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Business Intelligence application in COVID-19 Vaccine Distribution

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ABSTRACT

COVID-19 vaccination manufacturing and distribution plays an important role in the efforts needed to fight the spread of the Corona virus. The pharmaceutical industry expedited its processes to produce reliable vaccines.There are six major manufacturers of COVID-19 vaccinations to date are Pfizer-BioNTech, Moderna, Johnson & Johnson, Astrazeneca, Sputnik and Sinopharm. The administration of the vaccination to the global community started in December of 2020. Although more than 905 million vaccine administered worldwide, there is still a need to vaccinate the remaining six billion people around the world. The distribution of vaccines globally need a reliable and efficient supply chain model. There is an imbalance in the distribution of vaccines among countries. This paper investigates the use of business intelligence applications to help solve this problem.The implementation of an advances knowledge based supply chain system shall produce an efficient and effective COVID-10 vaccine distribution model. This globally monitored supply chain system shall provide authentic data about the number of does shipped and the routes it took to reach its final destination. As an intelligentknowledge sharing system, it shall provide accurate data about how many doses are shipped, and the exact date and time of each shipment. It shall also help countries learn, and make decisions on how to plan and manage the vaccination delivery process.

Keywords
Business Intelligence, COVID-19, vaccine, supply chain

Introduction

COVID-19 outbreak started in November of 2019. By March of 2020, the World Health Organization (WHO) declared it a global pandemic. COVID-19 virusisextremely infectious and is spreading very fast, among all countries [31]. Infection rates are reaching record high and lead to a large death rates. The number of new cases escalated on a daily basis and spread all over the world. Countries started to impose lockdowns and curfews for the first time in decades. The WHO started campaigns to educate people about the importance of social distancing and the wearing masks in public places. On a parallel track, scientists began studying the virus and developing expedited vaccines. To date there are six authorized vaccines by the world health organization.

All countries started contracting with major suppliers and vaccine developers to secure the right amount of vaccinations for their population [30]. The vaccination process in still in its infancy and the process is ongoing until this point in time, however the supply is limited with shortages for many under developed countries, which rely on funding, donors and support from global organizations.

Every country used its own vaccine delivery system. Some systems were manual, and some used smart applications, to track the delivery of each does. These systems did not intend to provide detailed reports to governments about the actual number of doses received and delivered. Governments need to know on the spot, how many doses were received, how many administered and how many is in inventory [22]. The current supply chain system is inefficient and inadequate

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and does not provide data for decision makers to makeintelligent decisions for the ordering and the delivery of vaccines.

The term “Business Intelligence” is the conversion of data resources to knowledge. It is the data mining and integration of information from data warehouses to produce large amounts of information needed for effectivedecision-making process [10].Business intelligence tools and applications use databases, data warehouse, data marts external and internal to the organization in order to gather, analyse and generate meaningful knowledge used by the organizations management to perform short and long term strategic planning [9].

Knowledge management (KM) uses a number of tools and techniques to identify, create, present, disseminate, and enable the use of insights and experiences. Organizational knowledge is either embodied in its workers or embedded in the organization’s processes and practices. [7, 13, 27].

Many researchers, economists, politicians and businessmen are referring to today’s economy as “knowledge economy” reflecting a shift in trends for organizations from relying on information to make decisions to relying on knowledge as vital component for organizational survival and success. Knowledge economy as a term also implies that today’s organizations has a continuing quest for knowledge neededto perform their daily operations[2, 3].

The main objective of this paper is to suggest the use of business intelligence knowledge based applicationfor an effective COVID-19 global vaccine distribution [1]. There proposed solution is the use of an efficient knowledge driven supply chain application, forcapturing and sharing vaccine distribution data among world countries.

Literature Review

This literature review provide background information related to the COVID-19 pandemic vaccination distributing process, and we explain the importance of adopting a Business Intelligence supply chain system in facilitating and documenting this process.

COVID-19

COVID-19 global vaccination campaign started in early December of 2020. On April 19, 2021, more than 905 million vaccine doses were administered worldwide [24, 25]. Because most vaccines needed more than one does to provide adequate protection, and some vaccine types were paused due to potential health risks, an imbalance in the distribution of vaccines among the general population and discrepancy in the vaccination records occurred.

Vaccines help the body to build immunity against the Corona Virus [26]. The vaccination process involves administering the vaccine to humans. The process is safe and simple provided that it provides adequate immunity against COVID-19 [23]. Vaccines help the body build a self-defense system within the body itself to protect it against future infections. If makes peoples immune system prepared to defend itself against the disease. When a body receives the vaccine, it may need following booster shots to build immunity and to keep the immune system prepared for future outbakes.

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There are different types of COVID-19 vaccines. Currently there are six major manufacturers of COVID-19 vaccinations, Pfizer-BioNTech, Moderna, Johnson & Johnson, Astrazeneca, Sputnik and Sinopharm [22]. The supply of each vaccine depends on the manufacturing capacity and demand for each one of them. All available vaccines needs to shots scheduled tree weeks in between except Johnson & Johnson, which requires only single shoot.

Each country handles the vaccination process in a different manner, based on the availability of the vaccines and the number of its population. Managing the vaccination process includes a stream flow of activities to insure efficient and reliable process [15]. The process starts with setting an appointment to the person receiving the vaccine and ends with that person receiving his final shot. Some countries issue a certificate of vaccination at the end of the process.

Eligibility for vaccination also play a crucial role in deciding who takes the vaccine first. Elderly people and people working in the health care, law enforcement, and education sectors are given priorities in most countries [11]. Although it may sound simple, the process is interrupted by several factors ranging from people being sick on the vaccination day, to people refusing to take certain types of vaccines. Such factors make it imperative to re seclude the vaccination timetable and creates discrepancies in the vaccination data.

A vaccination tracking and delivery system is also an important aspect of the vaccination process. It starts immediately after governments order vaccines, and keeps on-going until the vaccination is delivered to people.

A global knowledge based intelligent system, should be incorporatedto lead to a reliable vaccine delivery system. It follows the vaccinesupply chain process from start to end and keeps track of vaccines every step of the way. This plan should include the delivery routes and the means used to track and monitor the entire process. The deployment of an advances information system is need to tracking and reporting of immunization data. According the WHO “Each country’s NDVP should be developed through a consultative process, led by the country’s Ministry of Health and supported by other organizations, including WHO, UNICEF and other relevant partners, to fine-tune the plan until it is complete” [22].

Business Intelligence

Business Intelligence covers several processes and technologies including, data mining, data warehouse, and online analytical processing (OLAP) [5]. Business Intelligence (BI) represents the tools and systems that play a vital role in knowledge sharing and dissemination [4]. These systems allow a company to gather, store, access and analyse corporate data to aid in decision-making [12].

Business intelligence tools are software tools that allow the retrieval, analysis and reporting of data [6]. This widely set definition includes a wide variety of software tools ranging from spreadsheets, OLAP, visual analytics, querying tools, data mining, data warehousing, and decision making tools that help organizations management generate meaningful knowledge to perform short and long term strategic planning [8].

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Knowledge Sharing

Knowledge sharing is the actual process of sharing knowledge (information, skills, and expertise) explicit or tacit and exchanging it among people, friends, members of a family of organization [14]. Organizations has realized that knowledge is considered an extremely valuable resource, which shall led to achieving and sustaining competitive advantages.

Knowledge sharing activities are generally supported by knowledge management systems. However, technology constitutes only one of the many factors that affect the sharing of knowledge in organizations, such as organizational culture, trust, and incentives [16, 18]. Sharing of knowledge constitutes a major challenge in the field of knowledge management because some employees tend to resist sharing their knowledge with the rest of the organization. This requires employing the skills and techniques of knowledge engineers who help employees realize the importance of knowledge sharing within their organizations.

Proposed Business Intelligence VaccineDelivery System

Implementing a business intelligent knowledge based vaccine delivery system shall prove to be a reliable technology for global management of COVID-19 vaccines delivery. We propose a delivery system that is based on business intelligent tools including Online Analytical Processing, Data Mining, and Data Warehousing (see Figure 1). The system built on the notion of knowledge sharing of vaccines delivery data, to provide reliable means for tracking the vaccinedelivery process globally [19, 20].

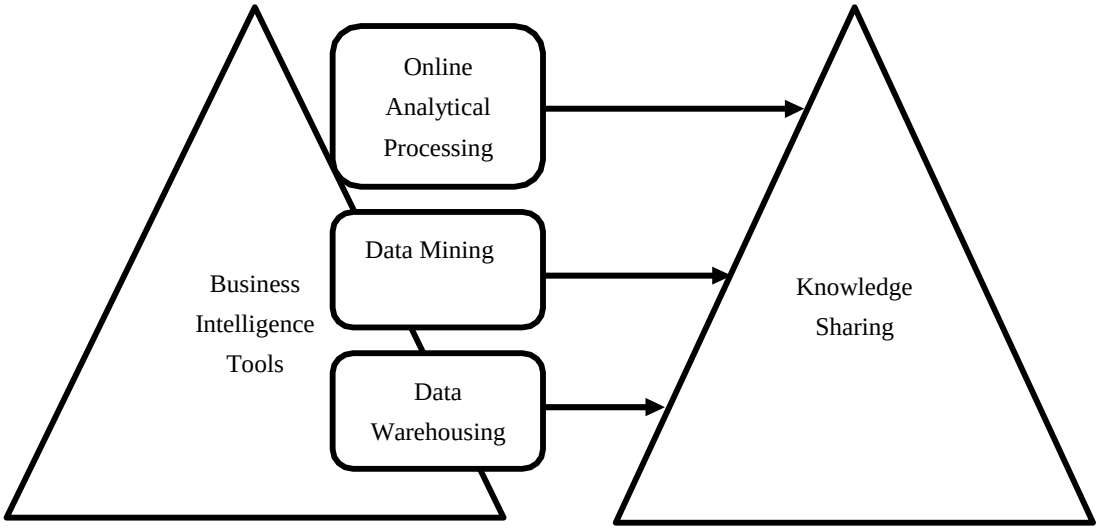

Figure 1. Fig. (1-1) Proposed Business Intelligence Vaccine Delivery System

The system collects vaccine delivery data online through a dedicated application available on

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mobile devices and smart boards. Our proposed system designed based on LAMP open source platform [17].

The impact of a Business Intelligence vaccine delivery system depends on the power of the Online Analytical Processing tools used and the sharing of vaccine delivery data. Online Analytical Processing plays an important role in knowledge sharing of vaccine delivery data [21, 28].

Data Mining encourages manufactures and countries to share knowledge on a global scale. The effect of Data Mining on Knowledge Sharing shall be significant for the success of this proposed vaccine delivery system. Data Warehousing also shall have a great impact on knowledge sharing of vaccine delivery data.

Discussions

Since the COVID-19 pandemic is a new issue. There are no prior literature covering this domain. Some Business Intelligence applications have been in use in limited areas of the supply chain deliverysystems in the health care sector, but none has explained the importance of BI-based healthcare solutions use in the vaccine deliveryfor a large number of populations. Governments and healthcare organizations can use the proposed system to improve streamline of the vaccination process to tackle the existing COVID-19 pandemic.

This research has the potential to make a significant impact on governments and healthcare agencies through presenting the importance of deploying a Business Intelligence vaccinedelivery system. Governments and healthcare agencies shall appreciate the use of the Business Intelligence technology to assist in tracking and monitoring of the COVID-19 vaccine delivery process. The implementation of the system will facilitate communication in real time, identify any issues during vaccine delivery, and allow for better efficiency in the use of limited resources. The implementation of the proposed vaccine delivery system in health care can help track each step of the vaccine supply chain from procurement of the vaccine to the delivery to the recipient. The major advantage of using Business Intelligence system are: improved assistance in scheduling vaccination appointments, improved assistance in tracking vaccinations and vaccinated people, improved overall vaccination productivity and efficiency.

Conclusion

In this paper, we introduced a Business Intelligence vaccine delivery system for tracking, and monitoring COVID-19 vaccine records. The proposed solution promotes transparency, and traceability. It also streamlines the communication between stakeholders. Our presented system addresses the problems governments and health care organizations is facing in the current pandemic. The system provides a reliable solution that shall help governments track the vaccination process and keep accurate, authentic records. A Business Intelligence system shall provide authentic data about the number of vaccines delivered and how many doses each of them received, and the exact date and time of each does. The system shall facilitate the shipping, management, and delivery of the COVID-19 vaccine and shall help countries learn, and make decisions on how to plan and manage the vaccination process. In this paper, we propose the

development of a Business Intelligence vaccine delivery and tracking system to enable governments deliver COVID-19 vaccine to its citizens effectively and efficiently.

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