COVID-19 and the Biopharmaceutical Sector

Outlook for the Financing and Deal Environment

April 2020

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Global COVID-19 Situation:
April 2020
Worldwide Humanitarian and Economic Challenge

- The Covid-19 Pandemic has created a worldwide humanitarian challenge.
  - The most significant global viral pandemic in many decades.
  - Over 2 million confirmed cases and 165,000 deaths
  - In places, the healthcare system is overloaded.
  - Major economic impact with high unemployment, global declines in GDP and lines of people in search of food.
- Widespread adoption of social distancing measures to slow viral spread. Cities, transportation hubs and like eerily quiet.
- Most biopharma industry professionals working from home for over a month.
- Path to getting to “normal” will be long.
- Biopharma sector vital to controlling pandemic.

COVID-19 New Cases Slowing After Pandemic

WEEK ON WEEK GROWTH IN NEW COVID19 CASES (WW EXCEPT CHINA)

- The number of worldwide cases of COVID-19 infection exceeds 2 million according to the World Health Organization.
- It is likely that the number of cases is substantially underreported given the lack of widespread testing.
- New case growth went negative in the week ended April 17th, 2020.

Source: World Health Organization & Worldometer
Impact on the Pharmaceutical Sector
Key Issues in Global Healthcare System

Healthcare Utilization Down
Routine doctor office visits down significantly. New therapy starts reduced in many areas.

Providers are Stressed
Many healthcare providers are severely stressed by lower utilization of many different types of services (e.g., primary care, radiology, elective surgeries). Many providers of elective procedures or non-life-threatening medical conditions have closed (e.g., aesthetic dermatology, fertility, orthopedics).

Weaker Access
Many patients not getting care that they need. Even important procedures for serious life-threatening conditions are not always available.

Hospital Systems Impacted
Many hospital systems are exhausted and not well supplied following the COVID-19 crisis period. Many have not been adequately reimbursed for dealing with large public need.

Drug Shortages at the Hospital Level
In addition to being short on ventilators, PPE and testing materials for COVID-19, many hospitals are increasingly short on essential drugs used to treat patients (e.g., sedatives, pressins, IL-6 inhibitors) due to high case loads in the last several months.

Usage of Drugs is Down
Significant declines in physician office administration of drugs for autoimmune diseases (e.g., MS, RA, IBD). Also significant impact in general on vaccines, drugs requiring infusions (particularly in the elderly) and rare disease drugs. Usage of cancer drugs is less affected. Some companies (like BMS with Zeposia® or Neurocrine) are delaying launches.

GlobalData’s survey of the industry revealed that 95 percent of persons spoken to are concerned about a negative impact of COVID-19 on performance. Roughly a quarter of respondents were also worried about supply chain issues.

**Illustrative examples of change in earnings and associated guidance...**

**April 14, 2020**

Lowered previous guidance for 2020 revenue to reflect the negative impact of COVID-19 on sales

While Aerie volumes increased in the first quarter of 2020 compared to the fourth quarter of 2019 for both Rhopressa® (netarsudil ophthalmic solution) 0.02% and Rocklatan® (netarsudil and latanoprost ophthalmic solution) 0.02%/0.005%, the pace of volumes, as seen with the entire pharmaceutical market according to IQVIA data, has declined as the COVID-19 impact became elevated in late March and into April 2020 to date. ...with many eye care professionals’ offices closed or in the process of closing, new prescription growth has slowed.
Our conversations with industry participants indicate that many (if not most) studies that have been actively enrolling clinical trials have been slowed down or paused during the COVID-19 pandemic period. Many companies have simply not announced specific decisions that have been made.

We believe that, on average, the completion of most non-COVID-19 clinical trials is going to be pushed back by four to six months across the industry. Some ongoing trials, unfortunately, have been shut prematurely and need to be rerun (or may not be repeated for financial reasons).

Source: Company press releases and industry discussions.
Global supplies of API and generics have being impacted and the world may see shortages in some molecules going forward.

There have been shortages of a number of hospital drugs already worldwide due to the COVID-19 pandemic. Groups like Civica which have stockpiled hospital drugs have really shined in recent months.

Manufacturing plants in India and China are not working at optimum capacity which could result in drug shortages for some molecules.

Many developed countries are considering moving manufacturing of certain critical life-saving drugs to their home geography. We have already seen Indian government announcing $2 billion of investment for reducing dependence on API and key starting materials for generics from China.

**Generic Prices:**
To address temporary shortages of certain medicines, inventory levels in the system would go up. Hence short term demand of many generics will rise, pushing prices upwards.

**Investment in Healthcare in Developing Markets:**
The spend towards healthcare infrastructure by various governments, especially developing markets, will increase given the underinvestment these countries have made in the sector.

**Generic M&A:**
We see increasing global generic M&A as generic pricing will improve. Manufacturing assets in developed markets will be in demand as companies wish to be better positioned in those markets.

Long-Term Societal Implications of COVID-19

Government Budget Constraints and Drug Price Pressures

Loïc Plantevin, Jason Evers and George Eliades, A Covid-19 Action Plan for Pharma Executives, April 03, 2020

"Importantly, the underlying economic crisis triggered by the Covid-19 pandemic will have a significant ripple effect on state and national budgets. Urgent and costly measures to shore up businesses and support individuals will force governments to contain outlays in every category, including healthcare. The incremental innovation required for premium-price drugs will continue to rise, as will pricing pressure on commodity products such as generics and biosimilars."


Potential for Greater Social Division

Martin McKee, London School of Hygiene and Tropical Medicine & David Stuckler, Bocconi

"The COVID-19 pandemic could encourage people to realize that they all depend on each other on this small planet and, whether it is global heating, inequality, or environmental degradation, will either swim or sink together. On the other hand, populist politicians and the vested interests that support them could use this crisis to sow divisions, creating cleavages between the young and old, rich and poor, sick and healthy, ethnic minorities and population majorities, immigrants and domestic groups, weakening the collective bonds and support for essential public goods."

https://www.nature.com/articles/s41591-020-0863-y

"The push in Congress to drive down U.S. prescription drug costs has taken a backseat to all things COVID-19, but that reprieve may be about to end as freshman members of the House urge their leaders to include bipartisan drug pricing proposals in the next COVID relief bill. "We have consistently heard from our constituents that costs are prohibitive to obtaining their medications, a problem that is exacerbated during a crisis," the lawmakers said Wednesday in a letter to House Speaker Nancy Pelosi (D-Calif.) and Minority Leader Kevin McCarthy (R-Calif)."
Regulators have been highly responsive to the outbreak

**U.S. FOOD & DRUG ADMINISTRATION**

FDA is working tirelessly on three fronts to deal with the COVID-19 pandemic:

1. **Tests**: Achieving Emergency Use Authorizations (EUAs) for previously unapproved tests for COVID-19
2. **Devices**: Achieving rapid approvals for devices, including PPEs, respirators and swaps, for treatment of COVID-19
3. **Drugs**: The FDA is facilitating development and availability of potential COVID-19 treatments including expedited review of IND applications.

In total, the FDA has approved 67 EUAs for test kits and devices between Feb 4 and April 18, 2020.

Further, in the last eight weeks (Feb 24 to April 20) the FDA has approved 14 new drugs for the first time for a range of diseases including Tukysa for breast cancer, Jemlyto from Urogen for bladder cancer and Koselugo for neurofibromatosis. This is a record pace for NDA/BLA approvals.

**EUROPEAN MEDICINES AGENCY**

The COVID-19 EMA pandemic Task Force is the main tool of EMA and the European medicines regulatory network for enabling EU Member States and the European Commission to take quick and coordinated regulatory action during the pandemic.

National Medical Products Administration in China has moved with lightning speed to encourage the development of multiple COVID-19 vaccines and is now cooperating with other agencies to coordinate development and hopefully, ultimate approvals.
Response from Industry Encouraging

Pharma has been highly responsive to the outbreak

The pharma sector has also been remarkably focused helping to combat the Coronavirus and manage patient burdens while the pandemic is ongoing. Measures taken include work on novel antivirals and vaccines, donations of protective equipment, responsibly suspending clinical trials, making essential medicines (e.g., insulin) available to patients and donating employee time. Without intention to exclude many other groups with high impact programs, examples of companies with notable initiatives include:
Impact on the Public Primary Market Environment
Recent movements in the NASDAQ Biotech Index have been small relative to historical market breaks.

The NASDAQ Biotech Index fell 28% at its low between the Feb 20 and April 20, 2020. The Index is up slightly as of April 20th. However, while the swings have been substantial they are not major in light of historical volatility in the index.

Source: Data from NASDAQ
The NASDAQ Biotech Index is a market weighted index of 207 biotech shares. We looked at the returns on each of the constituents from Jan 1, 2020 to April 20, 2020. The index overall was up by 4.9% in this period. We found that if three stocks were omitted from the index, the returns would have gone negative. The stocks were Gilead, Moderna and Regeneron. All three companies have had outstanding returns due to their potential development of COVID-19 therapies in recent months.

It’s important to note that the median return on the components of the Index was -10.6% from the beginning of the year. In fact, only 64 of the 207 (31%) index components had positive returns YTD.

Index returns can give a distorted view of what is actually going on in the market.
Analyzing Returns in Market Segments

Given the issue with indices as a measure of returns, we chose to study the full global healthcare market.

We used S&P CapitalIQ to access returns on the entire public universe of healthcare stocks worldwide in the 90 day period from Jan 21, 2020 to April 20, 2020.

We then broke down this dataset by region, industry segment etc. to gain greater insight into what has happened in the markets during COVID-19 period. We focused in on the US and EU population, breaking down the companies into groups that would normally be referred to by industry participants.*

We chose to focus on median return in subgroups, asking what happened to the typical company rather than the exceptional company.

To benchmark returns, we have shown market index returns over the same 90 day period at right.

The NASDAQ Biotech Index return is exceptional due, in part, to the presence of several COVID-19 driven stocks. Most global indices are down 15 to 25% in the last 90 days.

* We defined companies as being in biotech if they did not yet have an approved product, as being a COVID virology leader if they have received significant publicity for contributions to COVID pharmacology in recent months (e.g., Gilead, Regeneron), as a specialty pharma company if they market a commercial product that is not based upon an NCE, a generics company if they market products that have lost patent protection and as an innovative pharma company if they market on patent new chemical entities.
Global Share Price Returns in Healthcare Sector

The chart at right shows aggregate global share price returns over a 90 day period ending April 20th split by healthcare segment.

Notably, the best performing segment was life sciences tools and diagnostics which includes many companies which make COVID-19 tests. The worst performing segment was healthcare facilities (i.e., hospitals) which have suffered due to the financial burden of caring for COVID-19 patients. Service business have also struggled in this time period. Pharma and biotech company returns have been in the middle of the pack, showing global losses in the range of 9% to 12%.

Source: Data from S&P, CapitalIQ
Global Share Price Returns in Healthcare Sector

The chart at right shows aggregate global share price returns over a 90 day period ending April 20th split by country. We selected the 15 countries with the most public companies (90% of the total).

Notably, the best performing country was China which has largely put the COVID-19 outbreak behind it and has minimized the long-term impact. In contrast, Canada, Australia and the US have all seen significant impact on their healthcare sectors. France, India and Taiwan have fared relatively well.

Source: Data from S&P, CapitalIQ
Share Returns in US Biopharma Segment*
(this analysis excludes nine companies with high returns due to COVID-19 programs)

We have seen a strong rotation out of less innovative companies and into innovation companies. Investors rotated from small caps into large caps, greatly impacting returns across the sector.

**Median Returns by Pharma Segment**
Jan 21, 2020 to April 20, 2020, Analysis of 424 Public Companies

- Specialty Pharma, -29.8%
- Generic Pharma, -27.6%
- Biotechnology, -21.2%
- Innovative Pharma, -12.0%

**Median Returns by Capitalization (Jan 21)**
Jan 21, 2020 to April 20, 2020

- Large cap (market cap > $10 bn), 7.3%
- Mid cap ($10bn > market cap > $1bn), -14.0%
- Small cap ($1bn > market cap > $200mm), -19.8%
- Microcap (market cap < $200mm), -26.0%

*We defined companies as being in biotech if they did not yet have an approved product, as being a COVID virology leader if they have received significant publicity for contributions to COVID pharmacology in recent months (e.g., Gilead, Regeneron), as a specialty pharma company if they market a commercial product that is not based upon an NCE (but rather a reformulation of an existing product) or even a branded generic, a generics company if they market INN products that have lost patent protection and as an innovative pharma company if they market on patent new chemical entities (e.g., big pharma, companies like Vertex, companies with recent approvals such as Esperion Therapeutics.
Share Returns in Europe Biopharma Segment*
(this analysis excludes three companies with high returns due to COVID-19 programs)

Much less sector rotation is visible in the European markets. While large caps such as Sanofi and GSK fared better than most, there is no strong pattern of cross-sectional variance in return.

**Median Returns by Pharma Segment**
Jan 21, 2020 to April 20, 2020, Analysis of 250 Public Companies

- Biotechnology, 8.60%
- Innovative Pharma, 8.80%
- Specialty Pharma, -5%
- Generic Pharma, -1.90%

**Median Returns by Capitalization (Jan 21)**
Jan 21, 2020 to April 20, 2020

- Large cap (market cap > $10 bn), -3.8%
- Mid cap ($10bn > market cap > $1bn), -7.5%
- Small cap ($1bn > market cap > $200mm), -10.0%
- Microcap (market cap < $200mm), -7.7%

* We defined companies as being in biotech if they did not yet have an approved product, as being a COVID virology leader if they have received significant publicity for contributions to COVID pharmacology in recent months (e.g., Gilead, Regeneron), as a specialty pharma company if they market a commercial product that is not based upon an NCE (but rather a reformulation of an existing product) or even a branded generic, a generics company if they market INN products that have lost patent protection and as an innovative pharma company if they market on patent new chemical entities (e.g., big pharma, companies like Vertex, companies with recent approvals such as Esperion Therapeutics.)
Torreya has spoken to more than a dozen public markets investors in the last four weeks.

We have asked these investors how they view the COVID-19 pandemic overall, how the pandemic has impacted their appetite for new investments and how they see the markets playing out.

These investors have included hedge funds, long-only funds and some venture groups that participate in public market offerings.

We have also spoken to a number of bankers that are active in marketing offerings.

While not a scientific survey, we believe that we have a good picture of how investors are viewing the markets during the COVID-19 pandemic.
What Public Investors are Saying

1. Some Have Pulled Back
   A significant minority of investors have moved to the sidelines going largely or partially into cash – many believe that the market has more room to fall and are surprised that biotechs are flat since the COVID outbreak began.

2. Others Jumping In
   We spoke to several investors that have stepped up investment activity in the markets and are looking to put money to work in follow-ons and convertibles. We think this group is fairly small.

3. No View that Long-Term Fundamentals Have Changed
   Investors were unanimous that the long-term fundamentals (dramatic bioinnovation) remain in place and that the biotech sector will grow in the long-run.

4. Higher Bar
   Most investors we spoke to have “raised the bar” for what they are putting money into given the more volatile environment. Most investors would still participate in follow-on equity offerings but these offerings need to be priced in a manner that offers a discount or provide access to exceptional shares that would not otherwise be available.

5. IPO Market is Pre-Arranged
   All IPOs that have happened this month have been pre-arranged by crossover investors. That is, all deals that went into the market had excess demand from inside investors. These IPO’s do not necessarily presage a full recovery in the initial offerings market.

   Investors have noticed that many companies are linking their technologies and pipelines to COVID-19. Most investors view this as not terribly interesting because of the view that COVID-19 will be gone by the time any of these projects reach commercialization. Some companies like Vir, Moderna and Regeneron see it differently.
There have been three IPO’s in April 2020. This has been the slowest month in six months.

Source: Data from CapitalIQ
IPO volume in the first two weeks of April 2020 puts this month in the 52nd percentile of all IPO volume months since 2013. Put another way, this has been an average month for IPO activity over the long run.
The volume of follow-on equity offerings in April 2020 is down substantially from recent months. This is one of the slower months of the last eight years.

Source: Data from CapitalIQ
1. While many biopharma companies have fared well during the COVID-19 epidemic, the typical company in the sector has lost substantial value.

2. In the US this negative market cap impact has been most pronounced for small cap companies and those that are involved in generics and specialty pharma.

3. IPO activity has been respectable but deals have been largely pre-arranged by investor syndicates.

4. Follow-on equity offerings are down reflecting a difficult market. Most investors bargain hunting or on sidelines for now.

**Torreya’s View**

While open, the biopharma equity issuance market is not nearly as strong as it was in the previous 12 months.

It will take time for investor confidence to return in biopharma but we believe that it will not be too long before we are testing new heights in the biopharma market indices. The rally in large caps and companies with very high science appeal will continue and, in time, small and mid-caps are likely follow.
Impact on the Private Markets
Funding Environment
The first few weeks of Q2 2020 alone would make it the second largest venture financing period in the last two years.
The Last Six Weeks (Mar 1 to Apr 15, 2020) Have Been the Strongest Period for Venture Financing in a Year

Note: April 2020 volume is extrapolated based on volume in the first two weeks of the month. Data from Crunchbase.
Comments from the Capital Raising Front Lines

Torreya speaks with many private venture stage biotech companies that are in the market raising money. We have asked entrepreneur CEO's in recent weeks what they are experiencing from investors. Here are some paraphrased comments:

Everyone is nice but it feels like around a third of funds are out of the market and many others are really focused on guarding their own portfolios. Lots of interest but no one is rushing to term sheets.

CEO of a very strong pre-clinical oncology company in California (seed raise)

We’ve been pleasantly surprised. Investors are definitely open for business and are doing diligence on us. We aren’t done with our raise but it feels like we will get there.

CFO of a very strong Phase 2 oncology company in China & US (Series B raise)

We have been able to get two term sheets after a multi-month marketing process. It hasn’t been easy going. Importantly, we are seeing strong interest from corporate VCs across the board. COVID-19 or not, this deal will close.

Bankers to an exceptional pre-clinical therapeutics company in Europe (Series A raise)

We’re talking to most of the top funds for our $70mm pre-IPO raise. Discussions are moving well and everyone is professional but things are slower than the last time around. Funds are dragging their feet to see how the environment shapes up. We’ll get it done but will be delayed.

CEO of a US hospital-based medicine company with good POC data (Series B raise)

We need to close our Series A by October to stay on track. Our story is very good so I was planning to start the raise in the Summer. I am now thinking that I should jump in the market now given the possibility of delay in this market.

CEO of a strong pre-commercial diagnostics company in California (Series A raise)

Public investors are fascinated by our platform. We have a lot of forward spend and could either partner our lead or raise a private round. Given the strong demand, we might go ahead and finance ahead of an IPO.

CEO of a very strong pre-commercial genetic medicine company on the West Coast (possible Series C raise)

Interpretation: VCs who have reloaded recently and evergreen funds are very much open for business. The others are more worried about how to conserve reserves for bridging clinical stage companies in the portfolio. Overall, credentialed companies with strong stories are generally able to raise without difficulty. For many others, the going is slow.
The pace of new venture capital raised for biopharma investments has been at $1 billion a week through mid-April 2020 (or $25 million a business hour). This is by far the highest volume period for fresh venture capital in our memory.

Source: Data from Crunchbase
Top 20 Biopharma Venture Investors by Firepower

Each of these groups has more than $800mm in firepower for venture stage biopharma equity investments.

<table>
<thead>
<tr>
<th>Investor</th>
<th>Firepower ($bn)</th>
<th>Last Raise</th>
<th>Investments Since Jan 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackstone</td>
<td>$3.4</td>
<td>Jan 2020</td>
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<td>DEERFIELD</td>
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<td>OrbiMed</td>
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<td>ARCH Venture Partners</td>
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<td>Nan Fung Group</td>
<td>$1.5</td>
<td>Evergreen</td>
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<td>VIVO Capital</td>
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<td>HBM Partners</td>
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<td>Public Fund</td>
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<td>Novo Holdings</td>
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<td>SoftBank</td>
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<td>QIMING VENTURE MANAGEMENT</td>
<td>$1.1</td>
<td>Apr 2020</td>
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<tr>
<th>Investor</th>
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Notes and sources: In general we relied on information from fund press releases, SEC Form Ds, discussions with funds and information compiled on Crunchbase. We define firepower as the size of the last fund raised or our estimate of the potential amount the investor could put to work in the next five years (generally defined as average recent annual investment volume times five). In many cases, groups have told Torreya roughly the size of their pocket of money allocated to private life sciences investments and we have replicated that amount here. For certain fund groups such as Deerfield and OrbiMed we added up the size of separate funds that had been raised recently with the capability of participating in biopharma venture investments. Certain funds listed are much larger than shown but most capital is being spent outside of the biopharma area. For example, for Softbank, we looked at the proportion of their investments made in biopharma to estimate firepower in this area.
Our database counts $72 billion in venture investment firepower today. We should see more than $10 billion in spend on biopharma venture investments a year in the future. This would be a significant increase from levels of recent years.
Private Debt Market Has Softened

The dollar volume of debt deals is down this year by a good 15% from 2019. But deal count is down 50%, reflecting skittishness on the part of lenders in the COVID-19 period.

* Volume numbers for 2020 are annualized as of April 15, 2020.

Source: Data from Torrey's internal database of life science debt issuances.
We count 15 private debt deals in the life science sector so far in 2020. The pace of deals is significantly slower than it was in 2018 and 2019.

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<td>1/22/2020</td>
<td>Crescita Therapeutics</td>
<td>Specialty Pharma</td>
<td>USA</td>
<td>RBC</td>
<td>3.5</td>
</tr>
<tr>
<td>1/9/2020</td>
<td>ChemoCentryx</td>
<td>Biotechnology Company</td>
<td>USA</td>
<td>Hercules</td>
<td>40</td>
</tr>
<tr>
<td>1/6/2020</td>
<td>Alimera Sciences</td>
<td>Specialty Pharma</td>
<td>USA</td>
<td>Solar Capital</td>
<td>45</td>
</tr>
<tr>
<td>12/20/2019</td>
<td>Gensight</td>
<td>Biotechnology Company</td>
<td>Europe</td>
<td>Kreos</td>
<td>17</td>
</tr>
<tr>
<td>12/17/2019</td>
<td>BioNTech</td>
<td>Biotech</td>
<td>Europe</td>
<td>European Investment Bank</td>
<td>58</td>
</tr>
<tr>
<td>12/13/2019</td>
<td>Sarepta Therapeutics</td>
<td>Specialty Pharma</td>
<td>USA</td>
<td>Pharmakon</td>
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<tr>
<td>12/10/2019</td>
<td>Orchestra Biomed</td>
<td>Medical Device</td>
<td>USA</td>
<td>SVB</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Data from Torreya's internal database of life science debt issuances.
Comments from the Front Lines: What Healthcare Lenders and PE Investors are Saying

1. Cost of Capital Jumped
   “A deal that would have priced at L+6 last week is now going for L+10.”
   “Hard to push through at old prices when good credits are trading at 75% of par in the liquid market”

2. Heightened Interest in Debt Products From CFOs, But...
   With reduced equity valuations, more CFOs are considering debt capital markets.
   “I’ve actually been inundated by inbounds from CFOs who were dismissive a month ago”

3. ...Pricing Gap Still Exists
   “Most companies are slow to get their head around our terms now that the venture debt providers are on the sidelines”
   While improving, coupons jumped as those still in the market tried to price risk and leverage scarcity.
   Velocity and volume way down as a result.

4. Higher Bar
   Like their public counterparts, private investors we have spoken have “raised the bar” for what they are putting money into given the volatile environment and the fact many are reserving money for portfolio companies.
   For services focused companies, many investors want to see where the floor is before guessing at future cash flows.

5. A Rush to Medical Necessities and Telehealth/HCIT
   HC Services and Rx products linked to doctor visits are seeing major strain. There is a rush to “life saving” product companies and businesses focused on digital outsourcing. Telehealth on fire.

6. Private Equity M&A Hurt by Credit Market Conditions
   PE buyers heavily reliant on debt are struggling to finance acquisitions. Even for businesses that have performed through the pandemic, the same amount of capital is just not available.
   “Many of our lenders just won’t engage, and those that have are pricing 30% above where we built our model.”
Why Did the Debt Market Soften So Much?

High yield bond spreads (a measure of health of the credit market) jumped by six percentage points from Feb 17th to March 23rd and then started to recede. At one point, spreads hit 10%, indicating that relatively good quality bonds (rated B/BB) were trading at a huge premium over treasuries.

Weaker credits (those that were CCC) briefly traded with a spread of thirty percentage points (3000 basis points) over treasury. Traditional venture debt in the life sciences sector trades somewhere around five points over the high yield spread.

There are three types of lenders in the healthcare private field: (1) venture lenders, (2) hedge fund lenders / specialist lenders and (3) banks.

Venture lenders pulled out the market entirely because their cost of funds went through the roof and it became uneconomic to lend. Banks largely pulled out as well due to the sudden need to expand balance sheets to make stimulus loans. This left hedge fund lenders who had the choice of buying discounted liquid debt in the market or making new illiquid loans to healthcare borrowers. As one might imagine, many of these lenders are also very worried about the portfolios of loans that are already in place.
Royalty Monetization Market is Robust

The pace of royalty monetizations is on track to hit a record in 2020. This market is open and remains well funded.

Pharmaceutical Sector Royalty Monetization Volume in Life Sciences, 2011-2020

Note: Volume numbers for 2020 are annualized as of April 15, 2020.

Source: Data from Torreya’s internal database of royalty monetization transactions.
Impact on the Environment for M&A Deals
Healthcare M&A Activity Overall is Down

Through April 15, 2020 there was only $20.3bn of US healthcare M&A, implying an annualized volume of $76 billion. This represents a 2/3rds decline in volume year on year.

Source: Dealogic, CapitalIQ
While we are only three weeks into the new quarter, M&A activity in biopharma has been all but non-existent (the M&A level here has been extrapolated out for the whole quarter). Q1 was the second weakest quarter for M&A volume since the beginning of 2014.
## Biopharma M&A Activity Year to Date
(inclusive of acquisitions, mergers and asset sales)

<table>
<thead>
<tr>
<th>Deal Size ($mm)</th>
<th>Announcement Date</th>
<th>Target</th>
<th>Buyer</th>
<th>Area</th>
<th>Buyer Territory</th>
<th>Target Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td>$140</td>
<td>01/06/2020</td>
<td>Elanco’s Osumia Portfolio</td>
<td>Dechra Pharmaceuticals</td>
<td>Animal Health</td>
<td>Europe</td>
<td>US</td>
</tr>
<tr>
<td>$60</td>
<td>01/06/2020</td>
<td>Arthosurface</td>
<td>Anika Therapeutics</td>
<td>Spec Pharma</td>
<td>US</td>
<td>US</td>
</tr>
<tr>
<td>$35</td>
<td>01/06/2020</td>
<td>Parcus Medical</td>
<td>Anika Therapeutics</td>
<td>Spec Pharma</td>
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<td>US</td>
</tr>
<tr>
<td>NA</td>
<td>01/08/2020</td>
<td>Riemser</td>
<td>Esteve</td>
<td>Spec Pharma</td>
<td>Europe</td>
<td>Europe</td>
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<tr>
<td>$1,100</td>
<td>01/10/2020</td>
<td>Dermira</td>
<td>Eli Lilly</td>
<td>Spec Pharma</td>
<td>US</td>
<td>US</td>
</tr>
<tr>
<td>$35</td>
<td>01/16/2020</td>
<td>Neon Therapeutics</td>
<td>BioNTech</td>
<td>Biotech</td>
<td>Europe</td>
<td>US</td>
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<tr>
<td>$53</td>
<td>01/24/2020</td>
<td>Amerigen Product Portfolio</td>
<td>ANI Pharma</td>
<td>Generics</td>
<td>US</td>
<td>US</td>
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<tr>
<td>NA</td>
<td>01/27/2020</td>
<td>Allergan’s ZENPEP</td>
<td>Nestlé</td>
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<td>US</td>
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<tr>
<td>NA</td>
<td>01/28/2020</td>
<td>Conatus Pharmaceuticals</td>
<td>Histogen</td>
<td>Biotech</td>
<td>US</td>
<td>US</td>
</tr>
<tr>
<td>NA</td>
<td>02/02/2020</td>
<td>Fairjourney Biologics</td>
<td>Vantico</td>
<td>CRO</td>
<td>Europe</td>
<td>Europe</td>
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<tr>
<td>$375</td>
<td>02/06/2020</td>
<td>Covis Pharma</td>
<td>Apollo</td>
<td>Spec Pharma</td>
<td>US</td>
<td>US</td>
</tr>
<tr>
<td>$259</td>
<td>02/12/2020</td>
<td>Assertio’s NUCCNTA</td>
<td>Collegium Pharma</td>
<td>Spec Pharma</td>
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<td>US</td>
</tr>
<tr>
<td>$55</td>
<td>02/19/2020</td>
<td>Elanco’s Vecoxan Product</td>
<td>Merck Animal Health</td>
<td>Spec Pharma</td>
<td>India</td>
<td>India</td>
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<tr>
<td>NA</td>
<td>02/19/2020</td>
<td>Tocagen</td>
<td>Forte Biosciences</td>
<td>Biotech</td>
<td>US</td>
<td>US</td>
</tr>
<tr>
<td>$34</td>
<td>02/26/2020</td>
<td>PHARMA LIMIRIO</td>
<td>Blau Farmacêutica</td>
<td>Generics</td>
<td>Brazil</td>
<td>Brazil</td>
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<tr>
<td>$41</td>
<td>02/28/2020</td>
<td>Rights to IXINITY</td>
<td>Medexus Pharma</td>
<td>Spec Pharma</td>
<td>Canada</td>
<td>US</td>
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<tr>
<td>$4,952</td>
<td>03/02/2020</td>
<td>Forty Seven</td>
<td>Gilead Sciences</td>
<td>Biotech</td>
<td>US</td>
<td>US</td>
</tr>
<tr>
<td>$825</td>
<td>03/02/2020</td>
<td>Takeda LATAM Products</td>
<td>Hyepra</td>
<td>OTC</td>
<td>Latam</td>
<td>Japn</td>
</tr>
<tr>
<td>$85</td>
<td>03/06/2020</td>
<td>UCB Alprostidil</td>
<td>ADVANZ PHARMA</td>
<td>Spec Pharma</td>
<td>Europe</td>
<td>Europe</td>
</tr>
<tr>
<td>$600</td>
<td>03/10/2020</td>
<td>Polypus-transfection SA</td>
<td>Warburg Pincus</td>
<td>CDMO</td>
<td>Europe</td>
<td>US</td>
</tr>
<tr>
<td>$36</td>
<td>03/13/2020</td>
<td>Redx Pharma</td>
<td>Yesod Bio-Sciences</td>
<td>Biotech</td>
<td>US</td>
<td>Europe</td>
</tr>
<tr>
<td>$128</td>
<td>03/16/2020</td>
<td>Zyla Life Sciences</td>
<td>Assertio Therapeutics</td>
<td>Spec Pharma</td>
<td>US</td>
<td>US</td>
</tr>
<tr>
<td>$70</td>
<td>03/16/2020</td>
<td>Correvio Pharma</td>
<td>ADVANZ PHARMA</td>
<td>Spec Pharma</td>
<td>US</td>
<td>US</td>
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<tr>
<td>$43</td>
<td>03/16/2020</td>
<td>Kindred’s Miratax</td>
<td>Dechra Limited</td>
<td>Spec Pharma</td>
<td>US</td>
<td>Europe</td>
</tr>
<tr>
<td>$28</td>
<td>03/16/2020</td>
<td>Tetraphase Pharma</td>
<td>AcelRx Pharma</td>
<td>Animal Health</td>
<td>US</td>
<td>Europe</td>
</tr>
<tr>
<td>$274</td>
<td>03/17/2020</td>
<td>MolMed</td>
<td>Asahi Glass</td>
<td>CDMO</td>
<td>Japan</td>
<td>Europe</td>
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<tr>
<td>$161</td>
<td>03/17/2020</td>
<td>Hypera - 12 products</td>
<td>Eurofarma Laboratórios</td>
<td>OTC</td>
<td>Brazil</td>
<td>Brazil</td>
</tr>
<tr>
<td>NA</td>
<td>04/03/2020</td>
<td>Symphogen A/S</td>
<td>Servier</td>
<td>Biotech</td>
<td>Europe</td>
<td>Europe</td>
</tr>
<tr>
<td>NA</td>
<td>04/21/2020</td>
<td>Amblyotech</td>
<td>Novartis</td>
<td>Digital Health</td>
<td>Europe</td>
<td>US</td>
</tr>
<tr>
<td>$15</td>
<td>04/21/2020</td>
<td>Nanna</td>
<td>Astellas</td>
<td>Biotech</td>
<td>Japan</td>
<td>Europe</td>
</tr>
</tbody>
</table>

Source: Torreya Pharma M&A database and S&P CapitalIQ
We speak with pharma acquirers as a normal part of business. We have summarized views heard from six senior corporate development professionals in the last 60 days as the COVID-19 pandemic has unfolded. Five of these were from top 10 pharma and one was from a top 25 pharma.

Internal activity on evaluating targets and doing work in March/April 2020 time frame
5 of 6 corporate development leaders said activity was “high”, in some cases at record levels

Active in M&A during COVID-19 pandemic:
1 of 6 top pharma M&A leaders said “maybe”. The rest said “no”

Top reasons for largely staying out of the market during the pandemic:
Now is not the time for large deals. Need to stay focused on COVID-19 (mentioned by 3 of 6)
Approaching a biotech with a shaky valuation is not being a good partner (mentioned by 2 of 6)
Big M&A not in the cards for us anyway this year (mentioned by 2 of 6)
We need to focus on the state of our own business (mentioned by 1 of 6)

**Interpretation:** For the most part big pharma is very focused on doing their part to help with the COVID-19 pandemic and thinks this is not the right time for large scale acquisitions. Some firms with weaker balance sheets are also assessing any damage on themselves. We expect M&A volume to return to normal (or even exceed normal) once the pandemic has passed.
M&A Activity in the 2017-Jan 2020 Period

### Biopharma M&A Activity by Type of Buyer, 2017-Jan 30, 2020 ($millions)

<table>
<thead>
<tr>
<th>Type of Buyer</th>
<th>Number of Deals</th>
<th>Dollar Value</th>
<th>Deal Count Share</th>
<th>Dollar Value Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biotech (Rank &lt; 50)</td>
<td>46</td>
<td>$5,545</td>
<td>29.9%</td>
<td>1.5%</td>
</tr>
<tr>
<td>China Buyer</td>
<td>11</td>
<td>$2,370</td>
<td>7.1%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Private Equity</td>
<td>2</td>
<td>$14,328</td>
<td>1.3%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Commercial Pharma (Rank &lt; 50)</td>
<td>18</td>
<td>$4,661</td>
<td>11.7%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Pharma Value Rank 1-20</td>
<td>48</td>
<td>$308,894</td>
<td>31.2%</td>
<td>86.2%</td>
</tr>
<tr>
<td>Pharma Value Rank 21-50</td>
<td>29</td>
<td>$22,586</td>
<td>18.8%</td>
<td>6.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>154</strong></td>
<td><strong>$358,384</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Large pharma comprises 86% of the M&A dollar value in the pharmaceutical sector. More than half of this volume has been in oncology and neurology.

Large pharma acquisitions tend to be motivated by:
1. Replacement of revenue after patent expirations (late stage / commercial)
2. Missing pipeline in areas they are already in (early to mid-stage)
3. Want to build new areas (e.g., enter gene therapy or cell therapy)

Mid-cap companies like Alexion, Astellas, Otsuka and Vertex are also highly acquisitive but tend to have smaller budgets than big pharma. In total, companies ranked 21-50 accounted for 6% of deal volume.

### M&A Transactions by Therapeutic Area of Target Company

**Deals Under $15 Billion, 2017-Jan 30, 2020**

<table>
<thead>
<tr>
<th>Therapeutic Area</th>
<th>Deal Count</th>
<th>Value ($mm)</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oncology</td>
<td>52</td>
<td>$71,239</td>
<td>44.0%</td>
</tr>
<tr>
<td>Neurology</td>
<td>19</td>
<td>$19,481</td>
<td>12.0%</td>
</tr>
<tr>
<td>Hematology</td>
<td>7</td>
<td>$18,996</td>
<td>11.7%</td>
</tr>
<tr>
<td>Dermatology</td>
<td>6</td>
<td>$12,159</td>
<td>7.5%</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>7</td>
<td>$11,209</td>
<td>6.9%</td>
</tr>
<tr>
<td>Musculature</td>
<td>5</td>
<td>$5,966</td>
<td>3.7%</td>
</tr>
<tr>
<td>Hospital</td>
<td>5</td>
<td>$5,453</td>
<td>3.4%</td>
</tr>
<tr>
<td>Women’s Health</td>
<td>3</td>
<td>$3,045</td>
<td>1.9%</td>
</tr>
<tr>
<td>Bone</td>
<td>5</td>
<td>$2,984</td>
<td>1.8%</td>
</tr>
<tr>
<td>Vaccines</td>
<td>6</td>
<td>$2,017</td>
<td>1.2%</td>
</tr>
<tr>
<td>Respiratory</td>
<td>3</td>
<td>$1,553</td>
<td>1.0%</td>
</tr>
<tr>
<td>Gastroenterology</td>
<td>4</td>
<td>$1,524</td>
<td>0.9%</td>
</tr>
<tr>
<td>Cardiometabolic</td>
<td>5</td>
<td>$1,222</td>
<td>0.8%</td>
</tr>
<tr>
<td>Hepatology</td>
<td>6</td>
<td>$1,221</td>
<td>0.8%</td>
</tr>
<tr>
<td>Rare Disease</td>
<td>2</td>
<td>$1,176</td>
<td>0.7%</td>
</tr>
<tr>
<td>Infectious Disease</td>
<td>4</td>
<td>$668</td>
<td>0.4%</td>
</tr>
<tr>
<td>Immunology</td>
<td>4</td>
<td>$595</td>
<td>0.4%</td>
</tr>
<tr>
<td>Renal</td>
<td>2</td>
<td>$576</td>
<td>0.4%</td>
</tr>
<tr>
<td>Endocrinology</td>
<td>4</td>
<td>$354</td>
<td>0.2%</td>
</tr>
<tr>
<td>Platform</td>
<td>3</td>
<td>$169</td>
<td>0.1%</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>1</td>
<td>$90</td>
<td>0.1%</td>
</tr>
<tr>
<td>Pain</td>
<td>1</td>
<td>$80</td>
<td>0.0%</td>
</tr>
<tr>
<td>Biodefense</td>
<td>1</td>
<td>$8</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Source: Torreya analysis of its internal M&A database. Transactions with value < $10mm excluded.
Predictions for M&A After the COVID-19 Pandemic

We have spoken to the great majority of large pharma acquirors in the last few quarters about their M&A “wish lists” and intentions. Discussions in the last month have confirmed that these interests remain, if anything, stronger today. Based on these discussions our predictions for biopharma M&A are as follows:

1. High M&A volume in precision oncology likely
2. High M&A volume in novel therapeutics for genetic disease likely, especially in neurology
3. Medium M&A volume in immuno-oncology with a focus on novel targets and game-changing cell therapy
4. Medium M&A volume in immunology, eye, kidney and neuro
5. Other therapeutic areas will see less volume
6. Late stage assets with differentiation and outstanding efficacy against real medical need always in demand
We have mapped the M&A “wish lists” of 90 frequent or likely acquirers in the biopharma sector to over 1300 potential targets and classified them by therapeutic area. This resulted in the table at right which shows TA’s where there are lot of buyers and few sellers and vice-versa.

The biggest imbalances favoring sellers are in renal, precision oncology, hospital products, hematology, genetically targeted neuroscience, innovative women’s health, innovative dermatology and fibrosis.

The areas of most intense buyer interest are precision oncology (e.g., the next Loxo) and genetic medicine in serious neurologic disease (e.g., the next AveXis).
Impact on the Environment for Pharmaceutical Licensing
Annual Worldwide Pharmaceutical Licensing Activity

Volume of Pharmaceutical Industry License Deals Per Month
All License Types, 2010-2020

Unlike the M&A market, both licensing deal count and estimated aggregate transaction value in 2020 is at a record level. We believe that this reflects long-term secular trend of growth of the sector and associated transaction activity rather than anything remarkable about 2020 itself.

Notes/Sources: BioPharm Insight data. We extrapolated 2020 volume for the for period Jan 1 to April 15 out to the full year. Deal value is estimated as the sum of the upfront payment plus 25% of all other milestone payments.
The volume of pharma licensing deals has been above the median in three out of four months thus far in 2020.

**Number of Pharmaceutical Industry License Deals Per Month**
All License Types, Jan 2018-April 2020

**Monthly median: 55 deals**

Notes/Sources: BioPharm Insight data, we extrapolated April 2020 volume for the full month as of April 15th.
The pharmaceutical industry is open for business. Most major players are active in the licensing market today.
Recent License Deals

On April 8, 2020, Arrakis Therapeutics entered into a strategic collaboration and licensing agreement with Roche for the discovery of RNA-targeted small molecule (rSM) drugs against a broad set of targets across all of Roche’s research and development areas. The terms of the deal include an upfront payment of $190mm in cash and potential milestone payments and royalties for resulting products.

On April 2, 2020, Fate Therapeutics entered a collaboration and option agreement with Janssen Biotech that leverages Company’s iPSC platform and Janssen’s tumor-targeting antigen binders to create novel CAR NK and CAR T-Cell product candidates. Terms include a $50mm upfront payment and $50mm equity investment, plus full R&D funding for candidates through IND filing, as well as up to $3bn in milestones, plus royalties on resulting products.

On March 31, 2020, Sitryx entered into a collaboration and licensing agreement with Eli Lilly for the assessment of up to four novel preclinical targets that may help develop medicines for autoimmune diseases. Terms include a $50mm upfront payment and $10mm equity investment with development milestones up to $820 million, as well as commercialization milestones and royalty payments on potential sales in the mid- to high-single digits.

The Arrakis and Fate deals illustrate pharma’s increasing interest in genetic medicine and cell therapy. The Sitryx deal is consistent with Lilly’s long-term declared intention to build out in treatments for immunologic disease.
Impact on the Environment for Licensing into Japan
Japan In-Licensing Deal Activity is Steady Despite COVID-19

Number of Pharmaceutical In-Licensing Deals for Japan Rights, 1998-2020
(annualized as of 4/15/2020)

Source: Torreya Japan Deal Database, April 2020
Recent Transactions into Japan

On April 14, 2020 Evox Therapeutics Ltd, a leading exosome therapeutics company, and Takeda Pharmaceutical Company Limited have entered into the multi-target collaboration, focusing on developing up to five novel protein replacement and mRNA therapies, including Evox’s preclinical program in Niemann-Pick disease type C (NPC) and a second new program directed at another undisclosed rare disease. Evox will be eligible to receive up to $44 million in upfront, near-term milestone payments and research funding in total of approximately $882 million in development, and commercial milestone payments as well as tiered royalties on net sales of each product from Takeda.

On March 23, 2020 CytomX Therapeutics, Inc. and Astellas Pharma Inc. entered into a strategic collaboration agreement focused on the discovery, development and commercialization of novel T-cell engaging bispecific antibodies targeting CD3 and tumor antigens for the treatment of cancer. The parties will use CytomX’s Probody® therapeutic technology platform, as well as its proprietary bispecific formats. Astellas will make an upfront cash payment of $80 million to CytomX with CytomX eligible to receive future preclinical, clinical and commercial milestones of over $1.6 billion as well as tiered royalties on global net sales that range from high-single digits to mid-teens.

On April 14, 2020 MEI Pharma, Inc. and Kyowa Kirin Co., Ltd. entered into a global license, development and commercialization agreement to develop and commercialize MEI’s ME-401, an oral, once-daily, investigational drug-candidate, selective for phosphatidylinositol 3-kinase delta (PI3Kδ), for B-cell malignancies. MEI will receive $100 million in an upfront cash payment and is eligible to receive up to an additional $582.5 million based on the achievement of specified development, regulatory and commercial milestones.
Covid-19 Cases in Japan and Impact on Pharma Deals

On April 20, Japan’s COVID-19 infections totaled 11,463 with 184 deaths, inclusive of those detected at the cruise ship.

Prime Minister Shinzo Abe declared a state of emergency on April 8 for all 47 prefectures and asked the public to reduce person-to-person contact by 70 to 80 percent to contain the pandemic.

However, it has turned out only 40%-50% reduction occurred on April 20 because a) most small-mid size companies can’t afford portable workstations and b) small-mid size shops refuse to close because no government subsidy is yet to be guaranteed.

Pharma companies have generally become more adapted to ‘work-from-home’ practices than other industries.

Big companies have no change in speed, but smaller size companies have become slower in responding.

The latter companies have traditionally relied on face to face decision-making through a committee system and may find it difficult in making larger licensing and/or M&A decisions.
Global Plasma Leaders Collaborate to Accelerate Development of Potential COVID-19 Hyperimmune Therapy

April 6, 2020

Partnership brings together world-leading plasma companies to focus on developing and delivering a hyperimmune immunoglobulin in the global fight against COVID-19

Osaka, JAPAN, and King of Prussia, PA, USA – April 6, 2020 – Biotest, BPL, LFB, and Octapharma have joined an alliance formed by CSL Behring (ASX:CSL/USOTC:CSLLY) and Takeda Pharmaceutical Company Limited (TSE:4502/NYSE:TAK) to develop a potential plasma-derived therapy for treating COVID-19. The alliance will begin immediately with the investigational development of one, unbranded anti-SARS-CoV-2 polyclonal hyperimmune immunoglobulin medicine with the potential to treat individuals with serious complications from COVID-19.

“Unprecedented times call for bold moves,” said Julie Kim, President of Plasma-Derived Therapies Business Unit, Takeda. “We collectively agree that by collaborating and bringing industry resources together, we could accelerate bringing a potential therapy to market as well as increase the potential supply. We invite companies and institutions focusing on plasma to support or join our alliance.”

“Leaders lead during uncertainty. There is no question that we are all experiencing the impact of COVID-19,” said Bill Mezzanotte, CSL Behring’s Executive Vice President and Head of Research and Development. “This effort aims to accelerate a reliable, scalable and sustainable option for caregivers to treat patients suffering from the impact of COVID-19. In addition to pooling industry resources, we will also collaborate with government and academic efforts as a single alliance whenever we can, including important activities like clinical trials. This will make it more efficient in these hectic times for these stakeholders as well.”
Impact on the Environment for Licensing into China
China In-Licensing Deal Activity is Up Despite COVID-19

Number of Pharmaceutical In-Licensing Deals for China Rights, 2004-2020
(annualized as of 4/15/2020)

Source: Torreya China Deal Database, April 2020
Dollar Volume of Investment & Upfronts in China Licensing Deals

Volume of Upfront Payments, Milestones and Investment in China Deals, 2004-2020 ($mm) (annualized as of 4/15/2020)

Source: Torrey China Deal Database, April 2020
**Comments from the Deal Front Lines in China**

We speak with China pharma companies and investors as a normal part of business. We have summarized views heard from over two dozen business development professionals in the last 30 days as China has resumed business activities.

<table>
<thead>
<tr>
<th><strong>Interest in licensing-in products is quite high</strong></th>
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<tbody>
<tr>
<td>Most groups are looking for innovative assets</td>
</tr>
<tr>
<td>Access to capital is very good and many new companies have been able to raise funds</td>
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</table>

**We are “back to work” but life has changed**

- It is mandatory to wear a face mask when in public throughout China
- Not everyone is working from the same place as before – more distributed work taking place
- A sense of urgency to do what can be done to improve healthcare in China

**Government supportive of pharma innovation**

- More favorable regulatory policies and patent regulations expected to be released in 2020
- Interest in products to prevent COVID-19 and future pandemics is also in place

**Global pharma getting more serious about the China market**

- Last year we saw a major collaboration between Amgen and BeiGene allowing Amgen greater presence
- We also saw Pfizer move its Upjohn subsidiary HQ to China (with Mylan now called Viatris)
- Torreya is seeing other global pharmas show increased interest in building presence in China
Recent Transactions into China

**On April 8, 2020,** Zai Lab obtained rights to develop and commercialize REGN1979 (CD20xCD3 bispecific antibody) in oncology in Greater China for $30mm upfront, $160mm in milestones and royalties. Collaboration will also support enrollment of patients into Regeneron’s global trials evaluating REGN1979 in Non-Hodgkins Lymphoma.

**On January 8, 2020,** Shield Therapeutics licensed Feraccru®/Accrufer® to Ask Pharma in Greater China. Shield will receive an upfront payment of $11.4 million and is eligible to receive a further $11.4 million upon regulatory approval in China. Shield will also receive up to US$40 million in milestones and royalties. Torreya advised Shield Therapeutics.

**On April 5, 2020,** Japanese infectious disease specialist Shionogi & Co. Ltd. announced it will partner with Chinese insurance giant Ping An to establish a data-driven joint venture in Hong Kong to develop new drugs for China in a deal involving $311 million paid by Ping An for a 2% stake in Shionogi. Shionogi will own 51% of the joint venture while Ping An owns 49%.
Our data show that China deal volume through April 15th is at a record dollar volume level and close to a record in terms of deal count.

This seems hard to explain because China as a country was basically shut down for much of Q1.

Interestingly, when one delves into the data the following becomes apparent:

- The first day with more than 1,000 new cases of COVID-19 was Jan 28, 2020.
- The last day with more than 1,000 new cases was Feb 22nd, 2020. Following this day, China remained with enforced social distancing for another two to three weeks.
- From Jan 27th to March 4th, 2020 there were no deal announcements out of China. And more than half of new announcements have come in just the last four weeks.

We think this is quite interesting as it may foreshadow what is to come in the M&A market in the rest of the world. Once it is politically and logistically practical to carry out M&A, we think this activity will resume at levels close to where it previously was.
Impact on Digital Therapeutics and Telehealth
Digitization of Healthcare is Accelerating

**Telehealth**
Remote access to physicians and medical support

**Digital Therapeutics**
Computerized treatments of disease via apps and other digital formats will become commonplace

**AI / Big Data**
AI combined with big data is transforming drug development, treatment decisions and diagnostics. Intersection with genomics important

**Bioelectronics**
Our bodies will increasingly be assisted by implantables with a focus on real time treatment of disease

**Digital Era**
Rapidly Transforming Medicine
Rapid Increase in Telehealth Utilization in Recent Months

**United States**

IQVIA notes that usage of telehealth rose by 14 times from the January/February time period to the first week of April 2020.*

We saw particularly high usage of telemedicine for psychiatric, rheumatic and endocrinology.

U.S. prescription volume has been held up, to some degree, by telemedicine. We have gone from a national average of 79 million new prescriptions weekly to around 71 million new prescriptions.

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**Europe and Asia**

Vasileios Nittas, Professor of Epidemiology, University of Zurich (April 7, 2020):#

“Telehealth services are rapidly becoming a major force in the effort to reduce healthcare-related COVID-19 transmissions, and ultimately protecting our health personnel. The effectiveness of telemedicine has been promising for many health areas, including diabetic care, dermatology and cardiology; allowing for high-quality remote care, while saving time and valuable physical space.”

Rockwell and Gilroy (April 2020):

“Many European Union countries and countries in Asia have expanded laws and regulations to permit greater adoption of telemedicine systems...”

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Digital Therapeutics Also Accelerating during COVID-19 Period: FDA Encouraging Digital Psychiatry, For Example

The FDA recognizes the importance of providing patients ongoing access to behavioral therapies and has posted new guidelines to facilitate the use of digital health devices during COVID-19.

**Overview of FDA Guidelines for Digital Health Devices For Treating Psychiatric Disorders During COVID-19**

- During the pandemic, the FDA is allowing digital therapeutics that treat psychiatric disorders that would normally require a 510(K) clearance or other market authorization to go to market without FDA approval.
- Device availability may increase patient access to therapy while maintaining "stay at home" orders and ease the burden on hospitals and other healthcare facilities.
- The scope of the policy applies to the following types of *adjunct* digital therapies:
  1. Computerized Behavioral Therapy Devices, which are typically prescription-only
  2. Low risk general wellness and digital health products for mental health or psychiatric conditions, this includes products that have not pursued an FDA approval, but have typically been commercialized via health plans or DTC.

**What Indications Are Included?**

- Relevant psychiatric conditions include, but are not limited to:
  - Obsessive-Compulsive Disorder
  - Generalized Anxiety Disorder
  - Insomnia Disorder
  - Major Depressive Disorder
  - Substance Use Disorder
  - Post-traumatic Stress Disorder
  - Autism Spectrum Disorder
  - Attention Deficit Hyperactivity Disorder

**Implications and Opportunity**

- Demonstrates the value and importance of digital therapies to all key healthcare stakeholders: patients, HCPs, pharma and health systems/payers.
- Companies awaiting FDA approval may opt to launch their products ahead of schedule.
- Digital therapies that are not FDA approved and currently commercialized via health systems and self-insured may use this opportunity to expand their reach to HCP’s.
Key Emerging Digital Companies

**Digital Therapeutics**
- Akili
- Apple
- Lark
- Happify
- Luminopia
- Noom
- PEAR Therapeutics
- Omada
- Talkspace
- Proteus
- Vivante Health
- Quartet
- Welldoc

**Telehealth - Access**
- Amazon
- Cricket Health
- Amwell
- Babylon
- Livongo
- Ping An
- HomeDoc
- Philips Healthcare
- Singtel
- TytoCare

**Telehealth - Pharma**
- Capsule
- GoodRx
- Hims
- Nurx
- Pill Club
- Veru Healthcare

**AI / Big Data**
- 23andMe
- A2A Pharma
- BenevolentAI
- Deepmatter
- Color
- Freenome
- Grafal
- Modern Health
- Lantern Pharma
- Molecular Health
- NantHealth
- Nomad
- Oscar
- PathAI
- Roche
- Saama
- Schrödinger
- Tempus
- Veeva
- Verily

**Bioelectronics**
- AliveCor
- Axon Therapies
- Biotronik
- Boston Scientific
- Cala Health
- Galvani Bioelectronics
- Ota Biosciences
- Kernel
- Neuralink
- Neuspera
- Saluda Medical
- SetPoint Medical

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**Recent Transactions of Note**

**Large pharma M&A of a digital therapeutic**

“Basel, April 20, 2020 — Novartis announced today that it has completed the acquisition of Amblyotech, a US-based software startup, and will, in collaboration with Ubisoft and McGill University, pursue the development of the acquired digital technology for the treatment of amblyopia.”

**Mainstream biopharma VC in telehealth**

Venture Beat (April 7, 2020): “Tyto Care raises $50 million to And it’s against that backdrop [COVID-19] that Tyto Care, a New York-headquartered telehealth startup with Israeli roots, announced that it had raised $50 million in a round of funding co-led by Insight Partners, Olive Tree Ventures, and Qualcomm Ventures, with Orbimed, Echo Health, Qure, Teuza, and others.”

**Largest therapeutics IPO in AI**

“Feb 10, 2020 - Schrödinger, Inc. (Nasdaq: SDGR), whose differentiated, physics-based software platform enables discovery of high-quality, novel molecules for drug development and materials applications, today announced the closing of its initial public offering of 13,664,704 shares of common stock at a public offering price of $17.00 per share.” Market cap today: $2.5bn
Summary and a Look to the Future
As we write this report we are seeing new cases of COVID-19 start to decline for the first time around the world.

The time period to achieve the effects of social distancing has been longer in Europe and North America than in China, reflecting differences in governance systems. The time required to fully eradicate the threat of COVID-19 to humanity is unknown.

But it appears likely that business activities will resume to some extent in most countries by Summer of 2020 if not sooner.

This will depend on the strength of policymakers’ resolve and compliance with social distancing by country.

Despite massive stimulus measures taken in Europe and the United States, it is expected that GDP will show a severe decline in Q1 and Q2 2020.

There will be some instability in the system going forward but a strong economic recovery in the latter half of 2020 looks increasingly likely. This is not assured to be smooth by any means as real shocks have taken place. The stock market in recent weeks has been predicting a strong recovery. Historically, the stock market has been a good forward predictor of economic activity.

China provides forward signs of what we can expect. The Chinese economy suffered greatly in Q1 2020 and is showing gradual signs of recovery as we write this report in mid-April 2020.

Revenues in the pharma sector will be impacted along with the rest of the economy. Patients have slowed new starts and physicians have been focused on those afflicted with COVID-19.

Amidst the pandemic, the pharma sector has stepped up. We count more than 50 programs started to help treat the disease. Every major global pharma has undertaken initiatives to help society with the COVID-19 crisis, in many cases, diverting significant R&D resources to development of new vaccines and antivirals for COVID-19. Many have also made medicines available to patients in this time at concessionary prices. Others have donated supplies of key drugs such as hydroxychloroquine to governments at little to zero cost.
## Summary of Impact of COVID-19 Pandemic on the Biopharma Financing and Deal Environment

Based on analysis in this report, we expect the economy to take some time to fully recover, while the biotech market has regained lost ground rapidly. Using history as a guide, we expect to see an increase in follow-ons, followed by a fuller recovery of the IPO market. The debt market will take some time to come back as many healthcare credit funds have investment in commercial stage companies that have been severely impacted by social distancing policies. We see the M&A market as likely to pick up significantly in the next quarter. We also expect regional and global licensing activity to remain robust.

<table>
<thead>
<tr>
<th>Market</th>
<th>Status Prior to COVID-19 Outbreak</th>
<th>Status – March 22, 2020</th>
<th>Status – April 22, 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Economy – G7 Countries</td>
<td>Strong</td>
<td>Weak</td>
<td>Weak</td>
</tr>
<tr>
<td>Public Biotech Market</td>
<td>Strong</td>
<td>Weak</td>
<td>Slowed</td>
</tr>
<tr>
<td>Market for New Equity Issuance</td>
<td>Strong</td>
<td>Stopped</td>
<td>Weak</td>
</tr>
<tr>
<td>Private Venture Equity Market</td>
<td>Strong</td>
<td>Slow</td>
<td>Picking Up</td>
</tr>
<tr>
<td>Private Debt Capital Markets</td>
<td>Strong</td>
<td>Slow</td>
<td>Weak</td>
</tr>
<tr>
<td>Royalty Monetization Market</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>Biopharma M&amp;A</td>
<td>Strong</td>
<td>Stopped</td>
<td>Weak</td>
</tr>
<tr>
<td>Biopharma Licensing</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>China Regional Licensing</td>
<td>Strong</td>
<td>Stopped</td>
<td>Strong</td>
</tr>
</tbody>
</table>

We are cautiously optimistic about the outlook for markets going forward. We see the credit markets and the IPO market as being most likely to be slow in recovery. We see the M&A and follow-on equity markets as likely to pick up within a quarter or two.
History also teaches us that major economic disruptions can have lasting economic effects. While the episode should be short in historical terms, we believe that there will be important effects of the COVID-19 pandemic and associated policy response. Our best guess as to what these might be includes the following:

### Greater Budget Pressures

The bottom line is that governments are committing trillions to stimulus response. With a temporarily weakened economy it will be years to get budgets to where they were before. A consequence will be less overall spending on healthcare relative to GDP going forward. In the US, roughly half of healthcare is paid for Medicare and Medicaid (both federal and local spend). The other half is paid for by private carriers. With an economic downturn and high unemployment, the pressure on the Medicaid system is going to rise, putting unwanted pressure on states.

### Great Focus on Health Security

In the announcement of its new fund, Flagship speaks of: “the launching of an initiative focused on Health Security, which is designed to create a range of products and therapies to improve societal health defenses by treating pre-disease states before they escalate. The current COVID-19 crisis deeply underscores the essential need for a comprehensive Health Security initiative to complement our current health care system.” We think Flagship’s idea presages a general social reprioritization of the importance of “biological defense” and further investment in the area.

### Greater Focus on Infectious Disease

Society’s relatively parsimonious budgets for pandemic preparedness in particular highlights underinvestment in therapeutics for infectious disease in general. We should see increased spend in this area and better reimbursement for anti-infectives and virology products overall. Recent decades have seen increased spend on specialty medicines, especially for rare disease, autoimmune disease treatments and cancer care. The fraction of budgets available for infectious disease should rise and crowd out this spend to some degree.
## Looking to the Future (continued)

<table>
<thead>
<tr>
<th>Supply Chain Adjustment</th>
<th>A Boom in Telehealth and Digital</th>
<th>Greater Support for Bio Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>As mentioned in this report, the COVID pandemic has highlighted issues with long cross-border supply chains for inputs to medicine manufacture including starting material, excipients, API and formulations. We expect to see greater redundancy get built into the supply chain over time. We also expect to see greater local production of pharmaceutical inputs and products for essential medicines. We expect to see groups around the world that are focused on medicine stockpiling (e.g., CivicaRx) become more important and gain resources.</td>
<td>We have made more progress in telehealth usage in the last sixty days than in the previous five years. We expect that telehealth will become a permanent fixture. We see good times ahead for companies like Amwell, Lemonaid, Pill Club, Teladoc and Veru. We expect to see greater focus here, improvement in platforms and consolidation in this area. The importance of digital therapeutics, AI and bioelectronics is likely to rise. Many persons, for the first time, have used digital therapeutics in recent months. This exposure bodes well for this area.</td>
<td>Social awareness of the importance of the biopharma sector is at an all time high (as one might imagine). This is a positive factor that can help offset years of bad press. We expect to see greater support in governments and markets for innovation. Interest in biotech from all quarters will rise. Attacks on the pharma sector feel to us to be likely misplaced following the COVID-19 pandemic. If pharma companies can avoid egregious price increases it feels likely that societal and political support for the industry will shift in a positive direction.</td>
</tr>
</tbody>
</table>
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