsevier) and Google Scholar. This process of using an array of iterative search techniques, such as citation mapping and reference harvesting, is a powerful method of identifying "hard to find" articles in fields where there is variable terminology. In addition to the published literature we also reviewed grey literature, including the websites of the FDA, the EMA and other regulators and general Google searches.

To determine when to terminate our search, we used the theory of theoretical saturation—a commonly used approach, particularly in qualitative research. In practice, this means that once we started finding that each new article we assessed was not adding anything new in terms of metrics or innovations, we decided that we had adequately covered the main issues and concepts.

### Expert engagement

The initial findings through the literature review were used to inform the research framework and the next step in the EIU project methodology—the expert panel. Central to the entire research project, the expert panel was composed of carefully selected experts representing industry, researchers, payers, professional bodies, data analytics and the technology industry.

#### The expert panel:

- **Dr Roy Auty**—Associate Director, Pipeline & Portfolio Planning, Genentech
- **Dr Lynda Chin**—Associate Vice Chancellor of Healthcare Transformation; Chief Innovation Officer for Health Affairs; Director, Institute for Health Transformation, The University of Texas System
- **Dr David Epstein**—former Medical Director of a large national health plan
- **Dr Alberto Grignolo**—Corporate Vice President, PAREXEL
- **Jim Kremidas**—Executive Director, Association of Clinical Research Professionals
- **Dr Rebecca Miksad**—Senior Medical Director, Flatiron Health
- **Dr Tina Moen**—Deputy Chief Health Officer, IBM Watson
- **Bernard Munos**—Senior Fellow, FasterCures; Founder, Innothink Center for Research in Biomedical Innovation

The aim of the expert panel meeting was to provide feedback and insight on the EIU’s preliminary findings on potential areas of innovation, including the factors that inhibit their uptake. Starting by coming up with a clear definition of innovation—as it pertains to multifaceted aspects of the drug development and market access process—and using that as a guidepost, the panel then discussed a variety of types of innovation, such as in trial design and execution and the application of data analytics. The expert discussion, guided by EIU staff also sought to delve into additional factors, such as geography, therapeutic areas and stakeholder perspectives, as well as industry experts’ experiences in facilitating innovation.

The output of the expert panel consisted of both a list of innovations selected for further study and a list of the enabling factors deemed critical to the future adoption of these innovations in drug development. With this framework of analysis established, the EIU conducted additional primary interviews with other experts from around the globe in order to fill in remaining knowledge gaps and provide a holistic view of the issues impacting innovation.



# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

The bilateral interviewees for this report were:

### Bilateral interviews conducted:

- **Michael Ackerman**—Medical Director, Anthem
- **Kate Bingham**—Managing Partner, SV Life Sciences (UK)
- **Sir Alasdair Breckenridge**—Emeritus Professor of Clinical Pharmacology, University of Liverpool; former Chair of the UK Medicines and Healthcare Products Regulatory Agency (MHRA)
- **Robert Califf**—Vice Chancellor for Clinical and Translational Research at Duke University; former Commissioner of the US Food and Drug Administration
- **George Demetri**—Director, Center for Sarcoma and Bone Oncology, Dana Farber Cancer Institute
- **Felix Frueh**—Executive Partner, Opus Three
- **Patricia Furlong**—Founding President and CEO of Parent Project Muscular Dystrophy
- **Fabrizio Gianfrate**—Professor of Health Economics, University of Rome
- **Christian Gossens**—Global Head, Early Development Workflows, Roche pRED Informatics
- **Reto Knutti**—Professor, Institute for Atmospheric and Climate Science, ETH Zurich
- **Craig Lipset**—Head of Clinical Innovation, Pfizer
- **Julie Locklear**—Managing Partner, Genesis Research; former VP, Health Economics and Outcomes Research, EMD Serono; Board Director, Network for Excellence in Health Innovation
- **Yannis Natsis**—Policy Manager for Universal Access and Affordable Medicines, European Public Health Alliance
- **Chirag Patel**—Assistant Professor of Biomedical Informatics, Harvard Medical School; Chirag Patel Group
- **Bob Ruffolo**—former President of Research and Development, Wyeth Pharmaceuticals
- **Peter Speyer**—Head of Development Portfolio, Medical, Digital & RWE Solutions, Novartis
- **Sameer Tandon**—Head of Strategic Alliances and Customer Transactions in US Medical Affairs, Novartis
- **Michael Tranfaglia**—Medical Director and Chief Scientific Officer, FRAXA Research Foundation
- **Jaap Verweij**—Dean of the Faculty of Medicine and Health Sciences, Erasmus University; Associate Editor, *Journal of Clinical Oncology*
- **Abhimanyu Verma**—Lead, Applied Technology Innovation, Novartis
- **Thomas Wilckens**—CEO, InnVentis
- **Carol Zhu**—Senior Vice-President and Managing Director, Drug Information Association, Greater China

To ensure honest and credible insights, engagement with all experts was done on a confidential basis. Quotes included in this report were approved by the individuals interviewed for external dissemination. The combined knowledge derived from these bilateral interviews and the insights generated by the expert panel were used as inputs for the EIU's analysis and conclusions.

## References

1. Hay M, Thomas DW, Craighead JL, et al. "Clinical development success rates for investigational drugs". *Nature Biotechnology*. 2014;32(1):40-51.
2. Paul SM, Mytelka DS, Dunwiddie CT, et al. "How to improve R&D productivity: the pharmaceutical industry's grand challenge". *Nature Reviews Drug Discovery*. 2010;9:203-14.
3. Mestre-Ferrandiz J, Sussex J, Towse A. *The R&D Cost of a New Medicine*. London: Office of Health Economics, 2012. Available from: <https://www.ohe.org/publications/rd-cost-new-medicine>
4. DiMasi JA, Grabowski HG, Hansen RW. "Innovation in the pharmaceutical industry: new estimates of R&D costs". *Journal of Health Economics*. 2016;47(May):20-33.
5. Thomas DW, Burns J, Audette J, et al. *Clinical development success rates 2006-2015*. Washington (DC): Biotechnology Innovation Organization, 2015. Available from: <https://www.bio.org/sites/default/files/Clinical%20Development%20Success%20Rates%202006-2015%20-%20BIO,%20Biomedtracker,%20Amplion%202016.pdf>
6. Quintiles IMS Institute. *Lifetime trends in biopharmaceutical innovation: recent evidence and implications*. Parsippany (NJ): Quintiles IMS Institute, 2017. Available from: [https://www.statnews.com/wp-content/uploads/2017/01/Lifetime\\_Trends\\_in\\_Biopharmaceutical\\_Innovation.pdf](https://www.statnews.com/wp-content/uploads/2017/01/Lifetime_Trends_in_Biopharmaceutical_Innovation.pdf)
7. Raghupathi W, Raghupathi V. "Big data analytics in healthcare: promise and potential". *Health Information Science and Systems*. 2014, 2:3.
8. Velasco E, Agheneza T, Denecke K, et al. "Social media and internet-based data in global systems for public health surveillance: a systematic review". *Milbank Quarterly*. 2014 Mar;92(1):7-33.
9. Shaywitz D. "Data Silos: Healthcare's Silent Shame". *Forbes*. 24 Mar 2015. Internet.
10. Pollack A. "Questcor Finds Profits, at \$28,000 a Vial". *New York Times*. Dec 29 2012. Internet.
11. Rubin R. "EpiPen price hike comes under scrutiny". *The Lancet*. 2016 Sep 24;388(10051):1266.
12. Luthra S. "'Pharma Bro' Shkreli Is In Prison, But Daraprim's Price Is Still High". *Kaiser Health News*. May 4 2018. Internet.
13. Beasley D. "Costs to public of \$84,000 hep C drug 'outrageous'" —Kaiser. Reuters. April 2 2014. Internet.
14. Brown P, Calnan M. "Braving a faceless new world? Conceptualizing trust in the pharmaceutical industry and its products". *Health* (London). 2012 Jan;16(1):57-75.
15. Vicari S, Cappai F. "Health activism and the logic of connective action. A case study of rare disease patient organizations". *Information, Communication & Society*. 2016 Nov 1; 19(11): 1653–1671.
16. Mervis J. "Data check: U.S. government share of basic research funding falls below 50%". *Science*. Mar 9 2017. Internet. <http://www.sciencemag.org/news/2017/03/data-check-us-government-share-basic-research-funding-falls-below-50>

17. Wellcome. Wellcome Brexit briefing for policymakers [Internet]. [https://wellcome.ac.uk/sites/default/files/wellcome-brexit-briefing-for-policymakers.pdf?utm\\_source=twitter&utm\\_medium=referral-wellcome&utm\\_campaign=news](https://wellcome.ac.uk/sites/default/files/wellcome-brexit-briefing-for-policymakers.pdf?utm_source=twitter&utm_medium=referral-wellcome&utm_campaign=news)
18. ECFS. The registry [Internet]. Karup: European Cystic Fibrosis Society. Available at: <https://www.ecfs.eu/projects/ecfs-patient-registry/project>
19. About RD-Connect [Internet]. Available at: <https://rd-connect.eu/about-rd-connect/>
20. The RD-Connect Genome-Phenome Analysis Platform [Internet]. Available at: <https://platform.rd-connect.eu/>
21. FAIRification of rare disease registries [Internet]. Available at: <https://rd-connect.eu/data-linkage/fairification/>
22. Underwood G. "The clinical trial of the future". *PharmaTimes*. 2016; October.
23. Houser AR. How the cancer registry can support clinical trials recruitment [Internet]. Berkeley (CA): C/Net Solutions. Available from: [http://www.askcnet.org/wpcontent/uploads/ClinicalTrialsMatching\\_CNETSolutions.pdf](http://www.askcnet.org/wpcontent/uploads/ClinicalTrialsMatching_CNETSolutions.pdf)
24. Tan MH, Thomas M, MacEachern MP. "Using registries to recruit subjects for clinical trials". *Contemporary Clinical Trials*. 2015;41(31-38).
25. Alsumidaie M. "Pfizer's first predictive modeling system". *Applied Clinical Trials*. 2016;2016(May 18).
26. Fees payable to the European Medicines Agency [Internet]. Available from: [http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document\\_listing/document\\_listing\\_000327.jsp&mid=WCob01ac0580024596](http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document_listing/document_listing_000327.jsp&mid=WCob01ac0580024596)
27. Brown AS, Kong SW, Kohane IS, Patel CJ. "ksRepo: a generalized platform for computational drug repositioning". *BMC Bioinformatics*. 2016;17(78).
28. Sun XF, Tan J, Tang L, et al. "Real world evidence: experience and lessons from China". *BMJ*. 2018;2018(360):j5262.
29. SAS. Analyzing real-world data: generate new scientific insights to increase patient and medical product understanding. Cary (NC): SAS Institute, 2017. Available from: [https://www.sas.com/content/dam/SAS/en\\_us/doc/solutionbrief/life-sciences-real-world-data-107697.pdf](https://www.sas.com/content/dam/SAS/en_us/doc/solutionbrief/life-sciences-real-world-data-107697.pdf)
30. Treweek S, Lockhart P, Pitkethly M, et al. "Methods to improve recruitment to randomised controlled trials: Cochrane systematic review and meta-analysis". *BMJ Open*. 2013;3:e002360.
31. Big Data to Knowledge [Internet]. Available from: <https://commonfund.nih.gov/bd2k>
32. Phelps K. "Mergers may buy time, but fundamental changes necessary, GSK's Garnier". *The Pink Sheet*. 2007;February 26:p.11.
33. Richman B, Mitchell W, Vidal E, et al. "Pharmaceutical M&A Activity: Effects on Prices, Innovation, and Competition". Durham (NC): Duke University, 2017.
34. Our mission statement [Internet]. Conshohocken (PA): TransCelerate. Available from: <http://www.transceleratebiopharmainc.com/our-mission/>
35. PWC. *Pharma 2020: challenging business models. Which path will you take?* London: PricewaterhouseCoopers, 2009. Available from: <https://www.pwc.com/gx/en/pharma-life-sciences/pdf/challenge.pdf>

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

---

36. EMA. Adaptive pathways [Internet]. London: European Medicines Agency. Available from: [http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/general\\_content\\_000601.jsp](http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/general_content_000601.jsp)
37. Uchida T, Kobayashi F, Tanaka K, et al. "Promoting clinical trials in Japan". *Applied Clinical Trials*. 2007;2007(Mar 01).
38. EMA. Parallel consultation with regulators and health technology assessment bodies [Internet]. London: European Medicines Agency. Available from: [http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/general\\_content\\_001857.jsp&mid=WCob01ac0580a11c96](http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/general_content_001857.jsp&mid=WCob01ac0580a11c96)
39. Darrow JJ, Avorn J, Kesselheim AS. "Speed, Safety, and Industry Funding—From PDUFA I to PDUFA VI". *New England Journal of Medicine*. 2017; 377:2278-2286.
40. Barlas S. "Drug Companies Breathe Easier As PDUFA VI Heads for Approval". *Pharmacy & Therapeutics*. 2017 Jun; 42(6): 357.
41. PDUFA reauthorisation performance goals and procedures fiscal years 2018 through 2022 [Internet]. Available from: <https://www.fda.gov/downloads/ForIndustry/UserFees/PrescriptionDrugUserFee/UCM511438.pdf>
42. ICH. Welcome to the ICH official website [Internet]. Geneva: International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use. Available from: <http://www.ich.org/>
43. ICH. ICH Guidelines [Internet]. Geneva: International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use. Available from: <http://www.ich.org/products/guidelines.html>
44. FDA. US/Japan regulatory collaboration [Internet]. Silver Spring (MD): US Food & Drug Administration. Available from: <https://www.fda.gov/MedicalDevices/InternationalPrograms/USJapanRegulatoryCollaboration/default.html>
45. Richardson E, Daniel G, Joy D, et al. "Regional Approaches to Expedited Drug Development and Review: Can Regulatory Harmonization Improve Outcomes?" *Therapeutic Innovation & Regulatory Science*. 2018;16.
46. Torqui A, Macau AM. "Regional Differences During the ICH Regulatory Consultation Process Between the EU, US, and Japan". *Therapeutic Innovation & Regulatory Science*. 2017 Jan 1:2168479017744199.
47. Li H, He S, Richmond FJ. *The Historical Evolution of China's Drug Regulatory System*. Available from: [https://regulatory.usc.edu/files/2014/08/Evolution\\_China\\_Reg\\_system\\_2014.pdf](https://regulatory.usc.edu/files/2014/08/Evolution_China_Reg_system_2014.pdf)
48. Akhmetov, I. Bubnov, R.V. "Innovative payer engagement strategies: will the convergence lead to better value creation in personalized medicine?" *EPMA Journal*. 2017;8(1):5-15. doi:10.1007/s13167-017-0078-6.
49. FDA. Patient-Focused Drug Development [Internet]. Available from: <https://www.fda.gov/downloads/forindustry/userfees/prescriptiondrugusefee/ucm328652.pdf>
50. Patrick-Lake B. "Patient engagement in clinical trials: the Clinical Trials Transformation Initiative's leadership from theory to practical implementation". *Clinical Trials*. 2018;1 (Supp):19-22.

# THE INNOVATION IMPERATIVE: THE FUTURE OF DRUG DEVELOPMENT

## PART II: BARRIERS, ENABLERS AND CALLS TO ACTION

---

51. Smith SK, Selig W, Harker M, et al. "Patient Engagement Practices in Clinical Research among Patient Groups, Industry, and Academia in the United States: A Survey". *PLoS One*. 2015 Oct 14;10(10):e0140232.
52. EUPATI. What is EUPATI? [Internet]. Available from: <https://www.eupati.eu/what-is-eupati/>
53. Endpoint News. "The top 15 spenders in the global drug R&D business: 2017". 2017 Apr 24. <https://endpts.com/special/top-research-budgets-in-pharma-and-biotech/>
54. Herzlinger, Regina E. "Why Innovation in Health Care Is So Hard". *Harvard Business Review*. May 2006. <https://hbr.org/2006/05/why-innovation-in-health-care-is-so-hard>
55. *The Wall Street Journal*. "John Noseworthy on the Best Cure in Medicine: Teamwork". 17 Jan 2018.
56. Townsend D, Mills N, Savovic J, Donovan JL et al. "A Systematic Review of Training Programmes for Recruiters to Randomised Controlled Trials." *Trials* 16 (2015): 432. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4587840>

# Discover opportunities in over 140 countries and 1,000 cities with Market Explorer

---

## Market Explorer

Market Explorer is a unique online tool that empowers marketing, forecasting, business development and strategy professionals to see which countries and cities offer the greatest opportunities for their products and services, now and in the future.

Precise, reliable and fast, Market Explorer provides evidence-based, actionable results tailored to your requirements.

Powered by EIU Canback and developed by experts in economic modelling and forecasting, Market Explorer hones in on markets that match your target demographic both at country and city level. It also allows you to weight those opportunities against the risk inherent in any new investment.

## A global online market scanning and forecasting tool that's light years ahead

- **Emerging markets focus:** With over 140 countries and 1,000 cities at your fingertips Market Explorer puts a particular spotlight on centres of rapid economic growth. Rank and compare countries and cities in terms of their market potential by drawing on EIU Canback's world renowned demographic and income data forecasts. We've incorporated over 2,000 data points per city. No other provider can deliver this level of granularity.
- **Plan for today and forecast through to 2030:** With data available from 2005 – 2030 Market Explorer helps you form a view on markets over time and access results from past, current and future years.
- **Precise outcomes, reliable data:** Powered by our rigorous approach to data standardisation, economic analysis and forecasts, Market Explorer offers precise comparisons between potential markets in terms of size and nature of opportunity. Users have the option to view income at purchasing power parity (PPP) in addition to perceived annual market exchange rates.
- **Evidence-based, actionable results tailored to your requirements:** Adjust rankings according to your appetite for risk or return by refining and weighting results by adding 15 external environment indicators.
- **Fast, user-friendly and with a choice of reporting:** In just a few simple steps you can have access to tailored market opportunities and forecasts with your choice from a range of reporting options.
- **Support from our team of experts when you need it:** We'll always be on hand to provide training and customised support when you need it.

For more information please visit [eiu.com/market-explorer](https://eiu.com/market-explorer)



Access China is a unique service that will help your business to succeed in China. It is the only single source of data, analysis and forecasts for all 31 provinces and 292 of China's largest cities, providing you with a comprehensive understanding of China today, but more importantly giving you confidence that you will still understand China in ten and twenty years' time.

## What will Access China allow you to do?

- Benchmark in detail provinces and prefectures of China using consistent and comparable data.
- Understand the market potential for your products and services in any location within China.
- Investigate operating costs, infrastructure development and labour markets to help you to make investment decisions.
- Monitor what other businesses are doing in various regions.
- Gain a forward-looking perspective on how fast China's cities and its regions are growing.
- Feed reliable data into your own China business strategy models.

## Who should use Access China?

- Organisations that require an understanding of how the Chinese market works, or are already operating in or looking to enter the Chinese market.
- Companies already operating in China that need to benchmark their performance in particular provinces and assess the market potential for products and services in any region or city.
- Government agencies can use Access China to assist trade mission efforts and exporting companies, and as a research tool for understanding China's internal and external dynamics.
- Academic institutions use Access China to help faculty and students conduct detailed political, economic, and business research across China.

To request a demonstration of how Access China could benefit your organisation, please get in touch.

### Americas

Tel: +1 212 698 9717

Email: [americas@eiu.com](mailto:americas@eiu.com)

### Asia

Tel: +852 2802 7288

Email: [asia@eiu.com](mailto:asia@eiu.com)

### Europe, Middle East & Africa

Tel: +44 (0) 20 7576 8181

Email: [london@eiu.com](mailto:london@eiu.com)

### **Copyright**

*© 2018 The Economist Intelligence Unit Limited. All rights reserved. Neither this publication nor any part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of The Economist Intelligence Unit Limited.*

**While every effort has been taken to verify the accuracy of this information, The Economist Intelligence Unit Ltd. cannot accept any responsibility or liability for reliance by any person on this report or any of the information, opinions or conclusions set out in this report.**

LONDON  
20 Cabot Square  
London  
E14 4QW  
United Kingdom  
Tel: +44 (0) 20 7576 8181  
Email: london@eiu.com

NEW YORK  
750 Third Avenue  
5th Floor  
New York, NY 10017  
United States  
Tel: + 1 212 698 9717  
Email: americas@eiu.com

HONG KONG  
1301 Cityplaza Four  
12 Taikoo Wan Road  
Taikoo Shing  
Hong Kong  
Tel: + 852 2802 7288  
Email: asia@eiu.com