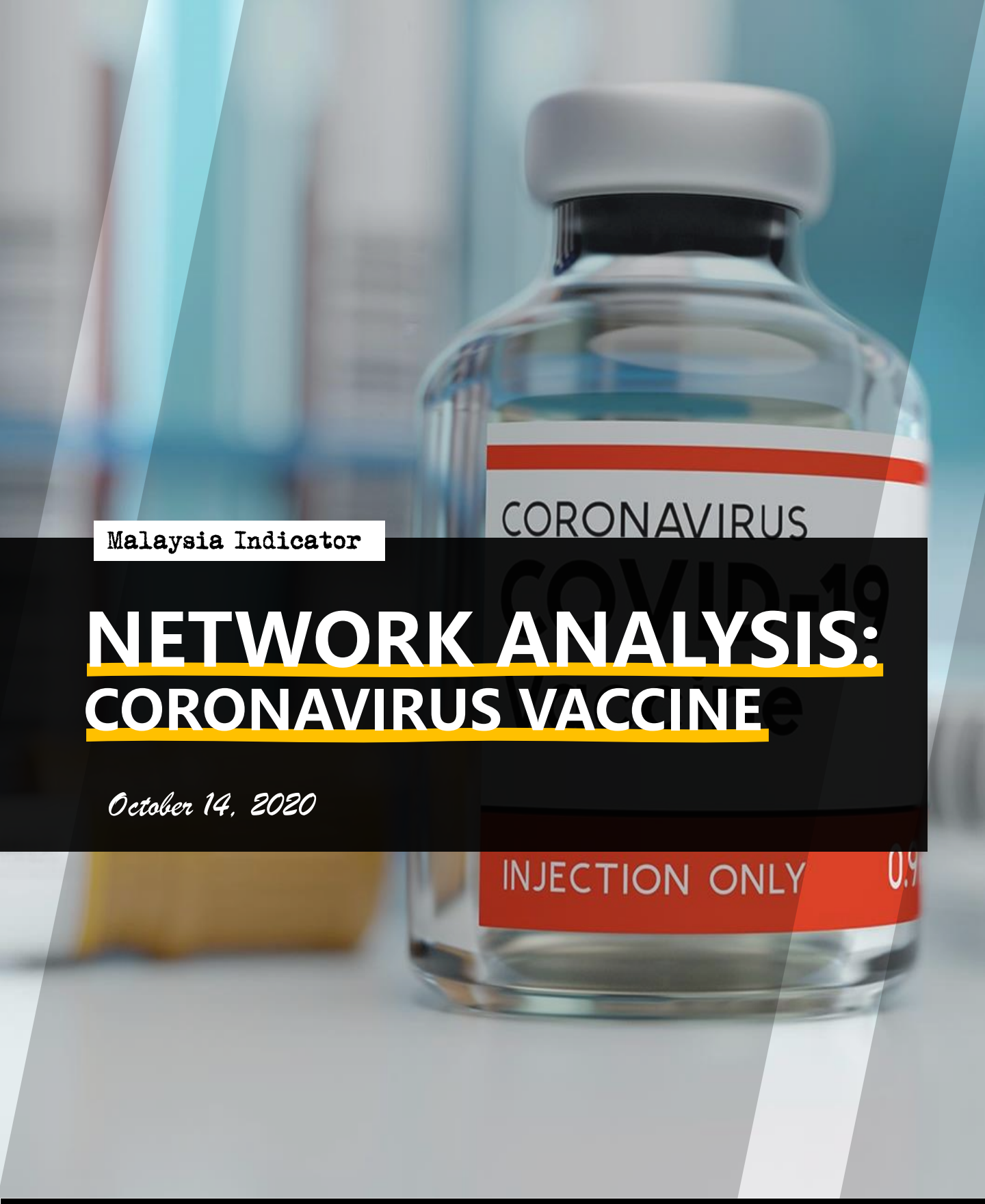
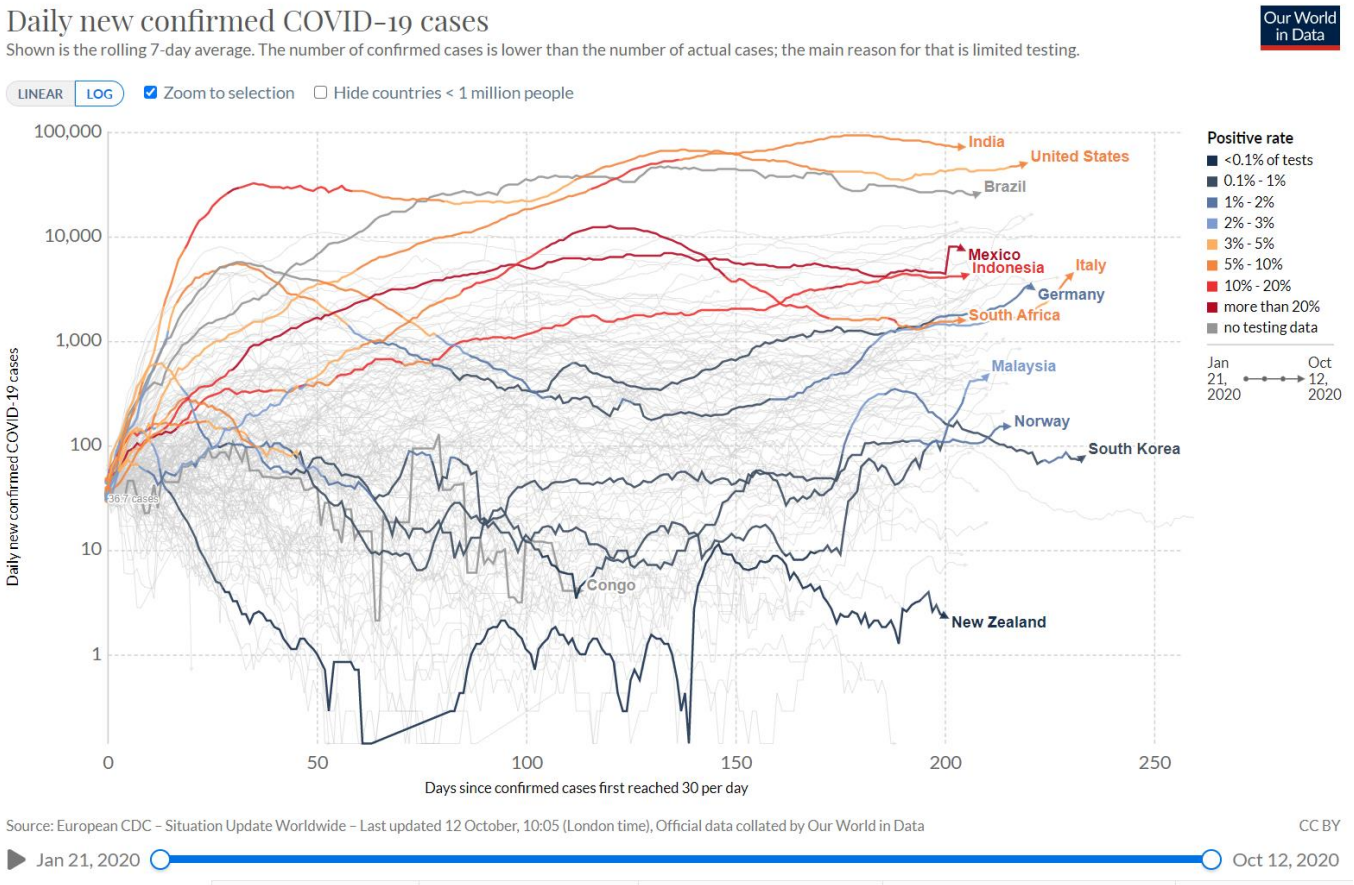


Malaysia Indicator

NETWORK ANALYSIS: CORONAVIRUS VACCINE

October 14, 2020



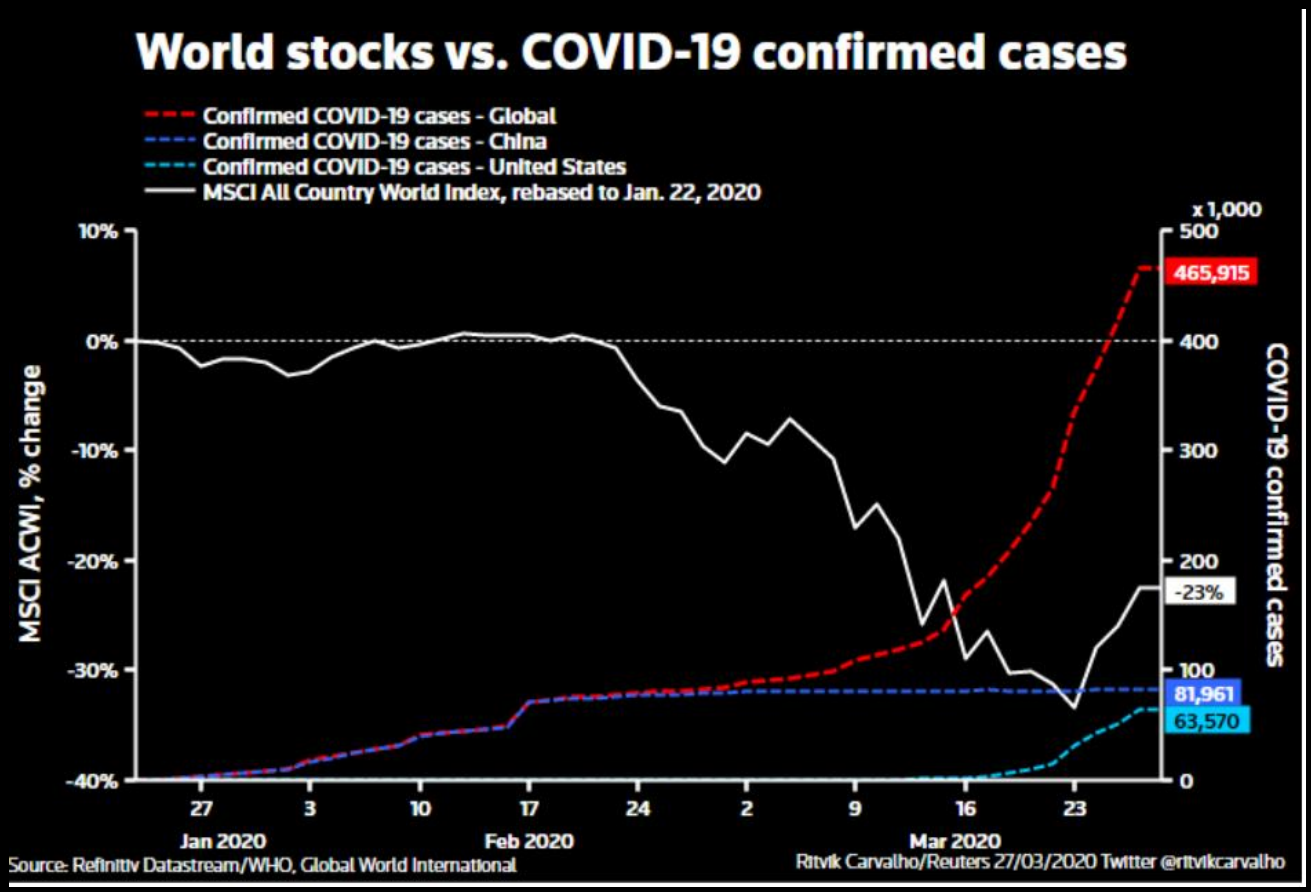
A CASE LIKE NO OTHER

On December 31, 2019, the World Health Organization (WHO) was informed of an outbreak of “pneumonia of unknown cause”, detected in Wuhan City, Hubei Province, the seventh-largest city in China with 11 million residents.

Previously referred to as 2019 novel coronavirus or 2019-nCoV, the disease originated from a new coronavirus that has not been previously identified. In a span of just a few month, the number of infected cases has grown in unprecedented rate and WHO has declared it as pandemic in March 2020.

Having met the criteria of a pandemic, its economic consequences are likely to be compounded by unfavorable conditions beginning with China’s increased economic vulnerability. In 2003, China constituted only four percent of global GDP; today, that figure stands at 17 percent.

As the world economy is more dependent on China than ever, its economic disruption will have a domino effects to others.



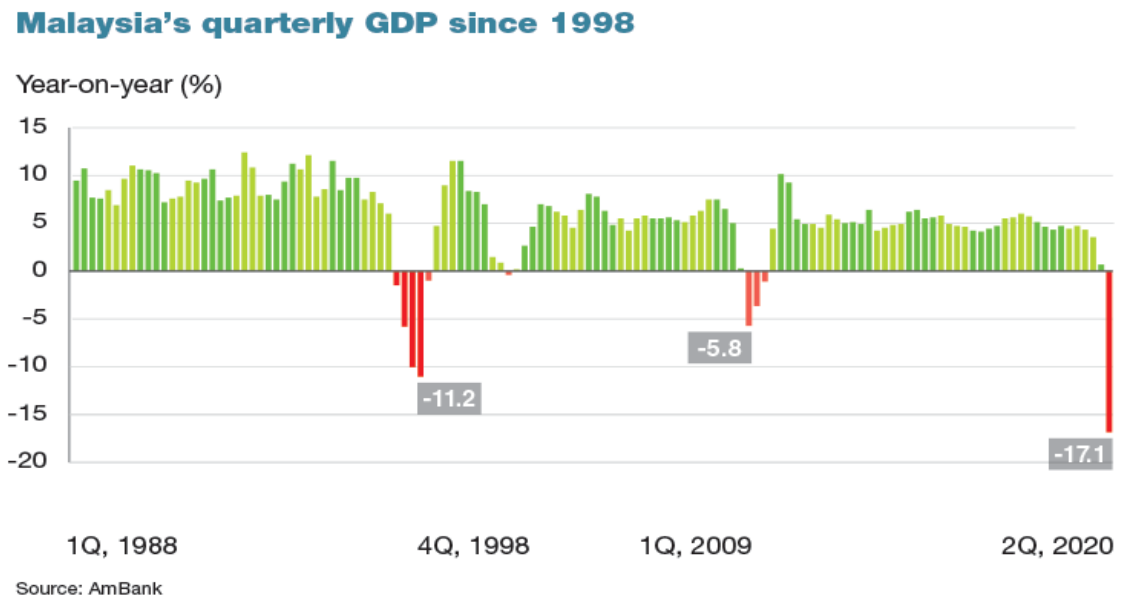
The Covid-19 pandemic has caused a crisis for the world's economy and markets. Both the pandemic and the corresponding public health measures as the forced closures of businesses and schools have taken a toll on people's ability to work across the income distribution. The world stocks plummeted following the spike in the Covid-19 cases as nation around the world took necessary measure to curb public mobility.

Similarly, in Malaysia, the pandemic economic consequences are compounded with the implementation of Movement Control Order (MCO). With the quarantining of huge subsets of the population, the disruption in economic activity is immeasurable.

The economy of Malaysia has also been heavily impacted by the Covid-19 pandemic, with significant blow in Malaysia's gross domestic product (GDP). The economic activity in the country was momentarily halted during MCO as only businesses selling essential goods were allowed to operate. The impact on employment status was consequently detrimental.

THE ECONOMIC BURDEN

THE IMPACT AT HOME

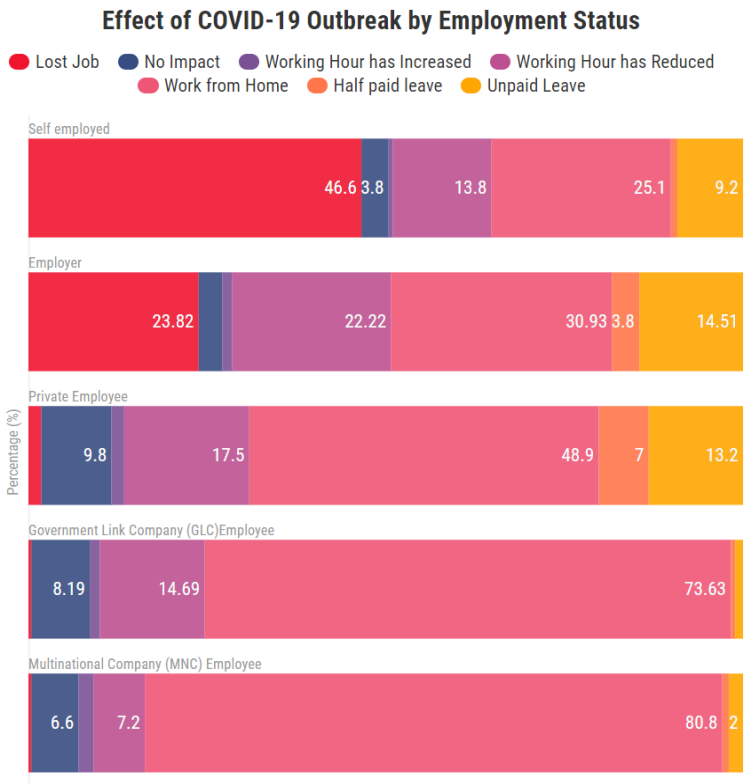


Following MCO, the nation's GDP contracted by 17.1% in the second quarter of 2020, the lowest growth ever recorded by the nation since the Asian Financial Crisis when GDP fell 11.2% in fourth quarter of 1988.

MICRO ECONOMY PERSPECTIVE

The most vulnerable group was the self-employed individuals. 46.6% self employed individuals was affected during the MCO as they lost their source of income.

Even among those who are still employed, significant income adjustment was observable.



Source: DOSM

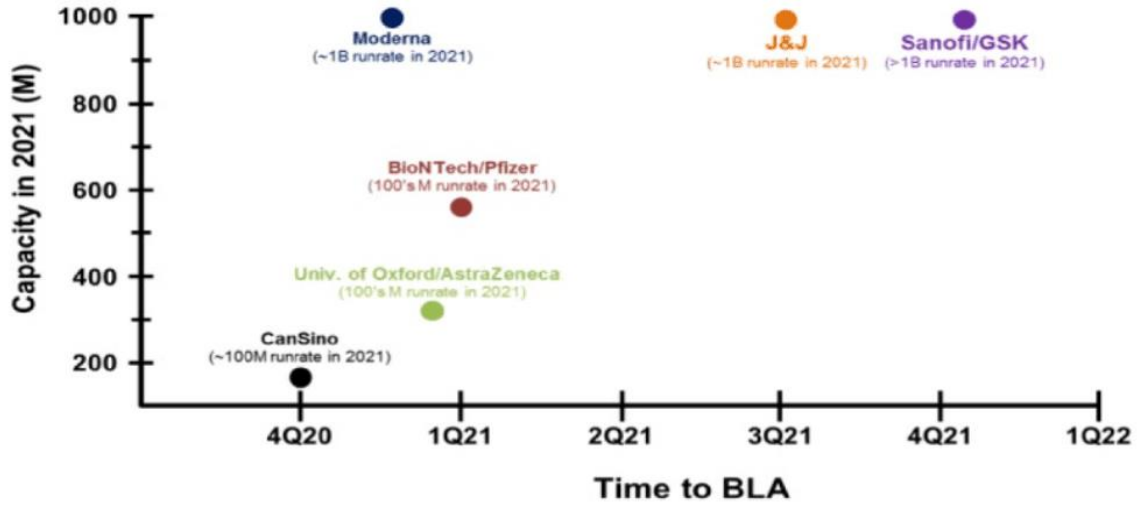
IN HOPE FOR A VACCINE

With the palpable impact of the pandemic on the economy and the public's quality of life, the demand for a vaccine to fight the pandemic also becomes stronger.

Researchers around the world are working around the clock to find a vaccine for the virus which has caused the unfortunate pandemic.

With much effort placed, it means that a fast-tracked vaccine could come to market anywhere from the end of 2020 to the middle of 2021.

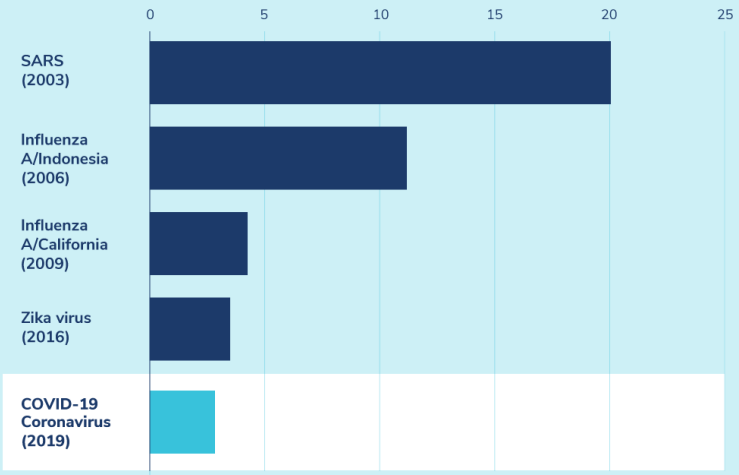
Exhibit 1: Potential Vaccine Timeline and Production Capacity



Source: Morgan Stanley Research, Company reports

BLA: Biologics Licence Application

VACCINE DEVELOPMENT: Months from viral genetic-sequence selection to first human study



Note: Timeline for Wuhan virus vaccine is projected.
Timelines for first four vaccines published in JAMA in 2018.
Source: National Institute of Allergy and Infectious Diseases

While 12-18 months might sound a long time for the still-escalating pandemic, it is already considered a breakneck speed for launching a new vaccine.

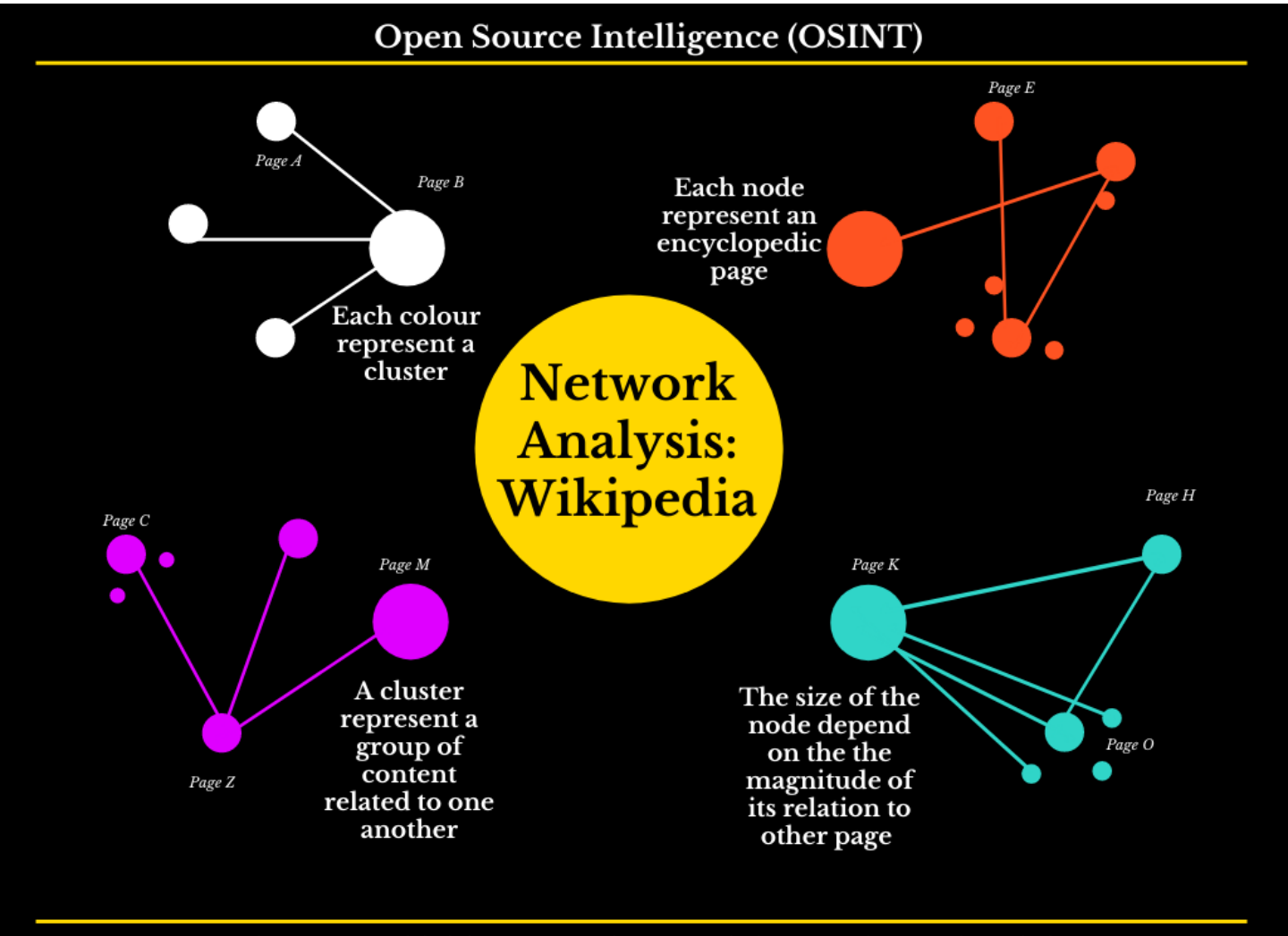
Some epidemics even ended before vaccine development was complete. Work on SARS vaccines, for example, was canceled after the outbreak was contained.

OSINT NETWORK ANALYSIS

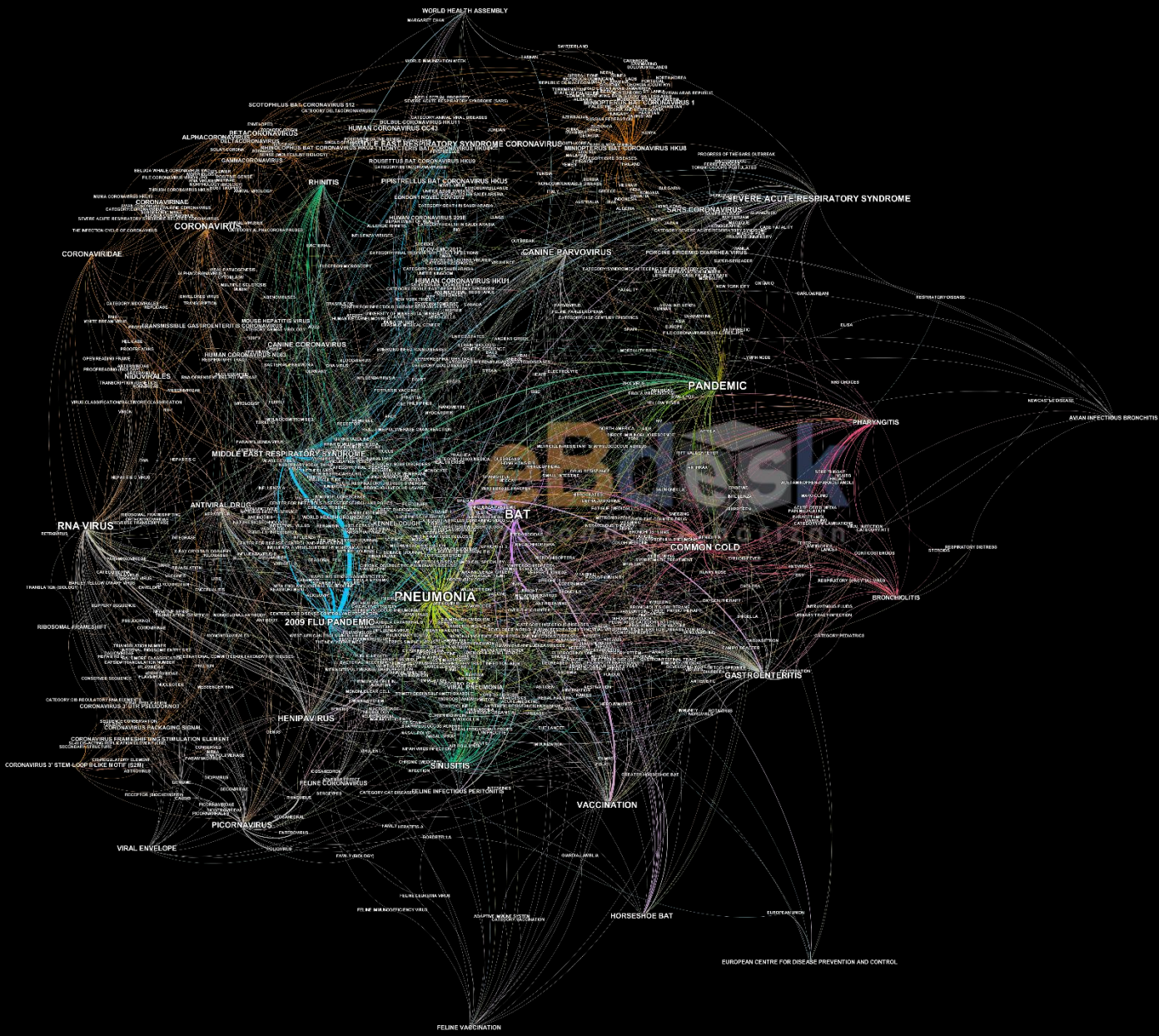
Network analysis can be used to analyse open source content. In the context of Wikipedia, creating a network of all the encyclopedic page relation help us to see how an issue relate to one another. This would allow a comprehensive visual overview of an issue produced from the dominant node and discover its related clusters.

Utilising Wikipedia as the data source, specific pages that are of relevant to the discussion related to the coronavirus vaccines are selected. The free online encyclopedia was crawled to provide a comprehensive view of the discourse related to the race for the new vaccine.

The interaction between page is represented with a line between the node. While each node is represented by a colour of its cluster, the node may also interact with other node outside of its colour cluster. The rest of the network analysis can also be summarized as follows:



THE DREADED FAMILY



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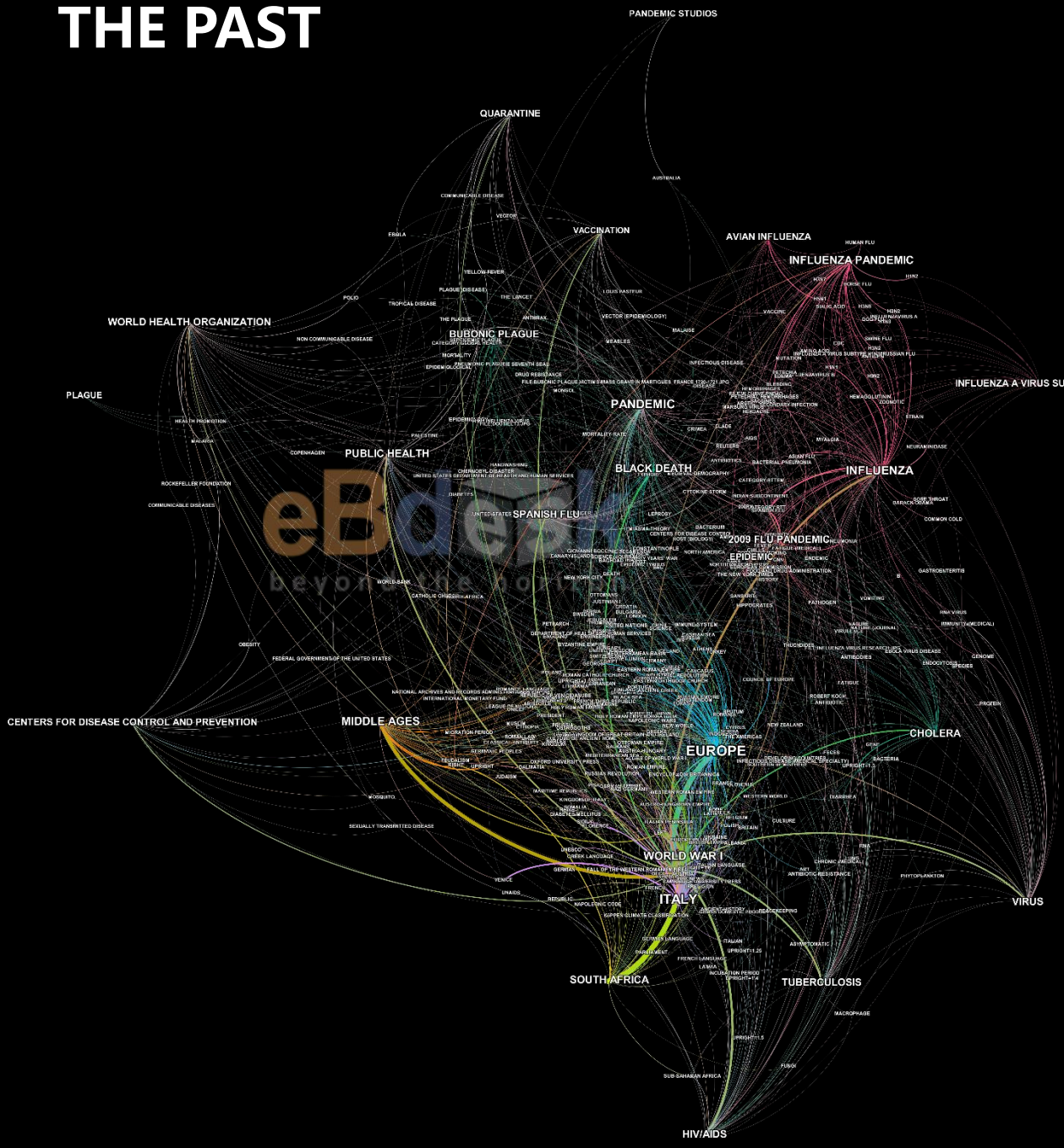
Covid-19 now adds to the list of coronavirus diseases that have threatened global health, along with the SARS (severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome) coronaviruses that emerged in 2002/2003 and 2012, respectively.

As seen by the network analysis of the “coronavirus” family through open source intelligence, pneumonia appear as the mutual mention of the dreaded family virus.

LEARNING FROM THE PAST



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Most of the pandemics in the 20th and 21st centuries, have either been caused by an influenza virus or a coronavirus. Based on the network analysis on the “pandemic”, the dominion of world war I in sight was mostly related to the Spanish flu, caused by H1N1 influenza virus.

The 1918 pandemic that coincided with the world war has been estimated to infect 500 million people, a third of the world's population at the time.

NO PREVIOUS SUCCESS

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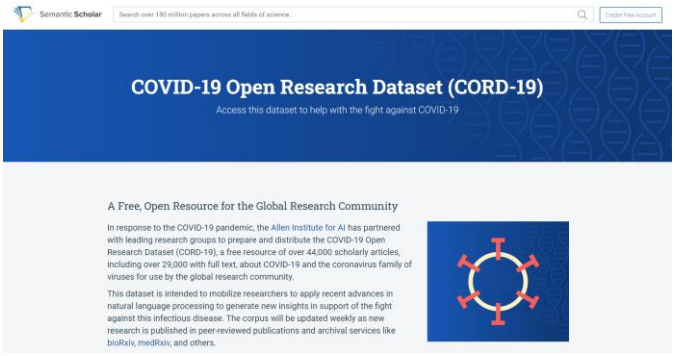
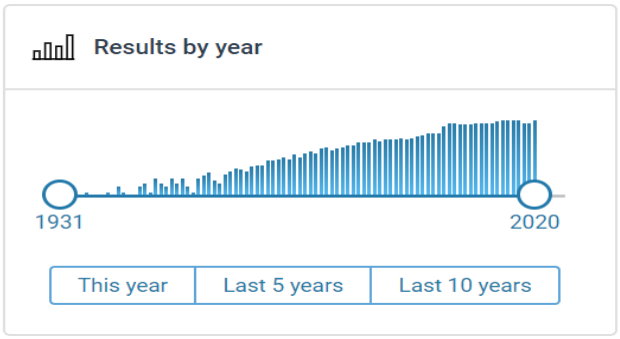
Since the first vaccine inoculated by Edward Jenner and the ultimate eradication of smallpox, vaccination has been seen as one of the brightest chapters in the history of science on human longevity and health.

Unfortunately, while the world has experienced previous coronavirus infection, no vaccine is commercially available for MERS and SARS. As seen by the network analysis of “vaccine” through open source intelligence, the coronavirus was not among its mentioned diseases.

MEDICAL LITERATURE ANALYSIS





A more detailed look on the network of vaccine related content can be generated from the medical literature. By utilizing Covid-19 Open Research Dataset (CORD) and other medical journal, medical literature related to the coronavirus family is analysed.

A comprehensive clinical healthcare terminology directory is used as a reference point to analyse the medical literature. With massive classification of medical terms and references captured from open source data intelligence, the lexicon serves as a learning platform to establish Artificial Intelligence-based data analytics result.

Utilising the top five medical term hierarchies, the medical research paper is analysed to explore observable patterns in key terms mentioned.

Clinical finding (finding)

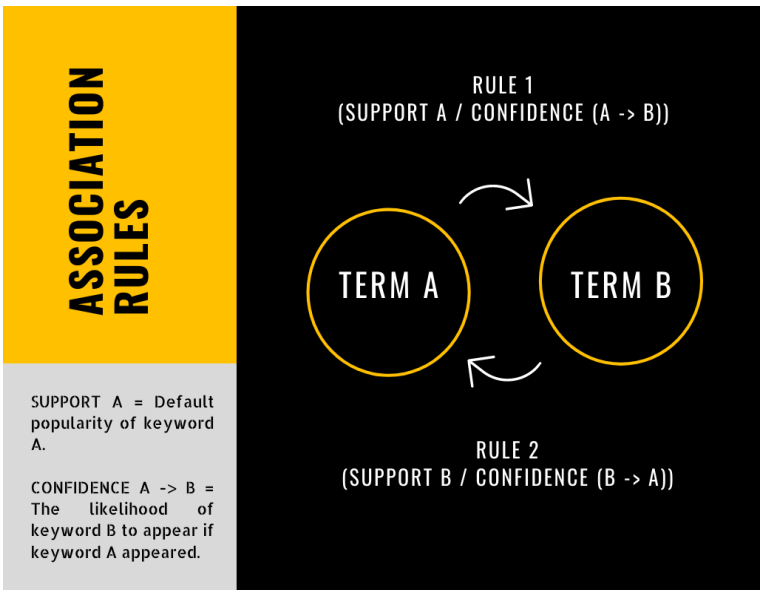
Procedure (procedure)

Organism (organism)

Substance (substance)

Pharmaceutical / biologic product (product)

IDENTIFYING CORRELATION

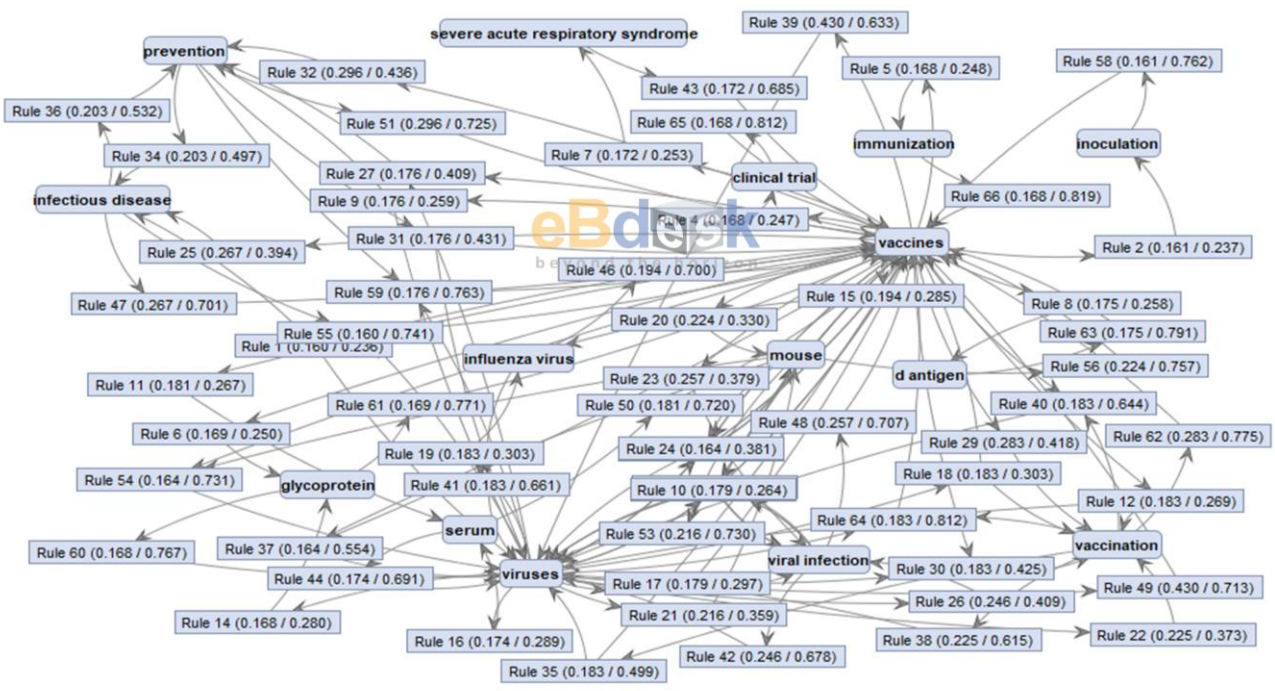


With over 29000 full texts about Covid-19 and the coronavirus family of viruses, association rule is utilized to detect specific relation patterns.

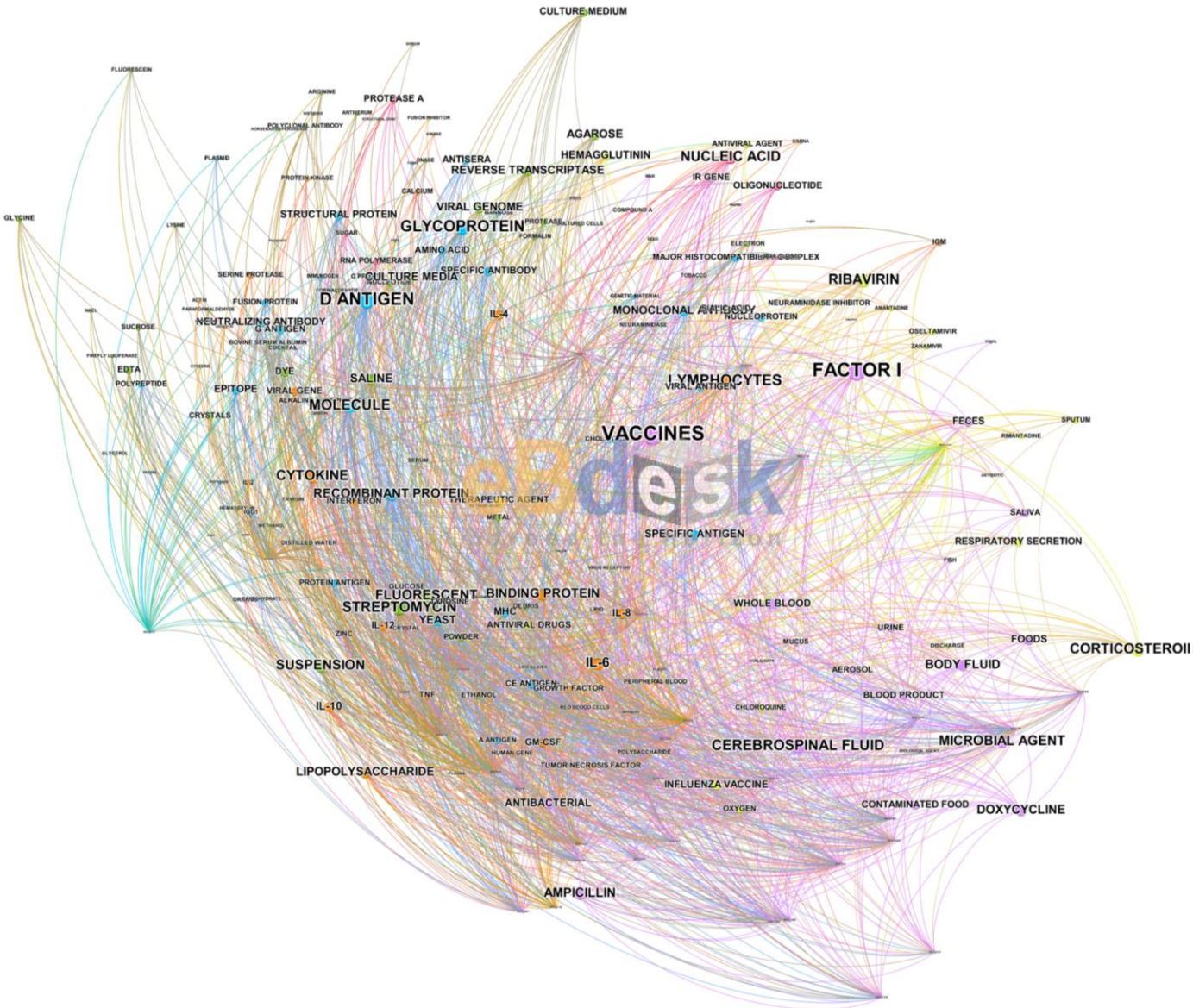
Association Rule is an analysis method for finding specific relation patterns between objects in large dataset. Using association rule, the likelihood of terms to appear together is quantified based on support and confidence rule of each term.

As reflective of the absence of vaccines for the coronavirus family, 'clinical trial' was among the most frequent term that appear to 'vaccines' in the CORD database.

While there is no vaccine commercially available for the coronavirus strains, the knowledge obtained from the vaccine development efforts for MERS and SARS can be of high value for the pivotal effort in developing Covid-19 vaccine.



THE SARS VERSION



The network analysis on SARS vaccine was generated based on 4068 papers that mentioned the term “vaccine” and SARS virus related terms to depict the scientific community effort in providing a concrete solution to the once lethal infection.

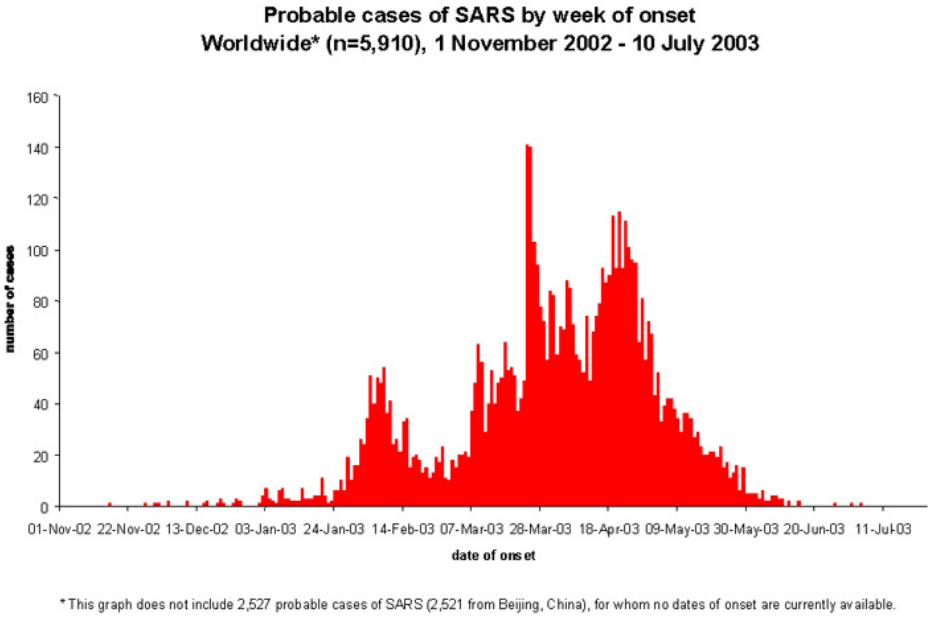
SARS was characterized by high fever, eventually developing into shortness of breath and pneumonia.

Utilizing similar model to the OSINT network analysis in Wikipedia, the network formed by related terms in the medical literature is observed.

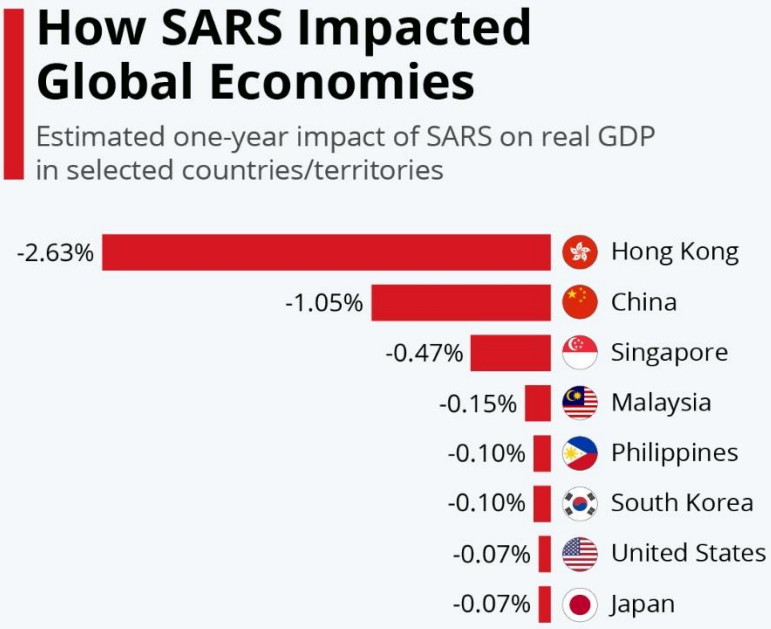
THE FADING THREAT

Originated from southern China, Severe Acute Respiratory Syndrome (SARS) cause 8096 cases, resulting in 774 deaths in 26 countries.

From its emergence in 2002, the world experienced what would become the first of a series of lethal coronavirus infections.



Source: WHO

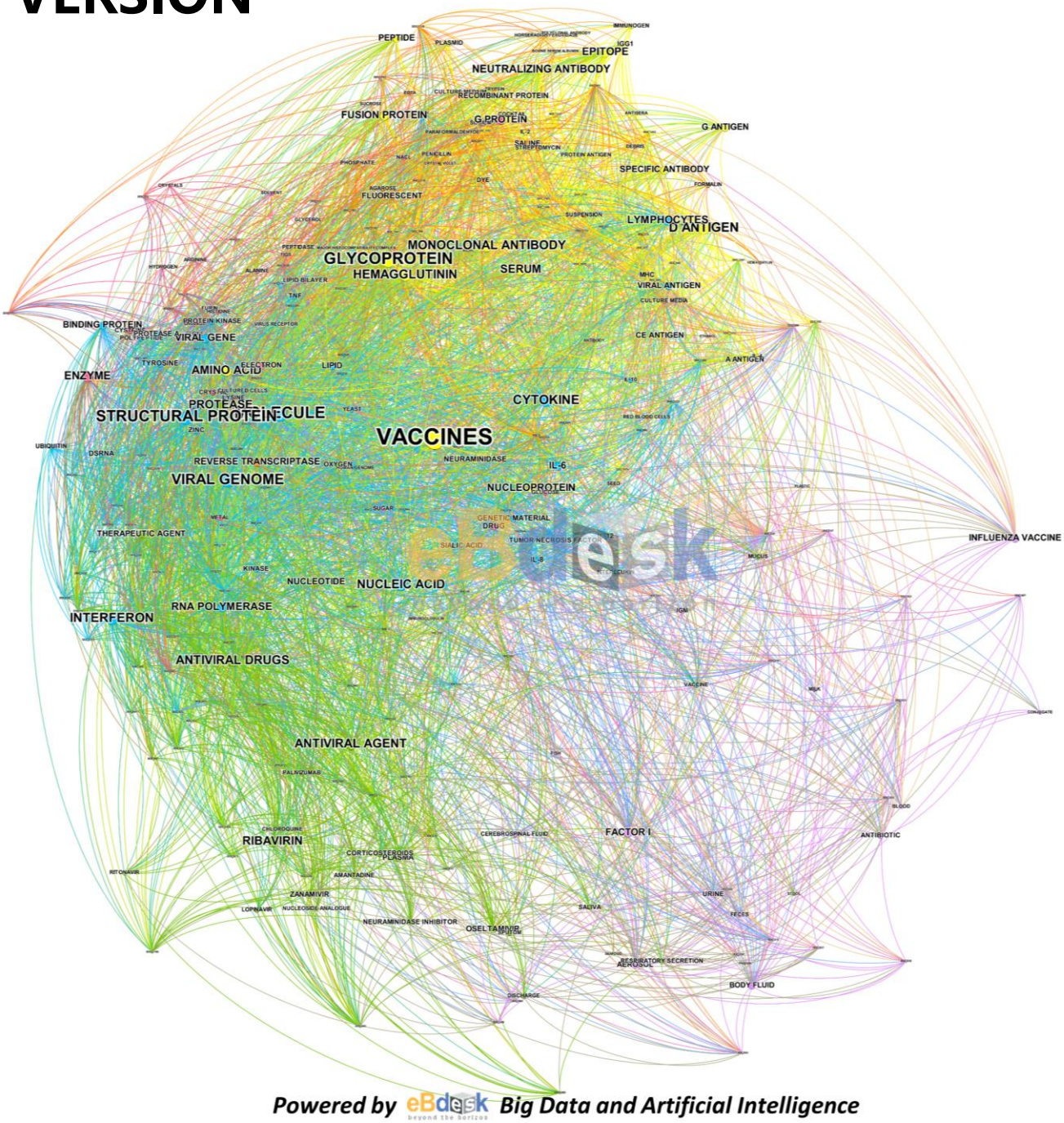


After one year, SARS has impacted the global economies with Hong Kong suffering the most.

After one year, SARS reduced China's real GDP by 1.05 percentage points while the special administrative region of Hong Kong experienced a cut of 2.63 percentage points.

Despite previous efforts, no vaccine became commercially available as it was considered pointless to continue investing in a vaccine for a disease whose cases ceased to be reported since 2004.

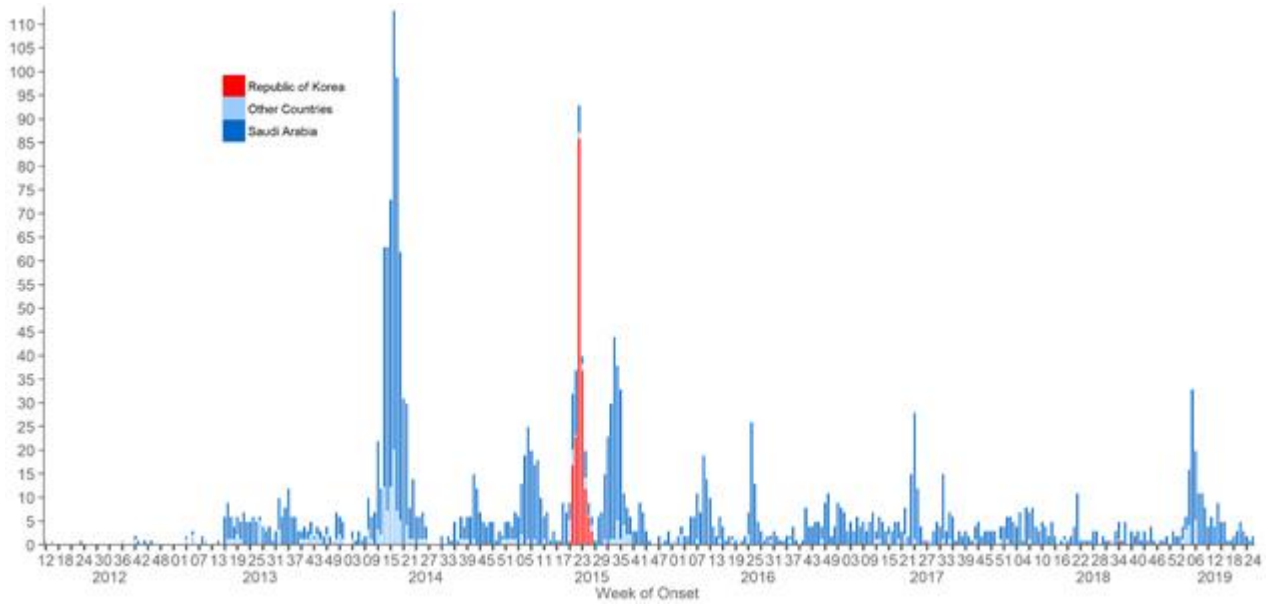
THE MERS VERSION



In September 2012, the world experienced the emergence of the Middle East respiratory syndrome (MERS) coronavirus. Originated in Saudi Arabia, the infectious disease is characterized by mild respiratory symptoms, but these could develop into acute respiratory distress syndrome and death.

Based on 1476 papers that mentioned the term “vaccine” and MERS virus related terms, network analysis on the medical literature is generated.

MERS BACKGROUND

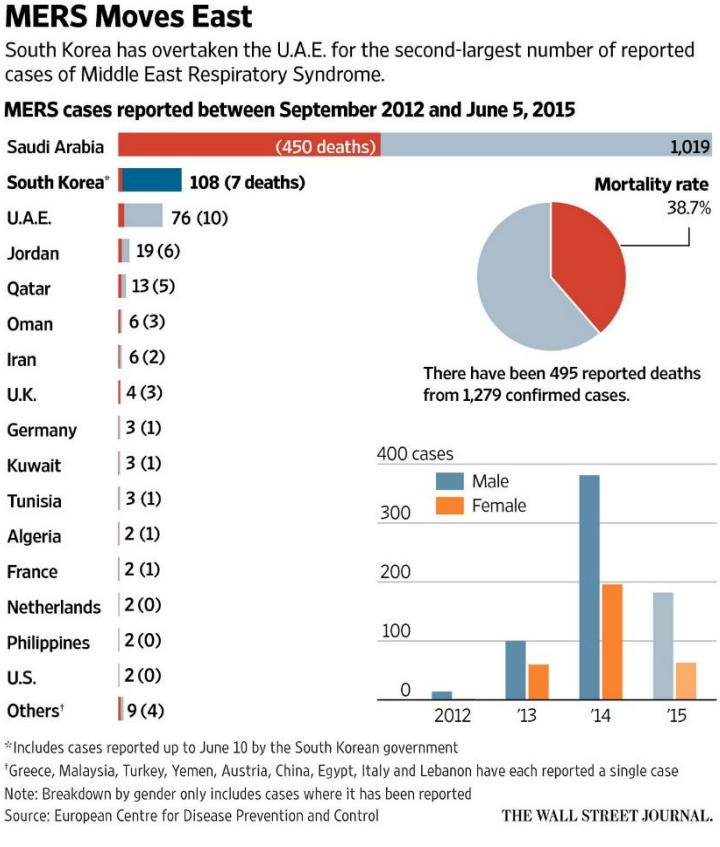


Source: WHO

MERS has affected 27 countries, resulting in 2494 cases and 858 deaths. MERS cases are still being reported but no major outbreak has been declared since 2015. As in the case of SARS, no commercial vaccine is available for MERS.

Despite the occurrence of MERS outbreak in South Korea, the disease has produced relatively low and geographically centralized cases compared with other more global and persistent infectious diseases such as influenza, HIV and tuberculosis.

As such, its vaccine development was not as enthusiastically pursued as other vaccine endeavor.



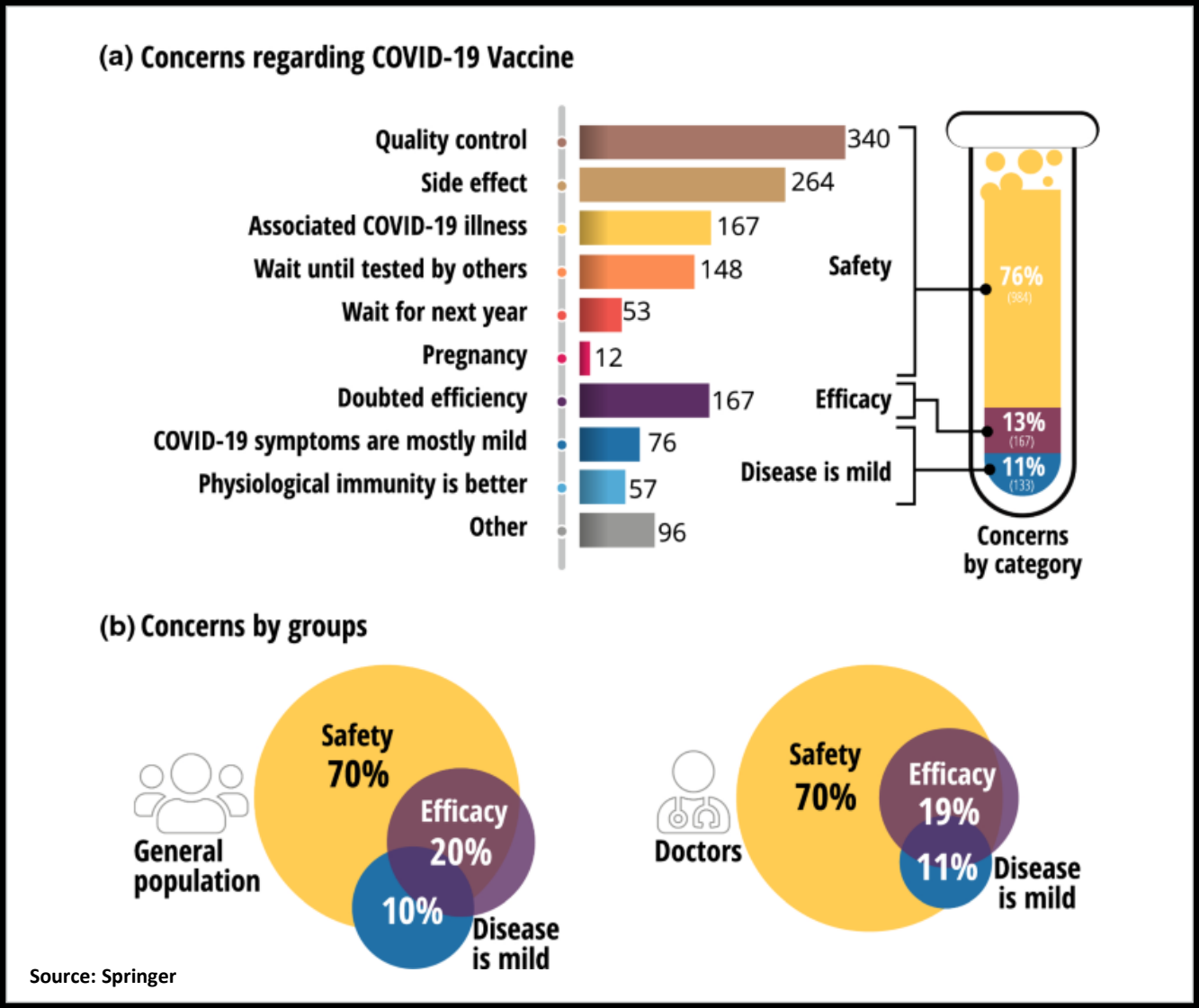
THE CONTAGIOUS

Source: SCMP

Till date six coronaviruses are known to infect human, while no vaccine is approved against the coronavirus disease. Given the fact that SARS and MERS are extremely rare to be reported after 2004 and 2013 outbreaks respectively, the drive to fuel its vaccination research has also cease to continue.

SARS outbreak was largely brought under control by simple public health measures as testing symptomatic patients, isolating and quarantining suspected cases. In contrast, as Covid-19 efficiently spread before people get sick, traditional symptomatic-based public health restrictions, which worked well for SARS, has become largely incapable of containing Covid-19.

In a similar timeframe to the original SARS, Covid-19 has proved to be more contagious but seemingly less deadly than its coronavirus cousin or Ebola infection. With the struggle to contain the highly infectious virus, until there is a safe and effective vaccine available to the masses, it's difficult to speculate how long will it take for the global economy to recover to its former state.



Source: Springer

ANOTHER SET OF CHALLENGE

On top of the mounting discourse on vaccine production, vaccine hesitancy could also become a barrier to full population inoculation against the highly infectious diseases.

As such, combating misinformation about Covid-19 and strengthening the population's confidence in vaccines, particularly once a safe and effective Covid-19 vaccine becomes available, is also a matter to be address.

Yet it's normal for the public to be worried about the safety and efficacy of a vaccine that will be manufactured and distributed in a scale that has never been seen before in scientific history.

Even if a vaccine has been successfully formulated, the real challenges is in the manufacturing, storing and distribution of the vaccine to meet the global public demand especially when the manufacturing and logistics sector has been deeply paralysed by the pandemic itself.

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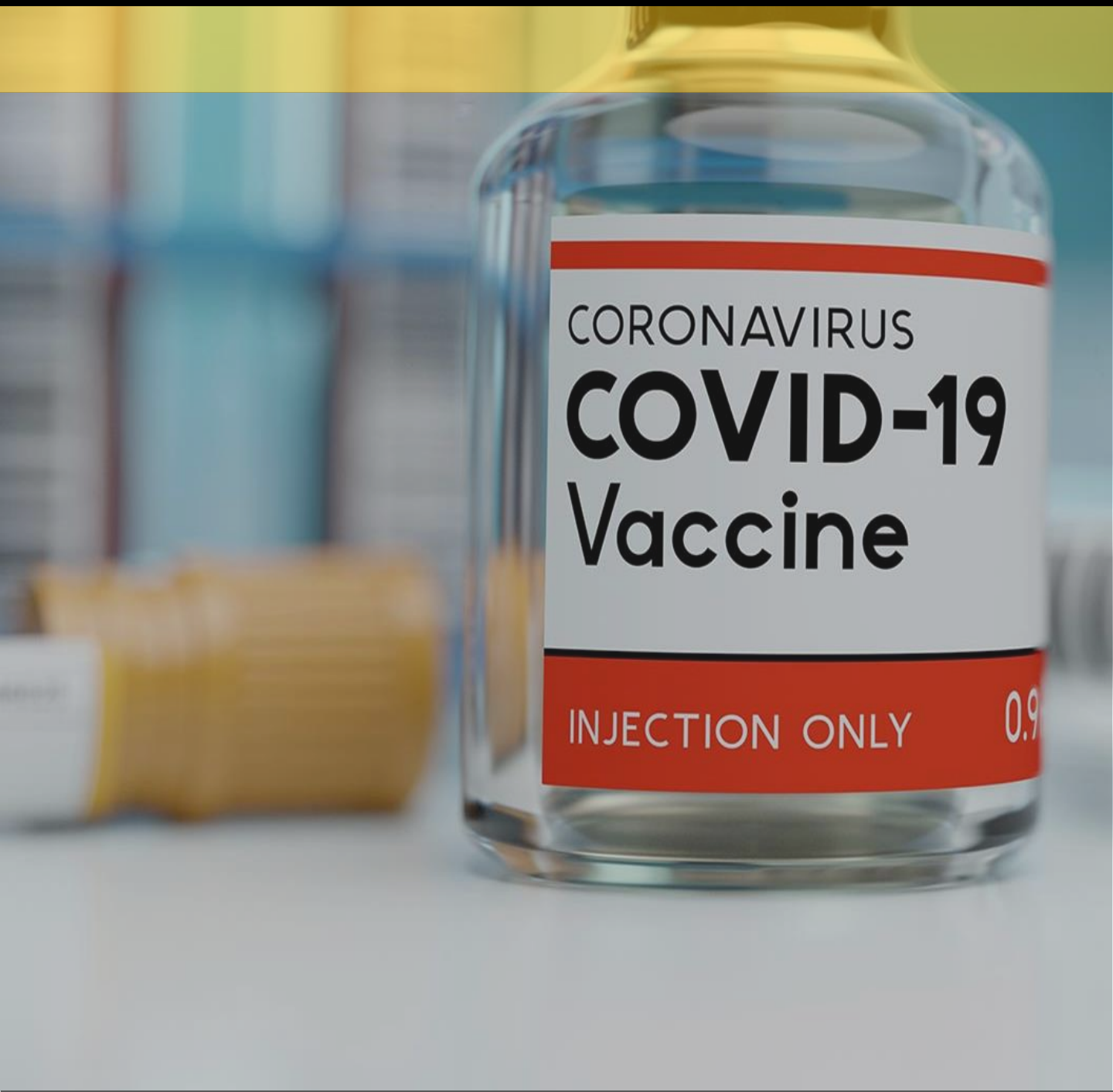

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