Conceptualizing a Data Visualization Platform for Understanding a New Pandemic Outbreak

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Abstract

The world was caught off guard when the Covid-19 pandemic struck, late 2019. It has spread from China, across to the other end of the world in just a few months. This is a concept paper to help the decision-makers in each country to make fast and good decisions in confronting the new wave of unprecedented events triggered by the virus, never seen before in the last few decades. An intelligent dashboard prototype is proposed to enable the authorities to access and study available data, using Big Data technology in a single platform, where they can pinpoint the source of specific issues instantly and choose the best decision for ongoing operation. This dashboard can also benefit the public by increasing the awareness of the ongoing situation and reflecting on major outbreaks over the past decades. Literature review on past pandemics and their outcomes will be used to identify suitable pandemic indicators in order to design and develop an intelligent dashboard prototype for current and future pandemic situations. Any key findings found in this research not only serve as a support for the current decision-making process in the COVID-19 outbreak but also as a preparation plan for decision-makers and experts to implement in the future if another health emergency is to arise.

Keywords: *pandemic, intelligent dashboard, pandemic indicator, COVID-19, Big Data.*

1. Introduction

The end of 2019 saw the birth of a novel coronavirus in Wuhan city, China, where a large number of its population was infected by a deadly pneumonia-like disease - which created the first cluster of human to human transmission case that was spreading very fast across that province. This contagious disease causes serious infections in the human respiratory system. By early 2020, this severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) has also spread at an alarming rate across the globe. The virus was later named COVID-19 by the World Health Organization (WHO)[1-3]. In late January of 2020, several cities in China such as Shanghai and Beijing decided to restrict residents' movement for an undetermined period – businesses that are not essential, schools, universities, and public transportations were suspended[4-6].

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In March 2020, WHO declared the disease as a pandemic. As of May 28th 2020, 216 countries have been affected. Officially 5 596 550 positive cases have been recorded and the death toll has reached 353 373 worldwide [6]. Due to the danger of the virus, many countries are forced to take unprecedented measures including a ban of mass gatherings, travel restrictions, closure of non-essential public places, and implementation of social distancing, which slows down the world's economy greatly. With international travel bans affecting over 90% of the world population and wide-spread restrictions on public gatherings and community mobility, tourism largely ceased in March 2020. Early evidence on impacts on air travel, cruises, and accommodations have been devastating [7].

With fear and uncertainty running rampant during the pandemic, leaders need to make critical decisions quickly on how to handle the situation. From a public health perspective, they need to plan on how to write health and safety guidelines for various sectors, ensure public outreach, build awareness, allocate scarce resources, limit public movement, and such [8]. From the uncertain business perspective, they need to plan on how to support businesses of all sizes, protect employees, generate real income and maintain the stock market [5][9]. These kinds of plans are needed to be properly informed as the decisions that officials must make will influence the safety of the community as well as the growth of the economy over the years to come [2]. However, there are some challenges that they are facing in making an informed decision amid the COVID-19.

The main issue faced by leaders and experts is the limited knowledge of effective measures to handle a sporadic surge of new infections [10-12]. The coronavirus, COVID-19, is a new type of virus so it is highly expected that some health experts and researchers to examine observational clinical studies based on past pandemics with similar nature, namely SARS, MERS and influenza A to identify potential treatments. Others also have investigated other pandemics with different approaches to analysis. For instance, highlighting a few lessons learned from the Ebola outbreak [4][13-14].

The number of COVID-19 cases is continuously increasing, which means the dataset has the characteristics of Big Data: volume, variety, velocity. Even though the new cases reported on a particular day do not necessarily represent the actual new cases on that day due to the period for testing results and reporting, it shows the volume and the velocity of data flowing in [15]. Receiving proper active and closed COVID-19 clinical data from various hospitals is laborious, which requires sophisticated data management to merge and clean large and varied data [16]. Experts must be careful in handling and managing such important data. The data has to be interpreted wisely as it is not appropriate to criticize the competencies of the authorities in handling disease cases solely based on the number of new cases, deaths and recovered cases alone. This is because each country has a different history and infection rate coming from different cases in which some of them might be unique and isolated [17]. Circulation of unverified data is also a big challenge during this pandemic chaos, therefore, experts have to filter the information obtained and shared, well. Facts and contradictions have to be sorted out [18].

2. Statement of the Problem and Research Objectives

Despite the latest technological advances and the archived data from previous pandemics, the world is still unprepared to confront this new pandemic. Many lives are lost, job loss, a broken marriage, hardship and stress are some of the challenges faced by the world today. Even with all the relentless warnings and advice from health experts, leaders remained obstinate with their other agendas which resulted in the world being unable to handle the damages done by the COVID-19 pandemic, nearly a year after it started making its appearance.

With data and research papers on the COVID-19 pandemic continuously flooding in, it is still difficult for leaders and experts to make the best decisions. Policies keep on changing to accommodate the evolution of the virus spread. Without having all the data in front, it is difficult to see the big picture. One way to solve such a problem is through data visualization using an intelligent dashboard where all the necessary information to make a quick decision can be visualized right in front of their eyes.

This paper aims to present the concept of identifying significant patterns and important information to aid analysis and immediate decision making on the COVID-19 situation in the country.

It is important to choose the best solutions to propose to the country's decision-makers. From the dashboard, it is hoped that a wider range of audiences from different expertise can communicate and discuss urgent issues relating to the pandemic. At the same time, it helps to increase the awareness of the latest situation and to plan for what to do next. It can also be a platform to reflect on other major outbreaks in the past and learn some invaluable lessons from them. And lastly, to serve as a rich database for decision-makers to make important decisions when another health emergency calls.

3. Concept of Pandemic Intelligent Dashboard

Raw data and principles of open science are very much needed in this time of crisis. Furthermore, analyzing historical data of past pandemics can be considered as the best approach under restricted time. Examples of pandemics with similar nature such as SARS, MERS and Influenza A can be taken into consideration.

The proposed dashboard will enable users to access and study the data readily. All relevant data that has been pooled together are analyzed and organized in a platform where the decision-makers can identify the source of specific issues instantly and choose the best decision for their current operations. In this current global crisis that has heightened the importance of decision-making, business intelligence and analytics tools are the greatest assets.

This conceptual paper aims to help decision-makers with the critical decisions amid the COVID-19 outbreak by developing an intelligent dashboard prototype that contains information of the current situation as well as past pandemics.

The options of past pandemics that can be studied are limited such that there are some that do not have the data in a form that can be readily transformed and analyzed with business intelligence and analytics tools. For example, the data for the Spanish flu is in the form of old documents which have few missing pages. Thus, after some exploration, the research will focus on H1N1, SARS and Ebola for past

pandemics on top of COVID-19. All four pandemics in this research will be visualized using Power BI.

4. Methodology

There are two main phases for the project methodology. Firstly, a literature review on the health impacts of pandemics, existing effective dashboards and past pandemics' patterns will be carried out. Next, the dashboard will be designed and developed. The result will be in the form of an intelligent dashboard that can be used to visualize and analyze different pandemics and facilitating decision-makers' actions. The methodology is summarized in Figure 1 below:

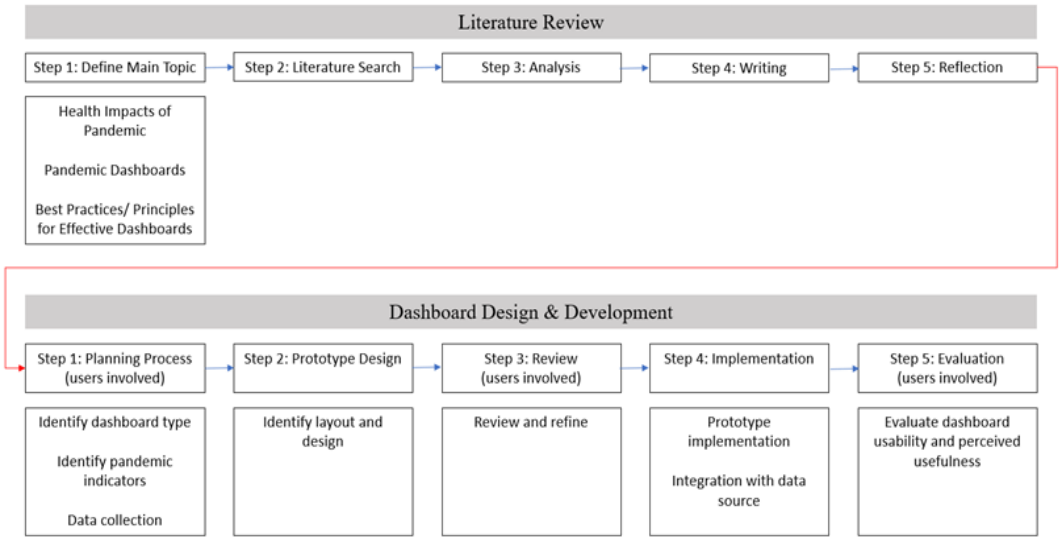

Figure 1: Methodology of the Pandemic Dashboard Prototype

During the stage of designing and developing the dashboard, the potential users will be involved. They will be interviewed and some background questions to understand their knowledge background and issues or topics of interest will be asked.

Due to its great importance and the critical actions to be taken to confront the COVID-19 pandemic, researchers all over the world are sharing their data in order to be able to collaborate with their peers all over the world and come up with solutions that can benefit everyone. There are many COVID-19 research databases available out there such as the Global Research database gathered by WHO (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/global-research-on-novel-coronavirus-2019-ncov), which is updated every working day (Monday to Friday) and can be suitable to be used for the development of this prototype.

The implementation of the prototype dashboard will be done business intelligence tool called Microsoft PowerBI. Besides the ability to create charts, graphs and other data to be visualized for the dashboard, PowerBI can also transform and clean the pandemic datasets. The tool is chosen because its design is close with Excel but built-in with Artificial Intelligence (AI) capabilities. These

features are useful for users with average Microsoft Excel skills. Existing work can be saved of backed up into Excel format. On top of that, it can read data from multiple sources like XML, JSON, etc. which overcome the challenge of combining and synthesizing pandemic datasets coming from various sources.

In the evaluation stage, the prototype will be assessed by potential users. The evaluation aims to extract the usability and the perceived usefulness of the dashboard prototype. Once the prototype dashboard is fully implemented, they will need to do answer some questions regarding the usability and the perceived usefulness of the dashboard to measure the dashboard's performance.

5. Conclusion

To conclude, this conceptual paper can be divided into two phases. The first one is to study and review the health impacts of pandemics, existing effective dashboards and past pandemics' patterns will be carried out. The second phase includes the design and development of an intelligence dashboard. This paper proposes an intelligent dashboard capable of helping decision-makers to come up with good moves in order to deal with health issues related to current and future pandemics. They will be able to access and study available massive data, using Big Data technology in a single platform. At the same time, this dashboard can also benefit the public by increasing the awareness of the ongoing situation and reflecting on major outbreaks over the past decades. Any key findings found in this research will not only serve as a support for the current decision-making process during the COVID-19 outbreak but also as a preparation plan for decision-makers and experts to implement in the future should another health emergency is to arise.

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