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Managed Care & Facilities
COVID-19 Daily Tracker: April 28, 2020

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Recent public health readiness guidelines from the White House and the National Governors Association emphasize sustained declines in COVID-19 cases and/or % of tests that are positive over a 14-day period as a key threshold that must be met before reopening of the economy. The decline in cases would appear to be the simplest measure and one that should be improving in many states 40+ days post lockdown. However, the trend of decline has been upset by recent ebbs and flows in testing capacity which have served to cloud our ability to quantify progress on this measure (today's data was an improvement with an increase of only 2.3%, down 60bp d/d). Given this complication, we are increasingly focusing on the trend in % of positive tests, which today stands at 17.5%. This is a significant improvement from 19.2% just a week ago, though even here it is difficult to determine if gains are simply attributable to expansion in testing beyond those who are symptomatic (itself positive) or indicative of a decline in prevalence.

- **GLOBAL CASES:** Total global confirmed cases of COVID-19 reached 2.88mn as of April 27th, representing an increase of 2.6% over the prior day. **The US has the most confirmed cases (981.1K), followed by Spain (207.6K) and Italy (197.7K).**

- **US TESTING**: After two-weeks stuck at a run rate of ~1mn diagnostic tests per week, **the weekly test rate appears to have increased to ~2.0mn inclusive of 190K+ tests reported yesterday** (and excluding a boost from recent reporting changes in CA).

- **USA:** There were 981,134 cases in the US**, an increase of 2.3% from the prior day, with the growth rate down 60bps. Percentage of positive cases declined 20bp d/d to 17.5%.**

- **NEW YORK STATE:** 292.0K cases, up 1.4% from the prior day. Case growth decelerated to 4.0K d/d, **down significantly from the increase of 10.6K two days ago. Within New York City, growth of 1.4% was the lowest rate we have seen and new daily cases were the lowest number added since April 5th.** There was a modest decline in daily tests in the state though the decline in cases was more significant than the decline in tests.

- **U.S. HOSPITALIZATIONS:** Though New York has been slow to provide data, press briefings by the Governor allow us to update recent data on current hospitalizations as of April 26th. The number of hospitalized individuals has declined each day from April 12th (18.8K hospitalizations) to April 25th (12.7K). In other words, **there has been a clear stabilization and decline in net new hospitalizations.**

- **ICU UTILIZATION:** ~9.7K ICU beds currently in use, which is <u>down</u> 35% from the prior day, perhaps an anomaly. The rate of ICU as a % of positive cases was down 56bps to 1.0%.

<u>Case Summary:</u> **Changes in Cases Indexed to April 3 (3 day averages every 3 days)**

Source: Nephron Research, The COVID Tracking Project

Please see important disclosures at the end of this report.

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COVID-19 Daily Tracker – Summary of Today's Update

Case Growth (i.e.: Where are we now?):

We have again streamlined the COVID-19 Tracker around three primary topics: Case Growth, Trajectory and Mortality

- **GLOBAL CASES:** Total global confirmed cases of COVID-19 reached 2.88 million as of April 27th, representing an increase of 2.6% over the prior day. **The US has the most confirmed cases (981.1K), followed by Spain (207.6K) and Italy (197.7K).**

- **USA:** The data shows a decline in new cases to a normalized level. We continue to see in case growth directly tied to testing totals. There were 981,134 cases in the US**, an increase of 2.3% from the prior day, with the growth rate down 60bps. The percentage of positive cases as a % of total testing also ticked down 20bps to 17.5% (the lowest level since March 31st), which helps corroborate the fact case growth is related to testing increases.**

- **NEW YORK STATE:** 292.0K cases, up 1.4% from the prior day. Case growth decelerated to 4.0K d/d, **down from the increase of 5.9K in the previous day. This is the lowest d/d increase since March 21st. Within New York City, growth of 1.4% is the lowest rate period. The absolute number of new daily cases ticked down and is the lowest number added since April 5th.** There was a modest decline in daily tests in the state though the decline in cases was more significant than the decline in tests.

- **U.S. HOSPITALIZATIONS:** Though New York has been slow to provide data, press briefings by the Governor allow us to update recent data on current hospitalizations as of April 26th. The number of hospitalized individuals has declined each day from April 12th (18.8K hospitalizations) to April 26th (12.7K). In other words, **there has been a clear stabilization and decline in net new hospitalizations.**

- **ICU UTILIZATION: ~9.7K ICU beds that are currently in use, which is down 35% from the prior day**. It certainly possible that this is an anomaly in the reported data, and we could see a commensurate increase tomorrow. **The rate of ICU as a % of positive cases was down 56bps to 1.0%.** We are monitoring this closely as we would like to see fewer positive cases require the highest (and least supplied) level of care.

COVID-19 Trajectory (i.e.: What happens next?)

- **TESTING UPDATE: After two-weeks stuck at a run rate of ~1mn diagnostic tests per week, the weekly test rate appears to now be running ~2.0mn inclusive of the lower 190K+ tests reported yesterday (and excluding a boost from reporting changes in CA).** While a substantial improvement, we remain well below the 3.5-5.5mn level epidemiologists suggests is required.

- **PEAK CASE GROWTH:** China and Italy saw peak daily case growth at 10 days and 13 days post lockdown vs Spain at 18 days. **In comparison, the US recorded a daily high in new cases April 25th, resetting fifteen days since the previous peak achieved April 10.**

Mortality (i.e.: How many have we lost?)

- **GLOBAL MORTALITY:** Global deaths reached 198.7K, representing an increase of 5.0K, or **2.6%**, relative to the prior day. **The US continues to have the greatest number of deaths (50.3K), followed by Italy (26.6K) and Spain (23.2K).**

Headlines and Updates

U.S. Governors Move Ahead With Reopening, Despite Health Worries - New York Times

Several states, including Texas and Florida, have stay-at-home orders expiring this week. "That executive order has done its job to slow the growth of Covid-19," Gov. Greg Abbott of Texas said. Governors across the country forged ahead Monday with plans to reopen their economies, even as the nation hit a grim milestone of 50,000 deaths from the coronavirus and public health experts warned against lifting stay-at-home orders too quickly. Numerous states, including some of the largest, began the process of lifting shelter orders in what could be a pivotal stage in the U.S. response to the pandemic.

In Race for a Coronavirus Vaccine, an Oxford Group Leaps Ahead - New York Times

In the worldwide race for a vaccine to stop the coronavirus, the laboratory sprinting fastest is at Oxford University. Most other teams have had to start with small clinical trials of a few hundred participants to demonstrate safety. But scientists at the university's Jenner Institute had a head start on a vaccine, having proved in previous trials that similar inoculations — including one last year against an earlier coronavirus — were harmless to humans. That has enabled them to leap ahead and schedule tests of their new coronavirus vaccine involving more than 6,000 people by the end of next month, hoping to show not only that it is safe, but also that it works.

How New Zealand 'eliminated' Covid-19 after weeks of lockdown – CNN

After weeks of lockdown, New Zealand has achieved its ambitious goal of eliminating the coronavirus. But the country isn't celebrating yet. Over the past few days, newly diagnosed infections have been in the single digits. And on Monday, New Zealand reported just one new case. "That does give us confidence that we've achieved our goal of elimination, which never meant zero but it does mean we know where our cases are coming from," Ashley Bloomfield, New Zealand's Director General of Health, said on Monday, adding that there was only one case since April 1 where authorities were still investigating the source of infection.

Consumer Beware: Coronavirus Antibody Tests Are Still A Work In Progress – Kaiser Health News

After hearing for months about serious access issues involving tests that diagnose COVID-19 based on swabs from the nose or throat, Americans are being inundated with reports about promising new tests that look for signs of infection in the blood. There are high hopes for these antibody tests, which detect proteins that form in blood as part of the body's immune response to an invading virus.

N.Y.C. Deaths Reach 6 Times the Normal Level, Far More Than Coronavirus Count Suggests – New York Time

More than 27,000 New Yorkers have died since the start of the novel coronavirus outbreak in March — 20,900 more than would be expected over this period and thousands more than have been captured by official coronavirus death statistics. As of Sunday, the city had attributed 16,673 deaths to coronavirus, either because people had tested positive for the virus, or because the circumstances of their death meant that city health officials believed the virus to be the most likely cause of death. But there remains a large gap between this number and the total deaths above typical levels in the last six and a half weeks: more than 4,200 people whose deaths are not captured by the official coronavirus toll.

Behind the data: Breaking down the statistical models of COVID-19 – Atlanta Journal-Constitution

The public's thirst for information about the coronavirus has sharply elevated the profiles of academic and government research institutions that analyze data about the virus. The COVID-19 tracker developed by Johns Hopkins University became a near-constant image on cable news, showing new cases glowing red in hotspots around the world.But there are other sources that go beyond recording new cases, deaths and mapping them around the world. These sources take data about the virus and forecast the future. But they each do it in different ways and it's important to understand the differences.

'Quarantine Fatigue' Has More People Going Outside – New York Times

For more than a month, governors in a vast majority of states have urged people to stay indoors and away from one another, critical measures needed to slow the spread of the coronavirus. But as the lockdowns drag on, the weather gets warmer and some states move to reopen, researchers at the University of Maryland have found that more people across the country are going outside, that they are doing so more frequently and that they are traveling longer distances.

Trump Administration Has Enough Tests for 2% of Each State's Population, Official Says – Wall Street Journal

"We're deploying the full power and strength of the federal government to help states, cities, to help local governments get this horrible plague over with," Mr. Trump said in a Rose Garden press conference, in which he was joined by several executives. Adm. Brett Giroir, the administration official overseeing coronavirus testing efforts, said the federal government would be able to supply every state with the supplies and tests they need to "dramatically increase" the number of tests.

Pence to visit Mayo Clinic to learn about testing 'moonshot' – Associated Press

Vice President Mike Pence has an appointment Tuesday at Minnesota's Mayo Clinic to learn about a new coronavirus testing "moonshot" that has the famed clinic partnering with the state and its flagship university to quickly boost the state's capacity to 20,000 tests a day. It's an approach that leverages a health care infrastructure not all states can match. And it should help Minnesota become one of the most aggressive states at testing on the scale experts say is necessary to safely reopen the economy. Minnesota is one of several states that have quit waiting for the federal government for help.

1 in 4 in NYC May Have Been Infected, New Study Finds – NBC New York

Nearly two months into the region's coronavirus pandemic, New York released new data Monday showing that nearly 15 percent of those tested had antibodies to the virus — suggesting as many as 2.9 million New Yorkers may have been infected at some point, fully 10 times what the state has reported officially. The numbers are even higher in New York City — antibody testing found a positivity rate of 24.7 percent in city samples, suggesting almost 2.1 million city residents could have been infected at some point.

Case Growth – Where are we now?

Total global confirmed cases of COVID-19 reached 2.88 million as of April 27th, representing an increase of 2.6% relative to the previous day. The US has the most confirmed infections in the world, followed by Spain and Italy. Among the five countries with the most infections, **the US saw the largest absolute increase in documented cases, with 21.9K (2.3%) additional individuals testing positive for the virus. This is the second consecutive day of declining growth.** The UK had the second highest case growth on April 27th, with confirmed cases increasing 4.5K (3.0%) d/d. **Spain saw a retroactive decrease of 12.1K,** as the country's Ministry of Health, Consumer Affairs and Social Welfare revised its total case count to reflect positives derived only from certain types of tests (i.e. serological test positives were removed).

Over the past three days, case growth in the US, Germany, and Italy has decelerated.

In the chart below, we display changes in cases among the five countries with the most confirmed infections. To start, we note that Italy is seeing a gradual decline in daily case growth. Over the past 3 days, **Italy's average daily case growth was 2.6K (1.3%),** which compares to average growth of 2.9K (1.6%) over the preceding 3-day period. **Germany has also seen a slight downtick in daily case growth, with average d/d increases of 1.6K (1.1%) over the past 3 days**. This compares to average growth of 2.3K (1.6%) in the prior 3-day period. Finally, we note that **US case growth has also decelerated in recent days.** Over the past 3 days, **the US' average daily case growth has been 28.3K (3.1%)**, which compares to average d/d case growth of 31.3K (3.8%) from April 22nd to April 24th.

**Fig. 1: Confirmed Case Tracker, Top 5 Countries**

Date	World Total	U.S.			Spain			Italy			Germany			U.K.		
		Total	D/D	% D/D	Total	D/D	% D/D	Total	D/D	% D/D	Total	D/D	% D/D	Total	D/D	% D/D
13-Apr	1,773,084	576,875	24,969	5%	166,019	4,167	3%	156,363	4,092	3%	123,016	2,537	2%	84,283	5,288	7%
14-Apr	1,844,863	602,668	25,793	4%	169,496	3,477	2%	159,516	3,153	2%	125,098	2,082	2%	88,625	4,342	5%
15-Apr	1,914,916	633,112	30,444	5%	172,541	3,045	2%	162,488	2,972	2%	127,584	2,486	2%	93,877	5,252	6%
16-Apr	1,991,562	664,129	31,017	5%	177,633	5,092	3%	165,155	2,667	2%	130,450	2,866	2%	98,480	4,603	5%
17-Apr	2,074,529	695,761	31,632	5%	182,816	5,183	3%	168,941	3,786	2%	133,830	3,380	3%	103,097	4,617	5%
18-Apr	2,160,207	723,776	28,015	4%	188,068	5,252	3%	172,434	3,493	2%	137,439	3,609	3%	108,696	5,599	5%
19-Apr	2,241,359	751,287	27,511	4%	191,726	3,658	2%	175,925	3,491	2%	139,897	2,458	2%	114,221	5,525	5%
20-Apr	2,314,621	776,419	25,132	3%	195,944	4,218	2%	178,972	3,047	2%	141,672	1,775	1%	120,071	5,850	5%
21-Apr	2,397,216	802,330	25,911	3%	200,210	4,266	2%	181,228	2,256	1%	143,457	1,785	1%	124,747	4,676	4%
22-Apr	2,471,136	830,223	27,893	3%	204,178	3,968	2%	183,957	2,729	2%	145,694	2,237	2%	129,048	4,301	3%
23-Apr	2,544,792	861,788	31,565	4%	208,389	4,211	2%	187,327	3,370	2%	148,046	2,352	2%	133,499	4,451	3%
24-Apr	2,626,321	896,306	34,518	4%	213,024	4,635	2%	189,973	2,646	1%	150,383	2,337	2%	138,082	4,583	3%
25-Apr	2,719,897	932,242	35,936	4%	219,764	6,740	3%	192,994	3,021	2%	152,438	2,055	1%	143,468	5,386	4%
26-Apr	2,804,796	959,258	27,016	3%	219,764	0	0%	195,351	2,357	1%	154,175	1,737	1%	148,381	4,913	3%
27-Apr	2,878,196	981,134	21,876	2%	207,634	-12,130	-6%	197,675	2,324	1%	155,193	1,018	1%	152,844	4,463	3%
Day/Day	**73,400**		**21,876**			**-12,130**			**2,324**			**1,018**			**4,463**	
% d/d	*2.6%*		*2.3%*			*-5.5%*			*1.2%*			*0.7%*			*3.0%*	

*Data for the US is sourced from The COVID Tracking Project. All else sourced from the World Health Organization.

Source: Nephron Research analysis of data from the World Health Organization and the COVID Tracking Project

Case growth across the world remains strong. Over the past five days, global cases have increased by 407.1K, equating to growth of 16.5%. The US has been one of the primary accelerants of this growth, with confirmed cases increasing 150.9K over the past five days.

Fig. 2: US Confirmed Case Growth
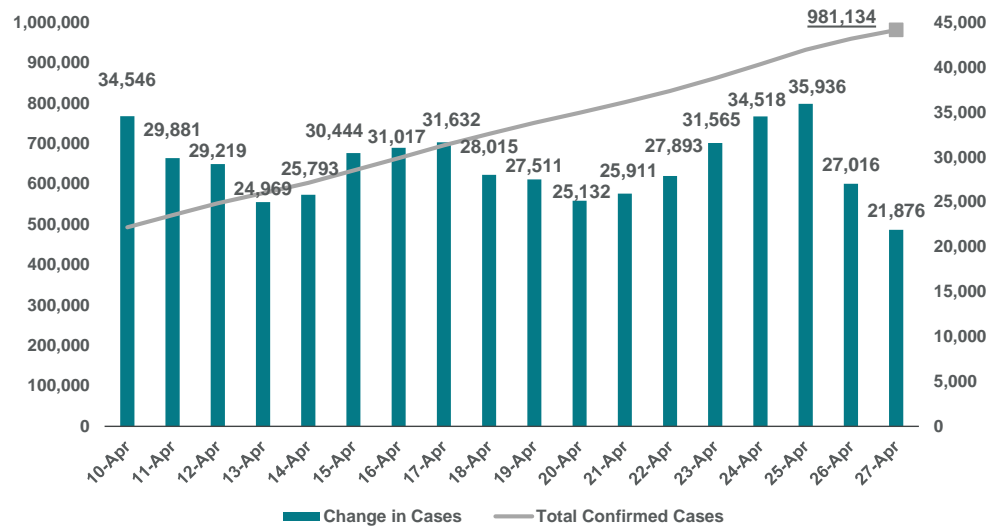
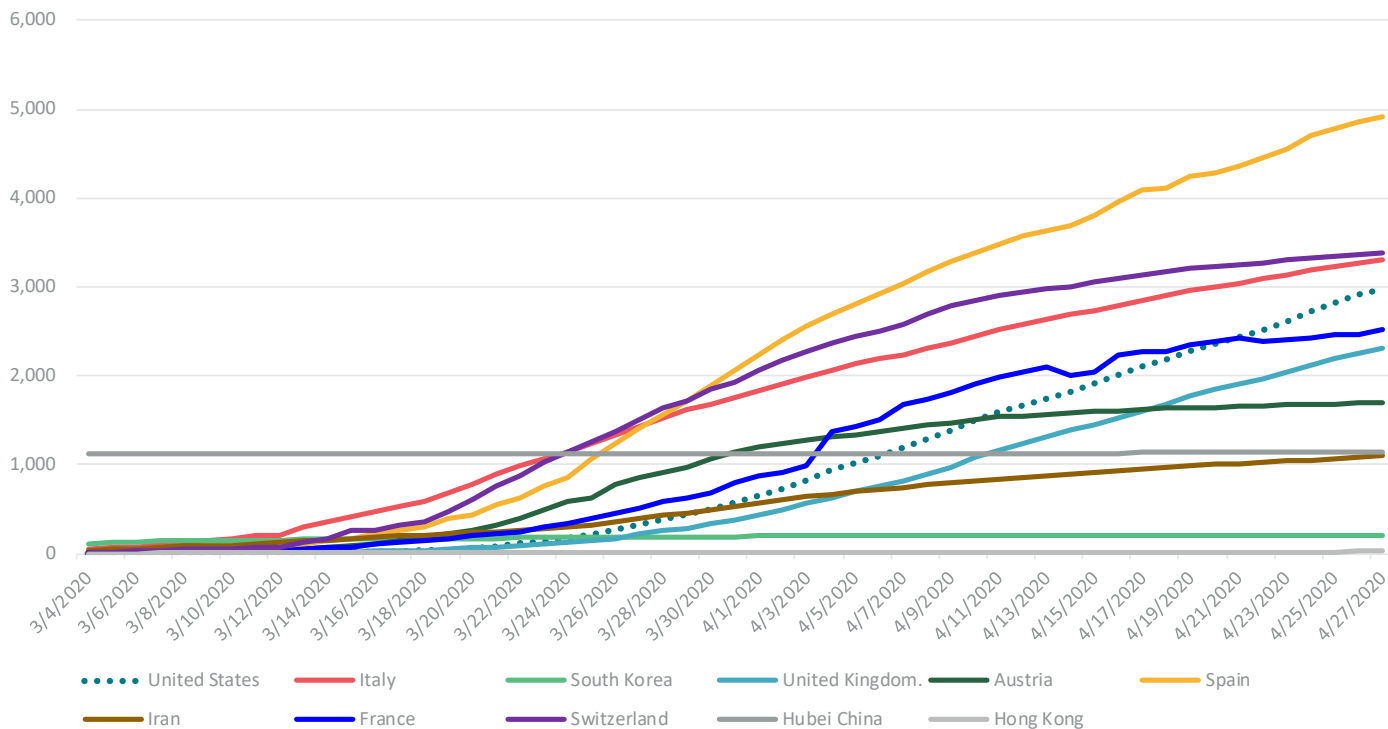Source: Nephron Research analysis of data from the COVID Tracking Project

For a measure of relative prevalence, we compare cases per 1mn pop. *(However, this measure is limited by testing and definitions of positives.)*

Relative Measure: cases relative to population. While case growth rates help us determine where the virus is spreading, they provide limited insight into relative prevalence between countries. As such, we turn to the metric of cases per 1mn population. This metric has its own limitations (particularly until such time that testing expands beyond those that are symptomatic to a broader cross-section of the population) but provides a relative measure for considering the 'depth' of the virus within and among countries (as well as states, counties and cities).

- **Severity/Density:** Presenting cases on a population adjusted basis enables us to compare across countries. **We find that the U.S. entered lockdown at a lower level of cases than did all countries save for Korea. However, it should be noted that specific states, including NY, NJ and WA, entered lockdown at levels that were above Korea and Hubei China**, again all on a populated basis. Also it should be noted that definitions of 'positive' cases vary by country with China no longer reporting asymptomatic positives in the official case count beginning in February.

- **Recent Trends:** Cases per 1mn pop continue to expand in the U.S. where we are increasingly focused on variance between U.S. states. Looking to Europe, Spain and Switzerland have now surpassed Italy in the number of positive cases per 1mn population. The US has now passed France.

Fig. 3: Positive Cases per 1mn Population by Country: The U.S. appears low but testing lags other countries

Source: Nephron Research analysis of Johns Hopkins Center for Systems Science and Engineering COVID data

United States Commentary

National Data:

We saw another material decline in new cases yesterday to the lowest level of additions since March 30th. However, there tends to be some variation around weekends and coming out of the weekend (for reporting). **We continue to believe the growth in testing is the primary reason we are seeing any elevated positive case results. The increase in cases is only due to the increase in the number of tests completed.** Case growth grew by 21.9K yesterday which is below the peak level of adds on April 25th of 40.9K adds.

Fig. 4: National Daily New Positive Case Growth, March 5, 2020 to Present
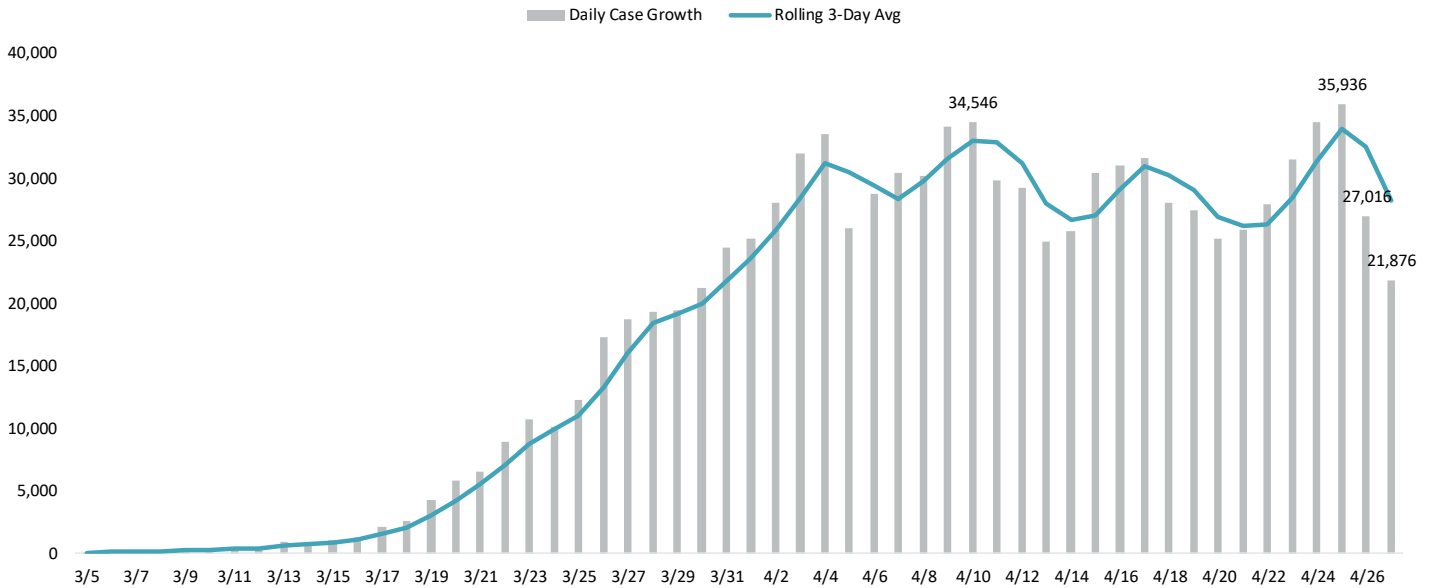
Source: Nephron Research analysis of The COVID Tracking Project

We are watching for an inflection in % of cases that are positive as testing expands – the decline on 4/22 of 70bps was very positive

Next, we look at the percentage of tested COVID-19 cases that are positive and the total number that have been tested. **The latest data suggests that the % of positive cases is 17.5%, which is down 20bps from the prior day. <u>This is the lowest rate since March 31st</u>.** The percentage of positive cases ticked down again for the sixth day in a row as the total testing increased to over 5.6M tests, up by 190K tests from the prior day. **As expected, when testing expands to those that are not symptomatic, we should start to see a decline in the percentage of positive tests**. Hopefully this is the beginning of that trend. We view inflection in this datapoint from increase to decrease as a key leading indicator. The data from 4/22 was the first sign of a meaningful decline in the % of cases that test positive.

Fig. 5: Cumulative % of Tested Cases that are Positive
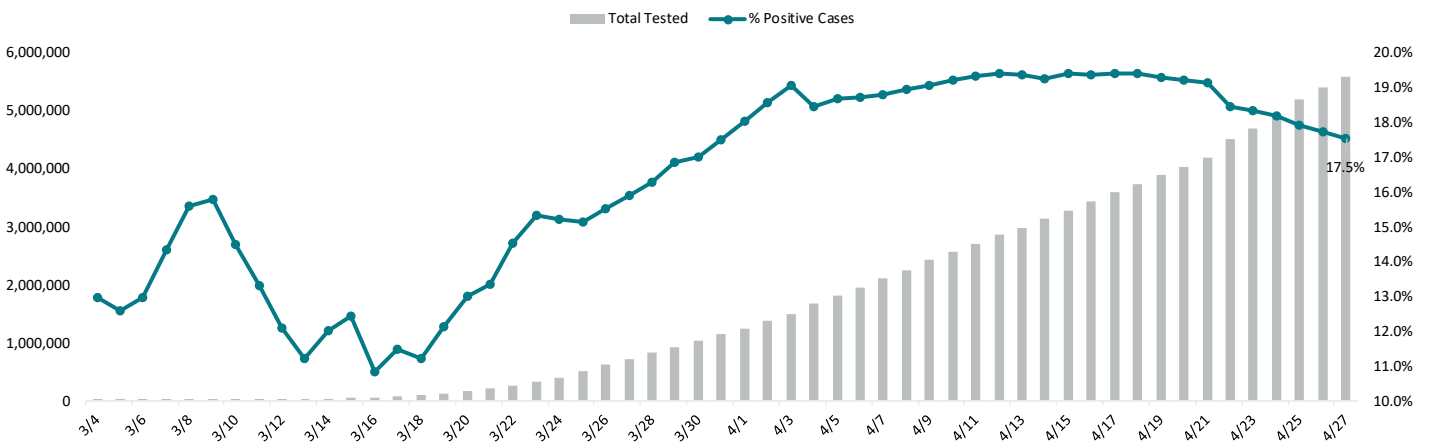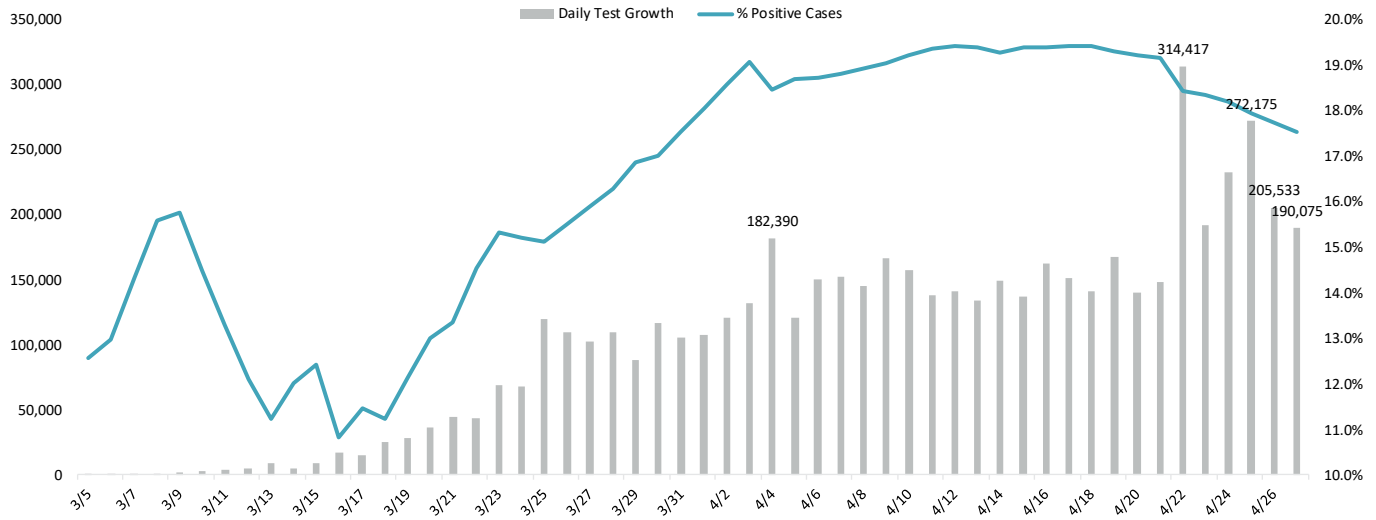

Source: Nephron Research analysis of The COVID Tracking Project

The level of new tests has been elevated since we saw an initial spike on 4/22. The increased testing has been sustained as we have been tracking at a higher level of testing than prior to the spike. If the US can continue to test ~300K new tests daily, we are on track to reach the goal of 2M tests per week.

On a trailing 7-day basis, the number of tests was ~1.6 million which is 504K more tests performed than the prior week. We are carefully monitoring for material growth in the number of tests that are conducted on a daily basis as that's a key indicator of whether there is an improvement in the distribution of supplies. In addition, as the number of daily new tests increases, we would expect an inflection in the percentage of positive cases – the data from 4/22 exhibits this point. If the percentage of positive cases remains flat, it suggests that we are still only testing those who are more than likely COVID positive.

Fig. 6: National Daily New Test Growth vs. % of Tested Cases that are Positive, March 5, 2020 to Present

Source: Nephron Research analysis of The COVID Tracking Project

State-by-State Data:

Beyond NY, NJ, and MA, key states to watch include IL, CA, PA, and MI.

Based on the data as of April 27th, 2020, the states with the highest concentrations of COVID-19 cases are NY, NJ, and Massachusetts. In terms of state specific moves, the top 15 states remained the same, though there were minor shifts between the states.

Fig. 7: Top 15 States in the US with Positive COVID-19 Cases
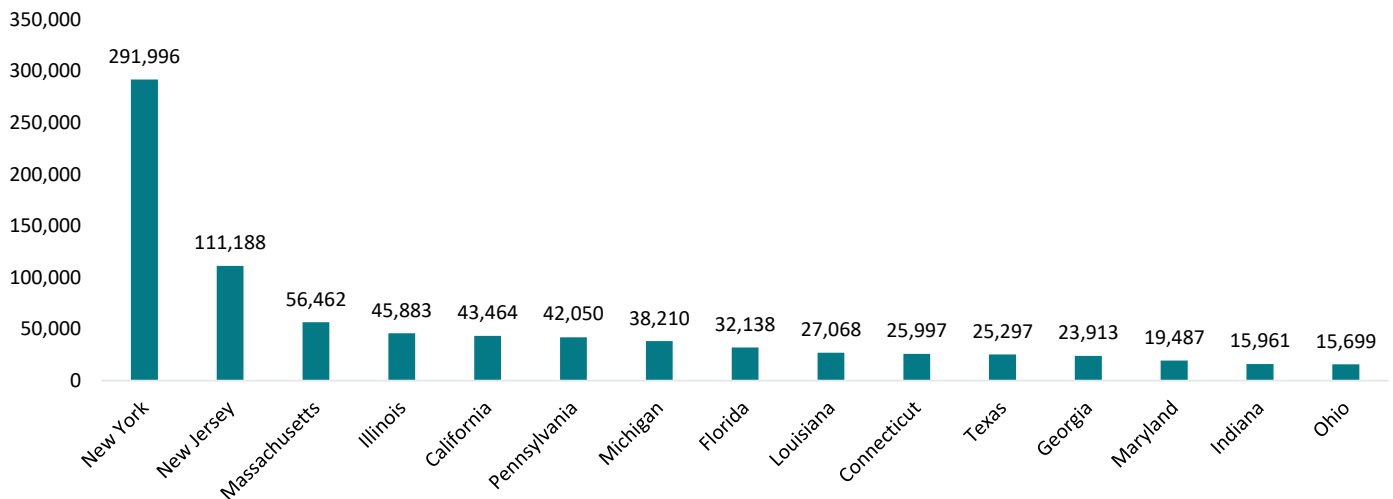
Source: Nephron Research analysis of The COVID Tracking Project

Below, we compare the change in daily case growth over the past two days. Among the top five states, 1 saw higher d/d case growth than yesterday (CA), while 4 saw lower growth (NY, NJ, MA, and IL). **Within the top 15 states,** 10 saw a deceleration in case growth over the past day, whereas 5 saw an acceleration (CA, LA, CT, MD, and IN).

Fig. 8: Daily Case Growth in the Top 15 States in the US with Positive COVID-19 Cases
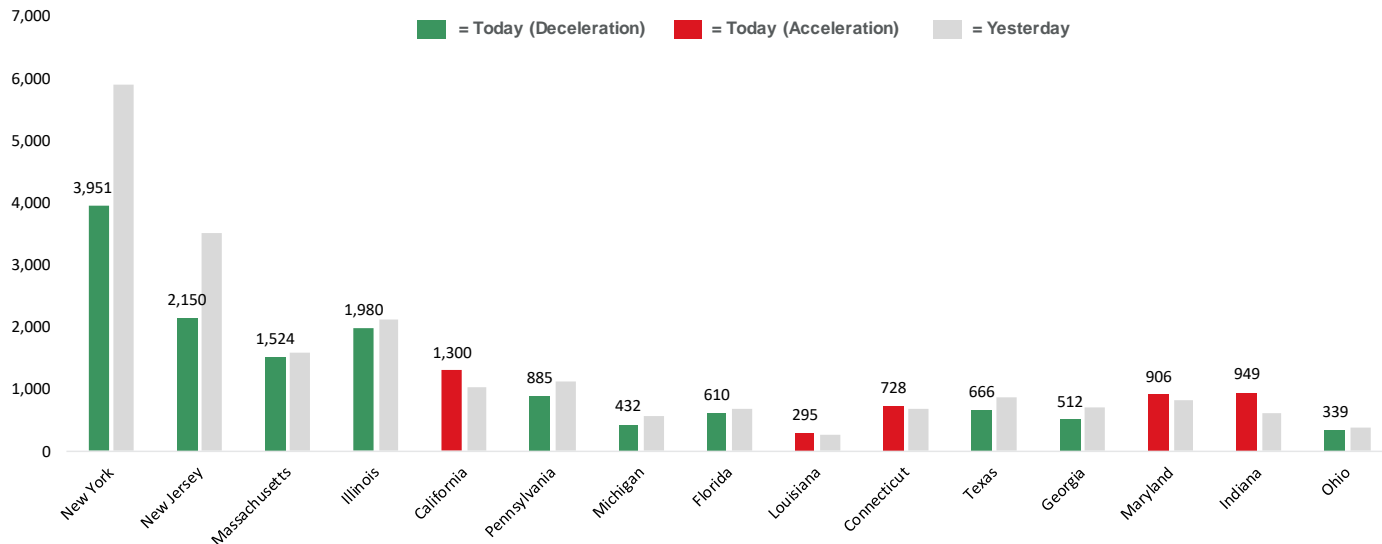
Source: Nephron Research analysis of The COVID Tracking Project

NY case growth declined to 4.0K d/d, down from the increase of 5.9K in the previous day.

In today's review of the data, New York remains the number one state with the most positive COVID-19 cases. **As a reminder, New York State implemented shelter at home and other mandates on March 22nd, and the data is now 36 days post that lockdown.** The number of cases per 100K residents in New York has risen to 1,501, compared to 1,481 in the previous day. As of April 27th, New York has an estimated 292.0K cases which is up 1.4% from the prior day. **Case growth decelerated to 4.0K d/d, down significantly from the increase of 5.9K in the previous day.** This is the second consecutive day of declining case growth. Daily growth has been volatile over the past week, so it will be interesting to see how it develops from this point forward.

New Jersey remains the second largest state with 111.2K cases, which is up 2.0% from the prior day. Throughout the state, 1,252 per 100K residents have tested positive for the virus, up from 1,228 in the previous day. **Massachusetts has the third most cases,** with 56.5K confirmed cases (up 2.8% d/d). Approximately 819 per 100K residents have tested positive within the state. Illinois has the fourth most cases, with 45.9K confirmed diagnoses (up 4.5% d/d) and a prevalence of 362 per 100K residents. Rounding out the top 5 is **California,** with 43.5K cases (up 3.1% d/d) and a prevalence of 110 per 100K. **For perspective, the top 3 states alone represent ~47% of all cases in the US, which is down ~27bps from the prior day's data.** The top 5 states represent 56% of total cases.

Fig. 9: Trend in COVID-19 Cases for Top 5 States

Date	US Total	New York per 100K	Total	D/D	% D/D	New Jersey per 100K	Total	D/D	% D/D	Massachusetts per 100K	Total	D/D	% D/D	Illinois per 100K	Total	D/D	% D/D	California per 100K	Total	D/D	% D/D
4-Mar	207	0	22			0	1			0	2			0	0			0	0		
5-Mar	275	0	33	11	50%	0	1	0	0%	0	8		0%	0	5	5		0	60	60	
6-Mar	387	0	76	43	130%	0	4	3	300%	0	13		0%	0	6	1	20%	0	69	9	15%
7-Mar	538	1	105	29	38%	0	6	2	50%	0	13		0%	0	6	0	0%	0	88	19	28%
8-Mar	721	1	142	37	35%	0	11	5	83%	1	41		0%	0	7	1	17%	0	114	26	30%
9-Mar	1,013	1	173	31	22%	0	15	4	36%	1	92		0%	0	19	12	171%	0	133	19	17%
10-Mar	1,280	1	216	43	25%	0	24	9	60%	1	92	0	0%	0	19	0	0%	0	157	24	18%
11-Mar	1,672	1	216	0	0%	0	30	6	25%	1	95	3	3%	0	25	6	32%	1	202	45	29%
12-Mar	2,142	2	421	205	95%	1	50	20	67%	2	123	28	29%	0	32	7	28%	1	202	0	0%
13-Mar	3,004	3	524	103	24%	1	50	0	0%	2	138	15	12%	0	46	14	44%	1	252	50	25%
15-Mar	4,843	4	729	205	39%	1	98	48	96%	2	138	0	0%	1	64	18	39%	1	293	41	16%
16-Mar	6,130	5	950	221	30%	2	178	80	82%	2	164	26	19%	1	93	29	45%	1	335	42	14%
17-Mar	8,288	9	1,700	750	79%	3	267	89	50%	3	218	54	33%	1	161	68	73%	1	483	148	44%
18-Mar	10,865	12	2,382	682	40%	5	427	160	60%	4	256	38	17%	2	289	128	80%	2	611	128	27%
19-Mar	15,063	21	4,152	1,770	74%	8	742	315	74%	5	328	72	28%	3	426	137	47%	3	1,058	447	73%
20-Mar	20,840	37	7,102	2,950	71%	10	890	148	20%	6	413	85	26%	5	590	164	38%	3	1,286	228	22%
21-Mar	27,372	53	10,356	3,254	46%	15	1,327	437	49%	8	525	112	27%	6	759	169	29%	3	1,286	0	0%
22-Mar	36,334	78	15,168	4,812	46%	22	1,914	587	44%	9	646	121	23%	8	1,058	299	39%	4	1,536	250	19%
23-Mar	47,013	107	20,875	5,707	38%	32	2,844	930	49%	11	777	131	20%	10	1,285	227	21%	4	1,733	197	13%
24-Mar	57,179	132	25,665	4,790	23%	41	3,675	831	29%	17	1,159	382	49%	12	1,551	266	21%	5	2,102	369	21%
25-Mar	69,473	158	30,811	5,146	20%	50	4,402	727	20%	27	1,838	679	59%	15	1,865	314	20%	5	2,102	0	0%
26-Mar	86,789	192	37,258	6,447	21%	77	6,876	2,474	56%	35	2,417	579	32%	20	2,538	673	36%	8	3,006	904	43%
27-Mar	105,462	229	44,635	7,377	20%	99	8,825	1,949	28%	47	3,240	823	34%	24	3,060	522	21%	10	3,879	873	29%
28-Mar	124,815	269	52,318	7,683	17%	125	11,124	2,299	26%	62	4,257	1,017	31%	28	3,491	431	14%	12	4,643	764	20%
29-Mar	144,297	306	59,513	7,195	14%	151	13,386	2,262	20%	72	4,955	698	16%	36	4,596	1,105	32%	14	5,708	1,065	23%
30-Mar	165,521	342	66,497	6,984	12%	187	16,636	3,250	24%	83	5,752	797	16%	40	5,057	461	10%	16	6,447	739	13%
31-Mar	189,998	390	75,795	9,298	14%	210	18,696	2,060	12%	96	6,620	868	15%	47	5,994	937	19%	19	7,482	1,035	16%
1-Apr	215,177	430	83,712	7,917	10%	251	22,255	3,559	19%	112	7,738	1,118	17%	55	6,980	986	16%	21	8,155	673	9%
2-Apr	243,235	475	92,381	8,669	10%	288	25,590	3,335	15%	130	8,966	1,228	16%	61	7,695	715	10%	23	9,191	1,036	13%
3-Apr	275,234	529	102,863	10,482	11%	337	29,895	4,305	17%	151	10,402	1,436	16%	70	8,904	1,209	16%	27	10,701	1,510	16%
4-Apr	308,752	584	113,704	10,841	11%	384	34,124	4,229	14%	170	11,736	1,334	13%	82	10,357	1,453	16%	30	12,026	1,325	12%
5-Apr	334,718	627	122,031	8,327	7%	422	37,505	3,381	10%	181	12,500	764	7%	89	11,256	899	9%	34	13,438	1,412	12%
6-Apr	363,465	672	130,689	8,658	7%	463	41,090	3,585	10%	201	13,837	1,337	11%	97	12,262	1,006	9%	36	14,336	898	7%
7-Apr	393,874	714	138,863	8,174	6%	500	44,416	3,326	8%	221	15,202	1,365	10%	107	13,549	1,287	10%	40	15,865	1,529	11%
8-Apr	424,045	768	149,316	10,453	8%	534	47,437	3,021	7%	244	16,790	1,588	10%	119	15,078	1,529	11%	43	16,957	1,092	7%
9-Apr	458,260	822	159,937	10,621	7%	574	51,027	3,590	8%	275	18,941	2,151	13%	130	16,422	1,344	9%	46	18,309	1,352	8%
10-Apr	492,806	877	170,512	10,575	7%	615	54,588	3,561	7%	304	20,974	2,033	11%	141	17,887	1,465	9%	49	19,472	1,163	6%
11-Apr	522,687	928	180,458	9,946	6%	655	58,151	3,563	7%	332	22,860	1,886	9%	151	19,180	1,293	7%	49	19,472	0	0%
12-Apr	551,906	970	188,694	8,236	5%	696	61,850	3,699	6%	370	25,475	2,615	11%	165	20,852	1,672	9%	55	21,794	2,322	12%
13-Apr	576,875	1,003	195,031	6,337	3%	727	64,584	2,734	4%	390	26,867	1,392	6%	174	22,025	1,173	6%	57	22,348	554	3%
14-Apr	602,668	1,039	202,208	7,177	4%	775	68,824	4,240	7%	409	28,163	1,296	5%	183	23,247	1,222	6%	59	23,338	990	4%
15-Apr	633,112	1,099	213,779	11,571	6%	800	71,030	2,206	3%	434	29,918	1,755	6%	194	24,593	1,346	6%	62	24,424	1,086	5%
16-Apr	664,129	1,143	222,284	8,505	4%	848	75,317	4,287	6%	467	32,181	2,263	8%	203	25,733	1,140	5%	66	26,182	1,758	7%
17-Apr	695,761	1,180	229,642	7,358	3%	883	78,467	3,150	4%	499	34,402	2,221	7%	218	27,575	1,842	7%	70	27,528	1,346	5%
18-Apr	723,776	1,217	236,732	7,090	3%	917	81,420	2,953	4%	528	36,372	1,970	6%	230	29,160	1,585	6%	73	28,963	1,435	5%
19-Apr	751,287	1,248	242,786	6,054	3%	960	85,301	3,881	5%	552	38,077	1,705	5%	240	30,357	1,197	4%	77	30,333	1,370	5%
20-Apr	776,419	1,272	247,512	4,726	2%	1,000	88,806	3,505	4%	575	39,643	1,566	4%	249	31,508	1,151	4%	78	30,978	645	2%
21-Apr	802,330	1,294	251,690	4,178	2%	1,040	92,387	3,581	4%	598	41,199	1,556	4%	261	33,059	1,551	5%	84	33,261	2,283	7%
22-Apr	830,223	1,322	255,216	5,526	2%	1,079	95,865	3,478	4%	623	42,944	1,745	4%	277	35,108	2,049	6%	90	35,396	2,135	6%
23-Apr	861,788	1,354	263,460	6,244	2%	1,126	99,989	4,124	4%	668	46,023	3,079	7%	291	36,934	1,826	5%	95	37,369	1,973	6%
24-Apr	896,306	1,396	271,590	8,130	3%	1,151	102,196	2,207	2%	739	50,969	4,946	11%	313	39,658	2,724	7%	99	39,254	1,885	5%
25-Apr	932,242	1,450	282,143	10,553	4%	1,188	105,523	3,327	3%	774	53,348	2,379	5%	330	41,777	2,119	5%	104	41,137	1,883	5%
26-Apr	959,258	1,481	288,045	5,902	2%	1,228	109,038	3,515	3%	797	54,938	1,590	3%	346	43,903	2,126	5%	107	42,164	1,027	2%
27-Apr	981,134	1,501	291,996	3,951	1%	1,252	111,188	2,150	2%	819	56,462	1,524	3%	362	45,883	1,980	5%	110	43,464	1,300	3%
Day/Day	21,876		3,951				2,150				1,524				1,980				1,300		
% d/d	2.3%		1.4%				2.0%				2.8%				4.5%				3.1%		

Source: Nephron Research analysis of The COVID Tracking Project

*Green highlights indicate effective date of stay-at-home orders

In the chart below, we show the trend in case growth in the top 20 counties as of April 26, 2020. The cases in these counties have grown as a percentage of total cases in the US. From the beginning of when we started tracking county data, the top 20 counties today represented 19.0% of total cases. This has accelerated to 51.4% of the total as of April 26, which is down from a peak of 75.7% on March 21. **This suggests that while the total number of cases are clearly growing in absolute numbers, the top 20 counties have been growing at a slower pace since March 21.**

Fig. 10: COVID-19 Cases in the Top 20 Counties

State	County	3/14/2020	3/21/2020	3/28/2020	4/4/2020	4/11/2020	4/18/2020	4/19/2020	4/20/2020	4/21/2020	4/22/2020	4/23/2020	4/24/2020	4/25/2020	4/26/2020
New York	New York City	95	9,045	33,768	67,552	103,208	134,446	136,816	139,335	142,442	145,855	150,484	155,124	158,268	160,499
New York	Nassau	41	1,900	6,445	14,398	23,553	30,013	30,677	31,079	31,555	32,124	32,765	33,798	34,522	34,865
New York	Suffolk	20	1,034	5,023	12,933	20,816	26,888	27,662	28,154	28,854	29,567	30,606	31,368	32,059	32,470
Illinois	Cook	27	286	3,445	8,043	14,585	21,272	22,101	23,181	24,546	25,811	27,616	29,058	30,574	31,953
New York	Westchester	148	1,873	8,519	13,722	19,313	23,803	24,306	24,655	25,275	25,959	26,632	27,230	27,664	28,007
California	Los Angeles	27	349	2,136	5,940	9,192	12,341	13,816	15,140	16,435	17,508	18,545	19,107	19,528	20,417
Michigan	Wayne	1	477	2,704	7,518	11,164	13,692	13,912	14,255	14,561	14,994	15,407	15,548	15,748	15,872
New Jersey	Bergen	13	457	2,169	6,187	9,784	12,639	13,011	13,356	13,356	14,049	14,049	14,738	14,965	15,104
New Jersey	Hudson	1	126	974	3,924	7,469	10,486	11,150	11,636	11,636	12,645	12,645	13,367	13,708	13,925
New Jersey	Essex	1	172	1,227	4,082	7,410	10,304	10,729	11,128	11,128	11,811	11,811	12,520	12,863	13,047
Massachusetts	Middlesex	49	199	981	2,632	5,660	8,737	9,253	9,621	10,094	10,724	11,681	12,253	12,648	12,953
Pennsylvania	Philadelphia	3	91	865	3,135	6,352	9,214	9,553	10,028	10,643	11,226	11,877	12,329	12,566	12,329
New Jersey	Union	1	124	896	3,216	6,180	9,609	9,972	10,289	10,289	10,935	10,935	11,523	11,853	12,011
Massachusetts	Suffolk	22	126	940	2,658	5,359	8,074	8,314	8,669	9,060	9,739	10,724	11,218	11,543	11,883
Florida	Miami-Dade	2	227	1,471	4,145	7,057	9,353	9,656	10,055	10,152	10,587	10,925	11,004	11,350	11,569
New York	Rockland	7	455	2,209	5,362	7,721	9,364	9,457	9,568	9,699	9,828	10,091	11,091	11,256	11,366
New Jersey	Passaic	1	95	831	3,227	5,590	8,288	8,479	8,941	8,941	9,874	9,874	10,738	11,137	11,349
New Jersey	Middlesex	2	147	938	2,950	5,693	8,017	8,346	8,767	8,767	9,530	9,530	10,075	10,642	10,767
Connecticut	Fairfield	4	140	1,245	3,050	5,534	7,434	8,320	8,472	9,883	10,008	10,227	10,373	10,529	10,763
New York	Orange	1	247	1,247	3,102	5,027	6,394	6,497	6,576	6,705	6,816	7,170	7,988	8,121	8,253
Sub-Total		**466**	**17,570**	**78,033**	**177,776**	**286,667**	**380,368**	**392,027**	**402,905**	**414,021**	**429,590**	**443,594**	**460,450**	**471,544**	**479,402**
Total US Cases		**2,450**	**23,203**	**118,234**	**308,752**	**522,687**	**723,776**	**723,776**	**751,287**	**776,419**	**802,330**	**830,223**	**861,788**	**896,306**	**932,242**
% of Total US Cases		*19.0%*	*75.7%*	*66.0%*	*57.6%*	*54.8%*	*52.6%*	*54.2%*	*53.6%*	*53.3%*	*53.5%*	*53.4%*	*53.4%*	*52.6%*	*51.4%*

Source: Nephron Research analysis of The COVID Tracking Project

We also show the number of positive COVID cases per 1MM in the top 20 counties. This speaks to the relative impact of COVID, rather than the sheer absolute number of cases. Surprisingly, despite the number of cases in New York City, the number of cases per 1MM is a little more than half of Rockland, NY cases per 1MM. **Among the counties with the most cases in the US, Rockland, NY has the highest density of COVID-19 cases per 1MM of population at 34,888 cases, followed by Westchester, NY with 28,948 cases per 1MM.** In all, **12 of the top 20 counties** now have more than 1% of their populations that have tested positive. Rockland County is the highest at 3.5% of their population.

Fig. 11: Top 20 Counties in the US with Positive COVID-19 Cases per 1MM Population

State	County	3/14/2020	3/21/2020	3/28/2020	4/4/2020	4/11/2020	4/18/2020	4/19/2020	4/20/2020	4/21/2020	4/22/2020	4/23/2020	4/24/2020	4/25/2020	4/26/2020
New York	New York City	11	1,085	4,050	8,103	12,380	16,127	16,411	16,713	17,086	17,495	18,051	18,607	18,984	19,252
New York	Nassau	30	1,400	4,750	10,611	17,358	22,118	22,608	22,904	23,255	23,674	24,147	24,908	25,441	25,694
New York	Suffolk	14	700	3,402	8,759	14,097	18,209	18,734	19,067	19,541	20,024	20,727	21,243	21,711	21,990
Illinois	Cook	5	56	669	1,562	2,832	4,130	4,291	4,501	4,766	5,012	5,362	5,642	5,936	6,204
New York	Westchester	153	1,936	8,805	14,183	19,962	24,602	25,122	25,483	26,124	26,831	27,526	28,145	28,593	28,948
California	Los Angeles	3	35	213	592	916	1,229	1,376	1,508	1,637	1,744	1,847	1,903	1,945	2,034
Michigan	Wayne	1	273	1,546	4,298	6,382	7,827	7,953	8,149	8,324	8,571	8,807	8,888	9,002	9,073
New Jersey	Bergen	14	490	2,327	6,637	10,496	13,558	13,957	14,327	14,327	15,071	15,071	15,810	16,053	16,202
New Jersey	Hudson	1	187	1,449	5,836	11,108	15,595	16,583	17,305	17,305	18,806	18,806	19,880	20,387	20,710
New Jersey	Essex	1	215	1,536	5,109	9,274	12,897	13,428	13,928	13,928	14,783	14,783	15,670	16,099	16,330
Massachusetts	Middlesex	30	123	609	1,633	3,512	5,421	5,741	5,969	6,263	6,654	7,248	7,603	7,848	8,037
Pennsylvania	Philadelphia	2	57	546	1,979	4,010	5,817	6,031	6,331	6,719	7,087	7,498	7,783	7,933	7,783
New Jersey	Union	2	223	1,611	5,781	11,108	17,272	17,924	18,494	18,494	19,655	19,655	20,712	21,305	21,589
Massachusetts	Suffolk	15	85	637	1,800	3,629	5,468	5,630	5,871	6,136	6,596	7,263	7,597	7,817	8,048
Florida	Miami-Dade	1	84	541	1,526	2,597	3,442	3,554	3,701	3,737	3,897	4,021	4,050	4,177	4,258
New York	Rockland	21	1,397	6,780	16,459	23,699	28,743	29,028	29,369	29,771	30,167	30,974	34,044	34,550	34,888
New Jersey	Passaic	2	189	1,656	6,431	11,139	16,516	16,896	17,817	17,817	19,676	19,676	21,398	22,193	22,615
New Jersey	Middlesex	1	91	582	1,830	3,532	4,974	5,178	5,440	5,440	5,913	5,913	6,251	6,603	6,681
Connecticut	Fairfield	4	148	1,320	3,233	5,866	7,881	8,820	8,981	10,477	10,609	10,841	10,996	11,161	11,410
New York	Orange	3	642	3,239	8,058	13,059	16,610	16,878	17,083	17,418	17,707	18,626	20,751	21,097	21,440
Sub-Total		**315**	**9,417**	**46,266**	**114,417**	**186,957**	**248,437**	**256,144**	**262,941**	**268,563**	**279,970**	**286,842**	**301,881**	**308,838**	**313,184**
Total US Cases		**7**	**71**	**360**	**941**	**1,592**	**2,205**	**2,205**	**2,289**	**2,365**	**2,444**	**2,529**	**2,625**	**2,731**	**2,840**

Source: Nephron Research analysis of The COVID Tracking Project, US Census Bureau

Focusing on growth in the top 5 counties, we show the trend in case growth since we started tracking the data. New York City's growth as declined from a peak of 108% on March 18 to just 1.4% on April 26th. **This is the lowest growth rate we have seen for New York City.** With the lowest growth rate to date, the daily new case growth also declined to 2.2K new adds, which is the lowest number of new cases since April 5th. **It appears that city case growth is stabilizing with the low growth rate of 1.4%. It has been 34 days since the lockdown order to control the spread of COVID19.** As a reminder, Governor Cuomo announced on Friday, March 20 that all non-essential travel and in-office work will be banned starting on Sunday, March 22 – essentially announcing sweeping restrictions on movement in New York.

The other largest COVID counties in New York appear to be stabilizing as well. Each of their growth rates were below 2% (and much closer to 1%). **However, the daily new cases added in Cook, Illinois remains elevated and the growth rate is ~5%.** Case growth continues to be an imperfect analog for the expanding prevalence of coronavirus (a better measure of the expanding prevalence is testing). We continue to monitor closely case growth post social distancing mandates (IL also put such measures in place on March 21st) in the top five counties.

Fig. 12: COVID-19 Cases in the Top 5 Counties

Date	US Total	New York City New York			Nassau New York			Suffolk New York			Cook Illinois			Westchester New York		
14-Mar	3,759	95			41			20			27			148		
15-Mar	4,843	329	234	246%	98	57	139%	47	27	135%	70	43	159%	196	48	32%
16-Mar	6,130	463	134	41%	109	11	11%	63	16	34%	77	7	10%	220	24	12%
17-Mar	8,288	644	181	39%	131	22	20%	84	21	33%	107	30	39%	380	160	73%
18-Mar	10,865	1,339	695	108%	183	52	40%	116	32	38%	178	71	66%	538	158	42%
19-Mar	15,063	2,469	1,130	84%	372	189	103%	178	62	53%	278	100	56%	798	260	48%
20-Mar	20,840	4,408	1,939	79%	754	382	103%	371	193	108%	411	133	48%	1,091	293	37%
21-Mar	27,372	9,045	4,637	105%	1,900	1,146	152%	1,034	663	179%	286	-125	-30%	1,873	782	72%
22-Mar	36,334	12,305	3,260	36%	2,442	542	29%	1,458	424	41%	805	519	181%	2,894	1,021	55%
23-Mar	47,013	14,905	2,600	21%	2,869	427	17%	1,880	422	29%	1,194	389	48%	3,890	996	34%
24-Mar	57,179	17,857	2,952	20%	3,285	416	14%	2,260	380	20%	1,194	0	0%	4,690	800	21%
25-Mar	69,473	21,394	3,537	20%	3,914	629	19%	2,735	475	21%	1,904	710	59%	5,943	1,253	27%
26-Mar	86,789	25,399	4,005	19%	4,657	743	19%	3,385	650	24%	2,239	335	18%	7,186	1,243	21%
27-Mar	105,462	30,766	5,367	21%	5,537	880	19%	4,138	753	22%	2,613	374	17%	7,874	688	10%
28-Mar	124,815	33,768	3,002	10%	6,445	908	16%	5,023	885	21%	3,445	832	32%	8,519	645	8%
29-Mar	144,297	37,454	3,686	11%	7,344	899	14%	5,791	768	15%	3,445	0	0%	9,325	806	9%
30-Mar	165,521	43,139	5,685	15%	8,544	1,200	16%	6,713	922	16%	4,496	1,051	31%	9,967	642	7%
31-Mar	189,998	47,440	4,301	10%	9,555	1,011	12%	7,605	892	13%	5,152	656	15%	10,683	716	7%
1-Apr	215,177	51,810	4,370	9%	10,587	1,032	11%	8,746	1,141	15%	5,575	423	8%	11,566	883	8%
2-Apr	243,235	57,160	5,350	10%	12,024	1,437	14%	10,154	1,408	16%	6,473	898	16%	12,350	784	7%
3-Apr	275,234	63,307	6,147	11%	13,346	1,322	11%	12,328	2,174	21%	7,439	966	15%	13,080	730	6%
4-Apr	308,752	67,552	4,245	7%	14,398	1,052	8%	12,933	605	5%	8,043	604	8%	13,722	642	5%
5-Apr	334,718	68,776	1,224	2%	15,616	1,218	8%	14,473	1,540	12%	8,728	685	9%	14,293	571	4%
6-Apr	363,465	76,876	8,100	12%	16,610	994	6%	15,561	1,088	8%	9,509	781	9%	14,804	511	4%
7-Apr	393,874	81,803	4,927	6%	18,548	1,938	12%	15,844	283	2%	10,520	1,011	11%	15,887	1,083	7%
8-Apr	424,045	87,028	5,225	6%	20,140	1,592	9%	17,413	1,569	10%	11,415	895	9%	17,004	1,117	7%
9-Apr	458,260	92,384	5,356	6%	21,512	1,372	7%	18,692	1,279	7%	12,472	1,057	9%	18,077	1,073	6%
10-Apr	492,806	98,308	5,924	6%	22,584	1,072	5%	19,883	1,191	6%	13,417	945	8%	18,729	652	4%
11-Apr	522,687	103,208	4,900	5%	23,553	969	4%	20,816	933	5%	14,585	1,168	9%	19,313	584	3%
12-Apr	551,906	106,764	3,556	3%	24,358	805	3%	21,643	827	4%	15,474	889	6%	19,785	472	2%
13-Apr	576,875	110,465	3,701	3%	25,250	892	4%	22,462	819	4%	16,323	849	5%	20,191	406	2%
14-Apr	602,668	118,302	7,837	7%	26,715	1,465	6%	23,278	816	4%	17,306	983	6%	20,947	756	4%
15-Apr	633,112	123,146	4,844	4%	27,772	1,057	4%	24,182	904	4%	18,087	781	5%	21,828	881	4%
16-Apr	664,129	127,352	4,206	3%	28,539	767	3%	25,035	853	4%	19,391	1,304	7%	22,476	648	3%
17-Apr	695,761	131,273	3,921	3%	29,180	641	2%	26,143	1,108	4%	20,395	1,004	5%	23,179	703	3%
18-Apr	723,776	134,446	3,173	2%	30,013	833	3%	26,888	745	3%	21,272	877	4%	23,803	624	3%
19-Apr	751,287	136,816	2,370	2%	30,677	664	2%	27,662	774	3%	22,101	829	4%	24,306	503	2%
20-Apr	776,419	139,335	2,519	2%	31,079	402	1%	28,154	492	2%	23,181	1,080	5%	24,655	349	1%
21-Apr	802,330	142,442	3,107	2%	31,555	476	2%	28,854	700	2%	24,546	1,365	6%	25,275	620	3%
22-Apr	830,223	145,855	3,413	2%	32,124	569	2%	29,567	713	2%	25,811	1,265	5%	25,959	684	3%
23-Apr	861,788	150,484	4,629	3%	32,765	641	2%	30,606	1,039	4%	27,616	1,805	7%	26,632	673	3%
24-Apr	896,306	155,124	4,640	3%	33,798	1,033	3%	31,368	762	2%	29,058	1,442	5%	27,230	598	2%
25-Apr	932,242	158,268	3,144	2%	34,522	724	2%	32,059	691	2%	30,574	1,516	5%	27,664	434	2%
26-Apr	959,258	160,499	2,231	1%	34,865	343	1%	32,470	411	1%	31,953	1,379	5%	28,007	343	1%
Day/Day	27,016	2,231			343			411			1,379			343		
% d/d	2.9%	1.4%			1.0%			1.3%			4.5%			1.2%		

Source: Nephron Research analysis of The COVID Tracking Project

*Highlighted green denotes effective date of lockdown orders

We show the number of COVID-19 hospitalizations by state. This is an important metric to monitor to evaluate the COVID-19 impact on hospital capacity and we expect this data to become more refined and robust over time. Not surprisingly, the most hospitalized cases have been reported in New York which has a reported 57,103 hospitalizations in the state. **We also show that New Jersey has 8,270 hospitalizations, the second largest state in terms of hospitalizations after NY.**

Fig. 13: Top 15 States by Hospitalizations, March 21 to Present
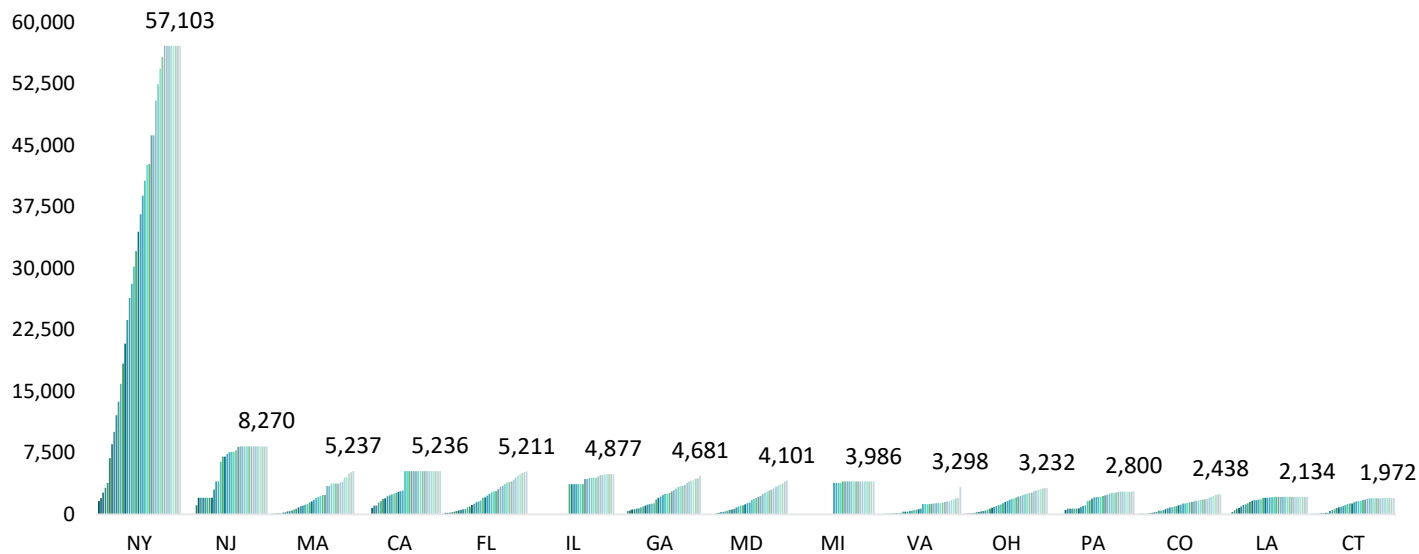
Source: Nephron Research analysis of The COVID Tracking Project

Below, we show the 3-day rolling average growth in hospitalizations across the top 10 states. This chart is displayed as a 3-day rolling average to cut through some of the reporting issues that states like New York have exhibited over the past several days. Unfortunately, New York has not provided an update on hospitalizations since April 20th, which complicates our view of the state's progression. As a reminder, **the most recent data from New York showed a slight decline and stabilization in new hospitalizations within the state.** For the three-day period ended April 20th, New York reported an average of 1.6K new hospitalizations d/d. This was down from the 3-day average increases of 1.8K and 2.7K in the previous two days.

Fig. 14: 3-Day Rolling Average Growth in Hospitalizations in the Top 10 States, March 21 to Present
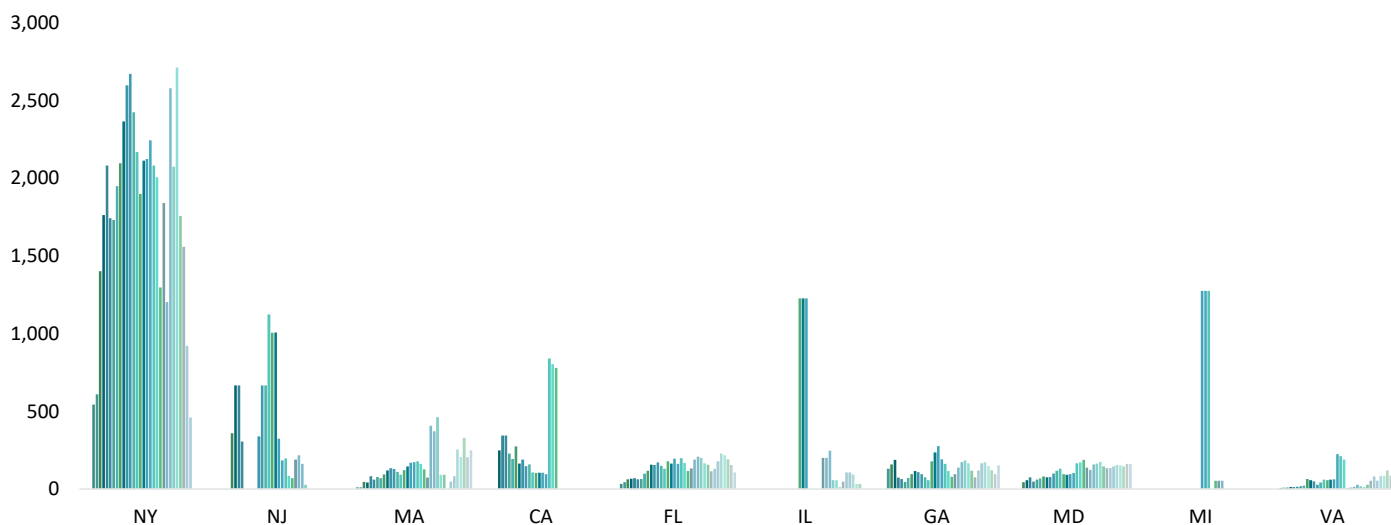
Source: Nephron Research analysis of The COVID Tracking Project

Below, we present the number of individuals currently hospitalized in New York. As shown by the following chart, **there has been a clear stabilization and decline in net new hospitalizations over the**

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past two weeks. The number of individuals within the New York hospital system declined each day from April 12th to April 26th. As of April 26th, there were a total of 12.7K hospitalizations within the state, down from a high of 18.8K on April 12th.

Fig. 15: Total Hospitalizations, New York State
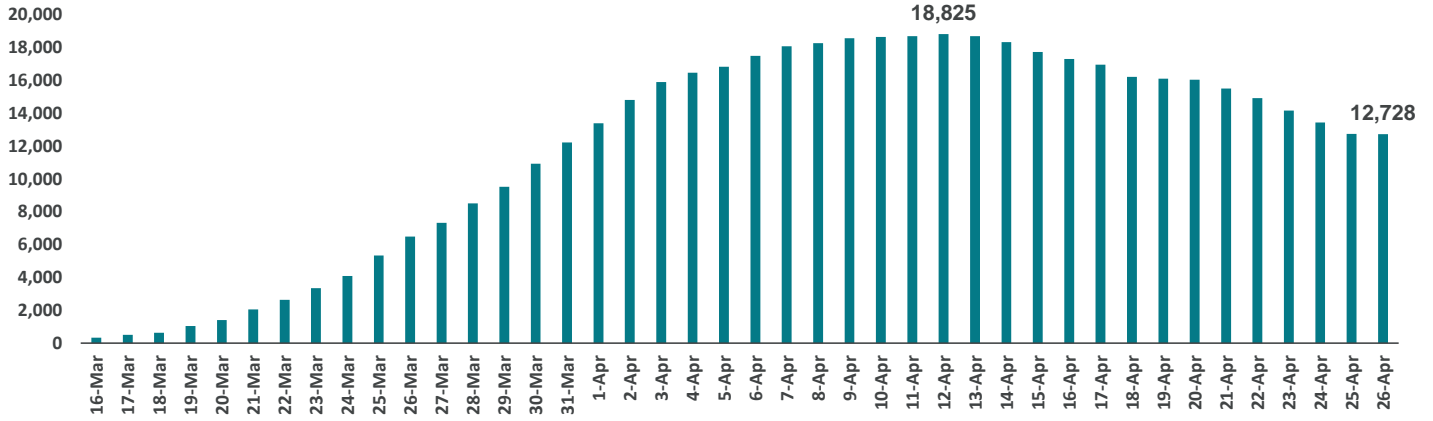
Source: Nephron Research analysis of New York Department of Health

We are tracking ICU hospitalization rates – with ~1% utilization rate among positive cases

We next track current COVID ICU bed counts. This is important to monitor as we track national demand in the US for the limited set of ICU beds. **Based on the data so far, there are ~9.7K ICU beds that are currently in use, which is a decline of 35% from the prior day**. It certainly possible that this is an anomaly in the reported data, and we could see a commensurate increase tomorrow. Based on the current ICU bed utilization, the ICU rate (the % of positive cases that are now in ICU) is now 1.0% in the US, down 56bps from the prior day.

Fig. 16: US ICU Patient Count vs ICU Count as a % of Positive Cases
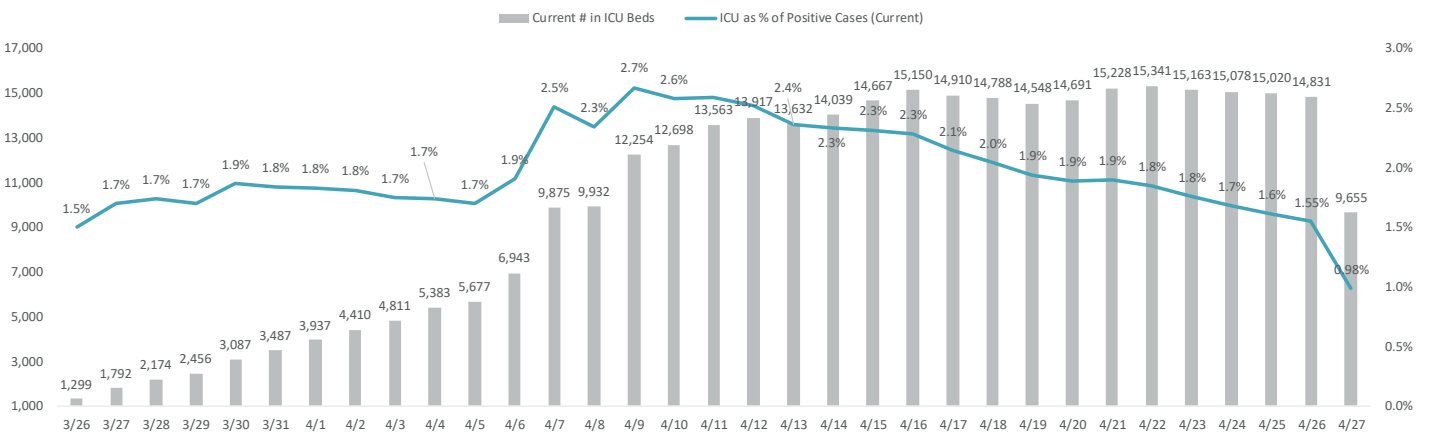
Source: Nephron Research analysis of The COVID Tracking Project

U.S. Testing & Tracing

Notable Change: After many fits and starts, the U.S. may be showing some expansion of diagnostic tests from 1mn per week to 1.5mn- 2mn per week

We remain extremely focused on the supply of diagnostic tests as with only 5,597,572 (up 190,075 d/d) tests administered in the U.S. to date, the 981,134 (up 21,876 d/d) confirmed positives we analyze within this report clearly represent only the tip of the iceberg on virus prevalence. **After spending April 8th to 22nd stuck at a run rate of ~1mn tests per week, the weekly test rate appears to have increased to ~2.0mn over the last week inclusive of 190k tests reported yesterday.** We saw an uptick in daily tests reported on April 22nd but this turned out to be largely driven by a change in reporting in CA. Given

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volatility in daily reports we have been careful to not overstate improvement but we now have seen five days at an elevated level including 190k tests reported yesterday, and the two largest drivers, CA and NY, contributing ~32% of the growth.

A run rate of ~1.5mn-2.0mn, would represent an improvement over the previous ~1mn per week, but still well below the 3.5-5.5mn per week required to enable material relaxation of social distancing measures. Below we outline some encouraging announcements this week with respect to the White House's new 'testing blueprint' and expanded diagnostic test commitments from the commercial labs and retailers, though we remain cautious until production is delivered and quality improves.

Fig. 17: Cumulative Tests Completed per 1mn Population
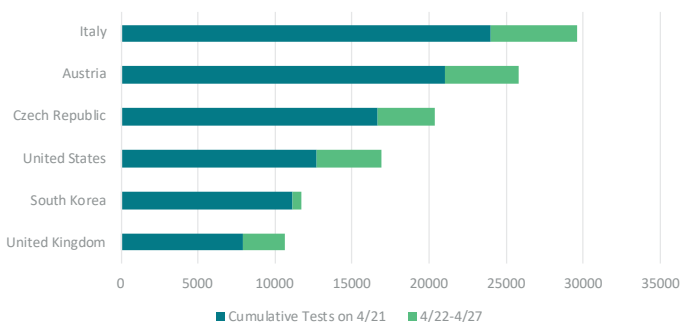
Source: Nephron Research analysis of The COVID Tracking Project and Country Websites

Fig. 18: New Tests Completed over Trailing 7-Days
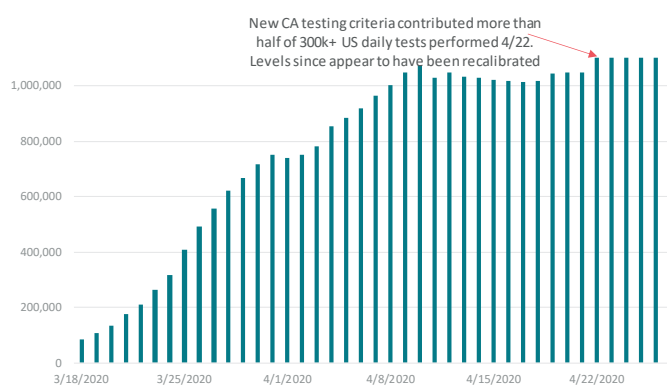
Source: Nephron Research analysis of The COVID Tracking Project

Note: Data collected is up to date as of 4PM the prior day. Testing numbers compiled afterwards are not reflected in the above chart.

- **The addition of 190k tests performed (including pending) over the prior day is encouraging, but we remain cautious of different reporting standards from states.** As of 4PM Monday, 5,597,572 cumulative tests have been completed in the U.S. based on data from The COVID Tracking Project. We calculate that the weekly testing run rate was roughly 1.5mn compared to 1mn the prior week. **Yesterday's weekly run rate suggests a sustained increase from the prior run rate plateau of ~1mn, the level at which epidemiologists suggested the U.S. could** *begin* **to track and contain the virus (though another precursor is the development of thousands of teams to track the virus and we expect the test rate needs to expand closer to 3.5-5.5mn to enable widespread relaxation of social distancing measures).**

- **The U.S. supply chain is experiencing a number of challenges.** With respect to testing, the initial challenge of securing an adequate supply of the reagent used in diagnostic kits has now given way to a potential bottleneck from the shortage in the specialized swabs used to test patients. Alternative testing mediums and swabs have been validated, and the U.S. Air Force is flying in Italian test strips three times a week. **On April 17th, the FDA announced that after reviewing studies from United Health Group and the Gates Foundation it will allow a broader range of swabs to be used in tests and secured a U.S. manufacturer of polyester-based swabs compatible with COVID-19 testing with U.S. Cotton.** The new guidelines allow for simple nasal swabs and can be conducted by the patient, dramatically reducing PPE required. The federal government is expected to make several hundred thousand swabs available to CA and NY over the next two weeks, enabling an expansion of testing and broadening of testing beyond those who are symptomatic and essential workers.

Diagnostic Testing

Update: The White House and partners announced new testing goals on April 27th

Commercial lab capacity for diagnostic tests now stands at 80k+ tests per day. This expansion has helped to drive testing toward the near-term goal of 1mn tests per week, but we are still far from the goal of 2mn test per week in April. **On Premier's weekly call, presenters noted that Quest and LabCorp have worked through their backlog and it is now taking Quest 1-2 days to turn around tests (1 day for priority tests).** The American Clinical Laboratory Association has become increasingly critical of the administration and congress, noting that the clinical labs have excess capacity and stating a need for clear federal goals for testing.

- **The Trump administration** stated a near term goal to enable each state to test 2% of its population per month on April 27th but provided no time frame for achieving this goal of specifics on how the task force will work to address supply chain constraints and lab capacity.

- **Quest** is currently conducting 50k diagnostic tests per day and is targeting an expansion to 100k by the end of May.

- **Lab Corp** is expanding to 60k tests per day near term and has introduced a take home test.

- **Walgreens** announced plans to work with Lab Corp to open testing locations in 49 states and Puerto Rico with the ability to test more than 50k per week.

- **CVS Health** announced a plan to have 1,000 testing locations up and running by the end of May with a goal of processing 1.5mn tests per month.

- **Kroger** announced plans to expand its drive through COVID-19 testing model to 50 locaitons and perform 100k tests by the end of May (vs 8,000 in 30 locations to date).

Antibody Testing

Recent Development: Quest and LabCorp are adding and expanding anti-body testing

Following on recent announcements of antibody tests from Abbot, Roche and Cellex, we learned April 21st that both Quest and LabCorp have begun to perform antibody testing alongside their molecular diagnostic testing. Quest, which is initially utilizing tests from Abbot and EUROIMMUN/PerkinElmer expects to expand from 70,000 antibody tests per day at the end of this week to 150k tests per day by early May with antibody results reported within 1-2 days of collection. LabCorp's capacity now stands at 50,000 antibody tests per day and is expected to increase over the coming weeks and reach several hundred thousand per day by mid-May with results reported within 1-3 days. **The hope is that within a month the two clinical labs could be processing 2mn-3mn antibody tests per week.**

- **On April 16th, Abbot announced it expects to make 4mn antibody tests available in April ramping to 20mn per month in June.** Yesterday, Abbot announced a lab-based antibody blood test that will ship in the U.S. beginning April 16th. The lab-based antibody test is distinct from the ID NOW rapid molecular point of care diagnostic test discussed below. Unlike Cellex's antibody test it was not approved by the FDA but is utilizing the Emergency Use Authorization pathway.

- **On April 17th, Roche announced a new antibody test that will ramp to 'double digit' millions in June.** Following on Abbot's heals, Roche announced a high throughput antibody test on April 17th. The company expects to ship tests over the next two weeks and hopes to ramp production to 'double-digit' million in June (though we note this is a global number whereas Abbot's 20mn goal is within the U.S.).

Recent Development: FDA approves first antibody test. Concerns are building on tests that have not gone through FDA review

- **On April 2nd, the FDA approved the first COVID-19 antibody test from Cellex.** An antibody test which identifies the presence of antibodies in blood derived from a simple pin prick could play a key role in determining the true prevalence rate in the population and who is immune to the virus

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(assuming herd immunity). Such tests detect if a patient has been exposed to the virus, which is different from tests used to diagnose the disease. We see approval and mass production of such tests for clinic and home use as key to enabling the eventual liberalization of shelter-in-place measures. In early April, we began to hear concerns around the accuracy of serology tests that are being used without FDA review under *enforcement discretion policy* adopted by the FDA in March.

- o At present there are 90 antibody tests on the market but only Cellex's test has received government approval and now there is concern that many of these tests may not be accurate. The Whitehouse has suggested that millions serological of tests could be available shortly but reality is that it will likely take several weeks before such tests are deployed to analyze community spread across the country.

- o The results of antibody tests are useful for helping public health officials plot the progression of the virus, however the question of whether antibodies will result in immunity from the virus remains open. While most infectious disease experts believe this is the case, clinical testing raises moral quandaries.

Recent Development: FDA approves first saliva based test.

- ■ **On April 14th, the FDA approved the first saliva-based coronavirus test under its emergency powers.** The FDA deployed its emergency-use authorization to approve of the test from the Rutgers lab RUCDR Infinite Biologics, informing the university of its approval on Saturday. The new saliva-based test aims to allow for increased testing and safety for health professionals conducting screening and will be available via hospitals and clinics associated with the university with capacity of 10k tests per day. The benefits of the test include safety for those conducting screening as well as lower use of PPE and swabs currently impacted by shortages. While helpful in identifying positives, for now the FDA has directed patients that receive negative results to receive confirmation via a second test.

LA County is the first we have heard of to examine prevalence in the general population

Initial efforts to determine prevalence. Given the lack of testing to date, tests have been focused on those who were already symptomatic tests to evaluate prevalence in the broader population have only begun to be conducted. On April 4th, L.A. County's public health department announced a plan to test 1,000 randomly selected residents using one of the antibody tests and New York recently announced a broader initiative. This will help the department discover how many people have actually been infected, recovered and developed immunity to the virus. The answer to that question carries hefty ramifications for health officials – both at the state and national level – considering how to keep the public safe and restart economic activity.

RECENT DEVELOPMENT: An early study suggests as many of 20% of NYC residents may possess COVID-19 antibodies

- ■ On April 22nd , NY Gov Cuomo shared preliminary results of a random antibody test of 3,000 people conducted by public health authorities that could imply roughly 20% of New Yorker City residents currently possess COVID-19 antibodies. The study of 3,000 included 1,300 New York City residents of which 21% tested positive as compared to 17% on Long Island and 12% in Westchester. The results were preliminary and the extent to which the tests taken at grocery and big-box stores is representative of the broader public is a major question (Are those who were out and about last week more likely to have come into contact with the virus when they were out and about four weeks ago?). It should be noted that the tests were sent to the Wadsworth lab and were calibrated for conservatism so should side step some of the critiques of antibody testing broadly. While more study is required, antibody testing will be a key measure in determining when to reopen the state alongside hospital utilization and test capacity.

- ■ On April 20th we learned the results of the L.A. county study which found 4.1% (range of 2.8% to 5.6%) of adults tested positive for coronavirus antibodies, suggesting the rate of infection may be 40 times higher than the number of confirmed cases. The antibody tests indicate the death rate from the pandemic could be lower than currently thought but also suggests that the virus is being

spread by patients that are asymptomatic. While researchers used a random sample of residents the opt in of the nature has led to a fair amount of criticism and we caution that the results should be ready as a single directional data point that is not so far off from what we have seen in other countries with more rigorous methods).

▪ A study conducted by Stanford University in Santa Clara County tested 3,330 volunteers for antibodies. The study found that just 1.5% of these volunteers were positive and an adjusted measure accounting for population bias suggested prevalence of 2.5-4%. Again the methods of the study have been criticized and given shortcomings should only be viewed as a directional data point in our view.

▪ New York State announced on April 20th that it will begin statewide antibody testing focus on 3,000 randomly selected people.

The level of testing in the U.S. has improved over the course of April but still remains behind Italy.

Below we compare tests performed relative to population in order to enable comparison among countries over time. As can be seen, **the level of testing in the U.S. has improved over the course of March. Testing still lags Italy but has now reached about the same level as South Korea**.

▪ **Testing campaigns are the focus outside the US**. Austria and Germany began conducting systematic testing campaigns earlier this month on randomized population groups, with Britain and Sweden announcing similar projects for the end of the month. Such methodological approach to testing is one way for large countries to address mass screening needs. Austria's Minister for Health, notably commented on March 24 that the countries testing capacity had increased to 2,000-4,000 tests per day from 1,000-1,5000, and had plans to ramp to 15,000 tests per day in the near future. We believe we are starting to see such increase below.

▪ **As European countries look to open up, testing remains the limiting factor.** In early April, French president Emmanuel Macron promised citizens his quarantine restrictions would begin to ease in mid-May, but current testing capacity of only 150,000 tests per week, are calling into question the reality of this move. **According to the Executive Director of WHO's Health Emergencies Program, the recommended benchmark for testing should be at least 10 negative tests for every one positive**, which France is not close to meeting. Testing capacity for the UK (120,000 tests per week) also doesn't meet the above criteria, but Italy and Spain (both 300,000 tests per week) and Germany (350,000 per week) surpass the 10:1 level.

Fig. 19: Cumulative Tests Performed per 1mn Population with Lockdown Date circled
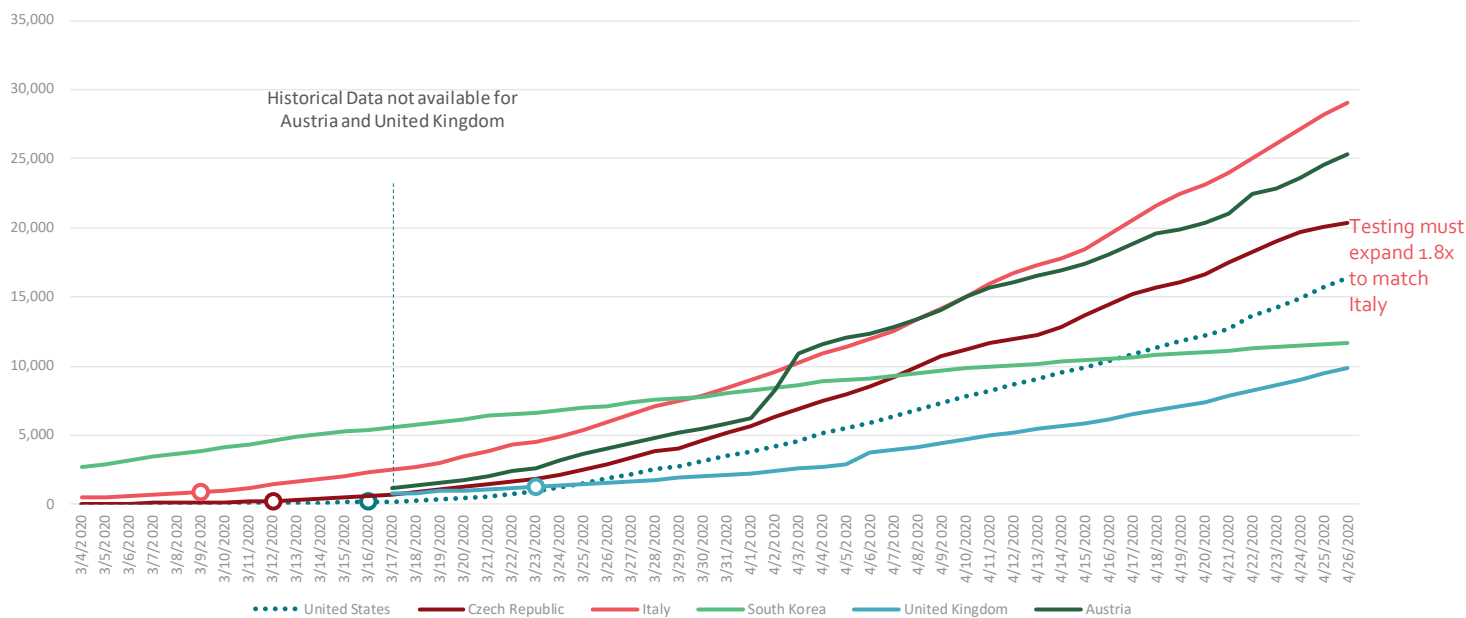
Historical Data not available for Austria and United Kingdom

Testing must expand 1.8x to match Italy

Legend: ⋯⋯ United States — Czech Republic — Italy — South Korea — United Kingdom — Austria

Source: Nephron Research analysis of Johns Hopkins Center for Systems Science and Engineering COVID data, worldpopulationreview.com

We shift from a focus on cumulative tests per 100k population to a focus on average tests per 100k population over the last seven-days, a key measure for enabling relaxation of social distancing

At a point in time when news articles have labeled New York, New Jersey and Washington as epicenters of the Coronavirus, we were interested to consider to what extent expanded positive diagnoses reflect expanded diagnostic testing.

The figure below plots all states by average number of new tests added over the last seven days. According to estimates by researchers at the Harvard School of Public Health, states must reach a minimum of 152 tests / 100k population to get to a level that enables identification of the majority of positive cases – a prerequisite for safely scaling back social distancing measures. What we see is that as of 4/27, West Virginia, Massachusetts, and Rhode Island exceed the 152-test threshold. The average for the rest of the country fell slightly yesterday to 63 from 64, excluding RI. The limitations of our testing data should serve as a warning to all the states which have yet to ramp testing. For example, the surge in LA has gone hand in hand with an increase in testing though it likely dates back to Mardi Gras in late Feb.   While it is easy to label NY and WA as the epicenters and attribute the surge in NY to density and use of public transit, we know little about the true progression of the virus in these states and even less in the rest of the country and harbor significant concerns about the state of progression in low testing states such as TX, GA, MI, CA and IL and IN.

- NY Gov. Cuomo returned from a meeting with President Trump on April 21st with a pledge to help double testing in the state to 40k per day, a level that would put NY above the 152 tests/100k pop required to enable case identification and tracing.   As of 4/27, the state is now averaging 141 tests/100K per day, up from 138 yesterday and 110 a week ago.

Fig. 20: Average Daily Test Per 100k Population: Almost all states fall far below the 152 tests per 100k population researchers suggest is the minimum level needed to identify the majority of people infected on an ongoing basis.
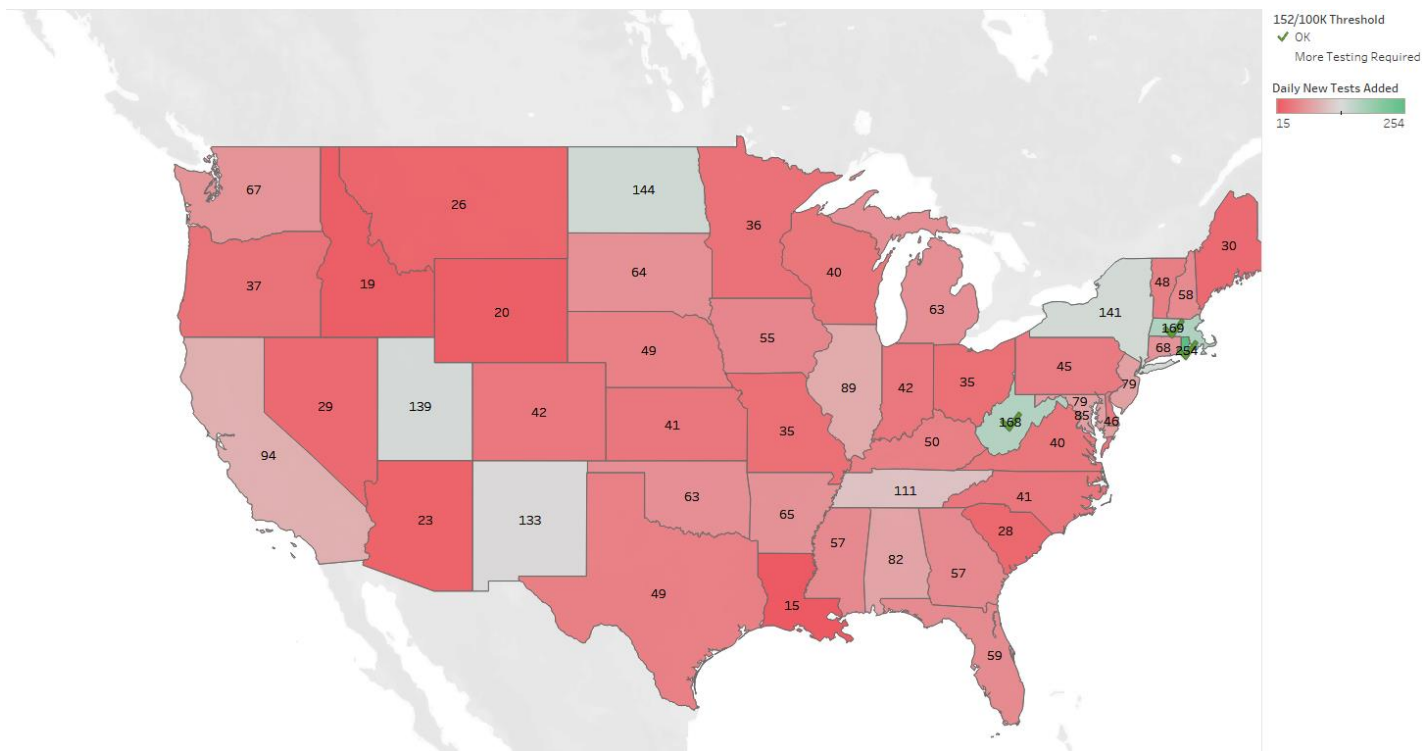
Source: Nephron Research analysis and visualization of The COVID Tracking Project data

Note: Harvard T.H. Chan School of Public Health Study report estimates 152 Tests/100k required to safely reopen https://nyti.ms/2Kls92g

Contact-tracing is key to any effort to relax social distancing and reopen the economy: We highlight several recent developments

As testing expands, the focus turns to contact-tracing. We are following efforts to develop contact-tracing via state and local health departments and the application of digital solutions that may help expedite the manual process given the need to potentially track tens of thousands of cases. The experience of past viral outbreaks suggests that public health workers typically require several hours over 2-4 days to complete a single case. In China, Korea, Singapore and Taiwan we saw successful deployment of cellphone-based apps that utilized location data (and credit card data and surveillance camera footage in the case of Korea) to help accelerate the process of tracing and informing individuals of potential exposure. While these apps proved effective, they clearly raise privacy concerns in the U.S. (as they have in Europe). Absent a national response, we are closely tracking state efforts alongside early reports of collaboration in the healthcare and tech industry that could lead to national solutions (national solutions that unlike China leave it to individuals to opt in).

New Development: Apple and Google partner to help enable contact-tracing apps

■ **Apple and Google to develop contact-tracing apps.** Apple Inc. and Google have agreed to partner on developing contact-tracing smartphone technology that will alert users if they have come into contact with someone infected with COVID-19 while still preserving privacy. The goal is to provide the groundwork for public health contact-tracing app developers via the May release of API that public health organizations can leverage (the API will not be available to private companies).

   o The API will enable apps on the phone to use Bluetooth to determine if the smartphone has come within 30 feet of the phone of someone who later turns out to be infected with COVID-19 (the apps will not track user location or identifying data). We expect participation and disclosure of COVID-19 diagnosis will be voluntary given the obvious privacy concerns. The goal would be for the individual who is alerted to significant exposure (as determined by the

app developer) to be tested and isolated - which of course requires that testing is available for this to work – and then share their diagnosis so that others can be alerted.

- o   It appears that the companies will make the building blocks available to app developers in May and then embed it into the operating system in June. While there are significant limitations relating to self-reporting and the fact that COVID-19 can be treated without direct interaction, we view the effort as an important contribution that may help along-side a massive expansion of traditional contract-tracing methods.

- ■   **MIT Safe Paths contact tracing platform.** MIT and Mayo Clinic are working with Facebook and the to create an open source platform that enables jurisdictions and individuals to provide data to public health officials in an anonymized fashion. A phone-based app that collects information using a technique known as differential privacy that can share information publicly without identifying the individuals represented. The app enables individuals to check if they have crossed paths with someone who is later diagnosed positive and allows public health officials to redact individual information when broadcasting location information to protect patients and local businesses.

- ■   **Change Healthcare and Allscripts to contribute to Federal data registry.** On April 9th, it was reported that Change Healthcare and Allscripts have committed to donating data to help create a registry of Covid-19 patients by pooling medical records from across the country. The initiative is one of several sources of data the federal government is considering monitoring the spread of coronavirus in the U.S., another person familiar with the matter said. The registry wouldn't include patient names or other identifying details but would include detailed information about their past and current conditions and medications, drawing on data that originates from hospitals, pharmacies and health-insurance companies.

- ■   **LabCorp and Ciox to create data registry for clinical research.** LabCorp and Ciox announced that an agreement to collaborate on a comprehensive U.S.-based COVID-19 patient data registry. This registry will house curated, HIPAA-compliant de-identified data sets to expedite clinical research and analyses related to COVID-19. This patient data registry is expected to enable researchers to better understand and characterize COVID-19 diagnoses and treatments and generate insights that will aid ongoing and future pandemic preparedness and prevention efforts.

Trajectory – What happens next?

We expect the experience of the U.S. will vary widely from that of other countries and that within the U.S. the impact will vary wide from state to state

Our ability to draw straight lines between the reported experience of other countries and the likely experience of the U.S. is hamstrung by a wide range of factors that include respective political systems, health systems, geography and transit systems, approaches to suppression, populace response to suppression measures, speed and abundance of testing conducted, and definitions of positive cases, to name just a few. Given these systemic and cultural differences as well as the still relatively limited level of testing that has been conducted within the U.S. to date, it is important to acknowledge that our analysis will be 'directional' at best and the factors that differentiate the U.S. from other countries also differentiate states and counties across the U.S. from each other. Regional disparities in geography/density, approach/response to suppression, levels of testing and even healthcare systems will likely lead to wide variance within the U.S. with some states tracking closer to Italy while others look more like South Korea.

Below, we chart daily growth in cases (on an absolute basis) after each country issued 'lockdown' orders. The general purpose of this chart is to show how many days it took for each country to reach peak daily case growth (so far) after adopting restrictive social policies. That said, we acknowledge that all lockdowns are not created equally, with the restrictions in place in Hubei (China), Italy, and Spain

being stricter than the guidance released by the Trump administration. Interestingly, **China, Italy, France, and Spain all reached peak daily case growth 13-18 days after lockdown. The US had appeared to have potentially peaked on day 25, but reached a new daily high in case growth on April 25th (40-days post lockdown).** While variance in state lockdown orders complicates direct comparison and the validity of Chinese data is in question, the US has clearly lagged.

Fig. 21: Daily Change in Confirmed Cases vs Days since Lockdown – cases appear to peak 13-19 days post 'lockdown'
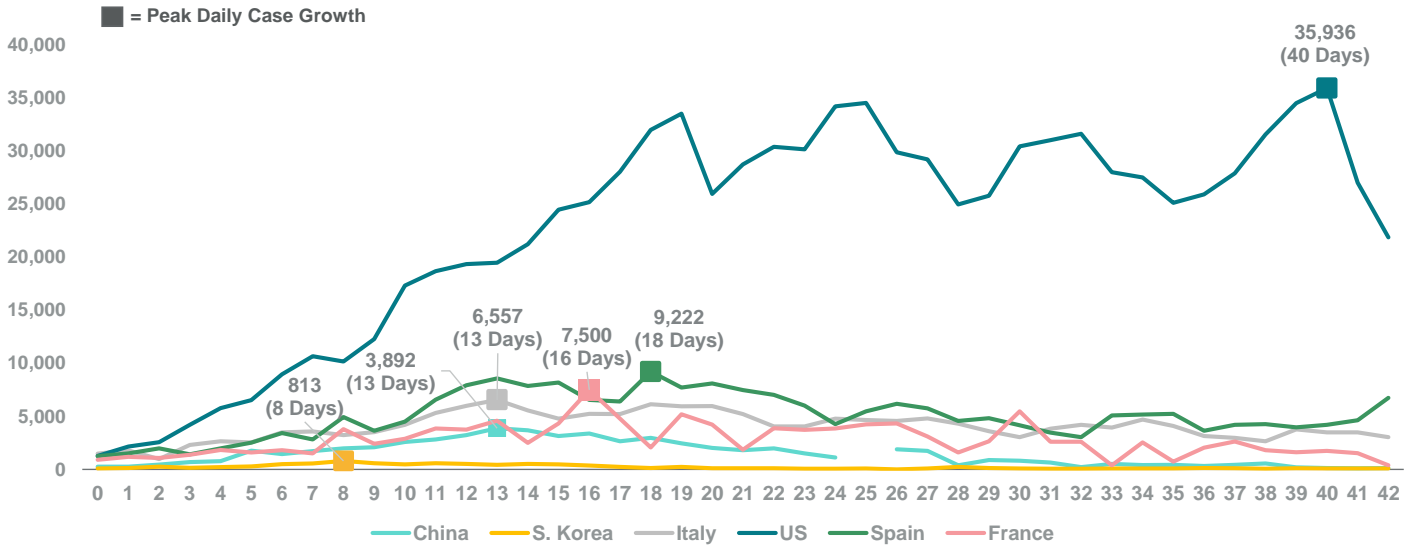

Data for the US is sourced from The COVID Tracking Project. All else sourced from the World Health Organization

Source: Nephron Research analysis of data from the World Health Organization and The COVID Tracking Project

Fig. 22: Cumulative Cases Per 1mn Pop since Lockdown: Cases appear to peak 13-19 days post 'lockdown'; US cases reached a new peak yesterday (40 days post lockdown), resetting what appeared to be the peak April 10 (25 days)
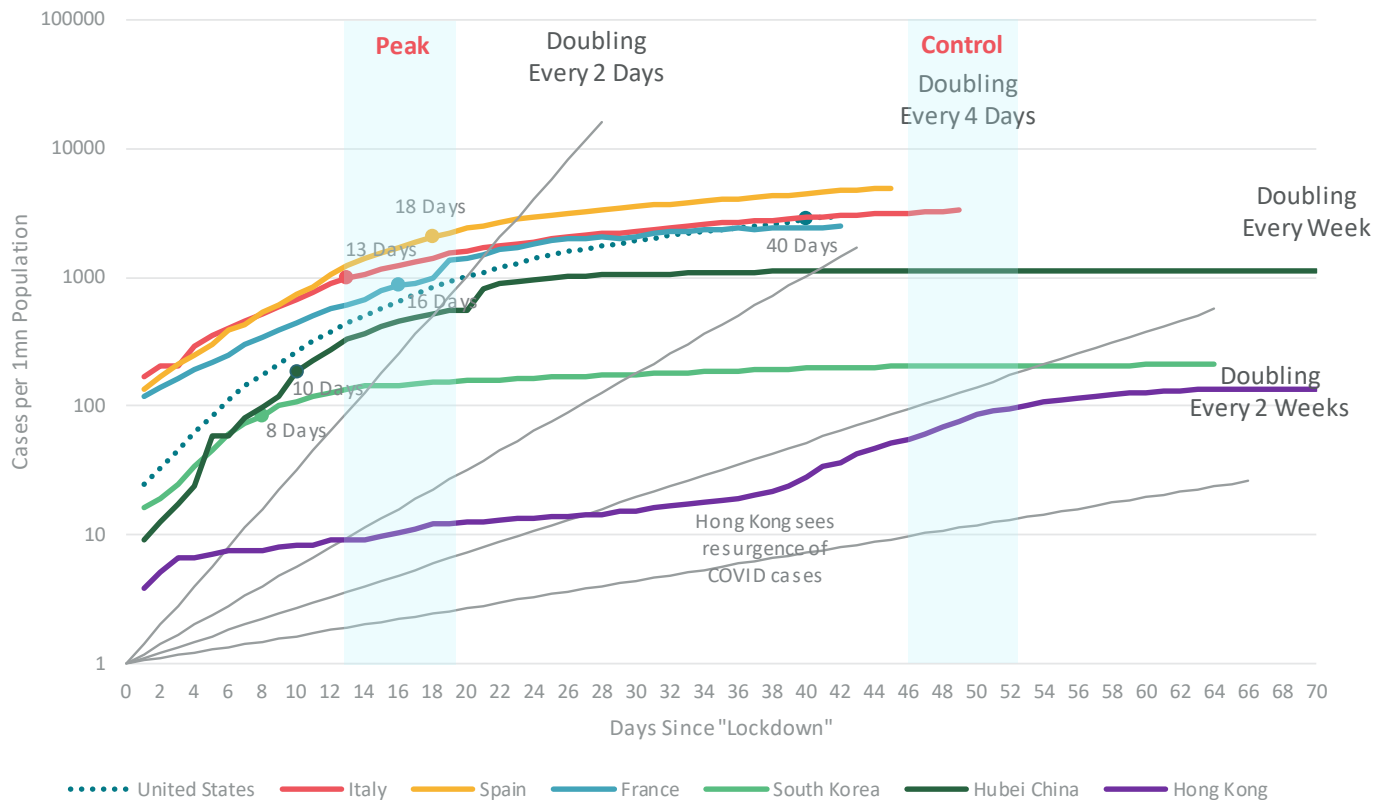
Source: Nephron Research analysis of Johns Hopkins Center for Systems Science and Engineering Data and The COVID Tracking Project
Note: Case peak relative to current datapoints available, we will continue to monitor for changes

We define 'lockdown' as follows (note that these are imperfect measures):

- **Hubei China (1/23)** – Wuhan City travel restrictions and lockdown

- **Hong Kong (2/8)** – Hong Kong enforced a mandatory two-week quarantine for anyone arriving from mainland China. The quarantine required daily calls and spot checks by officials, and up to 6 months prison time for anyone that breached.

- **South Korea (2/23)** – President Moon Jae-in issues the country's highest threat alert level. Although, the country never issued an official lockdown, by raising the threat level, the President gave the government the ability to restrict public transit, borders, and close schools.

- **Italy (3/9)** – Prime Minister Giuseppe Conte announces all of Italy under lockdown, banning all public events, suspending religious services, and mandating school closures.

- **Spain (3/13)** – Prime Minister Pedro Sanchez issued lockdown of four municipalities before placing restrictions on the whole country a day later.

- **France (3/16)** –French president Emmanuel Marcon ordered a 15-day lockdown for the country as France became the third European country to do such.

- **US (3/16)** – President Trump urged the public to avoid public gatherings of more than 10 people but refrained from a national lockdown order.

We now compare the experience of each country to the experience of those U.S. states with the greatest number of cases and highest case growth rates.

Fig. 23: Days since lockdown in the 42 states that have issued orders. (Counties have issued orders in three of the eight states with no state-wide order.) South Carolina is the most recent state to issue lockdown, effective April 7th.
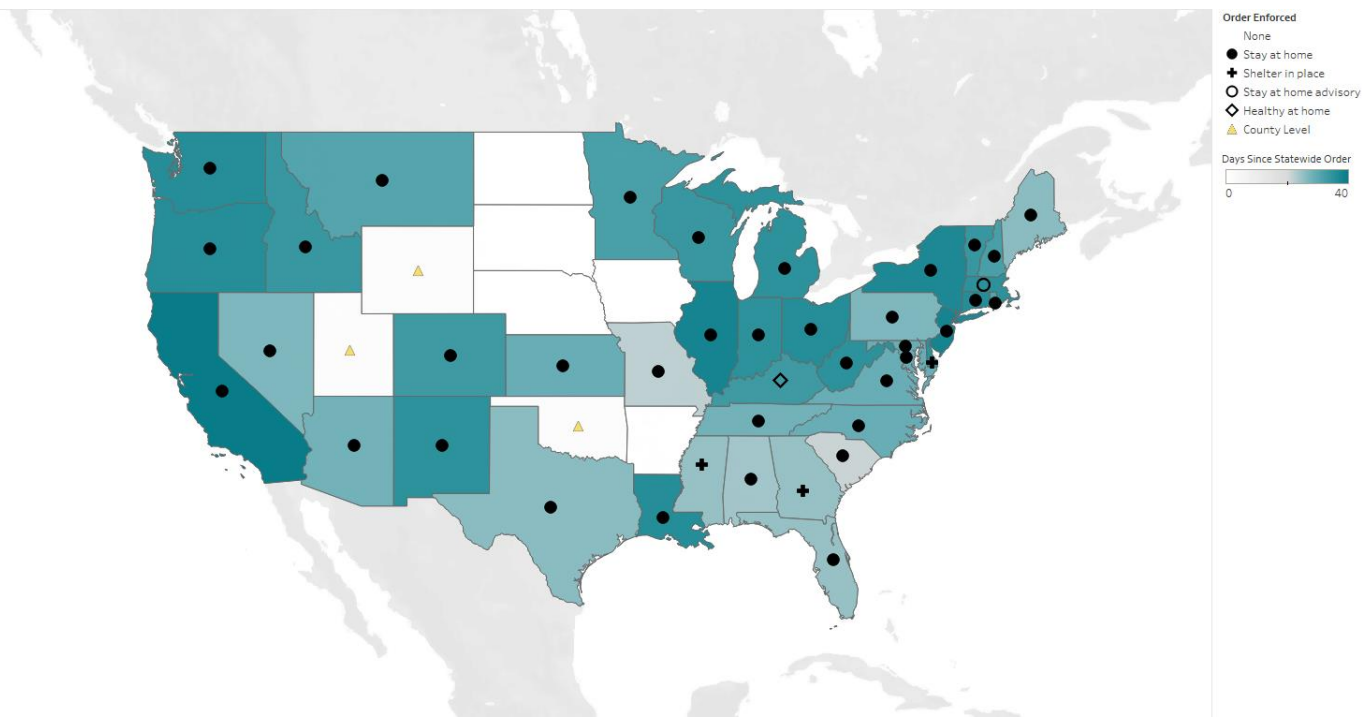
Source: Nephron Research Graphic, State "Lockdown" Order Information obtained from https://nyti.ms/3aNXhmy

Examining Trends Post 'Lockdown'

Italy and China saw peak cases 10-13-days post lockdown, while the US set a new peak on April 25th (40 days post lockdown).

Interestingly, **it appears that both Italy and China saw their peak daily case growth 10-13 days after issuing lockdown orders. France** and **Spain** reached peak growth at slightly later dates, with their highest d/d increases coming a respective 16 and 18 days post lockdown. **Meanwhile, the recent acceleration in testing has resulted in a new peak in US case growth on April 25th (40 days post lockdown).**

Our analysis doesn't consider the severity of lockdown; we know Hubei China's lockdown was more severe and likely more effective at slowing case growth than the US's current social gathering guidance, and thus inflection points could vary country to country. It is possible that those U.S. cities that instituted aggressive suppression efforts (which continue to see growth in mortality 18-days post the Trump Administration issuing guidance to limit social gatherings to less than 10-people) could see peak case growth within one or two weeks (with variance across states and counties).

- Hubei China's suppression efforts led stabilization in the rate of mortality per 1mn population roughly 24-days after the inflection point. South Korea has yet to truly flatten but appears well on its way to a similar result 20-days post inflection. We conjecture that the time from lockdown to inflection to control could be greater in the U.S. given variance between approaches to lock-down across states.

- **China revised Wuhan death toll upwards by 50% last Friday**. Amidst pressure from around the world to produce more accurate data, on Friday, China added 1,290 more deaths to the cities death

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toll, citing new statistical evidence that has emerged. We believe the revised death toll also corresponded with an increase in total number of cases.

- **Hong Kong researchers say more than 232,000 people may have been infected in mainland China, 4x reported numbers.** According to academic researchers at Hong Kong University's school of public health, had China reported original COVID cases with their now revised definition, the total number would have been far greater.

Hong Kong appeared to experience a modest increase in cases after lifting of restrictions

Recent activity in Hong Kong demonstrates the importance of post lock down tracing and isolation measures. Hong Kong was perhaps the country best positioned to respond to COVID-19 given that social distancing became ingrained in society after the SARS epidemic which disproportionately impacted the nation. Swift government action and strict social distancing measures and testing helped limit the spread of COVID-19 in Hong Kong. **Recent data suggests that following the relaxation of work restrictions in March, the number of cases increased with media reports pointing to an influx of expats returning and bringing the virus with them.**

- The experience of Hong Kong, where local health systems are actively tracing the interactions of those who test positive and citizens are submitting to testing and isolation shows us what will be required of the U.S. over the next 18-months (with state and local health departments working in partnership with local health systems).

- **Hong Kong and Singapore see increase in the number of positive COVID cases April 8th**. Singapore has seen COVID cases jump, with total positives increasing more than 60% in the past week. While the rise in cases in Hong Kong have largely been local, cases in foreign worker dormitories in Singapore have accounted for 35% of new cases over the past 3 days. In response, Hong Kong has extended closures of entertainment venues and restrictions on public gatherings for another two weeks, while Singapore has banned social gatherings of any size, valid for up to six months.

Fig. 24: Hong Kong Daily Case Growth per 1mn appears to have flattened alongside with Hubei and South Korea
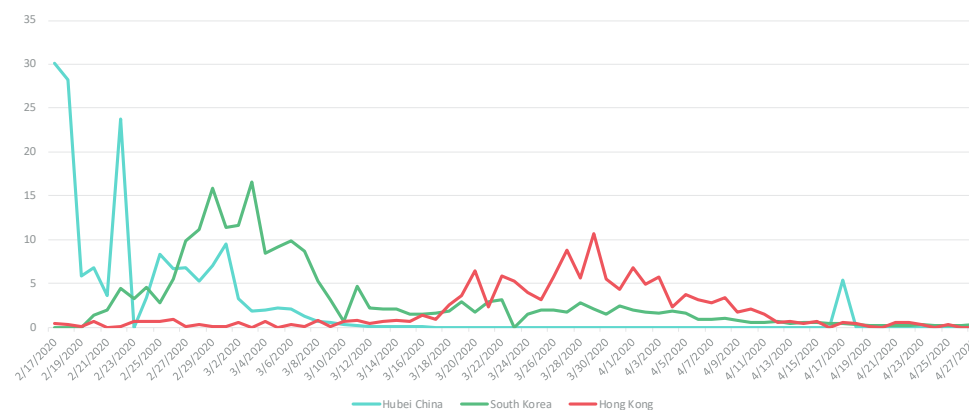
Source: Nephron Research analysis of Johns Hopkins Center for Systems Science and Engineering COVID data

Similar to the case charts above, **we also show daily growth in deaths (on an absolute basis) after each country issued lockdown orders.** Again, the general purpose of this chart is to show how many days it took for each country to reach peak daily death growth after adopting restrictive social policies. Given the lag between diagnosis and death, it is unsurprising that peaks in daily deaths have generally taken longer to reach. For example, **it took approximately 21 days after the lockdown of Hubei for China to reach its highest daily death toll.** Notably, this excludes the data from April 17th, which

showed an unusually high d/d increase due to a retroactive revision made by Chinese health officials. In comparison, Italy, France, and Spain achieved their highest daily growth in deaths 19-20 days post lockdown. **The US has taken longer to peak, recording a new high of 2.6K deaths on April 21st (36 days post lockdown).**

The U.S. entered lockdown at a lower level of mortality than did all countries save for Korea. However, it should be noted that specific states, including NY, NJ and WA, entered lockdown at levels that were above Korea and Hubei China, again all on a populated basis (unfortunately comparison to Northern Italy are not possible).

Fig. 25: Daily Change in Deaths vs Days since Lockdown – Deaths may peak 10-25 days post 'lockdown'
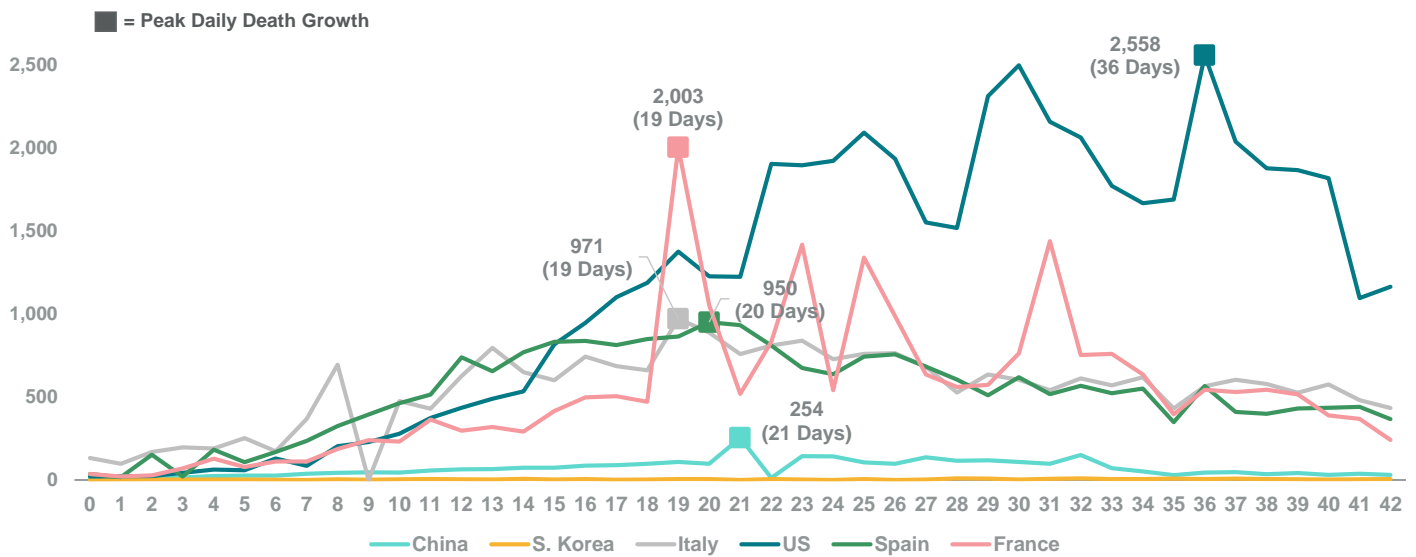
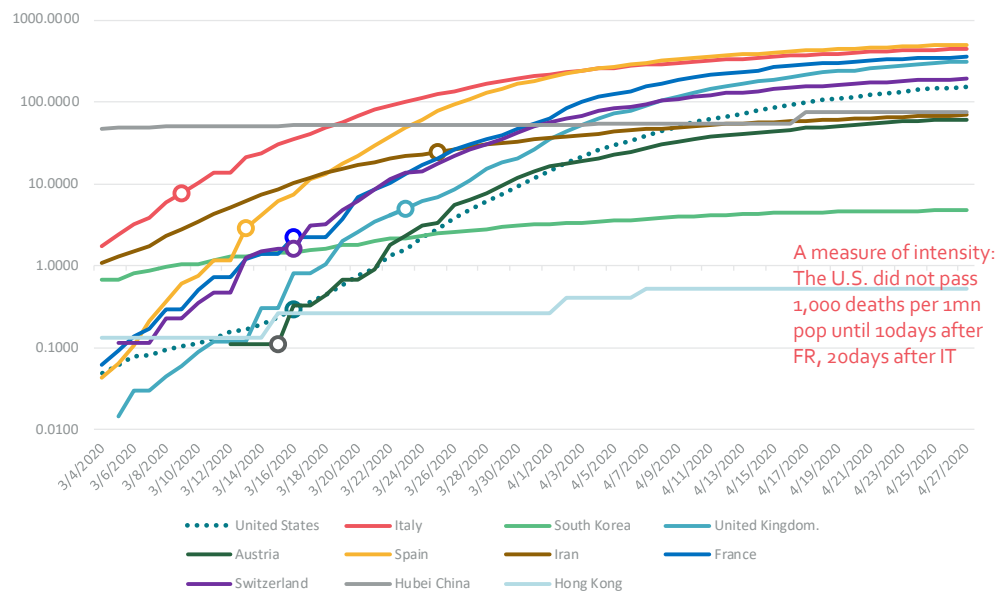*Data for the US is sourced from The COVID Tracking Project. All else sourced from the World Health Organization

Source: Nephron Research analysis of data from the World Health Organization and The COVID Tracking Project

Fig. 26: Country Mortality Rate Per 1mn Pop: Rate of growth appears to inflect 13-19 days post 'lockdown', the US is an outlier
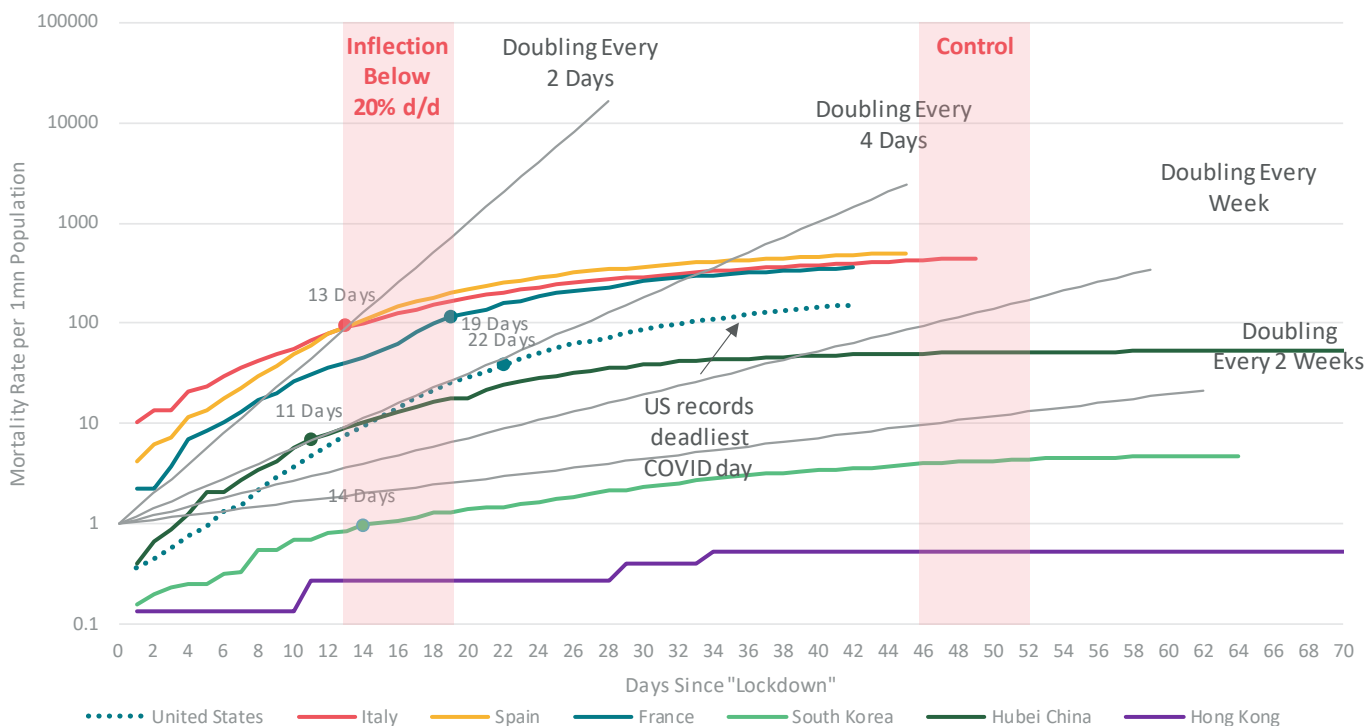
Source: Nephron Research analysis of Johns Hopkins Center for Systems Science and Engineering COVID data and The COVID Tracking Project

Note: Due to limitations in data availability, we are only able to look accurately at China's Hubei province

Considering the Trajectory of the U.S. relative to Asia and Europe

Examining the coronavirus experience of China, Hong Kong and Korea, it appears that each has progressed through a roughly 8 to 10 week cycle. While each country is unique, the virus peaked within 3-4 weeks of suppression measures being introduced (perhaps two weeks post implementation of aggressive measures) with the number of new cases declining over a period of 3-5 weeks while the populace continued to observe social distancing mandates. It is important to note that strict shelter in place mandates in these countries went hand-in-hand with extensive testing and the tracking/testing/isolation of potential carriers (with the later expanding as social distancing mandates began to be relaxed).

There is good reason to expect that progress in the U.S. could lag that of Asian countries that were better prepared and responded more aggressively

We are tracking closely several developments that we view as essential to enabling the U.S. to follow similar path, chiefly: 1) Expansion of aggressive suppression measures from early adopters to much of the rest of the country; **2)** The 10x increase in testing over the last week must again double by early April to facilitate tracing; **3)** State and local public health departments must form thousands of teams to conduct tracing; **4)** Manufacturers must produce and providers must source PPE adequate to enable testing and treatment.

- **We expect it is likely that the progress of the U.S. will lag that of Asian countries:** Hong Kong was deeply impacted by the SARS and so on guard for COVID-19; Hubei benefitted from the centralized nature of China's political system (though there is reason to doubt official case and death counts) and; Korea quickly adopted an aggressive testing and tracking program. **As the U.S.**

did not have its guard up, missed early opportunities to respond and has adopted a state-centric approach, we expect it could take longer to reach the peak and achieve containment.

Mortality – How many have we lost?

Global deaths reached 198.7K, representing an increase of 5.0K (or 2.6%) relative to the prior day. The US saw the largest absolute increase in deaths, with 1.2K individuals passing away from the virus. Spain saw the second largest increase for the day, recording growth of 666 (3.0%) d/d. As of April 27th, the US continues to have the highest death toll in the world at 50.3K, followed by Italy (26.6K), Spain (23.2K), and France (22.8K).

Fig. 27: Global Death Tracker, Top 10 Countries

Date	World Total	Top 10 Countries									
		U.S.	Spain	Italy	Germany	U.K.	France	Turkey	Iran	Russia	China
13-Apr	111,652	23,754	16,972	19,901	2,799	10,612	14,374	1,198	4,474	148	3,351
14-Apr	117,021	26,066	17,489	20,465	2,969	11,329	14,946	1,296	4,585	170	3,351
15-Apr	123,010	28,564	18,056	21,069	3,254	12,107	15,708	1,403	4,683	198	3,352
16-Apr	130,885	30,722	18,579	21,647	3,569	12,868	17,146	1,518	4,777	232	3,352
17-Apr	139,378	32,785	19,130	22,172	3,868	13,729	17,899	1,643	4,869	273	4,642
18-Apr	146,088	34,557	19,478	22,747	4,110	14,576	18,659	1,769	4,958	313	4,642
19-Apr	152,551	36,224	20,043	23,227	4,294	15,464	19,294	1,890	5,031	361	4,642
20-Apr	157,847	37,913	20,453	23,660	4,404	16,060	19,689	2,017	5,118	361	4,642
21-Apr	162,956	40,471	20,852	24,114	4,598	16,509	20,233	2,140	5,209	456	4,642
22-Apr	169,006	42,508	21,282	24,648	4,879	17,337	20,763	2,259	5,297	513	4,642
23-Apr	175,694	44,385	21,717	25,085	5,094	18,100	21,307	2,376	5,391	555	4,642
24-Apr	181,938	46,251	22,157	25,549	5,321	18,738	21,823	2,491	5,481	615	4,642
25-Apr	187,705	48,069	22,524	25,969	5,500	19,506	22,212	2,600	5,574	615	4,642
26-Apr	193,710	49,164	22,524	26,384	5,640	20,319	22,580	2,706	5,650	681	4,642
27-Apr	198,668	50,327	23,190	26,644	5,750	20,732	22,821	2,805	5,710	794	4,643
Day/Day	**4,958**	**1,163**	**666**	**260**	**110**	**413**	**241**	**99**	**60**	**113**	**1**
% d/d	*2.6%*	*2.4%*	*3.0%*	*1.0%*	*2.0%*	*2.0%*	*1.1%*	*3.7%*	*1.1%*	*16.6%*	*0.0%*

*Data for the US is sourced from The COVID Tracking Project. All else sourced from the World Health Organization.

Source: Nephron Research analysis of data from the World Health Organization and The COVID Tracking Project

Below, we focus on changes in deaths among the five countries with the most confirmed infections. To start, we note that **Italy has experienced a downtick in d/d growth over the past 3 days.** From April 25th to April 27th, Italy's average daily death growth was 365 (1.4%), which compares to average growth of 478 (1.9%) over the preceding 3-day period. **Germany has also seen a deceleration in daily deaths,** with average daily death growth 143 (2.6%) over the past three days. This compares to average growth of 241 (5.0%) in the prior 3-day period. Finally, we note that **the US is seeing a gradual decline in d/d deaths.** From April 25th to April 27th, the US saw average daily death growth of 1.4K (2.9%). This compares to average daily growth of 1.9K (4.6%) over the prior 3-day period.

Fig. 28: Global Death Tracker, Top 5 Countries

| | World | U.S. | | | Spain | | | Italy | | | Germany | | | U.K. | | |
Date	Total	Total	D/D	% D/D	Total	D/D	% D/D	Total	D/D	% D/D	Total	D/D	% D/D	Total	D/D	% D/D
13-Apr	111,652	23,754	1,517	7%	16,972	619	4%	19,901	431	2%	2,799	126	5%	10,612	737	7%
14-Apr	117,021	26,066	2,312	10%	17,489	517	3%	20,465	564	3%	2,969	170	6%	11,329	717	7%
15-Apr	123,010	28,564	2,498	10%	18,056	567	3%	21,069	604	3%	3,254	285	10%	12,107	778	7%
16-Apr	130,885	30,722	2,158	8%	18,579	523	3%	21,647	578	3%	3,569	315	10%	12,868	761	6%
17-Apr	139,378	32,785	2,063	7%	19,130	551	3%	22,172	525	2%	3,868	299	8%	13,729	861	7%
18-Apr	146,088	34,557	1,772	5%	19,478	348	2%	22,747	575	3%	4,110	242	6%	14,576	847	6%
19-Apr	152,551	36,224	1,667	5%	20,043	565	3%	23,227	480	2%	4,294	184	4%	15,464	888	6%
20-Apr	157,847	37,913	1,689	5%	20,453	410	2%	23,660	433	2%	4,404	110	3%	16,060	596	4%
21-Apr	162,956	40,471	2,558	7%	20,852	399	2%	24,114	454	2%	4,598	194	4%	16,509	449	3%
22-Apr	169,006	42,508	2,037	5%	21,282	430	2%	24,648	534	2%	4,879	281	6%	17,337	828	5%
23-Apr	175,694	44,385	1,877	4%	21,717	435	2%	25,085	437	2%	5,094	215	4%	18,100	763	4%
24-Apr	181,938	46,251	1,866	4%	22,157	440	2%	25,549	464	2%	5,321	227	4%	18,738	638	4%
25-Apr	187,705	48,069	1,818	4%	22,524	367	2%	25,969	420	2%	5,500	179	3%	19,506	768	4%
26-Apr	193,710	49,164	1,095	2%	22,524	0	0%	26,384	415	2%	5,640	140	3%	20,319	813	4%
27-Apr	198,668	50,327	1,163	2%	23,190	666	3%	26,644	260	1%	5,750	110	2%	20,732	413	2%
Day/Day	4,958	1,163			666			260			110			413		
% d/d	2.6%	2.4%			3.0%			1.0%			2.0%			2.0%		

*Data for the US is sourced from The COVID Tracking Project. All else sourced from the World Health Organization.

Source: Nephron Research analysis of data from the World Health Organization and The COVID Tracking Project

The global case mortality rate was 6.9% on April 27ᵗʰ. France has overtaken Italy for the highest case mortality rate, with total deaths representing 18.5% of all those who have tested positive. To compare, Russia's mortality rate is 0.9% of confirmed cases (the lowest among the ten countries with the most infections). As of April 26ᵗʰ, **the US mortality rate is 5.1% of confirmed cases, which is well below the global average of 6.9%, as well as the rates in countries such as France, Spain, and the UK.**

Fig. 29: Case Mortality Rate, April 27, 2020
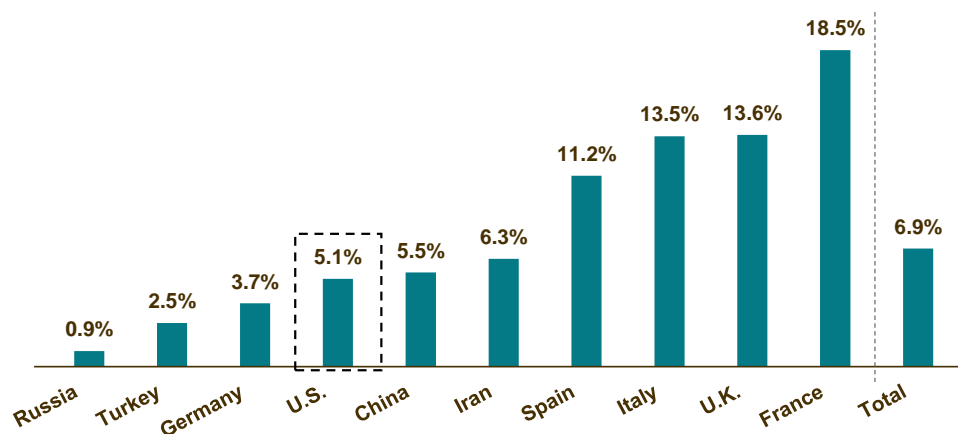
Source: Nephron Research analysis of data from the World Health Organization and The COVID Tracking Project

Population weighted mortality may provide a clearer view of the progression of COVID-19 than do measures of cases (we use this metric in our examination of case growth post 'lockdown' above). Specifically, diagnostic testing levels vary widely between the countries we are comparing as do definitions of cases (the most significant variance being that China is not reporting positive tests as cases where the patient is asymptomatic). **As such we expect that the metric of deaths per 1mn population will become a more important indicator of COVID-19 advancement as the virus progresses over the next several weeks.** Of course, the death per 1mn citizens measure is only valid to the extent that cumulative COVID-19 deaths have been accurately categorized since January.

In the following figure, we have assembled a time series of cumulative deaths per 1mn population (logarithmic scale).

- **Mortality Per 1mn Population.** Mortality per 1mn population provides a measure of severity at a given point in time. **The U.S. passed the bar of 1 death per 1mn population on March 22nd, four days after the U.K., ten days after France and Switzerland, 11 days after Spain and more than 20 days after Italy and Iran.** We should note there that reporting has suggested that China/Hubei deaths may be significantly under reported as may the estimates of Iran). It is notable that South Korea did not cross the death per 1mn population mark until March 10th.

- **Limitations of testing measures.** Even adjusting testing data for population, testing levels remain far enough behind other countries that we have limited insight into the extent the virus is already present within the U.S. population and consequently the number of deaths that can no longer be prevented (with the timing of demand surges and ICU capacity being key variables). With no randomized tests of the population likely in the U.S. near term, it is difficult to develop an informed view of prevalence. As such, we focus as much on the measures of mortality as the measures of cases.

Fig. 30: Cumulative Deaths per 1mn Population (with 'lockdown' date circled)

A measure of intensity: The U.S. did not pass 1,000 deaths per 1mn pop until 10days after FR, 20days after IT

Source: Nephron Research analysis of Johns Hopkins Center for Systems Science and Engineering COVID data, worldpopulationreview.com

Coverage Universe Commentaries

Hospitals

We estimate that Tenet and Universal Health have the highest weighted-average revenue exposure to counties with COVID-19 cases. The companies with the highest revenue exposure have been shifting daily as the number of cases expands into new county geographies and as certain counties become more infected. As a reminder, we began our analysis by mapping out the states where hospitals have exposure by both the number of hospitals and the number of beds. In our prior analysis, we used state-based data, not county level, for two reasons. First, it was obviously easier to complete the analysis and get these reports out more timely. Second, we are not sure that County data is as appropriate for hospitals (relative to Medicare Advantage) as patients can easily cross county lines for care. **However, after spending more time mapping out our coverage universe hospitals located in counties with positive COVID-19 cases, the "worst case" revenue exposure is meaningful for our hospitals.** In our analysis below, we calculate the revenue exposure by summing up total revenues for hospitals located in counties with at least 1 COVID-19 case. In this <u>un-weighted</u> analysis, all COVID-19 counties are treated the same, regardless if they had 100 cases or just 1 case. **On average, we estimate HCA has the highest % of <u>un-weighted</u> revenue exposure with 90.5% of total revenues generated in counties that have at least 1 confirmed case of COVID-19, followed by Tenet with 72.3% revenue exposure.** Community Health has ~70% revenue exposure, and then Universal Health has the lowest revenue exposure at ~50% (we only analyzed acute care hospitals).

<u>**The revenue exposure is much more limited if you use a weighted average analysis of the counties with COVID-19 cases.**</u> If the revenues are weighted against the actual % of COVID-19 cases in each county, the revenue exposure is less than 0.5% for each of our hospitals (with the exception of Tenet which is 0.57%). Importantly, we are not suggesting that this is the revenue impact from COVID-19, but rather simply show the *weighted-average revenue exposure* to COVID-19. **While it's hard to make a call around the financial impact, from an anecdotal level we would assume that higher revenue exposure is likely a negative for the hospitals as the number of increased patient activity related to COVID-19 is more than offset by patients that delay (or eliminate) elective procedures.**

Fig. 31: Hospital County Overlap with Cases of COVID-19

County	State	Cases	Revenues (2017) HCA	CYH	THC	UHS	# of Beds (2017) HCA	CYH	THC	UHS
Cook	IL	30,574	$0	$0	$549,584,514	$0	0	0	639	0
Los Angeles	CA	19,528	$603,779,519	$0	$216,735,558	$187,519,096	538	0	172	157
Wayne	MI	15,748	$0	$0	$1,554,384,327	$0	0	0	1,204	0
Middlesex	MA	12,648	$0	$0	$239,688,064	$0	0	0	224	0
Miami-Dade	FL	11,350	$783,661,367	$0	$853,014,417	$0	774	0	1,735	0
Oakland	MI	6,928	$0	$0	$182,237,617	$0	0	0	128	0
Orleans	LA	6,342	$460,410,316	$0	$0	$0	459	0	0	0
Harris	TX	5,729	$2,484,178,455	$0	$0	$0	2,888	0	0	0
Broward	FL	4,729	$969,691,841	$0	$0	$0	1,286	0	0	0
Worcester	MA	4,572	$0	$0	$446,331,389	$0	0	0	259	0
District of Columbia	DC	3,841	$0	$0	$0	$577,941,801	0	0	0	329
Clark	NV	3,665	$1,172,982,124	$0	$0	$1,736,635,813	1,030	0	0	1,578
Riverside	CA	3,563	$510,163,505	$0	$680,857,341	$663,692,157	456	0	455	540
Maricopa	AZ	3,359	$0	$0	$748,131,637	$0	0	0	1,069	0
Dallas	TX	3,014	$1,027,910,962	$0	$87,306,365	$0	927	0	187	0
Fairfax	VA	2,889	$42,849,816	$0	$0	$0	116	0	0	0
Palm Beach	FL	2,695	$785,482,360	$0	$1,248,353,029	$194,873,247	827	0	1,435	233
Denver	CO	2,583	$903,742,700	$0	$0	$0	568	0	0	0
Davidson	TN	2,370	$1,379,533,625	$0	$0	$0	1,096	0	0	0
Shelby	TN	2,296	$0	$0	$394,549,362	$0	0	0	509	0
Woodward	OK	1	$0	$39,891,009	$0	$0	0	40	0	0
Revenues in COVID-19 Counties			$39,477,091,366	$11,195,960,415	$13,871,632,393	$5,200,368,985	37,432	14,047	15,499	4,611
% of 2017 Total			*90.5%*	*70.2%*	*72.3%*	*50.0%*	*82.3%*	*67.4%*	*81.0%*	*15.8%*
Weighted COVID-19 Case "Exposure"			*0.21%*	*0.03%*	*0.57%*	*0.31%*	*0.2%*	*0.0%*	*0.6%*	*0.3%*

Source: Nephron Research analysis of Company Filings and The COVID Tracking Project

Managed Care

Within managed care, we focus our attention primarily on the Medicare Advantage population. Based on the information so far, the virus has a more severe impact on seniors and the concern here is that they are more prone to hospitalization. This compares to the rest of the population where the vast majority of COVID-19 cases are mild (if even symptomatic) and mirrors a typical flu season. UnitedHealth recently noted that they expect the US mortality rate to eventually level out to ~1% once testing becomes more pervasive (it currently sits closer to 5%), but the mortality rate for seniors in China was ~3% for those in their 60s, ~8% for those in their 70s, and ~15% for those in their 80s. **Given that seniors are disproportionately impacted, this is an area where utilization could unexpectedly increase if more seniors need to be hospitalized.**

To better understand the potential implications of COVID-19 for the MCOs, we start by creating an index with all the counties in the US with a positive COVID case and the number of positive cases in that county. This was gathered through a variety of information sources including local state websites and local news sources for every state. Then we take the CMS Medicare Advantage data (we have that at the county level) and map out each MCO's MA enrollment in those counties specifically. The "un-weighted" exposure is simply a sum of that MCO's MA enrollment in those counties that have at least 1 case of COVID divided by their total MA enrollment. The "weighted" exposure is created by taking the number of cases in each county and showing it as a % of total, and then applying that % against the MCO's MA enrollment in those counties. **So basically, the more cases in a county and the more MA members the plan has in that county, the higher our rating of that plan.**

In terms of the "un-weighted" exposure, given the increased number of counties, we estimate that ~97.4% of total Medicare Advantage members reside in counties with at least 1 case of COVID-19. This is clearly the worst case scenario if the concern is that COVID-19 spreads quickly among seniors.

Fig. 32: COVID-19 Un-Weighted Medicare Advantage Membership Exposure
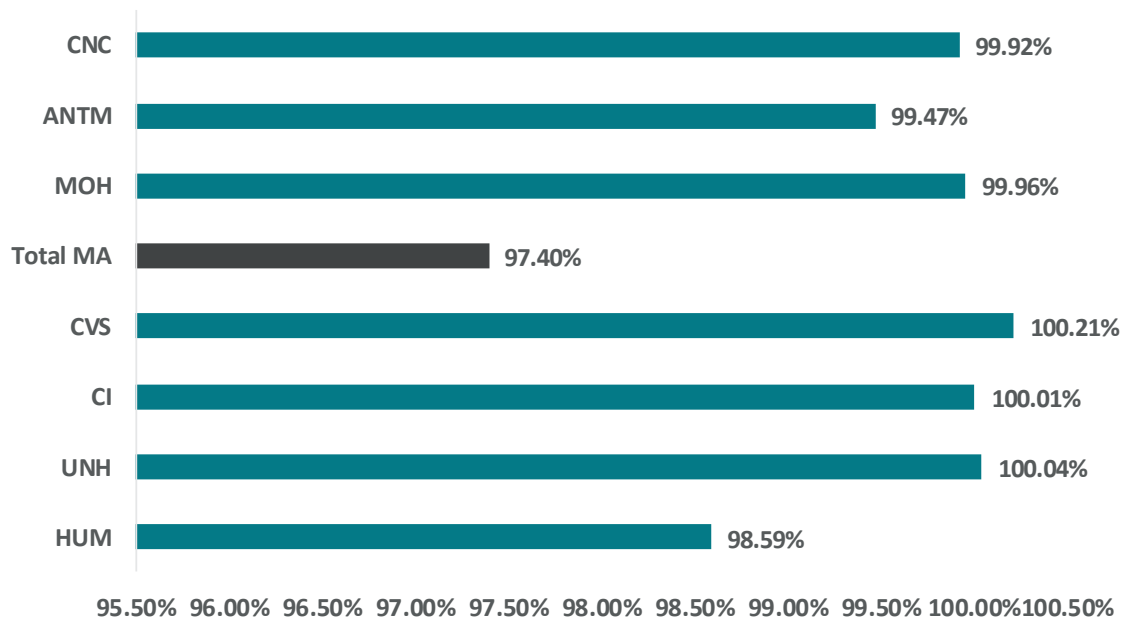
Source: Nephron Research analysis of data from CMS and The COVID Tracking Project

However, in terms of the "weighted" exposure, the risk is significantly lower for the MCOs. The chart below shows which MCOs have a greater weighted % of their Medicare Advantage membership exposed to counties with positive COVID-19 cases. We estimate that the overall Medicare Advantage industry has about ~0.40% of total membership in counties where COVID-19 cases have been confirmed. **With the updated county cases, Centene, Anthem, and Molina show greater risk of exposure to COVID-19 with 0.61%, 0.48%, and 0.40% exposure, respectively, to these counties.** Conversely, Humana has the lowest exposure with just 0.22% of MA membership exposure.

Fig. 33: COVID-19 <u>Weighted</u> Medicare Advantage Membership Exposure
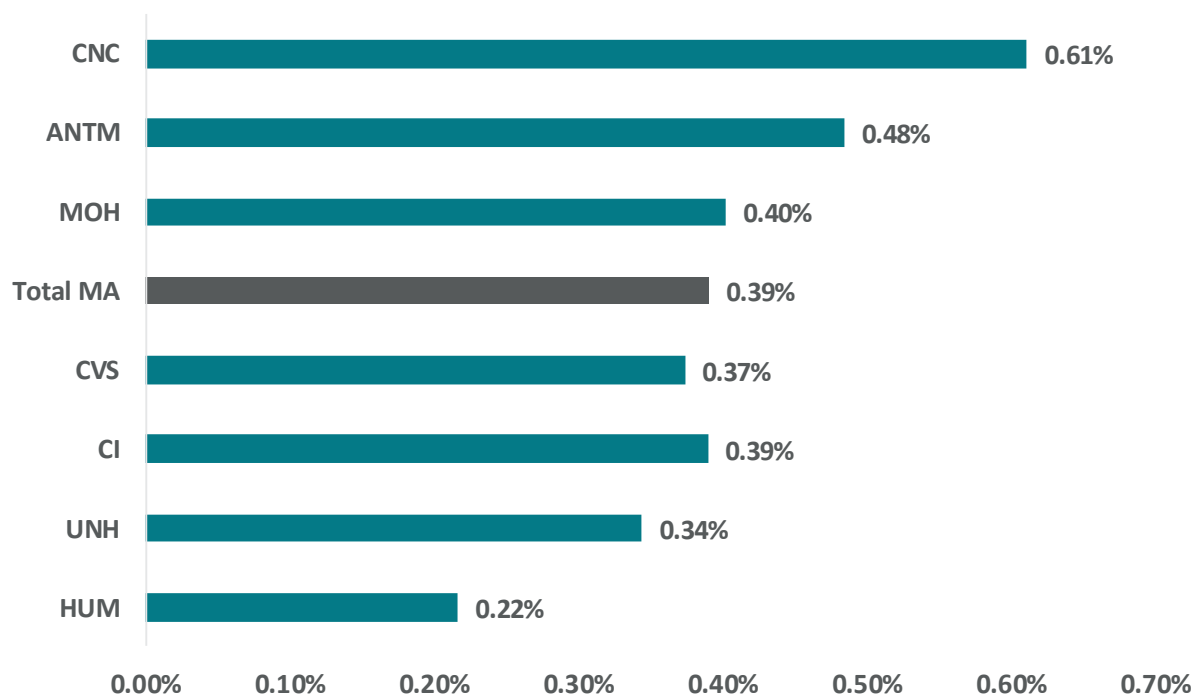
Source: Nephron Research analysis of data from CMS and Local State Health Websites

COVID-19 Pharma and Pharmacy Impact Analysis

Script trend data suggests the COVID-19 roller coaster is starting to slow

The impact of COVID-19 on script demand is like nothing we have seen over the last 20-years. A period of panic buying March 1-21 was followed by a period of destocking and reduced demand from shelter-in-place orders March 22-31. We are closely monitoring a new IQVIA measure of daily retail volume alongside more traditional (and tested) measures of weekly volume. While much noise was made when the daily volume dropped from +10% in mid-March to a -10% decline in late March, this measure has rebounded to -1% over the first 8- days of April. It will take several weeks to separate the relatively benign impact of destocking from the potentially more significant impact of fewer office visits and elective procedures.

- **Chronic scripts account for 69% of total scripts.** Segmenting Total Rx (TRx) between those treating chronic disease on an ongoing basis and those treating acute conditions we find chronic scripts make up 69% of total. **There is a high probability such scripts will continue to be written and filled even during a 3-6mo period of disruption.**

- **Refill scripts account for 77% of total.** In order to capture all refill scripts we must aggregate the IQVIA category of 'Refill Scripts' (42% of total) and the 'New Refill Scripts' portion of 'New Scripts' which incapsulates new refills in the period as opposed to refills on file. **In total refills, which are likely to continue to be written during a period of disruption account for 77% of total scripts.**

While COVID-19 and the resulting recession will weigh on the 19% of scripts attributable to new therapy starts, fully 77% of scripts are attributable to refills

- **New Therapy Starts are only 19% of total.** The category of 'New Rx (NRx)' is somewhat of a misnomer as it includes New Therapy Starts as well as Switch/Add-on Scripts and New Script Refills. **Most important, the New Therapy Starts (NTS Rx) most likely to be significantly impacted by the decline in physician office visits and screening activity represent only 19% of Total Rx.**

Fig. 34: Chronic scripts account for 69% of Total Rx – should prove highly inelastic through pandemic and recession

ACUTE
31%

CHRONIC
69%
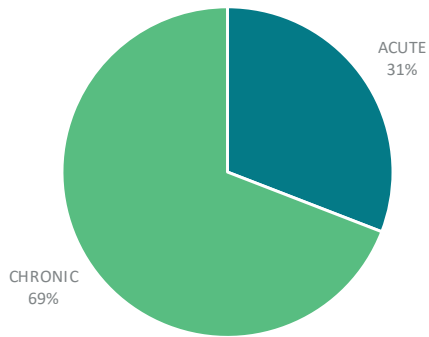
Source: Nephron Research, Script data from IQVIA "SMART – US Edition", IQVIA Institute

Fig. 35: Refill scripts account for 77% of Total Rx – the new therapy starts most at risk account for 19%

New Therapy Starts
19%

Switch/Add-on Scripts
4%

Refill Scripts
42%

New Script Refills
35%
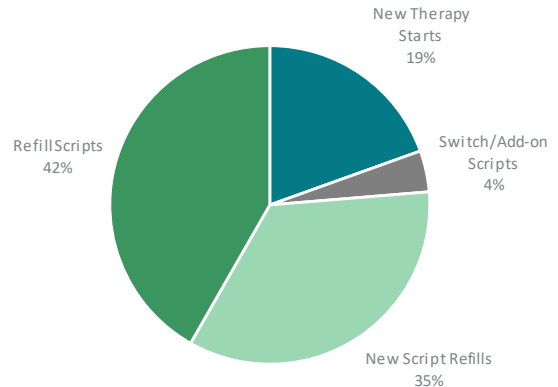
Source: Nephron Research, Script data from IQVIA "SMART – US Edition", IQVIA Institute

For a detailed analysis of the latest weekly and daily scripts trends, see our March 13th note: *New Script Trends Suggest COVID-19 Roller Coaster is Beginning to Normalize* in the Nephron Research library.

Nephron Research Outlook for 2020 COVID-19 Impact (by month)

We project the impact of the pandemic on volume will be less than 1% in 2020 but expect the recession will meaningfully shift lives between commercial, Medicaid, cash and discount cards

We have attempted to estimate the incremental impact of COVID-19 on retail pharmacy volumes (above/below our initial 2020 estimates). **We expect a 3% outperformance in March will be offset by 2% underperformance in April,** with script growth normalizing May to June but still suffering from physician office avoidance and a recessionary pressure (the later of which is likely a greater margin than revenue impact as volume shifts from commercial to Medicaid and cash/discount cards). For the full year we project retail scripts will be less than 1% off from our original 2020 estimate.

Fig. 36: Nephron Estimates of COVID-19 Incremental Impact: Retail Pharmacy Channel
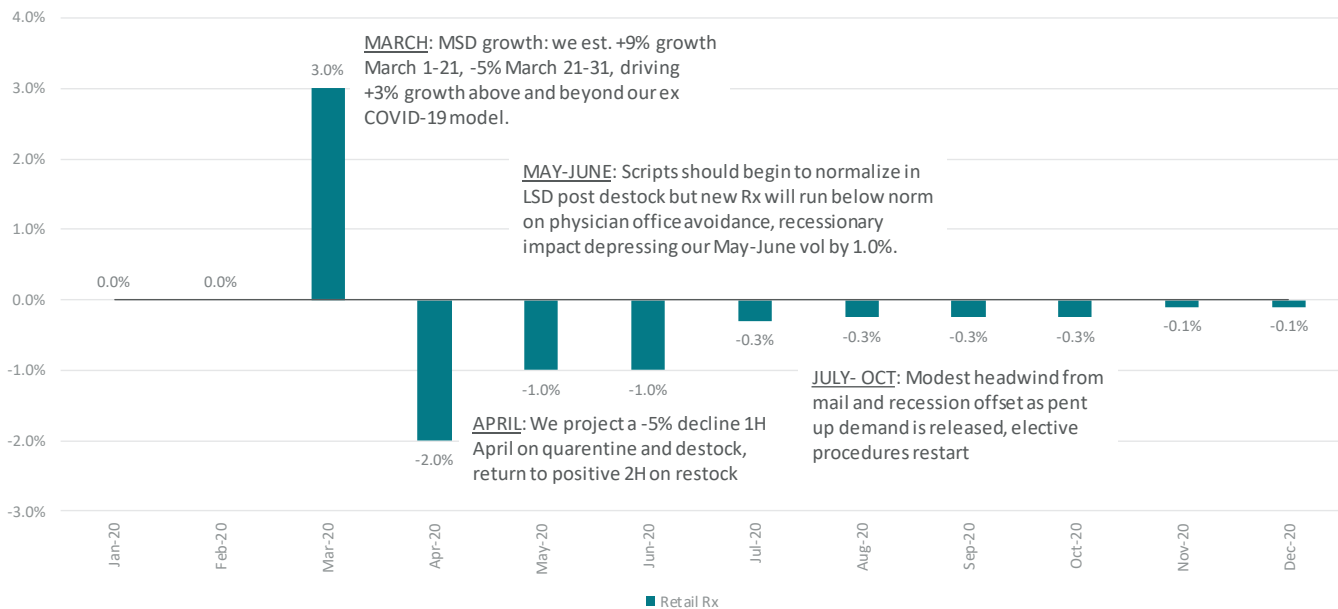
MARCH: MSD growth: we est. +9% growth March 1-21, -5% March 21-31, driving +3% growth above and beyond our ex COVID-19 model.

MAY-JUNE: Scripts should begin to normalize in LSD post destock but new Rx will run below norm on physician office avoidance, recessionary impact depressing our May-June vol by 1.0%.

APRIL: We project a -5% decline 1H April on quarantine and destock, return to positive 2H on restock

JULY- OCT: Modest headwind from mail and recession offset as pent up demand is released, elective procedures restart

Jan-20: 0.0%, Feb-20: 0.0%, Mar-20: 3.0%, Apr-20: -2.0%, May-20: -1.0%, Jun-20: -1.0%, Jul-20: -0.3%, Aug-20: -0.3%, Sep-20: -0.3%, Oct-20: -0.3%, Nov-20: -0.1%, Dec-20: -0.1%

Retail Rx

Source: Nephron Research

- **Mail order impact is likely to be quite limited.** It is possible we may see a negative headwind in retail pharmacy from the shift to mail order. However, our discussions with pharmacists, PBMs and payors suggest that 70%-80% of the increase in mail in March was attributable to early refills vs only 20%-30% from first mail fills. While this number is likely to increase as we progress through the lock down, **even if 50% of elevated March mail growth is attributed to gains from the retail channel that are sustained through the year, this would represent only a -40bp headwind to retail pharmacy script growth**. We expect the actual impact will be far less than -40bp.

- **The impact of the recession is far more concerning**. With unemployment insurance claims exceeding 16mn over the last three weeks we expect major changes in healthcare coverage for millions of Americans. The Nephron Research house view is that commercial insurance rolls will decline by 10mn members, or 6%, of which 1.25mn lives will shift to the exchanges. Of the remaining 8.75mn lives we assume 50% move to Medicaid (not a bad margin for pharmacy in the 25% of the market that is fee for service Medicaid, lower margin where managed) and 37.5% could simply go uninsured (potentially beneficial to pharmacy margins for cash payment but negative when consumers utilize discount cards). **We size the earnings headwind to CVS and Walgreens from recessionary margin shift as several orders of magnitude larger than pandemic volume reductions.**

For our pharmacy and PBM impact analysis see our March 13th CVS note: *CVS: COVID-19 Impact Analysis: 2020 EPS Impact Sized at -$0.47 (7%)* and our March 14th WBA note: *WBA: Updated to COVID-19 Impact Analysis: Pharmacy Margin Revised Downward*.

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