Predicting the Impact of Coronavirus on Human Brain in India using Machine Learning

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ABSTRACT

This research proposes a robust in-time predictor of human brain affected by COVID'19 and also survey on COVID'19 for India. Psychiatric symptoms and other COVID-19 related symptoms are analyzed and assessed to conclude that the proposed methodology aims to achieve detecting brain and mental disorders in persons affected with coronavirus. The approach takes the past and present experience of the patient using the questionnaire and analyze it to provide a treatment action plan where the user is also given information regarding the treatment that the person needs to undergo. The proposed methodology is successfully achieved using assessment tools to arrive the desired output in determining the brain abnormality due to COVID-19.

1. INTRODUCTION

Coronaviruses are a group of related RNA (Ribonucleic Acid) viruses that cause diseases in mammals and birds. They cause respiratory infections in humans, include common cold – a mild infection and severe infections like SARS (Severe Acute Respiratory Syndrome), MERS (Middle Eastern Respiratory Syndrome), and COVID-19. In December 2019 to December 2020 there was no anti-dote/Vaccine availabled to treat or to prevent from coronavirus infections. In the World-Wide First Covid-19 Drug was Remdesivir (Through an IV) and Hydroxychloroquine (Malaria Drug). It is believed that most of the Coronaviruses are spread by mammals like bat, pangolins (Added) and rat. Several diseases from the corona family have been listed in the below diagram. SARS-CoV and SARS-CoV2 are a type of coronavirus originated in bats and transmitted to humans via cats. SADS-CoV (Swine Acute Diarrhea Syndrome) is a virus from the corona family, which was originated in bats and was transmitted to pigs and spread to humans. MERS-CoV (Middle Eastern Respiratory Syndrome) and HCoV-229E (Human Coronavirus 229E) viruses were originated in bats and camels were thought to be the cause of spread to humans. HCoV-NL63 is a coronavirus, which was emerging from bats and the circulated animal was not proved yet. HCoV-OC43 and HCoV-HKU1 are coronaviruses whose origin was rats and they pass the spread to humans via cows and the medium of HCoV-HKU1 virus was not yet proved. The Novel Coronavirus, COVID-19 is under research. The originated and transmitted animals to humans were not yet proved.
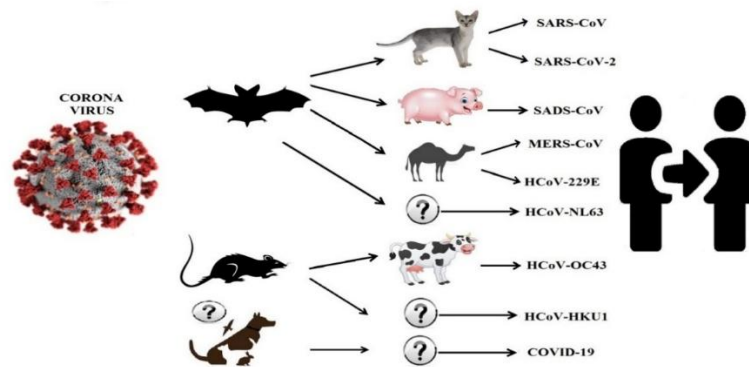
Figure. 1 Overa all Virus

In China, people from Wuhan city faced the first dangerous infection in December 2019. China announced the virus was a non-communicable one, later declared that the virus was from SARS (Severe Acute Respiratory Syndrome) virus family. The infection got increased day by day and then the WHO went to china and conducted study and research, officially WHO renamed the disease as a communicable disease COVID-19 on 11 March 2020. An outbreak has begun in China. By this time, the disease spread to several countries, after the announcement was given by WHO all countries took immediate actions against COVID-19. Airline services from and to all over the countries have been stopped first. Many countries declared lockdown to prevent the people and to stop the spread. As per WHO guidelines, social distancing has to be maintained between people and hand hygiene should be ensured by handwash, or using sanitizer frequently or after touching any common surfaces. People are advised to wear a mask when they go outside.

The most common symptoms of COVID-19 were; fever, dry cough, and tiredness. Less common symptoms were nasal congestion, sore throat, loss of taste or smell, headache, and diarrhea. Almost 80% of tests positive patients are asymptomatic. If the patients were found with the mentioned symptoms, then they are advised to be in quarantine for 14 days. If such persons had any previous medical history (like heart and lung problems, high blood pressure, diabetes, cancer, etc.) they need to be monitored by a doctor. People were not allowed to gather in common places. Every single person should wear masks and follow social distancing while outside. Everyone should maintain a distance from the person who is coughing or sneezing. Most people recover from the virus without any hospital treatment. Children, aged peoples and pregnant women should be more careful and prevent themselves by avoiding outside trips. Patients should take nutritious food and should take a rest. The virus infection will weaken the immune system of our body. So iron-rich foods and vitamin C rich fruits will help to boost up the immunity.

The first Corona affected person in India was from the Kerala state, who returned from Wuhan, China. Doctors who treat the patients should wear PPE (Personal Protective Equipment) suit, surgical gloves, and mask with face shield. After attending the COVID positive patients the suit should be disposed of properly.

2. METHODOLOGY

In India, the health care system plays an important role. The total Indian population was 137.13Crores. Totally 69,264 hospitals are only available for the people. Out of which 25,778

(37,732 (pib.gov.in) 2018) government hospitals and 43,486 private hospitals. By March 2021, 11,210,799 people were affected by the Corona virus. The same date itself 157,756 people deaths. 8,571,933 people were recovered and 56,890 current active cases were recorded. Though, Positive cases were increasing gradually daily, to overcome this pandemic situation India is not affordable with good medical support. To control the Corona outbreak methodologies should be announced by the government. Ultraviolet (UV) rays can kill the coronavirus, but UV rays should not spread to areas of the skin hence it causes skin allergies and irritation. People should not take any antibiotics to prevent coronavirus, antibiotics will work against bacteria only, not against viruses.

Swab sample has been collected from suspected, symptomatic, and contacts of corona positive patients and will send off for testing. A cotton swab is sent via nasal to the throat and the sample will be collected from the screening people. The swab will undergo for a RT-PCR (Reverse Transcription Polymerase Chain Reaction). PCR (Polymerase Chain Reaction) test. The PCR test will diagnose the COVID virus and the result will be positive if the patient was affected by the coronavirus.

Another test method to confirm COVID positive patients was an antibody test. This requires the blood sample of the suspect, If the person was affected by the Coronavirus then his/her body will generate an antibody to fight against the virus. And the antibody test will prove that the patient was infected by the virus. The antibody kit is not providing an accurate

result, because it takes 3 to 4 days for an infected person to develop the antibody. It's according to the patient's immune system. So, ICMR (Indian Council of Medical Research) recommended stopping believing the antibody test alone. In India, only PCR test results were considered to be the accurate one.

States/UTs	Population	Government Hospital	Private Hospital	Total Hospital
Andaman and Nicobar	417,036	30	6	36
Andhra Pradesh	53,903,393	258	670	928
Arunachal Pradesh	1,570,458	218	20	238
Assam	35,607,039	1,226	503	1,729
Bihar	124,799,926	1,147	1,887	3,034
Chandigarh	1,158,473	9	4	13
Chhattisgarh	29,436,231	214	182	396
Dadra & N Haveli	257,862	12	6	18
Daman & Diu	357,862	5	21	26
Delhi	18,710,922	109	67	176
Goa	1,586,250	43	22	65
Gujarat	63,872,399	438	970	1,408
Haryana	28,204,692	668	1,480	2,148
Himachal Pradesh	7,451,955	801	235	1,036
Jammu & Kashmir	13,606,320	143	14	157
Jharkhand	38,593,948	555	809	1,364
Karnataka	67,562,686	2,842	7,842	10,684
Kerala	35,699,443	1,280	2,062	3,342
Ladakh	289,023	NA	NA	NA
Lakshadweep	73,183	9	4	13
Madhya Pradesh	1,239,244	90	23	113
Maharashtra	85,358,965	465	506	971
Manipur	123,144,223	711	2,492	3,203
Meghalaya	3,091,545	30	8	38
Mizoram	3,366,710	157	28	185
Nagaland	2,249,695	36	13	49
Odisha	46,356,334	1,806	695	2,501
Puducherry	1,413,542	14	6	20
Punjab	30,141,373	682	1,638	2,320
Rajasthan	81,032,689	2,850	2,794	5,644
Sikkim	690,251	33	8	41
Tamil Nadu	77,841,267	1,217	1,222	2,439
Telangana	39,362,732	863	3,247	4,110
Tripura	4,169,794	156	8	164
Uttar Pradesh	237,882,725	4,635	12,468	17,103
Uttarakhand	11,250,858	460	829	1,289
West Bengal	99,609,303	1,566	697	2,263
Total	1,371,360,351	25,778	43,486	69,264

Table1: Hospitals in States/UTs

An average rating of 80,000 positive cases has been recorded in India daily. 80% of the affected patients were recovered by normal treatment and only 20% of the patients need intense care with ventilators, out of which 5% of patients need to be treated with critical care. As per records, the available numbers of beds were not sufficient for the patients to be treated. After the PCR test, the positive patients were shifted to hospitals or quarantine centers according to their health condition. And the contacts of the patients should undergo the test and they should also be quarantined. As per requirement, the government arranged temporary hospitals and COVID care centers in colleges ,Hotels and marriage halls. There is no antibiotic and antiviral drug available for COVID, plasma treatment is helpful for better recovery. The plasma of Corona recovered patients were collected and the serum was given to the corona affected patients for a speedy recovery.
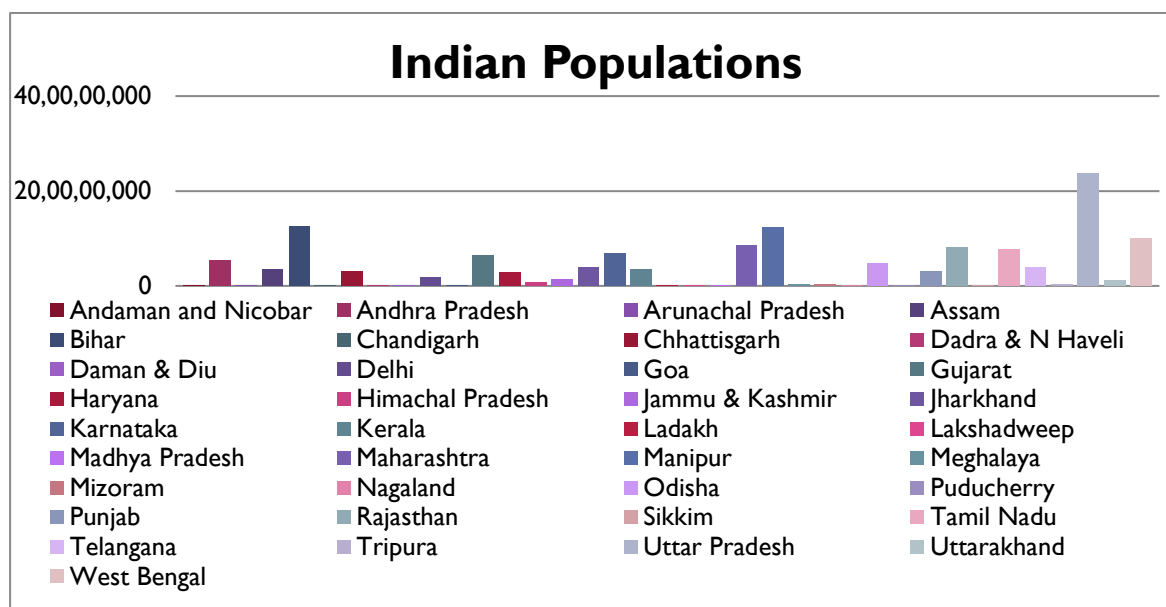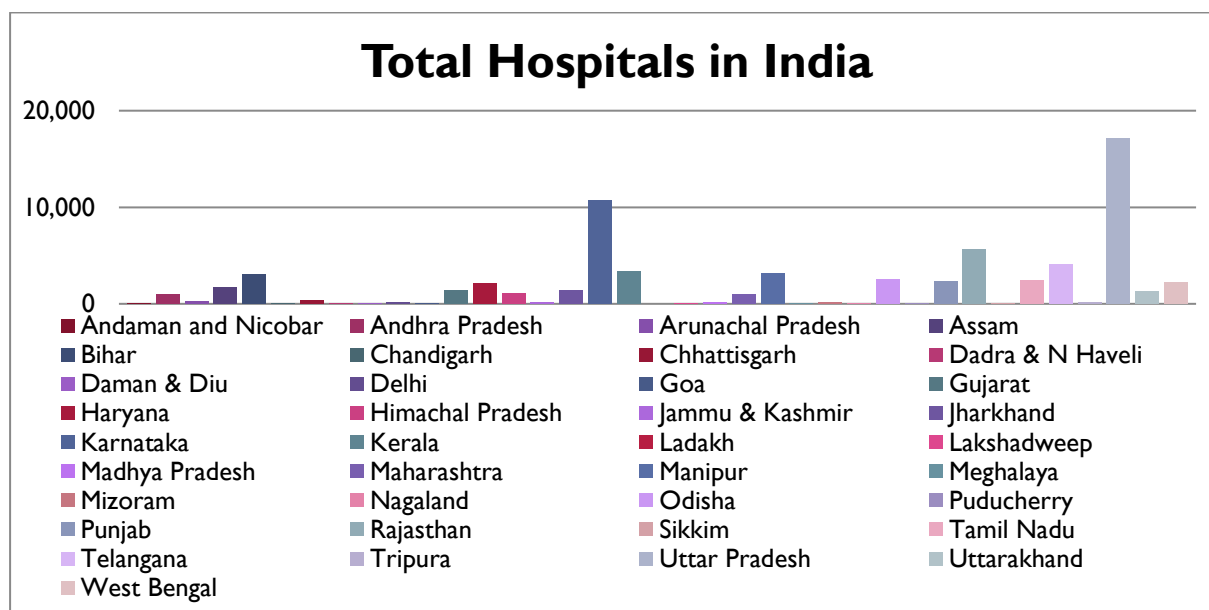

Figure. 2. Population

Figure. 3. Total Hospitals in Indian

States/UTs	Beds in Government	Beds in Private	Total Beds
Andaman and Nicobar	54	11	65
Andhra Pradesh	1,157	3,005	4,162
Arunachal Pradesh	120	11	131

Assam	857	352	1,209
Bihar	583	960	1,543
Chandigarh	188	94	282
Chhattisgarh	471	401	872
Dadra & N Haveli	31	16	47
Daman & Diu	12	51	63
Delhi	1,219	754	1,973
Goa	151	79	230
Gujarat	1,009	2,234	3,243
Haryana	562	1,245	1,807
Himachal Pradesh	620	182	802
Jammu & Kashmir	365	35	400
Jharkhand	539	786	1,325
Karnataka	3,486	9,619	13,105
Kerala	1,900	3,061	4,961
Ladakh	NA	NA	NA
Lakshadweep	15	6	21
Madhya Pradesh	1,555	1,692	3,247
Maharashtra	2,572	9,015	11,587
Manipur	71	18	89
Meghalaya	223	39	262
Mizoram	100	25	125
Nagaland	94	34	128
Odisha	926	357	1,283
Puducherry	178	80	258
Punjab	897	2,153	3,050
Rajasthan	2,353	2,306	4,659
Sikkim	78	20	98
Tamil Nadu	3,877	3,892	7,769
Telangana	1,049	3,947	4,996
Tripura	221	12	233
Uttar Pradesh	3,813	10,257	14,070
Uttarakhand	426	767	1,193
West Bengal	3,928	1,748	5,676
Total	35,700	59,264	94,964

Table 2 : Hospital Beds in States/UTs
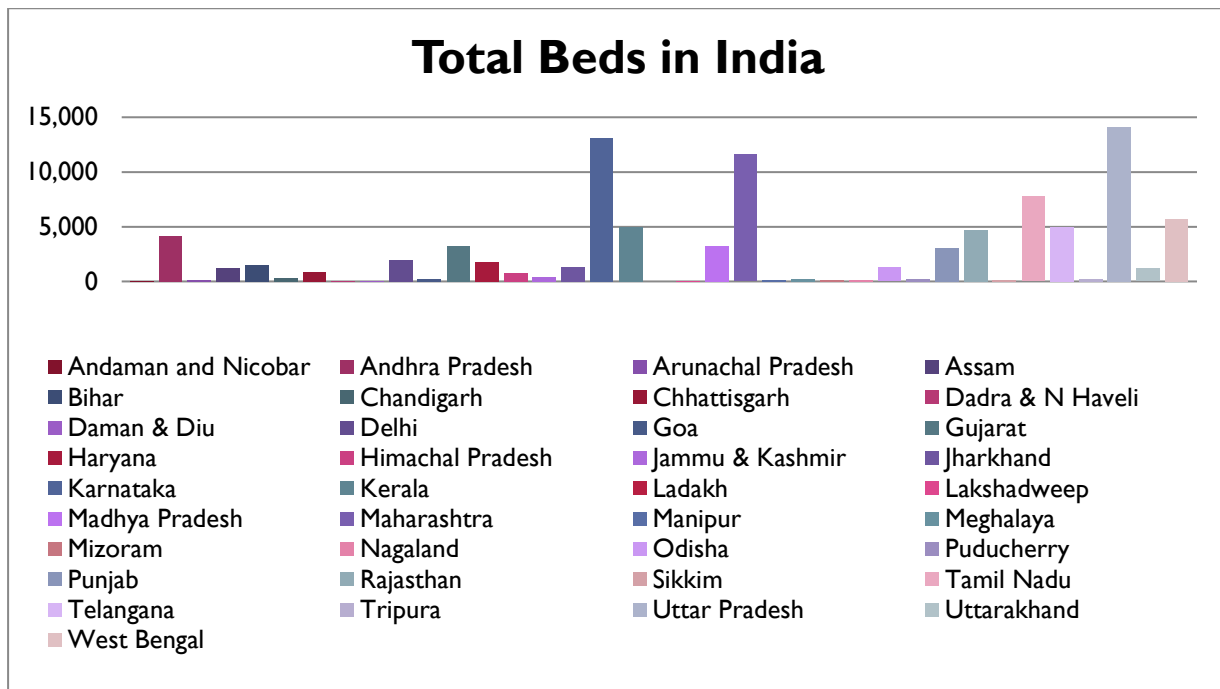
Total Beds in India

Figure .4 Total Beds in India

States/UTs	Ventilators in Government	Ventilators in Private	Total ventilators
Andaman and Nicobar	27	5	32
Andhra Pradesh	578	1,502	2,080
Arunachal Pradesh	60	6	66
Assam	429	176	605
Bihar	292	480	772
Chandigarh	94	47	141
Chhattisgarh	235	200	435
Dadra & N Haveli	15	8	23
Daman & Diu	6	25	31
Delhi	610	377	987
Goa	75	39	114
Gujarat	504	1,117	1,621
Haryana	281	623	904
Himachal Pradesh	310	91	401
Jammu & Kashmir	182	18	200
Jharkhand	270	393	663
Karnataka	1,743	4,810	6,553
Kerala	950	1,531	2,481
Ladakh	NA	NA	NA
Lakshadweep	8	3	11
Madhya Pradesh	778	846	1,624
Maharashtra	1,286	4,507	5,793
Manipur	36	9	45
Meghalaya	111	20	131

Mizoram	50	12	62
Nagaland	47	17	64
Odisha	463	178	641
Puducherry	89	40	129
Punjab	448	1,077	1,525
Rajasthan	1,176	1,153	2,329
Sikkim	39	10	49
Tamil Nadu	1,938	1,946	3,884
Telangana	525	1,973	2,498
Tripura	111	6	117
Uttar Pradesh	1,907	5,129	7,036
Uttarakhand	213	383	596
West Bengal	1,964	874	2,838
Total	17,850	29,631	47,481

Table 3 : ICU Beds in States/UTs
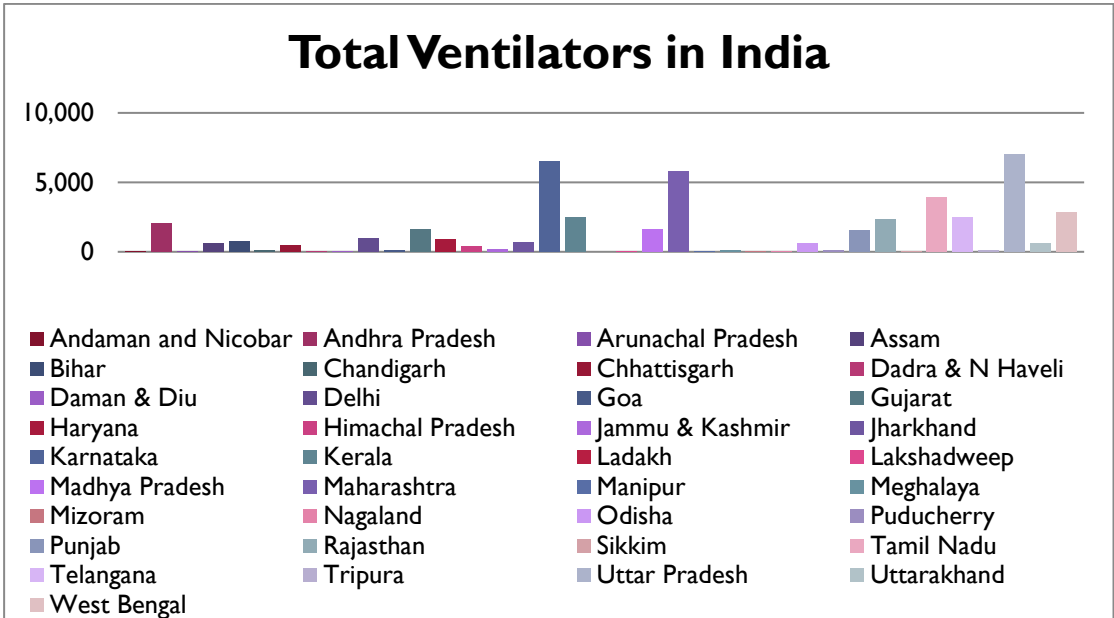
Figure. 5 Total Ventilators in India

3. LITERATURE SURVEY (Copied Content (Sciencedirect.Com / Researchgate.Com)

The common symptoms of COVID-19 are fever, dry cough, tiredness, aches, pains, sore throat, and headache, loss of taste or smell, difficulty breathing, shortness of breath, chest pain and pressure at the inception of poor health except quick pathology evolve towards a respiratory distress syndrome (ARDS), as well as the majority of the cases admitted to the ICU might not take breaths impulsively. Concerning 50 % - 65 % of the patients in the ICU worsen in a short period and died due to respiratory failure [1]. The analysis of the survey from the current outbreak had suggested that fever 88% - 92% and dry cough 54% - 72 % are predominant complaints and overall 20% - 30% of the infected individuals needed ICU admission [10]. HTN (high blood pressure) 10% - 17% diabetes, 3% - 8 % and heart disease 2% - 5% were an occurrence of illness or disease, or a single symptom of that illness [11]. The neurological manifestation may perhaps live derived en route for straight neuroinvasion by means of the coronavirus. Like just before a lot of respiratory viruses, Coronaviruses are pragmatic to contain unswerving special effects resting on neuronal systems [12 - 13]. Like sensible for the most key epidemic circulate strain of HCoVs they occupy more commonly an unaided population. Also, it has been reported with the intention of various patients exaggerated by SARS as well as show neurologic signs such as headache, nausea, and vomiting [2-5]. A lot of studies demonstrate that HCoVs can invade the CNS [6-8] and that Neuro tropism is one common feature of these groups of the virus [9]. Facing the COVID-19 epidemic, we agree with Ying Shao et al., 2020 with the

intention of the infirmary managing strategy cover toward live superior, not no more than inside psychiatric wards except in all hospitals. Virchow's arpeggio describes three types of factors intending to supply to the progress of thrombosis: stasis (abnormalities in blood flow); endothelial injury (abnormalities of the blood vessel wall); and a hypercoagulable state (abnormalities of the blood constituents). Our proteomics studies, we cover occupied go together start and hypercoagulation past headed for the beginning of subclinical psychotic experiences in addition to the psychotic mess inside the common people [14]. Especially reported professional psychological stress; expressive suffers exhaustion along with somatic symptoms. This outcome has required notice since the prior study show to express suffering be linked through lifelong consequence on professionals' physical condition, together with the danger of post-traumatic pressure confusion [15].

An expediency taster of 1,000 above professionals be invited in the direction of fill up an online opinion poll plus the Maslach Burnout Inventory [16] and unprepared objects en route for evaluating emotional symptoms plus self-perceived universal physical condition position. For the MBI record, bring to end criterion intended for Italian healthcare personnel comprise be adopted [17]. Human coronavirus (HCoVs), which be huge, envelop activist brain RNA virus, usually originates enteric as well as respiratory disease inside animals along with humans [18]. Furthermore, the opening of a SARS-CoV-2 hooked of individual crowd cells has been recognized just before making use of a similar entry receptor-like SARS-CoV, portends the possibility of the identical people of cells human being embattled with contaminated [19-22]. The neurotropic possible of SARS-CoV-2 within patients report during the current eruption of COVID-19 have been measured as a potentially somber danger in favor of every one physical condition mind system, worldwide. Accumulating confirmation indicate with the intention of HCoVs are neuro invasive in human with we hypothesize correspond to a key section of CNS viral disease connected with encephalitis, meningitis, myelitis, and enduring neurological disorders, moreover, as an outcome of inadequate host impervious responses and viral spread in the along with this cause COVID-19 will need to be studied of an extended instance even behind the Italian and European healthiness urgent situation is trounce to keep away from the feasible extra formidable penalty of community health. Accepting the mechanisms of neuro invasion also the interface of SARS-HCoV-2 amid the CNS is necessary to assess a potentially pathological small and enduring penalty. Antiviral treatment is supposed to conceded out as early as possible and it is as well critical to find successful antiviral drugs that can irritate the BBB [23]. The surveys of this paper explore sleep difficulty during the COVID-19 epidemic in a Greek population. This reading exposed a high occurrence of wakefulness through the COVID-19 epidemic. Women and citizens living in metropolitan areas were new prone to snooze difficulty. Lack of knowledge of probable get in touch with COVID-19, small-mindedness to indecision, COVID-19 interrelated be anxious, being alone and depressive symptoms were radically connected with insomnia. These results may give to the organization of insomnia during the COVID-19 epidemic. A stipulation of simple and clear information about the occurrence to battle indecision and be anxio

us, improvement of social contact with the aid of expertise, as well as the external circumstances for screening and treatment of sadness and nervousness may get better sleep difficulties [24]. Women look to be further susceptible, a ruling like-minded by means of the confirmation symptomatic of that they are more lying on your front to stress-related disorders such as post-traumatic pressure disorder and anxiety disorders [25]. All country say to work together categorize possible chinks in the armor of COVID-19 and recognize the best possible antibody test and develop a vaccine [26], let us not remember to think about the psychological health special effects of COVID-19 on laboratory scientists, the very citizens combating this skirmish or their generation whose non-COVID-19 employment to be blocked suddenly for the reason that pandemic. Neuroleptic Malignant Syndrome (NMS) for the duration of a discriminating transferable segment of COVID-19 has not been before described. Naturally, NMS is related to the use of antipsychotics or anti-Semitic, particularly when used in high doses or repository formulations. Conversely, some studies propose that selective medical illnesses contain natural brain disease are dangerous factors for emergent NMS [27].

Moreover, the danger issue of haloperidol deaconate utilizes three weeks past to permit, it is feasible that the COVID-19 disease complete the patient more prone to the growth of NMS. The link between COVID-19 and NMS needs to be further studied [28]. The primary epicenter of the COVID-19 contamination details that patients within attendance neurological manifestation. In an examination of 214 patients with COID-19, 126 patients (58.9%) had a non-server disease, and 88 (41.1%) had server disease, according to their respiratory report. Comparisons with non-severe disease and severe disease were older, and they presented more primary disorders, particularly hypertension, and fewer typical symptoms of COVID-19, such as fever and dry cough [29]. Neurological symptoms such as interruption of awareness, epilepsy, and neuralgia I point out in the vision of SARS-CoV-2 into the central nervous system [30]. Even though the appearance of the ACE2 receptor in the people anxious scheme has not been fully recognized, ACE2 was detected in neuron and microglia in the spinal dorsal horn of mice [31]. The meta-analysis algorithm provides a suitable and complete combination of the exiting proof of the importance of the high occurrence rates of depression, anxiety, and insomnia of a health care professional. Pronouncement can help to enumerate employees' support needs and notify tiered and tailored intervention under endemic conditions that increase elasticity and moderate vulnerability [32].

4. COVID-19 SURVEY IN INDIA

Indian Council of Medical and Research (ICMR) start surveillance for COVID-19. In India, as they announced a 21-day lockdown with effect from 25 March 2020. This lockdown more help to stop 70 % speared COVID-19 in India. In

additionally infected people maintaining social distancing and isolation themselves. The common people also follow frequent hand washing and Hand Santatizer, reduced mass gatherings, and quarantines, etc. They decide to take four kinds of scenarios first baseline survey, second moderate lockdown survey, third hard lockdown survey, and fourth hard lockdown and continued social distancing or isolated cases. In these scenarios baseline surveys indicated the infection spread (55%) more in all states. The second moderate lockdown survey indicated to reduce the infection spread (40%) in all states. The third hard lockdown survey indicated to reduce the infection spread (30%) in all states. Fourth hard lockdown and continued social distancing survey indicated (10% - 20%) infection spread in all states. According to this survey in September 2020, it increases more approximately 5,000,000.

States/Uts	Population	Total Confirmed	Cured/ Migrated	Deaths	Treatment	Covid Average	Death Average	Cured Average
Andaman and Nicobar	417,036	5024	4955	62	69	1.20%	1.23%	98.63%
Andhra Pradesh	53,903,393	891000	882000	7173	9000	1.65%	0.81%	98.99%
Arunachal Pradesh	1,570,458	16839	16780	56	59	1.07%	0.33%	99.65%
Assam	35,607,039	218000	215000	1094	3000	0.61%	0.50%	98.62%
Bihar	124,799,926	263000	261000	1545	2000	0.21%	0.59%	99.24%
Chandigarh	1,158,473	22238	21208	355	1030	1.92%	1.60%	95.37%
Chhattisgarh	29,436,231	314000	308000	3855	6000	1.07%	1.23%	98.09%
Dadra & N Haveli	257,862	1704	1601	1	103	0.66%	0.06%	93.96%
Daman & Diu	357,862	1702	1602	1	100	0.48%	0.06%	94.12%
Delhi	18,710,922	641000	628000	10919	13000	3.43%	1.70%	97.97%
Goa	1,586,250	55361	53862	799	1499	3.49%	1.44%	97.29%
Gujarat	63,872,399	273000	265000	4414	8000	0.43%	1.62%	97.07%
Haryana	28,204,692	272000	267000	3056	5000	0.96%	1.12%	98.16%
Himachal Pradesh	7,451,955	59059	57473	997	1586	0.79%	1.69%	97.31%
Jammu & Kashmir	13,606,320	127000	124000	1961	3000	0.93%	1.54%	97.64%
Jharkhand	38,593,948	120000	119000	1091	1000	0.31%	0.91%	99.17%
Karnataka	67,562,686	954000	935000	12359	19000	1.41%	1.30%	98.01%
Kerala	35,699,443	1080000	1030000	4287	50000	3.03%	0.40%	95.37%
Ladakh	289,023	9830	9656	130	174	3.40%	1.32%	98.23%
Lakshadweep	73,183	473	313		160	0.65%	0.00%	0.00%
Madhya Pradesh	1,239,244	264000	257000	3868	7000	21.30%	1.47%	97.35%
Maharashtra	85,358,965	2210000	2060000	52440	150000	2.59%	2.37%	93.21%
Manipur	123,144,223	29288	28884	373	404	0.02%	1.27%	98.62%
Meghalaya	3,091,545	13970	13810	148	160	0.45%	1.06%	98.85%
Mizoram	3,366,710	4428	4409	10	19	0.13%	0.23%	99.57%
Nagaland	2,249,695	12211	12105	91	106	0.54%	0.75%	99.13%
Odisha	46,356,334	338000	335000	1917	3000	0.73%	0.57%	99.11%
Puducherry	1,413,542	39843	39000	670	843	2.82%	1.68%	97.88%
Punjab	30,141,373	187000	174000	5910	13000	0.62%	3.16%	93.05%
Rajasthan	81,032,689	321000	317000	2789	4000	0.40%	0.87%	98.75%
Sikkim	690,251	6167	5988	135	179	0.89%	2.19%	97.10%

Tamil Nadu	77,841,267	855000	838000	12517	17000	1.10%	1.46%	98.01%
Telangana	39,362,732	300000	296000	1641	4000	0.76%	0.55%	98.67%
Tripura	4,169,794	33424	33003	391	421	0.80%	1.17%	98.74%
Uttar Pradesh	237,882,725	604000	594000	8729	10000	0.25%	1.45%	98.34%
Uttarakhand	11,250,858	97363	95073	1694	2290	0.87%	1.74%	97.65%
West Bengal	99,609,303	576000	563000	10277	13000	0.58%	1.78%	97.74%
Total	1371360351	11216924	10867722	157755	349202	1.69%	1.41%	96.89%

Table 4: Experiment result

Experimental results (Table 4) show that 11216924 people were affected by COVID. Out of the total Indian population, the average rate of positive patients was 1.69%. The Death rate of corona affected patients was 157755 as on 7th March 2021. The average death rate, according to corona affected patients was 1.41%. The patient cure rate tends to 96.89%.

Even though COVID positive cases were increasing rapidly in India, the patient's recovery rate is also increasing. That is giving confidence for everyone, lockdowns are over and the people have to move on in their work. Everyone should aware of social distancing, hand hygiene, and self-hygiene. When compared to other foreign countries the death rate in India is very low, it's because of the traditional food items and our ancestor's strong immune system which helps us to overcome this pandemic situation. Also, natural medicines like pepper, garlic, turmeric, ginger, etc. took place in Indian food and build our immune system strong. The Indian government is providing Arsenic album (TN) (Kadha in hindi (garlic, turmeric, black pepper, tulsi leaf and dry roast)) Siddha tablets which act as an immunity booster. Even the weaker patients can gain immunity after having the tablets. Also, a multivitamin tablet supports the poor people, those who cannot afford the money for vitamin-rich fruits and nuts. Zinc tablet helps to heal from the sense of smell and taste. According to the survey taken from various people, it shows that the Coronavirus is a dangerous one. This weakens the immune system of our body, so COVID positive patients experience tiredness, restlessness, anorexia, and insomnia even after the recovery. Healthy and normal life will be retained only after the immunity level backs to the earlier level. Only intake of the vitamin, nutrition, and iron-rich food, fruits, and nuts will help the patients for their speedy recovery. Steps that are taken by the government are appreciable. Patients are provided an Arsenic album (immunity booster), multivitamin tablets, and zinc tablets free of cost. The pandemic situation has been handled very well by the government and government officials. Everyone should cooperate with the government and obey the rules.
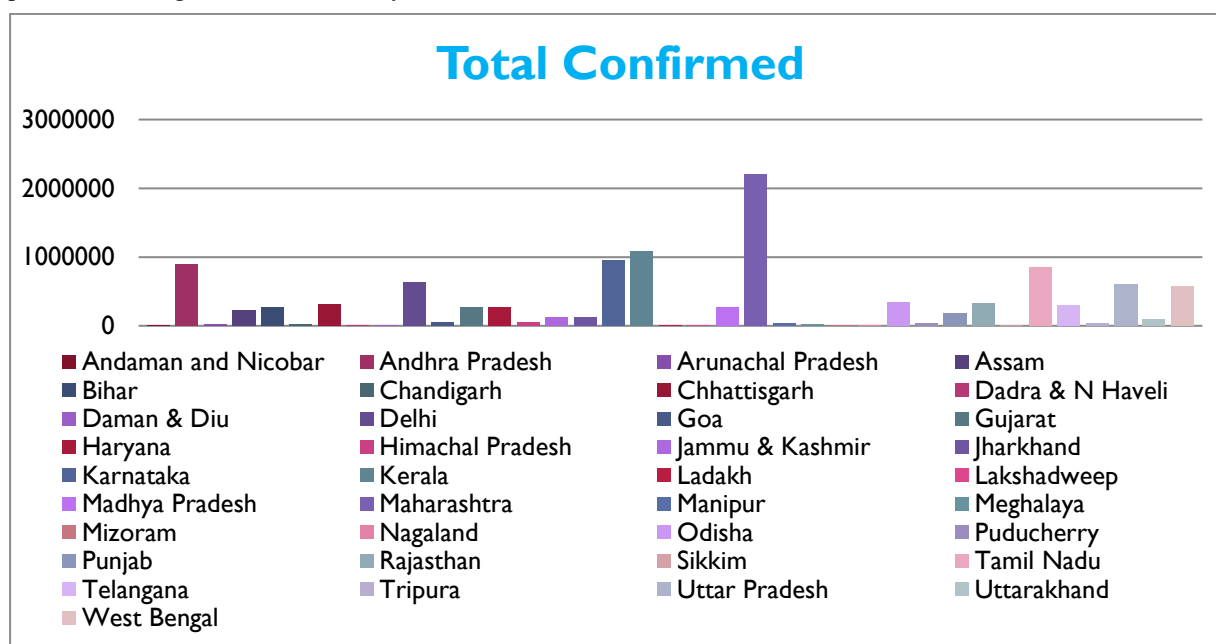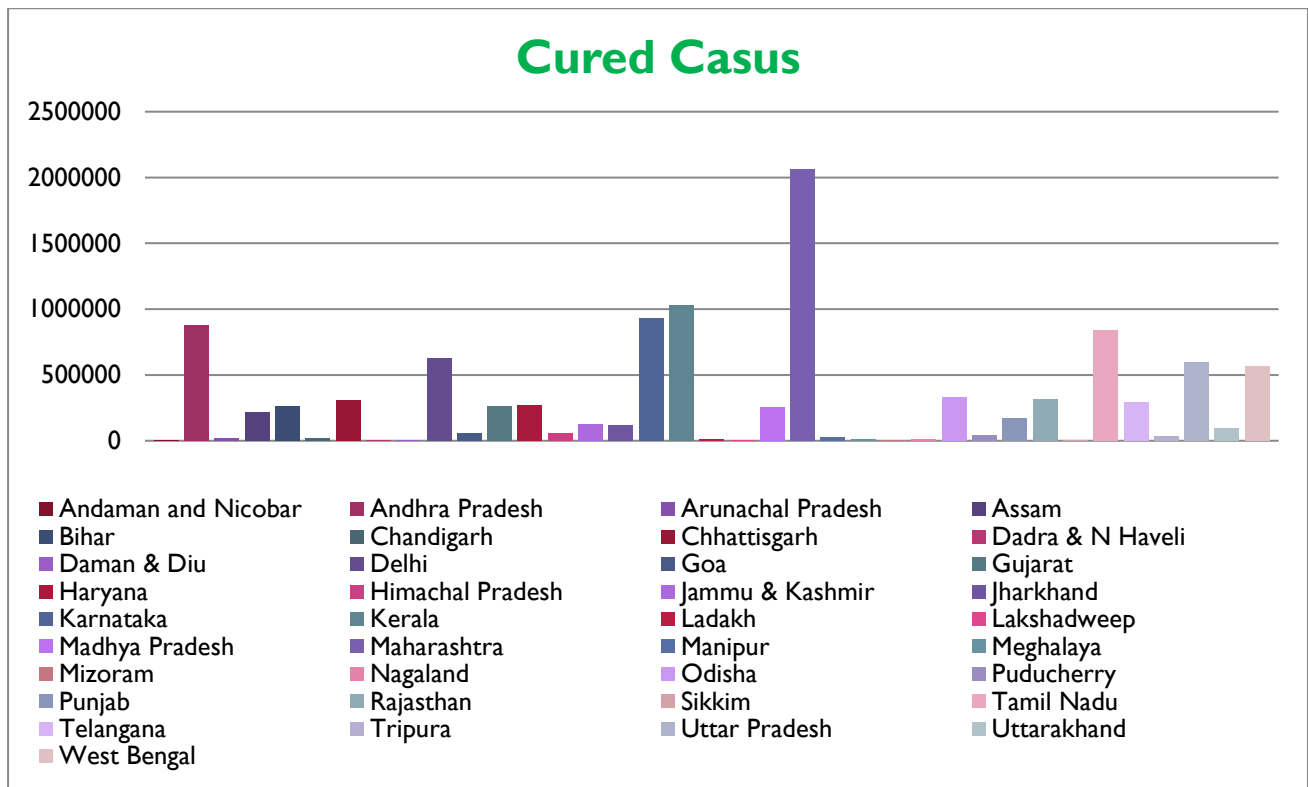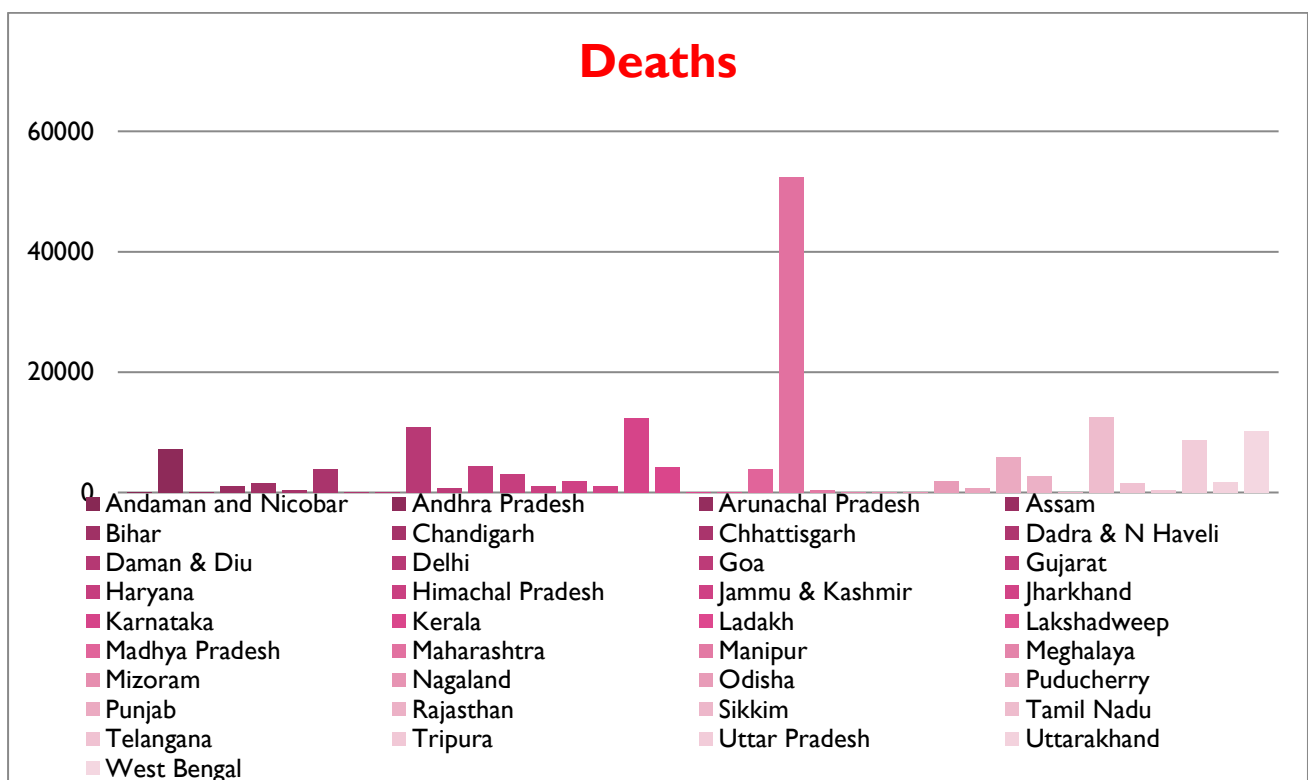

Figure.5 Total Confirmed casus

Cured Casus

Figure. 6 Cured causes

Deaths

Figure. 7 Death cause

Covid Average Casuses
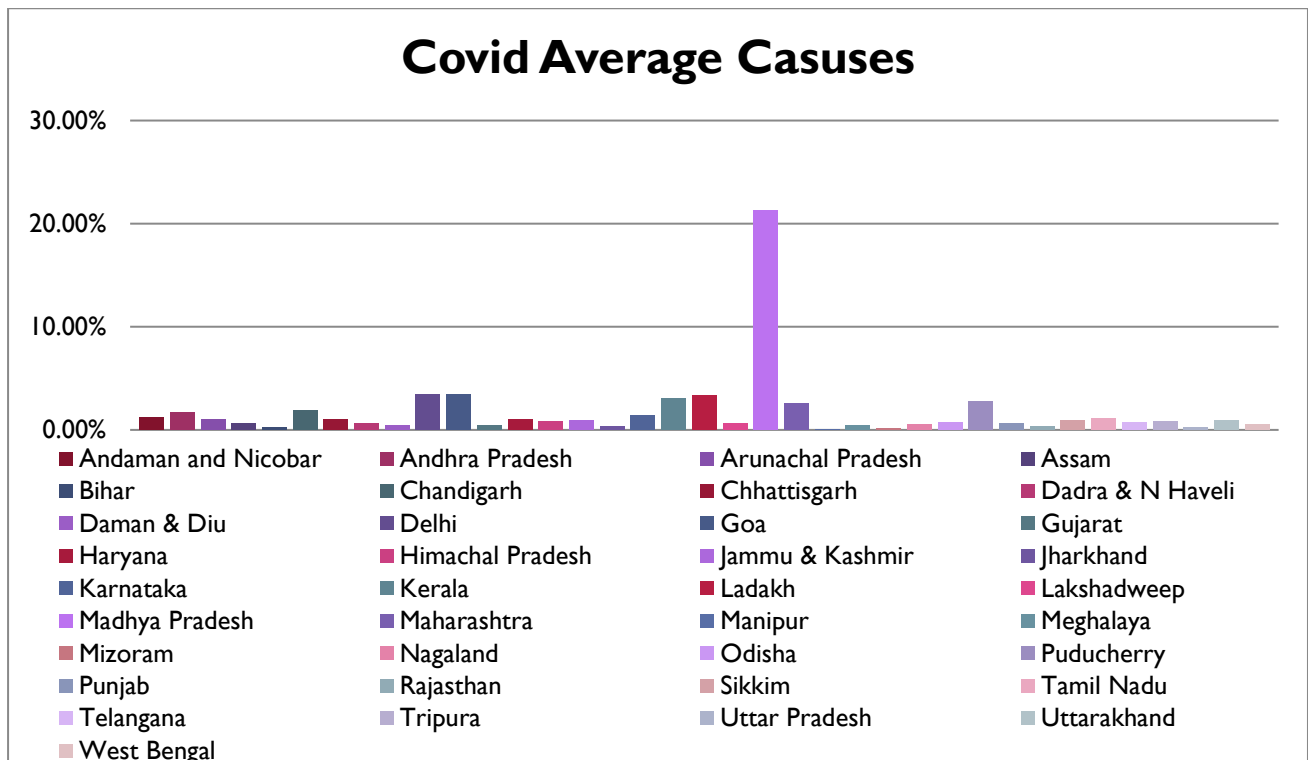

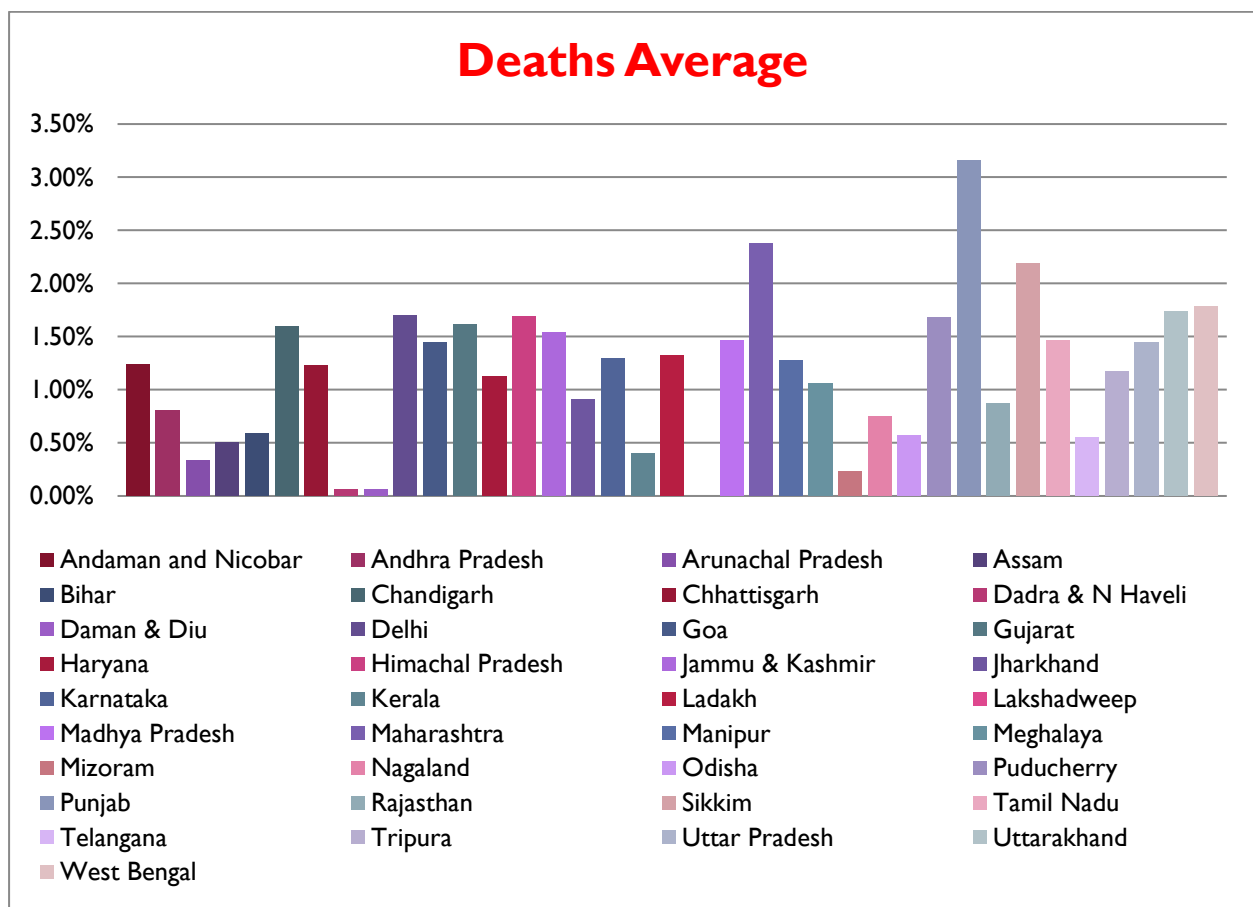**Figure. 8 Covid Aveare cause**
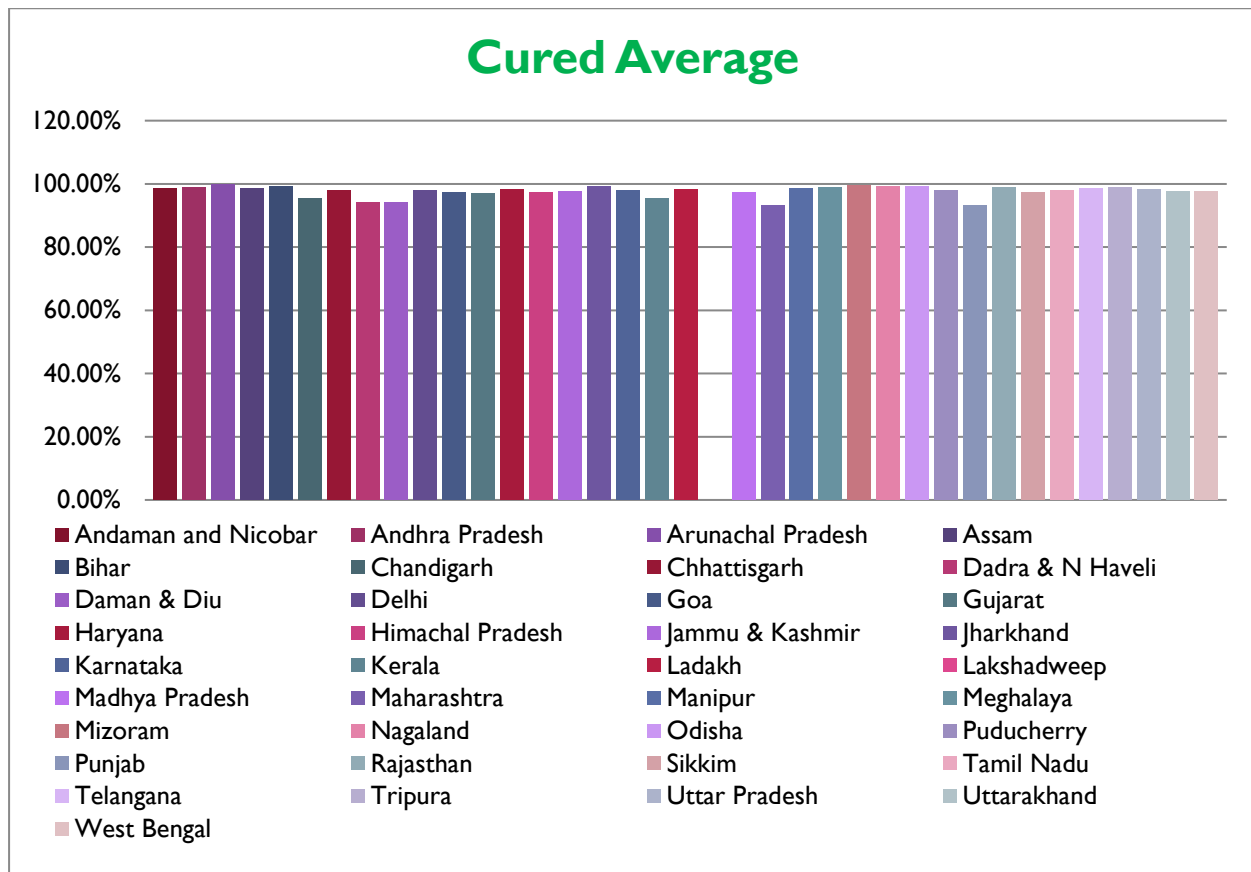
Deaths Average

Figure. 9 Death Average

Figure. 10 Cured Average

5. ASSESSMENT TOOLS

BDI-II, Beck Depression Inventory-II: Manual

The Beck Depression Inventory (BDI) is a self-report inventory that was invented for computing the extremity of depression symptomology.

BDI has three versions:

- The original BDI - published in 1961
- BDI-1A   - published in 1978
- BDI-II   - published in 1996

The commencement of BDI was developed by collating patient's verbatim descriptions of their symptoms and making it as a structure which would reflect the severity of a symptom. Instead of being rooted in the patient thoughts it had observed depression from a psychodynamic outlook. The psychological assessment known as Children's Depression Inventory(CDI) used BDI as a model for its development process. In the current version of BDI inventory age ranges from 13 – 80 related to symptoms of depression like negative cognitions such as irritability, hopelessness, feelings of being punished and, also physical symptoms like fatigue and weight loss.The BDI-II contains 21- question multiple choice, self-report inventory, each answer being scored on a scale value of 0 to 3.

- 0–13: minimal depression
- 14–19: mild depression
- 20–28: moderate depression
- 29–63: severe depression

Beck Anxiety Inventory (BAI)

Beck Anxiety Inventory (BAI) - is one of the common mental disorder occurs in children and adults. Now a days this disorder is mostly occurring to the children from the age 8-11 and it continues to teenage children and continues to adulthood. This disorder occurs due to fear or tension of the daily activities.It has a symptom like feeling nervous, restless,

sweating, trembling, getting panic for every work, increase in heart beat, feeling tired, feeling sleepless, gastrointestinal problems, feeling helpless, hyperventilation, tingling, Depression. The BAI contains 21 questions, each answer being scored on a scale value of 0 to 3 Higher total scores indicate more severe anxiety symptoms. It has 4 types here it is standardized with cutoffs:

- 0–7: Minimal
- 8-15: Mild
- 16-25: Moderate
- 26-63: Severe

6. SELF RATING ANXIETY SCALE (SAS)

It is a process of measuring the anxiety level in patients who has anxiety related symptoms.It generally focuses on the general disorders and anxiety causes stress typically. SAS is a 20 item self assessment device to build the anxiety level based on a 4 point scale from" none of the time" " to most of the time" The anxiety level falls in two categories

- Self-evaluation
- Clinic-evaluation

Answering the statement a person should be instructed how statement applies to him or her within a period of time to prioritize the test. Every question is scored like a like rtype -scale (1-4). Some questions are avoided to in order to avoid the problems of set response. Assessments are totally done by a scoring method. The overall score ranges from 20-80. The overall scores are converted to "ANXIETY INDEX" using the paper vision on the chart of the test. The anxiety index score can be used to determine the anxiety level of one's clinical interpretation.

- 20-44 normal person
- 45-59 mild anxiety level
- 60-74 severe anxiety level
- 75 and above extreme anxiety level

Center for Epidemiologic Studies Depression Scale (CES-D)

The center for epidemiologic studies depression scale has been used in the Community Mental Assessment. This has been used in the national health system. It is the tool to identify the survey of the depression scale studies. The center for epidemiologic studies depression scale has identified the depression scale among the students due to their work . It is possible to get the difference in the ages between the human, and this depression scale is mainly among the high school students and the college students. This depression has became the major problem in our country. This depression scale states that the depression find in the younger generation will not be same to the older generation. The depression scale had identified the screener for the sample of 1.005 community is between the age of (50-96). It has been estimated by the epidemiology study depression scale.

Generalized Anxiety Disorder Assessment (GAD-7)

Generalized Anxiety Disorder Assessment (GAD-7) is referred to as a screening questionnaire which is generally used for primary care patients, were they can take the self-assessment test which takes about 1 to 2 minutes to answer the questions. GAD-7 has seven instrument tools, based on the response for the question it measures the severity of GAD. Were the individuals are asked to rate severity of their symptoms over the past 2 weeks. The responses are included with options and points, which are as follows:

- Not at all – 0 point
- Several days – 1 point
- More than half the days – 2 points
- Nearly every day – 3 points

The total score of seven item tool ranges from 0 to 21, which indicates levels of anxiety which are as follows:

- 0 to 4 - minimal anxiety
- 5 to 9 - mild anxiety
- 10 to 14 - moderate anxiety
- 15 to 21 - severe anxiety

7. PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

Phq 9 is actually abbreviated as patient heath questionnaire (phq 9).

PHQ is a self evaluation questions which is given to different ages of people to find out the mental strengthness. This will help us to find people with mental disorder and give them treatment according to their mental health. Usually the patients marks are calculated accordingly from 0 to 27. Its questionnaire depends happens in 3-5 mins to check the depression level of the respective patient.If one Recent survey will be said in India43% of peoples will be sicked in mental disorder and depression .It will calculate the patient mental condition with some questions and estimate the range to found the depression level. The PHQ-9 is the depression module, which scores each of the 9 DSM-IV criteria as "0" (not at all) to "3" (nearly every day).

Hamilton Anxiety Rating Scale (HAM-A)

The Hamilton Anxiety Rating Scale is the tool is used to the clinical interview. It gives the clear points about the rating of the system. It is used to ask the questions from the clinical patients about their anxiety. It is used to rate the patients by finding their answers in the collected manner. It has the different phases that is used to rate their anxiety. It uses the fourteen questions that it make the easier to collect the information. It uses the five responses to the each questions that will be asked to each of their patients and it makes to collect easily without any difficulties. It is possible to collect the information in ordered manner. This Hamilton Anxiety Rating Scale that makes the analyst to do their work in appropriate manner. Then the analyst makes use of this rating to create correct data which they need to be produced and it has the different emotions to collect the information.

8. HAMILTON DEPRESSION RATING SCALE(HAM-D OR HDRS):

The HRDS most commonly known as clinical administrates depression assesment scale. It contain 17 items defining the symptoms of depression experienced over the past weeks.It is designed after an unstructured clinical review.The main motive to develop HRDS is for hospital in patients.After that 21 items version including 4 items intended to the subtype of the depression.A limited scale of HRDS is a typical symptoms of depression(eg:hypersomnia).A score breakdown levels of depression are as follows.

- 0-7 Not depressed.
- 8-13 Mild (subthreshold)
- 14-18 Moderate (mild)
- 19-22 severe (moderate)
- 0>23 very severe (severe)

Aggressive Incidents Scale (AIS)

The Aggressive Incidents Scale (AIS) is the record of aggression and violence involving patients using a common language that describes aggressive incidents. The incidents are noted daily and reported for each week and month. This shows patient record of aggression level including improvement or escalation. The AIS language is a two-part code. The first part describes the severity of the incident using the scale values which ranges between 1-9. The second part is a letter that describes the type of intervention that occurred during the incident.

The first part has 9 decreasing levels of order:

- Violent Assault with Serious Injury: Imaginable Life and death, Possible Police Call
- Violent Assault: No Strong Antecedents
- Violent Assault: Antecedents Identifiable
- Push/Shove
- Ruin of Property
- Unsuitable Physical Contact
- Frightening, Aggressive, Personal Space Disrupted
- Scary, Raised Voice
- Bad-mannered, Argumentative

The intervention scales

- N – No Intervention
- P – Physical Intervention
- V – Verbal Intervention

- PC – Police Called

Hamilton Anotomy of Risk Management (HARM)

The Hamilton Anatomy of Risk Management (HARM) is a developed for the judgement tool for the use of forensic inpatient psychiatric settings. It is a standardised method for the recording aggressive incidents. It guides the assessors to formulate opinions regarding risk of violence. The results indicated strong support for the concurrent validity of HARM and AIS promising support for the predictive accuracy of the tool for the inpatient aggression. The present findings on the predictive validity of the HARM in the short term for varying severities of aggressive acts. It combines both historical / static and dynamic factors to assess risk as reflected in the literature. It was created to,

- Predict imminent and short-term risk
- Bring all information to bear in assessment risk
- Foster and document discussion of risk among clinical team members
- Provide a guided, continuous risk assessment and Management process

It captures three stages of assessment PAST, PRESENT, and FUTURE. Moving from the Past analysis to the Present then the assessor can predict the future stage of the patient's condition.

Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) is a self-report questionnaire that concentrates on the quality of sleep in a month. This questionnaire is used for clinical activities and research for clinicians which is used to diagnose sleeping disorders. PSQI is a valid and authentic sleeping problems assessment and provides a clear view of patients and clinicians to use the report. It was a standardized estimation that was designed to gather intelligence about the sleep habits of people. The PSQI seven components are sleep latency, duration, efficiency, quality, disturbances, use of sleeping medication, and daytime dysfunction. Totally 24 questions,19 questions are self-related and 5 rated by bed partner/roommate. These are grouped and forms a point range as 0-3. Finally total score is calculated to find the final master score which ranges from 0-21, whereas 0 shows no difficulty and 21 shows severe difficulty.

Depression, Anxiety and Stress Scale (DASS-21)

The Depression, Anxiety and Stress Scale (DASS-21) reflects a pessimistic psychic symptoms. It is a 42 self-report items to be finished within 10 minutes, which returns symptoms. It is conventionally designed for the process of definition, perception, and measurement of emotional states like anxiety, depression and stress. The depression scale is especially developed to identify the variation among anxiety, depression and stress undergone by the patients. It is purely based on dimensional conception of disorders.

Characteristics:

- The depression scale characteristics are pessimistic, disheartened, undesirable, lacking in initiative, negative thoughts on life, and neglection.
- The anxiety scale characteristics include xerostomia, dyspnea, increased heart pulse, hyperhidrosis frenzy. restless, panic and shivering,
- The stress scales characteristics are parochialism, awakening, high-strung, awkwardness, sensitivity, and timid

Patient Health Questionnaire (PHQ-9)

The Patient Health Questionnaire (PHQ-9) is a 9 question depression scale of PHQ which is the self-administered version of the Prime-MD. Prime-MD is a screening tool to evaluates health disorders. The modules are based on diagnostic criteria of depression-like mood, anxiety, alcohol, eating, and somatoform disorders. In the interpretation of results, the score ranges from 0-27. Questions are about doing things, depression , sleeping difficulty, energy levels, eating habits, self-perception, concentration, functioning speed, and negative thoughts. The sum of the response is used to identify the levels of severity.

The various levels of depression are,

- 0-4 – None
- 5-9 – Mild
- 10-14 – Moderate
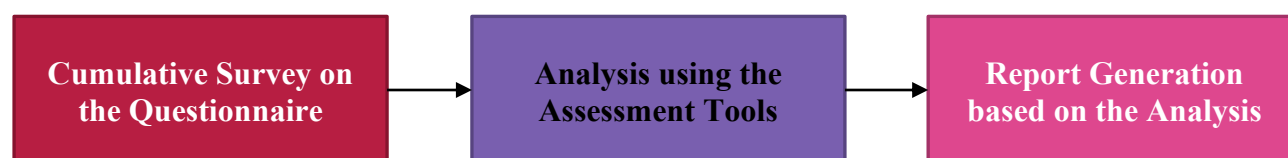- 15-19 – Moderately Severe
- 20-27 – Severe

9. PROPOSED SOLUTION

Analyzing other assessment tools, we came to a conclusion that those tools could only be used analyze depression severity. There are various setbacks considering the current assessment tools. Limitations of such tools are, Time consuming, Complex, Not User Friendly. Hence, we have proposed a solution that has a set of questionnaires that could be used to predict the presence of COVID-19 in a patient. A recent study says Doctors around the world have seen significant change in the mental status of an individual. The study also states that the world's pollution and has reduced by 72%. The Proposed methodology mainly focusses on predicting the impact of Coronavirus on brain.

10. QUESTIONNAIRE

1. Whether the person is affected with COVID-19 for the past 3 months?

2. Whether the person has made in contact with the person who has affected with COVID-19 recently?

3. Has the person undergone any COVID-19 testing in the nearby Primary Health Centers or any other Private or Govt. Hospitals?

4. Has the person taken any medication without the prescription of the Doctor with symptoms relating to COVID-19?

5. Has the person undergone any surgery for the recent years?

6. Is the person diabetic?

7. Has the person felt himself under severe stress or headache that prevailed for more than a day?

11. WORKFLOW ARCHITECURE

Cumulative Survey on the Questionnaire → Analysis using the Assessment Tools → Report Generation based on the Analysis

12. LEVELS OF SCORING

On analyzing the questionnaire, the cumulative study of the responses is analyzed and scored based on the present and the past experiences of the person himself. The different levels of scoring as per the questionnaire are listed below,

- **1** – No Stress Experienced
- **2** – Moderately Stressed
- **3** – Highly Stressed
- **4** – Extremely Stressed

13. PERSONAL INFORAMTION FOR THE REPORT

The below table 5 shows the personal information questionnaire that adds up to the prediction assessment. This could help finding the analysis with respect to the **Gender**, **Age**, **Place**, etc.,

S.No	Question	Response
1	Name of the person	
2	Age of the person	
3	Gender	
4	Marital Status	
5	Occupation of the person	

Table 5 Personal Information

14. QUESTIONNAIRE FORMAT

The table 6 show is a format of the questionnaire with fields, depicting the **7-set** of assessment **Question** with a **Response** column wherein the person specifies the reason for the cause.

s

S. No	Question	Response (whether "Yes" or "No")	Reason (whether "Yes" then specify the reason for the response	Score (score ranging from 1 to 4 as per the scoring level basis)
1	Whether the person is affected with COVID-19 for the past 3 months?			
2	Whether the person has made in contact with the person who has affected with COVID-19 recently?			
3	Has the person undergone any COVID-19 testing in the nearby Private or Govt. Hospitals?			
4	Has the person taken any medication without the prescription of the Doctor with symptoms relating to COVID-19?			
5	Has the person consumed drugs under stress?			
6	Has the person experienced stress of any kind during isolation?			
7	Has the person felt himself under severe headache that prevailed for more than a day?			

Table 6 7-set of assessment Questions

15. SOLTUION ARCHITECTURE

For the master report to be generated the results of the questionnaire needs to analyzed. As our ultimate aim is to find the brain disorders based on the stress experience by people during the COVID-19 pandemic it is necessary that the overall score of the above needs to be calculated. Let us now discuss about how the prediction made using the questionnaire. The person is given with the questionnaire where the user responds to every question in the questionnaire.
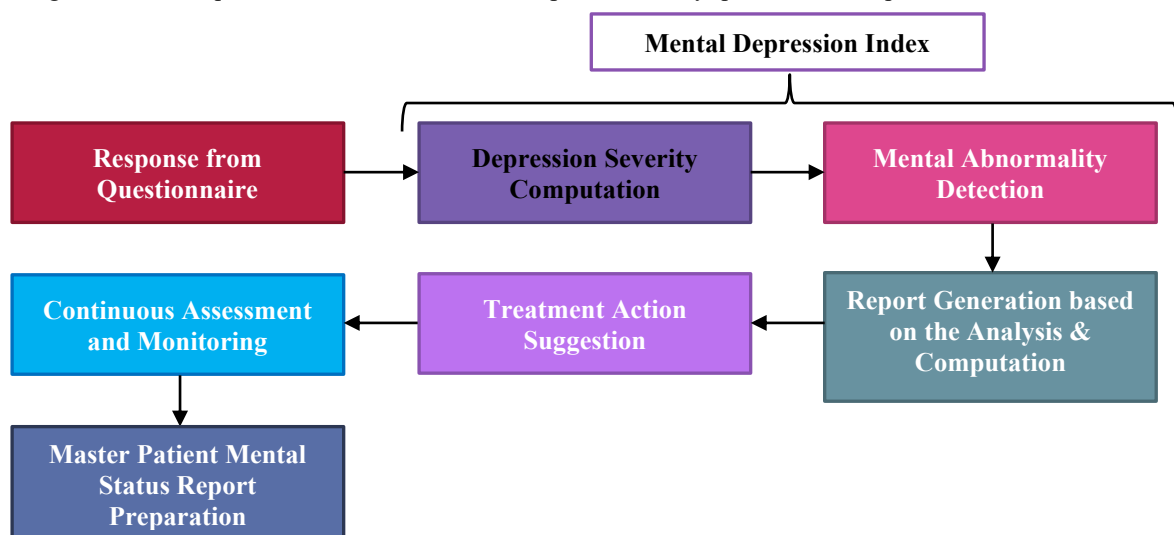

Figure 11 Architecture for questionnaire

The overall score of the person and the medical officer is calculated and they mean is calculated by using the mean formula.

$$m = \frac{\sum x}{n}$$

Where **x** – sum of all individual scores,

n – number of scoring levels for the questionnaire, (ie. 4)

m – mean value.

This could be done by taking the mean of the individual scores. Now the overall score is checked for its extremity. The overall score must vary from **1.0** to **4.0**. The final score helps predict that the patient has been affected with brain disease. The prediction criteria depend upon the overall validation, scale is as follows,

1.0 - 1.5 – *Less Brain Impact*

2.0 - 2.5 – *Moderate Brain Impact*

3.0 - 3.5 – *High Brain Impact (needs medication and doctor's advice)*

>=4.0 - *Extremely High Brain Impact (advice to consult a doctor and medication)*

Depending on the output of the score an initial report is generated for the person for further examination. Since, this process is iterative and needs continuous monitoring for best results this practice is followed. Now based on the report generated the person is now suggested with treatment suggestions which could help him recover soon. Upon suggesting treatment suggestions, the user is again let to go through the assessment using the questionnaire. On analyzing the Reason column of the questionnaire symptoms of the person affected could be extracted and analyzed closely to get treatment suggestions using diagnosis API's available online such as the one provided by **infermedica.com** and Symptoms could be extracted and analyzed using API provide by **apimedic.com.** Now the treatment suggestion in hand affected person gets to know the treatment he needs to undergo. Since the entire process is continuously iterative the person is again let to take the assessment to check the effect of the treatment undergone now the mean of the score is caculate and the affected person's status is now checked. Changes in the score is observed. Finally the master health report for the person is generate for further use in the Monitoring Process.

Various conditions tells the change in the stress levels and scores of the questionnaire of the affected person,

Scenario 1 : *Person with High Brain Impact*

S. No	Question	Response (whether "Yes" or "No")	Reason (whether "Yes" then specify the reason for the response	Score (score ranging from 1 to 4 as per the scoring level basis)
1	Whether the person is affected with COVID-19 for the past 3 months?	Yes	Travelled to outside places during the pandemic	2
2	Whether the person has made in contact with the person who has affected with COVID-19 recently?	No	N/A	1
3	Has the person undergone any COVID-19 testing in the nearby, Private or Govt. Hospitals?	Yes	A recent visit to the nearby Govt. Hospital for check up. For getting affected with throat pain.	1
4	Has the person taken any medication without the prescription of the Doctor with symptoms relating to COVID-19?	No	N/A	1
5	Has the person consumed drugs under stress?	Yes	On several days of lockdown consumed drugs	3
6	Has the person experienced stress of any kind during isolation?	Yes	Being isolated for so long months got stressed	3
7	Has the person felt himself under severe headache that prevailed for more than a day?	Yes	Got headaches few times	2

Table 7 Person with High Brain Impact Analysis

On analyzing the reasons and the computation of the scoring made by taking the mean of the individual scores,

$$m = \frac{2 + 1 + 1 + 1 + 3 + 3 + 2}{4}$$

$$= \frac{13}{4}$$

$$m = \mathbf{3.25}$$

The above score computed from the questionnaire clearly tells us that the person has a major brain impact that the computed score lies between **3.0** and **3.5** with High Brain Impact.

Scenario 2 : *Person with Extremely High Brain Impact*

S. No	Question	Response *(whether "Yes" or "No")*	Reason *(whether "Yes" then specify the reason for the response*	Score *(score ranging from 1 to 4 as per the scoring level basis)*
1	Whether the person is affected with COVID-19 for the past 3 months?	Yes	Travelled to outside places during the pandemic	2
2	Whether the person has made in contact with the person who has affected with COVID-19 recently?	Yes	Met a friend after a long time who has recovered from CoVID-19 recently	3
3	Has the person undergone any COVID-19 testing in the nearby, Private or Govt. Hospitals?	Yes	Visited a to nearby Hospital for check up. For getting affected with throat pain.	2
4	Has the person taken any medication without the prescription of the Doctor with symptoms relating to COVID-19?	No	N/A	1
5	Has the person consumed drugs under stress?	Yes	On several days of lockdown consumed drugs	4
6	Has the person experienced stress of any kind during isolation?	Yes	Being Alone most of the times	4
7	Has the person felt himself under severe headache that prevailed for more than a day?	Yes	Got headaches A lot of the times	3

Table 8 Person with Extremely High Brain Impact

On analyzing the reasons and the computation of the scoring made by taking the mean of the individual scores,

$$m = \frac{2 + 3 + 2 + 1 + 4 + 4 + 3}{4}$$

$$= \frac{19}{4}$$

$$m = \mathbf{4.75}$$

The above score computed from the questionnaire clearly tells us that the person has a extreme and a serious brain impact that the computed score is greater than **4.0** with *Extremely High Brain Impact.*

Scenario 3 : *Person with Moderate Brain Impact*

S. No	Question	Response *(whether "Yes" or "No")*	Reason *(whether "Yes" then specify the reason for the response*	Score *(score ranging from 1 to 4 as per the scoring level basis)*
1	Whether the person is affected with COVID-19 for the past 3 months?	No	N/A	2
2	Whether the person has made in contact with the person who has affected with COVID-19 recently?	Yes	Met a friend recently who has recovered from CoVID-19	2

3	Has the person undergone any COVID-19 testing in the nearby, Private or Govt. Hospitals?	No	N/A	1
4	Has the person taken any medication without the prescription of the Doctor with symptoms relating to COVID-19?	No	N/A	1
5	Has the person consumed drugs under stress?	No	N/A	1
6	Has the person experienced stress of any kind during isolation?	Yes	Being isolated for so long months got stressed	3
7	Has the person felt himself under severe headache that prevailed for more than a day?	Yes	Got headaches few times	1

Table 9 *Person with Moderate Brain Impact*

On analyzing the reasons and the computation of the scoring made by taking the mean of the individual scores,

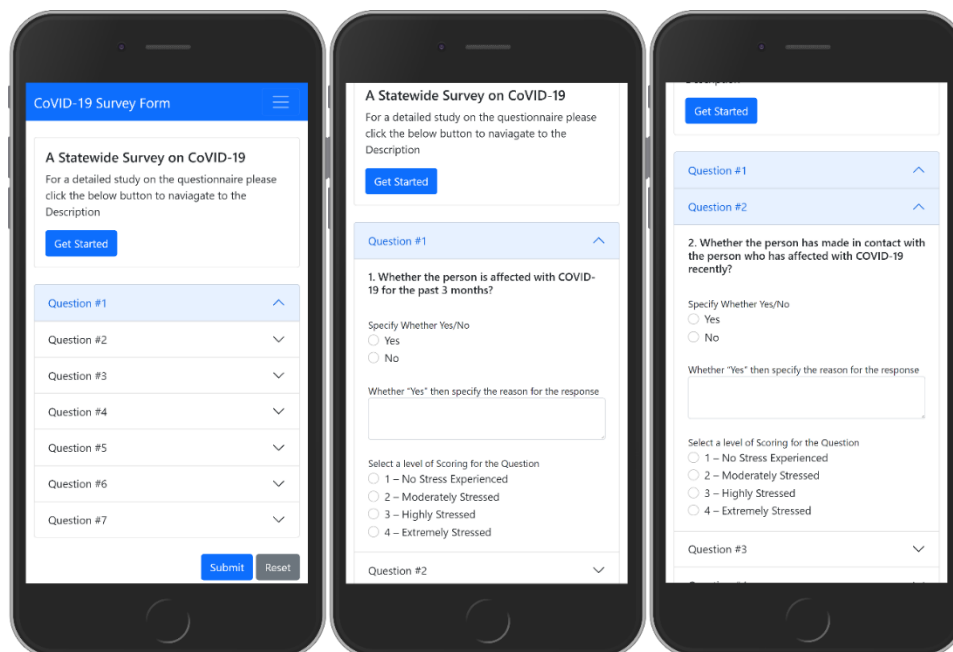$$m = \frac{2 + 2 + 1 + 1 + 1 + 3 + 1}{4}$$

$$= \frac{11}{4}$$

$$m = 2.75$$

The above score computed from the questionnaire clearly tells us that the person has a major brain impact that the computed score lies between the relative ranges **2.0** and **2.5** with Moderate Brain Impact.

Scenario 4 : Person with Less or No Brain Impact

S. No	Question	Response *(whether "Yes" or "No")*	Reason *(whether "Yes" then specify the reason for the response*	Score *(score ranging from 1 to 4 as per the scoring level basis)*
1	Whether the person is affected with COVID-19 for the past 3 months?	No	Travelled to outside places during the pandemic	1
2	Whether the person has made in contact with the person who has affected with COVID-19 recently?	No	N/A	1
3	Has the person undergone any COVID-19 testing in the nearby, Private or Govt. Hospitals?	No	N/A	1
4	Has the person taken any medication without the prescription of the Doctor with symptoms relating to COVID-19?	No	N/A	1
5	Has the person consumed drugs under stress?	No	N/A	1
6	Has the person experienced stress of any kind during isolation?	Yes	Sometimes got stressed	1
7	Has the person felt himself under severe headache that prevailed for more than a day?	Yes	Got headaches few times	1

Table 10 Person with Less or No Brain Impact

On analyzing the reasons and the computation of the scoring made by taking the mean of the individual scores,

$$m = \frac{1 + 1 + 1 + 1 + 1 + 1 + 1}{4}$$

$$= \frac{7}{4}$$

$$m = \mathbf{1.75}$$

The above score computed from the questionnaire clearly tells us that the person has a major brain impact that the computed score lies between the relative ranges of **1.0** and **1.5** with Less or No Brain Impact.

16. SURVEY APPLICATION SCREENSHOTS

The Survey Application is built using HTML, Bootstrap and Javascript. Bootstrap adds beautiful user interface to the survey form. HTML is used to define the structure of the form while Javascript is used to add functionality to components and collecting data.

Figure 12 COVID-19 Survey Form Application

17. VALIDATION

Below is a sample response from the survey from filled by a user having experienced stress.

With the below response let us analyze the symptoms remedies and treatment suggests that the affected person can be given.

S. No	Question	Response (whether "**Yes**" or "**No**")	Reason (whether "**Yes**" then specify the reason for the response	Score (score ranging from **1** to **4** as per the scoring level basis)
1	**Whether the person is affected with COVID-19 for the past 3 months?**	Yes	Travelled to outside places during the pandemic	2
2	**Whether the person has made in contact with the person who has affected with COVID-19 recently?**	Yes	Met a friend after a long time who has recovered from CoVID-19 recently	3
3	**Has the person undergone any COVID-19 testing in the nearby, Private or Govt. Hospitals?**	Yes	Visited a nearby Hospital for check up. For getting affected with throat pain.	2
4	**Has the person taken any medication without the prescription of the Doctor with symptoms relating to COVID-19?**	No	N/A	1
5	**Has the person consumed drugs under stress?**	Yes	On several days of lockdown consumed drugs	4
6	**Has the person experienced stress of any kind during isolation?**	Yes	Being Alone most of the times	4
7	**Has the person felt himself under severe headache that prevailed for more than a day?**	Yes	Got headaches A lot of the times	3

On performing necessary computations from the responses it is clearly seen that the person is experiencing Scenario 2 which is the Person with Extremely High Brain Impact. Hence analyzing the Reasons that he has responded He has experienced the following impacts,

- Throat Pain
- Headache
- Consumed Alcohol

The above observed symptoms analyzed from the responses are taken and used to suggest diagnosis using the APIMedic API that gives the accurate results of the diagnosis for the requested symptoms. Now these remedies are generated reports to the patient. A Sample report is given below,

Figure 13 Health Report

18. RESULT

Psychiatric symptoms and other COVID-19 related symptoms are analyzed and assessed to conclude that the proposed methodology aims to achieve detecting brain and mental disorders in persons affected with coronavirus. The approach takes the past and present experience of the patient using the questionnaire and analyze it to provide a treatment action plan where the user is also given information regarding the treatment that the person needs to undergo. The proposed methodology is successfully achieved using assessment tools to arrive the desired output in determining the brain abnormality due to COVID-19.

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