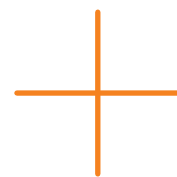




Global Medicine Spending and Usage Trends

OUTLOOK TO 2025



APRIL
2021

Introduction

The future level of global spending on medicines has implications for healthcare systems and policymakers across developed and emerging economies, and these issues are even more important in light of the ongoing global COVID-19 pandemic. Stakeholders share common goals of improving health outcomes while controlling costs and expanding access to medicines, which is made more challenging with the numerous uncertainties surrounding the progress of the pandemic.

Past spending growth typically offers some clues to the level of growth to expect in the future and broadly that will still be true, despite the unprecedented dynamics at play with the COVID-19 pandemic. Medicine spending growth will continue to be driven by traditional factors including patent expiries, launches of new medicines as well as changing volume demand particularly in pharmerging and lower income countries.

In this report, we quantify the impact of these dynamics and examine the spending and usage of medicines in 2020, globally and for specific therapy areas and countries. We intend this report to provide a foundation for meaningful discussion about the value, cost and role of medicines over the next five years in the context of overall healthcare spending.

Medicine spending in this report, is based on audited spending data at prices reported in IQVIA audits of pharmaceutical spending that are, in general, reported at the invoice prices wholesalers charge to their customers including pharmacies and hospitals. As this level does not reflect the true spending level net of discounts and rebates, it is more helpful when focused on growth trends or volume metrics. As in last year's

report, analyses include a measure of days of therapy, essentially turning counts of pills, vials, patches, creams, etc., into normalized days of therapy through the use of defined daily dose (DDD) assumptions per product. Interpreting drug shipment data as normalized days of therapy puts a useful patient lens on otherwise dissimilar volumes.

The study was produced independently by the IQVIA Institute for Human Data Science as a public service, without industry or government funding. The contributions to this report by Aurelio Arias, Onil Ghotkar, Urvashi Porwal, Sarah Rickwood, Durgesh Soni, Alan Thomas, and dozens of others at IQVIA are gratefully acknowledged.

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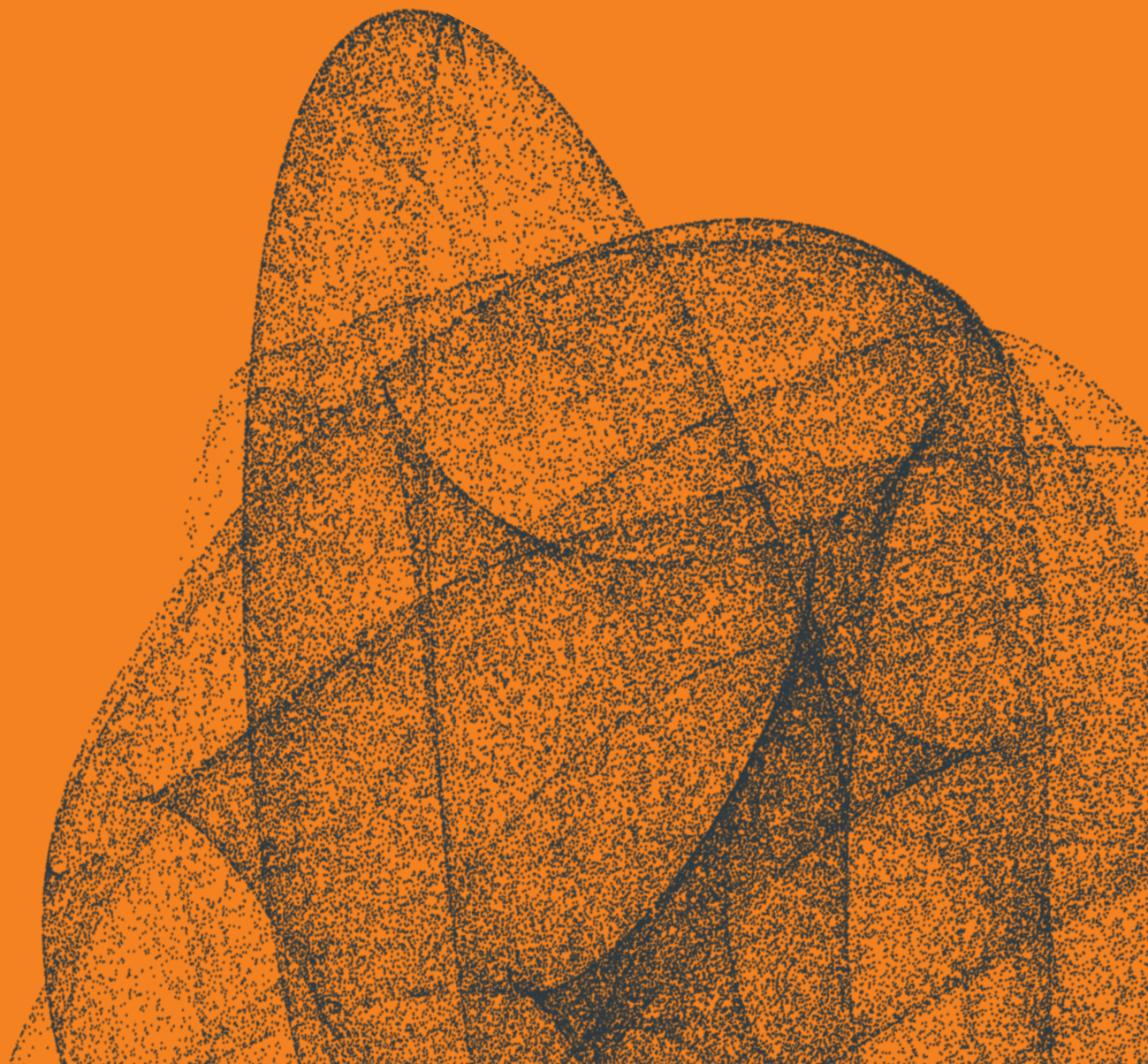
Executive Director

IQVIA Institute for Human Data Science

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Executive summary

The COVID-19 pandemic has been the most impactful global health crisis in decades and its' direct and indirect impacts are critical to understanding the global use of medicines.

While the pandemic has been extremely disruptive, it is clear that other aspects of healthcare have continued and the immediate shocks in early 2020 have given way to patterns of adaptation and adjustment around the world. The success of countries around the world in implementing a global vaccination program unprecedented in speed or scope will be key to the outlook for all medicine use through 2025 and beyond. The key elements of the outlook to 2025 are therefore the handling of the pandemic as well as how that will affect non-COVID healthcare and use of medicines.

The pre-pandemic drivers of medicine use and spending remain a significant driver of the outlook and have been only modestly impacted by the immediate effects of COVID-19.

In developed countries, the adoption of new treatments, offset by patent lifecycles and competition from generics and biosimilars are expected to continue as the main factors influencing medicine spending and growth. In pharmerging countries, dramatic increases in healthcare access were the largest driver of changes in the use of medicines historically but the trend is slowing and will result in volume declines across many markets.

The global medicine market — using invoice price levels — is expected to grow at 3–6% CAGR through 2025, reaching about \$1.6 trillion in total market size in 2025 excluding spending on COVID-19 vaccines. The total cumulative spending on COVID-19 vaccines through 2025 is projected to be \$157 billion, largely focused on the initial wave of vaccinations to be completed 2022. In later years, booster shots are expected to be required on a biennial basis as the durability of immunity and the continued emergence of viral variants make an endemic virus the most likely outcome.

Growth in Global Medicine Spending will be lifted by stronger pharmerging market growth through 2025 and

offset by developed markets where slower growth will result as losses of exclusivity for original brands outweigh growth from new products. The U.S. market, on a net price basis, is forecast to grow 0–3% CAGR over the next 5 years, down from 3% CAGR for the past 5 years. Japan, the third largest global market will have flat to declining medicine spending as a result of the continued biennial price cut policy, but see rising patent-protected original brand spending coinciding with policies to encourage a shift to generics for older medicines. Spending in Europe is expected to increase by a total of \$35 billion in five years to 2025 with a focus on generics and biosimilars. In pharmerging markets, growth will be led by China, which is expected to accelerate post-COVID driven by greater uptake and use of new original medicines.

New brands in developed markets through 2025 are projected to be similar in absolute spending to the last five years, continuing a historically high period of spending on novel medicines. Through 2025 the number of new active substances (NAS) launches are also projected to continue at an above average rate, with an average of 54–63 per year, totaling 290–315 for five years through 2025. The impact of exclusivity losses will increase to \$166 billion over the next 5 years mostly due to the availability of biosimilars, and the cumulative savings from biosimilars will reach an estimated \$285 billion. Five years from now, medicine spending will be nearly 60% from specialty medicines in developed markets and 50% globally, with the remainder predominately older and traditional therapies, becoming progressively lower cost over time.

The two leading global therapy areas — oncology and immunology — are forecast to grow 9–12% CAGR through 2025, lifted by significant increases in new treatments and medicine use. Oncology is projected to add 100 new treatments over five years, contributing to an increase in spending of more than \$100 billion to a total of more than \$260 billion in 2025.

Neurology includes a range of diseases which are expected to see many new therapies including novel migraine therapies, potential treatments for rare neurological diseases, and the potential for therapies for Alzheimer's and Parkinson's.

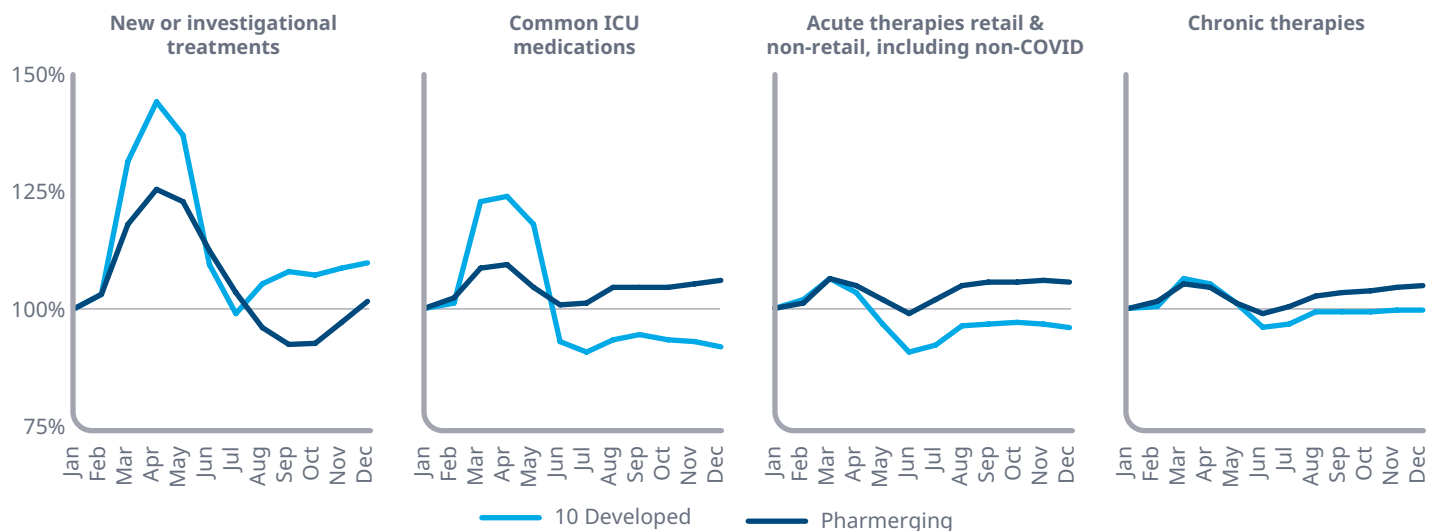
Impact of COVID-19 on the use of medicines

- Medicine use was disrupted in 2020, with varying timing and impact in developed and pharming countries.
 - Short-term stockpiling of chronic therapies occurred early in the pandemic, and over-the-counter medicine use was also affected, including a 14.3% increase in calming/sleeping/mood drugs.
 - The economic impact of quarantines and shutdowns has not been consistently correlated across countries with changes in use of medicines and while medicine use recovered by the end of 2020 there was about +/- 10% variability in specific countries.
 - A range of changes in the use of medicines will be prompted by COVID-19, with demand for new vaccines and therapeutics as well as shifts in demand for existing therapies and changes in patient behaviors.
- A worldwide vaccination effort is expected to be completed within two years, later requiring periodic booster shots and with total vaccine costs of \$157 billion through 2025.
 - Medicine spending through 2025 is expected to be a cumulative \$88 billion higher than the pre-COVID outlook, despite new vaccine spending and declines in non-COVID and non-vaccine spending.
 - Long-term budget pressures are expected to escalate countries' use of cost containment approaches.

The impact of COVID-19 has defied expectations throughout 2020, but the evolution from pandemic to endemic is reasonably certain, even if the interplay between vaccination levels and periodic outbreaks around the world remain challenging to predict.

Medicine use was severely disrupted and supply chains challenged in 2020, with different timing and impact across countries

Exhibit 1: Monthly Percent Change in Medicine Use in 2020 Compared to Expected



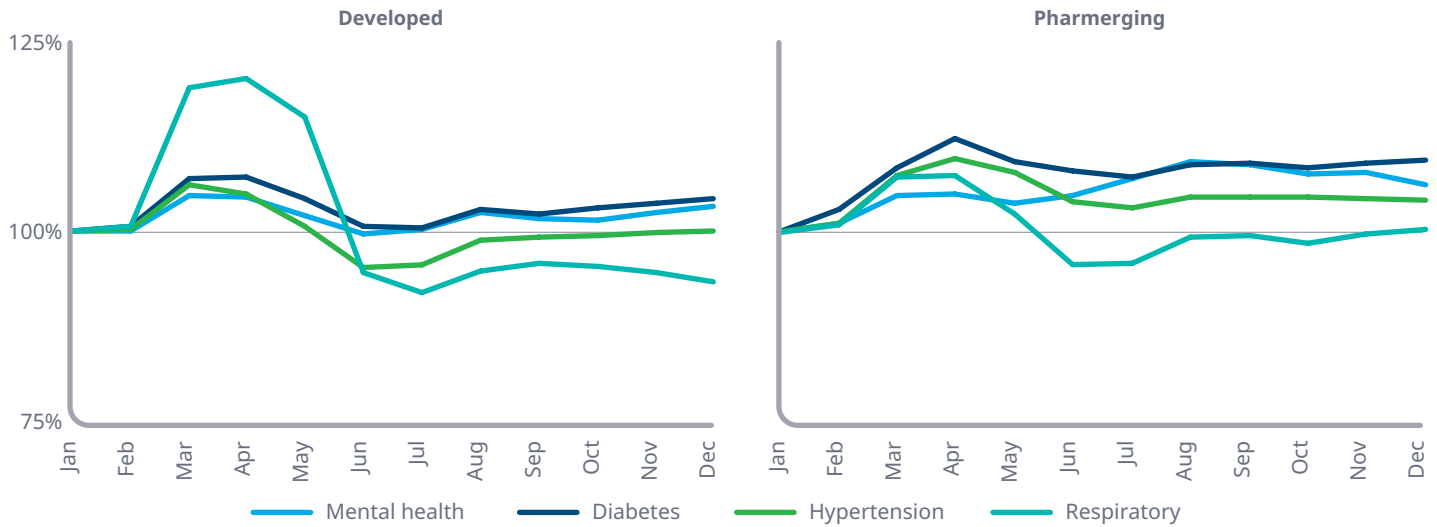
Source: IQVIA MIDAS, Dec 2020; IQVIA Institute, Mar 2021

- As the early outbreaks of SARS-CoV-2 began to spread, significant uncertainties affected multiple aspects of global healthcare, including the supply chain for medicines due to the significant concentration of raw active ingredient manufacturing (API) in countries with early impacts from the pandemic.
- These supply chain concerns contributed to abnormal purchasing patterns by large providers and individual patients alike, some of which were driven by common ICU treatments in countries with large waves of hospitalizations, particularly the larger developed countries, while others were driven by fears of disruptions of supply for non-COVID patients.
- As providers struggled with COVID patients unresponsive to common respiratory treatments and having cascading immunological and neurological symptoms, existing medicines for other diseases, including common autoimmune treatments like hydroxychloroquine, began to be widely used.
- In the broader population, societal shutdowns drove the reduction of acute therapies as common infections and hospitalizations became less common and the antibiotics and pain medicines given to such patients were less in demand, despite shortages of some treatments for patients with COVID in ICUs.
- For patients receiving longer-term chronic therapies, shifts in demand were driven by stockpiling surges followed by returns to normal demand flows later in the summer as peak cases waned and pharmacies remained able to supply medications.

Exhibit Notes: Based on rolling three-month totals in standard units. Expected values in 2020 are based on 2019 monthly trends applied after January 2020 and are charted as three months of rolling data ending in the month displayed. New or Investigational therapies include siltuximab, tocilizumab, sarilumab, chloroquine, hydroxychloroquine, lopinavir/ritonavir, ruxolitinib, fingolimod, bevacizumab, methylprednisolone, remdesivir, bamlanivimab, casirivimab+imdevimab, and bamlanivimab+etesevimab to the extent they appear in IQVIA audits, which may be limited as they were approved via emergency use authorizations (EUA). Common ICU medications as defined by American Society of Health System pharmacists, <https://www.ashp.org/COVID-19/Bi-weekly-PPE-Survey-Results-Covid-19>.

Short-term stockpiling of chronic therapies occurred early in the pandemic

Exhibit 2: Monthly Percent Change in Cumulative Medicine Use in 2020 Compared to Expected



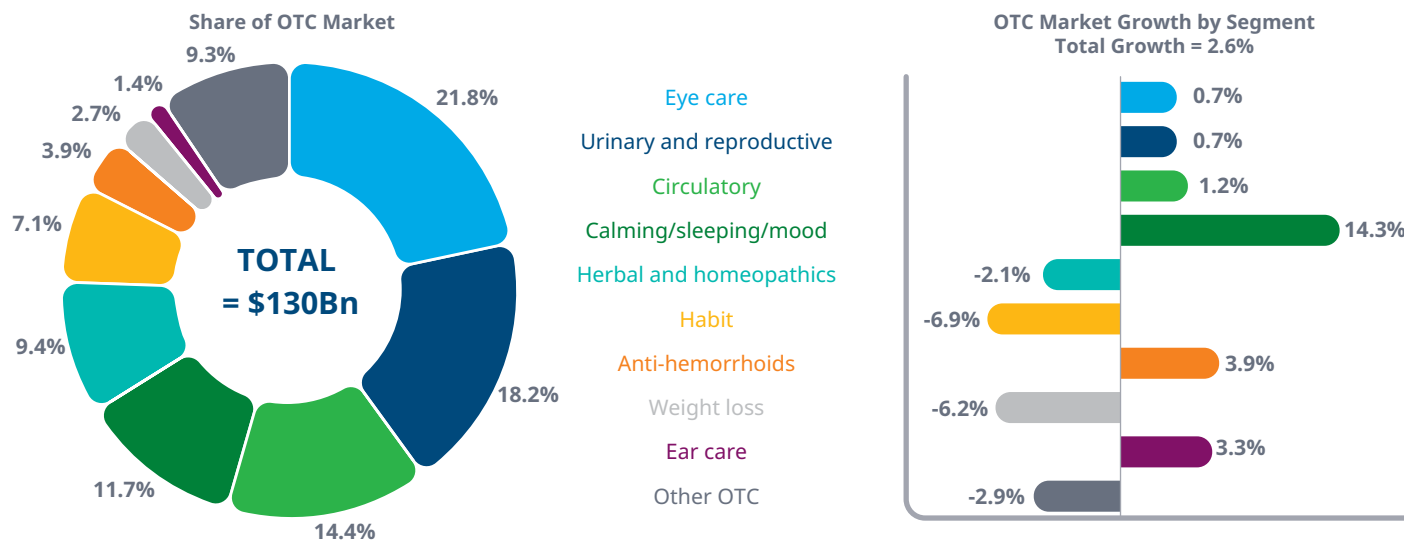
Source: IQVIA MIDAS, Dec 2020; IQVIA Institute, Mar 2021

- Early in the pandemic, with few treatments appearing to offer benefits for patients, there was an increased use of rescue inhalers, normally for asthma, in patients in ICUs, driving a significant shift in usage in the respiratory market overall and then falling as hospitalization rates fell.
- Notably, hypertension treatments appear to be trending below expected volumes after the initial surge in developed markets, raising the potential that patients with untreated disease may have worse outcomes in the long term.
- Mental health therapies have seen a gradual rise in usage, though more modest than some had expected, potentially due to barriers to beginning new treatments for mental health disorders, including social stigma.
- Pharmerging markets have seen generally less disruption to these therapies, as many countries were later impacted by COVID-19 and experienced less of the early wave of uncertainty-driven behavior changes.

Exhibit Notes: Based on rolling three-month totals in standard units. Expected values in 2020 are based on 2019 monthly trends applied after January 2020. Cumulative difference between expected and actual compared to January 2020 are displayed. Countries represent those which have monthly data available and include developed markets: Australia, Canada, France, Germany, Italy, Japan, Spain, UK, U.S., and pharmerging markets: Brazil, China, India, Mexico, Philippines, Russia, and Turkey.

Over-the-counter medicine use was also affected, including a 14.3% increase in calming/sleeping/mood drugs

Exhibit 3: Global Over-the-Counter Medicine Spending and Growth by Segment in 2020



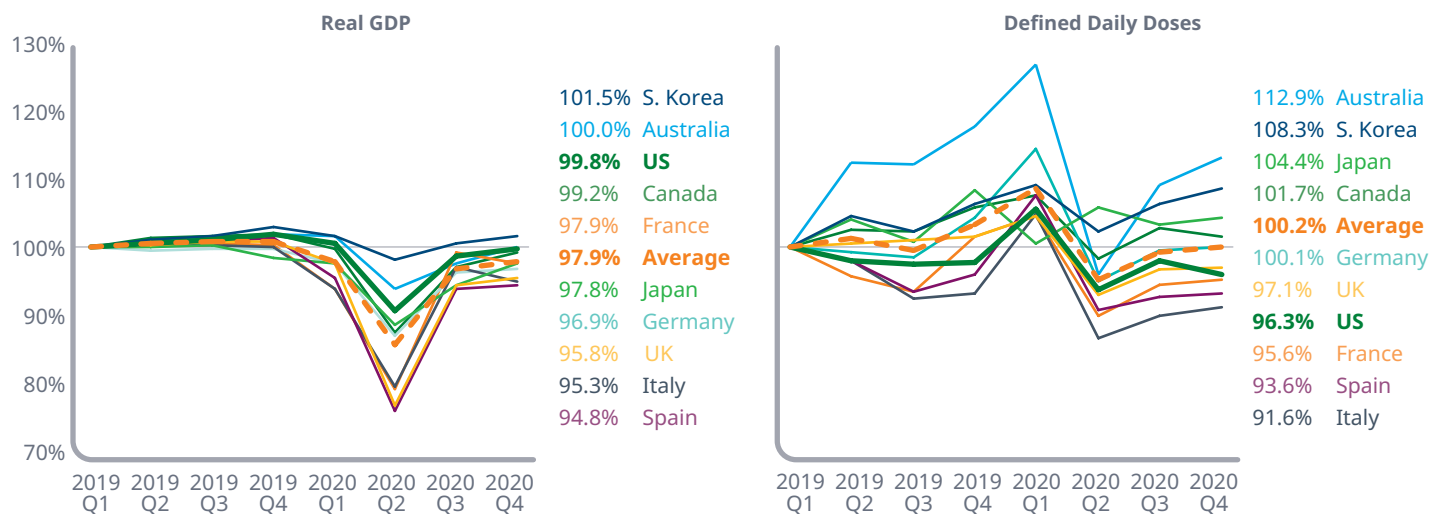
Source: IQVIA Global OTC Insights, Sep 2020

- In addition to the predominately prescription-bound volume trends, many patients around the world self-medicate with over-the-counter (OTC) medicines, which was also disrupted during the pandemic.
- Globally, most OTC treatments are low cost and the trend in usage parallels the change in overall spending growth, which was 2.6% through the 12 months ending September 2020, encompassing six months pre-COVID and six months during the pandemic.
- The most dramatic shifts in demand were the 14% increase in treatments for calming, mood and sleep, consistent with the widespread reporting of anxiety, depression, and trouble sleeping many people have had during the pandemic.
- It is further likely that lower barriers from regulation as well as stigma may have allowed patients to take the first step to manage stress induced by the pandemic through self-medication.
- Notable also are the declines in habit treatments, which are most commonly anti-smoking gums and patches and weight loss, which both declined between 6–7%.
- Patient behavior in adapting to COVID has been complex and varied and these self-medication trends illustrate some signs that many people globally are experiencing significant disruptions.

Exhibit Notes: Data is based on spending for year ending Sept. 2020, and growth is compared to spending in year ending Sept. 2019. Habit refers to anti-habit and includes anti-smoking treatments.

Medicine use recovered by the end of 2020 in developed markets on average, though about +/- 10% variability in specific countries

Exhibit 4: Trends in GDP and Defined Daily Doses (DDD) in 10 Developed Markets Indexed to Q1 2019 Values



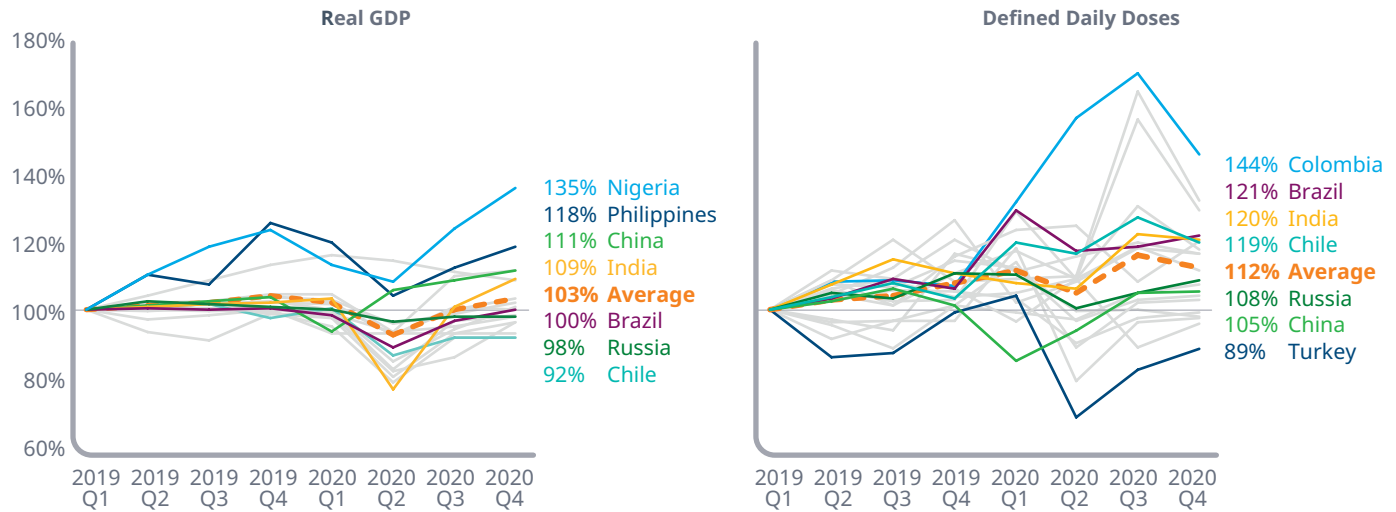
Source: IQVIA MIDAS, Feb 2021. OECD, Dec 2020. GDP projections accessed 3/2/2021

- The global pandemic’s disruptions to the wider economy have been common across developed economies, with an average 12% dip in GDP in the second quarter of 2020 and rebounding strongly in Q3. All developed countries were at 95% or higher of their pre-COVID GDP level by the end of the year.
- The impact of the pandemic on medicine use was much more varied but included both a surge in usage referred to as stockpiling and then returning to a more normal trend, with the average for developed markets at baseline volumes by the end of 2020.
- Countries with the least impact from the pandemic, largely due to early and effective containment, include Australia, South Korea and Japan, while those with some of the worst outbreaks had the most sustained impact on medicine usage, including Italy, Spain, France the UK, and the U.S.
- Volume impacts were less dramatic than overall economic effects, both due to the large share of medicines for chronic diseases and activities to mitigate disruptions for patients that were common across most developed countries.
- Mitigation strategies included shifting doctor visits to remote via telephone and Internet conferencing, which became common even in countries not widely using technology before the pandemic.

Exhibit Notes: All charted values are indexed to Q1 2019 values, such that the Q1 2019 value is set equal to 100%. Defined daily dose (DDD) data based on IQVIA MIDAS (see methodology).

Pharmerging markets exhibited diverse responses to COVID-19 disruptions while overall averaging strong volume growth

Exhibit 5: Trends in GDP and Defined Daily Doses (DDD) in Pharmerging Markets Indexed to Q1 2019 Values



Source: IQVIA MIDAS, Feb 2021. OECD, Dec 2020. GDP projections accessed 3/2/2021

- The COVID-19 pandemic’s early spread had the greatest impact in China, starting in Hubei province, where it was initially isolated, but spread nationally later as the global pandemic spread.
- Overall, China’s GDP in Q4 2020 was down 8% from the level in early 2019.
- Average pharmerging GDP has returned to above 2019 levels and medicine use is up 12% above early 2019 as these economies and use of medicines have been resilient to disruptions from the pandemic.
- Some of the countries with the greatest volume impacts were very late in the relative timing of the increase in cases in the pandemic and may be experiencing the disruptions continuing into 2021.
- Consistently, pharmerging markets have lower per capita use of medicines, often with significant economic disparities within the countries, meaning aggregate impact on volume may be masking more significant impacts on individual patients.

Exhibit Notes: Note, selected countries shown labeled for emphasis. Pharmerging markets defined as those with per capita incomes below \$30,000 and five-year pharmaceutical market growth over \$1 billion. Defined daily dose (DDD) data based on IQVIA MIDAS (see methodology). DDD analysis does not include Nigeria of the pharmerging markets as it is unaudited. All charted values are indexed to Q1 2019 values, such that the Q1 2019 value is set equal to 100%.

New demand for therapeutics and vaccines is expected related to the needs of COVID infection survivors as well as other patients

Exhibit 6: Summary of Expected Impacts of the COVID-19 Pandemic on Patients and Therapeutics

COVID-related co-morbidities for infection survivors

- Neurological, psychiatric, cardiovascular, respiratory and other issues, some with extended durations and potential to be misdiagnosed
- Multi-system inflammatory syndrome for pediatric patients

Vaccines for COVID-19

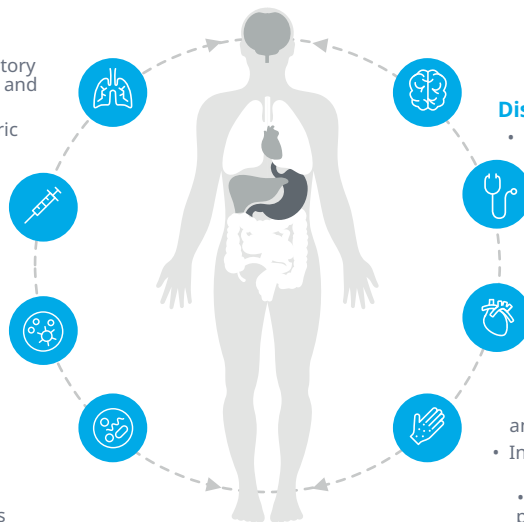
- Initial wave of vaccination across countries expected to continue through 2022
- Subsequent rounds of vaccination may be required if immunity is ephemeral or if vaccines are not effective on viral variants

Therapeutics for COVID-19

- Antivirals
- Antibody treatments
- Treatments for varying severity of disease

Repurposing existing therapeutics

- Asthma drugs
- Antibody treatments originally for other diseases



Population level mental health

- Depression/anxiety, stress disorders
- Substance abuse / dependency

Disrupted or delayed diagnoses of conditions

- Interruption of typical healthcare seeking behaviors due to quarantines / shutdowns could have lasting effects or result in more severe disease when diagnosed, especially cancer

Greater rates of chronic disease

- Obesity, type-2 diabetes, heart disease rates increase due to sustained reductions in activity

Impact on infectious diseases

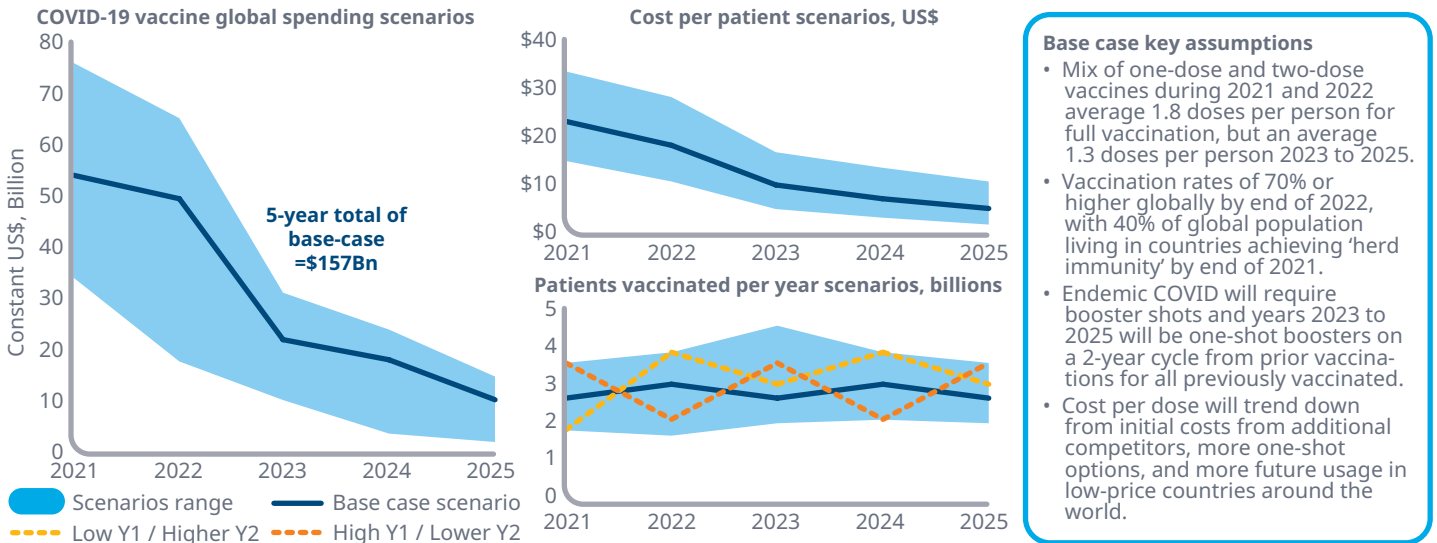
- Seasonal flu season largely absent in 2020, could result in more virulent strains in future seasons
 - Excessive hand sanitizer use could result in antimicrobial resistance or alcohol resistant microbes
- Increased interest in better treating/preventing other pathogens with pandemic potential such as
 - Influenza A (H7N9), RNA viruses (paramyxoviruses, pneumoviruses, and picornaviruses), pathogens that utilize Anopheles and Aedes mosquitoes

Source: IQVIA Institute for Human Data Science, Mar 2021

- As countries around the world emerge from the pandemic, a number of complex factors will influence medicine use, including treatments for COVID-19 patients as well as impacts on the wider population.
- As the numbers of infected patients has risen, small but important clusters of survivors have been demonstrating a cascade of multi-system symptoms, some with extended periods of debilitation.
- Some patients who had asymptomatic COVID-19 infections have been presenting with a spectrum of difficult to diagnose patterns of disease, which could mean millions may have a lingering effect of the pandemic for years.
- New therapeutics for COVID-19 and the use of existing treatments for related symptoms has been widespread and will likely shift as more than 1,000 clinical trials started in the pandemic are completed and interventions are adapted based on evidence.
- Vaccines have been developed with unprecedented speed and numbers, with 11 approved and in use globally, and all administered for the first time less than a year after being initially developed. These vaccines are expected to be given to billions of people over the next several years.
- There will also be significant long-term consequences for non-COVID patients, particularly those whose diagnoses or treatments were disrupted by the societal and personal responses to the pandemic.
- These could include greater rates of chronic lifestyle diseases and mental health, as well as missed screenings to detect early cancers or other diseases.
- The patterns of seasonal influenza and the common cold have notably been disrupted as billions of people wore masks and socially distanced which, while desirable, may have long-term and unexpected impacts.

Global spending on COVID-19 vaccines is modeled to be \$157 billion over the next five years, though cost and volume estimates vary

Exhibit 7: Estimates of Global Vaccine Spending, Cost per Patient and Patients Vaccinated Globally



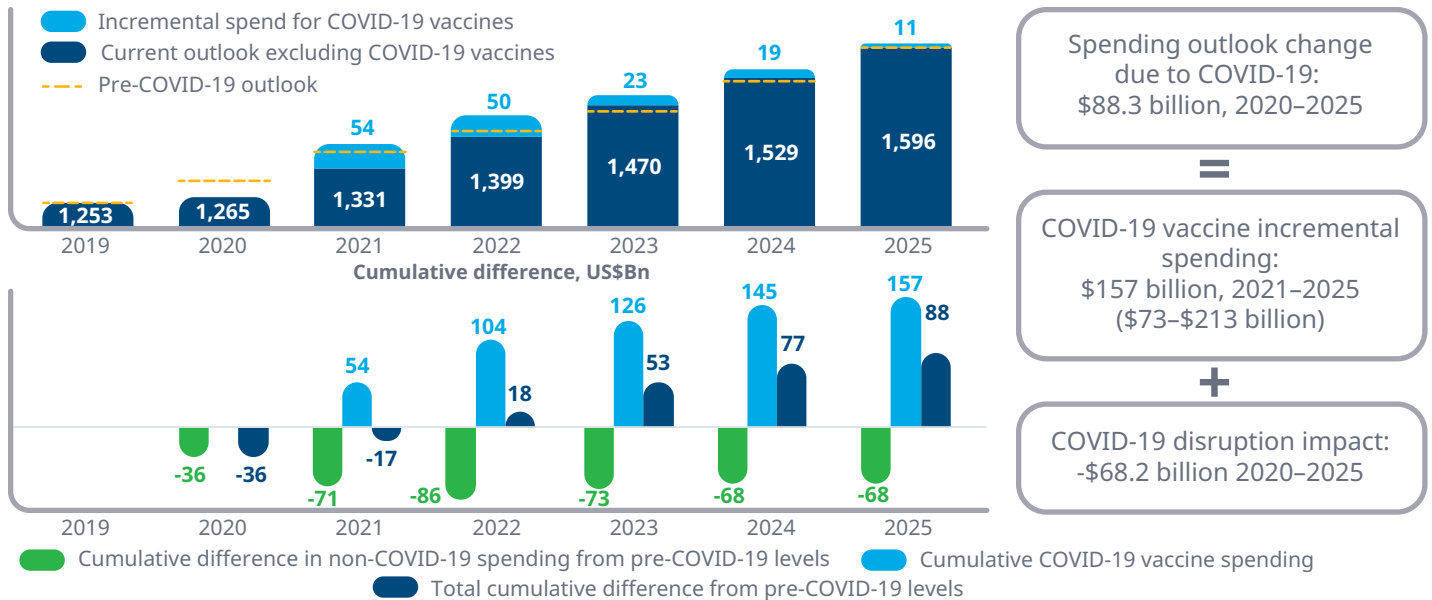
Source: IQVIA Institute, Mar 2021; Pricing information from public disclosures as of Mar 25, 2021; Vaccination trends to date from Ourworldindata.org

- The unprecedented speed with which COVID-19 vaccines were developed and rolled out have raised the possibility — imperative while the pandemic is still spreading — to vaccinate a significant proportion of the global population.
- Infectious disease experts have long suggested that 'herd immunity' would be achieved after more than 70% of a population received vaccination (or achieved acquired immunity), and while this level would not prevent infections it would make rapid, uncontrolled spread dramatically less likely.
- In this model, vaccinations to-date, global planned manufacturing capacity, and announced rollout strategies and contracts have been considered to create a base case estimate for the number of people who will be vaccinated each year in an initial wave and then receive booster shots later.
- The number of doses consumed per patient is expected to change as the mix of usage shifts between current vaccines, which are either one-dose or two-dose administrations, and then transitions to booster shots, which are expected to be given as one additional dose on a biennial basis.
- Because the effectiveness of current vaccines against new variants, as well as the duration of immunity, remains uncertain, it is expected that many people will need to receive new booster vaccinations in future years.

Exhibit Notes: Scenario modeling was conducted by the IQVIA institute based on public information as of March 25th, 2021. Estimates of future vaccination trends include input from the public statements of responsible agencies and manufacturers, as well as modeling by the IQVIA Institute. Estimates of cost per patient are based on assumptions of the number and mix of doses of available vaccines, the published prices, and IQVIA Institute estimates of the prevailing prices that will exist across geographies through 2025. As costs are based on public statements, they may overstate the true costs after negotiated discounts.

Global medicine spending will rebound in 2021 including COVID-19 vaccines and exceed the pre-pandemic outlook through 2025

Exhibit 8: Changes in the Historical and Projected Global Medicine Spending Model due to COVID-19, 2019–2025, US\$Bn



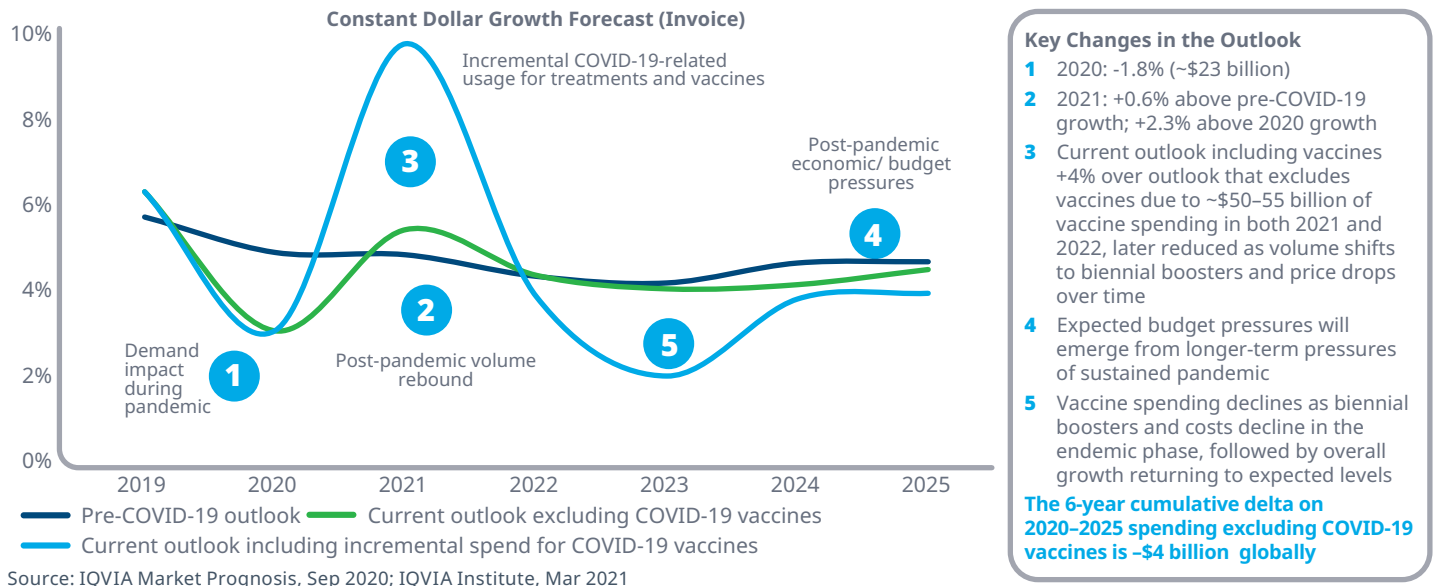
Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- The outlook for global medicine spending has shifted considerably in the years 2020 to 2022, but afterwards is expected to be largely similar to the pre-COVID outlook, excluding the spending for COVID-19 vaccines.
- As a result of lower spending in the near-term, spending is expected to be \$68 billion lower over six years to 2025 than it would have been without the pandemic, excluding the incremental spending on vaccines and therapeutics for COVID-19.
- The phased rollout of vaccines and booster shots in the base case estimate (see exhibit 7) will result in \$157 billion in incremental spending globally, resulting in a net impact on spending of \$88 billion, or about 2% of the cumulative global spend during that period.
- In the lower-bound vaccine scenario, spending of \$73 billion on vaccines could result from lower vaccination rates or lower prices and would likely have other impacts on non-vaccine spending, some driving increases, others contributing to lower spending and worse outcomes.
- A rapid first wave of vaccinations, reaching 70% of the world by the end of 2022, is possible with current manufacturing capacity estimates and would potentially cost \$104 billion, but would likely bring significant benefits to both the global economy and global health in ushering the unprecedented pandemic if not to a close, at least to endemic status.
- If vaccinations fail to reach herd immunity levels, it is likely that continued waves of infections and economic and health impacts will be felt for years to come.

Exhibit Notes: Estimates of pre-pandemic outlook are based on US\$ at variable exchange rates under the same ex-rate assumptions as the current non-COVID outlook. Neither outlook were modeled including COVID-19 vaccines and the estimates of vaccine spending are entirely incremental spending. Vaccine costs reflect medicine costs only and do not include costs from provider administration or government contributions to manufacturing or distribution costs. No confidential or proprietary information is included in these estimates.

Global market growth rates will return to pre-pandemic projections by 2025 despite year-to-year fluctuations

Exhibit 9: Comparison of Current Outlook to Pre-COVID-19 Outlook



- While the short-term impact from COVID-19 in 2020 and 2021 has been significant, the long-term impact on growth trends is more muted.
- Including estimates of higher spending growth from COVID-19 vaccines and lower spending from existing treatments due to disruptions from the pandemic, the five-year CAGR to 2025 is expected to be 4.6%, compared to 4.5% if the pandemic had not taken place.
- Perhaps the largest uncertainty in the next five years will be the potential impact of economic factors on countries' budgeting and whether there will be shifts in policies regarding healthcare and medicine spending.
- It is expected that the pricing and value of medicines will be under increased scrutiny during this period, but this was an event that was already underway in most developed markets and an increasingly key issue in the U.S. market.
- While the pandemic has dominated much of the past year, the wider trends on the use of medicines continue to evolve relatively unchanged, which offers some hope to the millions living in lower income markets, with their improved health situation largely a result of increased access to medicines.

Exhibit Notes: Pre-COVID outlook based on IQVIA Market Prognosis, Sept. 2019 edition. Current outlook based on IQVIA Market Prognosis Sept. 2020 edition. Incremental COVID vaccine scenario based on current outlook combined with incremental spending for vaccines.

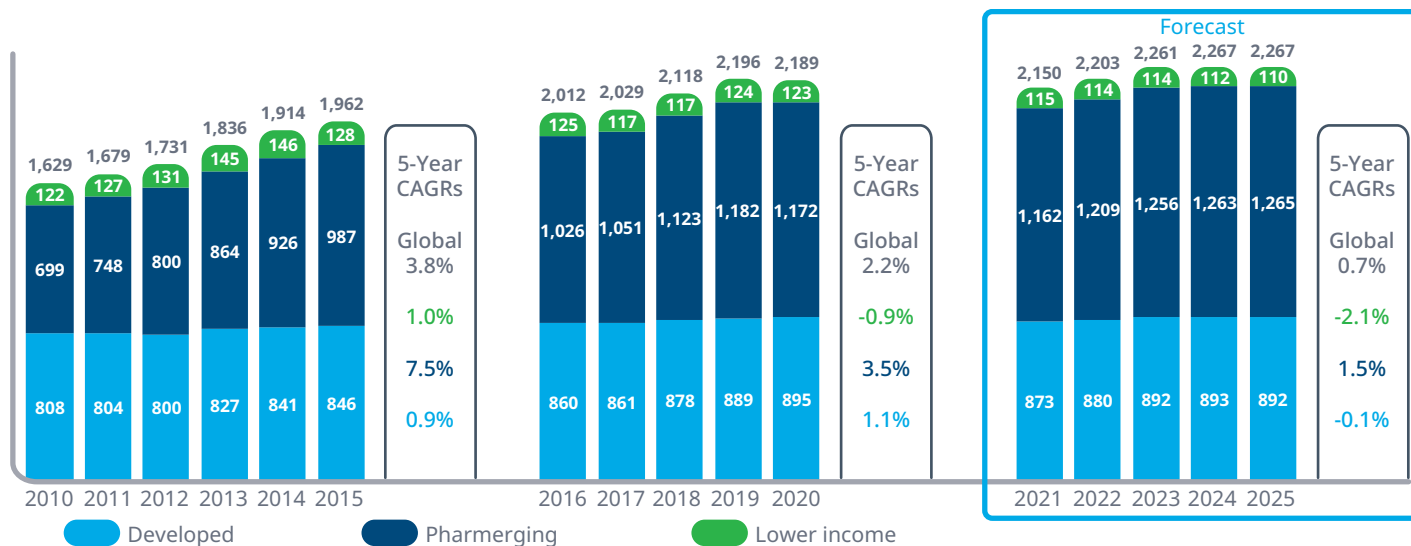
Historic drivers and outlook for the use of medicines

- Slowing growth in the use of medicines in pharmerging markets will drive global growth to less than 1% CAGR over the next 5 years.
 - Lower-income countries have dramatically lower access to medicine on a per capita basis. Access has been declining for the past five years and is projected to continue, potentially putting prior health improvements at risk.
 - Per capita use of medicines varies by national income with use in developed countries typically higher than in Pharmerging countries.
- Use of medicines increased in all major disease areas in pharmerging markets over the past decade, including a 30% CAGR in oncology
 - Developed countries have higher use of medicines in chronic diseases, which have the highest disease burden
 - Oncology has seen the largest relative rise in medicine use over the past decade in developed markets with a 14% CAGR.

Medicine use grew by one-third over the past decade, driven by expansion of healthcare access in pharmerging countries, but is projected to slow through 2025. Meanwhile gains in global health have been the greatest in the lowest income countries despite declining drug volumes.

Slowing growth in the use of medicines in pharmerging markets will drive global growth to less than 1% CAGR over the next 5 years

Exhibit 10: Historical and Projected Use of Medicine by Segment, 2010–2025, Defined Daily Doses (DDD) in Billions



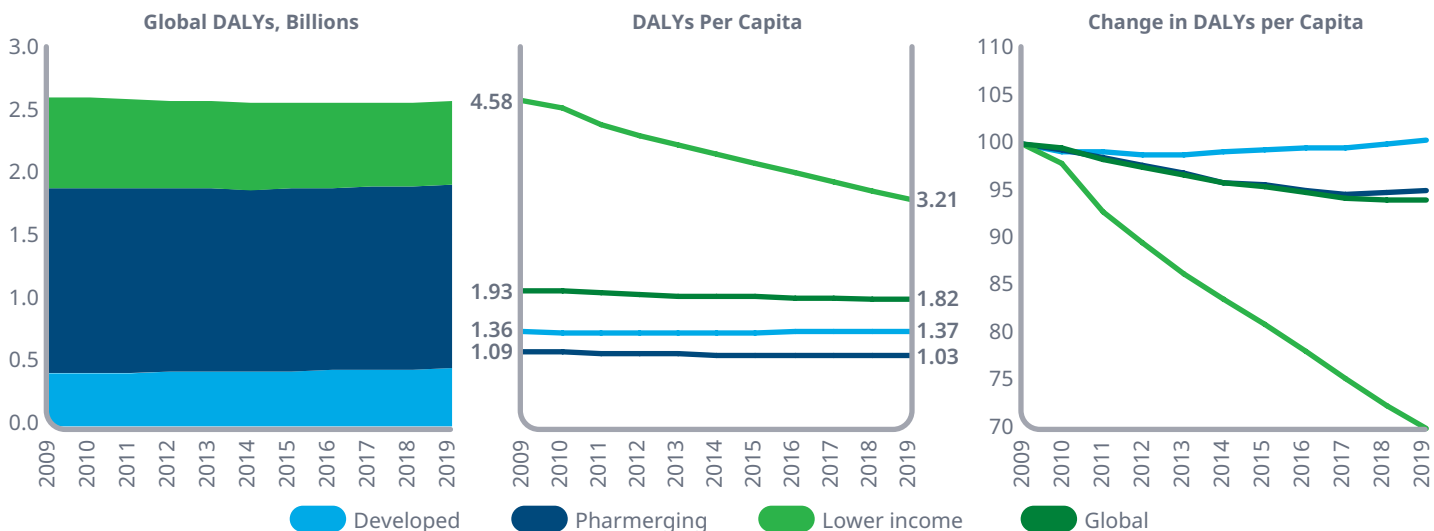
Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Jan 2021

- The global use of medicines — based on modeling medicine volumes shipped according to defined daily dose assumptions — has been growing for the past decade, driven by access expansions in pharmerging markets.
- Lower-income countries have dramatically lower access to medicine. Access has been declining for the past five years and is projected to continue, potentially putting health improvements at risk.
- It is important to interpret these trends with caution, as chronic diseases drive many days of therapy in developed and pharmerging markets, and treatments for them are often much less common in lower income countries.
- As health improves, not all medicine use is desirable and, for example, eradication of parasitic diseases could drive usage for related diseases down, which would be a desirable outcome.
- Most lower income countries are unaudited, however, and medicine use estimates are based on aggregate amounts of spending with no granular analysis possible.

Exhibit Notes: Chart represents IQVIA Institute estimates of global defined daily doses (DDD). These estimates are based on IQVIA audited data and application of WHO-DDD factors in IQVIA MIDAS as well as additional DDD calculation assumptions developed by the IQVIA Institute (see Methodology). For pharmerging and developed, see definitions. Lower income are based on the world bank income bands and include low and lower middle income countries, which are not otherwise included in pharmerging.

Lower income countries have had the largest decline in disease burden over the past decade but remain higher than other countries

Exhibit 11: Absolute, Per Capita, and Change in Per Capita Global Disability-Adjusted Life Years (DALYs), 2009–2019

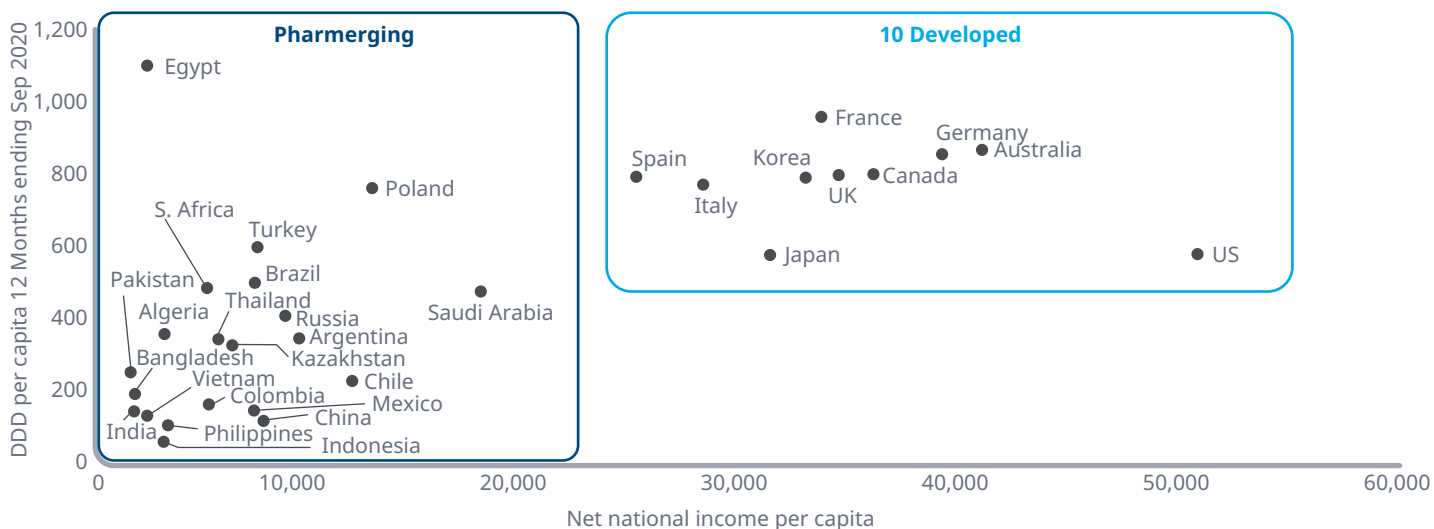


Source: IHME Global Burden of Disease 2019, accessed Feb 2021; The World Bank Country Income Bands

- As the volume of medicine use has increased over a sustained period, it becomes possible to correlate the shifts observed in the global burden of disease with the trends in medicine use.
- Overall, the disability adjusted life years lost to disease has declined dramatically in lower income countries where the DALY lost per capita declined from 4.58 in 2009 to 3.21 in 2019, the latest year of the study.
- DALYs were reduced 30% over ten years in lower income countries, as significant progress has been made in addressing several diseases through philanthropy and global health outreach by wealthier countries.
- A sustained period of global economic growth has also likely contributed to improvements in the lowest income countries, though they will remain exposed to risks as their economies are not equipped to weather disruptions such as the current pandemic.
- Disease burden has dropped 5% on a per capita basis in pharmerging markets over this 10-year period.
- Notably, the burden of disease is focused in dramatically different areas, with 70% of lower income country burden coming from poor nutrition, maternal and child health, injuries, and communicable diseases.
- Those causes represent only 17% in developed countries and 31% in pharmerging countries.

Per capita use of medicines varies by national income with use in developed countries typically higher than in pharmerging countries

Exhibit 12: Defined Daily Doses (DDD) Per Capita Compared to National Income Per Capita



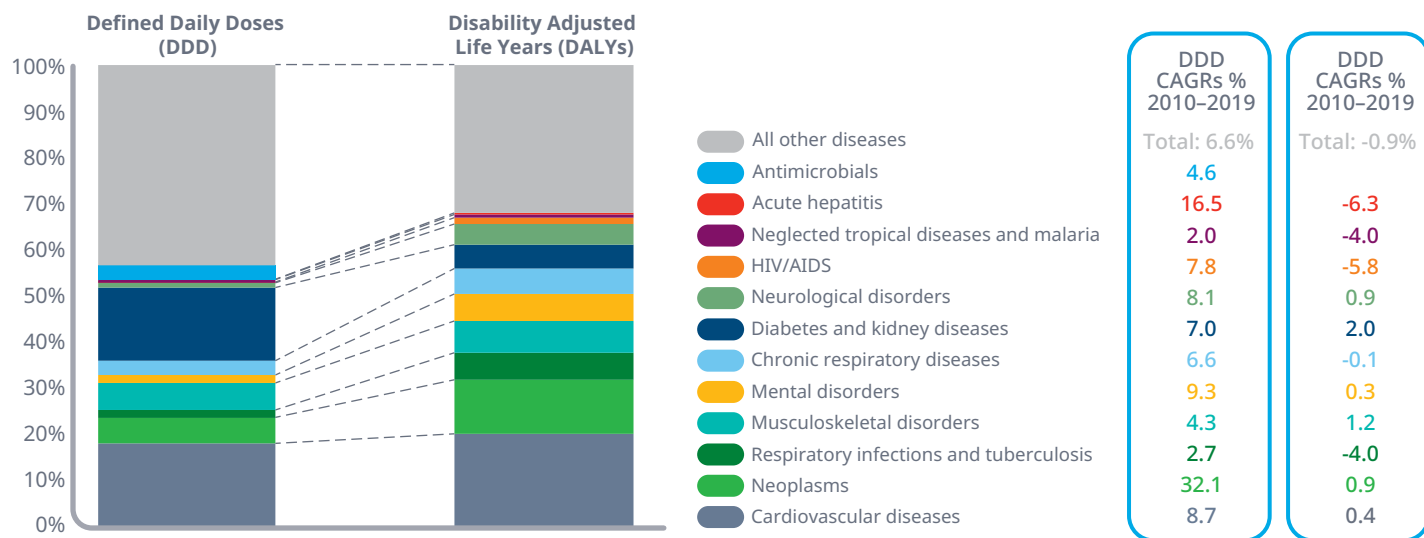
Source: IQVIA MIDAS, Sep 2020; IQVIA Institute, Jan 2021; The World Bank, Sep 2020; UN Statistics, Jan 2021

- The use of medicines varies considerably within both developed and pharmerging countries but includes some correlation to national income per capita.
- The correlation with income is weaker in developed markets because of the predominance of socialized medicine systems, whereas in pharmerging countries it is more common for patients to carry a larger share of the cost burden.
- As countries vary in the cost burden patients directly bear, there is some correlation in the way patients use medicine.
- Other factors include the disease burden patients face and the aspects of the health system they can readily access to begin using medicines for a specific disease.
- Life expectancy differences are also likely a factor, where some diseases more often affect the elderly.
- National environmental factors may also impact medicine use, for example where common parasitic infections are a driver of higher-than-average use of vitamin supplements in Egypt.

Exhibit Notes: Chart represents IQVIA Institute estimates of AUDITED COUNTRIES ONLY defined daily doses (DDD). These estimates are based on IQVIA audited data and application of WHO-DDD factors in IQVIA MIDAS as well as additional DDD calculation assumptions developed by the IQVIA Institute (see Methodology).

In pharmerging countries, medicine use is largely aligned with the burden of disease

Exhibit 13: Medicine Use and Disease Burden in Pharmerging Countries, 2019



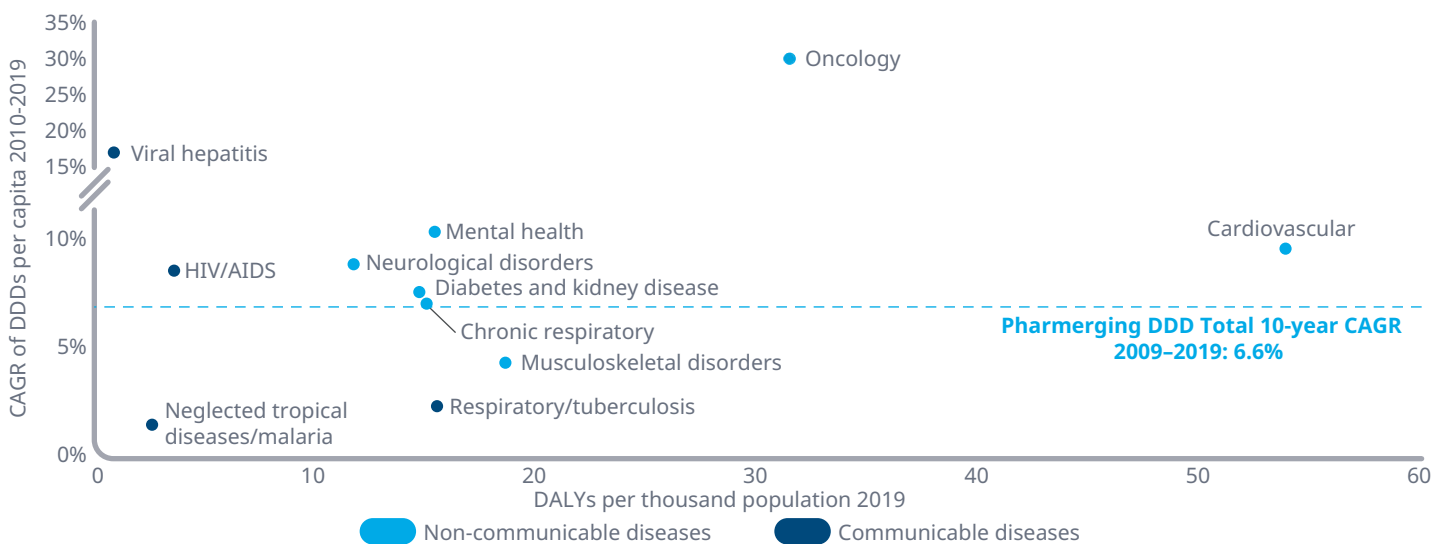
Source: IHME Global Burden of Disease 2019, accessed Feb 2021; IQVIA MIDAS, Sep 2020; IQVIA Institute, Jan 2021

- In comparing the burden of disease in pharmerging markets to the U.S. of medicines, it is notable that two of the largest areas of medicine use are cardiovascular and diabetes, which appear to contribute to those areas having a lower share of DALYs than they otherwise would.
- Medicine use for cancers (neoplasms) are a smaller share of treatment than DALYs, reflecting that access to cancer care may be lagging due to the combination of infrastructure requirements and potentially due to costs.
- Pharmerging markets do not include countries where many neglected tropical diseases are large burdens, contributing to this area being a small share of treatment and DALYs whereas it is a much larger share of DALYs in lower income countries, particularly in Africa.
- While there is not perfect alignment of the use of medicines to DALYs, the growth in medicine use over the past decade is impacting DALYs as the growth in medicine use consistently exceeds the growth in disease burden for the same disease areas.

Exhibit Notes: Chart represents IQVIA Institute estimates of pharmerging countries defined daily doses (DDD). These estimates are based on IQVIA audited data and application of WHO-DDD factors in IQVIA MIDAS as well as additional DDD calculation assumptions developed by the IQVIA Institute (see Methodology). For Pharmerging, see definitions.

Use of medicines increased in all major disease areas in pharmerging markets over the past decade, including 30% CAGR in oncology

Exhibit 14: Pharmerging Markets Selected Disease Areas DALY and DDD Change 2010–2019

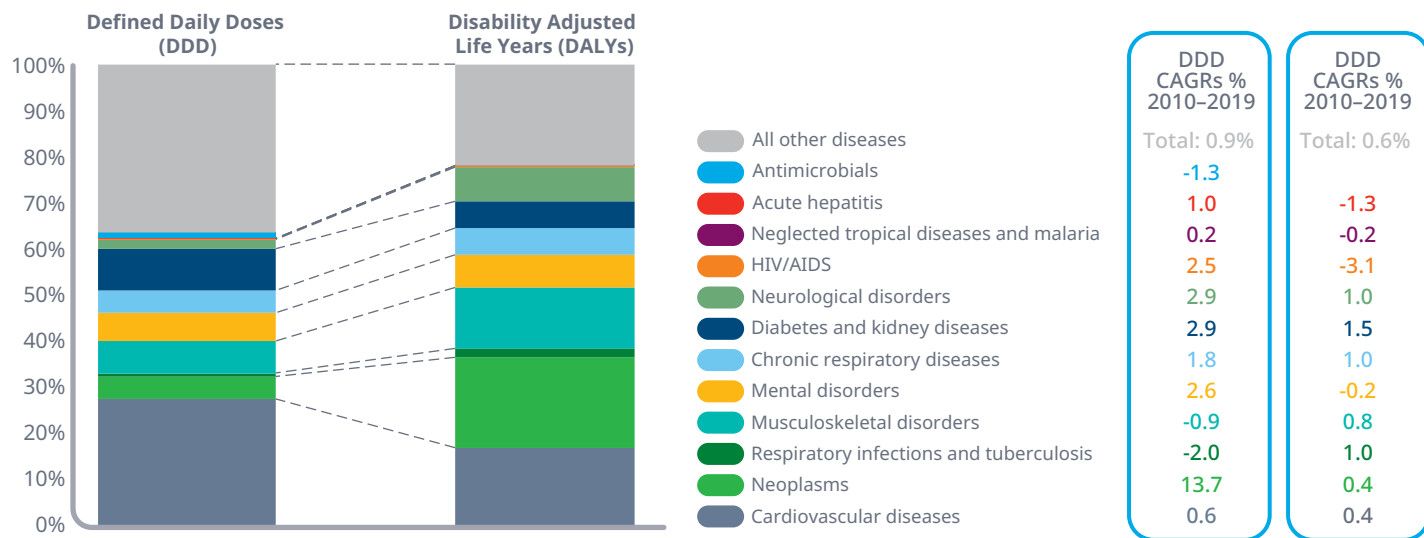


Source: IHME Global Burden of Disease 2019, accessed Feb 2021; IQVIA MIDAS, Sep 2020; IQVIA Institute, Jan 2021

- In pharmerging countries, the most common communicable diseases have seen falling DALYs as treatment levels have risen.
- Some areas have increased medicine use dramatically, especially oncology and viral hepatitis, driven by a focus on access to the large numbers of high-quality newer treatments in both areas.
- Viral hepatitis, including type A, B and C, has notably had dramatic improvements in the efficacy and tolerability of treatments over the past decade, and while the overall burden of disease is a smaller share in these countries, the use of functional cures will have widespread benefits for affected patients.
- Overall, significant progress is being made to address the burden of disease in pharmerging markets, largely through the steady expansion of access to healthcare and medicines.

Developed countries have higher use of medicines in chronic diseases, which have the highest disease burden

Exhibit 15: Developed Country Medicine Use and Disease Burden 2019



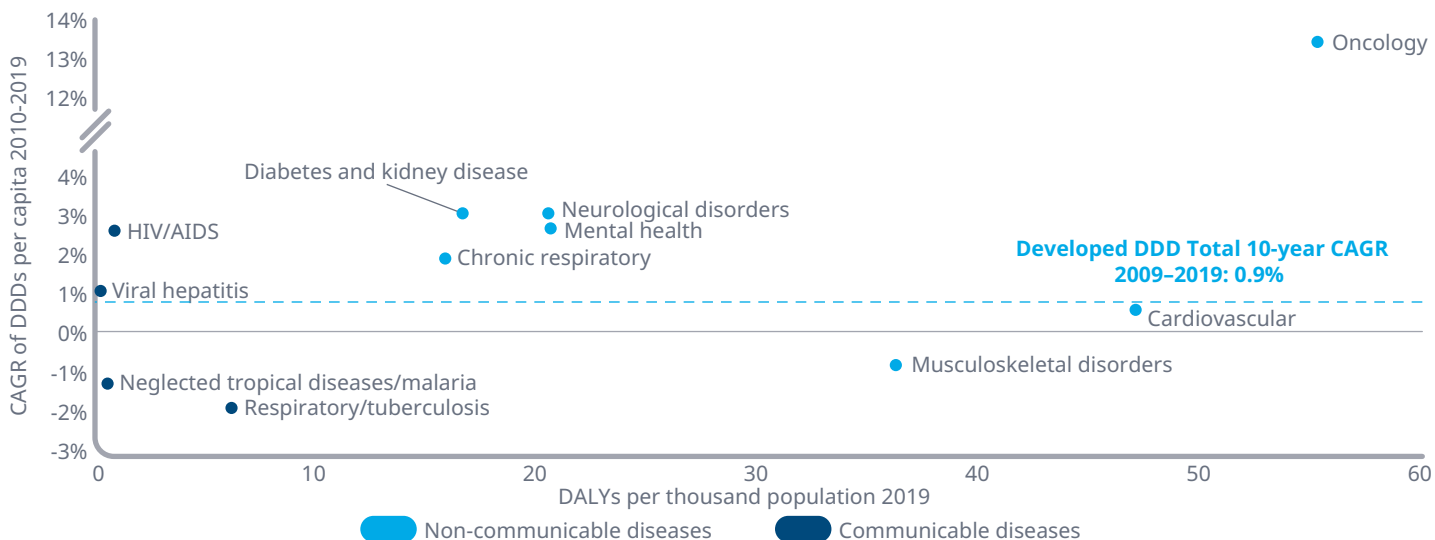
Source: IHME Global Burden of Disease 2019, accessed Feb 2021; IQVIA MIDAS, Sep 2020; IQVIA Institute, Jan 2021

- In developed markets, the management of large chronic populations with cardiovascular diseases, diabetes, respiratory, and mental health conditions is resulting in days of therapy increases averaging less than 1% overall and relatively consistent with the trends in the burden of disease.
- Some disease areas show the clear impact of changes in medicine use, such as viral hepatitis, where the 10-year CAGR in DDDs is 1.0% and DALYs have declined 1.3% per year over the same period.
- Oncology days of therapy have increased on average 13.7% per year while DALYs only increased by 0.4% per year, driven by the significant numbers of new oncology treatments, extended durations of therapy due to increased survival, and new treatment options

Exhibit Notes: Chart represents IQVIA Institute estimates of developed markets defined daily doses (DDD). These estimates are based on IQVIA audited data and application of WHO-DDD factors in IQVIA MIDAS as well as additional DDD calculation assumptions developed by the IQVIA Institute (see Methodology). Analysis based on ten developed countries with largest pharmaceutical spending.

In developed countries, oncology has the greatest burden of disease and of related medicines has increased at a 14% CAGR

Exhibit 16: Changes in DALYs and DDDs in 10 Developed Markets and Selected Disease Areas 2010–2019



Source: IHME Global Burden of Disease 2019, accessed Feb 2021; IQVIA MIDAS, Sep 2020; IQVIA Institute, Jan 2021

- The most dramatic change in medicine use and disease burden in developed markets has been in oncology.
- In oncology, the disease burden is so large partly because of the prevalence of pediatric cancers, where a child’s death will account for a full lifetime lost, while other drivers of cancer DALYs are the high mortality rates for some tumors affecting adults.
- The improvements in cancer care have dramatically improved the survival and quality of life for many cancer patients with some tumors, while others remain significant challenges.

Spending and growth by regions and key countries

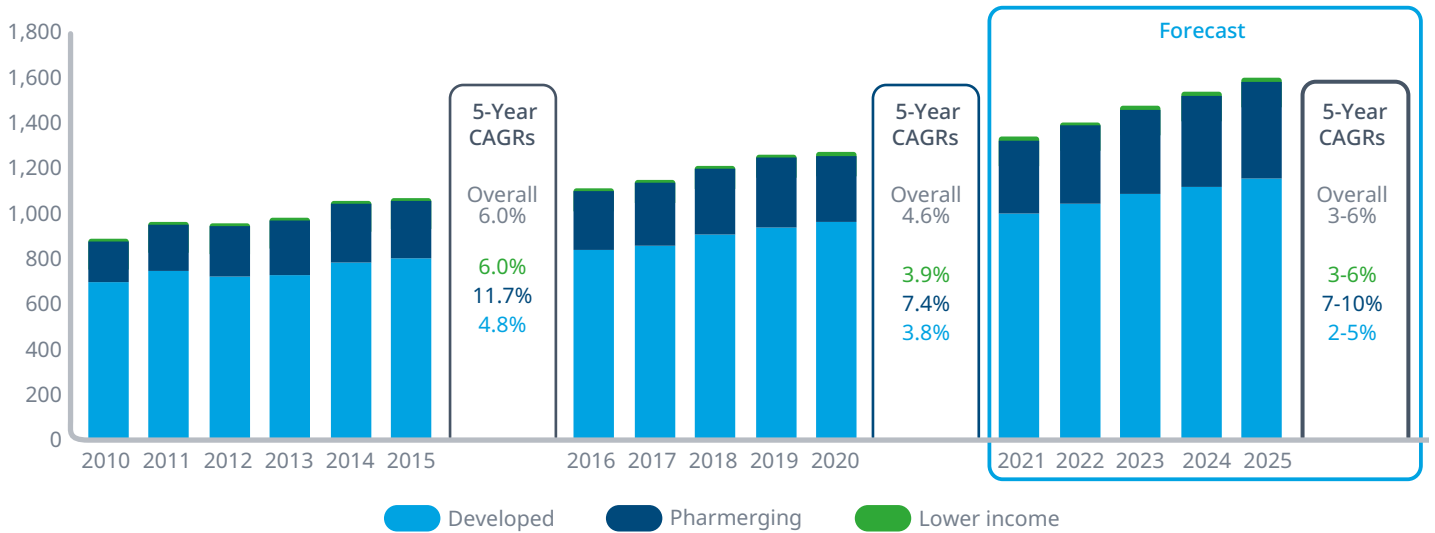
- The global medicine market — using invoice price levels — is expected to grow at 3–6% CAGR through 2025, reaching about \$1.6 trillion in total market size.
- The COVID-19 impact in ten developed markets varies but a return to steady low single digit growth is projected after 2021.
- The U.S. market, on a net price basis, is forecast to grow 0–3% CAGR over the next 5 years, down from 3% CAGR for the past 5 years.
- Japan medicine spending is forecast to decline slightly through 2025 due to continued biennial price cuts and a shift to generics.
- Spending in Europe is expected to increase by \$35 billion through 2025 with a focus on generics and biosimilars.
- Spending growth in China is expected to accelerate post-COVID driven by greater uptake and use of new original medicines.

Growth in developed economies continues at relatively steady rates with new products offset by patent expiries; Pharmerging countries access-expansion driven growth is being augmented in some markets with greater use of newer original branded products.

SPENDING AND GROWTH BY REGIONS AND KEY COUNTRIES

The global medicine market — using invoice price levels — is expected to grow at 3–6% CAGR through 2025, to about \$1.6 trillion

Exhibit 17: Global Medicine Market Size and Growth 2010–2025, Const US\$Bn



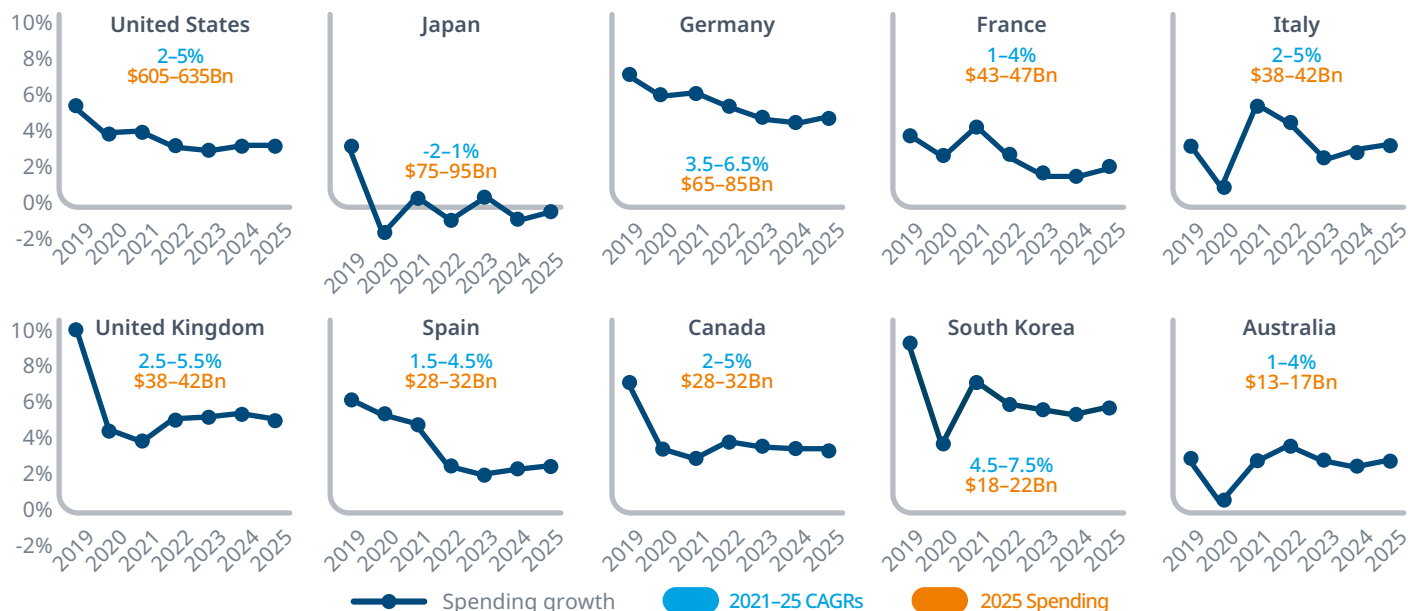
Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- Global medicine spending — the amount spent purchasing medicines from manufacturers before off-invoice discounts and rebates — is expected to reach \$1.6 trillion by 2025, increasing at a rate of 3–6% per year.
- This outlook is excluding the separate impact of spending on COVID-19 vaccines modeled separately (see exhibits 7 and 8).
- Developed countries — those with upper middle or high incomes — are expected to grow from 2–5% through 2025, similar by comparison to the past five years.
- The past five years had similar growth globally but had slower contribution from pharmerging and lower income countries than earlier in the decade.
- The differing impact of the COVID-19 pandemic across countries has affected 2020 spending and is expected to impact growth through 2022 before returning to historic patterns.

Exhibit Notes: Does not include estimates for COVID-19 vaccines. Spending is in US\$ with variable exchange rates, CAGR in constant US\$ with Q2 2020 exchange rates. Lower income is low or lower middle income based on the World Bank (TWB) income bands, but excluding some pharmerging, which have higher incomes and are shown separately.

The COVID-19 impact in ten developed markets varies but a return to steady low single digit growth is projected after 2021

Exhibit 18: Spending Growth in Ten Developed Countries, Total Market, Const US\$ 2019–2025



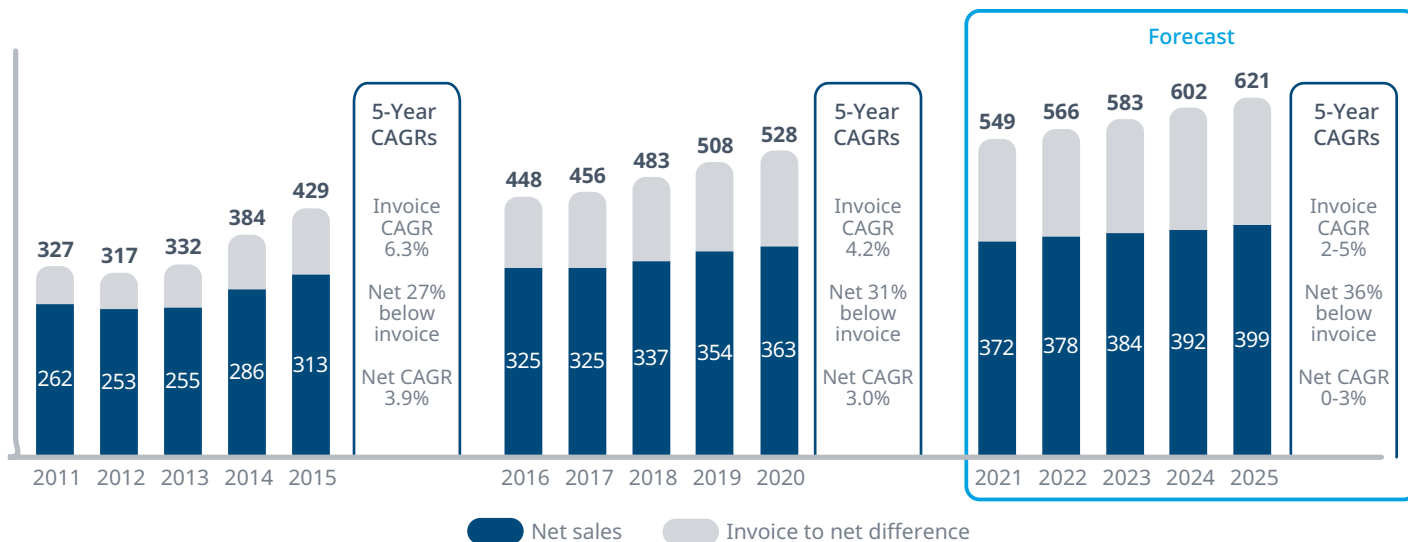
Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- Medicine spending trends differed significantly by country prior to the COVID-19 pandemic and the disruptions in 2020 and rebounds afterwards are expected to evolve differently as well.
- The U.S. remains remarkably resilient in spending trends, registering negligible slowdown in the trend compared to previous expectations and a continued 2–5%, five-year CAGR to 2025.
- Japan’s sharp decline in 2020 was a result of the April 2020 biennial price-cut coinciding with disruptions from the pandemic.
- Other countries such as Germany, France and Spain had more modest impacts on spending in 2020 and are projected to rebound in 2021 as they return to normal trends.
- Italy, the most impacted country early in the pandemic and the first to experience additional waves, has had some of the greatest impacts from the pandemic and is expected to take longer to return to normal trends.

SPENDING AND GROWTH BY REGIONS AND KEY COUNTRIES

The U.S. market, on a net price basis, is forecast to grow 0–3% CAGR over the next 5 years, down from 3% CAGR for the past 5 years

Exhibit 19: U.S. Medicine Spending and CAGR Growth at Invoice-Level and Estimated Net 2011–2025



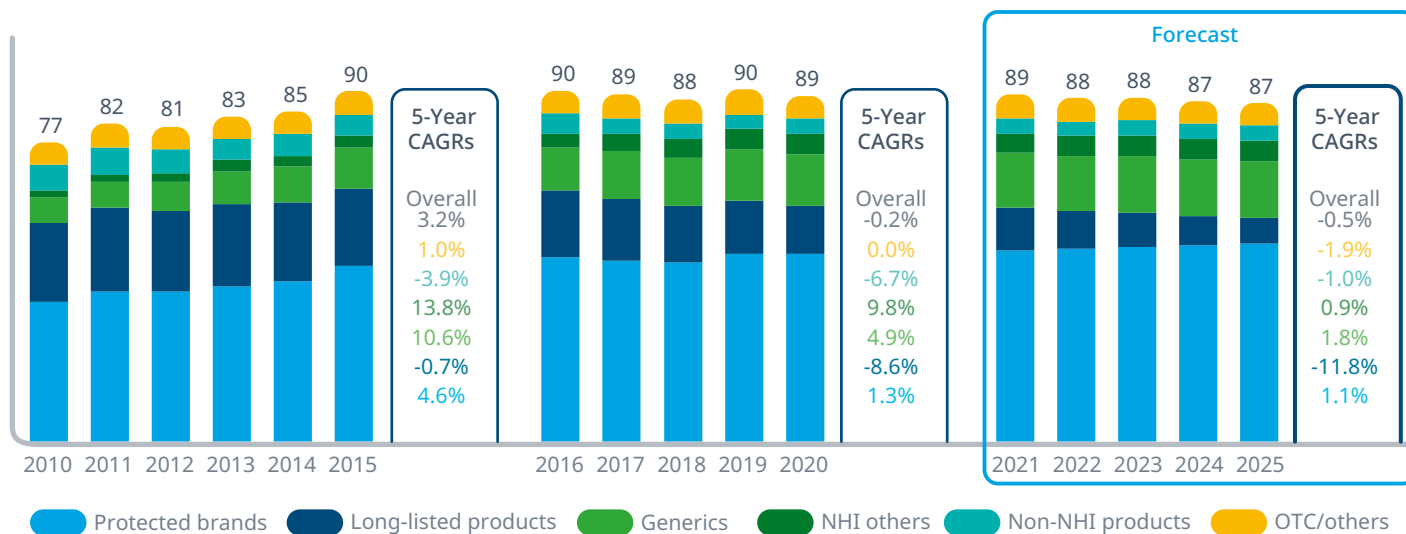
Source: IQVIA Institute, Feb 2021

- Spending at net levels in the U.S. is projected to grow at 0–3% as rising off-invoice discounts and rebates are expected to slow spending growth over time.
- The fragmented payer environment in the U.S. includes a range of stakeholders who receive off-invoice discounts and rebates, including statutory discounts and rebates for the government, negotiated rebates by pharmacy benefit managers and insurers as well as discounts negotiated by purchasers, and coupons used by patients.
- In total, these off-invoice discounts and rebates result in spending that is estimated at 31% lower than invoice level in 2020 and projected to be 36% lower than invoice level in 2025.
- In addition to discounts and rebates, ongoing market dynamics around the use of medicines, the adoption of newer treatments, the impact of patent expiries, and new generic or biosimilar competition will all contribute to historically slow market growth in the U.S. for the next five years.

Exhibit Notes: Estimates of net manufacturer sales are based on analysis by the IQVIA institute from public sources combined with IQVIA's audited invoice-level data (see Methodology).

Japan medicine spending is forecast to decline slightly through 2025 due to continued biennial price cuts and a shift to generics

Exhibit 20: Japan Medicine Spending by Product Type 2010–2025, Constant US\$Bn



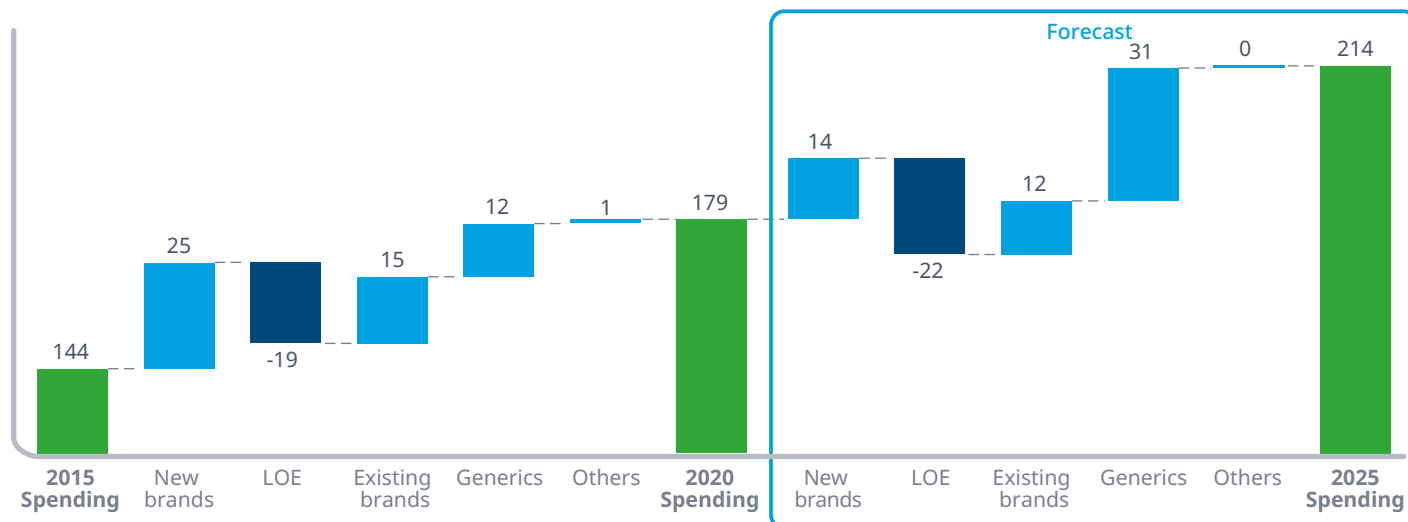
Source: IQVIA Market Prognosis, Sep 2020; IQVIA Japan, Dec 2020; IQVIA Institute, Mar 2021

- Slowing growth in 2020 was a result of both the COVID-19 pandemic and the price-cut year, which took effect in April 2020.
- Uniquely, Japan has a government-mandated drug pricing system that sets prices at launch and implements price cuts every other year, effective in April.
- Additionally, the price cut policies apply differently to protected brands than they do to so-called long-listed products, meaning those that have been marketed longer than a patent life.
- Over the past decade, protected brands share of spending has risen from 47% to 54%, reversing a long historical trend where share would decline over time.
- The previous pricing policies coincided with years where new medicines would launch many years later in Japan than in other countries, but over the past five years many new medicines launch less than two years after a global launch, bringing new medicines much sooner.
- Long-listed products have declined from 27% of spending in 2010 to 14% in 2020 and are expected to drop to 8% by 2025.
- Generic share of spending is also expected to rise, supported by policies that have been largely effective over this entire 15-year period, encouraging doctors to substitute available generics with a combination of incentives and penalties.

Exhibit Notes: Medicine spending at ex-manufacturer level, segmented according to Japan-specific product types which differ, from segmentations used elsewhere in this report.

Spending in Europe is expected to increase by \$35 billion through 2025 with a focus on generics and biosimilars

Exhibit 21: Spending and Growth Drivers in France, Germany, Italy, Spain, and UK 2015–2025, Const US\$Bn



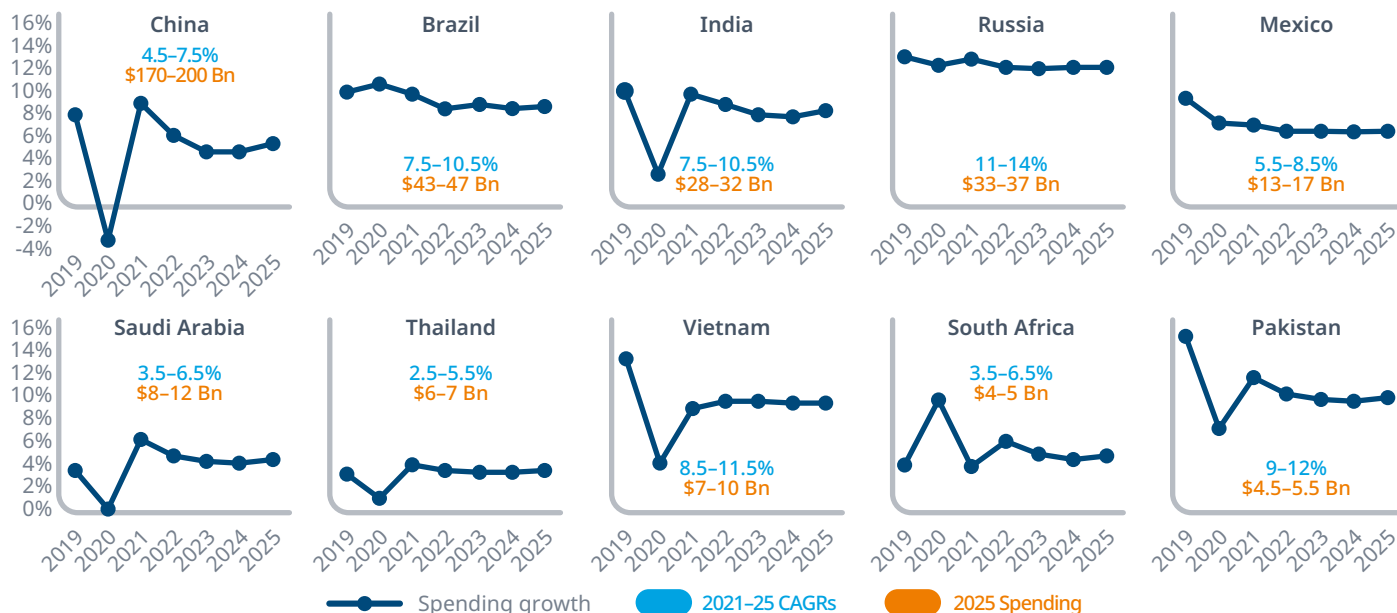
Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- Medicine spending in the top five European markets is expected to increase by \$35 billion over the next five years, the same increase as in the past five years but with large shifts in the drivers of growth.
- While new brands were the largest driver of growth from 2015 to 2020, they are expected to contribute less in the next five years.
- Generics, including biosimilars, are expected to add over \$31 billion in growth over the next five years, more than double the contribution in the past five years, as a range of patent expiries, and the maturation of biosimilars contribute to lower spending overall.
- Innovation had been expected to be significantly strong in the next five years, but adoption of newer medicines will be slowed by the disruptions to industry promotional activity from the pandemic and greater scrutiny of the value of new medicines in the form of health technology assessments.
- Payer actions will be shaped by the pace of economic and COVID recovery and may be more impactful later in the forecast.

Exhibit Notes: Spending in US\$ with constant Q2 2020 exchange rates. New brands growth contribution defined as the growth during periods when products had been marketed for less than two years. Existing brands are those which are no longer new and not yet off-patent. Off-patent brands have faced Loss of Exclusivity (LOE). Generics includes non-original branded products or 'branded generics' as well as biosimilars.

COVID-19 impact on the pharmerging markets in 2020 and 2021 varies considerably but steady single-digit growth is projected after 2021

Exhibit 22: Spending Growth in Select Pharmerging Countries 2019–2025, Total Market, Const US\$

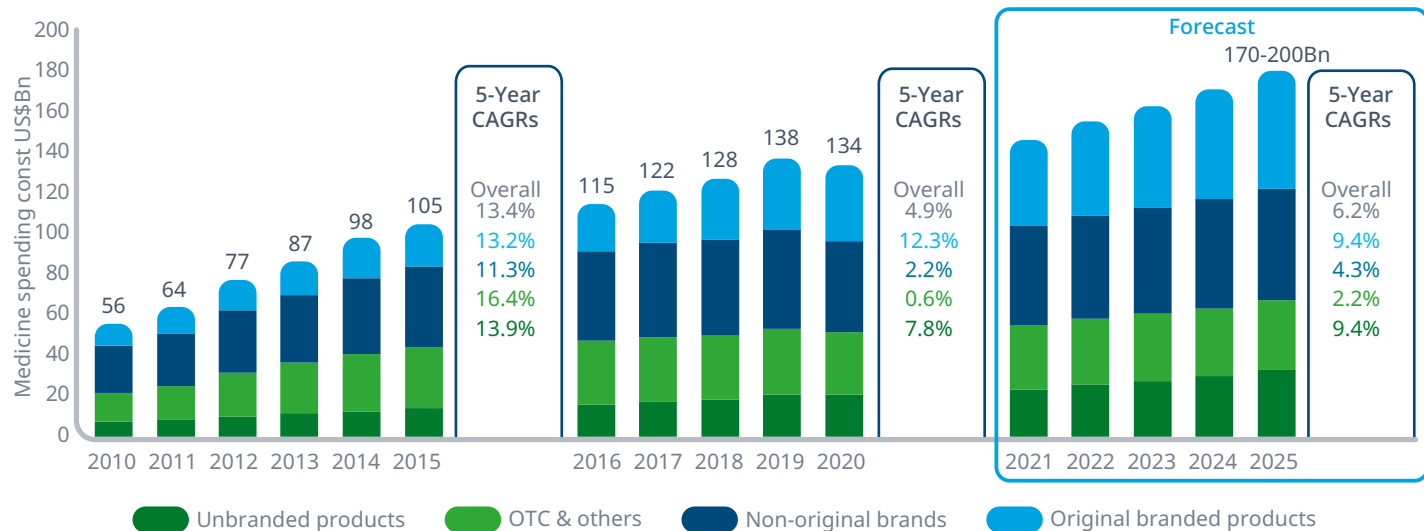


Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- The impact of the pandemic on medicine spending growth has been significant in some pharmerging countries including China, where growth dropped from 8% to -3% in a single year before a projected rebound in 2021.
- Brazil’s spending growth is expected to remain robust; however, it was later than many countries to enter the pandemic, has had some of the highest per capita rates of infections globally and may see impacts to medicine spending in the next few years.
- Across pharmerging markets of varying levels of total spending, relatively high rates of growth belie the relatively low levels of per capita medicine use, and provided there are mechanisms to pay for treatment, patients have continued to seek care and use medicines in increasing numbers.
- China’s growth remains the largest driver of this group of countries and is being driven by a shift in the types of products being used, with spending being driven by new medicines to a greater degree than the very common traditional Chinese medicines.

Spending growth in China is expected to accelerate post-COVID, driven by greater uptake and use of new original medicines

Exhibit 23: China Medicine Spending by Product Type 2010–2025



Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- Medicine spending in China has risen from \$56 billion in 2010 to \$138 billion in 2019, dipping to \$134 billion in 2020 due to COVID.
- Over the past five years spending growth was driven by original branded products, most often from multinational companies, which grew at an average of 12.3% per year to reach 28% of spending in 2020, up from 20% five years earlier.
- Over the next five years, the government policies to update the national reimbursement drug list (NRDL) more frequently is contributing to a greater share of new original medicines being reimbursed, resulting in higher levels of spending.
- Over the next five years original brands and generics will each grow by more than 9% per year, while other types of products will grow at less than half that rate.
- By 2025, China is projected to exceed \$170 billion, an increase of almost \$50 billion in the next five years.

Exhibit Notes: Original brands are those marketed by their originator (or licensed partner) and includes vaccine products by all manufacturers. Analysis does not include COVID-19 vaccines.

Almost all countries are expected to have a lower growth rate through 2025 than in the past 5 years

Exhibit 24: Global Invoice Spending and Growth in Selected Countries

	2020 SPENDING US\$BN	2016–2020 CAGR	2025 SPENDING US\$BN	2021–2025 CAGR
Global	1,265.2	4.6%	\$1580–1610	3–6%
Developed	959.5	3.8%	\$1130–1160	1.5–4.5%
10 Developed	847.2	3.8%	\$990–1020	1.5–4.5%
United States	527.8	4.2%	\$605–635	2–5%
Japan	88.2	-0.2%	\$75–95	-2–1%
EU5	180.4	4.4%	\$215–245	2–5%
Germany	54.9	5.3%	\$65–85	3.5–6.5%
France	36.3	2.4%	\$43–47	1–4%
Italy	33.3	4.2%	\$38–42	2–5%
United Kingdom	30.2	5.3%	\$38–42	2.5–5.5%
Spain	25.7	4.6%	\$28–32	1.5–4.5%
Canada	22.8	4.8%	\$28–32	2–5%
South Korea	16.2	6.8%	\$18–22	4.5–7.5%
Australia	11.8	3.3%	\$13–17	1–4%
Other Developed	112.3	4.2%	\$125–155	2.5–5.5%
Pharmerging	290.8	7.4%	\$415–445	7–10%
China	134.4	4.9%	\$170–200	4.5–7.5%
Brazil	28.7	10.7%	\$43–47	7.5–10.5%
Russia	17.5	10.8%	\$33–37	11–14%
India	21.1	9.5%	\$28–32	7.5–10.5%
Other Pharmerging	89.1	9.6%	\$120–150	8.5–11.5%
Lower Income Countries	15.0	3.9%	\$18–22	3–6%

Source: IQVIA Market Prognosis, Sep 2019; IQVIA Institute, Dec 2019

- Spending across major pharmerging markets is expected to grow 7–10% CAGR through 2025, driven by the largest countries — China, Brazil, India and Russia — but generally outperformed by smaller pharmerging markets, which are growing at a rate of 8.5–11.5% over the same period.
- In the next five years, global spending will increase by nearly \$350 billion, lifting spending to nearly \$1.6 trillion in 2025, with most of the increase from developed countries, despite their lower rates of growth.

Exhibit Notes: Spending in US\$Bn, CAGR = Compound Annual Growth Rate using Constant US\$ with Q2 2020 exchange rates.

Pharmerging, Developed and Lower Income Countries are defined based on a mix of national income and pharmaceutical market dynamics, see definitions.

SPENDING AND GROWTH BY REGIONS AND KEY COUNTRIES

While the top four developed markets retain their global ranking, others lose position relative to faster growth emerging markets

Exhibit 25: Global Top 20 Countries, Ranking and Invoice Spending Relative to the United States

RANK	2015	% OF U.S. SPENDING	RANK	2020	% OF U.S. SPENDING	RANK	2025	% OF U.S. SPENDING
1	United States	100.0%	1	United States	100.0%	1	United States	100.0%
2	China	24.6%	2	China	25.4%	2	China	29.2%
3	Japan	20.9%	3	Japan	16.8%	3	Japan	14.0%
4	Germany	9.8%	4	Germany	10.3%	4	Germany	11.1%
5	France	7.5%	5	France	6.8%	5	Brazil	6.7%
6	Italy	6.3%	6	Italy	6.3%	6	France	6.5%
7	United Kingdom	5.4%	7	United Kingdom	5.7%	7	Italy	6.3%
8	Spain	4.7%	8	Brazil	5.1%	8	United Kingdom	5.9%
9	Canada	4.1%	9	Spain	4.8%	9	India	5.2%
10	Brazil	3.8%	10	Canada	4.3%	10	Russian Federat.	5.0%
11	India	3.1%	11	India	4.0%	11	Spain	4.8%
12	South Korea	2.7%	12	Russian Federat.	3.3%	12	Canada	4.3%
13	Russian Federat.	2.4%	13	South Korea	3.0%	13	South Korea	3.4%
14	Australia	2.3%	14	Australia	2.2%	14	Turkey	2.6%
15	Saudi Arabia	1.6%	15	Mexico	1.9%	15	Mexico	2.2%
16	Mexico	1.6%	16	Saudi Arabia	1.6%	16	Australia	2.1%
17	Poland	1.4%	17	Poland	1.5%	17	Saudi Arabia	1.8%
18	Switzerland	1.3%	18	Turkey	1.5%	18	Poland	1.6%
19	Belgium	1.3%	19	Belgium	1.4%	19	Belgium	1.6%
20	Netherlands	1.2%	20	Taiwan	1.3%	20	Egypt	1.5%

Change in ranking over prior five years

Source: IQVIA Market Prognosis, Sep 2020

- Over the past 10 years, the relative spending of countries has shifted; generally, pharmerging countries have risen while slower-growing, developed markets have dropped.
- In 2010, China was the third-ranked global market, rising to second in 2015 when it was 25% the size of the U.S., and with sustained growth through 2025 it is projected to be 29% the size of the U.S. on an invoice-basis.

Exhibit Notes: Rankings using constant US\$ with Q2 2020 exchange rates, except Argentina, using US\$ due to hyperinflation. Country spending percentage of the level in the U.S. using the same currency as rankings.

Spending and growth drivers by product type

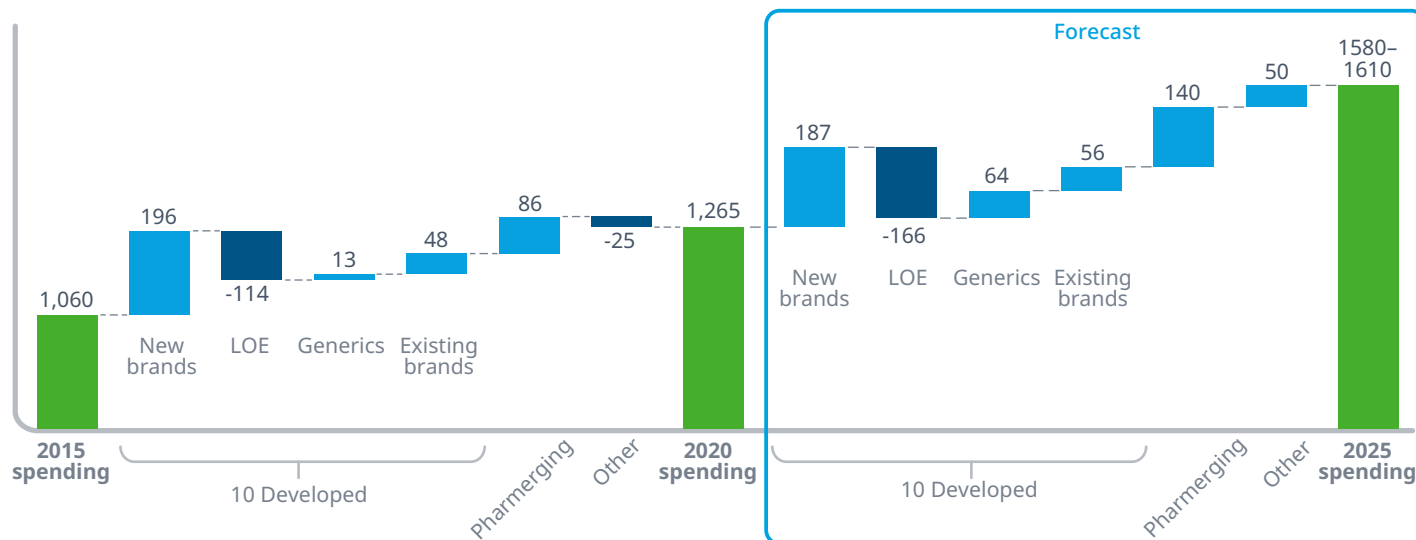
- Growth in Global Medicine Spending will be lifted by stronger pharmerging market growth through 2025 and offset by developed market losses of exclusivity for original brands.
- New Brand Spending in developed markets Projected to be Similar to the Last Five Years but Represent a Smaller Share of Spending.
- Global new active substances (NAS) launches are projected at an average of 54–63 per year, totaling 290–315 for five years through 2025. The last five years averaged 52 per year.
- The impact of exclusivity losses will increase to \$166 billion over the next 5 years mostly due to the availability of biosimilars.
- Global savings from biosimilars will have a significant impact on country medicine spending through 2025, estimated at a cumulative \$285 billion below estimates of spending without biosimilars.
- Specialty medicines will represent nearly half of global spending in 2025 and almost 60% of total spending in Developed markets.

Pharmerging markets will grow through continued access expansion and wider use of more novel medicines in those countries, while in developed markets, new medicines that are increasingly specialty, niche and rare-disease-focused will drive growth and be offset by declining costs in older medicines.

SPENDING AND GROWTH DRIVERS BY PRODUCT TYPE

Stronger growth in pharmerging markets will lift global medicine spending through 2025, offset by developed market LOEs

Exhibit 26: Spending and Growth Drivers 2015–2025 Const US\$BN



Source: IQVIA Institute, Feb 2021; IQVIA Market Prognosis, Sep 2020

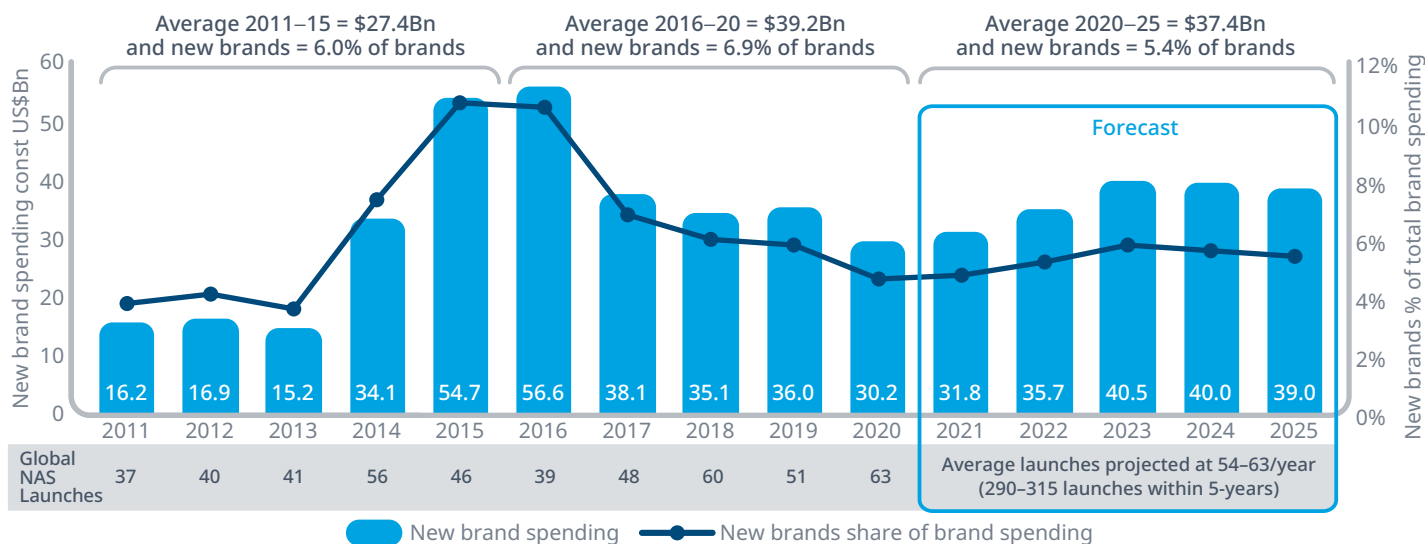
- Global medicine spending continues to increase, with most driven by new medicines, increasing \$187 billion over the next five years compared to \$196 billion over the past five.
- Losses of exclusivity are expected to be significantly higher through 2025 than the past five years, contributing to overall slowing growth.
- Generic spending growth contribution is typically muted as volume increases are offset by price deflation, but the influx and maturation of biosimilars, particularly in the U.S., is expected to result in higher absolute growth.
- Pharmerging growth is expected to accelerate through 2025, driving an increase of nearly \$140 billion in global spending.

Exhibit Notes: LOE (loss of exclusivity) includes small molecules and biologics; other includes rest of world and OTC/other products in developed markets and ex-rate impact. Year values shown in US\$ with historic and forecast exchange rates; growth in constant US\$. Ex-rate impact -\$48Bn for 2016-20, +25bn for 2021-25.

SPENDING AND GROWTH DRIVERS BY PRODUCT TYPE

New brand spending in developed markets projected to be similar to the last five years but represent a smaller share of spending

Exhibit 27: Ten Developed Countries New Brand Spending



Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Feb 2021

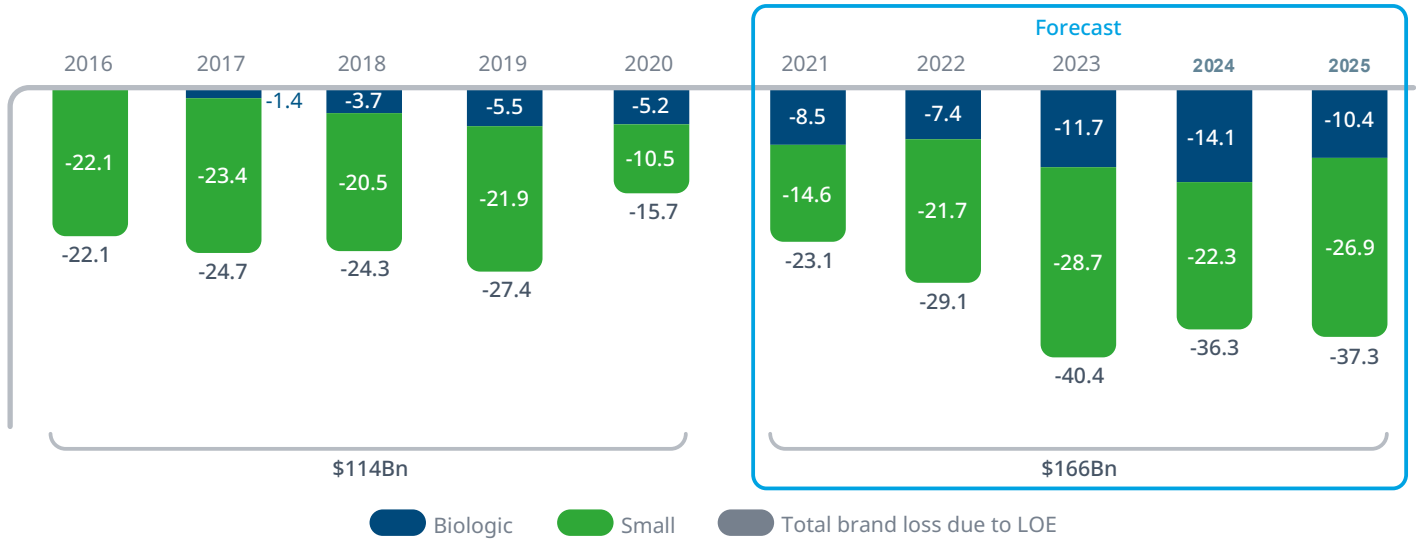
- Medicine spending on new branded products is the largest driver of increased spending growth globally and is expected to add \$187 billion to spending over the next five years.
- Annual average spending for new brands is expected to drop compared to the last five years as the outlook includes fewer outlier events, notably not including the spending expectations for COVID-19 vaccines (see exhibit 7).
- Over the next five years, an average of 54–63 new active substances (NAS) are expected to launch globally per year, totaling 290–315 over five years.
- In the past five years there were an average of 52 NAS launches per year, totaling 261 over five years and representing a significant increase over 2011–2015 when it was 220.
- The continuing increases in the numbers of actively researched compounds is expected to contribute a rising number of new medicines, albeit a group of products becoming more specialty, niche and related to rare diseases.
- The combination of payer concerns about spending trends in the post-COVID environment and the types of products launching will result in trends to lower spending per launch and an average \$37.4 billion spending on new products per year, down nearly \$2 billion from the average in the last five years.

Exhibit Notes: Developed markets include: U.S., Japan, Germany, France, Italy, UK, Spain, Canada, S. Korea, Australia. New brands defined as those launched less than two years previously, measured separately in each country as launches of the same products at different times.

SPENDING AND GROWTH DRIVERS BY PRODUCT TYPE

The impact of exclusivity losses will increase to \$166 billion over the next 5 years mostly due to the availability of biosimilars

Exhibit 28: Developed Markets Impact of Brand Losses of Exclusivity 2016–2025, US\$Bn



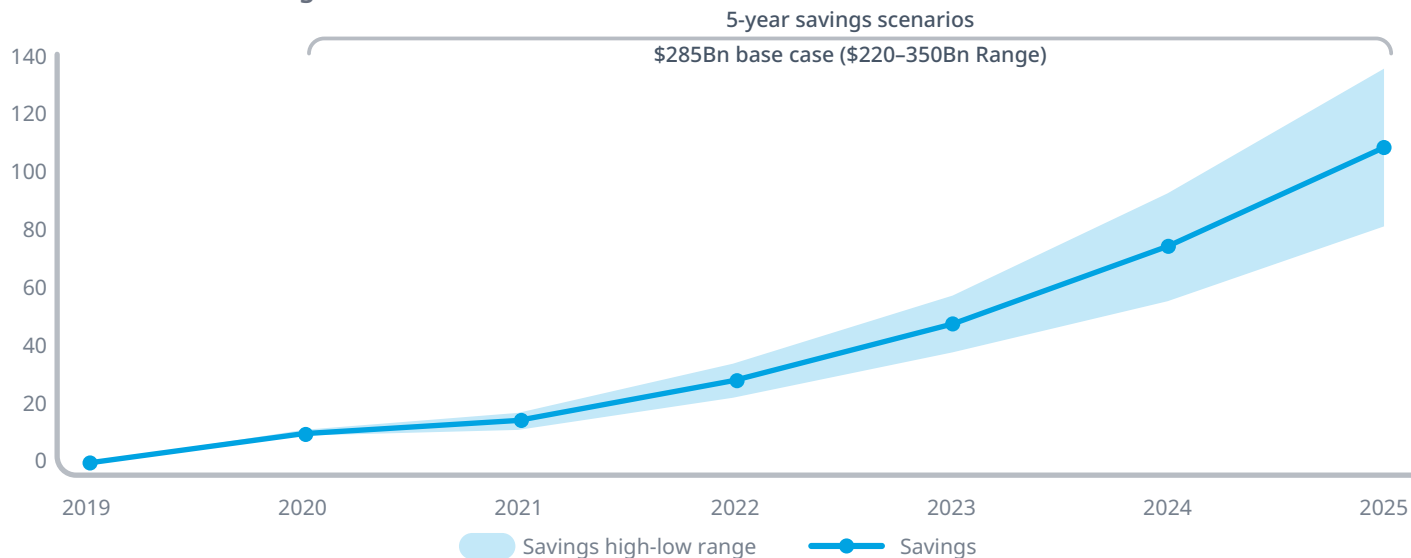
Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Feb 2021

- The ongoing flow of innovation and the lagged savings as those medicines face competition and become cheaper has continued to reward innovators and challengers alike.
- The last five years represent a relative lull in the impact of LOE, contributing only \$114 billion in lower brand spending over the period as relatively few of the largest selling products faced LOE during the period, and notably by contrast to the so-called patent cliff of 2011 and 2012.
- In the next five years the impact of LOE is expected to be \$166 billion, and while it will be offset by the spending on associated generics and biosimilars, the savings to healthcare systems and patients in the next five years will be significant.
- The introduction of regulatory frameworks for biosimilars over the past 15 years has finally begun to contribute to systemic savings in a tangible way, and 2020, in particular, contributed a significant boost in biosimilar impact from the U.S. for the first time.
- In the next five years, biologics will see \$52 billion in lower brand spending, compared to \$15.8 billion in the past five.
- Small molecules, by contrast, lost \$98 billion in the past five years and are projected to lose \$114 billion through 2025.

Exhibit Notes: Does not reflect offsetting spending increases from generic or biosimilar competitors. Losses in future periods are modeled based on expected pre-expiry growth for the brand and subsequent post-expiry loss of sales for the brands. The rates of loss are based on historic averages in each country and inclusive of adjustments for products with expiries in progress from historic periods where losses extend into the forecast periods. Historic period analyses are based on audited data. Expected loss of exclusivity dates are highly variable and can change due to outcomes of litigation, granting of new patents or changes in the expectation of launch of biosimilars. Information is current as of January 2021.

Global savings from biosimilars will have a significant impact on country medicine spending through 2025

Exhibit 29: Global Savings from Biosimilars



Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- Savings from biosimilars are expected to be a cumulative \$285 billion globally from 2020 to 2025.
- This measures the difference between a biologic spending forecast that reflects expected biosimilar utilization and cost reductions, compared to a baseline projection of historical biologic spending growth without the impact of new biosimilars.
- Annual savings could exceed \$100 billion in 2025 as some of the largest spending biologic molecules will face biosimilar competition during this period.
- This level of savings will also likely mean the opening of access to relevant biologic medicines to more people globally, as costs of treating patients for cancer or autoimmune disorders are reduced to affordable levels for patients or governments across all countries.
- As a result of bevacizumab biosimilar availability, the National Institute for Health and Care Excellence (NICE) has recommended wider use of the medicine in England and Wales, expanding access to an already widely recommended cancer therapy.
- Incremental usage of biologic therapies has been observed in periods after biosimilar entry and this is expected to be particularly important in lower income countries, but the largest savings will still be focused in developed markets, which already have very high levels of usage of originator versions of these medicines.
- Key upcoming biosimilars are expected to reach patients throughout the next five years but particularly notable are autoimmune therapy adalimumab, currently the worlds leading medicine by spending.

Exhibit Notes: Savings estimated by calculating spending in a scenario where historic trends continue and compared to modeled impact of brand losses of exclusivity and biosimilar uptake. Range reflects uncertainty of the level of uptake, price deflation, and incremental volume after LOE.

Medicine spending and growth by product type varies by region

Exhibit 30: Global Medicine Spending and Growth by Product Type

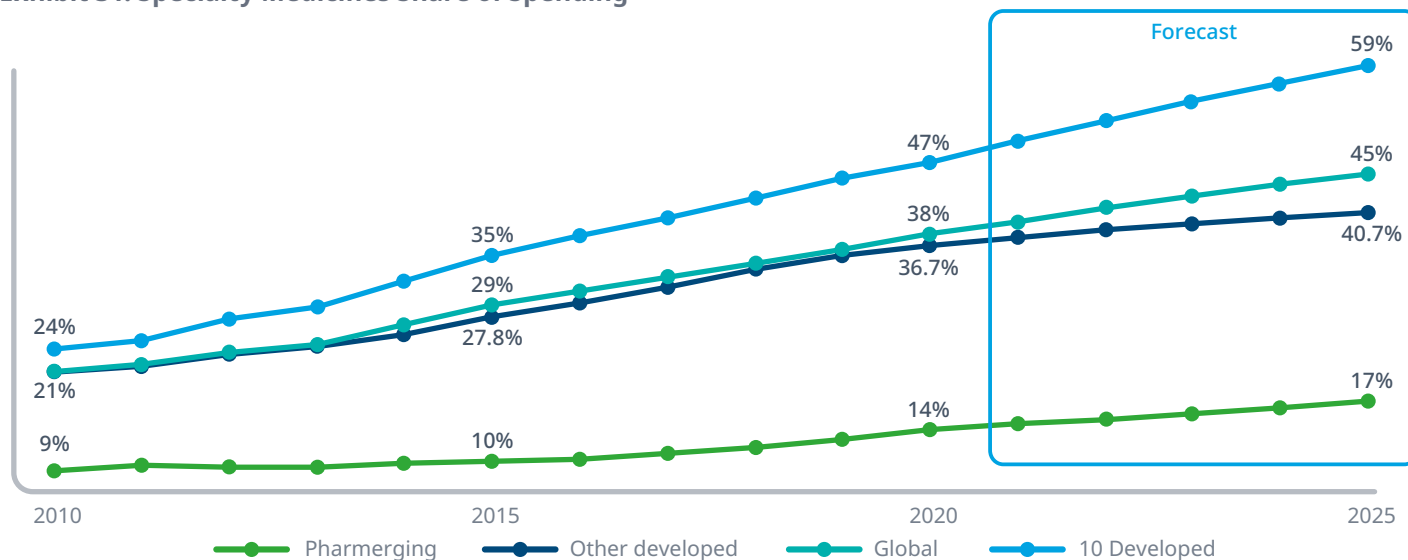
		ORIGINAL BRANDS	NON-ORIGINAL BRANDS	UNBRANDED GENERICS	OTHER	TOTAL
Spending 2020 US\$	Global	796.6	215.1	113.8	139.7	1,265.2
	Developed	705.7	102.3	48.5	103.0	959.5
	10 Developed	637.8	77.8	38.2	93.4	847.2
	Other Developed	67.9	24.5	10.3	9.5	112.3
	Pharmerging	85.7	106.6	62.9	35.6	290.8
	Lower Income Countries	5.2	6.3	2.5	1.0	15.0
Constant Dollar CAGR 2016-2020	Global	5.2%	6.0%	2.6%	1.1%	4.6%
	Developed	4.7%	5.7%	0.7%	-1.0%	3.8%
	10 Developed	4.7%	6.2%	0.0%	-1.4%	3.8%
	Other Developed	4.6%	3.9%	3.3%	3.9%	4.2%
	Pharmerging	10.7%	6.4%	4.3%	9.3%	7.4%
	Lower Income Countries	3.7%	3.4%	4.6%	6.1%	3.9%
Spending 2025 US\$	Global	\$940-970	\$330-360	\$120-150	\$145-175	\$1580-1610
	Developed	\$795-825	\$170-200	\$48-52	\$90-110	\$1130-1160
	10 Developed	\$710-740	\$140-170	\$33-37	\$80-100	\$990-1020
	Other Developed	\$75-95	\$28-32	\$10-14	\$11-15	\$125-155
	Pharmerging	\$125-155	\$140-170	\$75-95	\$40-70	\$415-445
	Lower Income Countries	\$5-9	\$6-10	\$2-4	\$1-2	\$17-21
Constant Dollar CAGR 2021-2025	Global	2-5%	8.5-11.5%	1.5-4.5%	1-4%	3-6%
	Developed	1-4%	10.5-13.5%	-2-1%	-2.5-0.5%	1.5-4.5%
	10 Developed	1-4%	12.5-15.5%	-3-0%	-3-0%	1.5-4.5%
	Other Developed	2.5-5.5%	2-5%	1-4%	4-7%	2.5-5.5%
	Pharmerging	8.5-11.5%	6.5-9.5%	4-7%	8-11%	7-10%
	Lower Income Countries	4-7%	3-6%	2-5%	3.5-6.5%	3-6%

Source: IQVIA Market Prognosis, Sep 2020; IQVIA Institute, Mar 2021

- Developed countries typically have higher shares from original branded products but vary to the degree they shift usage to generics or non-original products after patent expiry, contributing to differences in spending share for originators including those that are off-patent.
- Pharmerging and lower income countries have much lower shares of spending from originator products with a greater focus on either generics or non-original branded products, and all products typically have lower prices.

Specialty medicines will represent nearly half of global spending in 2025 and almost 60% of total spending in developed markets

Exhibit 31: Specialty Medicines Share of Spending



Source: IQVIA Institute, Feb 2021

- Specialty medicines have been increasing as a share of spending in higher-income countries, such as the 10 largest developed countries and other high and upper-middle income countries where they have reached 47% and 37% respectively in 2020, up from 24% and 21% 10 years earlier.
- Specialty medicines are those which treat chronic, complex and rare diseases, and while they have a range of characteristics — including the complexity of disease management or distribution — the most commonly noted attribute is that they are more expensive than other more traditional medicines.
- Pharmedging countries have lagged behind largely due to cost and had 14% of spending in 2020 on specialty medicines, rising to 17% in 2025.
- As specialty medicine share increases, it is notable that they treat only 2–3% of patients. While the unmet needs of these few patients are being addressed, by contrast other patients getting traditional therapies are seeing their costs decline.
- Globally specialty medicines will be 45% of global spending by 2025, with more than half of spending on these product in major developed markets.

Key therapy areas

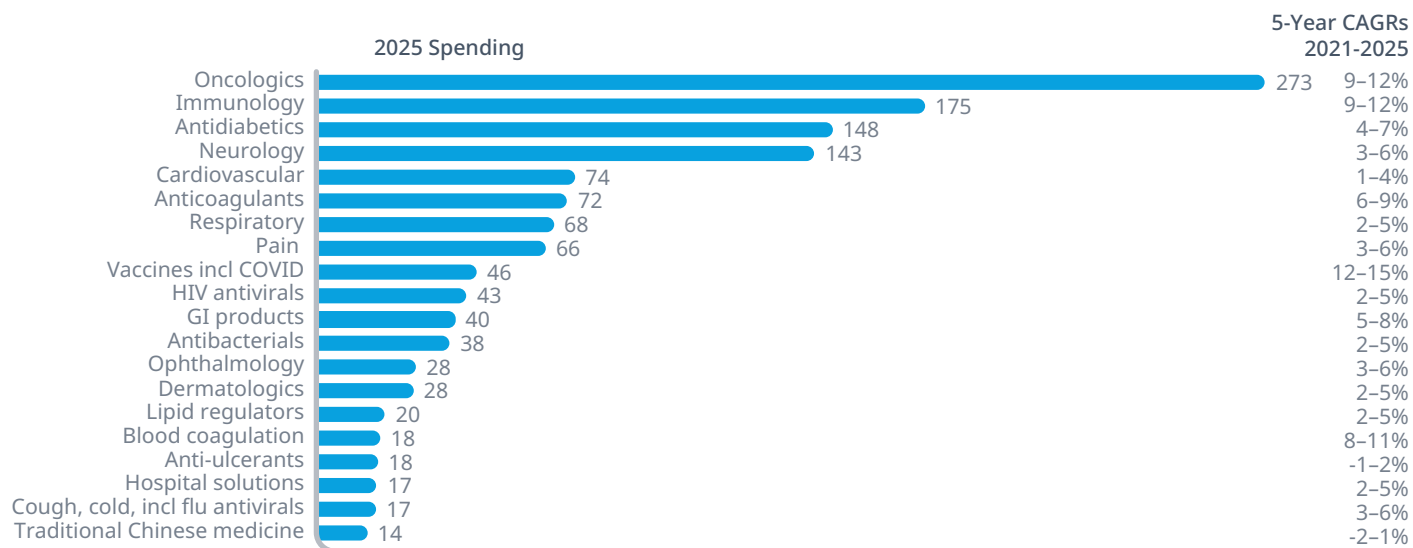
- The two leading global therapy areas — oncology and immunology — are forecast to grow 9–12% CAGR through 2025.
 - Most therapy areas are forecast to grow more slowly over the next 5 years, with the exception of vaccines.
 - Oncology is projected to add 100 new treatments over five years, contributing to an increase in spending of more than \$100 billion to a total of more than \$260 billion in 2025.
 - Diabetes spending growth is slowing to low single-digits in most developed markets and declining in some, especially net of rebates.
- Treatments for autoimmune disorders are forecast to exceed \$170 billion globally by 2025, driven by steadily increasing numbers of treated patients and offset after 2023 due to biosimilars.
 - New therapies contribute to rapid acceleration of Neurology markets, including greater use of novel migraine therapies, potential treatments for rare diseases, and the potential for therapies for Alzheimer's and Parkinson's.

While COVID-19 has garnered the most attention in the past year, the vast majority of patients with other diseases will need to work around social disruptions to receive care. Major advances are expected to continue, especially in oncology, immunology and neurology.

KEY THERAPY AREAS

The two leading global therapy areas — oncology and immunology — are forecast to grow 9–12% CAGR through 2025

Exhibit 32: Top 20 Therapy Areas in 2025 in Terms of Global Spending with Forecast 5-year CAGRs, Const \$US



Source: IQVIA Institute, Feb 2021

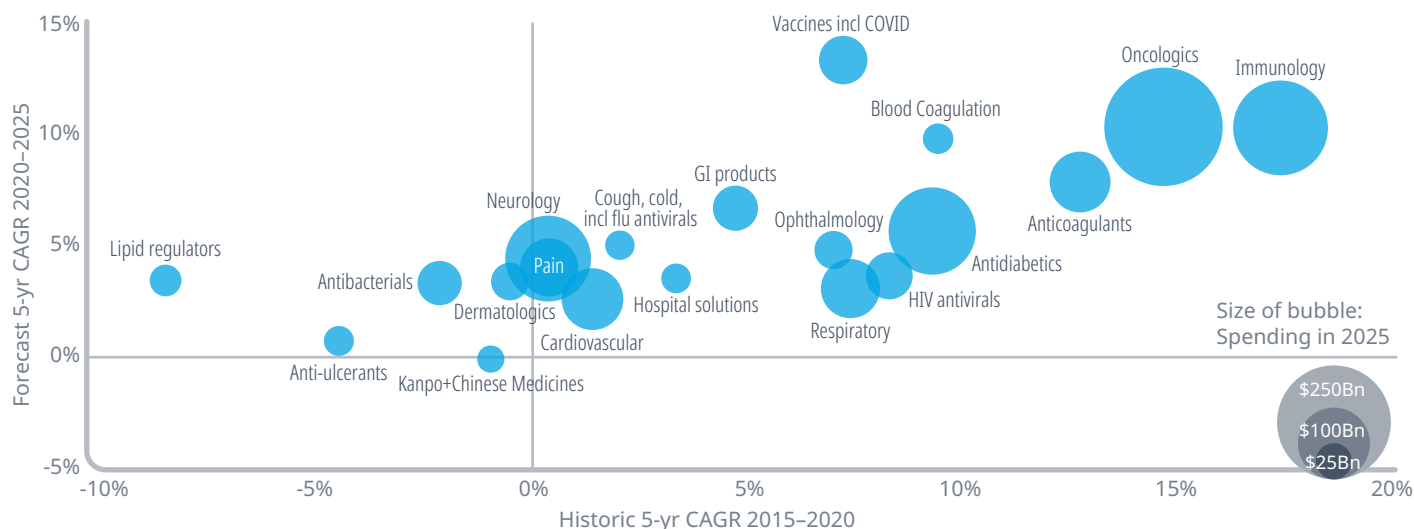
- Oncology continues as the largest spending therapy area with growth projected in the 9–12% range through 2025 as new treatments continue to be launched but the impact of biosimilars slows growth for some widely used therapies.
- Immunology, which includes autoimmune therapies for rheumatoid arthritis, ulcerative colitis, Crohn’s disease, psoriasis, and related conditions, as well as a new range of autoimmune dermatology conditions, will see growth of 9–12%, including expected negative impact by biosimilars.
- Leading immunology medicines are already facing biosimilar competition in Europe but are expected to face it in the U.S. in 2023 when adalimumab biosimilars will launch.
- Diabetes is the third largest therapy area globally, expected to reach nearly \$150 billion by 2025 and growing at 4–7%, though understood to be heavily discounted, which could cause spending to be dramatically lower.
- Neurology is expected to grow at 3–6% to more than \$140 billion by 2025 but includes much higher growth subsegments, as a range of rare neurological diseases have had new treatments approved or continuing in research as well as the potential that large population diseases like Alzheimer’s or Parkinson’s disease could see new treatments.
- The fastest growing category over the next five years will be vaccines, including COVID-19 vaccines, at 12–15%, which likely understates the spending impact of these new vaccines as spending will have moderated by 2025.

Exhibit Notes: Oncology includes therapeutic oncology only and not supportive care. Immunology includes small molecule and biologic treatments for a range of diseases as noted. Neurology includes central nervous system disorder treatments and mental health treatments but does not include pain management or anesthesia. Pain includes narcotic and non-narcotic analgesics, muscle relaxants and migraine treatments. Cardiovascular includes hypertension and other cardiovascular treatments with the exception of lipid regulators, which are shown separately.

KEY THERAPY AREAS

Most therapy areas are forecast to grow more slowly over the next 5 years, with the exception of vaccines

Exhibit 33: Global Historic and Forecast Spending Growth for Top 20 Therapy Areas



Source: IQVIA Institute, Feb 2021; Bubble Size represents forecast in 2025; COVID Vaccine estimates based on estimates of periodic booster shots; Neurology includes Nervous system disorders such as epilepsy, Parkinson's, Alzheimer's, other neurological disorders and mental health. Neurology estimate based on risk-adjusted potential for Alzheimer's approval and uptake.

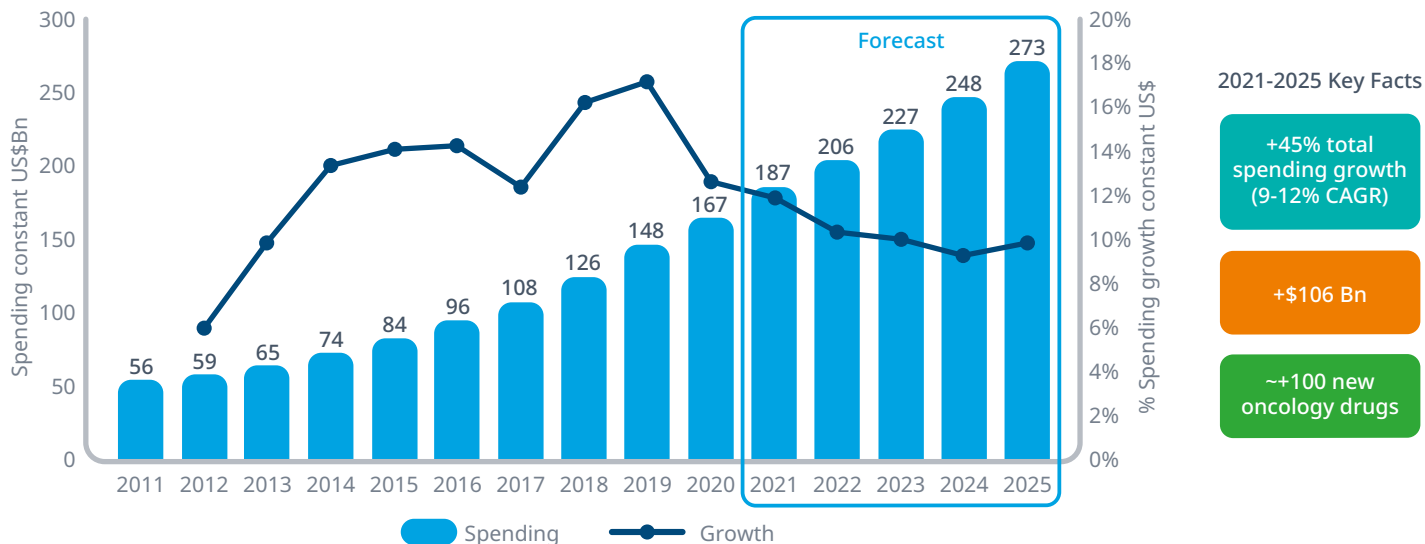
- Immunology, oncology and neurology represent the largest aggregate contributors to growth in the next five years, predominately from a continued flow of new medicines and offset by losses of exclusivity.
- Overall growth in neurology is not significantly lower than diabetes but has much lower discounts and rebates and embeds significant upside uncertainty related to Alzheimer's therapies.
- Therapy areas with lower growth in the next five years than in the last five, including lipid regulators, anti-ulcerants, dermatology, and cardiovascular, are consistently those focused in more traditional therapy areas where fewer new launches have happened and where savings from losses of exclusivity are contributing to lower growth.

Exhibit Notes: Bubble size represents forecast in 2025; COVID vaccine estimates are lower in 2025 based on estimates of periodic booster shots and thus do not reflect the full five-year spending impact; neurology includes nervous system disorders such as epilepsy, Parkinson's, Alzheimer's, other neurological disorders and mental health. Neurology estimate based on risk-adjusted potential for Alzheimer's approval and uptake.

KEY THERAPY AREAS

Global oncology spending growth to exceed \$260 billion by 2025, with growth slowing to 10% from biosimilar savings

Exhibit 34: Global Oncology Spending and Growth



Source: IQVIA Institute, Feb 2021

- Global oncology spending is expected to slow to 10% through 2025 as biosimilars offset a continued flow of newer treatments.
- Over the next five years spending is expected to increase 45%, an average of 9–12% per year, and add \$106 billion in spending.
- More than 100 new oncology drugs are expected based on current pipeline, although they are expected to be increasingly narrowly focused as precision medicine and biomarker-driven therapies become more common.
- While some therapies are being developed with wide tumor applicability and are being approved based on biomarkers or mutations and termed ‘tissue-agnostic’ approvals, there are also a continued flow

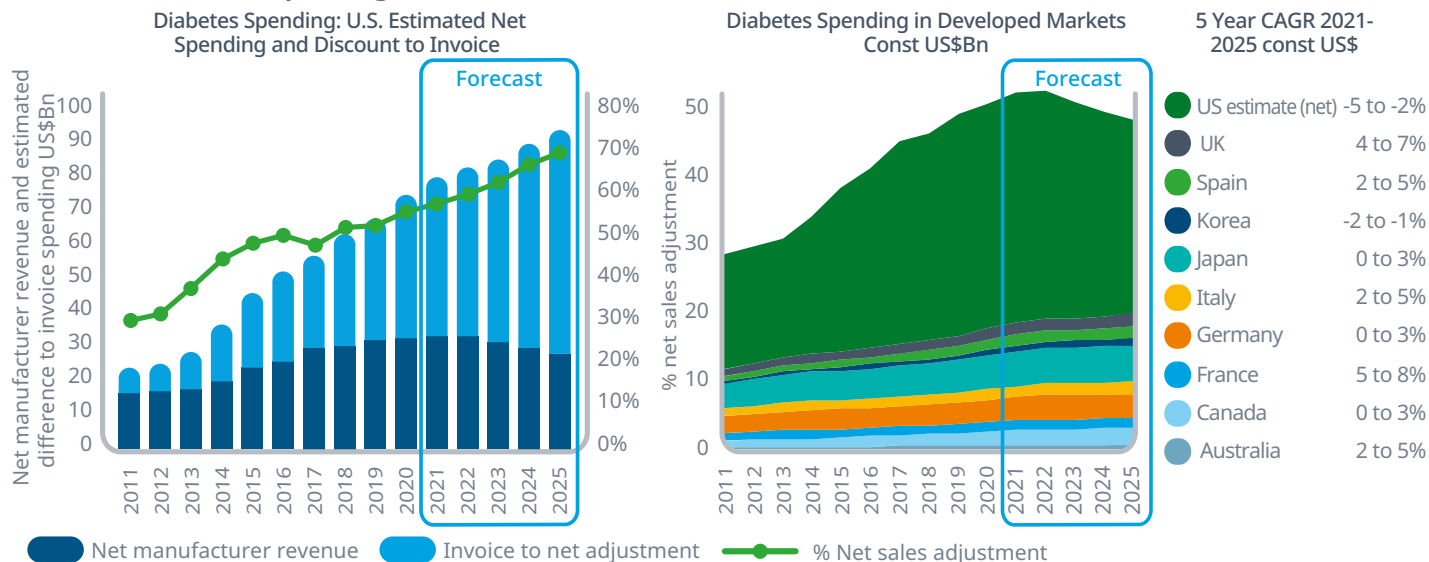
of treatments for very specific tumor or biomarker situations which do not translate to wider use.

- In addition to the flow of more biomarker-driven therapeutic choices, developed markets will benefit from wider use of next-generation sequencing technologies (NGS), which can test for multiple potential mutations at once and guide therapy selection more precisely.
- In earlier stages of adoption, the use of liquid biopsies where NGS is used on blood samples has the potential to identify tumors much earlier and drive much more effective outcomes for patients.
- Savings from biosimilars are expected to contribute to slower spending growth despite the wide range of expected innovations.

KEY THERAPY AREAS

Diabetes spending growth is slowing to low single-digits in most developed markets and declining in some

Exhibit 35: Diabetes Spending and Growth



Source: IQVIA Institute, Feb 2021

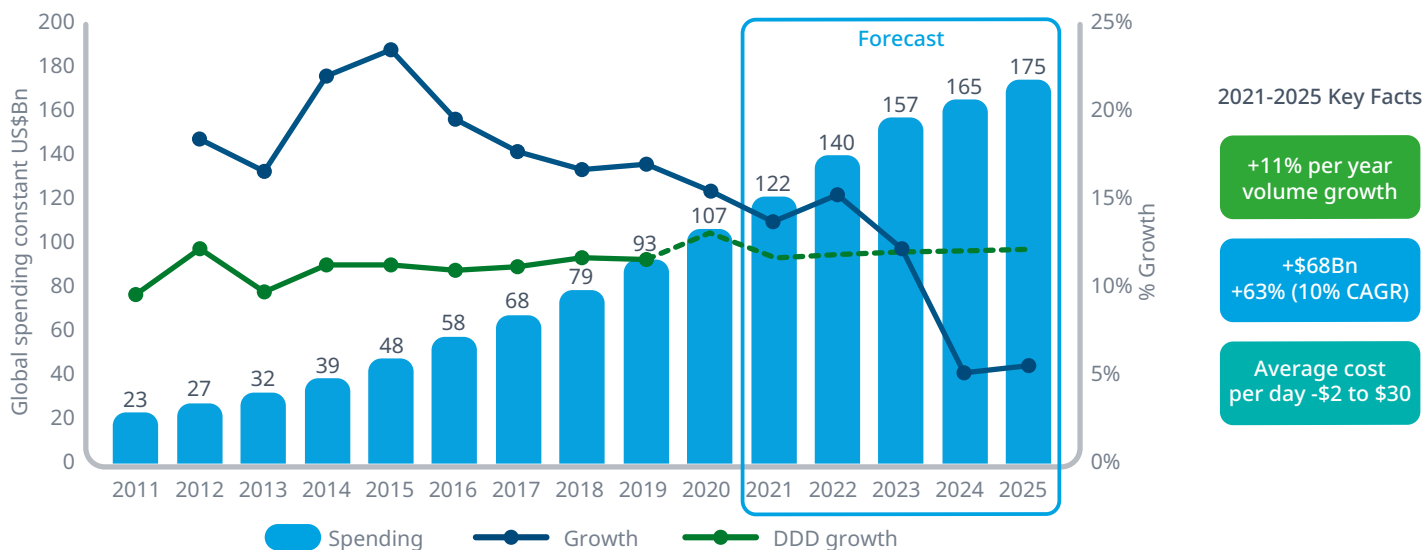
- Diabetes spending in developed markets reflects both the consistent use of older therapies as patients' type 2 disease progresses, and the adoption of novel therapies later in the treatment pathway.
- The key element in assessing trends in diabetes is the current 56% lower-than-net revenue in the U.S. compared to invoice and projected to increase to 70% lower by 2025.
- This impact of off-invoice discounts and rebates is far higher than other therapy areas in the U.S. or that is expected in other countries.
- The estimate of U.S. net spending provides a more comparable trend to the other developed markets and also embeds the significant impacts in recent years and projected to 2025 from rising discounts and rebates.

Exhibit Notes: Estimates of U.S. net manufacturer revenues based on comparisons of IQVIA audits to company-reported net spending in the U.S. (see methodology). Ex-U.S. spending has not been adjusted to an estimate of net level as company net spending is not reported on a country-by-country basis and estimates can only be based on less reliable methods.

KEY THERAPY AREAS

Treatments for Autoimmune Disorders to Exceed \$170 Billion Globally by 2025, Slowing after 2023 due to Key Biosimilars

Exhibit 36: Global Autoimmune Spending and Growth



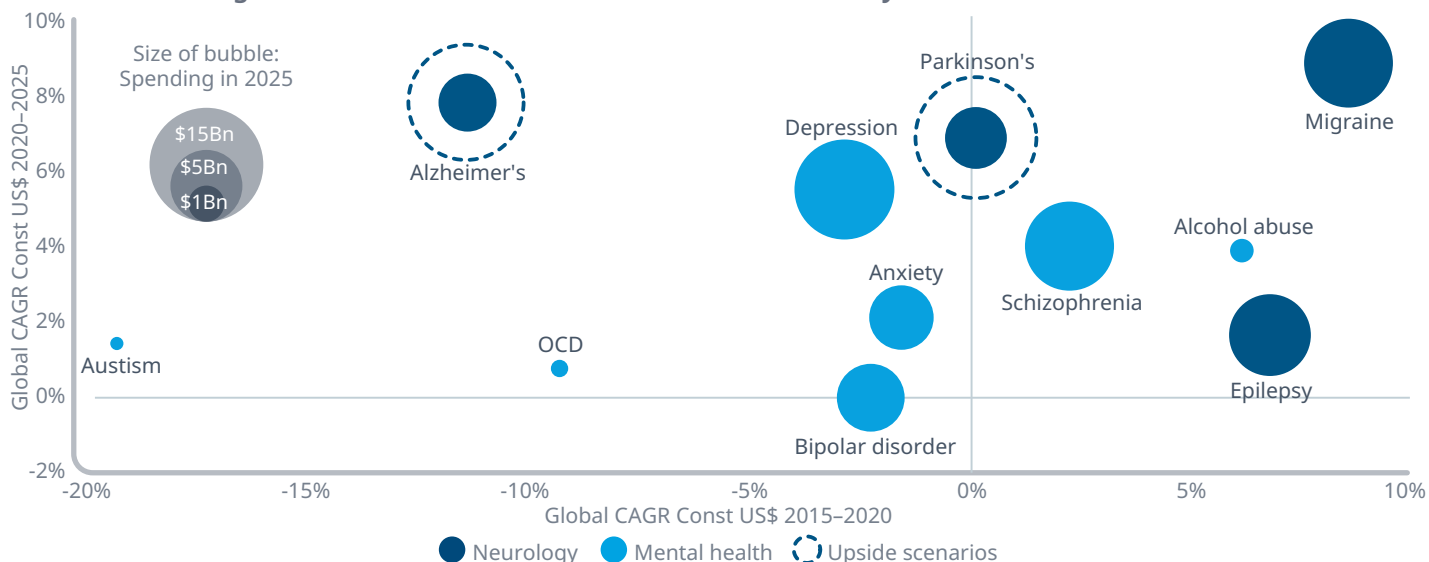
Source: IQVIA Institute, Feb 2021

- Over the past 10 years, immunology treatments have consistently been driven by increasing volume, averaging 11% volume growth in days of therapy and averaging a higher rate of growth in spending as newer products with higher prices have contributed to growth.
- In the next five years, spending is expected to increase 63% or \$68 billion.
- While costs vary across countries, the average cost per day globally has been relatively stable throughout the past 10 years and was \$32 per day of therapy in 2020.
- During this same period, the average cost of a day of therapy is expected to decline to \$30, driven by the introduction of biosimilar adalimumab (Humira) in the U.S. in 2023, and likely to decline further in the years that follow.
- In 2025, spending is expected to grow at a 10% CAGR through 2025 to exceed \$170 billion.
- There was a notable increase in days of therapy in immunology in 2020 as the category includes hydroxychloroquine, which was used for COVID-19 patients when it is otherwise used for autoimmune conditions such as lupus and rheumatoid arthritis prior to the use of biologic treatments.

KEY THERAPY AREAS

New therapies are expected to contribute to rapid acceleration of the CNS market

Exhibit 37: Leading CNS Disorders and Their Global Market Growth Dynamics



Source: IQVIA A New Dawn: At the Cusp of the CNS Decade, Jan 2021, <https://www.iqvia.com/library/white-papers/a-new-dawn-at-the-cusp-of-the-cns-decade>, Accessed Jan 2021

- The golden era of primary care, from the early 1990s through mid-2000s, saw the first major wave of innovation in the pharmacological treatment of CNS disorders, including conditions such as depression, schizophrenia, bipolar disorder, migraine, epilepsy and Alzheimer’s disease, but have seen very little innovation since that time.
- In the last five years a new wave of rare disease neurological treatments, including dozens with orphan designations have been approved.
- Highly prevalent conditions such as migraine, depression and anxiety have also seen a range of new treatments and more are expected.
- There are still poorly controlled patient populations — for example, those suffering from treatment-resistant depression or migraine — while many debilitating conditions lack disease-modifying treatments, such as Alzheimer’s or Parkinson’s, as well as hundreds of rare neuromuscular diseases.
- If new treatments were to emerge in these areas, there would be a significantly large demand and the spending on these areas could expand greatly.
- Recent scientific advances in genomics, biomarkers, diagnostics, and imaging techniques and/or regenerative medicine, combined with the emergence of disruptive digital technologies, are changing the fundamentals of CNS innovation.

Exhibit Notes: Disease areas have been factored based on expected indication profiles. Migraine therapies are included in this analysis while otherwise indicated as pain management in this report. Dotted line circles for Alzheimer’s and Parkinson’s represent an upside scenario not considered the base case by IQVIA. Findings above are adapted from original paper with input and permission from authors.

THIS REPORT IS BASED ON THE IQVIA SERVICES DETAILED BELOW

MIDAS™ is a unique platform for assessing worldwide healthcare markets. It integrates IQVIA's national audits into a globally consistent view of the pharmaceutical market, tracking virtually every product in hundreds of therapeutic classes, and provides estimated product volumes, trends and market share through retail and non-retail channels. MIDAS data is updated monthly and retains 12 years of history.

IQVIA™ MARKET PROGNOSIS is a comprehensive, strategic market forecasting publication that provides decision-makers with insights on the drivers and constraints of healthcare and pharmaceutical market growth. This includes political and economic developments, alongside dynamics in healthcare provision, cost containment, pricing and reimbursement, regulatory affairs, and the operating environment for pharmaceutical companies. Market Prognosis contains economic forecasts from the Economist Intelligence Unit and delivers in-depth analysis at a global, regional and country level, and analyzes dynamics at distribution channel, market segment and therapy class levels.

NOTE ON PRICING LEVELS

This analysis of medicine spending reports net market size, which is based on audited spending data. Invoice spending is based on prices reported in IQVIA audits of pharmaceutical spending that are, in general, reported at the invoice prices wholesalers charge to their customers including pharmacies and hospitals. In some countries, these prices are exclusive of discounts and rebates paid to governments, private insurers or the specific purchasers. In other countries, off-invoice discounts are illegal and do not occur. The mix of true prices and opaque pre-discounted prices

means the invoice-level analyses in this report do not reflect the net market size. Throughout this report unless explicitly noted, currency values for medicine are represented in nominal dollar values with exchange rates varying by period, while growth rates and ranking are represented in constant dollars with Q2 2020 exchange rates.

Definitions & Methodologies

ESTIMATES OF NET MANUFACTURER REVENUE AND PRICES

IQVIA audits reflect invoice-based pricing derived from proprietary information gathered from wholesalers and company direct sales. While IQVIA invoice prices reflect supply-chain price concessions, they do not reflect the off-invoice discounts and rebates separately paid to insurers, or other price concessions paid to patients or other health system participants. Estimates of net manufacturer revenue and prices are based on a sample of companies and products where details are reported to the U.S. Securities and Exchange Commission (SEC) and where the volume of sales captured in IQVIA audits is consistent with information provided directly by manufacturers in support of IQVIA proprietary datasets. Net prices are calculated by dividing publicly-reported net sales values by volumes for the same products reported to IQVIA. Estimated brand net price growth for the total market is projected from the analysis sample to the total market. Net prices represent an estimate of the average manufacturer realized price, reflecting any reductions in net revenues due to off-invoice discounts, rebates, co-pay assistance, or other price concessions, and do not necessarily reflect the net costs paid by insurers, the federal government or patients, which all vary significantly and independently.

NEW ACTIVE SUBSTANCES (NAS): Medicines are considered a NAS if at least one active ingredient has not been previously marketed globally.

SPECIALTY PHARMACEUTICALS

IQVIA defines specialty medicines as those that treat chronic, complex or rare diseases, and that have a minimum of four out of seven additional characteristics related to the distribution, care delivery and/or cost of the medicines.

Chronic diseases are long-lasting and often without direct cure, and treatments are intended to be used for more than six months.

Complex diseases have both environmental and genetic components, meaning they may be hereditary and/or exacerbated by environmental factors (e.g., obesity, diet, etc.). Complex diseases can affect multiple organ systems and may be caused or be the cause of secondary diseases (e.g., diabetes can cause renal failure such that both are considered complex diseases).

Rare diseases are defined as those with fewer than 200,000 new cases annually, equivalent to the U.S. definition of orphan diseases, but not exclusively linked to the granting of an FDA orphan drug designation.

Additional product characteristics, where a product must exhibit four of the seven to be considered specialty are:

- Costly: list price is in excess of \$6,000 per year
- Initiated/maintained by a specialist
- Requiring administration by another individual or healthcare professional (i.e., not self-administered)
- Requiring special handling in the supply chain (e.g., refrigerated, frozen, chemo precautions, biohazard)
- Requiring patient payment assistance
- Distributed through non-traditional channels (e.g., specialty pharmacy)
- Medication has significant side-effects that require additional monitoring/counselling (including, but not limited to, REMS programs) and/or disease requires additional monitoring of therapy (e.g., monitoring of blood/cell counts to assess effectiveness/side effects of therapy).



Developed markets are defined by IQVIA based on The World Bank's income definitions and include high and upper-middle income countries, with the exception of pharmerging markets. Within the developed markets are a subset focusing on the 10 largest countries with high incomes and with pharmaceutical spending greater than \$10 billion. These countries are Australia, Canada, France, Germany, Italy, Japan, South Korea, Spain, the UK, and the U.S.

Pharmerging markets are defined as countries with per capita income below \$30,000/year and five-year absolute growth in pharmaceutical spending greater than \$1 billion. These countries are Algeria, Argentina, Bangladesh, Brazil, Chile, China, Colombia, Egypt, India, Indonesia, Kazakhstan, Mexico, Pakistan, Philippines, Poland, Russia, South Africa, Saudi Arabia, Thailand, Turkey, and Vietnam.

Lower income countries includes lower middle and low income countries using the World Bank's bands.

World Bank Income Bands such as high, upper middle, lower middle, and low are based on World Bank methodologies. For current World Bank classifications, see: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>

Innovation Insights is IQVIA's proprietary product classification system, categorizing products as original brands, non-original brands, unbranded, OTC, or other on the basis of a selection of product attributes.

WHO-DDD — The World Health Organization (WHO) has developed a method of normalizing medicines of varying intended doses using a defined daily dose (WHO-DDD). The WHO-DDD measure is intended to represent a standard day of therapy for a maintenance dose of a chronic therapy. The WHO-DDD measure does not reflect actual treatment decisions and is not derived from distinct patients measured with anonymized data. The WHO-DDD guidance is provided online (see https://www.whocc.no/atc_ddd_index/) but does not include factors or guidance for all drug products. Distinct numeric factors are provided in relation to milligrams or international units (IU) depending on the medicine, or in terms of number of pills per day in the case of chronic medicines such as hypertension. WHO provides guiding principles for calculating DDDs for fixed-dose combination products. The IQVIA institute has developed additional factors using the same or highly similar concepts to represent more than 75% of audited standard unit volume globally. DDDs have been estimated for other products based on the standard unit to DDD ratios per therapy area in each country, where specific DDD values have been determined. In unaudited countries, IQVIA Market Prognosis collates sales values from international trade data for the pharmaceutical sector. The IQVIA Institute has used audited data in geographically adjacent countries to infer various characteristics from this international trade data, including standard unit volumes. DDD in these countries has been estimated based on standard unit to DDD ratios in adjacent countries. DDDs in unaudited countries represent less than 5% of global estimated DDDs.

About the authors



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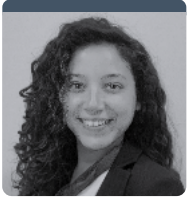
Murray Aitken is Executive Director, IQVIA Institute for Human Data Science, which provides policy setters and decisionmakers in the global health sector with objective insights into healthcare dynamics. He led the IMS Institute for Healthcare Informatics, now the IQVIA Institute, since its inception in January 2011. Murray previously was Senior Vice President, Healthcare Insight, leading IMS Health's thought leadership initiatives worldwide. Before that, he served as Senior Vice President, Corporate Strategy, from 2004 to 2007. Murray joined IMS Health in 2001 with responsibility for developing the company's consulting and services businesses. Prior to IMS Health, Murray had a 14-year career with McKinsey & Company, where he was a leader in the Pharmaceutical and Medical Products practice from 1997 to 2001. Murray writes and speaks regularly on the challenges facing the healthcare industry. He is editor of Health IQ, a publication focused on the value of information in advancing evidence-based healthcare, and also serves on the editorial advisory board of Pharmaceutical Executive. Murray holds a Master of Commerce degree from the University of Auckland in New Zealand, and received an M.B.A. degree with distinction from Harvard University.



MICHAEL KLEINROCK

Research Director, IQVIA Institute for Human Data Science

Michael Kleinrock serves as research director for the IQVIA Institute for Human Data Science, setting the research agenda for the Institute, leading the development of reports and projects focused on the current and future role of human data science in healthcare in the United States and globally. Kleinrock leads the research development included in Institute reports published throughout the year. The research is focused on advancing the understanding of healthcare and the complex systems and markets around the world that deliver it. Throughout his tenure at IMS Health, which began in 1999, he has held roles in customer service, marketing, product management, and in 2006 joined the Market Insights team, which is now the IQVIA Institute for Human Data Science. He holds a B.A. degree in History and Political Science from the University of Essex, Colchester, UK, and an M.A. in Journalism and Radio Production from Goldsmiths College, University of London, UK.



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Thought Leadership Manager, IQVIA
Institute for Human Data Science

Elyse Muñoz is a Thought Leadership Manager for the IQVIA Institute, managing aspects of IQVIA Institute research projects and conducting research and analysis within global healthcare. Elyse joined IQVIA in 2017 as an associate consultant in the Competitive Intelligence consulting group, where she developed rich clinical and commercial insights to serve clients. She worked in major therapy areas including diabetes, cardiovascular disease and kidney dysfunction, as well as rare diseases such as hemophilia. Elyse holds a Bachelor of Science from Arizona State University in Genetics, as well as a Ph.D. in Genetics from Pennsylvania State University. Her research focused on the genetic makeup of the parasite that causes malaria to aid in the development of targeted drugs to eradicate the disease.

About the Institute

The IQVIA Institute for Human Data Science contributes to the advancement of human health globally through timely research, insightful analysis and scientific expertise applied to granular non-identified patient-level data.

Fulfilling an essential need within healthcare, the Institute delivers objective, relevant insights and research that accelerate understanding and innovation critical to sound decision making and improved human outcomes. With access to IQVIA's institutional knowledge, advanced analytics, technology and unparalleled data the Institute works in tandem with a broad set of healthcare stakeholders to drive a research agenda focused on Human Data Science including government agencies, academic institutions, the life sciences industry and payers.

Research Agenda

The research agenda for the Institute centers on 5 areas considered vital to contributing to the advancement of human health globally:

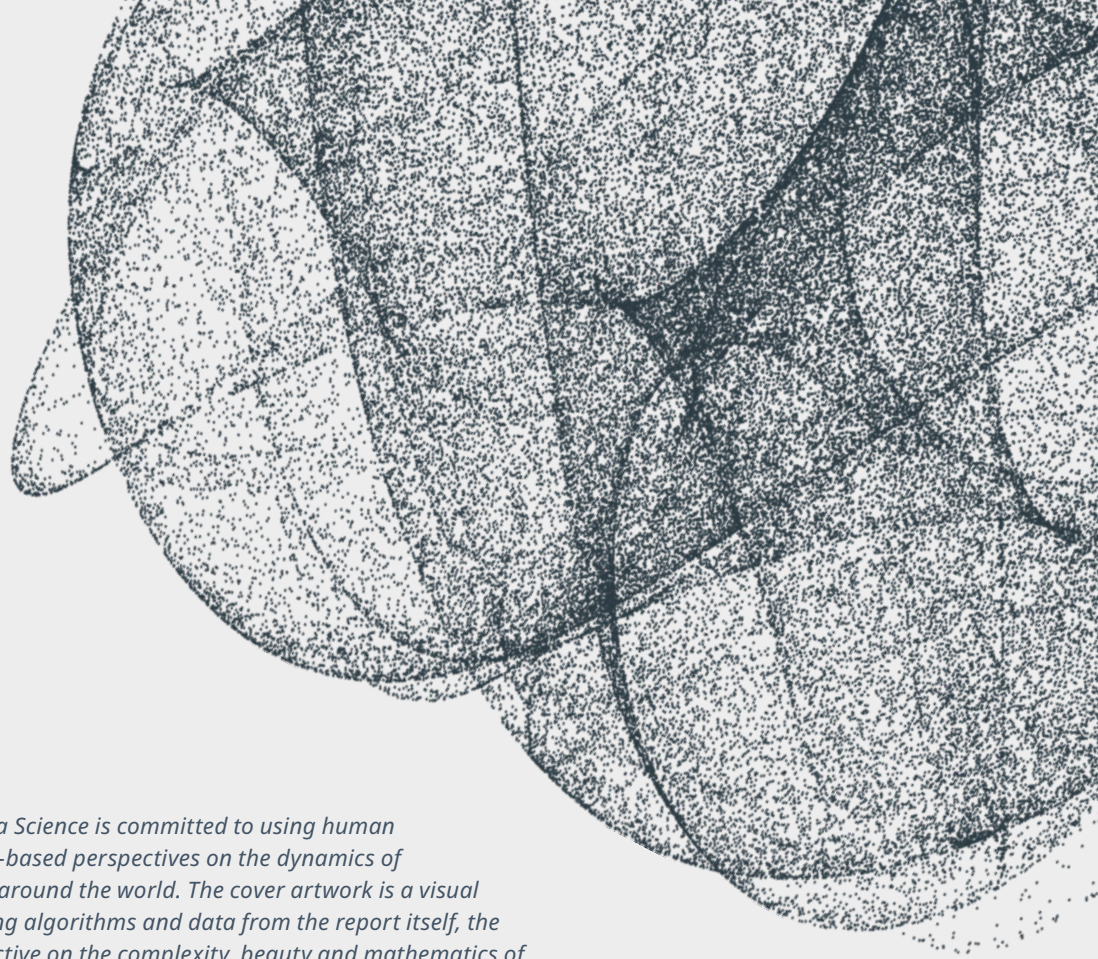
- Improving decision-making across health systems through the effective use of advanced analytics and methodologies applied to timely, relevant data.
- Addressing opportunities to improve clinical development productivity focused on innovative treatments that advance healthcare globally.
- Optimizing the performance of health systems by focusing on patient centricity, precision medicine and better understanding disease causes, treatment consequences and measures to improve quality and cost of healthcare delivered to patients.

- Understanding the future role for biopharmaceuticals in human health, market dynamics, and implications for manufacturers, public and private payers, providers, patients, pharmacists and distributors.
- Researching the role of technology in health system products, processes and delivery systems and the business and policy systems that drive innovation.

Guiding Principles

The Institute operates from a set of guiding principles:

- Healthcare solutions of the future require fact based scientific evidence, expert analysis of information, technology, ingenuity and a focus on individuals.
- Rigorous analysis must be applied to vast amounts of timely, high quality and relevant data to provide value and move healthcare forward.
- Collaboration across all stakeholders in the public and private sectors is critical to advancing healthcare solutions.
- Insights gained from information and analysis should be made widely available to healthcare stakeholders.
- Protecting individual privacy is essential, so research will be based on the use of non-identified patient information and provider information will be aggregated.
- Information will be used responsibly to advance research, inform discourse, achieve better healthcare and improve the health of all people.



The IQVIA Institute for Human Data Science is committed to using human data science to provide timely, fact-based perspectives on the dynamics of health systems and human health around the world. The cover artwork is a visual representation of this mission. Using algorithms and data from the report itself, the final image presents a new perspective on the complexity, beauty and mathematics of human data science and the insights within the pages.

The artwork on this report is cover is created from information about the volume of medicines used in the last three years. The dataset includes information about the countries and numbers of doses and normalized days of therapy or Defined Daily Doses (DDD) in 78 audited countries.



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