



SEPTMBER 2022

THE ROLE OF INTELLECTUAL PROPERTY IN THE BIOPHARMACEUTICAL SECTOR

This report was produced by FTI Consulting and
commissioned by INTERPAT and IFPMA

EXPERTS WITH IMPACT™





The Role of Intellectual Property in the Biopharmaceutical Sector: Why it Matters and Who Benefits from it

Executive Summary

The ongoing COVID-19 pandemic has brought about an unprecedented public health challenge: vaccinating the world as quickly as possible. The drive to vaccinate the global population against COVID-19 is the largest vaccine campaign ever rolled out, characterised by complex production, distribution, access, and administration considerations.

Achieving the goal of vaccinating 70% of the world's population requires around 5.5 billion doses, accounting only for one dose per person.¹ Considering that most of the vaccines approved by the European Medicines Agency (EMA) and the Food and Drug Administration (FDA) require two doses, with an additional booster dose recommended 5-6 months after getting the initial doses, a minimum of 16 billion doses would be needed to achieve this ambitious target. As of March 2022, nearly 11.12 billion doses have been administered worldwide.ⁱ While 78.91% of citizens in high-income countries had received at least one dose by March 2022, the rate dropped to only 58.70% in lower-middle-income countries. Furthermore, only a mere 14.4% of people in low-income countries were able to obtain at least one shot.ⁱⁱ These disparities have triggered public debates on global health inequalities and how to effectively respond to the COVID-19 pandemic. Despite the gap gradually decreasing over time, the drastic differences in access conditions at the start of the pandemic have highlighted the need for a true *'leaving no one behind'* approach.

Intellectual property (IP) considerations around the development of COVID-19 vaccines and therapeutics emerged early on as a central tenant in the discussion on the role of the private sector to facilitate global access. Some policymakers have argued that overriding intellectual property rights is one way to expedite vaccine production and distribution; others claim that without strong intellectual property protections, production and distribution would be further delayed. In May 2021, United States (U.S.) trade representative Ambassador Katherine Tai argued in a statement: *"This is a global health crisis and the extraordinary circumstances of the COVID-19 pandemic call for extraordinary measures. The Administration believes strongly in intellectual property protections, but in service of ending this pandemic, supports the waiver of those protections for COVID-19 vaccines"*.ⁱⁱⁱ

Other policymakers have been more skeptical of proposals to weaken intellectual property protections. For example, a spokesperson from the German chancellor's office argued that *"the protection of intellectual property is a source of innovation and must remain so in the future"*^{iv}. Against this background, on 17 June at the 12th Ministerial Conference of the World Trade Organization (WTO) 164 participating countries agreed on a text for an intellectual property waiver for COVID-19 vaccines^v. The waiver enables 'eligible Members' (i.e. 'developing country Members') to produce COVID-19

¹ Following the U.S. and EU targets of 70%

vaccines for the next five years without needing permission from the patent holder ‘to the necessary extent to address the COVID-19 pandemic.’ The waiver can be enabled by ‘eligible Members’ through ‘any instrument available’ (i.e. executive order, emergency decree), regardless of whether or not a country has a compulsory license agreement in place, but needs to be communicated to the Council for Trade-Related Aspects of Intellectual Property Rights (TRIPS). The decision also includes the commitment that within six months from the adoption of the decision, members would decide whether to extend the waiver to cover COVID-19 treatments and diagnostics (by December 17 2022). To fully understand the ongoing conversation between policymakers and WTO leaders, it is vital to reflect on the contributions of the intellectual property regime that allow for innovation within the life science sector, while weighing these against the claimed benefits of overriding intellectual property protections for COVID-19 vaccines.

To better understand this resulting dichotomy, this white paper answers the following **five key questions**, with a focus on applications related to innovation in the life sciences sector and the COVID-19 pandemic:

- 1 What is intellectual property?
- 2 Does intellectual property protection matter?
- 3 Does the protection of intellectual property stimulate innovation?
- 4 Does the protection of intellectual property impact citizens?
- 5 What role can intellectual property protection play in the context of addressing both current and future pandemics?

The global intellectual property regime is governed by the WTO’s Trade-Related Aspects of Intellectual Property Rights Agreement (TRIPS). Adopted in 1994, the TRIPS agreement includes considerable protections for innovators and allows some flexibility in the granting of licenses to address public health crises. When considering whether these protections and flexibilities are sufficient for facilitating access or if intellectual property protections undermine the fight against global health crises like COVID-19, we need to acknowledge the contribution that intellectual property makes to innovation and productivity in the life sciences sector. Intellectual property plays a crucial role in the life sciences industry, even more so than other industries which rely heavily on innovation. Investors and firms are unlikely to invest in life sciences research and development without strong intellectual property provisions. Motivations for doing so include high up-front costs to discover and develop new drugs, long development timelines, the risk of duplication once a drug is on the market, and strict regulatory frameworks.

Without investment to fund research and development, the life sciences sector could not function. Several studies have estimated the upfront costs of developing a drug and found that they range between USD 1 to USD 2.6 billion. Intellectual property law enables such financing because it enhances the possibility of innovators attaining a return on investment on successful new products. It does so by providing market exclusivity in areas where the failure rate and investment costs are very high in comparison to other sectors. Without intellectual property provisions, companies would not find it attractive to invest in the research and development of the sector that ensures societal access to life-saving drugs and vaccines.

Intellectual property is critical to facilitate innovation in the life sciences sector. The current system not only catalyses financing but also contributes to placing cutting-edge innovations into the public domain, making them available for other innovators. One of the tenets of intellectual property protection rests on a form of social contract — the patent bargain — whereby the inventor of a novel idea or technology agrees to publish information relating to this new idea in exchange for the exclusive rights to use it for a limited period. This approach is beneficial to society as it places significant amounts of novel, innovative information into the public domain, while fostering further research and innovation. Intellectual property is like a Lego block, in the sense that it allows scientists to build on each other's discoveries. If intellectual property protection were to be reduced or even temporarily removed, the uncertainty triggered would negatively impact research and innovation. Scientists would increasingly embrace secrecy and inventors would be disincentivised from publishing their findings. As a result, there would be a reduced amount of information available in the public domain.

This paper aims to outline how intellectual property facilitates innovation in the life sciences sector, and to estimate how intellectual property impacts social welfare globally by applying an economic model developed by the authors. Through this economic model, the authors tested hypothetical scenarios in which a complete intellectual property protection waiver—i.e., eliminating patents and market exclusivity, removing regulatory data protection, requiring compulsory licensing, disallowing trade secrets, and broader intellectual property waivers—was applied to 10%, 25%, and 50% of drugs on the market. Whilst the American Food and Drug Administration (FDA) approved on average 46 new drugs between 2016 and 2020, our model estimates that overriding intellectual property protections for 10% of drugs would lead producers to reduce their investment in innovation and, in turn, reduce the number of new drugs launched per year from 46 today to 44 new drugs per year by 2025 (a 4% decrease) and to 41 new drugs per year by 2050 (an 11% decrease). Due to this dramatic decline in new drug approvals and reduced investments in research and development (R&D), we estimate that over the next 30 years, social welfare would decrease by USD 214.5 billion per year, equivalent to 0.2% of the total global gross domestic product (GDP). For the purposes of the ongoing discussion, social welfare is understood as the economic construct that incorporates both the positive gains to society from lower drug prices and the negative impacts on patient health due to fewer new treatments being developed. These findings indicate that large-scale changes to the intellectual property system would produce negative health impacts on patients that dramatically outweigh the short-term price benefits.

The economic modelling, despite the hypothetical scenarios it explores, is timely in context of the current political debates surrounding the COVID-19 pandemic. The intellectual property regime has played an instrumental role in the record-breaking pace of COVID-19 vaccine development. Overriding intellectual property protections, such as waiving patents, would not actually solve the disparities in access to COVID-19 vaccines. The collaboration-enabling effect of the current intellectual property system was one of the core reasons why Moderna and BioNTech were able to develop their vaccines so quickly – both within nine months. Furthermore, existing flexibilities within the current system could help facilitate access to vaccines and treatments (e.g., the Doha Declaration on the TRIPS Agreement and Public Health, adopted in 2002²). Undermining the existing regime does not seem worthwhile, given that the measure would likely not significantly expand access to COVID-19 vaccines, which is inhibited due to a number of different factors. In this sense, the compromise deal put forward to WTO members to waive intellectual property for COVID-19 vaccines (and potentially all therapeutics) would not enable increased access during this ongoing crisis. Conversely, waiving intellectual property protections may even distract from current initiatives to scale up manufacturing capacities and to train local workforce to produce the vaccines. Getting new facilities up and running, for instance, takes a significant amount of time which also needs to be considered. Due to these factors, COVID-19 vaccine delivery would not be accelerated, even if intellectual property protections were waived. This is acknowledged even by critics of the current intellectual property system, who note the need for additional enabling measures to facilitate access. Hence, the authors conclude that the expected costs of undermining the current TRIPS system for innovation and social welfare at large outweigh the hypothetical benefits produced by improved access conditions.

2 World Trade Organization, Ministerial Declaration of 14 November 2001, WTO Doc. WT/MIN(01)/DEC/1, 41 ILM 746 (2002)



Based on existing evidence and the results from our economic model, this paper reaches **nine key conclusions**:

1. Intellectual property protection is the cornerstone of drug discovery and development and fosters an innovative environment in the life sciences sector.
2. Intellectual property law provides a framework that supports collaboration, which is critical to effectively support innovation through the long, complex, and risky innovation process, from bench to bedside.³
3. Maintaining the intellectual property framework results in long-term benefits for various stakeholders including firms, investors, universities, and society.
4. Intellectual property protection incentivises investments and innovation.
5. In some cases, existing intellectual property provisions may need to be supplemented with new incentives to address unmet medical needs.
6. The benefits of maintaining the current intellectual property system protections are considerable. Under an extreme case where intellectual property protections—patents, exclusivity, trade secrets, and the freedom for manufacturers to license their product as they please—overrides were applied to 10% of drugs, the long-term loss in societal well-being would be worth USD 214.5 billion per year on average, equivalent to 0.2% of global GDP. Out of this figure, patients would bear 70% of the harm due to fewer new drugs being developed to treat existing diseases.
7. Overriding intellectual property rights for 10% of drugs would result in a loss of 445,000 jobs (90,000 workers directly employed by life sciences firms and 355,000 employees working in supporting industries) over 30 years.
8. If middle income countries—such as Brazil, Russia, India, and China—decided to override intellectual property protections for *all* life sciences treatments, the number of new drugs created globally would fall by 24% over a 30-year time frame and the total cost to society would be USD 2.4 trillion on average per year, or 2.5% of global GDP.
9. Removing or overriding intellectual property protections would not have sped up the creation or distribution of COVID-19 vaccines. Suspending intellectual property provisions would not increase the speed of vaccination campaigns and could, in fact, even undermine efforts to scale up vaccine production or to face future health emergencies or pandemics.

³ This is supported by initiatives such as the INTERPAT IP Principles for Advancing Cures and Therapies (IP PACT) document.

Table of Contents

THE ROLE OF INTELLECTUAL PROPERTY IN THE BIOPHARMACEUTICAL SECTOR: WHY IT MATTERS AND WHO BENEFITS FROM IT	2
Executive Summary	2
SETTING THE SCENE	7
An unprecedented spotlight on biopharmaceutical research	7
Methodology and approach	9
WHAT IS INTELLECTUAL PROPERTY?	10
DOES INTELLECTUAL PROPERTY PROTECTION MATTER?	15
Intellectual property protection is fundamentally important for the biopharmaceutical sector	15
Why intellectual property protection is of core importance to drug development	16
Intellectual property protection has helped foster a culture of collaboration	19
Intellectual property protection is the backbone to the broader innovation ecosystem, beyond biopharmaceutical companies	20
DOES THE PROTECTION OF INTELLECTUAL PROPERTY STIMULATE INNOVATION?	24
Intellectual property protection makes investment attractive	24
The ‘Lego model’ – intellectual property protection puts knowledge in the public domain	25
DOES THE PROTECTION OF INTELLECTUAL PROPERTY IMPACT CITIZENS?	27
Developing a robust model to quantify changes in intellectual property protection	27
Robust intellectual property protection leads to long-term benefits to consumers, firms, and broader society	28
WHAT ROLE CAN INTELLECTUAL PROPERTY PROTECTION PLAY IN THE CONTEXT OF ADDRESSING BOTH CURRENT AND FUTURE PANDEMICS?	34
The role of the intellectual property framework in bringing COVID-19 vaccines to market	34
Political pressure on the current intellectual property framework	35
Waiving intellectual property protection is not the solution to facilitate better access	39
THE WAY FORWARD	46
ANNEX	47
Acknowledgements	47
Technical Appendix	47
I. Project the value of new pharmaceutical innovation	47
II. Measure relationship between intellectual property and innovation	48
III. Quantify the impact of intellectual property policy changes on social welfare	48
IV. Overview of parameters	48
Abbreviations	50
Endnotes	51

Setting the Scene

While the ongoing COVID-19⁴ pandemic has led to unprecedented collaboration and speed of development for medical countermeasures, such as vaccines and therapeutics, it has also served as a stark example of growing global inequalities. The protection of the intellectual property framework has been perceived as a pivotal factor in both facilitating and restricting access to COVID-19 vaccines and treatments. Advocates of the intellectual property framework claim that intellectual property protection has greatly accelerated the development, production, and distribution of vaccines and therapeutics to fight COVID-19, arguing that intellectual property laws and arrangements that have worked for many years should not be dismantled. At the other end of the spectrum, intellectual property framework sceptics claim that intellectual property laws have impeded vaccine and therapeutic distribution and have called for patent waivers and compulsory licensing measures as tools aiming to increase access in low-income countries.

To help bring clarity to this debate, this paper takes a closer look at the role that intellectual property law plays in fostering innovation in the life biopharmaceutical sector, as well as the extent to which patents impact patients and broader society in both the short and long-term. Additionally, it also assesses whether amending the intellectual property framework for COVID-19 health products and technologies could help facilitate access to COVID-19 vaccines and therapeutics.

An unprecedented spotlight on biopharmaceutical research

By March 2022, there were nearly 474 million confirmed cases and over 6.1 million reported deaths from COVID-19 globally.^{vi} As economies worldwide shut down and people were asked to stay at home, researchers — in both the public and private sectors — worked to develop vaccines and therapeutics to mitigate the virus. These efforts so far yielded 119 vaccine candidates being researched in clinical trials,^{vii} resulting in 35 vaccines receiving conditional or full market approval as of March 2022.^{viii} Additionally, 345 therapeutic and 254 anti-viral medications development projects have started by April 2021, demonstrating an unprecedented industry response.^{ix} The pace at which public institutions, universities, and private firms conducted research and clinical trials to bring their respective vaccines and drugs to market is unprecedented. As an example, Moderna's mRNA-1273 COVID-19 vaccine set a pathbreaking speed by reaching clinical trials only 66 days after the sequencing of the virus, while it took 326 days from virus sequencing to approval for Pfizer's vaccine.^{xi}

COVID-19 has exacerbated health inequalities, leading to debates on access to vaccines and the role of intellectual property regimes. Despite the success of R&D efforts, which led to 11.12 billion vaccine doses administered as of March 2022,^{xii} COVID-19 vaccination efforts reflect considerable global inequalities. While 78.91% of citizens in high-income countries had received at least one dose by March 2022, 58.70% in lower-middle-income countries and only 14.4% of people were able to obtain at least one shot in low-income countries.^{xiii} From the onset, high-income countries entered

4 Used to refer to Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2)

into deals with several companies for different technologies, not knowing at the time which of them would prove to be safe and effective. Against this background, high-income countries have been able to secure earlier access to vaccines, especially the most clinically effective vaccines based on mRNA technology. Not only are the major vaccine developers and producers primarily located in high-income countries, but these countries also helped fund both clinical trials and production operations (i.e., the United States government's funding via Operation Warp Speed⁵ and the European Commission and German government funding for CureVac and BioNTech⁶). Furthermore, these high-income countries also negotiated pre-purchase agreements that included early access as a condition of such agreements.

The dramatic inequalities in access to vaccines at the beginning of 2021, when vaccines started to be rolled out worldwide, triggered societal debates on global health inequalities and caused intellectual property protection to be increasingly perceived as pivotal in facilitating or restricting access to COVID-19 vaccines and treatments. While overriding intellectual property protections may, at first glance, appear to be a simple solution, amending intellectual property protections could pose significant challenges. This paper explores the potential impacts of both a targeted and a blanket waiver of intellectual property provisions. Given the grave consequences of COVID-19 for the health and wealth of people all over the world, an intellectual property waiver might be acceptable if it would increase access to vaccines considerably; however, it is far from certain that this would be the outcome.^{xiv} Other issues, such as access to raw materials, vaccine manufacturing capacity, the need for intensive technology transfer and guidance in order to produce any new vaccine at scale, and the availability of health infrastructure and procurement procedures represent major challenges which current proposals for a waiver do not address. When considering producing a brand-new technology such as mRNA, these challenges only increase.

5 "Explaining Operation Warp Speed", (2021) NIH. Available from <https://www.nih.gov/covid-19/wp-content/uploads/2020/08/Fact-sheet-operation-warp-speed.pdf>.

6 Commission (2020), Available from https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2136.

Methodology and approach

To understand the potential impact of waiving intellectual property rights on COVID-19 vaccines, it is essential to discuss the impact of intellectual property protection on the discovery, development, manufacture, and distribution of novel drugs. Therefore, a closer look needs to be taken at the role that intellectual property protection plays in research and development (R&D) and the extent to which it impacts access. To do so, this paper aims to:

1. lay out a definition of intellectual property protection;
2. illustrate the importance of the current intellectual property framework;
3. demonstrate how intellectual property protection stimulates innovation;
4. assess how intellectual property protection impacts citizens; and
5. explain why intellectual property protection remains critical in the current pandemic context.

We also review some proposed alternatives to the current intellectual property-based system, including their potential benefits and limitations. Based on these insights, we assessed the trade-off inherent in waiving intellectual property protection for COVID-19 health products and technologies.

We take a three-pronged methodological approach to assess the role of intellectual property in innovation, using literature review, stakeholder interviews, and economic modelling. The literature review summarises key findings from academic research on the impact of intellectual property protection on innovation. These academic insights are supplemented by real-world insights from interviews. The interviews aim to capture the perspective of key players instrumental to biopharma innovation, actors who rely on and benefit from intellectual property protection, but whose role is often overshadowed by large pharmaceutical companies, venture capitalists (VCs), and technology transfer officers (TTOs).⁷ In total, five interviews were conducted with VCs, and four with TTOs. Given that the political debate is focused on access, we also interviewed two global health experts and experts in the field of life sciences intellectual property (see Annex for complete list of interviewees). As VCs are one of the primary funders of early-stage, breakthrough health technologies, the goal of these interviews was to gauge the extent to which intellectual property impacts their decision on whether to invest in a life sciences technology. The second group of stakeholders, TTOs, are highly connected to universities and academic research. Their perspective is invaluable when assessing how intellectual property drives innovation in the academic sector and contributes to financing future discoveries. Finally, our bespoke economic model aims to answer two critical questions: how could waiving or reducing a considerable share of intellectual property protection affect long-term innovation? And how could weakening a considerable share of intellectual property protection affect society in the short and long-run? These economic hypothetical models do not quantify the likely loss of innovation due to waiving COVID-19 related intellectual property protection, but rather help understand the possible consequences of weakening the overall intellectual property regime. This last question is critical, as waiving intellectual property protection in the current climate of high public interest could plausibly create pressures for similar responses in other disease areas or if other pandemics were to occur.

⁷ TTOs aim to get academically derived research closer to patients by helping it through the development stages and translating early-stage research into something which can eventually be commercialised.

What is intellectual property?

The World Intellectual Property Organization (WIPO)⁸ defines intellectual property as ‘creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce’.^{xv} Intellectual property protection measures include patents, copyright, and trademarks, all of which enable innovators to be recognised and can help them to financially benefit from their inventions, by allowing the intellectual property holder to profit from their work or investment by controlling how their property is used.

When referring to intellectual property protection, this paper focuses on patents, which are the most commonly used intellectual property tool in the life sciences sector. According to WIPO, a patent is an ‘exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem’.^{xvi} To be awarded a patent, technical details regarding the invention must be revealed to the public through a patent application, but for a specified period of time, no other product based on that patent may be placed on the market by another party. In the life sciences sector, a typical patent lasts for 20 years.^{xvii} Once this patent expires, the original patent holder no longer has exclusive rights on the invention. Therefore, others can produce generic (or biosimilar) versions of this original invention and sell them at lower prices. As supply of products and competition increase, the product becomes more widely available and prices fall.^{xviii}

International intellectual property law globally is governed by the World Trade Organization’s (WTO) Trade-Related Aspects of Intellectual Property Rights Agreement, also referred to as TRIPS. This agreement was negotiated during the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) between 1986-1994 and has been in place since 1995. It links the intellectual property regime to the international trade regime to ensure innovation, technology transfer, and public welfare by providing countries with recourse to protect their citizens’ intellectual property rights.^{xix} This agreement applies to all 164 WTO Members and Observers.^{xx} Within the TRIPS framework, there are existing flexibilities which could potentially help facilitate access⁹. More specifically, the Doha Declaration on the TRIPS Agreement and Public Health — which was adopted by the WTO Ministerial Conference of 2001 in Doha on November 14, 2001 — reaffirmed the ability of TRIPS member states to circumvent patent rights for better access to essential medicines in the context of public health emergencies by clarifying the right of countries to issue compulsory licences and to permit parallel importation.^{xxi} This agreement enables increased flexibility in the intellectual property framework. Overall, this discussion illustrates the need for a robust intellectual property protection system which incorporates sufficient flexibility and access considerations.

In addition to the WTO regime, there are a number of policy frameworks for intellectual property protection at the national and supranational levels (see *Box 1*). While 20 years is the standard patent duration, there are exclusivity period exemptions and nuances across intellectual property frameworks including for orphan drugs, Supplementary Protection Certificates (SPCs), and Regulatory Data Protection (RDP). These incentives do not stack up but work side by side and protect different aspects of innovations. Orphan drugs, for instance, are created to treat very rare conditions and therefore receive a specific 10-year exclusivity period during which similar medicines for the same indication cannot be placed on the market to help spur innovation. In the European Union (EU), this is regulated through the

8 A United Nations Agency

9 Please see Box 6 for more information

Orphan Medicinal Products (OMP) Regulation, and in the U.S. through the Orphan Drug Act. On the other hand, SPCs are issued to compensate for the time lapse between patent application and the granting of marketing authorisation (i.e. drug approval by regulators). Within the EU, SPCs provide additional patent-like protection and can extend the patent period beyond 20 years, for up to five years.^{xxii} Notably, the combined patent and SPC protection period from marketing authorisation cannot be longer than 15 years. Finally, RDP is an intellectual property right available for a limited duration which protects the innovator's proprietary safety and efficacy data for an innovative product. This prevents any other party, during the RDP term, from relying on the innovator's proprietary data to obtain marketing authorisations and market follow-on for generic products. RDP is an essential means of protecting an innovator company's proprietary data and of rewarding the innovator company for its significant investment in the generation of this proprietary data. This is recognized by TRIPs in Article 39.3, requiring that all WTO members protect the data submitted to regulatory authorities against unfair commercial use and disclosure^{xxiii}. Critically, the existing intellectual property framework in the EU could be impacted by some of the proposals under consideration by the European Commission through the revision of the EU Pharmaceutical Legislation.

BOX 1

State of play in the regulatory framework for intellectual property incentives

ORPHAN DRUGS

EU

Orphan Medicinal Products (OMPs) are developed to treat rare diseases defined as affecting less than 5 out of every 10,000 people. The European Commission introduced the OMP Regulation in 2000 with the view to secure effective, accessible, and affordable treatments for rare disease patients. The rationale behind the OMP Regulation was to provide developers with appropriate incentives for the research, development, and marketing of OMPs. Under the OMP Regulation, the main incentive is a 10-year market exclusivity period after the marketing authorisation of an orphan medicine during which similar medicines for the same indication cannot be placed on the market. The introduction of the OMP Regulation had a significant positive impact on the number of annual designation applications, tripling since 2000 and with the total number of authorised OMPs increasing from 3 in 2001 to 169 in 2019^{xxiv}. Despite these developments, an overwhelming 95% of rare diseases are still without authorised treatments. To address these unmet needs, in the context of the 2020 EU Pharmaceutical Strategy, the European Commission is undertaking the revision of the current OMP Regulation with the view to create a robust R&D and regulatory framework that can improve OMP development incentives. Policy options under consideration include: (i) a baseline option under which the criteria for granting an orphan designation for a medicine remains unchanged and the market exclusivity period continues to apply; (ii) changing the criterion for granting an orphan designation to a medicine by changing the threshold of total number of cases of a disease at a specific time based on the type of disease; (iii) exploring novel incentives for products addressing an unmet need in rare diseases; (iv) removal of the market exclusivity incentive for medicines that do not address an unmet rare disease. Regarding the latter, there is a concern that the removal or weakening of intellectual property rights could accelerate the erosion of Europe's research base by driving away pioneering research towards other regions in the world, ultimately reducing the availability and quality of medicines available to patients in Europe.

US

In the U.S., orphan drug designation qualifies sponsors for incentives such as tax credits for qualified clinical trials, exemption from user fees charged by the Food and Drug Administration (FDA), clinical research subsidies (Orphan Product Grant Program), and potentially seven years of market exclusivity after approval.^{xxv xxvi}

EU PROTECTION

Supplementary Certificates

Supplementary protection certificates (SPCs) provide an additional protection period for pharmaceutical products. While standard patents provide protection for 20 years from filing, SPCs offer up to five years of additional protection for patented pharmaceutical products to compensate for the time spent on lengthy clinical trials and market authorisation processes, which prevent owners of the patent from benefiting from the patent protection during this period. The 2018 EU Commission study on the 'Economic Impact of SPCs, pharmaceutical incentives and rewards in Europe', highlighted a positive relationship between the effective protection period (extended by SPCs) and the level of pharmaceutical research and development.^{xxvii} Following the introduction of the SPC manufacturing waiver in 2019, the European Commission is currently revising the SPC system. The main goal of the revision is to tackle the fragmented implementation of the Regulation in EU member states resulting from the fact that SPCs are granted, administered, and enforced nationally, which has caused inefficiencies, lack of transparency, and predictability. Under the ongoing revision of the 2009 SPC Regulation, the Commission is currently assessing different policy options including the provision of unitary SPC protection in relation to unitary patents, as well as further measures to reduce the administrative burden related to obtaining and administering SPC protection.

EU Regulatory Data Protection (RDP)

Throughout the market authorisation process, pharmaceutical developers are required to provide extensive data on the preclinical and clinical trials to attest the safety, efficacy, and quality of the medicine. Unlike patents, RDP protects data generated by companies through investment in the development of the vast amount of data needed in the context of the market authorisation process. They do so by providing a period of exclusivity on the data following authorisation. During this RDP period, generic manufacturers are not able to rely on the original innovator's data to gain market authorisation for their products. This is an essential incentive for companies to make the necessary investments to prove the safety and effectiveness of new medicines. Under EU law¹⁰, there is a period of eight years during which a generic applicant cannot refer to the originator's data and an additional period of two years during which a generic product cannot be put onto the market. Therefore, the generic product cannot be placed on the EU market until ten years have elapsed from the originator's first marketing authorisation. RDP is considered a key accelerator of innovation and can increase access to new medicines. Considering the large amounts of investment needed to introduce new medicines in the market, innovators find markets with RDP systems in place more attractive as they prevent their new products from being copied. As a result, new medicines are introduced in these markets sooner than in other markets.

10 Article 14(11) of Regulation (EC) No 726/2004 laying down Community procedures for the authorization and supervision of medicinal products for human and veterinary use and establishing a European Medicines Agency.

U.S. PATENT APPEALS ADMINISTRATIVE PROCESS

In an effort to reduce prescription drug costs, the Restoring the America Invents Act (RAIA) bill was introduced in September 2021 to address some of the concerns that have developed since the passage of the America Invents Act (AIA) in 2011 and the creation of the Patent Trial and Appeal Board (PTAB). The RAIA would have several major effects on patent litigation. It would allow for government entities to challenge patents directly, which would further reduce the authority of the court system; reduce the discretion of PTAB judges to deny PTAB review (which would move the review back into PTAB); and allow for the director of United States Patent and Trademark Office to reconsider decisions made by PTAB. These would all have the effect of giving PTAB additional domain over patent review and reduce the oversight of federal courts in these matters. While some have claimed that this change in the process of government intellectual property right would help to reduce drug prices, denying innovators access to federal courts sets a problematic precedent.

As the above examples from real policy frameworks show, it is not the intellectual property system itself which hampers access. Rather, it is how the framework is perceived. Critics of the current framework often highlight the so-called ‘ophanisation of drugs’. This refers to the breaking down of indications, which would not normally qualify as an orphan medicine, into subsets of indications that are relevant for subpopulations of patients, so that these subsets qualify for an orphan designation.^{xxviii} Underlying these critiques is a concern that patents are granted for advances that are seen to hold less therapeutic value. In contrast, others argue that these concerns arise from a flawed understanding of the pharmaceutical development process, the patent system, and the benefits to patients of incremental innovation. The length of patent exclusivity, for example, cannot extend beyond the expiration date of the primary patent for the active ingredient, meaning that there is a built-in limitation. Furthermore, patents are only granted for new, non-obvious technical advances after assessment by highly skilled staff at patent offices across Europe. The value of a patent, both from a therapeutic and commercial perspective, is not assessed at the time a patent is granted, but rather determined by the market (i.e. patients, payors, healthcare professionals).

Overall, several interviewees suggested that there should be a stricter definition of what constitutes a novel invention to receive patent protection.^{xxix} At the same time, they also noted that failing to allocate patent rights for incremental improvements to new therapies may decrease research and development investments into said improvements. This could lead to reduced follow-on innovation, which in turn could reduce incremental but important improvements to therapies in terms of safety, efficacy, or convenience.

Does intellectual property protection matter?

This paper seeks to examine the impact that amending COVID-19 related intellectual property protections could have on the biopharmaceutical sector, by setting a precedent beyond the pandemic. To appreciate the potential ramifications of setting such a precedent, the following considerations should be made: the importance of intellectual property protection for the current system of innovation in the biopharmaceutical industry; the reasons why intellectual property is pivotal to drug development; how intellectual property protection helps stimulate collaboration; and the broader innovation ecosystem.

Intellectual property protection is fundamentally important for the biopharmaceutical sector

While intellectual property protection is important for many industries, it is the lifeline of the biopharmaceutical industry. In 2018, the global biopharmaceutical industry registered 9,114 patents through the Patent Cooperation Treaty (PCT) of WIPO, a 4% growth compared to 2017.^{xxx} There are over 70 patents per 1000 employees in the medical equipment and pharmaceuticals industries, ranking it in the top ten across all industries.^{xxxi} Additionally, intellectual property-licensing revenue for scientific R&D ranked fifth among industries in 2012, just behind motion picture, television services, and other information services.^{xxxii} One study that examined 100 U.S. manufacturing firms found that 65% of treatments would not have come to market in the biopharmaceutical sector without patent protection, compared to much lower percentages in other industries such as chemicals (30%), machinery (15%), and electrical equipment (4%).^{xxxiii}

Academic literature has shown that stronger intellectual property protection incentivises innovators to invest more in R&D and that patents are especially important to the biopharmaceutical sector. A recent meta-analysis summarising this trend indicates that intellectual property protection positively impacts both growth and innovation across sectors, although these benefits accrue more for developed than developing countries.^{xxxiv} These beneficial effects are particularly pronounced in the health sector, where patent protection has often been linked with increased innovation.^{xxxv} For example, the 1983 Orphan Drug Act (ODA) lengthened the duration of market exclusivity for orphan drugs in the U.S.^{xxxvi} As of 2009, the Food and Drug Administration (FDA) granted 2,002 orphan designations and approved 352 orphan drugs since the implementation of the ODA^{xxxvii} compared to only ten FDA drugs approved for orphan diseases before the introduction of the ODA.^{xxxviii} On average, the ODA increased the annual rate of new clinical trials for drugs that treat rare diseases, defined as those with a prevalence below 200,000 people.^{xxxix} Moreover, the 1995 TRIPS agreement increased patent term duration to 20 years from the filing date.^{xl} The increased patent duration boosted the value generated by new innovative products by 21%.^{xli} However, patent protection in the context of TRIPS increased R&D investment in diseases affecting high-income countries relative to diseases more prevalent in low and middle-income countries.^{xlii}

As increased intellectual property protection leads to more R&D investments and an increase in the number of drugs brought to the market, patent laws have significant effects on innovation in the biopharmaceutical industry. Securing market access through the exclusivity granted by intellectual protections or patenting is associated with higher generation of new and innovative therapies. A one-year reduction in expected market exclusivity is associated with a 15.9% average decrease in the number of new drugs that are brought to market.^{xliii} Research has demonstrated that there

is a positive correlation between market size and pharmaceutical innovation. In a 2004 study using 30 years of data, a 1% increase in the market size increased the number of new drugs approved by the FDA from 4% to 6%.^{xliv} By increasing market size, patents help incentivise additional innovation.

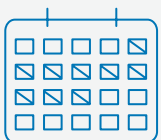
Why intellectual property protection is of core importance to drug development

Unlike in many other sectors, there is a high barrier to entry for investing in the biopharmaceutical sector. It is very risky and has a very high failure rate, due to complex pharmaceutical R&D and business models. This risk originates from **four main elements**, which are **high-up front R&D costs, long development timelines and the risk of failure, strict regulatory frameworks, and the risk of duplication once drugs are on the market**. Intellectual property provisions help mitigate these risks and incentivise companies and venture capitalists (VCs) to invest in R&D, which can ultimately yield high returns.



HIGH UP-FRONT R&D COSTS

Getting a drug to market requires a significant investment, with figures typically ranging from USD 1 to USD 1.5 billion.^{xlv} Other estimates, such as that of Di Masi et al., go even higher with possible costs up to USD 2.6 billion.^{xlvi} There is no revenue or return on investment for many years, until the product is approved by regulators in each country involved in the transaction. Because of these conditions, the majority of investments fail. Only 5 in 5,000 drugs that enter pre-clinical testing progress to human testing. Of these, only 1 out of 5 is eventually approved. As a result, the odds of a new drug making it to market are 1 in 5,000.^{xlvii} Without patented intellectual property, players in the R&D space will not put forward the necessary investments to get a drug to market.^{xlviii} All of the VCs interviewed noted that the intellectual property framework provides the protection required to decrease investment risks and that they would not risk investing in drug or vaccine development without strong patent protections. If this protection did not exist, investors could risk losing their entire investment, taking away the ultimate incentive to invest. This is due to intellectual property provisions, that prevent innovations from being picked up or copied by non-investors. This not only affects VCs, but also small biotechs and universities that fund a lot of the original research needed to ensure a drug is safe and effective.



LONG DEVELOPMENT TIMELINE

The process of drug development is long, taking anywhere from 10 to 15 years on average. For instance, it takes the U.S. Patent and Trademark Office (USPTO) 3.4 years on average to issue a patent after it has been filed. This timeline is even longer — 4.4 years — for biologic medications.^{xlix} Although patents generally last for 20 years,^l the majority of this time is occupied with running lengthy and expensive clinical trials. The amount of time between regulatory approval and patent expiration (also known as the effective patent length) is typically 12 years in the U.S.^{li} and ten years^{lii} in the EU.^{liii} The length of the drug development process increases the risk for investors as they have to commit to investing significant amounts of money over a very long period of time. The period of exclusivity granted by patent protection and the resulting recuperation of investment costs is usually the main incentive that makes it worth investing in the drug development process.^{liv} Overall, the time to market is much longer than

in other sectors, especially the tech sector, which is often lauded for its open approach to intellectual property.¹¹



STRICT REGULATORY FRAMEWORK

The biopharmaceutical industry is tightly regulated to ensure high standards of safety and quality for patients. Regulators require drug manufacturers to submit the molecule to rigorous pre-clinical trials as well as three phases of clinical trials in humans before the drug is approved for use by regulatory bodies such as the Food and Drug Administration (FDA) in the U.S. and the European Medicines Agency (EMA) in the EU.^{lv} This approval process is necessary but places additional costs on drug developers to get their drugs to market. It has been estimated that clinical trials required for FDA approval of new drugs can cost around USD 1 billion.^{lvi}



RISK OF DUPLICATION – DRUGS ARE HARD TO DISCOVER BUT EASY TO COPY

While there is a significant need for investment to get products out to market, in the absence of intellectual property protection once a product is released, it can be easily copied. Small molecules can easily be reproduced. Similar reverse-engineering is possible — although more difficult — for biologics and gene therapies. Additionally, while it takes billions to bring a new drug to market, estimates are that it takes a small fraction to bring a generic to market. Overall, the ability to quickly duplicate a drug means that the first-mover advantage on the market is limited. In this sense, getting a return on investment depends on the intellectual property framework and the period of exclusivity awarded, i.e., when the technology cannot be copied and exploited by another organisation.^{lvii}

11 Please see Box 2 for more details

BOX 2

The role of intellectual property protection in the biopharmaceutical sector compared to the technology sector

Where endnotes do not specify, all information was drawn from the interviews conducted – please see the Annex for the full list of interviewees.

FACTOR	BIOPHARMACEUTICAL SECTOR	TECHNOLOGY SECTOR
Time to market	10-15 years ^{lviii} Beta versions are not permitted	Beta versions can be launched in months, and updates can happen within weeks or months ^{lix} Beta versions are permitted and can generate revenue
Investment costs	1 – 2.5 billion EUR ^{lx}	Depends on the specific app and technology, but much lower barrier to entry. It is assumed to be between USD 10,000 and 500,000. Instagram, for example, is estimated to have cost +/- USD 60,000 to build. ^{lxi}
Obsolescence	Slower moving – drugs stay on the market for 20+ years ^{lxii} , as long as they remain an effective treatment	Very fast moving – technologies can become obsolete within a year
Regulatory Framework	Tightly regulated – rigorous evaluation of safety, quality, and effectiveness	Not strictly regulated – move fast and disrupt the market
Risks	No return on investment until company is acquired, asset is licensed, or product is approved for market ^{lxiii}	All about being first to market and capturing a large market share to buy up potential competitors to consolidate dominant position

Trade secrets	<p>Patents are favoured and are the vehicle to exploit discoveries. Patents are generated and exploited by a number of actors that all play a key role in the innovation process such as academia, start-ups, big pharma with TTOs and VCs^{lxiv}</p> <p>Information ends up in public domain. With trade secrets it is much harder to secure the collaborations required to bring a product to market</p>	<p>Secret code that cannot be copied as there is little pressure to make information public – key thing is to prevent knock off (i.e. ongoing Apple – Samsung lawsuits)</p> <p>Information not typically in the public domain, with the exception of open-source initiatives (i.e. Linux, Mozilla Firefox)</p>
Scope of patents	<p>Fewer core patents which tend to be structurally or functionally defined molecules that are generally real advances in the art (ways to treat/ cure diseases for example)</p>	<p>Many very narrow patents for small improvements on existing technology</p>

Intellectual property protection has helped foster a culture of collaboration

In addition to being critical to incentivise investment, the existing intellectual property framework has helped increase collaboration, which has led to more innovation. There are four key trends in the industry that can be attributed to this framework.

First, there has been a move towards a complimentary approach with larger biopharmaceutical companies having both in-house R&D as well as partnerships with small and medium enterprises (SMEs). In the past, research was done mainly in-house by larger pharmaceutical companies. Today, this research model works alongside a more complimentary model setting, comprised of thousands of start-ups and spinouts that are built with the financing strategy of taking a new concept and generating sufficient clinical evidence to make a product or firm attractive for purchase by pharmaceutical companies. The move from the predominately in-house R&D focus to a broader complimentary model has contributed to the rise of new firms, which are responsible for most of the innovation that has filled industry pipelines in recent years.^{lxv} Moderna, BioNTech and CureVac, the three biotechnology companies that developed the mRNA technology at the heart of several COVID-19 vaccines currently on the market, are just one example. These smaller biotech companies, in many cases, are either university spinouts, or have licensed intellectual property from universities which, with support from private investors, further develop it to the point at which it can be licensed to pharmaceutical companies. One consequence is that biopharmaceutical innovation relies heavily on a complex web of contractual agreements linking various actors at several stages of the drug development process. Intellectual property protections have played a critical role in moving from an internal R&D model to a broader external one.

Second, while there is still a lot of competition in the life science space, many companies also have started to collaborate to leverage each firm's unique skills. In other words, there is less of a 'going at it alone' mentality. One example is the GSK, Pfizer, and Shionogi three-party joint initiative to create a world-leading specialist company for HIV/AIDS, ViiV. The rationale for the venture is that the new firm will be more sustainable as a combined venture and will produce synergies on the commercial side.^{lxvi} This type of collaboration in the biopharmaceutical sector is typically based on intellectual property provisions, which serve as the basis for collaborations and contracts.^{lxvii}

Third, biopharmaceutical companies have adopted innovative licensing approaches, including non-assert declarations and voluntary licensing to enable wider access to technologies protected under the intellectual property framework. A non-assert declaration is when a patent holder commits to not enforce their patent rights for a specific group of countries so that a generic version can be produced during an agreed upon time frame and setting. Voluntary licensing is a mechanism whereby the patent holder gives authorisation to another company, often a generics company, to produce and distribute a patented vaccine, drug, device, or diagnostic. The license typically sets out quality requirements and defines the markets in which the licensee can sell the product.^{lxviii} Examples of voluntary licensing include:

- Between the years 2013–2019, several companies, including Pfizer, Bristol-Myers Squibb, and AbbVie, established long-term partnerships with the Medicines Patent Pool (MPP) to license their HIV, tuberculosis, and Hepatitis C products to well over a hundred countries.^{lxix}
- In 2014, Gilead entered into non-exclusive licensing agreements with seven India-based generic pharmaceutical manufacturers to expand access to its chronic hepatitis C medicines for distribution in 105 developing countries.^{lxx}
- In March 2020, AbbVie suspended its global patent rights for Kaletra, an HIV drug that has been identified as a potential treatment for coronavirus.^{lxxi}

In addition to voluntary licensing frameworks, compulsory licensing is an existing mechanism in TRIPS to overcome limited access to medicines of considerable public interest. When using compulsory licensing, governments allow other producers to manufacture a patented product or process without the patent owner's consent, or for the government to use the patent-protected inventions itself. Within this framework, the patent owner still has rights over the patent, including a right to compensation for copies of the product made under the compulsory licence.^{lxxii} As written in a paper by Jamie Love, an intellectual property activist and Director of Knowledge Ecology, *'Contrary to many popular news reports and statements by misinformed government officials and industry lobbyists, the WTO rules are quite liberal in terms of the grounds for granting compulsory licenses. There are no limitations on the scope of disease. Indeed, there is no requirement that compulsory licenses be limited to cases involving health care problems at all.'*^{lxxiii}

Finally, the intellectual property framework enables technology transfer. Technology transfer allows for the sharing of information between academia and industry. Often this takes place in the form of early-stage academic research with other stakeholders needed to bring the technology to market (biotech companies, investors, pharmaceutical companies, and others), without the risk that the technology is expropriated or the value is lost. Academic researchers and their institutions cannot bring a new drug or vaccine to market on their own as they do not have the expertise, the facilities, or financial resources. The same applies, in most cases, to small biotech companies. Only large pharmaceutical companies have all the capabilities and resources needed to bring a drug to market on their own and, despite this, this approach is less efficient than the favoured external collaboration model. As a result, technology transfer concerns the translation of research into marketable pharmaceutical products to address unmet clinical needs. In the case of technology transfer, navigating the business/economic model is complex. Many partners are involved, and companies cannot comprehensively control such collaboration with confidentiality or non-disclosure agreements. Therefore, patents are necessary to protect innovation.^{lxxiv}

Intellectual property protection is the backbone to the broader innovation ecosystem, beyond biopharmaceutical companies

It is not only larger pharmaceutical companies who benefit from a robust intellectual property framework, but also a multitude of actors along the drug development chain, including start-ups, investors, the public sector, and universities¹². One important consideration raised in four of the interviews is that the intellectual property framework helps maintain the balance between bigger (biopharmaceutical firms) and smaller players (universities and biotechs) in this innovation ecosystem^{lxxv}. In this sense, one of the interviewees used the analogy of David and Goliath, arguing that patent protection

12 Please see Box 3 for more details

is one of the primary forms of guarantee for researchers and developers against the more powerful large industry players.^{lxxxvi}

BOX 3

Beneficiaries of intellectual property protection – how innovation happens in the biopharmaceutical sector

Where endnotes do not specify, all information was drawn from the interviews conducted – please see the Annex for the full list of interviewees.



ACADEMIA

ACADEMIC RESEARCHERS

Patent applications and publications are two ways of bringing scientific knowledge into the public domain. The question of which to prioritise has long been ongoing in academic debates.

For an academic researcher, it can be rewarding to see a technology originating from their own lab being developed into a final product benefitting patients. Furthermore, there is a potential for revenue for their research group and for the researchers themselves, even if there is little possibility that any substantial profits will be generated. Lastly, academics involved in the development of intellectual property are becoming increasingly appreciated by research institutions that are using this as a criterion to rate academics for the purposes of promotions or tenure.^{lxxxvii}

For example, scientists have studied the use of mRNA as a novel therapeutic since the early 1990s^{lxxxviii}. It was not until 2005 that a group of researchers at the University of Pennsylvania published findings on mRNA technology that have since been critical in the development of mRNA vaccines.^{lxxxix}

TECHNOLOGY TRANSFER OFFICES (TTOS)

In the U.S., the Patent and Trademark Law Amendments Act of 1980 gave universities the right to retain title and sell patents and discoveries made through federally funded research – this is known as the Bayh-Dole Act.^{lxxx} Intellectual property protections are critical for academic institutions to attract industry partners and or private investors that are interested in the quality of research and the commercial opportunity the innovation provides.^{lxxxi} Much of the income received from patenting and licensing by universities is subsequently re-invested back into the university to fund new research projects that will fuel the new wave of biopharma innovations. For mRNA, U.S. Securities and Exchange Commission (SEC) filings show a number of sublicenses for mRNA-related patents which were granted by the University of Pennsylvania to both Moderna and BioNTech.^{lxxxii} The 2017 filings indicate that the University of Pennsylvania exclusively licensed their patents to mRNA RiboTherapeutics, who then sublicensed them to its affiliate CellScript. CellScript then went on to sublicense the patents to Moderna and BioNTech.



INVESTORS

VENTURE CAPITALIST FIRMS (VCS)

A Venture Capitalist firm's approach is to fund private biotech companies which carry on research and development to the point at which a pharmaceutical company will buy or license it and bring the research to next stage of the development process, or to the point that the private biotech company can be listed on a stock exchange via an initial public offering (IPO). The decision to invest heavily depends on intellectual property, which is the guarantee that the company owns proprietary knowledge. VC is a high-risk business and out of 10 high risk deals, eventually 1 or 2 on average will make a sufficient return to finance the other 8 or 9. To incentivise risk taking by VCs, such as in the rare disease space, returns anticipated thanks to intellectual property are critical. For mRNA, investment from Flagship Pioneering was critical for funding Moderna.



COMPANIES

START-UPS/ BIOTECHNOLOGY FIRMS

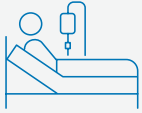
Patents play a pivotal role for start-up 'biotech' firms which are often backed by venture capital. As their value is largely dependent on their proprietary technologies and candidate drugs in development, intellectual property protection plays an essential role in funding and partnership opportunities for the development stage firms. Most biotech companies are solely focusing on R&D and do not make any revenue. While some do generate revenue through services or other offerings, generally they exclusively spend or "burn" money up to the point of exit, when they are able to out-license or sell an asset. The reason they keep operating and VCs continue investing in these companies, sometimes over decades, is the perceived value of their research or drug candidates and the protection that patents provide them to generate revenues and a return on investment, in the event that they are able to successfully develop and bring a new drug or vaccine to market.

Regarding COVID-19 vaccines, after a decade or more of investment Novavax was struggling financially, Moderna was making no revenues, CureVac and BioNTech received several grants and loans from the EU, and the latter was partly acquired by German government. While there are a few success stories, many companies will go bust and even more will remain among the living dead, with no real progress or potential for recovery of investment.

PHARMACEUTICAL COMPANIES

Most biotech companies do not have the capital, networks, resources, or even expertise to bring a product all the way to market without partners, and often aim at a trade sale or out-licensing to a pharmaceutical company. Therefore, pharmaceutical companies step in and invest a percentage of their existing revenues from current sales into the purchase or licensing to market launch of the next generation of drugs. This is feasible due to their revenue streams, capacities, and expertise.^{lxxxiii}

With COVID-19, larger companies partnered with smaller ones to rapidly run large clinical trials, secure emergency use authorisation, and produce vaccines, with the key examples being the Pfizer and BioNTech collaboration, and the Oxford University and AstraZeneca one.



PATIENTS

The economic modelling section of this paper shows that when changing the current intellectual property regime, consumers and patients suffer most from weaker intellectual property protections, bearing more than 70% of the burden due to fewer new drugs being developed to treat existing diseases.



KEY CONCLUSIONS

- Intellectual property protection is the cornerstone of drug discovery and development and fosters an innovation-friendly environment in the life sciences sector
- Intellectual property law provides a framework that supports collaboration that is critical to effectively supporting innovation through the long, complex, and risky innovation process, from bench to bedside
- Maintaining a strong intellectual property framework results in long-term benefits for various stakeholders, including firms, investors, universities, patients, and society

Does the protection of intellectual property stimulate innovation?

Based on the interviews conducted, we found that intellectual property provisions can help stimulate innovation by making R&D investments more attractive and by putting information in the public domain, which helps foster follow-up innovations. Despite this, intellectual property protection is not a fix-all, and there are areas where market failures hinder innovation, such as antimicrobial resistance (AMR) (see Box 4).

Intellectual property protection makes investment attractive

Due to the exceptionally high costs and risk of failure in biopharmaceutical investment, all interviewees noted that robust incentives are needed to drive investment. The intellectual property framework does this by providing a period of market exclusivity which enables investors to receive a return on investment, which then allows people, institutions, and companies to keep on innovating.

Monetary investments are typically made by the public sector and VCs for early-stage research. It is estimated that in 2020 the biotechnology sector raised just under 20 billion dollars and saw 448 venture capital financing rounds for biopharmaceutical companies.^{lxxxiv} For example, in 2017, out of 49 new medicines approved in the US, 92% were owned by public companies at the time of approval, 39% were developed in-house by Big Pharma companies, and 43% were developed by venture-backed start-ups, with the remaining primarily developed by mid-sized biotechs.^{lxxxv}

While slightly different to VCs, TTOs work with academic researchers and universities to help them identify which research portfolios are commercially viable, and once viability is identified, TTOs help researchers to patent their technology or research. Doing so helps them to progress one step further on the development pipeline by finding industry partners that are willing to invest in or buy the patented research.^{lxxxvi} When a technology requires more investment and development than what an institution can provide in order to reach an inflection point at which it can be sold or licensed to industry, TTOs can assign or out-license the technology to new spinouts, start-ups, or existing private biotech companies. These companies then carry out the additional research and development required. Most technology transfer offices are in-house at a given institution, although some are for profit, some are charities, and some are service organisations serving multiple institutions.

The services which TTOs offer universities are valuable, as promising scientific research can be identified, protected by intellectual property, and commercialised through the sale or licencing of the intellectual property to bigger players in the biopharmaceutical development chain. This process has two main benefits, the first of which is that it allows for the realisation of promising early-stage scientific research to be translated into a real product or technology which can improve patient lives. The second, being that a large percentage of the royalties earned by universities from the licencing of their intellectual property to bigger players, can be reinvested into university resources and facilities.^{lxxxvii}

The ‘Lego model’ – intellectual property protection puts knowledge in the public domain

The premise of intellectual property protection rests on a type of social contract — the patent bargain — whereby the inventor of a novel idea or technology agrees to publish the information in exchange for the exclusive rights to use this idea for a limited period.^{lxxxviii} This approach is beneficial to society as it places significant amounts of novel and innovative information into the public domain.^{lxxxix} More specifically, within 18 months of filing a patent, the information is made public. Such disclosure allows others to develop ideas based on the information leading to increased innovation in a given space. In this sense, one of the interviewees suggested that researchers can ‘build’ on each other’s knowledge — like Lego blocks.^{xc} Indeed, another interviewee, Christian Stein, the CEO of Ascenion, noted that *‘the notion of giving novel knowledge to society and giving society the opportunity to work with this novel knowledge is the heart and soul of intellectual property. This has a price, and the price is that the intellectual property holder has the right to control how others use that knowledge for a certain period of time.’*^{xc1}

Three interviewees argued that if this patent bargain were to disappear, we would shift from the Lego model to the Coca-Cola model.^{xcii} The Coca-Cola model is based on the secrecy of the Coca-Cola Company’s recipe for its most famous product. The recipe is a trade secret and has never been revealed to the public as there is no Coca-Cola patent on the ingredients or recipe. If there had been a patent, this would have expired over a 100 years ago. But with a trade secret, Coca-Cola can maintain their exclusive ability to produce Coca-Cola — rather than generic alternatives — indefinitely. This analogy paints a picture of what the biopharmaceutical industry would look like if intellectual property rights were removed or decreased. Many companies would keep their research and innovations secret. Secrecy in R&D performed by companies would lead to duplication of efforts as companies would not know what other competitors are researching. Patents, on the other hand, are publicly available and anyone can review them. They facilitate competition from other producers once the patent expires as the ‘how-to’ has already been disclosed in the patent. They provide a state of play of the knowledge in a specific field. Through licenses, patent holders can foster discoveries in areas which the original patent holder was not actively researching, which in return will increase knowledge and innovation for the whole benefit of the scientific community and society. A common misunderstanding about waiving intellectual property rights is that it would provide more transparency.

BOX 4

When patents fail – the case of antimicrobial resistance (AMR)

MARKET DRIVERS

The patent system can only contribute as an effective incentive mechanism if sufficient market drivers exist. Typically, when developing a medicine, companies calculate a price based on a number of factors — including market dynamics and the cost of R&D. Once a patent expires, generic companies are able to produce and sell the medicine and be competitive based on sales volume.

Despite the clear value of antibiotics for society, the incentives to develop them are notably limited. Generally, innovators and generics are commercially incentivized to sell high volumes of products to obtain a return on investment. In the case of antimicrobial resistance (AMR), where bacteria naturally develop resistance to antibiotics, the goal is to have effective antibiotics available, yet only give them patients who require powerful antibiotics to treat resistant bacteria. Therefore, there is a medical and public health rationale for using such new drugs only very selectively. This means low sales, which generally means an unsustainable business model in light of the high

development costs. So, a solution is required which provides innovators, investors, and pharmaceutical companies with a basis for sufficient return on investment without simply increasing the use of new drugs.

Many AMR experts view antimicrobial stewardship as a double-edged sword^{xciii}. To safeguard their effectiveness, physicians often avoid prescribing the newest antimicrobials. However, while limiting antimicrobial use can slow AMR, it also serves to discourage the industry from developing new therapies. Adding to the economic disincentive is the fact that, unlike other disease areas, most antimicrobial drugs cure an underlying infection relatively quickly (within days to a few weeks), resulting in limited sales volumes.

OVERCOMING MARKET FAILURES

The current intellectual property system has not managed to successfully overcome market failures faced by antimicrobial manufacturers. Only by changing the way such products are valued can we adequately address the need for the development of ‘reserve’ antibacterials^{xciv}, while reserving them for patients in most urgent need.

After years of focusing on cost control and limiting the use of antibacterials to curb inappropriate use, countries are now taking a range of measures to address the lack of supply of new products.^{xcv} Notably, in recent years, the so-called ‘One Health’ approach is increasingly considered by policymakers and has also been recognised by the 2016 United Nations Political Declaration on Antimicrobial Resistance^{xcvi}. The ‘One Health’ approach recognises the interconnectedness between human, animal and environmental health, and therefore emphasises the need for comprehensive and integrated multisectoral action and policies.

Incentives can be distinguished between so-called “*push, pull and decoupling*” measures^{xcvii}. Push mechanisms financially support research programs during the period between drug discovery and commercialisation. Pull incentives introduce new types of rewards to incentivise companies to invest in this area. Novel pull incentives recommended by expert literature and the industry include so-called transferable exclusivity extensions (TEE). TEE is a reward in the form of a transferable exclusivity voucher that an innovator can use for any other product in its portfolio or sell to another company. By transferring the exclusivity extension to another product in the portfolio that generates higher revenues, TEE can be a strong incentive for innovators to invest in AMR R&D.

Existing interventions centre on providing exceptions in cost-containment mechanisms to allow higher prices. In the U.S., certain antibacterials are granted additional years of protection from generic competition and faster regulatory review.



KEY CONCLUSIONS

- Intellectual property protection incentivises investments and innovation
- In some cases, existing intellectual property provisions may need to be supplemented with new incentives to address unmet medical needs

Does the protection of intellectual property impact citizens?

How would reductions in intellectual property protection affect citizens? To answer this question, we created a robust health economic model to consider the hypothetical scenario where world leaders have made the drastic decision to waive intellectual property rights for some life science innovations.

Developing a robust model to quantify changes in intellectual property protection

In part motivated by the current discussion on the importance of intellectual property protection in response to the COVID-19 pandemic, we developed an economic model to quantify the potential impact of changes to intellectual property protection on long-term social welfare. Specifically, we modelled how overriding intellectual property protections for some proportion of new life science innovations would affect consumers, producers, and overall society in both the short-term and the long-term.

A key outcome in the model is ‘social surplus’, which is the overall benefit to society derived from a medicinal product, which is measured as the value to patients minus the cost of producing the drug. These benefits can be divided into benefits that accrue to consumers (i.e., patients) and those that accrue to producers (i.e., innovative firms). Consumer surplus is measured as the net value to patients after subtraction of the drug price; producer surplus is equal to the revenue firms earn less the cost of production. Total social welfare is calculated by adding together the consumer and producer surplus.

This economic model quantifies how the removal of intellectual property would impact future innovation and social welfare. Our methodology relies on a three-step approach (please see the Annex for a detailed description). First, we projected the value of new pharmaceutical innovations under the current intellectual property framework. This estimate was attained by:

1. identifying recently approved pharmaceutical treatments.
2. quantifying the incremental value of such treatments measured in quality-adjusted life years (QALYs).
3. measuring disease prevalence to estimate the total number of individuals impacted.
4. measuring the share of the social surplus created that is attributed to consumers, per person.

Second, we estimated the impact of hypothetical changes in the intellectual property regime. We selected these extreme policy scenarios to more clearly demonstrate the potential impact that intellectual property overrides in COVID-19 drugs—such as the TRIPS waiver—could have if such overrides created a precedent that would be followed in other disease areas or indeed all-new health technologies. Specifically, we selected three different intellectual property regimes associated with potential future intellectual property protection overrides. The intellectual property overrides in this model include removing all relevant intellectual property protections, including removing patent protection, exclusivity, and regulatory data protection, requiring compulsory licensing, prohibiting trade secrets, and waiving

intellectual property rights broadly. Our baseline policy change modelled an extreme case where governments in the future would override intellectual property protections for 25% of drugs (1 in every 4 drugs). We also considered cases where intellectual property overrides were applied to 10% of drugs (1 out of every 10 drugs) and 50% of drugs (5 out of every 10 drugs).

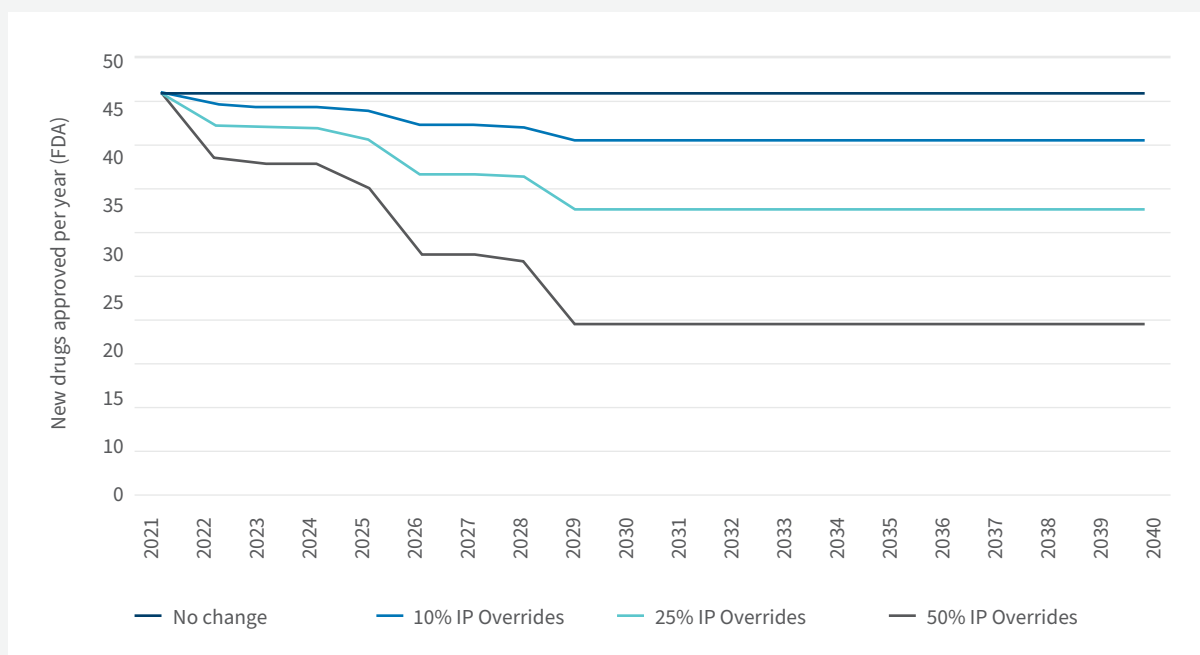
Third, we quantified how the impact of the changes in intellectual property regimes could affect the critical outcomes of interest: the number of drugs brought to market per year, overall social welfare, as well as consumer and producer surplus. Waiving intellectual property protection for some share of drugs leads to two offsetting effects: 1) in the short-term, prices fall and consumers benefit; but 2) in the long-term, R&D investments decline, and the number of new drugs brought to market falls. Our baseline approach focuses on measuring these outcomes for residents in the U.S., but we also extended our analysis to consider the impact on global societal welfare. We used a 3% discount rate to down-weight changes in welfare in the longer-term future and additionally report undiscounted figures.

Robust intellectual property protection leads to long-term benefits for consumers, firms, and broader society

The benefit of keeping the current intellectual property system compared to increasing the likelihood of overriding intellectual property protections by waiving patents for 25% of drugs amounts to USD 536.2 billion on average annually or USD 16.1 trillion over 30 years. Across various specifications, our model shows that overriding intellectual property

protections reduces the number of treatments brought to market. Overriding intellectual property for 25% of drugs would result in a reduction in the number of new drugs launched per year from 46 in 2021 to 33 in 2050 (2). Because many drugs are already in Phase 3 trials by the time intellectual property overrides are applied, by 2025 there are still 41 drugs entering the market (an 11% decrease). However, by 2050, our model estimates that only 33 drugs will be brought to market, a 29% decrease relative to the status quo.

Figure 2 – Number of New Drugs Launched Per Year between 2021 and 2040 (20 years)



Note: The model projects new drugs launched through 2050, but the figure reports results through 2040. Values are constant between 2040 and 2050.

Under any of the scenarios where intellectual property rights are overridden in our model, society is made worse off. The net discounted loss in social welfare from overriding intellectual property protections is USD 16.1 trillion (or USD 28.2 trillion if we do not discount future years by 3%) over the 30-year time frame we examined. Under the current intellectual property system, the social value of new drugs in the U.S. is USD 4.96 trillion per year. This estimate is in the range reported by others.^{xviii} The higher the likelihood that drug intellectual property protections will be overridden in the future over the life of the product, the lower the social benefits provided by pharmaceutical R&D. In our first scenario, a 25% chance of overriding a drug intellectual property protection reduces social surplus by USD 16.1 trillion (USD 536.2 billion per year on average, or 0.6% of global GDP) between 2021 and 2050 ([Figure 3 - Discounted Annual Loss in Social Welfare between 2021 and 2050](#)). In the second scenario, if the chance of overriding is reduced to 10%, the social surplus loss decreases to USD 6.43 trillion (USD 214.5 billion per year on average, or 0.2% of global GDP) over this period. Similarly, in the third scenario, a 50% chance of overriding that drug intellectual property protection results in a societal loss of USD 32.17 trillion (USD 1.1 trillion on average per year, or 1.1% of global GDP over 30 years).¹³

A reduction in intellectual property protections would also have a significant impact on life science sector investments in research and development. We estimated that, by waiving patents for 25% of drugs, annual R&D investments would fall by 9%, 11% and 29% by the year 2023, 2025, and 2030 respectively. Based on the current innovation pipeline—and not accounting for any likely changes to R&D for pre-clinical studies—the reduction in R&D spending on clinical trials would fall by USD 1.51 billion, USD 2.02 billion and USD 5.05 billion per year by 2023, 2025, and 2030. This decrease in investment would have a significant impact on patient outcomes.

Additionally, if employment decreases proportionally to profits, a 25% intellectual property protection override would lower employment by 26% over 30 years, resulting in a loss of 1,059,000 jobs (214,000 workers directly employed by biopharmaceutical firms and 845,000 employees working in supporting industries) (4). Overriding intellectual property for 10% and 50% of drugs respectively would lower employment by 11% and 49% over this period, amounting to a loss of 445,000 jobs (90,000 direct jobs; 355,000 indirect jobs) and 1,953,000 jobs (395,000 direct jobs, 1,558,000 indirect jobs) respectively. Our model likely underestimates the loss value because the results do not account for cost offsets – additional costs due to fewer therapies coming to market. According to a U.S. Congressional Budget Office (CBO) report, a 10% increase in drug spending (i.e. expenditures on prescriptions medicines and over-the-counter products) would result in a 2% decrease in medical costs^{xcix}. Using these estimates as applied to a US setting, if 25% of drugs were to have reduced intellectual property protection, there would be a 29% decrease in drug spending—due to a combination of lower drug costs, but largely fewer new drugs coming to market—resulting in a 5.8% increase in medical costs.

13 These net social welfare loss values are discounted by 3% each year. The undiscounted 30-year net social welfare loss from overriding intellectual property protections by 10%, 25%, and 50% are USD 11.28 trillion, USD 28.19 trillion, and USD 56.38 trillion respectively.

Figure 3 - Discounted Annual Loss in Social Welfare between 2021 and 2050

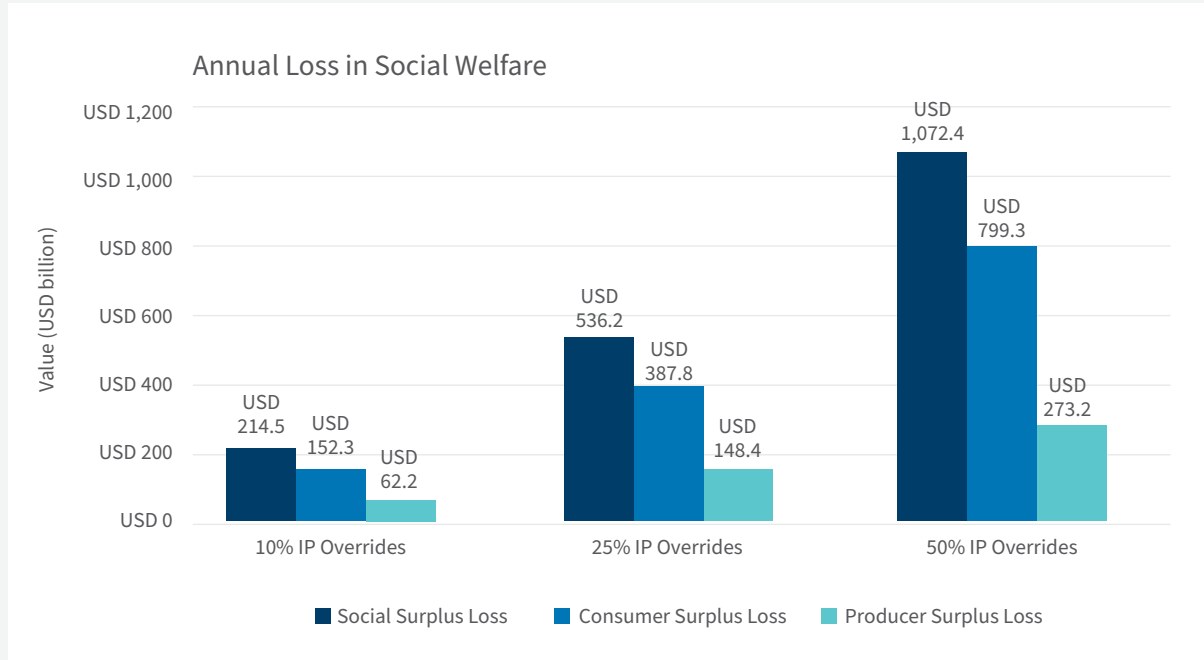
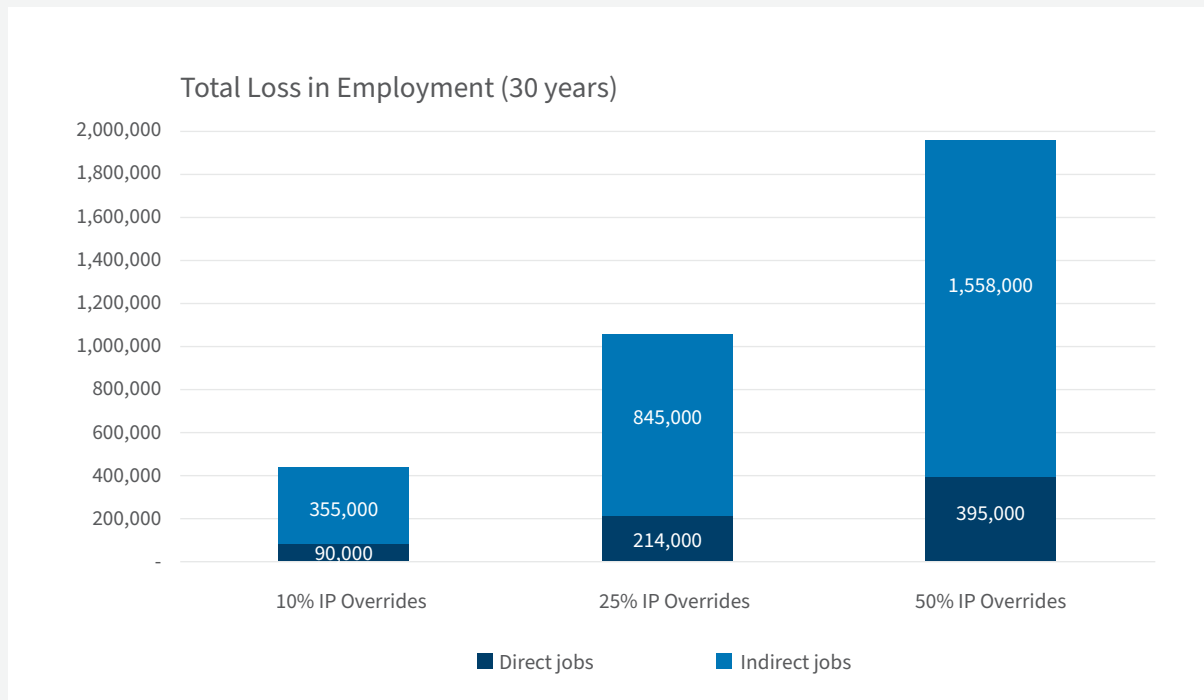
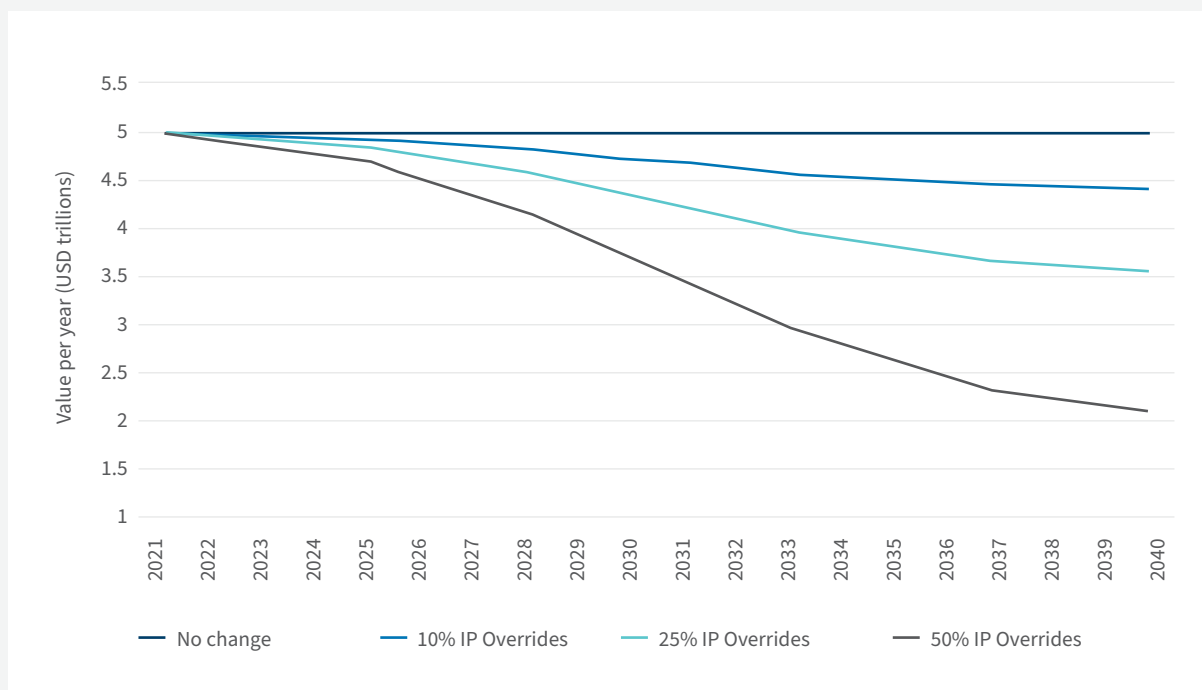


Figure 4 - Total Loss in Employment from between 2021 and 2050 (30 years)



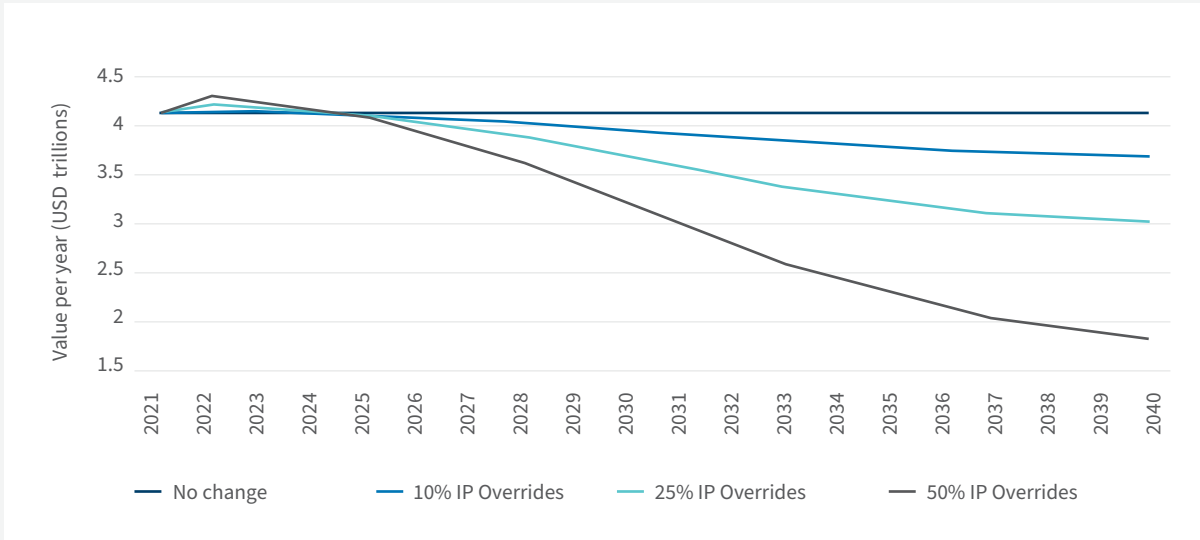
Both consumers and producers are harmed in the long-term by less innovation. In the first few years, the social welfare shifts from producers to consumers, but the total surplus to society remains the same. But in the longer term, fewer drugs created will lead to lower social welfare in the economy as fewer drugs are introduced (5). In the short term, consumers benefit from eliminating intellectual property protections because weaker protection, for instance, waiving patents, reduces prices while having only a limited impact on innovation in the short run. After only three years, however, consumers become worse off relative to the status quo and are significantly harmed in the medium to long-term (6). Additionally, consumers bear the largest share of this cost of overriding intellectual property. Producers lose out (on a relative scale) more than consumers (7). Still, because consumers get the majority of the value, in absolute terms, consumers incur three-quarters of the cost from overriding intellectual property. With a 25% chance of overriding intellectual property protection, consumers incur 74.0% of the undiscounted net loss (72.3% discounted loss). This loss percentage ranges from 72.6% (71.0% undiscounted) to 76.2% (74.5% undiscounted) when the chance of overriding protection is 10% and 50% respectively.

Figure 5 – Annual Social Welfare between 2021 and 2040 (20 years)



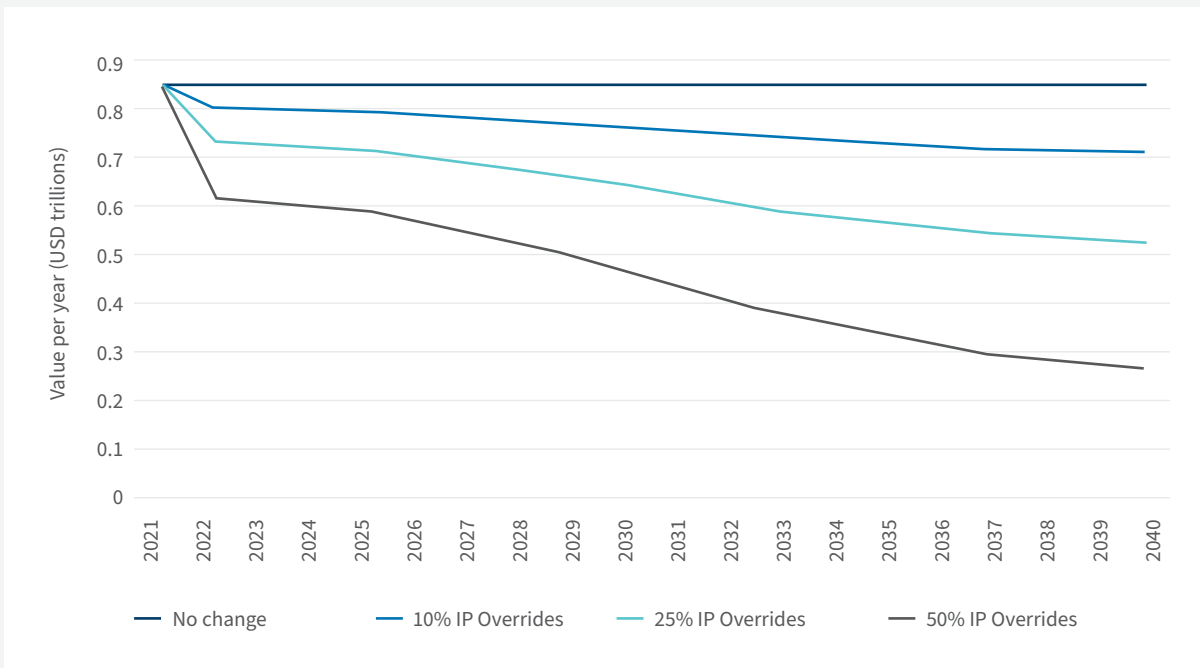
Note: The model projects social welfare through 2050, but the figure reports results through 2040. Values are constant between 2040 and 2050.

Figure 6- Annual Consumer Surplus between 2021 and 2040 (20 years)



Note: The model projects consumer surplus through 2050, but the figure reports results through 2040. Values are constant between 2040 and 2050.

Figure 7 - Annual Producer Surplus between 2021 and 2040 (20 years)



Note: The model projects producer surplus through 2050, but the figure reports results through 2040. Values are constant between 2040 and 2050.

An important consideration is the potential impact of developing countries reforming their intellectual property protections. In part due to inequalities in COVID-19 vaccine access, some policymakers have called for weaker intellectual property protection for COVID-19 vaccines and therapeutics, something we discuss further in the section below^{cxcviii}. Additionally, Brazil, for instance, has passed a bill that will temporarily waive patent rights and grant compulsory licenses for COVID-19 vaccines and therapeutics^{ci}. BRIC countries (Brazil, the Russian Federation, India and China), currently make up 40.7%^{cii} of the world's population and approximately 20.6% of current health care expenditures^{ciii}. To address this issue, we also considered another scenario whereby only middle-income BRIC countries would eliminate intellectual property protections on life science innovations. If BRIC countries were to override intellectual property protections on all life science treatments, the number of new drugs that would come to the market globally would fall by 24%, down to 35 per year (from a baseline of 46). The global 30-year social welfare losses will total USD 71.1 trillion (USD 2.4 trillion on average per year, or 2.5% of global GDP), with global consumers taking on 71.9% (undiscounted 73.6%) of the total losses. The USD 51.1 trillion (USD 1.7 trillion per year on average, or 1.8% of global GDP) 30-year consumer losses include both the annual gains in consumer surplus of up to 1.6% in the first 3 years after the policy is implemented and the annual losses of up to 21.9% afterwards. While the policy scenarios are extreme, they do demonstrate how overriding intellectual property rights would have a significant and negative impact on broader society.



KEY CONCLUSIONS

- The benefits of keeping the current intellectual property system protections are considerable. Under an extreme case where intellectual property protections—patents, exclusivity, trade secrets, and the freedom for manufacturers to license their product as they please—overrides were applied to 10% of drugs, the long-term loss in societal well-being would be worth USD 214.5 billion per year on average, equivalent to 0.2% of global GDP. Out of this figure, patients would bear 70% of the harm due to fewer new drugs being developed to treat existing diseases.
- Overriding intellectual property rights for 10% of drugs would result in a loss of 445,000 jobs (90,000 workers directly employed by life sciences firms and 355,000 employees working in supporting industries) over 30 years.
- If BRIC countries—i.e. as Brazil, Russia, India, and China—decided to override intellectual property protections for all life sciences treatments, the number of new drugs created globally would fall by 24% over a 30-year time frame and the total cost to society would be USD 2.4 trillion per year on average or 2.5% of global GDP.

What role can intellectual property protection play in the context of addressing both current and future pandemics?

So far, this paper has assessed the benefits that societies and industries gain from the current system of intellectual property protection, concluding that large-scale changes to weaken the current intellectual property system could have a considerable negative effect on society, including individual economic actors (firms) and citizens (patients). Whether such changes are an acceptable price to pay for increased access to COVID-19 products depends on whether waiving intellectual property protections would result in increased access in general. To answer this question, this section looks at the role of the intellectual property framework in bringing COVID-19 vaccines to market and the current political debate on temporarily removing some intellectual property protections.

The role of the intellectual property framework in bringing COVID-19 vaccines to market

A new technology platform — mRNA — which had been in the innovation pipeline for over 20 years, emerged as a frontrunner in the race for COVID-19 vaccines and is currently the leading response to COVID-19. This technology platform, the core of the Moderna, BioNTech/Pfizer and CureVac vaccines, has been studied extensively and financed by private investment for over a decade.^{ciiv} mRNA technology is revolutionary for vaccines and biopharmaceuticals generally: vaccines can be developed in a few days, instead of years, based on the genetic sequencing of the virus with exceptional efficacy levels above 90%.^{civ}

While this new technology has only recently come to widespread public attention, intellectual property protection has been an important part of its development. Scientists have studied the use of mRNA as a novel therapeutic since the early 1990s^{civi} Still it was not until 2005 that a group of researchers at the University of Pennsylvania published findings on mRNA technology that have since become critical in the development of mRNA vaccines.^{ciiv} As explained in Box 3, in 2017, the University of Pennsylvania exclusively licensed their mRNA-related patents to mRNA Ribo Therapeutics, which then sublicensed them to its affiliate, CellScript. CellScript then went on to sublicense the patents to Moderna and BioNTech. Here we see an example of how the foundational technology needed to develop a vaccine was invented and discovered in an academic lab and start-up research firm, protected through patents, and subsequently licensed out to a larger entity for further development and commercialisation.^{ciiii cix}

A core reason why Moderna and BioNTech's vaccines were able to get through the development process and to market so quickly — both within 9 months^{ciix} — was due to the current intellectual property framework, which enables collaboration. Initially developed by small biotech companies with less than 1,000 employees, these companies have partnered with

dozens of organisations to speed up production, including the pharma giant Pfizer for BioNTech and the world-leading contract research organisation (CRO) Lonza for Moderna.^{cxii}

Until the World Health Organization (WHO) declared the pandemic in early March 2020, mRNA technologies had no proven commercial potential but held the promise of leading to novel therapeutic discoveries, such as personalised medicine and vaccines for cancer. The hypothesis whereby mRNA may be effective against COVID-19, followed by risk-taking, investment and science-industry collaboration, has resulted in mRNA technology delivering two of the most effective vaccines on the market to protect against COVID-19.^{cxiii}

Indeed, as Kevin Noonan, Partner & Head of the Bio Pharmaceutical Practice Group at MBHB LLP, noted, *‘the fact that the world was able to access COVID-19 vaccines with a 90% efficacy rate just months after the start of the initial outbreak is nothing short of a miracle’*. He also stated that this *‘would not have been possible in the absence of an intellectual property framework. Considering that mRNA technology was behind many of the traditional vaccines that were already on the market, mRNA technology would simply not have been developed if the knowledge was not publicly available. This knowledge was available, at least partially, as a result of patent disclosures that were built upon by many scientists and developers.’*^{cxiii}

Political pressure on the current intellectual property framework

As the pandemic progressed and the shortages of critical supplies became more obvious, a highly politicised public debate began to develop around equitable access to COVID-19 products as well as countries’ preparedness and response capacities to address the pandemic. This debate became more acute as high-income countries were seen to be stockpiling vaccines beyond their immediate vaccination needs through pre-purchase agreements and in violation of international commitments that had been made to supply vaccines to lower-income countries. In response to this, there were several United Nations (UN) and UN member state-led initiatives^{cxiv}, including:

- March 2020 COVID-19 Therapeutics Accelerator (CTA): Philanthropic collaboration supporting efforts to research, develop and bring effective treatments against COVID-19 to market^{cxv}
- March 2020 IFPMA Global Biopharmaceutical Industry Commitment to Address Coronavirus Public Health Crisis: Industry commitments to use expertise and know-how to speed up development and ramp up production for COVID-19 vaccines
- April 2020 UN General Assembly resolution 74/274: Addresses international cooperation to ensure access to medicines, vaccines, and medical equipment for COVID-19^{cxvi}
- April 2020 COVAX/ ACT-Accelerator: CEPI, GAVI, UNICEF and PAHO initiative in collaboration with industry for equitable access COVID-19 vaccines^{cxvii}
- May 2020 World Health Assembly resolution on COVID-19 adopted by 130 countries: calls for equitable access and fair distribution of health technologies to combat COVID19^{cxviii}
- May 2020 WHO Technology Access Pool (C-TAP): WHO and international partner initiative to bolster the supply of COVID-19 therapeutics, vaccines, and other health products by sharing intellectual property, knowledge, and data^{cxix}

These initiatives were not sufficient to immediately enable more equitable distribution, as that was already largely defined through pre-purchase agreements. The role that a select group of high-income countries and regions played in restricting early access through significant over-purchasing cannot be ignored.

Therefore, in October 2020, a proposal to waive intellectual property rights for COVID-19 health products and technologies was introduced to the WTO by India and South Africa to address the shortage of COVID-19 vaccines and products in middle and low-income countries.^{cxv} How did WTO members respond? A consortium of low and middle-income countries¹⁴ issued a revised version of the Indian and South African waiver proposal to the WTO on 21 May 2021 to better define the scope and content of the initial proposal.^{cxvi} This proposal suggested a waiver from the implementation, application, and enforcement of Sections 1, 4, 5, and 7 of Part II of the TRIPS Agreement in relation to prevention, containment, or treatment of COVID-19. Additionally, it stated that the waiver should continue until widespread vaccination is in place globally and the majority of the world's population has developed immunity.^{cxvii} The proposal sought to encompass health products and technologies, including diagnostics, therapeutics, vaccines, medical devices, personal protective equipment, their materials or components, and their methods and means of manufacture for the prevention, treatment or containment of COVID-19.^{cxviii} In essence, the main difference from the original India and South Africa proposal was that the revised proposal was more definite in scope and duration, specifying the types of COVID-19 products for which patents would be waived and how long the waiver would last.

Building on this, the U.S. and the EU became more actively involved. In May 2021, U.S. Trade Representative (USTR) Katherine Tai announced that the U.S. would support a proposal to waive intellectual property rights for COVID-19 health products and technologies. The surprising announcement by the USTR spurred further public debate around the world about the effective functioning of the intellectual property framework at WTO level and surrounding the biopharmaceutical sector more generally. In June 2021, the European Commission announced its proposal to the WTO on alternative solutions to an intellectual property waiver in the context of the COVID-19 pandemic, arguing that waiving intellectual property was not the optimal solution. The Commission argued that countries should focus on utilising the existing flexibilities in the TRIPS agreement, such as compulsory licencing to increase equitable access to vaccines, as well as increasing manufacturing capacity and lifting export restrictions on vaccines and raw materials.^{cxix}

Against this background, on 17 June 2022, at the 12th Ministerial Conference of the World Trade Organization (WTO), 164 participating countries agreed on a text for an intellectual property waiver for COVID-19 vaccines which enables 'eligible Members' (i.e. 'developing country Members') to produce COVID-19 vaccines for the next five years without needing permission from the patent holder 'to the necessary extent to address the COVID-19 pandemic.' The waiver can be enabled by 'eligible Members' through 'any instrument available' (i.e. executive order, emergency degree), regardless of whether or not a country has a compulsory license agreement in place, but needs to be communicated to the Council for Trade-Related Aspects of Intellectual Property Rights (TRIPS). The decision also includes a commitment whereas within 6 months from the adoption of the decision, members would decide whether to extend the waiver to cover COVID-19 treatments and diagnostics.

Reactions to the waiver decision from civil society and the industry have been largely negative with many expressing immediate concerns over the effectiveness of the decision which is meant to respond to challenges that were felt strongly when the intellectual property waiver was originally proposed but which have altered considerably since. Specifically, this concerns the industry's increased capacity to produce over 1 billion doses of COVID-19 vaccines a month as a result of over 300 voluntary partnerships for manufacturing scale-up including manufacturers from low- and middle-income countries and collaboration with global partnerships such as COVAX^{cxv}. As of the end of 2021, there was a broad shift in acknowledging that the main challenge in the ongoing crisis no longer lies at the supply side but rather in demand and in the capacity to distribute and administer vaccines in a timely manner. In other words, in the current situation - unlike at the onset of the pandemic - there is an oversupply of vaccines and the lack of absorptive capacity has been a persistent challenge since the start. Therefore, there is a real concern that not only will the proposed solution create lasting damage to the incentive system in life sciences R&D but will also fail to improve access conditions.

An assessment of the motivations of the different parties who support changes to the intellectual property framework is beyond the scope of this paper. This may differ based on factors including positions on the TRIPS Agreement and Doha

14 The consortium of countries included the African Group, the Least Developed Countries Group, Bolivia, Eswatini, Fiji, India, Indonesia, Mongolia, Pakistan, South Africa, Vanuatu, the Bolivarian Republic of Venezuela and Zimbabwe.

protocols, domestic industrial policy, response to criticisms for lack of country support for COVAX/ACT Accelerator and other initiatives to achieve equitable access. However, it is important to debunk some of the common myths around COVID-19. Please see Box 5 for more details.

BOX 5

Debunking myths about COVID-19

Inputs for this section have been informed by the Position Statement of the Max Planck Institute for Innovation and Competition of 7 May 2021 entitled ‘Covid-19 and the Role of Intellectual Property’.^{cxxvi} Where endnotes do not specify all information was drawn from the report cited.

MYTH	FACT
<p>Waiving intellectual property protections will scale or speed up vaccine manufacturing and distribution.</p>	<p>Waiving intellectual property protections will not increase vaccine production or distribution — <i>please see section ‘Waiving intellectual property is not the solution to facilitate better access’ for more information</i></p> <ul style="list-style-type: none"> — The delays in vaccine manufacturing and distribution have been caused mainly by shortages in raw materials, insufficient production capacity and highly complex manufacturing processes. There are no substantiated instances in which intellectual property has hindered the development or production of COVID-19 countermeasures — Waiving intellectual property protections would not necessarily have any immediate effect on production volumes and distribution of vaccines.^{cxxvii}
<p>The intellectual property framework has not facilitated the collaborations and contracts between pharmaceutical companies necessary to advance vaccine research and development</p>	<p>Intellectual property protections have helped facilitate collaboration — <i>please see section ‘intellectual property has helped foster a culture of collaboration’ for more information</i></p> <ul style="list-style-type: none"> — The production cycle of the new mRNA vaccines is very complex. Cooperation throughout the development of vaccines has reached an unprecedented level ^{cxxviii} — Cooperation in the pharmaceutical sector is typically based on intellectual property protections, which serve as the basis for contracts — Furthermore, voluntary patent licenses are usually accompanied by a contractual technology transfer (transfer of know-how) which is necessary to exploit a licensed technology. In the course of research and development (R&D), vaccine developers accumulate considerable know-how necessary for vaccine manufacturing. A patent waiver removes an incentive of the developers of the original products to provide know-how to manufacturers of biosimilars.^{cxxix}

<p>The TRIPS Agreement does not contain sufficient flexibilities to enable sharing of knowledge & production of COVID medicines and technologies</p>	<p>TRIPS contains sufficient flexibilities to address access issues — <i>please see section ‘intellectual property has helped foster a culture of collaboration’ for more information.</i></p> <ul style="list-style-type: none"> — The TRIPS Agreement and its addenda have well-defined intellectual property flexibilities for both national and multilateral use in case of necessity in a public health emergency — These flexibilities – e.g. compulsory licenses, government use for non-commercial purposes, non-exclusive protection of test data and parallel imports have been utilised the past 15 years and incorporated into national laws — A study found 176 instances of possible use of TRIPS flexibilities by 89 countries between 2001 to 2016, 100 of which involved compulsory licences or public non-commercial use licences¹⁵ — The WHO also notes that TRIPS does not prevent compulsory licensing and that voluntary licencing is also an option
<p>A comprehensive waiver of intellectual protections will not have a detrimental effect on incentives for drug innovation</p>	<p>Given the correlation between intellectual property and innovation, a waiver will likely have a detrimental effect on incentives for drug development</p> <ul style="list-style-type: none"> — Waiving intellectual property protections for COVID-19 could leave societies vulnerable to emerging variants if the current intellectual property holders/vaccine developers abandoned research efforts as a result of an intellectual property waiver^{xxxx} — Unlike the existing TRIPS compulsory licensing provisions, the proposed intellectual property waiver would not require governments to provide a specific justification for the abrogation of IP rights, compensation, or legal process for rightsholders. This would almost certainly have a chilling effect on future investments in high-risk areas
<p>Higher global solidarity would not result in better access for developing countries.</p>	<p>Global solidarity including support for bespoke initiatives such as COVAX can go a long way to reducing vaccine inequity.</p> <ul style="list-style-type: none"> — It is widely accepted that global herd immunity can only be achieved by ensuring global equitable access to vaccines and that the propagation of variants will continue to undermine global efforts to tackle the COVID-19 pandemic until a large percentage of the global population is vaccinated — In the absence of spare manufacturing capacity, the proposed waiver is unlikely to help the fight against the pandemic. Therefore, it is imperative that more consideration be given to ensuring a more equitable distribution of vaccines to bridge the gap in the short term and provide vaccine doses to low- and middle-income countries^{xxxxi}

15 Hu, W., Is The Proposed Ip Waiver To Help Combat Covid-19 All It Seems?, CEPS In Brief (2021), Available from <https://www.ceps.eu/is-the-proposed-ip-waiver-to-help-combat-covid-19-all-it-seems/>

Waiving intellectual property protection is not the solution to facilitate better access

The WTO TRIPS debate around overriding intellectual property protections is yet to fully play out at the time of writing (March 2022). Nevertheless, it is paramount to understand the potential impact of such a proposal. Even if intellectual property protections were waived for COVID-19 health products and technologies, this would not immediately enable increased production or access to vaccines during this ongoing crisis. This is because amending intellectual property protections would:

1. Complicate existing partnerships
2. Not help speed up technology transfer
3. Divert from the current initiatives to scale up manufacturing capacity

For alternative options to intellectual property, please see box 6.

First, as previously outlined, the current vaccines on the market are heavily dependent on collaboration and partnerships. Globally, there are over 300 partnerships and agreements established between large pharmaceutical companies and contract manufacturing organisations in both developed and developing countries and 83 operational production sites^{cxxxii}. Overriding intellectual property protections would complicate these current arrangements, and there is no existing evidence that changing the existing system would help facilitate access to COVID-19 vaccines.

Second, the core issue with vaccine production scale-up is bio-manufacturing capacity and technology transfer. Overriding intellectual property protections for vaccines would only have a limited short-term effect on increasing access to vaccines for middle to low-income countries. Even many high-income countries do not have the manufacturing capacity or know-how to produce mRNA vaccines, as can be seen through the national efforts to put in place bio-manufacturing capacity in Australia and Canada. There are many different steps along the drug development chain. While the intellectual property framework is one of many contributing factors that may currently inhibit access for low and middle-income countries along this chain it is not a barrier itself.^{cxxxiii} Many countries simply do not have sufficient manufacturing capacity, or the technical expertise needed, to translate the scientific research that they would receive through a patent waiver into a fully developed drug.^{cxxxiv} For instance, the United Nations Conference on Trade and Development (UNCTAD) identified five common bottlenecks in low- and middle-income countries which would hinder their ability to produce COVID-19 vaccines, even if there was a patent waiver and the technology was freely available. These bottlenecks are^{cxxxv}:

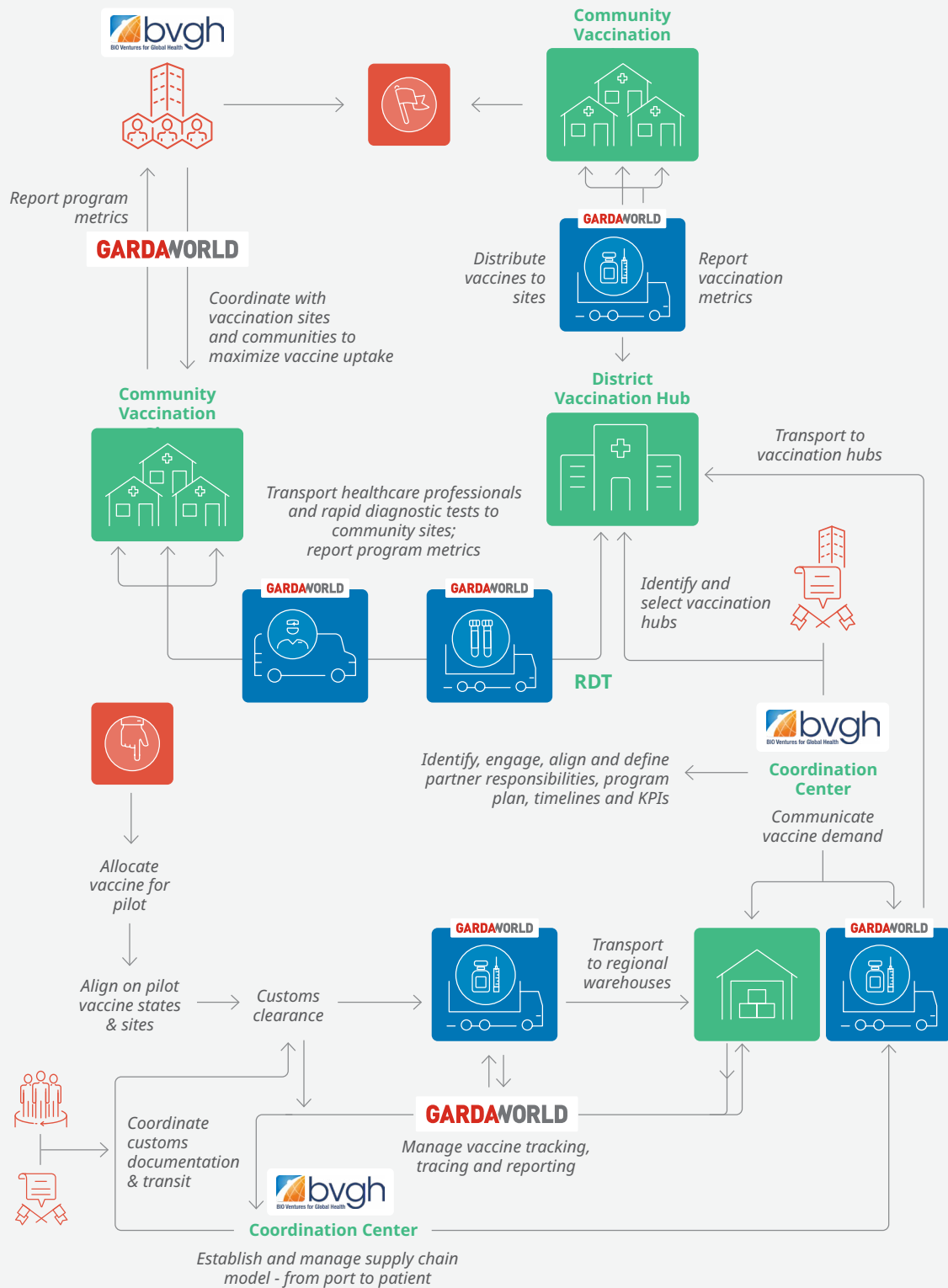
- Lack of capital, technology, and skills
- Low regulatory standards and quality
- Weak enabling policy/legal frameworks
- Small markets and unstable demand
- Poor infrastructure and supply chains

Most manufacturers with the skills and know-how in middle- and lower-income countries are already involved in existing partnerships—some of which were established even before the manufacturers with the vaccine technology had received market authorisation^{cxxxvi}. For instance, the Serum Institute of India produces billions of doses of AstraZeneca's vaccine, while South Africa's largest generics firm, Aspen Pharmacare, manufactures the Johnson & Johnson vaccine. Furthermore, the South African biopharmaceutical company Biovac has recently concluded a deal with BioNTech/Pfizer to carry out fill and finish operations for their COVID-19 vaccine and distribute it throughout the African continent.^{cxxxvii} India and South Africa's petition to waive intellectual property protections would have made such collaborations unworkable. Additionally, the access crisis was exacerbated by the impact of COVID-19 in India, which led to the Serum

Institute, one of the main suppliers of vaccines of COVAX, stopping all exports. That said, on 30 July 2021, industry and health organizations signed an agreement to create an mRNA tech transfer hub in South Africa which aims to help tackle vaccine inequality.^{cxviii} Most recently, on 8 March 2022, Moderna announced that it would set up a manufacturing facility in Kenya to produce mRNA vaccines, including COVID-19 shots. The company plans to invest USD 500 in the facility and supply 500 million doses for the continent each year.

The above examples highlight the importance of international partnerships and collaboration, not just between pharmaceutical companies but also including international and philanthropic organisations and government agencies. An example of such a partnership is the USD 32 million global partnership between LumiraDx and the Africa Union, Africa Centres for Disease Control and Prevention (Africa CDC), Africa Medical Supplies Platform (AMSP), Bill and Melinda Gates Foundation (BMGF), and Clinton Health Access Initiative (CHAI) with the support of the COVID-19 Therapeutics Accelerator, The Mastercard Foundation, and The Rockefeller Foundation to expand access to fast, accurate and equitable COVID-19 testing in Africa.^{cxix} Within this partnership, LumiraDx aims to provide five thousand portable diagnostic instruments and related COVID-19 antigen tests, while AMSP – the single-source platform enabling faster, more transparent, and cost-effective access to COVID-19-related critical diagnostics and medical equipment – is meant to supply them equitably across 55 African Union member states, addressing both the immediate critical need for COVID-19 testing and building the foundation for long-term primary care infrastructure.^{cxl} Jennifer Dent, President and CEO of BIO Ventures for Global Health (BVGH), noted that *'initiatives that link government and healthcare leaders in low-and-middle income countries with companies (such as LumiraDx, Johnson & Johnson, Pfizer, GardaWorld), and map robust distribution, access, tracking and reporting models, will do more to increase immediate access to COVID-19 vaccines than a waiver of intellectual property rights could achieve.'* Please see Figure 7 as an example of the type of logistical support that can be provided by organizations such as BVGH and GardaWorld that would actually move the needle in terms of facilitation access. Through these collaborations, it is also possible to translate and build up the knowledge and capacity needed to produce vaccines over time, resulting in a more sustainable and long-term vision for medicines manufacturing in middle-and-lower income countries.^{cxli}

Figure 7 - Example of the type of logistical support that can be provided by organizations that could help facilitate access



Even if compulsory licensing were to be used — which is explicit in the TRIPS agreement itself and is also outlined by the European Commission in its counterproposal as a solution to increase global vaccine access and equity — several difficulties would remain. Compulsory licencing of patented technology is not enough for a company to produce a vaccine. It would also need technology transfer to translate this knowledge into a vaccine product intended for the market.^{cxliii} For medicinal products based on known methods, such as small-molecule drugs or traditional vaccines using particles of a virus, a compulsory licence can provide a ready-to-deploy mechanism for production and distribution. In contrast, in vector-based or mRNA-based vaccines, replicating the technical teaching underlying a patent without access to the related know-how is much more complex.^{cxliii} It would therefore be necessary to somehow incentivise or compel the companies with the know-how to produce those specific vaccines to actively support a technology transfer process to get the new manufacturers up and running, and this could require an intensive human resources export from the top manufacturing experts at these companies, for several months at the very least (during which time they could not focus as intensively on scaling up their own production).

Furthermore, Jennifer Dent, President of BVGH, noted that *‘Partnerships with national organizations, such as the Nigeria Sovereign Investment Authority (NSIA), is the best approach and model to co-invest, translate and build up the knowledge and capacity needed to produce vaccines over time, resulting in an African-driven and determined, sustainable and long-term vision for medicines manufacturing in middle-and-lower income countries.’* She also noted that *‘simple technology transfer through compulsory licencing does little to support the necessary investments and long-term, sustainable development of manufacturing capacity and local skills and knowledge in low-and-middle income countries.’* Therefore, what becomes clear is that compulsory licensing is only effective when the country which is granted the licence possesses the necessary manufacturing capacity and technical know-how to produce a vaccine.^{cxliv}

Manufacturers, on their own initiative and supported by governments, have been doing what they can to increase production. As a result, the world vaccine production capacity was tripled for COVID-19 vaccines alone. As an example, before the pandemic, Pfizer was producing 200 million doses of vaccines (for all diseases combined), whereas in 2021 it produced 3 billion vaccines for COVID-19 vaccines alone. Any changes to the current system would detract from these efforts. Pharmaceutical manufacturers have continued efforts to expand global production and distribution of COVID-19 vaccines and therapies, focusing on increasing access to developing countries. For example, Pfizer announced its plan to deliver two billion doses to lower-income countries over the next 18 months, with one billion doses coming in 2021.^{cxlv} Amongst other pharmaceutical industry groups, in May 2021, at the start of the vaccine rollout, the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA), proposed a five-step plan to ‘urgently advance COVID-19 equity,’ including:

1. Increasing dose sharing among countries through COVAX and other mechanisms
2. Optimising production of vaccines and raw materials
3. Eliminating trade barriers for critical raw materials
4. Supporting country readiness to deploy vaccination programs
5. Driving further innovation.^{cxlvi}

On the therapeutics side, Merck, Gilead and Pfizer also each entered into voluntarily licensing programs, at a very cheap price.^{cxlvii}

In sum, considerable production constraints on governments in middle- and low-income countries would remain even if governments overrode intellectual property protections, something which intellectual property critics have acknowledged. This proposed policy measure is therefore not likely to be effective in facilitating quicker access if implemented. However, it would create a precedent that would rapidly undermine the current rules-based international system and the critical trust needed from investors to continuously invest in high- risk technologies. Such developments

would decrease the long-term benefits to social welfare provided by the current regime of intellectual property protection and resulting drug development, as it would curb innovation in the pharmaceutical sector. Given the limited impact on increasing access, these grave societal consequences seem difficult to justify.

BOX 6

Initiatives that can complement the intellectual property framework

OPEN SCIENCE

The idea is that ‘In general, society is better off when scientists have ready access to biomedical research tools’.^{cxlviii} This means that producers will share all or parts of their innovation with the world to be used as inputs into future innovations much earlier than with patents. For example, California’s Institute for Regenerative Medicine provided USD 3 billion over ten years for human embryonic stem cell research with the option for grantees to patent their inventions under the stipulation that the invention must be readily accessible for non-commercial research. Thus, patents remain core and do not oppose the open science principle. While open science can be helpful, patents already put innovations into the public domain. Open science, however, ignores that developing new drugs and devices is a capital-intensive endeavour, and without some degree of exclusivity, private firms would have little incentive to invent them.

GOVERNMENT PRIZES OR PRE-PURCHASE AGREEMENTS

Award producers a fixed sum of money for inventing a drug, and then the drug patents are voided. Like patents, prizes can incentivise innovation. These prizes eliminate the dead-weight loss from intellectual property protections by offering compensation close to the value of the patent. However, the public funding needed for these prizes creates its own dead-weight loss from increased taxes. Moreover, unlike patents, prizes may be harmful to incremental innovations.

GOVERNMENT/NON-PROFIT FUNDING OF ALL RESEARCH

Eliminates the burden of financial costs on producers for clinical trials and research and, under the stipulation of public access to results, promotes innovation.^{cxlix} Typically, the government funds most basic research and private sector covers later stage drug development. However, turning over all phases of R&D to the public sector may be problematic if it is less efficient than the private sector. Further, this approach relies on government discretion to ‘pick the winners’, and funding decisions may become politicised. Additionally, as bringing a drug to market can cost over USD 1 billion on average, will governments be able to stomach the costs incurred as most drugs fail their clinical trials?

PATENT POOLS

Agreements that allow third parties to gain access to all patents for an invention with one single package license or a 'one-stop-license' rather than obtaining individual licenses from each patent owner. In 2010, Unitaid established the first public health patent pool, known as the Medicines Patent Pool, to improve access to antiretroviral, tuberculosis and hepatitis c treatments in low and middle-income countries. The patent pool's generic partners provided almost 50 million life-years saved through treatment, amounting to USD 1.96 billion in savings. Patent pools could lower the costs and risks of R&D by reducing royalties, transaction costs, and enforcement litigation, and therefore significantly cut the costs to end-users. Although patent pools could improve access to medicines, challenges include constrained health systems and limited diagnostic capacity in developing countries, as well as the lack of international donors for scaling up treatments outside the domains of HIV, tuberculosis, and malaria.

COMPULSORY LICENSING

The process by which the government licenses companies or individuals other than the patent owner to use the patent rights – to make, use, sell, or import a product under the patent – without the patent owner's permission. While TRIPS enforces intellectual property, it provides flexibilities in the form of compulsory licensing such as i) limited exceptions to patent rights under certain conditions, and ii) bypassing of voluntary licensing in cases of a national emergency, extreme urgency, or public non-commercial use, predominantly for domestic use. More so, developing countries expanded these flexibilities to provide greater access to pharmaceuticals through the 2001 Doha Declaration. For example, the WHO COVID-19 Technology Access Pool (C-TAP), launched in May 2020, provides a global one-stop-shop for developers of COVID-19 vaccines and related health products to share their intellectual property and resources with manufacturers through public, voluntary, non-exclusive licenses. Compulsory licensing could be a potential alternative to achieve access to medicine through manufacturing and exporting patented pharmaceuticals. However, opponents argue that compulsory licensing often decreases prices which offsets the function of the patent system. Further, compulsory licensing may raise safety concerns, and discourage foreign patent-owning firms from investing in countries that use these provisions.⁴¹

COST-BASED REIMBURSEMENT

Under a cost-based reimbursement payment model, 'the amount of the payment is based on the costs to the provider of delivering the service.' In the context of pharmaceuticals, the government would pay drug companies based on their cost to develop a drug plus some margin. Although this payment model helps drug companies recoup some of the high costs of development, the downside of this approach is it would incentivise drug manufacturers to increase cost as much as possible rather than to focus on treatments that provide the highest value to patients. The margin would also need to be sufficient to compensate for the costs of all of the programs which did not succeed in bringing a new drug to market, and it is unlikely that the public will support paying pharma for four drug development programs in return for one new drug.

ADDITIONAL MEASURES AIMED AT IMPROVING FLEXIBILITY AND EQUITY

- TRIPS flexibilities highlighted in Box 6
- INTERPAT IP Principles for Advancing Cures and Therapies (IP PACT) document^{cli}



KEY CONCLUSIONS

- Removing or overriding intellectual property protections would not have sped up the creation or distribution of COVID-19 vaccines. Suspending intellectual property provisions would not increase the speed of vaccination campaigns and could, in fact, even undermine efforts to scale up vaccine production or efforts to face future health emergencies or pandemics.

The way forward

This paper has illustrated why intellectual property protection matters, how the intellectual property framework stimulates innovation, how intellectual property regimes impact citizens, and why intellectual property protection remains critical in the current pandemic context. In doing so, it reached **nine key conclusions**:

- 1** Intellectual property protection is the **cornerstone to drug discovery and development** and fosters an innovation-friendly environment in the life sciences sector.
- 2** Intellectual property law provides a **framework that supports collaboration** which is critical to effectively support innovation through the long, complex, and risky innovation process, from bench to bedside.¹⁶
- 3** Maintaining the intellectual property framework results in **long-term benefits that accrue to various stakeholders** including firms, investors, universities, and ultimately to society.
- 4** Intellectual property protection **incentivises investments and innovation**.
- 5** In some cases, existing intellectual property provisions **may need to be supplemented** with new incentives to address unmet medical needs.
- 6** The **benefits of keeping the current intellectual property system protections are considerable**. Under an extreme case where intellectual property protection—patents, exclusivity, trade secrets, and the freedom for manufacturers to license their product as they please—overrides were applied to 10% of drugs, the long-term loss in societal well-being would be worth USD 214.5 per year on average, equivalent to 0.2% of global GDP. Out of this figure, patients would bear 70% of the harm due to fewer new drugs being developed to treat existing diseases.
- 7** Overriding intellectual property rights for **10% of drugs** would result in a **loss of 445,000 jobs** (90,000 workers directly employed by life sciences firms and 355,000 employees working in supporting industries) over 30 years.
- 8** If BRIC countries—i.e. Brazil, Russia, India, and China—decided to override intellectual property protections for all life sciences treatments, the **number of new drugs created globally would fall by 24% over a 30-year time frame** and the total cost to society would be USD 2.4 trillion on average per year or 2.5% of global GDP.
- 9** Removing or overriding intellectual property protections **would not have sped up the creation or distribution of COVID-19 vaccines**. Suspending intellectual property provisions would not increase the speed of vaccination campaigns and could, in fact, even undermine efforts to scale up vaccine production or to face future health emergencies or pandemics.

Annex

Acknowledgements

The research for this paper was conducted by FTI Consulting, on behalf of INTERPAT. INTERPAT is a non-profit association of research-based biopharmaceutical companies that promotes effective intellectual property protection throughout the world as a key incentive for sustainable innovation to advance global health. Its representatives are the leading and senior executives of its member companies who are responsible for intellectual property and intellectual property related matters.

FTI conducted 11 interviews in total with various experts in the venture capital, technology transfer, biopharmaceutical intellectual property and global access fields. We would like to thank all those who took the time to be interviewed for their valuable contributions, including:

- Joël Jean Mairet, Managing Partner, Ysios Capital
- Geert-Jan Mulder, Forbion, Netherlands
- Leda Trivinos, Intellectual Property Partner, Flagship Pioneering
- Anji Miller, Senior Business Manager, LifeArc
- Tony Hickson, Chief Business Manager, Cancer Research UK
- Anjan Aralihalli, CTI Capital, New York
- Manuel Lopez-Figueroa, Managing Partner, Bay City Capital, San Francisco
- Kevin Noonan, Partner & Head of the Bio Pharmaceutical Practice Group, MBHB LLP
- Christian Stein, CEO, Ascenion
- Jennifer Dent, President & CEO, BIO Ventures for Global Health

Technical Appendix

The economic model quantifies how the waiving of patents will impact future innovation and social welfare. Our methodology relies on a **3-step approach**.

I. Project the value of new pharmaceutical innovation

We projected the value of recent treatments by reviewing new drugs approved by the FDA in the last 5 years, quantifying the health benefits for each drug. First, we identified the number of new drugs brought to market between 2016 and 2020 using FDA data.^{clii} Second, we quantified the health gains of these treatments in quality-adjusted life years (QALYs). The QALY metrics are identified based on cost-effectiveness models published in the Tufts Medical Center's Cost-Effectiveness Analysis (CEA) Registry^{cliii} and peer-reviewed journals. Specifically, our model uses the *incremental* QALY gain for each product relative to the standard of care to calculate the average health gains for each drug.^{cliv} We assume that drugs with

missing data have the same health gain as the median *incremental* QALY gain of all data pulled over the 2016-2020 period. Third, we measured disease prevalence to estimate the total number of individuals impacted. We collected prevalence or incidence data for the United States (as well as global data) on the primary indication treated by each new drug using the National Cancer Institute’s Surveillance, Epidemiology, and End Results Program (SEER) data (2018)^{clv}, peer-reviewed papers from the National Center for Biotechnology Information, academic journals like Neurology, and other sources. These prevalence and incidence^{clvi} metrics were then multiplied by the 2021 United States (world) population and estimated market uptake^{clvii} to get the count of individuals treated by each drug. Next, we measured the share of the social surplus created that is attributed to consumers and producers. Our model uses 83% as the % value patented drugs to consumers^{clviii} and a willingness to pay (WTP) for QALY of USD 150,000 as a baseline, per ICER’s suggested health-benefit price benchmark^{clix} to calculate social surplus.^{clx}

II. Measure relationship between intellectual property and innovation

We measured the impact of intellectual property rules on the number of new drugs developed based on our review of the literature. First, we looked at the impact of market size on innovation. According to the literature, there is a positive relationship between market size and the rate of pharmaceutical innovation. In a 2004 study using 30 years of data, a 1% increase in the market size increased the number of new drugs approved by the Food and Drug Administration’s FDA by 4-6%.^{clxi} We estimated the discounted firm income resulting from waiving drug patents in comparison to the status quo and used the relationship between market size and innovation to derive the reduction in drugs under each scenario. Specifically, we examined 3 scenarios associated with potential uncertainty about whether the government would override intellectual property protections in the future: 1) our baseline scenario assumed that intellectual property protection overrides would be applied to 25% of drugs (1 out of every 4 drugs), 2) the second scenario assumed that these overrides would be applied to 10% of drugs (1 out of every 10 drugs) and 3) the third scenario assumed that the overrides would be applied to 50% of drugs (5 out of every 10 drugs).

III. Quantify the impact of intellectual property policy changes on social welfare

Next, we quantified the impact of the changes in intellectual property regimes over the next 30 years on the three outcomes of interest: overall social welfare, consumer surplus, and producer surplus. Our baseline approach focuses on measuring these outcomes for residents in the US, but we also extended our analysis to consider the impact on global societal welfare. We used a 3% discount rate to down-weight changes in welfare in the longer-term future.

IV. Overview of parameters

Table 1 details the parameters used in the economic model.

PARAMETER	VALUE	SOURCE
Average number of new drugs approved per year/rate of innovation between 2016-2020	46	FDA ^{clxii}
Average QALY gain per drug	0.77	Peer-reviewed journals from (CEA) Registry ^{clxiii} and Google Scholar

U.S. Average QALY gain (Avg (US disease prevalence*QALY gain) *U.S. market uptake)	718,748	<i>Derived from</i> incremental QALY gain per drug, US disease prevalence for that drug, and US market uptake
Global Average QALY gain (Avg (Global disease prevalence*QALY gain) *Ex-US market uptake)	16,857,254	<i>Derived from</i> incremental QALY gain per drug, Global disease prevalence for that drug, and ex-US market uptake
Intellectual property policy implementation start date	Jan 2022	NA
WTP per QALY gain (US)	USD 150k	ICER (2020) ^{clxiv}
WTP per QALY gain (Global) (3×Global GDP per person)	USD 34,299	The World Bank ^{clxv}
% value to consumers	83%	Jena et al. 2008 ^{clxvi}
Drug production cost relative to price	17%	Sood et al. 2017 ^{clxvii}
Generic price discount (NDA)	49%	Conrad et al. 2019 ^{clxviii}
Biosimilar price discount (BLA)	27%	Mulcahy et al. 2018 ^{clxix}
Average BLA and NDA price discount	43%	<i>Derived from</i> Conrad et al. 2019, ^{clxx} Mulcahy et al. 2018, ^{clxxi} and FDA's share of new NDA drug approvals ^{clxxii}
Share of new drug approvals that are NDA in 2016-2020	73%	FDA ^{clxxiii}
Share of new drug approvals that are BLA in 2016-2020	27%	FDA ^{clxxiv}
Elasticity of NME with respect to market size	4	Acemoglu et al. 2004 ^{clxxv}
Discount rate	3%	ICER's standard discount rate ^{clxxvi}
Cost of capital	0.105	Di Masi et al. 2016 ^{clxxvii}
Medicare market share	0.33	Dranove et al. 2014 ^{clxxviii}
Effective Patent Life (EPL)	12 (rounded from 11.7)	Grabowski et al. (2000) ^{clxxix}
U.S. Market uptake	13.6%	Derived using US disease prevalence, Medicare market share, and US Census population
Ex-U.S. Market uptake	6.8%	50% of US market uptake

Abbreviations

ABBREVIATION	MEANING
ACT-A	Access to COVID-19 Tools Accelerator
AMR	Antimicrobial Resistance
EMA	European medicines Agency
EU	European Union
CEPI	Coalition for Epidemic Preparedness Innovations
COVAX	COVID-19 Vaccines Global Access
CRO	Contract Research Organisation
C-TAP	COVID-19 Technology Access Pool
FDA	Federal Drug Administration
GAVI	GAVI, the Vaccine Alliance
GSK	Glaxo Smith Klein
HIV	Human Immunodeficiency Virus
IFPMA	International Federation of Pharmaceutical Manufacturers and Associations
IP	Intellectual Property
MPP	Medicines Patent Pool
mRNA	Messenger
ODA	Orphan Drug Act
OMP	Orphan Medical Products
PAHO	Pan American Health Organisation
PCT	Patent Cooperation Treaty
R&D	Research and Development
SEC	US Securities and Exchange Commission
SPC	Supplementary Protection Certificate
TTO	Technology Transfer Officer
TRIPS	Trade Related Aspects of Intellectual Property Rights
UN	United Nations
UNTCAD	United Nations Conference on Trade and Development
UNICEF	United Nations Children's Emergency Fund
U.S.	United States of America
USTR	United States Trade Representative
USTPO	United States Patent and Trademark Office
VC	Venture Capital
WHO	World Health Organisation
WIPO	World Intellectual Property Office
WTO	World Trade Organization

Endnotes

- i World Health Organization. 2021. “WHO COVID-19 Dashboard.” Covid19.Who.int. World Health Organization. 2021. <https://covid19.who.int/>; Ritchie, Hannah, et al. “Coronavirus (COVID-19) Vaccinations - Statistics and Research.” Our World in Data, 5 Mar. 2020, <https://ourworldindata.org/covid-vaccinations>.
- ii “Coronavirus (COVID-19) Vaccinations”. 2022. Our World in Data. <https://ourworldindata.org/covid-vaccinations>
- iii Tai, Katherine [@ambassadortai]. “These extraordinary times and circumstances of call for extraordinary measures.The US supports the waiver of IP protections on COVID-19 vaccines to help end the pandemic and we’ll actively participate in @WTO negotiations to make that happen.” Twitter, 5 May 2021, <https://twitter.com/AmbassadorTai/status/1390021205974003720>
- iv “EU Nations Divided over Lifting COVID-19 Vaccine Patents.” Euronews, AP, 17 May 2021, <https://www.euronews.com/2021/05/06/us-backs-waiver-on-intellectual-property-rights-for-covid-19-vaccines>
- v Ministerial Decision on the Trips Agreement. 17 June 2022. World Trade Organization, available at <https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/MIN22/30.pdf&Open=True>
- vi “WHO Coronavirus (COVID-19) Dashboard”. 2021. Covid19.Who.Int. <https://covid19.who.int/>
- vii “Coronavirus Vaccine Tracker”. 2021. Nytimes.Com. <https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html>
- viii “COVID-19 Vaccine Market Dashboard”. 2021. Unicef.Org. <https://www.unicef.org/supply/covid-19-vaccine-market-dashboard>
- ix 2021. Cdn.Who.Int. https://cdn.who.int/media/docs/default-source/documents/r-d-blueprint-meetings/r-d-achievements-report_v42.pdf?sfvrsn=c4728b39_10&download=true ;
- x “COVID-19 Therapeutic Development Tracker”. 2021. [cited 28 July, 2022]; Available from: <https://www.bio.org/policy/human-health/vaccines-biodefense/coronavirus/pipeline-tracker>
- xi Steenhuisen, J. “Moderna Phase 1 results show coronavirus vaccine safe, induces immune response”. 2020. Reuters. <https://www.reuters.com/article/us-health-coronavirus-moderna-idUSKCN24F2SW>
- xii “Tracking Global COVID-19 Vaccine Equity”. 2021. KFF. <https://www.kff.org/coronavirus-covid-19/issue-brief/tracking-global-covid-19-vaccine-equity/>
- xiii Ritchie,H. et al. (2020) - “Coronavirus Pandemic (COVID-19)”. Published online at OurWorldInData.org. Retrieved from: ‘<https://ourworldindata.org/coronavirus>’ [Online Resource]
- xiv ‘Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xv “What Is Intellectual Property (IP)?”. 2021. Wipo.Int. <https://www.wintellectualproperty.int/about-intellectual-property/en/>
- xvi “Patents.” 2019. Wipo.int. 2019. <https://www.wipo.int/patents/en/>
- xvii “Patents.” 2019. Wipo.int. 2019. <https://www.wipo.int/patents/en/>
- xviii ‘Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex’; Williams, H.L., Intellectual property rights and innovation: Evidence from health care markets. Innovation Policy and the Economy, 2016. 16(1): p. 53-87.
- Embaye, Yafet
- xviii TRIPS: Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299, 33 I.L.M. 1197 (1994)

- xx “WTO | Members and Observers” Wto.org. 2022. https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm
- xxi “WTO | Ministerial Conferences - Doha 4th Ministerial - TRIPS Declaration.” 2016. Wto.org. 2016. https://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_trips_e.htm.
- xxii “Supplementary Protection Certificates For Pharmaceutical And Plant Protection Products - Internal Market, Industry, Entrepreneurship And Smes - European Commission”. 2021. Internal Market, Industry, Entrepreneurship And Smes - European Commission https://ec.europa.eu/growth/industry/policy/intellectual-property/patents/supplementary-protection-certificates_en
- xxiii https://www.wto.org/english/docs_e/legal_e/27-trips_04d_e.htm
- xxiv “Orphan Medicine Incentives”. 2021. European Expert Group on Orphan Drug Incentives. <https://od-expertgroup.eu/wp-content/uploads/2021/06/european-expert-group-on-orphan-drug-incentives-report.pdf>.
- xxv “Orphan Drugs in the United States, Rare Disease Innovation and Cost Trends through 2019.” 2020, accessed 3/25/2022, <https://rarediseases.org/wp-content/uploads/2021/03/orphan-drugs-in-the-united-states-NRD-2020.pdf>.
- xxvi “Designating an Orphan Product: Drugs and Biological Products.” 2021, accessed 3/25/2022, <https://www.fda.gov/industry/developing-products-rare-diseases-conditions/designating-orphan-product-drugs-and-biological-products>.
- xxvii European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, *Study on the economic impact of supplementary protection certificates, pharmaceutical incentives and rewards in Europe: final report*, Publications Office, 2018, <https://data.europa.eu/doi/10.2873/886648>
- xxviii ‘Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xxix ‘Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xxx WIPO (2019) Patent Cooperation Treaty Yearly Review – The International Patent System. Geneva: World Intellectual Property Organization, p 40 https://www.wintellectualpropertyo.int/edocs/pubdocs/en/wintellectualpropertyo_pub_901_2019.pdf. Also cited in INTELLECTUAL PROPERTYFMA Facts & Figures 2021 <https://www.ifpma.org/wp-content/uploads/2021/04/IFPMA-Facts-And-Figures-2021.pdf>
- xxxi Antonipillai, Justin, and Michelle K. Lee. “Intellectual Property and the US Economy.” (2016) See Table A-1.
- xxxii Antonipillai, Justin, and Michelle K. Lee. “Intellectual Property and the US Economy.” (2016) See Table 2.
- xxxiii Mansfield, Edwin. “Patents and innovation: an empirical study.” *Management science* 32, no. 2 (1986): 173-181.
- xxxiv <https://www.sciencedirect.com/science/article/abs/pii/S0264999321000274>
- xxxv Williams, H.L., Intellectual property rights and innovation: Evidence from health care markets. *Innovation Policy and the Economy*, 2016. 16(1): p. 53-87.
- xxxvi Lichtenberg, F.R. and J. Waldfoegel, Does misery love company? Evidence from pharmaceutical markets before and after the Orphan Drug Act. 2003, National Bureau of Economic Research.
- xxxvii Wellman-Labadie, O. and Y. Zhou, The US Orphan Drug Act: rare disease research stimulator or commercial opportunity? *Health Policy*, 2010. 95(2-3): p. 216-228.
- xxxviii Mikami, Koichi. “Orphans in the market: the history of orphan drug policy.” *Social History of Medicine* 32, no. 3 (2019): 609-630.
- xxxix Yin, W., Market incentives and pharmaceutical innovation. *Journal of Health Economics*, 2008. 27(4): p. 1060-1077.

- xl *Overview: the TRIPS Agreement*. 2021 [06/18/2021]; Available from: https://www.wto.org/english/tratop_e/trintellectual_property_e/intel2_e.htm#patents.
- xli A one standard deviation (114 days) increase in patent term extension increased the value of innovation, measured using citation-weighted patent counts, by 21%. See Abrams, D.S., *Did TRINTELLECTUAL PROPERTY spur innovation? An empirical analysis of patent duration and incentives to innovate*. University of Pennsylvania Law Review, 2009. 157(6): p. 1613-1647.
- xliv Kyle, Margaret K., and Anita M. McGahan. "Investments in pharmaceuticals before and after TRIPS." *Review of Economics and Statistics* 94, no. 4 (2012): 1157-1172.
- xliii Gaessler, F. and S. Wagner, *Patents, Data Exclusivity, and the Development of New Drugs*. The Review of Economics and Statistics, 2020: p. 1-49.
- xliv Acemoglu, D. and J. Linn, *Market size in innovation: theory and evidence from the pharmaceutical industry*. The Quarterly journal of economics, 2004. 119(3): p. 1049-1090.
- xlvi Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xlvi DiMasi, Joseph A, Henry G Grabowski, and Ronald W Hansen. 2016. "Innovation in the Pharmaceutical Industry: New Estimates of R&D Costs." *Journal of Health Economics* 47: 20–33. Available at <https://doi.org/10.1016/j.jhealeco.2016.01.012>. <https://pubmed.ncbi.nlm.nih.gov/26928437/>
- xlvii Drug Approvals - from Invention to Market ... A 12- Year Trip." 1999. MedicineNet. MedicineNet. July 14, 1999. Available at <https://www.medicinenet.com/script/main/art.asp?articlekey=9877>
- xlviiii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xliv Berger, J., et al., How drug life-cycle management patent strategies may impact formulary management. *Am J Manag Care*, 2016. 22(16 Suppl): p. S487-S95.
- l Lakdawalla, D.N., *Economics of the pharmaceutical industry*. *Journal of Economic Literature*, 2018. 56(2): p. 397-449.
- li Grabowski, H.G. and J.M. Vernon, *Effective patent life in pharmaceuticals*. *International Journal of Technology Management*, 2000. 19(1-2): p. 98-120.
- Grabowski, H., G. Long, and R. Mortimer, *Recent trends in brand-name and generic drug competition*. *Journal of medical economics*, 2014. 17(3): p. 207-214.
- Hemphill, C.S. and B.N. Sampat, *Evergreening, patent challenges, and effective market life in pharmaceuticals*. *Journal of Health Economics*, 2012. 31(2): p. 327-339.
- lii FM't Hoen, Ellen, Pascale Boulet, and Brook K. Baker. "Data exclusivity exceptions and compulsory licensing to promote generic medicines in the European Union: A proposal for greater coherence in European pharmaceutical legislation." *Journal of pharmaceutical policy and practice* 10, no. 1 (2017): 1-9.
- liiii The US Hatch-Waxman Act of 1984 extended the term of pharmaceutical patents by up to 5 years in addition to the baseline patent protection period, resulting in a minimum of 5 years of EPL, to allow innovators to recoup profits for the term prior to FDA approval. See Lakdawalla, D.N., *Economics of the pharmaceutical industry*. *Journal of Economic Literature*, 2018. 56(2): p. 397-449.
- liv Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lv https://ec.europa.eu/health/human-use/legal-framework_en
- lvi Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lvii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lviii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex

- lix Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lx Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex, DiMasi, Joseph A, Henry G Grabowski, and Ronald W Hansen. 2016. "Innovation in the Pharmaceutical Industry: New Estimates of R&D Costs." *Journal of Health Economics* 47: 20–33. <https://doi.org/10.1016/j.jhealeco.2016.01.012>.
- lxi "How Much Does It Cost to Make an App in 2020? App Budgeting 101 - Velvetech." 2018. Velvetech. December 7, 2018. Available at <https://www.velvetech.com/blog/how-much-mobile-app-cost/>
- lxii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxiii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxiv Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxv Iain M. Cockburn: IP rights and Pharmaceuticals, Challenges & Opportunities for Economic Research, WIPO, The Economics of IP, 165. Link this to the PWC 2020 report.
- lxvi PricewaterhouseCoopers. n.d. "Global Annual Review 2020." PwC. Available at <https://www.pwc.com/gx/en/about/global-annual-review-2020.html>
- lxvii Reto M. Hilty et al., Covid-19 and the Role of Intellectual Property, Position Statement of the Max Planck Institute for Innovation and Competition of 7 May 2021
- lxviii "Voluntary Licenses and Non-Assert Declarations." n.d. IFPMA. Available at <https://www.ifpma.org/resource-centre/voluntary-licenses-and-non-assert-declarations/#:~:text=A%20voluntary%20license%20is%20an,licensee%20can%20sell%20the%20product.>
- lxix "Licences." n.d. MPP. Accessed August 2, 2021. Available at <https://medicinespatentpool.org/progress-achievements/licences/>
- lxx "Chronic hepatitis C treatment expansion - Generic Manufacturing for Developing Countries Generic Agreements." 2017. Available at <https://www.gilead.com/-/media/files/pdfs/other/hcv-generic-agreement-fast-facts-11-15-17.pdf>
- lxxi "AbbVie Gives up Patent Rights to HIV Med Kaletra amid COVID-19 Tests: Report." n.d. FiercePharma. Accessed August 2, 2021. Available at <https://www.fiercepharma.com/pharma/abbvie-gives-up-patent-rights-to-hiv-med-kaletra-amid-covid-19-tests-report.>
- lxxii WTO | Intellectual Property (TRIPS) - TRIPS and Public Health: Compulsory Licensing of Pharmaceuticals and TRIPS." 2018. Wto.org. 2018. Available at https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm
- lxxiii Recent Examples of the Use of Compulsory Licenses on Patents." 2007. Available at https://www.keionline.org/misc-docs/recent_cls_8mar07.pdf
- lxxiv 'Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxxv 'Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxxvi 'Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxxvii Heus, Joris J., Elmar S. de Pauw, Leloux Mirjam, Morpurgo Margherita, Hamblin Michael R, and Heger Michal. 2017. "Importance of Intellectual Property Generated by Biomedical Research at Universities and Academic Hospitals." *Journal of Clinical and Translational Research* 3 (2): 250–59. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5881943/>.
- lxxviii Wolff, J. A. et al., Direct Gene Transfer into Mouse Muscle in Vivo, *Science* **247**, 1465–1468 (1990).
- lxxix Karikó, K., Buckstein, M., Ni, H. & Weissman, D., Suppression of RNA Recognition by Toll-like Receptors: The Impact of Nucleoside Modification and the Evolutionary Origin of RNA, *Immunity* 23, 165–175 (2005).

- lxxx Schacht WH. The Bayh-Dole Act: selected issues in patent policy and the commercialization of technology [Internet]. Washington (DC): Congressional Research Service; 2012
- lxxxi Van Norman, Gail A., and Roi Eisenkot. 2017. "Technology Transfer: From the Research Bench to Commercialization." *JACC: Basic to Translational Science* 2 (1): 85–97. <https://doi.org/10.1016/j.jacbts.2017.01.003>.
- lxxxii Abinader, L. G. Foundational mRNA patents are subject to the Bayh-Dole Act provisions. Knowledge Ecology International <https://www.keionline.org/34733> (2020). CellScript & Moderna. Patent sublicense agreement. EX-10.8. <https://www.sec.gov/Archives/edgar/data/1682852/000119312518323562/d577473dex108.htm> (2017).
- lxxxiii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxxxiv <https://www.fiercebiotech.com/special-report/biotech-s-top-10-money-raisers-2020>
- lxxxv https://www.baybridgebio.com/blog/vc_basics_1.html
- lxxxvi Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxxxvii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxxxviii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- lxxxix Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xc Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xci Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xcii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- xciii Towse A, Hoyle CK, Goodall J, et al., Time for a change in how new antibiotics are reimbursed: Development of an insurance framework for funding new antibiotics based on a policy of risk mitigation, *Health Policy* (New York), 2017;121(10):1025-1030, accessed February 2020
- xciv Best practice requires that new antibacterials are only used when truly necessary. New antibacterials would be held in reserve to treat patients whose infections are resistant to first and/or second line treatment, minimizing the number of units sold.
- xcv Hoffman SJ, Outterson K. What will it take to address the global threat of antibiotic resistance? *Journal of Law, Medicine & Ethics*. 2015;43(2)
- xcvi Political Declaration of the High-Level Meeting of the General Assembly on Antimicrobial Resistance. 2016. United National Digital Library, <https://digitallibrary.un.org/record/842813?ln=en>
- xcvii Roope LS, Smith RD, Pouwels KB, et al., The challenge of antimicrobial resistance: What economics can contribute, April 5, 2019, accessed February 2020
- xcviii A peer-reviewed study reported that the annual gains from increased longevity from 1970 to 1990 in the US is about USD 5.4 trillion today. Murphy, Kevin M. and R. Topel. "The Economic Value of Medical Research." (2000).
- xcix Congressional Budget Office. "Offsetting effects of prescription drug use on Medicare's spending for medical services." (2012).
- c Council for Trade-Related Aspects of Intellectual Property Rights Original: English WAIVER from CERTAIN PROVISIONS of the TRIPS AGREEMENT for the PREVENTION, CONTAINMENT and TREATMENT of COVID-19 REVISED DECISION TEXT." 2021. <https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/W669R1.pdf&Open=True>

- ci “Brazil’s Senate Passes Covid Vaccines License-Waiver Bill.” 2021, <https://www.law360.com/articles/1412275/brazil-s-senate-passes-covid-vaccines-license-waiver-bill>.
“Brazil Passes Compulsory Licence Bill for Covid-19 Vaccines.” 2021, <https://www.lifesciencesipreview.com/news/brazil-passes-compulsory-licence-bill-for-covid-19-vaccines-4540>.
- cii *World Population Prospects 2019*, D.o.E.a.S.A. United Nations, Population Division, Editor. 2019.
- ciii *Global Health Expenditure Database*, W.H. Organization, Editor. 2020.
- civ Gaviria, Mario, and Burcu Kilic. 2021. “A Network Analysis of COVID-19 mRNA Vaccine Patents.” *Nature Biotechnology* 39 (5): 546–48. <https://doi.org/10.1038/s41587-021-00912-9>. <https://www.nature.com/articles/s41587-021-00912-9>
- cv <https://www.yalemedicine.org/news/covid-19-vaccine-comparison>
- cvi Wolff, J. A. et al., Direct Gene Transfer into Mouse Muscle in Vivo, *Science* 247, 1465–1468 (1990).
- cvii Karikó, K., Buckstein, M., Ni, H. & Weissman, D., Suppression of RNA Recognition by Toll-like Receptors: The Impact of Nucleoside Modification and the Evolutionary Origin of RNA, *Immunity* 23, 165–175 (2005).
- cix Gaviria, Mario, and Burcu Kilic. 2021. “A Network Analysis of COVID-19 mRNA Vaccine Patents.” *Nature Biotechnology* 39 (5): 546–48. <https://doi.org/10.1038/s41587-021-00912-9>. Available at <https://www.nature.com/articles/s41587-021-00912-9>
- cx Commissioner, Office of the. 2020. “Moderna COVID-19 Vaccine.” FDA, December. Available at <https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/moderna-covid-19-vaccine>
<https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/pfizer-biontech-covid-19-vaccine>
- cxii “News | Lonza.” n.d. www.lonza.com. Available at <https://www.lonza.com/news/2020-05-01-04-50>
- cxiii The Open University.” n.d. business-school.open.ac.uk. Available at <https://business-school.open.ac.uk/news/pfizer-biontech-vaccine-openness-and-collaboration-tackle-world%E2%80%99s-problems>
- cxiiii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- cxv The Global Governance of Access to Countermeasures Ensuring Global Access to Drugs, Diagnostics and Vaccines Is Core to Preparedness | IHEID.” n.d. www.graduateinstitute.ch. Accessed August 2, 2021. Available at <https://www.graduateinstitute.ch/library/publications-institute/global-governance-access-countermeasures-ensuring-global-access>.
- cxvi Global Biopharmaceutical Industry Commitment to Address Coronavirus Public Health Crisis”. 2020. IFPMA, https://www.ifpma.org/wp-content/uploads/2020/03/IFPMA_Commitment_COVID-19.pdf.
- cxvii Seventy-Fourth Session Agenda Item 123 Strengthening of the United Nations System. International cooperation to ensure global access to medicines, vaccines and medical equipment to face COVID-19, 20 April 2020. Available at <https://rm.coe.int/a-res-74-274-e/16809e40f4>
- cxviii WHO. 2020. “COVAX: Working for Global Equitable Access to COVID-19 Vaccines.” www.who.int. 2020. Available at <https://www.who.int/initiatives/act-accelerator/covax>

- cxviii Historic Health Assembly Ends with Global Commitment to COVID-19 Response.” n.d. [www.who.int](https://www.who.int/news/item/19-05-2020-historic-health-assembly-ends-with-global-commitment-to-covid-19-response). Available at <https://www.who.int/news/item/19-05-2020-historic-health-assembly-ends-with-global-commitment-to-covid-19-response>
- cxix COVID-19 Technology Access Pool.” n.d. Error! Hyperlink reference not valid. at <https://www.who.int/initiatives/covid-19-technology-access-pool>
- cxx Council for Trade-Related Aspects of Intellectual Property Rights Original: English WAIVER from CERTAIN PROVISIONS of the TRIPS AGREEMENT for the PREVENTION, CONTAINMENT and TREATMENT of COVID-19 COMMUNICATION from INDIA and SOUTH AFRICA.” n.d. Available at <https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/W669.pdf&Open=True>
- cxixi Council for Trade-Related Aspects of Intellectual Property Rights Original: English WAIVER from CERTAIN PROVISIONS of the TRIPS AGREEMENT for the PREVENTION, CONTAINMENT and TREATMENT of COVID-19 REVISED DECISION TEXT.” 2021. <https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/W669R1.pdf&Open=True>
- cxixii Council for Trade-Related Aspects of Intellectual Property Rights Original: English WAIVER from CERTAIN PROVISIONS of the TRIPS AGREEMENT for the PREVENTION, CONTAINMENT and TREATMENT of COVID-19 REVISED DECISION TEXT.” 2021. Available at <https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/W669.pdf&Open=True>
- cxixiii Statement from Ambassador Katherine Tai on the Covid-19 Trips Waiver | United States Trade Representative.” n.d. Ustr.gov. Available at <https://ustr.gov/about-us/policy-offices/press-office/press-releases/2021/may/statement-ambassador-katherine-tai-covid-19-trips-waiver>
- cxixiv COMMUNICATION from the EUROPEAN UNION to the COUNCIL for TRIPS URGENT TRADE POLICY RESPONSES to the COVID-19 CRISIS: Intellectual Property.” n.d. https://trade.ec.europa.eu/doclib/docs/2021/june/tradoc_159606.pdf
- cxixv Five steps to urgently advance COVID-19 vaccine equity”. 2021. IFPMA, <https://www.ifpma.org/resource-centre/five-steps-to-urgently-advance-covid-19-vaccine-equity/>
- cxixvi Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549
- cxixvii Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549
- cxixviii Anthony King, Why manufacturing Covid vaccines at scale is hard (23 Mar 2021) <https://www.chemistryworld.com/news/why-manufacturing-covid-vaccines-at-scale-is-hard/4013429.article#/>
- cxixix Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549
- cxixxx Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549
- cxixxxi Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549

- cxxxii Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- cxxxiii Unctad.org. 2021. Ten actions to boost low and middle-income countries' productive capacity for medicines | UNCTAD. [online] Available at: <<https://unctad.org/news/ten-actions-boost-low-and-middle-income-countries-productive-capacity-medicines>> [Accessed 30 July 2021]
- cxxxiv Unctad.org. 2021. Ten actions to boost low and middle-income countries' productive capacity for medicines | UNCTAD. [online] Available at: <<https://unctad.org/news/ten-actions-boost-low-and-middle-income-countries-productive-capacity-medicines>> [Accessed 30 July 2021].
- cxxxv Unctad.org. 2021. Ten actions to boost low and middle-income countries' productive capacity for medicines | UNCTAD. [online] Available at: <<https://unctad.org/news/ten-actions-boost-low-and-middle-income-countries-productive-capacity-medicines>> [Accessed 30 July 2021].
- cxxxvi Rajagopal, D. "AstraZeneca & Serum Institute of India sign licensing deal for 1 billion doses of Oxford vaccine" *Economic Times*, (2020)
- cxxxvii Politico, South African company to help produce Biontech Pfizer vaccine for Africa (July 2021), available at <https://pro.politico.eu/news/south-african-company-to-help-produce-biontech-pfizer-vaccine-for-africa>
- cxxxviii Letter of Intent, https://cdn.who.int/media/docs/default-source/2021-dha-docs/press-release-letter-of-intent-30-july-2021.pdf?sfvrsn=7906619c_5&utm_source=POLITICO.EU&utm_campaign=71ca7ecd99-EMAIL_CAMPAIN_2021_07_30_03_24&utm_medium=email&utm_term=0_10959edeb5-71ca7ecd99-190008921
- cxxxix Global Partnership to Introduce a Connected, Point-of-Care Diagnostic Platform for COVID-19 Antigen Testing in Africa." n.d. www.lumiradx.com. Accessed August 16, 2021. <https://www.lumiradx.com/uk-en/news-events/global-partnership-for-antigen-testing-in-africa>
- cxl Global Partnership to Introduce a Connected, Point-of-Care Diagnostic Platform for COVID-19 Antigen Testing in Africa." n.d. www.lumiradx.com. Accessed August 16, 2021. <https://www.lumiradx.com/uk-en/news-events/global-partnership-for-antigen-testing-in-africa>
- cxli Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- cxlii Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549
- cxliii Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549
- cxliv Interview conducted by FTI Consulting for INTERPAT - please find full list in Annex
- cxlv Wall Street Journal, Pfizer, BioNTech to Deliver 2 Billion Covid-19 Vaccine Doses to Developing Countries (May 21, 2021), available at <https://www.wsj.com/livecoverage/covid-2021-05-21/card/GsPYoFscRppTzYYt0l4f>
- cxlvi IFPMA, Five steps to urgently advance COVID-19 vaccine equity (May 19, 2021), available at <https://www.ifpma.org/resource-centre/five-steps-to-urgently-advance-covid-19-vaccine-equity/>
- cxlvii Fierce Pharma, Gilead, Merck step in to help India's drug manufacturers fight surging COVID-19 outbreak (Apr. 27, 2021), **available at** <https://www.fiercepharma.com/pharma/gilead-merck-plan-production-boosts-for-covid-19-drugs-india-amid-surg-ing-outbreak>
- cxlviii Lee, Peter, Contracting to Preserve Open Science: Consideration-Based Regulation in Patent Law (October 22, 2008). *Emory Law Journal*, Vol. 58, p. 889, 2009, UC Davis Legal Studies Research Paper No. 153, Available at SSRN: <https://ssrn.com/abstract=1288183>

- cxlix Lewis, Tracy R., Jerome H. Reichman, and Anthony D. So. "The case for public funding and public oversight of clinical trials." *The Economists' Voice* 4, no. 1 (2007).
- cl Abbas, Muhammad Zaheer. "Pros and cons of compulsory licensing: An analysis of arguments." *International Journal of Social Science and Humanity* 3, no. 3 (2013).
- cli Interpat." n.d. Interpat. Accessed August 2, 2021. Available at <http://www.interpat.org/ip-principles-for-advancing-cures-and-therapies/>
- clii FDA. *Novel Drug Approvals for 2021*. 2021 06/08/2021]; Available from: <https://www.fda.gov/drugs/new-drugs-fda-cders-new-molecular-entities-and-new-therapeutic-biological-products/novel-drug-approvals-2021>
- cliii Center, T.M. *Cost-Effectiveness Analysis (CEA) Registry*. 2019 06/07/2021]; Available from: <https://cevr.tuftsmedicalcenter.org/databases/cea-registry>
- cliv An *incremental* QALY gain is defined as the difference between total QALYs for the drug of interest and total QALYs under the current standard of care.
- clv *SEER*Explorer: An interactive website for SEER cancer statistics [Internet]*. 6/18/2021]; Available from: <https://seer.cancer.gov/explorer/>
- clvi For conditions that have annual incidence data available rather than prevalence, the value per drug is multiplied by 30 to account for the additional value the drugs accrue as more people get the disease.
- clvii Typically, the uptake of a drug will not be 100% at launch. The Medicare market share is about 0.33 percentage points (See Dranove, D., C. Garthwaite, and M. Hermsilla, *Pharmaceutical profits and the social value of innovation*. 2014, National Bureau of Economic Research). Our model assumes a market uptake of 13.6% for the US, derived using US disease prevalence, Medicare market share, and US Census population. The ex-US (global) market uptake is assumed to be 50% of the US uptake, i.e. 6.8%.
- clviii According to a 2008 study that used 1976-2001 data from over 200 published cost-utility analyses in the Harvard Cost-Effectiveness Analysis (CEA) Registry, the producers' share of actual social surplus, associated with the median intervention that requires a spending per QALY of approximately USD 19,000, is 17%. Based on this estimate, the consumers' share of social surplus is 83%. See Jena, A.B. and T.J. Philintellectual propertyson, *Cost-effectiveness analysis and innovation*. *Journal of health economics*, 2008. **27**(5): p. 1224-1236.
- clix ICER, 2020-2023 Value Assessment Framework. 2020.
- clx Reto M., Hilty et al., *Covid-19 and the Role of Intellectual Property*, Position Statement of the Max Planck Institute for Innovation and Competition (7 May 2021), Available from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3841549
- clxi Acemoglu, D. and J. Linn, *Market size in innovation: theory and evidence from the pharmaceutical industry*. *The Quarterly journal of economics*, 2004. 119(3): p. 1049-1090.
- clxii FDA. *Novel Drug Approvals for 2021*. 2021 06/08/2021]; Available from: <https://www.fda.gov/drugs/new-drugs-fda-cders-new-molecular-entities-and-new-therapeutic-biological-products/novel-drug-approvals-2021>.
- clxiii Center, T.M. *Cost-Effectiveness Analysis (CEA) Registry*. 2019 [06/07/2021]; Available from: <https://cevr.tuftsmedicalcenter.org/databases/cea-registry>
- clxiv ICER, 2020-2023 Value Assessment Framework. 2020.
- clxv World Bank national accounts data, and OECD National Accounts data files. 2019: The World Bank
- clxvi Jena, A.B. and T.J. Philintellectual propertyson, *Cost-effectiveness analysis and innovation*. *Journal of health economics*, 2008. **27**(5): p. 1224-1236

- clxvii Sood, N., et al., *The flow of money through the pharmaceutical distribution system*. USC Schaeffer Leonard D Schaeffer Center for Health Policy & Economics CA, USA, 2017.
- clxviii Conrad, R. Generic Competition and Drug Prices: New Evidence Linking Greater Generic Competition and Lower Generic Drug Prices. 2019 [06/09/2021]; Available from: <https://www.fda.gov/media/133509/download>.
- clxix Mulcahy, A.W., J.P. Hlávka, and S.R. Case, Biosimilar cost savings in the United States: initial experience and future potential. *Rand health quarterly*, 2018. **7**(4).
- clxx Conrad, R. Generic Competition and Drug Prices: New Evidence Linking Greater Generic Competition and Lower Generic Drug Prices. 2019 [06/09/2021]; Available from: <https://www.fda.gov/media/133509/download>.
- clxxi Mulcahy, A.W., J.P. Hlávka, and S.R. Case, Biosimilar cost savings in the United States: initial experience and future potential. *Rand health quarterly*, 2018. **7**(4).
- clxxii FDA. *Novel Drug Approvals for 2021*. 2021 06/08/2021]; Available from: <https://www.fda.gov/drugs/new-drugs-fda-cders-new-molecular-entities-and-new-therapeutic-biological-products/novel-drug-approvals-2021>.
- clxxiii FDA. *Novel Drug Approvals for 2021*. 2021 06/08/2021]; Available from: <https://www.fda.gov/drugs/new-drugs-fda-cders-new-molecular-entities-and-new-therapeutic-biological-products/novel-drug-approvals-2021>.
- clxxiv FDA. *Novel Drug Approvals for 2021*. 2021 06/08/2021]; Available from: <https://www.fda.gov/drugs/new-drugs-fda-cders-new-molecular-entities-and-new-therapeutic-biological-products/novel-drug-approvals-2021>.
- clxxv Acemoglu, D. and J. Linn, *Market size in innovation: theory and evidence from the pharmaceutical industry*. *The Quarterly journal of economics*, 2004. 119(3): p. 1049-1090
- clxxvi Institute for Clinical and Economic Review. “2020-2023 Value Assessment Framework” January 31, 2020 (Updated October 23, 2020). https://icer.org/wp-content/uploads/2021/03/ICER_2020_2023_VAF_013120-4-2.pdf
- clxxvii DiMasi, J.A., H.G. Grabowski, and R.W. Hansen, *Innovation in the pharmaceutical industry: new estimates of R&D costs*. *Journal of health economics*, 2016. 47: p. 20-33.
- clxxix Grabowski, H., *Effective Patent Life in Pharmaceuticals*. 2000