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Article

Role of information technology in COVID19 vaccination drive: an analysis of the COVID-19 Global Beliefs, Behaviors, and Norms Survey

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Abstract: With the onset of the COVID19 pandemic, information technology has played a critical role in healthcare. A broad spectrum of information technology tools and applications played an essential role to create awareness of the COVID19 vaccination drive and its health benefits. We use the COVID-19 Global Beliefs, Behaviors, and Norms Survey for analysis of prevalence and factors associated with vaccination drives among men and women aged 20-80 years in 60 countries worldwide. Our analysis of the global survey offers a unique perspective about the role of information technology associated with vaccination drives involving social norms and human behavior among 437,236 respondents. The international survey was organized using a pre-registered randomized experiment demonstrating the role of technology in reaching out to people based in diverse communities and evaluating their beliefs, behavior, and social norms. The study shows that vaccine acceptance can vary due to descriptive norms. Our analysis shows 65.06% of people all over the globe are willing to get vaccinated and a large proportion of the population thinks that the COVID19 pandemic is a viable threat to the community and preventive measures need to be taken including vaccination drives.

Keywords: COVID19; vaccine; SARS nCoV-2; information technology; COVID19 vaccine survey; MIT vaccine survey

1. Introduction

A global survey was conducted using information tools to study the norms, beliefs, and human behavior towards COVID19 and vaccination drive. Information technology allows us to monitor the vaccination drive, create awareness, and develop a technical framework to better respond to challenges arising to the global health system. The study allows measuring the behavioral response of the participants towards the vaccination drive. It involves critical information related to the availability of multiple vaccines, hesitancy towards vaccines, and behavioral norms towards vaccine acceptance. Country-wise statistical information shows the effectiveness of information technology towards improving the behavioral response of the public to accept vaccination and achieving herd immunity. Though, there are lots of barriers towards imposing the vaccination drive such as false beliefs and misconceptions. But, technological tools like online surveys conducted via Facebook have the potential to reach over 2 billion people around the world. It has partnerships with numerous academic and non-profit institutions to offer humanitarian efforts and tackle challenges about the COVID19 vaccination drive [1-8].

2. COVID19 Vaccination Survey - Behavioral Norms and Beliefs

The COVID19 survey shows substantial variations among 60 countries in terms of vaccination acceptance. It includes demographic information regarding country of origin, gender, age group, and education. It reveals critical information regarding early warning, epidemic detection, public awareness, vaccination acceptance, beliefs, and control mechanisms. The framework of the survey and our analysis offers technical insights about managing the outbreak, reviewing health-specific information, highlighting the importance of vaccination, and relevant challenges related to technology design, implementation, and use [9-13].

The analysis involves risk perception and preventive behavior among adults aged 20-80 years old. The study involves significant predictors like knowledge about vaccination drive, local insights, public health decisions, and

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communication. The COVID-19 Global Beliefs, Behaviors, and Norms Survey conducted is fully secure as it offers complete privacy to the respondent and offers valuable information regarding understanding the importance of vaccination drive, sharing knowledge, and practices [14-28].

3. Benefits of the COVID19 Vaccination Survey

Our analysis of the survey will provide policymakers with critical insights to understand the effectiveness of the vaccination drive, preventive behavior, and norms of the public globally. It includes awareness of the healthcare policies about wearing masks, social distancing, along with parameters to measure the effectiveness of communication between public health officials, and the global community.

Moreover, scientists and researchers can benefit from this survey as it offers behavioral perception of the community towards vaccination and areas that need improvement. It also involves population characteristics like level of education, age, gender, geographical location, etc. which will benefit researchers to understand the risk of an outbreak [29-34].

4. Materials and Methods

The study was conducted using an off-platform survey involving 5 blocks with questions based upon demographics, vaccination drive, COVID19 information exposure, and healthcare. The data collected from the respondents are compiled as aggregated datasets. 5 point numerical scale outcome was incorporated to build the dataset. Sample weights were applied to the respondents who completed the full survey leading to a sample size of 437,236 participants. All the participants were categorized as per their geographical location. Respondents from 60 countries participated in the survey globally [Figure 1] [1, 2].

The respondents who completed the survey were assigned a random number as an identifier. Binary survey completion flags were allotted to respondents who possess a basic knowledge about the survey with demographic information. It also involved questions about vaccine acceptance, understanding COVID19 risk to the community, preventive measures, and COVID19 awareness while visiting businesses, health care facilities, public places, places of worship, places of employment, retail shops, restaurants, and schools. The survey questions also included questions about taking action and preventing the spread of the COVID19 virus.

The survey was analyzed using regular regression and post-stratification methods. It involved predictive analysis and health informatics with the help of Farr Institute - https://www.farrinstitute.org/healthcare-informatics wherein complex and adaptive modeling techniques were used for large scale data mining, statistics, and analysis. The study also involved a set of weights for the survey participants, modeling, assessing the pattern of engagement for each respondent including response and non-response behavior along with attributes for each participant. The study also involved randomized checks to build a robust dataset [35-37].

5. Study Design

Various parameters were used in the study to understand the behavioral belief and preventive measures of participants in the study. It examines the emerging challenges of vaccination, impact over healthcare, businesses, social distancing familiarity, wearing mask efficiency, risk of a COVID19 community outbreak, the importance of hand sanitization, conducting body temperature, types of preventive measures implemented while visiting restaurants, places of worship, retail stores, and health care facilities. Awareness of COVID19 news through various information technology tools like messaging apps, online sources, and news channels.

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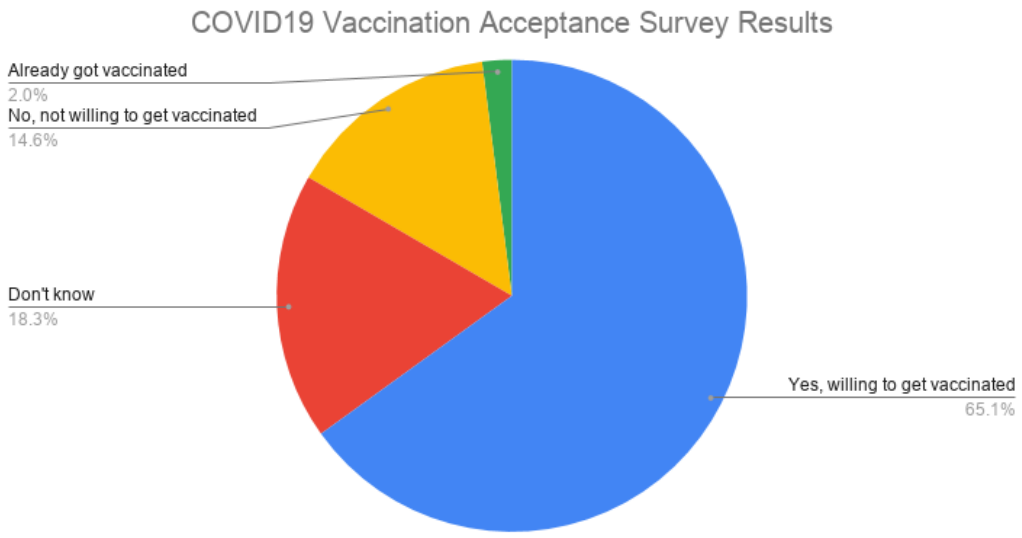

Figure 1: COVID19 Vaccination Acceptance Survey Results for 437,236 participants from 60 countries

The parameters used in the study were age, gender, education, race, and country. The variable age was divided into 6 categories 20-30, 31-40, 41-50, 51-60, 61-70, and 71-80 respectively. The gender category was subdivided into male, female, and other/unknown. The category education was subdivided into less than primary school education, primary school, secondary school, college-level education, and graduate education. The race category is subdivided into White, Hispanic, Asian, American Indian, Alaska Native, Black, African American, Hawaiian Native, Pacific Islander, and others. A 2 letter ISO code was assigned to 60 countries all over the globe. For example, US - United States of America, MX - Mexico, CA - Canada, BR - Brazil, and IN - India. Similarly, 2 letter code was used for the US and Indian states respectively [Figure 2] [Table 1].

The study was conducted in a wave pattern wherein responses were collected within 2 weeks and weights were computed for each wave once the respondent completed the survey. The study consisted of more than 11 waves and all parameters were applied for a subset of countries. The 1st wave started from July 6, 2020 - July 20, 2020. Similarly, the 2nd wave started from July 21, 2020 - August 3, 2020, and it continued for subsequent waves until March 2021. Each wave consisted of a duration of approximately 2 weeks.

The survey consisted of specific signals indicating various aspects of vaccination and preventive measures associated with the COVID19 pandemic. Each signal name was assigned a unique variable categorized with a set of options. For example, the signal name - vaccine_accept indicates whether respondents will be willing to get vaccinated if a COVID19 vaccine becomes available. The output values consisted of options like Yes, Don't know, or No. Another signal name - norms_vaccine asked the respondents to approximate the number of people who will take the vaccine out of 100 if it was made available in a community. The signal name density describes the area where they are currently based. Another signal name - flu_vaccine indicated whether the participants received their flu vaccine or they plan to take one in the coming weeks. The answer choices were subdivided into - "Don't know", "No", and "Yes". Signal name - future_vaccine showed that if a certain vaccine was available in the market, are they willing to take it? The option choices were - "No, definitely not", "Probably", "Probably, not", "Unsure", "Yes, definitely". Another signal - future_vaccine_recommended asked the respondents whether they are willing to take a vaccine against COVID19 infection if it was made available and recommended to them by the following - 1. "family and friends" and 2. "government health officials" with answer choices "Less Likely", "More Likely", or "No impact".

6. Discussion

Information technology plays a critical role in raising awareness among the general public about the importance of vaccination against COVID19 infection. The SARS nCoV-2 virus is an infectious disease and it can make us sick once

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we are exposed to the virus. A vaccine combats the spread of the infection in our body by activating the immune system and preventing further harm efficiently [38-40]. COVID19 virus has the potential to harm us as we are constantly exposed to the virus while visiting public places like restaurants, retail stores, businesses, places of worship, public parks and gardens, and places of work. Exposure to the virus can trigger our immune system to react to the virus as it has high negative outcomes towards our body which has led to intense research and human clinical studies about effective COVID19 vaccination [41-42].

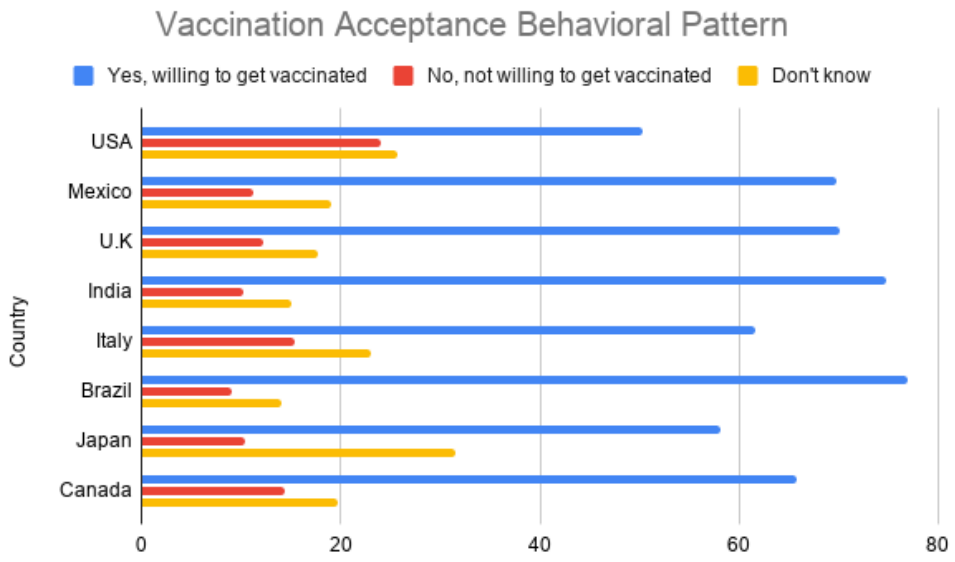

Figure 2: Country wise vaccination acceptance behavioral pattern

Mass production and distribution of reliable SARS nCoV-2 virus require the use of information technology. Study shows that vaccination offers optimal protective immune response against the virus. It is seen that COVID19 patients suffered disease severity to a greater extent with hospitalization and high-intensity medical care [43]. The beneficial effects of the COVID19 vaccine can be evaluated through seroconversion as multiple trial strategies encompassing individuals from diverse backgrounds were recruited to compare and validate serological assays. Presently, we have various vaccine products from different clinical trials. Information technology played a critical role in changing behavioral patterns and increasing the number of enrollees for vaccination. It is important to harmonize the various results of COVID19 vaccination trials [44]. Vaccination acts as a preventive measure against the spread of the COVID19 infection. It reduces the risk of contracting the SARS nCoV-2 virus. The primary goal of vaccination trials is to make sure that the subsequent SARS nCoV-2 infection risk remains low and the vaccine is safe to administer. The vaccine trial shows that it is efficient in neutralizing the virus with the enhancement of the antibodies [45].

Information technology has helped in formulating coordinated efforts in accelerating the development of the vaccination program with institutions like the World Health Organization (WHO), U.S Food and Drug Administration (FDA), Centers for Disease Control and Prevention (CDC), European Medicines Agency (EMA), U.S National Institute of Health (NIH) along with several other organizations from across the globe. It has played a crucial role in coordinating the efforts between several research groups, and biopharmaceutical companies. Most importantly, it has built a platform using various tools towards collaborative efforts between various organizations like Accelerating COVID19 Therapeutic Interventions and Vaccines (ACTIV) in prioritizing various drug and vaccination clinical trials, streamlining candidates for vaccination, building assets, and a consortium of health care professionals to respond against the COVID19 pandemic [38, 41].

In the study, respondents were shown how previous participants have answered survey questions in their country regarding behavioral perception about COVID19 pandemic, vaccination drive, social distancing, preventive measures like wearing masks, hand washing, using sanitizers, etc [42]. The information to the respondents was provided in a

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randomized way during the survey which showed the descriptive norms of the respondents about acceptance of the vaccination. The responses entered by the previous participants were summarized in a result format. Moreover, a message was shown at the beginning of the survey stating their responses are helping researchers across the world about the current COVID19 pandemic and vaccination program. The weighted percentage was calculated as per responses received about measured outcomes of accepting the vaccination if it is made available to the respondents [43-45].

7. Results

The survey conducted across 60 countries with 437,236 participants shows that 65.06% of the respondents are willing to get vaccinated with 2.03% of the total respondents already vaccinated. 18.03% of the respondents stated that they were not sure about vaccination while 14.60% of the respondents stated that they don't want to get vaccinated. The results were computed in waves with a 2 weeks duration period for each wave. The time frame for the 1st wave started from 06 July 2020 - 19 July 2020, subsequent waves continued till 28 March 2021.

Country	Yes, willing to get vaccinated	No, not willing to get vaccinated	Don't know	Sample Size
USA	50.33	23.96	25.7	15675
Mexico	69.71	11.18	19.09	15593
U.K	70.08	12.27	17.63	15391
India	74.77	10.23	14.99	10114
Italy	61.63	15.3	23.06	19742
Brazil	76.96	8.99	14.03	20516
Japan	58.2	10.33	31.46	10942
Canada	65.83	14.45	19.71	4119
Australia	73.42	10.75	15.81	4334
Nepal	76.23	9.23	14.53	1530
Algeria	42.08	29.68	28.23	2545
Afghanistan	77.72	9.61	12.66	1145
Mozambique	61.43	11.3	27.25	3107

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Cameroon	35.05	42.18	22.76	3659
Morocco	44.32	25.4	30.27	2211
Sri Lanka	65.64	15.26	19.09	1486

Table 1: Country specific vaccination acceptance behavioral pattern and sample size

In terms of behavioral belief and norms towards the COVID19 pandemic, 21.28% of all the respondents consider it extremely dangerous to the community while 6.37% of the respondents consider it as not dangerous at all. 23.67% of the respondents consider the pandemic as moderately dangerous, and 14.09% of the respondents consider it as slightly dangerous. Given the community outbreak and risk of contracting the virus at public places of engagement, 45.97% of the respondents indicated that they would prefer to visit retail shops amid the COVID19 pandemic, 42.40% would prefer to visit health care facilities, and 40.44% of the respondents would visit places of employment [1-2, 17].

In the U.S, 50.33% of the respondents are willing to accept vaccination, 25.70% of the respondents were not sure about the vaccination, and 23.96% don't want to get the vaccination. In Mexico, the vaccine acceptance rate is higher than in the U.S as 69.71% of the respondents are willing to take the vaccination, 19.09% of the respondents are not sure, and 11.18% of the respondents are ready to accept the vaccination. In India, 74.77% of the respondents are willing to accept vaccination, 14.99% of the respondents are not sure, and 10.23% of the respondents are not willing to accept vaccination [Table 1].

8. Conclusion

Information technology has played a critical role to control the outbreak of the COVID19 pandemic and create awareness about vaccination drives. It has helped policymakers and researchers around the world to understand people's behavioral patterns, norms, and beliefs about vaccination and combating the spread of the infection. Our analysis of the global survey offers a lot of insights at the respondent level of data regarding vaccination. The results show the importance of health information technology as a pivotal role to prevent the spread of the pandemic and increase development efforts concerning vaccination.

9. Limitations

The study has limitations in terms of wave time series as certain questions were asked to respondents from wave9 (Oct 26, 2020, until March 28, 2021) instead of July 06, 2021, until March 28, 2021.

10. Ethical Approval

We obtained publicly available aggregated data from the Massachusetts Institute of Technology (MIT) website - https://covidsurvey.mit.edu/api.html. The aggregated data API is freely available through creative commons attribution international license for various research groups. We have cited a Global survey on coronavirus beliefs, behaviors, and norms: Technical Report in our article as required for data usage. Our study is exempted from obtaining ethical approval as it consists of secondary data for research purposes.

Supplementary Materials: The following are available online at www.mdpi.com/xxx/s1, Figure S1: title, Figure S2: title, Table S1: title,

Author Contributions: Conceptualization, D.T.; methodology, D.T. and D.S.; validation, D.T., K.S. and D.S.; formal analysis, K.S.; investigation, D.T.; data curation, D.T. and K.S; writing—original draft preparation, D.T. and D.S; writing—review and editing, D.T and K.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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