Supply Chain of Covid-19 Vaccination Based On Blockchain

Abstract:

Covid 19 is the most ferocious and common enemy to the current world. It's too tough to fight against an invisible foe. After more than 1 year we managed to produce the vaccine. But the thing is that it's really very hard to maintain the proper supply and efficient distribution of vaccines because the production is very limited. Lots of gratification related questions are raising among people like trustworthiness, security, tamper issues, falsified cases and so on. The Centralized system is responsible for this kind of dissatisfaction. Here comes the most worthy technology Blockchain with its Decentralized features. We are going to implement a supply chain management system for the efficient and trustworthy supply of vaccines, where there won't have any central authority and thus data can not be altered or sold to a third party for their own benefits and the system will not be biased anymore. It will also ensure distribution of the vaccines to the general citizens and will also prevent the counterfeiting through generating a random hash which will define the batch number of each vaccine. People who want to verify the sustainability of the vaccine, can search the batch number to ensure. Information verification and environmental information registering in every step of the supply chain will ensure the quality of transportation and and safe preservation of the vaccines. Above all proper prioritization will be ensured for avoiding any kind of chaos since providing vaccines to all is quite impossible.

So the gist of our proposal is to make a blockchain based platform where all the information related to the supply chain of the vaccines from manufacturing to distribution , this whole process would be stored with a view to maintaining the quality of the vaccines and making the entire process more transparent.

Introduction:

Our proposal is to use Blockchain technology in this Covid-19 situation. What is happening in this situation will be analysed in future for further analysis. It is important to have clear and unbiased data for that. Our project can be a big solution for that. It can also solve the most recent problems that we are facing by using blockchain technology. What we are doing is tracking the vaccine from the first source to end user by blockchain technology.

It's quite impossible for a Vaccine manufacturer to manufacture and distribute all the vaccines on their own. They need to have some vendors to serve globally. So there is a possibility that the third party may fail to maintain their quality as well as for producing mass production there could exist lackings in quality check. If we can not track it in a proper way all the responsibility goes to the Mother manufacturing company of the vaccine.

It is quite a common issue we are facing about thermal Controlled supply chain. It may happen that any particular production has not maintained the proper method and for their failure the responsibility is on the vaccine formulation. Freezer firms are also a big problem that we have seen. Also management of adverse effects on the vaccine. One firm might have a problem and particularly those vaccines don't work up to the mark that responsibility goes to the vaccine formulation.

Vaccination process is also a complicated problem. There is a proper training procedure needed to follow. We need to take the history of this fact for a low performing vaccine. It is also important to find the symptoms from the end user. So there is a need to properly collect data collection with their age, medical history and medication history and location. The end user can register only by their national id or voter id card. So one person can order only one time.

We need to prioritize the vaccine receivers as per their profession for fairness, as we can't provide vaccines to all since there is a huge gap between supply and demand.

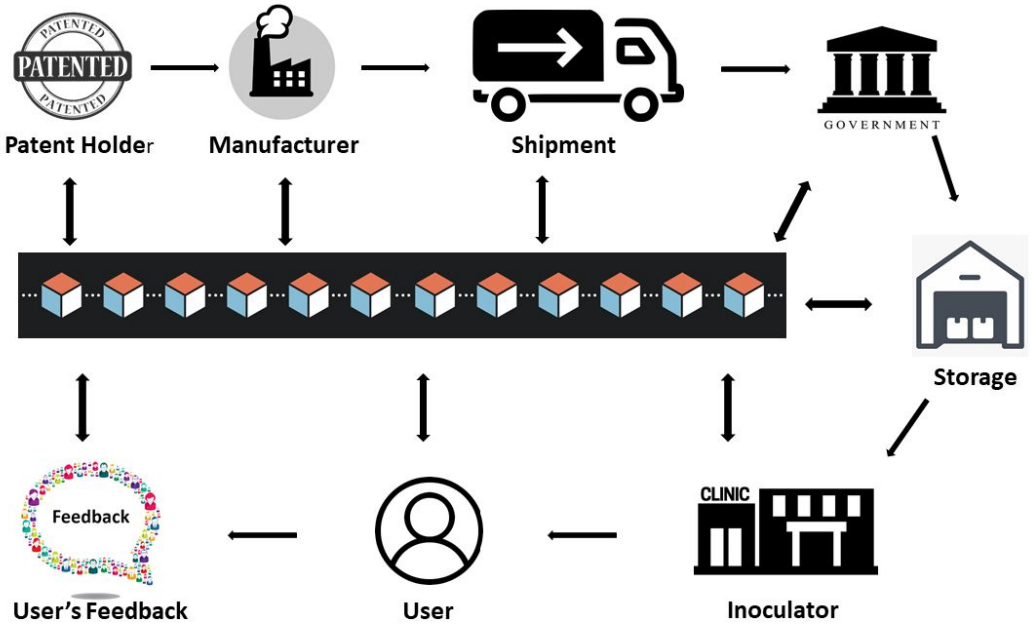


Fig: Use-Case Scenerio

Users' feedback is a very significant event in vaccination issues. As the covid 19 is just one year old in age and hopefully we have approved vaccines, there's a very high probability of having side effects though the vaccines have passed all the steps before getting approval. The main fact is that the vaccines are in an immature stage as it comes very early. So we are proposing a very interesting feature which is users feedback collecting. It's possible that the local vaccine importer can alter or delete the unpleasant harsh feedback to sustain their business. With the help of blockchain, the altering possibility of those feedback are mitigating.

The key concerns of this quality ensuring issues are maintaining the proper temperature and suitable humidity while transporting, taking good care of the products that will assure zero tolerance in terms of compromising the quality. So, for getting rid of such kinds of quality degradation concerns and monitoring the entire process, our proposal might be a satisfactory relevant solution. Also the feedback taking system ensuring the quality of the vaccine.

Problems:

While any kind of products are delivered to the end user by changing lots of hands during the transportation time, there exist several problems that may cause quality degradation. The supply chain of the Covid-19 vaccine is not the alternative too. Some of the problems related to the supply chain of the vaccine are stated below,

1) For such inestimable vaccine, maintaining the proper temperature and suitable humidity might not be done while the transportation event takes place which can hamper the quality of the vaccine,
2) Counterfeiting of vaccines may lead to severe injury to the health of the consumer,
3) Vaccines might exceed the delivery date due to some transportation complexity,
4) Some vaccines can be lost due to some reasons while transporting them and it is quite hard to track down in which phase they were lost,
5) There is a concern among the citizens whether the distribution of vaccines is fair or biased.
6) Vaccine takers can face side effects or any kind of health issues after taking the vaccine.
7) The Expiration date of a vaccine can be altered in the traditional system. Which can lead to severe damage to a consumer.
8) Since there is a huge gap between supply and demand it is not easy to provide vaccines to all of them. So, there is a high possibility of chaos.

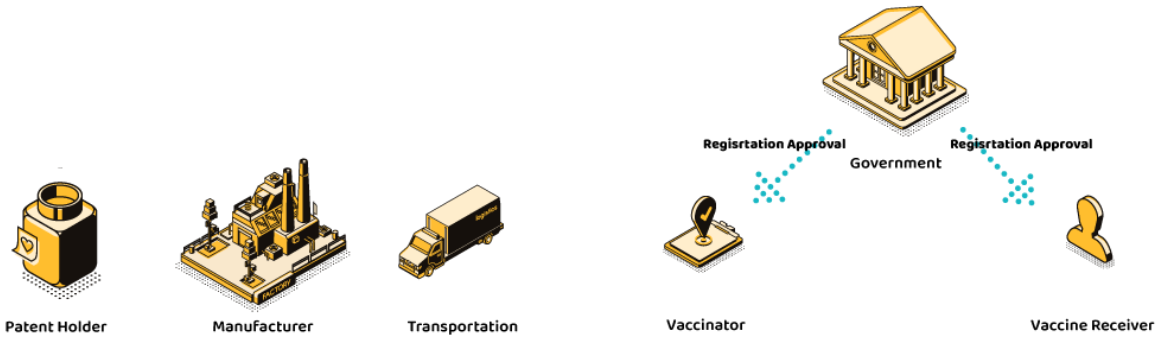
Proposed Solutions:

To eradicate most of the problems during transportation and vaccination introducing blockchain technology in the field might be a great solution in all aspects as stated below,

1) There should be an expert with all the vaccine transporters while they are transporting the vaccine. The expert should give an update to the blockchain based system about the current temperature and humidity of that time that is maintained to preserve the vaccines after every fixed interval of time.
2) After manufacturing the vaccines, a QR code containing the batch number should be attached to each vaccine for verifying whether it is original or not.
3) Vaccine transporters should give an update to the system about their whereabouts after every fixed interval of time. It should be monitored by the government for taking necessary steps if any transportation complexity arises.

4) It would be very easy to track down in which phase the specified amount of vaccines got lost if the transporters keep the system up-to-date with the information of vaccine quantity while they change hands.
5) It will create transparency between the general citizens and the vaccinator or government, if all can see the vaccination update which includes the number of vaccines remaining and how many citizens have taken it.
6) If any vaccine taker faces side effects or any kind of health issues after taking the vaccine, he should give feedback to the system. Both positive and negative feedback will assure the quality of the vaccine. It will definitely help for testing purposes.
7) Each vaccine will contain a manufacturing date and expiration date which will be stored in blockchain. By extracting qr code verifiers can check both dates.
8) Vaccine receivers can be prioritized and scheduled for vaccination by their profession for no chaos. And by the national level the whole project can be maintained easily. And we can find out the percent of people vaccinated.

Architecture & Governance (Implementation):



1: Onboarding: Registering on the system

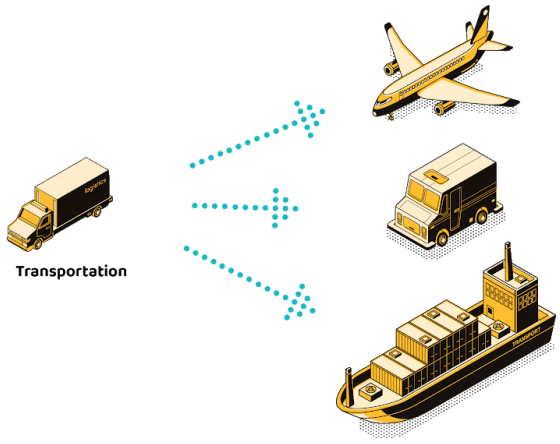
1) ***Prerequisite/ "Onboarding" step***: Every vaccinator and vaccine receiver has to make a request to sign up to the system as per their specific roles. Their roles and professions are then verified by the governmental authority. Their sign up requests will be approved or rejected on the basis of authentication of their provided data. Providing false information may cause permanent banning if detected. But patent holders, manufacturers and transports will sing up directly.

2-3: Invention of Vaccine and Sent for mass Production

2) ***Invention of the vaccine formula***: After passing all the medical phases the patent holder will approve a vaccine.
3) ***Hand over the formula for mass production***: Patent holder will hand over the formula to the manufacturers for mass production.

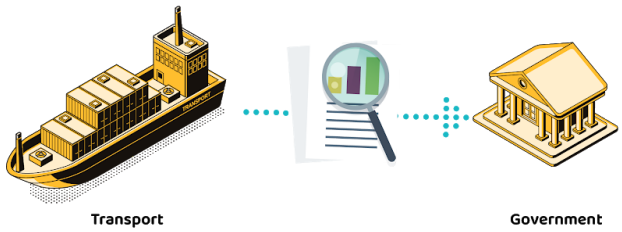
4-5: Mass Production and sent for shipment

4) ***Mass Production***: Manufacturers will commercially produce vaccines according to the given formula. A batch number will be attached with each vaccine along with their manufacturing and expiry dates (timestamp) in a form of QR code.
5) ***Sent for Shipment***: After manufacturing, vaccines will be sent for shipment storing the necessary documents (vaccine name, amount of vaccines, shipment date and deadline and so on) in the system.



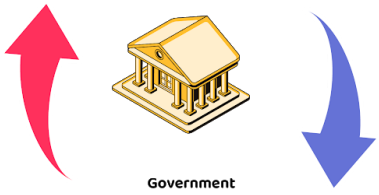
6: Changing Hands during transportation

6) ***Changing hands***: During the shipment vaccines are sure to change hands and the maintenance issues of the vaccines are updated in the system after each fixed interval of time by an expert carried along with each transporter.



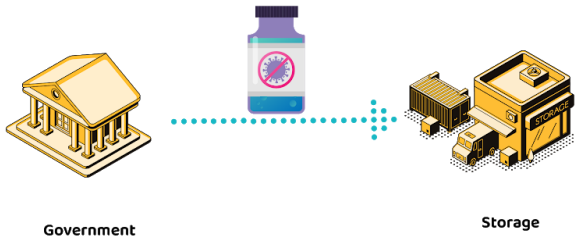
7: Handing over to the Government for Verification

7) ***Handing over to the Government***: Finally, the transporter will handover the vaccines to the government. Government will verify all the requirements (deadline, amount of vaccines, vaccine condition, batch number, expiry date) of the delivered vaccines and confirm the deal.



8: Prioritization

8) ***Prioritization***: Government will prioritize the vaccine receivers by their profession and schedule the time of vaccination regarding the amount of vaccines available at that moment.

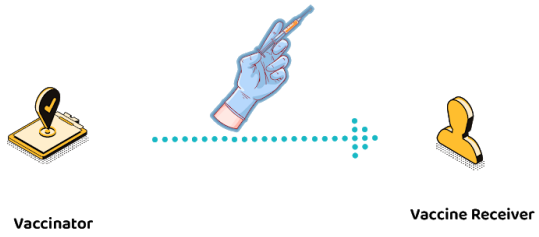


9: Storing Vaccines under the supervision of the Government

9) ***Vaccine Storage***: Vaccines will be stored in a storage under the supervision of the government maintaining requirements of vaccine preservation (temperature, humidity, etc).

10: Distributing Vaccine for Vaccination

10) ***Vaccine Distribution***: Vaccines will be distributed to the vaccinators as per needed for vaccination along with a documentation to the system about it (distributed to whom at which quantity).



11: Push Vaccine

11) ***Vaccination***: Vaccinators will push vaccines to the vaccine receivers along with some required entries to the system (vaccine receivers identity, timestamp, dose number, update storage).

12: Vaccine receiver's Feedback

12) ***Feedback***: If the vaccine receiver faces any kind of side effects or health issues after taking the vaccine he/she will give feedback (some sort of rating from 1-5, where 1 indicates the lowest satisfactory level and 5 indicates the highest satisfactory level) to the system which will help to make an analysis on the quality measurement of the vaccines.

Expected Outcomes:

Problem & Solution

All the benefits of our project are given below:

1. Ensure Vaccine Integrity: Counterfeiting, Tampering, Contamination, Theft

As we are using blockchain we can track every detailed information about the supply chain of the Covid-19 vaccine.

2. Authorization: Development, Testing, Regulation

By using the blockchain technology the mother company can easily track all the condition simultaneously, even symptoms from the end user. It has a huge effect for testing and development.

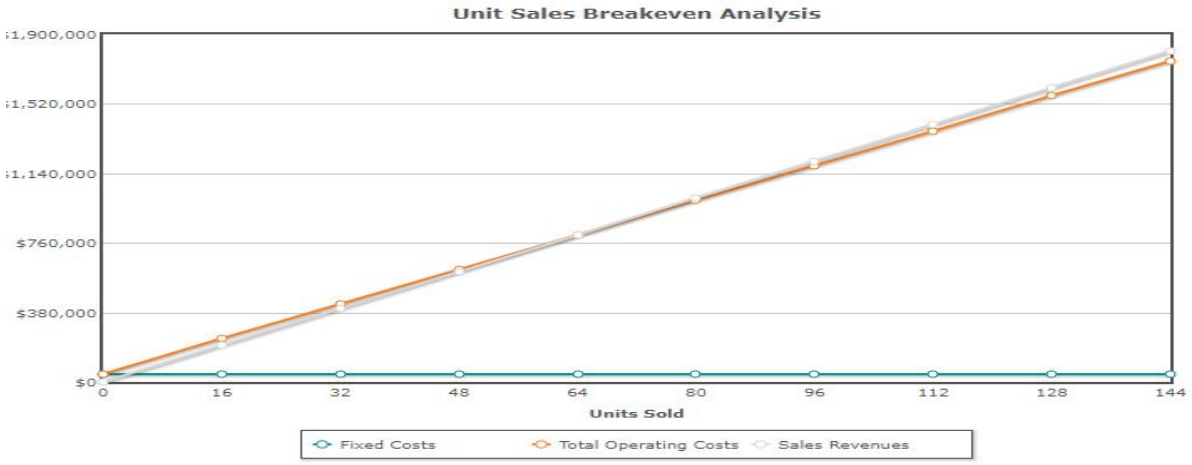
3. Prioritization: First, second prioritization and recommendation.

As there is a huge gap between supply and demand it is not easily possible to provide them all.

But by prioritization we can ensure a fair distribution among the vaccine receivers.
4. Allocation: Scheduling vaccine.
We can clearly see the product demand form the end user registration and Scheduling the vaccine.
5. Distribution: Guideline for no chaos.
Proper distribution is also a big problem. By registering the end user by their national id and taking information from each step is a handy effect for distribution.
6. Feedback from the end user.
Users can easily put their symptoms in their feedback section. This will help in further analysis on the vaccine quality.
7. Bottleneck Overview, Expired Stock, Overstocking and Damaged stock
8. Fully transparent process and safety.

Market Analysis:

This project will help a lot for project management of the vaccine on the international level.As there are not many others in the competition and for the government and international level it can easily save a lot of time and money because of the automation of the project.Our fixed cost of doing the project is the blockchain operation cost, training people for working with blockchain technology. Expected Fixed cost of the system will be approximately 40,500 taka. Whereas the variable cost will be approximately 11,500 tk. These are the operational cost of the authority entity(Government) of the system. Which is actually for paying the ether on per transaction.



We believe it can easily cross break even points and can go for the profit margin.

Competition & Risks:

No competition at all and for the project. Technical execution and operation may be one of the risks of doing it. But with proper training and with the right person this can easily be avoided. Data confidentiality and Security may be another risk factor but we believe with proper strategy and governance it will be solved. Not all the info will be revealed to everyone.

Architecture & Governance

Without blockchain tech this kind of information is very hard to maintain with proper accuracy. Easily manageable the whole project because of automation and programming for scalability. We will strictly follow the network and often check our quality and performance. There will be good security management and by the permissioned chain every step will be evaluated. All the manufacturing company and the logistic service will be verified and then added to our network.

Valuation & Distribution:

We are basically helping for project management of the Covid-19 vaccine. With the unbiased data it can easily work as a profit earning model. It will save a lot of time and energy. The whole distribution, logistics, performance can be easily monitored and maintained. And the data will be saved for future analysis.Our project will be launched nationally and the whole distribution network will be confirmed and connected. End users can easily register themself and the whole project can start.

Conclusion:

Humans are sitting on the driving seat of each technology. So it's impossible to resist the negative aspects of technology. But it has already proved its capability to change the world. Lots of security measures have been taken for bringing the trust. But still there are lackings. Blockchain is the great invention which mitigates the security leakage concern. Using its most promising feature we have implemented our system. As vaccines are the most hot cake now, it's a crying need to monitor the whole vaccine supply system. We are offering every possible security issue related to the supply chain of the vaccine. Also some additional features like feedback taking, counterfeit checking, vaccine expiration checking, transportation monitoring and so on are available. Which makes our system both feature enriched with security and trustworthy. Due to the very early stage of the vaccine, people can be demotivated due to security and quality concern of the vaccine. But our system is offering trustworthy and transparency of a vaccine's lifecycle. Which will assure the people about the authentic vaccine. Thus they will show more interest in taking vaccines.

People have faced lots of deaths, casualties during this pandemic. A well planned and faithful vaccine supply chain will ensure efficient, faster and safe vaccination. By this soon we will get a healthy world just like we all used to have.