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Review Article

Engineering Way of Stopping the Pandemic A Realistic Path Forward With Help From Artificial Intelligence

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Abstract

Since March of 2020 CORONA virus that is known as COVID-19, has had a devasting tow not only on our daily economy globally and nationally, but also has the tremendous psychological adverse on individual's due isolation from lockdown and stay home order from authorities in charge. Crisis from the impact of COVID-19, must lead to a different economy recovery, even though, we now have at least two claiming discovery of new vaccines by two different pharmaceutical manufactures. Comes with the discovery of these two types of vaccines is now going from manufactures to the arms of people through shipping and then delivery and administration of the vaccine in form of two doses. Then with that we need to have means of inventory to be able to have enough vaccine for such distribution and delivery/administration of it.

Now that the world is facing an unprecedented test, in particular with a new version of virus known as UK Corona, we need to find a need realistic path going forward to deal with all the side effects of this virus. Thus, we need to find a way out of this crisis not only to use all of our medical knowledge, but combined without innovative engineering and technologies, which have at our disposal such as Artificial Intelligence (AI). With help from AI and its sub-components such as Machine Learning (ML) that learns from vast data that we are collecting through Deep Learning (DL), we will find that path going forward. And this is the moment of truth.

Keywords: Artificial intelligence; Machine learning; Deep learning; Pandemic COVID-19; Vaccination; Delivery and distribution; Racial minorities and effective of vaccination

Introduction

The fight against the pandemic is not going well—but not for the reasons many people with political ideologies believe. A pandemic occurs when each infected person, on average, infects more than one other person. It stops when each infected person infects less than one person. The end of a pandemic does not imply that the disease disappears - only that there are small local outbreaks and no large outbreaks. One starts with three observations about this pandemic.

First, we have built an environmental niche for airborne viruses such as the flu and Covid-19 to move from one person to the next efficiently. We breathe each other's air in mass transit, crowded bars, energy-efficient buildings with high internal air circulation rates, and other locations. These locations are the airborne equivalents of sewage running down the street center that resulted in water-born pandemics in the Middle Ages. It was not a question of if but when a nasty virus would find these locations as a home where it could

move easily from person to person. We have had plenty of warning that would happen—on average, per year, 40,000 Americans die of the airborne flu despite a yearly flu vaccination program that has gone on for decades.

Second, this virus has qualities perfectly suited for a pandemic that bypasses most western public-health methods used to stop pandemics. With most diseases, people become infectious near the time they become sick. If one isolates people when they become sick and isolates people who have been in recent contact with that person, the pandemic is stopped. With COVID-19, many people become infected but do not become sick, thus invisibly spreading the disease. Second, people are infectious many days before they become sick. We created an environment for efficient transfer of the virus between strangers in mass transit and many other locations—people do not know who they have been in contact with, so those persons cannot be isolated. Third, contract tracing does not work well in the U.S. because less than half the population is willing to cooperate, and 80% of the population does not answer phone calls from unknown numbers [1]. Last, Covid-19 is in the animal population that may make it impossible to eliminate and where we have limited control of the disease.

Third, culture has a significant impact on whether a pandemic can be stopped. The progression and COVID-19 disease rates in the U.S. and Europe as a whole have been about the same [1] - despite different government leaders and very different health systems. The Covid-19 rates in Europe by country are partly reflected in the U.S. by which groups settled different parts of the U.S. In contrast, China, Japan, and South Korea have been able to control the pandemic even though those three countries have very different governments. Western culture emphasizes the rights of the individual where rule-breaking is the norm, while the eastern Confucian cultures emphasize the society over the individual. In Confucian societies, there is massive social pressure to follow the rules, accept government surveillance, and a willingness to use the government's power to follow the rules. Who is President of the U.S. or whether we have a national health care system is secondary to culture in determining the outcome of this pandemic? Culture changes over centuries, not administrations.

In response to the pandemic, the medical-scientific elites' recommendations have been to protect yourself with masks and social distancing until our "heroic" medical scientific community finds a vaccine. That is excellent advice for the Chinese government with a Confucian society and a government capable and willing to use the state's full force to enforce such mandates. It is poor advice to a western democratic government. Their advice partly reflects self-interest but also reflects a socially isolated community that does not understand U.S. culture. That is not surprising—we have many elites that went to elite high schools and universities and had little contact or understanding of the broader American culture. It places this elite at the center of power and money with a set of non-workable policies that blame bad outcomes on individuals. The question is then, what would be the advice if we are serious about stopping a pandemic in a western democratic country—beyond social distancing and masks

Vaccines

The need is to develop multiple vaccines because many of the vaccines may ultimately fail. The failures of 50 years of flu vaccines are a warning [1].

Flu viruses mutate, and so will this virus. Perhaps of equal importance, COVID-19 is in the animal population. Denmark is in the process of destroying 17 million mink. Some of the mink caught COVID-19, the virus mutated with a change in the virus spike, and the mink infected animal handlers. The animals are being destroyed because such mutations may make many human COVID-19 vaccines ineffective [2].

Multiple repeated vaccinations with multiple types of vaccines may require no assurance in advance that the vaccination strategy will do more than provide time. We have many diseases where we have not found effective long-term vaccines.

Engineering Solution

Almost all pandemics have been stopped by engineering. Waterborne pandemics were stopped by sewer systems and clean water, where we destroyed the environmental niche where these viruses grew and spread to the man. For all we know, some new super virus has shown up in sewage or untreated water, but it does not affect us because clean water and sewers stop all viruses. Malaria is controlled by draining the swamps and other methods to kill mosquitoes that transmit the disease to man.

We can stop this virus by filtering air or killing the viruses in the air with proper ventilation systems where there are large crowds [3].

It is unnecessary to clean all air - just where many people are crowded together each day to get the disease transmission rate below one new infection for each person with the virus. The big industrial companies, some schools, and my dentist have adopted this workable strategy. This solution works against all airborne viruses and is compatible with western culture that values the individual with rule breaking. It is the equivalent of providing clean water rather than asking everyone to boil their water.

In many offices, store, and factory environments, this implies the following points that put it in perspective of:

(1) Upgrading filters in the main ventilation systems and,

(2) Installing local cheap filter-fan systems that filter the air to remove the viruses.

Substantially higher air filtration rates are required to minimize transmission of the virus between people than used to heat and cool buildings. The low-cost option is local air-cleaning systems that consist of a high-quality filter with a fan—or potentially Ultra-Violate (UV) sterilization units with fans. This pandemic would be partly under control if there were a full push to put in clean air systems.

The fastest and most straightforward way to implement such changes is to pass legislation that makes the insurance industry liable for the cost consequences of the spread of COVID-19 in congested indoor spaces unless appropriate engineering changes are made to the buildings. Insurance is required to obtain loans on commercial property. Such legislation would bring to bear all the resources of banks and financial institutions that back commercial mortgages to fix the problem immediately.

Engineering solutions are the standard will-work option to reduce risk. In the 1800s, Chicago, Boston, and many other cities burnt down because the cities were built of wood—the fire equivalent of a pandemic. Fire departments, the equivalent of the medical profession to diseases, could not stop these fires. The solutions were building codes that required using brick, concrete, stone, and cement in new buildings. The engineering fix stopped city-wide fires. The engineering solutions did not stop an occasional building from burning to the ground but no city-wide fires. The same will be true if we use engineering to stop this airborne pandemic.

Sensors to Warn of Danger

We use smoke detectors to set off fire alarms. We use carbon monoxide sensors to warn us of faulty furnaces that heat our homes. Industry uses many other sensors to warn workers of danger. The loud horn warning of disaster is a staple of action movies. We need the same for the virus in the air.

Particles transmit Covid-19 in the air from the lungs of one person to the lungs of another person. We do not have sensors to detect virus particles in the air; but we do have cheap technologies to measure how much air we inhale that has been recently in another person's lungs. People breathe in oxygen and breathe out carbon dioxide. If the carbon dioxide content of the room or subway car you are in is much above average, you are breathing other people's air and getting their viruses unless outfitted with a carefully fitted N-95 mask or equivalent.

Cheap carbon dioxide detectors can set off alarms or tied to cell phones to give people warnings enabling them to leave the area. Some organizations have adopted such systems for workplace environments to warn people to open windows or leave the area; but none exist for public spaces such as mass transit and stores. They should be required for all public spaces.

Rate Location Based on Hazard

We can rate locations in terms of danger of transmitting an airborne virus and require large lettering at entrance points to warn the public. An existing subway car would have a ten painted on the side—indicating a great location to get Covid-19. A private car would be given a rating of one. If the subway car ventilation or subway platform had a modified ventilation system to lower the risk, a lower number would be assigned. Rating locations will force out the business for those businesses that do not clean up their act and reward businesses that create safer locations. It favors stores, cruise lines, and airlines that have modified their ventilation systems to protect the public. The current policy of shutting down particular types of establishments such as bars based on the sign on the front door is insane—if we shut down businesses, it should be on the risk to the public of each specific location.

Engineering solutions, sensors, and warning labels are opposed by big-city mayors, governors, building owners, and others because it places much of the blame and burden for stopping the pandemic on organizations rather than individuals. When shortcuts in Flint, Michigan, resulted in dangerous-to-drink water, officials were held accountable. We need the same attitude if an airborne disease outbreak because no clean air in public spaces.

Operational Responses

COVID-19 is unusual in terms of who becomes ill and dies. With most infectious diseases, the very young and very old are most at risk. With COVID-19, the risks for those under 40 are low [4].

The damage being inflicted upon the younger generation by the current approach is massive. It is the older population that must be protected. That has practical implications. School for younger students without elderly parents or relatives at home. Have younger teachers do double shifts at school while older teachers do remote teaching. We need honesty about risks to different age groups followed by age-appropriate recommendations for a virus that hundreds of times more dangerous for a person in their 80s compared to a young person.

In this context, the Swedish strategy is noteworthy. They worked to isolate the old but not the young. They recognized that the pandemic would be a long-drawn-out affair and that social isolation would collapse with time, as is now seen in Europe and the U.S. Given the low risks of Covid-19 to the young, the spread of Covid-19 and the buildup of herd immunity by those with the lowest risk of illness would reduce disease transmission over time. Equally important, those most likely to catch Covid-19 were those in contact with most people. Building up immunity in this group minimizes the future spread of Covid-19. While there is the general assumption that one needs 70% to stop a pandemic—that is not true. If those in close contact with many people catch

the disease or are vaccinated, this drastically slows the disease's spread. One wants politicians and prostitutes to be the first with immunity. Whether hermits have immunity by caching the disease or being vaccinated has no effect on the pandemic. It is too early to determine whether the Swedish strategy will succeed or fail, but as the pandemic goes on, it is beginning to look like the right decision.

The failure to stop the pandemic reflects the medical-scientific elite's poor advice that failed to account for western culture as much as the politicization of that advice. It was advice for an imaginary culture that does not exist in the west. The parallel pandemic failures of the U.S. and Europe with a common culture combined with 50 years of failures in fighting the airborne flu suggest we need better advice—a diverse set of experts with different backgrounds to find multiple solutions be implemented quickly. Where would a panel of such experts come from to stop this and future airborne pandemics?

Medical Science Elite

The followings are the medical experts in human viruses:

Agriculture

All the experience in fighting global pandemics is in the agricultural sector—fighting off viruses killing cattle, hogs, birds, dogs, cats, mink and other animals. They are the only ones with front-line experience in fighting global pandemics and the only ones who understand the virus as it moves through and mutates in the animal community.

Military

Unlike most other elites, military officers have real-world experience about most of society. Military officers in their first command lead soldiers mostly with high-school educations from across the country with different backgrounds. To a military officer, it would be obvious that many of the isolation and mask strategies would have high failure rates and that alternative strategies are required. Second, military officers understand you go to war with the weapons you have. If you suggested to a military commander a strategy of a holding action for a year or two while develop a weapon (such as a vaccine), you would be considered crazy. Last, they are in the world of hard choices where people die. To use one example, in developing vaccines one way to accelerate development is challenge testing. Give the vaccines to volunteers and then expose them to the virus—unlike vaccinating lots of people and seeing how many get Corona versus the rest of the population as the disease spreads through the population. Challenge testing provides much more definitive results in how good the vaccine really is. For a military commander, putting 1000 or 10,000 volunteers at risk that could save a 100,000 people is the right decision. The scientific elites rejected this option on moral and ethical grounds; but they do not have any special moral or ethical talents. Furthermore, in a democracy is undemocratic and unacceptable that an unelected elite make such decisions, the military understands this.

Engineering and Industry

Some industries are installing ventilation systems to protect workers on the job against air-borne viruses. This is no different than the ventilation systems used in industrial plants to protect workers against hazardous gases from welding and other activities—both are 1960s technologies. Some of the airlines are beginning to make ventilation and other changes aboard aircraft to reduce risks of transmission because pandemics are bad for business—as are many dental offices to protect dentists and many offices of engineering professors given that such changes are fast and quick for an office environment. That competence and capability is needed.

Special People

The example in this case is Bill Gates where his foundation has been on a campaign to wipe out diseases. He has the knowledge and skills. More important, he will tell hard truths, something one will not necessarily receive from a panel expert that run large institutions and what to protect those institutions.

One aspect of defeating viruses such as COVID-19 and now UK version of it, is collection of right and trusted data as director of National Institute of Allergy and Infectious Diseases (NIAID) Dr. Anthony S. Fauci all alone was relying on scientifically to predict, where we are going with this devasting virus and how and what is the best path to stop it on its track rather than spreading it further.

As he put it:

""We believe things will get worse as we get into January," Fauci, the director of the National Institute of Allergy and Infectious Diseases, told NPR in an interview [5]. He called for an acceleration in public-health measures during this time".

The winter season and cold weather forcing people to socialize and work indoors, as well as travel and family gatherings associated with the holiday season, will likely amount to a "terrible" situation in January, the veteran immunologist said as the global COVID-19 death toll exceeded 1.9 million.

As we stated in above that data collection and Data Analytics (DA) would empower us with a tool, namely the Data Predictive (DP) to help us to find a scientific way of stopping the speared of this deadly virus or for that matter any other pandemic virus of future, particularly at the global level, where the data collection is overwhelming, thus we need innovative tool such as Artificial Intelligence (AI), along with its sub-components of Machine Learning (ML) and Deep Learning (DL) to come to our aid to be able to filter these data for the right information for the right knowledge for a trusted and powerful decision making.

Considering that integration of Artificial Intelligence (AI) as a complement and supportive element to its human partner is invadable in order to operate these new generation and rare diseases. As we stated at the beginning of this paragraph, the operation complexity of these new generation of viruses requires manipulation of many data and analytics that implementation of AI with its subsets such as Machine Learning (ML) and Deep Learning (DL) becomes a mandatory factor to their human partner [8].

The basic idea is to apply AI integrated with ML and DL techniques would go through the mountains of data that come from public domain at worldwide level that would allow us to spot patterns in behavior of these viruses. The information that we collect from these data will make the human operators informed and it is not invadable.

Artificial Intelligence (AI) systems can help us not only bring these deadly viruses to dead stop on their track and prevent them to speared out, it also helps us to understand how to deal with side-effects and impacts such as economy, etc.

These are a few benefits that can be mentioned as a result of AI technology augmentation to the nuclear industry. In next section, we provide a holistic description of AI infrastructure and foundation.

What is Artificial Intelligence, Machine Learning And Deep Learning

The past decade up to now has encountered a new revolutionary technology that seems to have many applications across the entire industry (Figure 1). Intelligence to a different level, considering any business operation with a magnitude of incoming data to be analyzed. Day-to-day of these business operations with a share volume of data (i.e., Big Data) requires augmentation of AI in conjunction with High-Performance Computing (HPC).

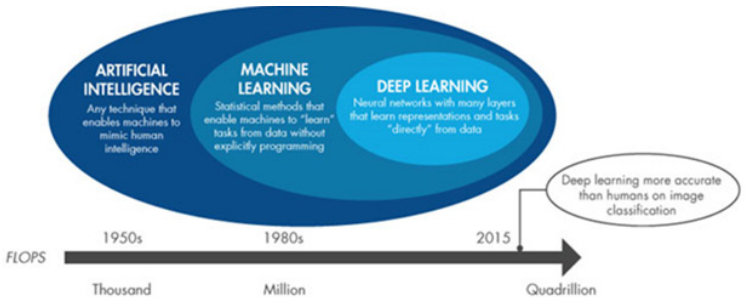

Figure 1: Pyramid of AI, ML and DL Historical Trend.

Even the medical sector, at all levels, from the discovery of new vaccines to the manufacturing of it and nanotechnology of its delivery and administration of it to the human body, all need AI, ML, and DL combination as an integrated system. The functionality and capability of their data analytics and data predictive [8], respectfully in real-time, is a mandatory augmentation in the path to stop and prevent further speared COVID-19 or now the UK version of it as recently.

This section briefly defines what AI is and what other components are involved with the AI system to make a business operational in a resilience model. A right Business Resilience System (BRS) [8].

In a very holistic way, Artificial Intelligence (AI), by today's definition, is known as narrow AI (or weak AI) [9].

This kind of AI (Figure 2) is designed to perform narrow/simple tasks such as facial recognition, internet searches, or driving a car in an autonomous mode.

To recap, Artificial Intelligence (AI) is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals.

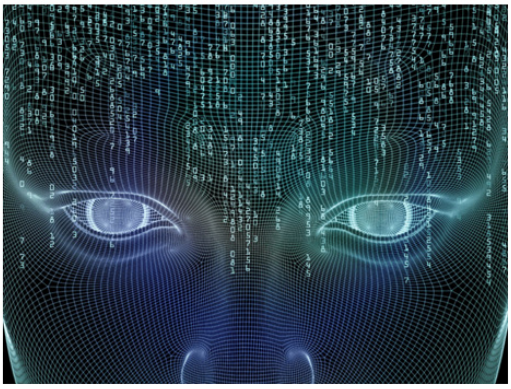

Figure 2: An Artificial Intelligence Inception.
An Artificial Intelligence Inception.

In other words, AI that is the new buzzword of the market of technology, is the science of making machines as smart and intelligent as a human as an ultimate goal, to the point that we go from a weak AI to Super-AI.

Such progression within the domain of AI by definition is the ability of a computer algorithm or program, particularly in the case of High-Power Computing (HPC) or machine, to think and learn

very similar to the human being. Two distinguished points about us as a human is that we can think logically and fabricate physically (i.e., Homo Sapiens or "Wise Man" in Latin and Homo Fabian or "Man the Maker."

With this basic understanding of AI, there are certain key factors one should know about AI:

- It is essential to distinguish different types of Artificial Intelligence and different phases of the evolution of AI when it comes to developing application programs
- Without recognizing the different types of AI and the scope of the related applications, confusion may arise, and expectations may be far from reality
- In fact, the "broad" definition of Artificial Intelligence is "vague" and can cause a misrepresentation of the type of AI that we discuss and develop today.

One of the significant advantages of Artificial Intelligence is the capabilities that make it possible for machines to learn from experience, adjust to new inputs, and perform human-like tasks. Most AI examples you hear about today – from chess-playing computers to self-driving cars – rely heavily on deep learning and Natural Language Processing (NLP) [7,9]. Using these technologies, computers can be trained to accomplish specific tasks by processing large amounts of data and recognizing patterns in the data.

Artificial intelligence will play in our fast-paced life, and modern technology that we encounter in our day-to-day life is essential.

Furthermore, integrating AI within technology as a wide range of smart tools these days, while partnering with humans, enables people to rethink and gather information, analyze the data, and finally, utilize the resulting insight to have a better-informed decision. These days, AI is essential since the amount of data generated by humans and machines far outpaces humans' ability to absorb and interpret the data and make complex decisions based on that data.

To understand how Artificial Intelligence works, one needs to deep dive into the various sub-domains of Artificial Intelligence (Figure 3) and understand how those domains could be applied to the industry's various fields.

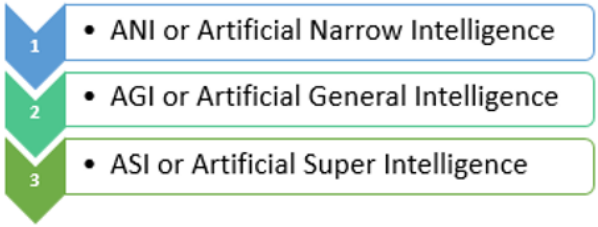

Figure 3: Different Types of AI.

Machine learning is the branch of artificial intelligence that Holistically addresses to build computers that automatically improve through experience. Indeed, machine learning is all about the knowledge from the data. It is a research field at the intersection of statistics, artificial intelligence, and computer science and is also known as predictive analytics or statistical learning. Indeed, machine learning's main idea is that it is possible to create algorithms that learn from data and make predictions based on them. Recent progress in machine learning has been driven by developing new learning algorithms and theory and the ongoing explosion in online data availability and low-cost computation.

With big data growth, machine learning has become a significant and key technique in solving problems. Machine learning finds the natural pattern in data that generates insight to help make better decisions and predictions. It is an integral part of many commercial applications ranging from medical diagnosis, stock trading, energy forecasting, and many more.

Consider the situation when we have a complicated task or problem involving a large amount of data with lots of variables but with no existing formula or equation. Machine learning is part of a new employment dynamic, creating jobs that center around analytical work augmented by Artificial Intelligence (AI).

Machine Learning provides smart alternatives to analyze vast volumes of data. Machine Learning can produce accurate results and analysis by developing fast and efficient algorithms and data-driven models for real-time data processing.

Deep learning is the subset of machine learning that, on the other hand, is the subset of artificial intelligence. Deep learning is inspired by the structure of the human's brain. Deep learning algorithms attempt to draw similar conclusions as humans would by continually analyzing data with a given logical structure. To achieve this, deep learning uses a multi-layered structure of algorithms called neural networks. Just as humans use their brains to identify the patterns and classify the different types of information, neural networks can be taught to perform the same data tasks.

Whenever humans receive new information, the brain tries to compare it with known objects. The same concept is also used by deep neural networks. By using the neural network, we can group or sort the unlabeled data based on similarities among the samples in the data. Artificial neural networks have unique capabilities that enable deep learning models to solve tasks that machine learning models can never solve.

One of the main advantages of deep learning lies in solving complex problems that require discovering hidden patterns in the data and/or a deep understanding of intricate relationships between a large number of independent variables. When there is

a lack of domain understanding for feature introspection, Deep Learning techniques outshine others, as you have to worry less about feature engineering. Deep Learning shines when it comes to complex problems such as image classification, natural language processing, and speech recognition.

The Role of Artificial Intelligence in Vaccination Process

AI Shows COVID-19 Vaccines May Be Less Effective in Racial Minorities.

Using Artificial Intelligence (AI) tools, researchers found that a form of vaccine similar to new COVID-19 vaccines is more likely to be ineffective in minority populations, as sort of illustrated in Figure 4.

Artificial intelligence tools examined a kind of vaccine similar to new COVID-19 vaccines and revealed that it could be less effective in people of black or Asian ancestry, according to a study conducted by researchers at MIT's Computer Science and Artificial Intelligence Lab (CSAIL).

Figure 4: Race Networks Illustration [9].

In response to the White House's Operation Warp Speed – an effort to produce and deliver 300 million doses of COVID-19 vaccines, with initial doses available by January 2021 – companies have raced to develop safe and effective treatments for the virus [9].

Currently, Moderna and Pfizer's vaccine candidates are leading the pack. Both have achieved over 90 percent efficacy against the coronavirus, and Pfizer's vaccine was just granted a temporary emergency use authorization in the UK [9].

However, the research from MIT suggests that the vaccines may not have the same impact among all patient populations.

CSAIL researchers used artificial intelligence and machine learning tools to examine a form of vaccine similar to Moderna and Pfizer's.

The team found that among white participants, the number of people whose immune systems didn't strongly respond to the vaccine was less than half of one percent. Among Asian participants, that figure was nearly ten percent.

The results indicate that clinical trials measuring the efficacy of COVID-19 vaccines should include diverse cohorts of participants, researchers stated [9].

Application of Artificial Intelligence Driving Nano-Based Drug Delivery, Administration Systems

Today's technologies, no matter which one, have some means of interoperability among each other. This is due to the sheer volume of data at the big data level that provides information and allows us to make a decisive road map to improve and enhance that particular technology. With nanoscience and nanotechnology comes the new world of size and scaling, which is as small as molecules and atom size. With small comes to the power that contains much information from its collective data, thus for us to be able to perform some means of data analytics and data mining, we need assistant from Artificial Intelligence (AI) and two of its sub-systems mainly, Machine Learning (ML) and Deep Learning (DL).

These data are a combination of structured and unstructured type, such as ASCII flat file in the form of comma delimited format or Comma Separated Values (CSV), such as Microsoft Excel spreadsheet or image processing form for unstructured type data. With the power of AI in today's world and nanoscience that has been thriving in the past few decades, these two technologies are converging to a focal point so rapidly. The convergence of AI into other technologies is invadable, no matter which technology we

are considering or interested in. Given the fact that AI has such a profound influence in the field of medicine these days; as a result, our need to augment AI, a nano-based drug, and its delivery process is also invadable when we are dealing with nanomedicine such as cancer cell, biomedicine, and nanobiology fields. This chapter explicitly concentrates on the description of artificial intelligence to show what AI is all about and how it works. It then describes the world of nanoscience and nanotechnology.

Finally, it connects them to deliver a nano-based drug delivery system throughout different nanoscience techniques. These techniques are presentation of how the emerging AI/ML and DL platforms are demonstrating the assistant of these systems, and how we truly can optimize treatment outcomes to be able to realize when drug selection and dosage identification are simultaneously achieved.

All these capabilities combined are essential for the field of nanomedicine, where combinations of different therapies are being integrated with a nanocarrier, of different classes of nanocarriers are being simultaneously administered to different patients with different medical conditions.

COVID-19 vaccine, the way behaves and the way the newly found vaccine works for the treatment of a patient, falls in this category when it comes to inject of vaccine into people arms.

If you look at a cartoon of the virus, it looks like a ball or a donut with some nucleic acid in the middle and spikes sticking out, and these spikes have little rounded ends (Figure 5). And indeed, that protein is called the "spike protein".

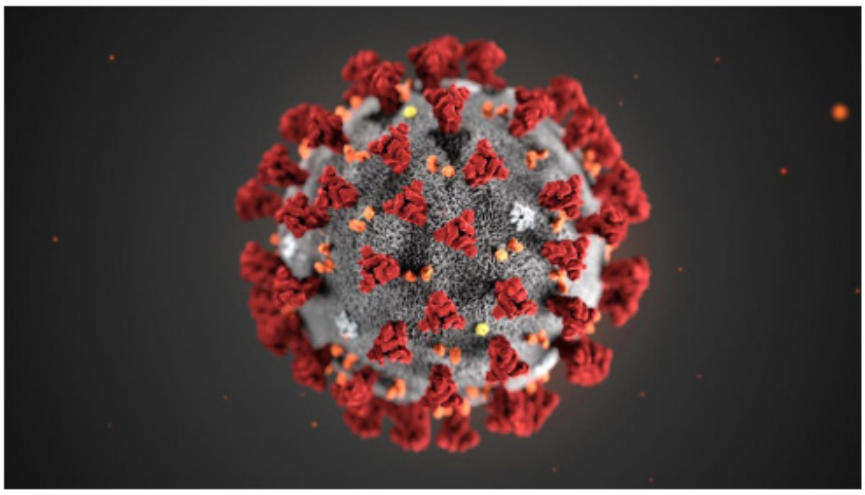

Figure 5: A Corona Virus Illustration.

At the end of this piece that called the receptor-binding domain. That is the part that docks with the receptor in human tissue called the ACE-2 receptor, allowing the virus to gain entry into the heart, the lungs, the vasculature, and other tissues.

Thus, by making an immune response against the spike protein in some capacity, you have a very good vaccine strategy Corona" is the Latin word for "crown." (Alissa Eckert, Dan Higgins/CDC) and illustration in Figure 5 is released by the CDC shows the spikes on its surface for which it is named.

Conclusion

We do not know how this pandemic will end. The vaccines may be a success, or the virus may mutate around the vaccines, and we may be back where we are today in a year from now. Viruses exchange genetic material with other viruses, and one of these other viruses may learn how to take advantage of this airborne niche to create a new pandemic where neither our tests nor existing vaccines are of any value. COVID-19 provides a starting point to anyone wanting to modify the virus to start a new pandemic - an option that may be attractive to some terrorist groups and certain nations. They now know we are incapable of stopping such an attack, and if you come from a society of young people, the damage will be primarily in the west.

We could be sure that sooner or later, another virus will find the environmental niche that Covid-19 found and start a new global pandemic unless we chose to destroy this environmental niche. Because moving today to such solutions will shorten this pandemic, it is also the short-term no-regrets policy. The question is how many dead bodies it takes to educate the political class, national press, and others to move to clean up the air in crowded places - the 21st-century version of building sewers, clean water systems, and fire-resistant cities.

In conclusion, as we have stated throughout this article, the world faces an unprecedented test. And this is the moment of truth.

Hundreds of thousands of people are falling seriously ill from COVID-19, and the disease is spreading exponentially in many places and societies are in turmoil and economies are in a nose-dive.

The International Monetary Fund has reassessed the prospect for growth for 2020 and 2021, declaring that we have entered a recession – as bad as or worse than in 2009.

We must respond decisively, innovatively and together to suppress the spread of the virus and address the socio-economic devastation that COVID-19 is causing in all regions.

The magnitude of the response must match the scale of the crisis -- large-scale, coordinated and comprehensive, with country and international responses being guided by the World Health Organization.

And it must be multilateral, with countries showing solidarity to the most vulnerable communities and nations.

The message of the report we are issuing today is clear: shared responsibility and global solidarity in response to the impacts of COVID-19.

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None.

Conflict of Interest

No conflict of interest.

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