



Infodemic- A new rapidly evolving virtual communicable pandemic with global threat! Hypothetical or real?

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Abstract

‘Infodemic’ is a pandemic of misinformation spread in a pandemic manner regarding health issues of global concern. Globally, Infodemic is rapidly rising and more adverse outcomes are observed in social, economic and family lives. Infodemic is reported first time during SARS in 2003 & now during evolution of COVID-19 pandemic in 2020. Infodemic is more rapidly spreading pandemic than any communicable disease due to its ultrafast method of transmission by means of electronic & social media in the form of print or digital platform. Here, in Infodemic, the culprit is ‘misinformation’ spread without any scientific evidence regarding health issues of global concern. During COVID-19 pandemic infodemic evolved parallel with actual natural viral disaster and documented comparable effects on mankind globally. Infodemic is considered a global issue of concern for this decade. Infodemic in COVID-19 pandemic was documented as source of agent to cause & its evolution globally, available treatment options such as Remdesivir and its safety with efficacy & lastly, COVID-19 vaccines and its role in preventing and protecting COVID-19 disease with adverse events. Infodemic needs more stringent steps to control before its evolution, which includes active involvement of health experts, medical scientists, government agencies and trust organizations working worldwide. Timely shared right and scientifically evidenced proof information is a key step in controlling misinformation and ‘infodemic’.

Keywords: COVID-19; Infodemic; Electronic and social media; Trust organizations; Medical experts; Vaccine; Remdesivir

1. Introduction

An infodemic is too much information including false or misleading information in digital and physical environments during a disease outbreak. It causes confusion and risk-taking behaviors that can harm health. It also leads to mistrust in health authorities and undermines the public health response. An infodemic can intensify or lengthen outbreaks when people are unsure about what they need to do to protect their health and the health of people around them. With growing digitization resulted into an expansion of social media and internet use resulting into information can spread more rapidly. This can help to more quickly fill information voids but can also amplify harmful messages [1]. Acceptability of appropriate pandemic measures including vaccinations is currently being hampered due to significant misinformation all over the globe, also known as the “infodemic” within the pandemic [1].

The term “infodemic” was coined by Rothkopf in 2003 in the wider context of a SARS outbreak. Specifically, Rothkopf defined an infodemic as “a few facts, mixed, with fear, speculation and rumor, amplified and relayed swiftly worldwide by modern information technologies [that] have affected national and international economies, politics and even security in ways that are utterly disproportionate with the root realities” [2]. Likewise, the WHO defines an infodemic

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as: “too much information including false or misleading information in digital and physical environments during a disease outbreak” [1].

2. Mechanism of the Infodemic [3]

The mechanism of the infodemic implies factors that are related to (1) the situation, (2) the sender of the message, (3) the communication instrument used, and (4) the recipient of the message. [Figure 1] [3].

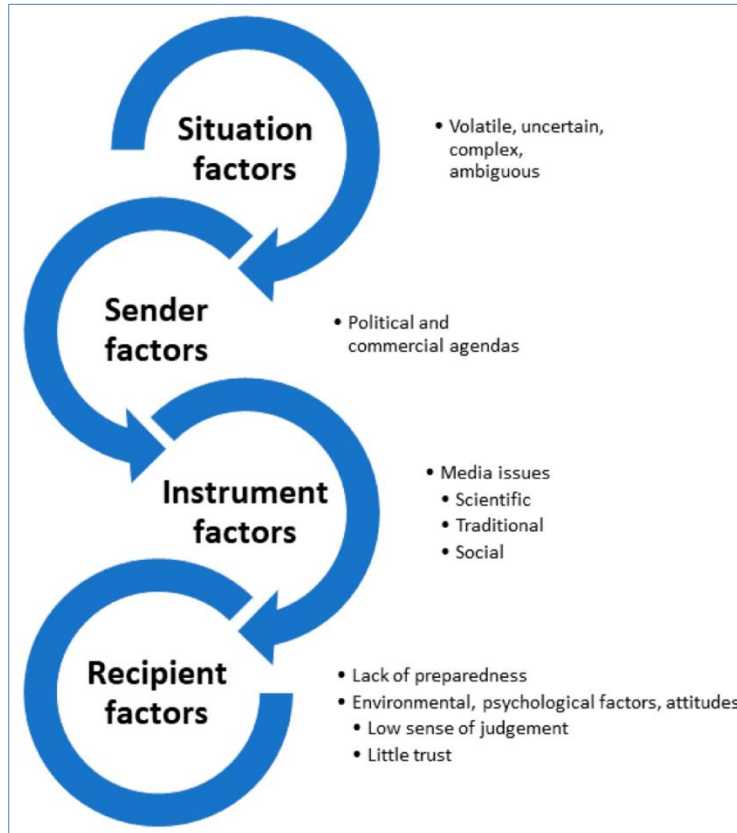


Figure 1 Mechanistic factors, described in reviews, of the infodemic during the COVID-19 pandemic

2.1. Situation Factors

Situation factors are issues inherent to the situation itself that subsequently fuel an infodemic. COVID-19 evolved as a rapidly changing, dynamic situation with volatile, uncertain, complex, and ambiguous elements [4]. There was an exponential increase of publications on the subject COVID-19 with biased peer-review and editorial processes [5,6]. Scientific information was produced fast at standards below best practice, disseminated at high visibility, and the captured interest did not correlate with quality [7]. The situation changed fast, messages disseminated were mixed, incomplete, conflicting, and sometimes incorrect [8,9]. Scientific information was exchanged fast and preliminary as non-peer reviewed preprints; in addition, an exceptionally high number of articles was later retracted [10]. There were many unknowns about the disease, such as transmission, manifestation, long-term sequelae, and immunity; at the same time the communication of these issues occurred in a complex scientific and mathematical-statistical language or by means of data-intense dashboards [11,12].

2.2. Sender Factors

Sender factors relate to originators of misinformation in the infodemic. Some senders had their own commercial or political agenda, i.e., misinformation can be disseminated with the intent to “trick people into believing something for financial gain or political advantage” [13]. The virus was indeed politicized [5]. Irrational beliefs including prejudice, paranoia, extremism, racism, conspiracy theories, and faith in magical cures played a role [14-16]. An example of inappropriate marketing was the direct-to-consumer targeted online advertisement of unproven and unauthorized stem-cell-based interventions in China [17]. Senders of misinformation can include individuals who deny scientific consensus on health issues [13]. Examples of misinformation tactics applied are the presentation of unqualified

“experts”, misleading the public through logical fallacies, creating impossible expectations for scientific research, cherry-picking data or selected anecdotes, and spreading conspiracy theories [13,18].

2.3. Instrument Factors

Instrument factors relate to issues with media that disseminate information leading to an infodemic. These issues were reported in scientific and general media, for traditional outlets (e.g., television channels, newspapers, and radio channels), as well as for online and social media formats [5-10,19-23]. Specifically, medical journals published low-quality non-transparent articles without the usual standard of academic and editorial rigor [7]. Most of the thousands of articles published on COVID-19 were not original research but reviews and editorials with evident absence of evidence-based guidelines [10]. Social media, usually operating in an unregulated environment, contributed to disseminating both accurate information conveyed by experts, but also misinformation and speculation [11,22,24]. False information and unsourced recommendations on health were spread by various outlets including digital media [6]. Widespread availability of information on the internet and low-barrier access to electronic media facilitated sharing and amplifying genuine and fake messages [16,19,23]. Bots (i.e., software applications that automatically conduct tasks on the internet and social media without human interaction) contributed to the infodemic [21].

2.4. Recipient Factors

Recipient factors relate to the individual or the group that is opposed to the infodemic. A lack of adequate preparedness for the pandemic was identified as an issue, in addition to a widespread low digital health literacy [15,21]. A lack of trust in the government and a lack of scientific knowledge can lead to the increased consumption of misinformation [24]. Magarini et al. identified specific socio-environmental conditions, psychological processes and attitudes in addition to contextual factors that can render individuals vulnerable to irrational and adverse beliefs in the infodemic [14]. In particular, these factors included low educational level, younger age, low level of epistemic trust, avoidance of uncertainty, extraversion, collective narcissism, a conspiracy-prone mindset, high level of self-perceived risk, and anxiety [14]. Possible reasons for susceptibility for vaccine hesitancy are mistrust of doctors, health services, the government, the pharmaceutical industry, safety concerns, complacency over low perceived personal risks, misinformation, religious beliefs, dietary restrictions, historical concerns, a particular lifestyle (“natural medicine”), or COVID-19 denial [25].

3. Misinformation and myths documented during COVID-19 pandemic

3.1. Origin of pandemic

Since the beginning of the pandemic, misinformation was circulated regarding the origin of COVID-19 pandemic. Misinformation was rapidly dispersed in communities with ultrafast social media such as electronic, newspaper, WhatsApp and social gatherings. More misinformation was transferred from social media to the general population with special emphasis such as viruses is man-made and this pandemic is intentionally done and global spread is as per strategy of third world to control the entire world. Another surprising hypothetical misinformation which has circulated for a longer time and created havoc in the community is Laboratory leak of manmade virus. Also, fake news was circulated that during the early phase of laboratory leak in Wuhan province in China few cases with throat infection and pneumonia were diagnosed and tried to notify by the otolaryngologist surgeon to health authority. The mentioned otolaryngologist surgeon who has tried to inform and make aware general community and health agencies which will prevent rapid transmission of virus in the community was mischievously disappeared and now he is not traceable since then. Another health conscious, disastrous misinformation was circulated in social media as COVID-19 is used as bio-weapon by using vector Corona virus and considered as Bioterrorism. Lastly, one more interestingly surprising, fake, and notorious misinformation spread that the COVID-19 cases data was intentionally underreported from China. Misinformation spread in such a way that China is making unaware of this deadly virus and cases to the entire world. The Chinese government is falsely reporting the number of cases and deaths to create distress in the community and general population of the entire globe. They are reporting a huge number of cases when there is an actual minor pandemic issue and reporting minor health issues in the community whenever there is a significant health burden. Misinformation was also spread regarding the number of cases and death due to COVID-19 in China.

Impact of these misinformation's has created misunderstandings in the community and resulted in facing difficulty in controlling pandemic during the 'lock down' period. This false information has developed the mindset of the general population against lockdown by government agencies to implement zero covid policy. Lockdown was the correct step to control pandemic by means of curtailing the natural course of viral transmission in a large geographical area. Lowdown has helped in decreasing the total number of cases, and the untimely total number of critical cases. Lockdown has given 'enough breath time' to fatigued health professionals and paramedical staff to rejuvenate and work efficiently

to tackle rapidly evolving pandemic in all three waves. Lockdown has taught the general community to concentrate on health in this day to day 'cat-mouse race' life. Still, as of today, this misinformation has not corrected in spite of awareness in community by utmost efforts by government agencies, health professionals and social media even after three years of pandemic [26-30].

3.2. 'Disease of concern'

The coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome (SARS)-Cov-2 virus, emerged into a pandemic within a month of its emergence. On January 30th, World Health Organization (WHO) declared a "public health emergency of international concern" and termed it as the "worst pandemic" the world has seen so far since the Spanish Flu of 1918. [26-30] Misinformation was circulating for a longer time till today regarding delay in information by the World health organization regarding potential spread of local corona virus outbreak in Wuhan, China and possible chance of spread to nearby countries and possible chance of epidemic and pandemic nature of disease. Another notorious and distressing misinformation was spread as like 'speed of light' that China and WHO jointly had intentionally delayed the announcement of 'public health emergency' in declaring COVID-19 pandemic. Further, rumors are circulating that WHO has waited till circulation and transmission of coronavirus related Global Pandemic COVID-19 occurs to one third of world's population and is delayed to declare as pandemic and 'Disease of Concern' afterwards. Even other misinformation was spread that local surge of corona virus cases in Wuhan, China has been noticed by WHO and even rapid rise leading to epidemic has been informed by CDC in China, but, still there was no restriction to travellers across the globe, those travelling from China which would have been halted transmission across the globe. This has created misunderstandings and doubt on information usually shared by the public health department and WHO to the community for the betterment of people living on this planet. But the real fact is, WHO has taken utmost efforts to save mankind on this planet from this deadly COVID-19 pandemic by timely sharing correct information, knowledge regarding treatment options and making availability of resources to tackle this pandemic for last three years as done before in previously known global pandemic as well.

3.3. Unnecessary evaluation and overestimation by antigen/RT PCR test, blood investigations and HRCT thorax

More misinformation was circulating after the more disastrous words as 'manmade viral pandemic' COVID-19 is irrational use of diagnostic methods, investigations during outdoor and indoor period and HRCT use to evaluate severity of illness. During the initial phase of pandemic and after a few days of first wave of COVID-19, more misinformation was evolved regarding the role of diagnostic kits such as rapid antigen test and-PCR test. In spite of correctly shared information regarding sensitivity of these tests, few anti-social organizations have created confusion in the general community that these tests are irrationally used and reports are manipulated as per policy makers decision. That time, many cases classically showing radiological patterns were shown negative antigen and RT PCR results and cases with minimally symptomatic to asymptomatic cases were shown positive test results. Due to the anxiety of the rapidly evolving pandemic, globally, many cases irrespective of their illness as mild to severe have lost their lives due to sudden cardiac insult due to fear of this illness. Many peoples have committed suicide due to misinformation of this disease.

Similarly, misinformation about the role of HRCT in evaluating severity was on top during all three waves of COVID-19 pandemic. More notorious and wrong comments were circulating towards overestimation of HRCT severity score and more fear about doing imaging due to chances of detection of lung infection and further steps as hospitalization. Imaging methods were a real guide along with inflammatory markers and clinical status such as oxygenation were assessed as 'composite index'. Still, as of today, misbelief is unnecessary hospitalization due to 'pseudo-covid like infiltrates' in lung imaging in ongoing chronic lung disease. This was partially correct due to overestimation in cases with cardiac failure and underlying ILDs but this line does not fit all.

Lastly, misinformation regarding laboratory markers of inflammation and their overuse, overestimation and overuse of IL-6 guided therapy were circulated till today. Inflammatory markers such as IL-6, CRP, LDH, Ferritin, D-Dimer were more commonly used during decision making whether to manage in indoor or outdoor settings. These markers were helped in treatment planning and interventions accordingly whenever the course deteriorates. Actually, these markers helped in prediction of outcome along with clinical and radiological parameters. Thus, composite index methods using clinical, imaging and laboratory markers have saved many cases due to early interventions. Financial burden was the main concern of these markers whenever performed frequently during hospitalization.

3.4. Treatment options

As of today, different institutional treatment protocols and respective national guidelines have been evolved all over the world with team of medical experts and recommended for combinations of antiviral, antibiotics, steroids,

anticoagulants with variable outcomes. COVID-19 pandemic is not ended up till today due to various mutants and genetic structural recombination's, and main hurdle is no effective treatment is available in spite of fast-track developments. Medical evidence suggests the beneficial role of 'combo therapy' as combination of antiviral, anticoagulants and steroids has shown mortality and morbidity benefit across the globe. Misinformation was evolved in parallel to COVID-19 waves to different treatment options such as Remdesivir, steroids, anticoagulants and anti-IL-6 therapies. Cases facing complications such as post covid lung fibrosis, mucormycosis (black fungus), rheumatological symptoms post covid and cases with cardiovascular or renal dysfunctions were spreading rumors irrationally which has created havoc in community [26-30].

Social media has played a crucial role in spreading wrong message regarding doubtful role of Remdesivir in COVID-19 and these non-scientific comments and statements spread without available research has created misunderstanding in majority of recovered cases, especially in those facing 'long covid' manifestations. [31-38] In an Indian study [39-40] it was observed, 8% patients had an ongoing symptomatic phase of COVID, lasting 1-3 months, and 31.8% patients had post-COVID phase, with symptoms lasting 3-12 months. 11% patients continued to have at least one symptom even at the time of the second interview (9-12 months from the disease onset). Long-COVID was reported in almost 40% of this study group. Occurrence of Post-COVID symptoms had no correlation to age, gender, comorbidities or to the disease severity. The duration of symptom resolution was also not associated with age, gender or comorbidity but was found to be significantly associated with severity of illness at the time of admission. Fatigue was significantly more prevalent amongst the elderly patients and in those who had severe COVID-19. Persistence of breathlessness was significantly more often reported by those patients, who had severe illness at presentation. Presence of neuropsychiatric symptoms like depression, anxiety, "brain fog" and sleep disorders were reported in nearly 9% of cases. No patient reported any significant organ damage. A significant number of patients (16.5%) continued to have some form of post COVID symptoms for as long as 6-12 months, a majority of them, had resumed their routine work much earlier. 31.2% patients took 1 month to resume daily routine while 6.4% took almost 4 months to resume their daily routine. [39-40] Thus Remdesivir was considered as 'causing more harm than actual benefit' due this misinformation which was rapidly evolved during second wave.

Post COVID fibrosis was most common Lung parenchymal sequel which has reversed and should be considered as sequel rather than fibrosis. The medical science is evolving, nobody knows fate of this dismal word fibrosis in COVID-19 is reversible during evolution of pandemic. This was critical misinformation circulating that COVID-19 is deadlier threat causing harm during and after disease as lung fibrosis especially in those cases requiring oxygen supplementation at home [41-43].

More misinformation and fear of Mucormycosis or 'black fungus' after Remdesivir and steroid use in COVID-19 cases was on top after second wave in India. Mucormycosis, both pulmonary and extrapulmonary (eyes, nose, sinuses, cerebral), a fungal infection as a complication documented during evolution of COVID-19 lung pneumonia predominantly in second wave as compared to first wave across the country. Rational for documentation especially in second wave was unclear, may be related to more steroid use due to rapidly evolving ARDS and more virulent nature of Delta variant, corona virus-mucor fungus symbiosis to gain access through mucosal inflammation in airways, humidifier chamber of oxygen supplementation system contamination with fungal spores, but exact reason of occurrence was unknown. Mucormycosis was never documented before with any respiratory virus-related pandemic as caused with influenza virus as in Spanish flu or corona virus related epidemics like SARS or MERS. Initially more misinformation was circulated regarding its association with use of Remdesivir. As of today, even after three years of pandemic, may patients have recovered from this deadly illness are considering this misbelief as concurrence with remdesivir use. But the actual fact is that, Remdesivir has saved millions of lives by preventing progression of illness and observed its role in COVID-19 pneumonia worldwide. Remdesivir has no significant effect on patients with COVID-19 who are already being ventilated. Among other hospitalised patients, it has a small effect against death or progression to ventilation due to COVID-19 pneumonia [75].

More misinformation was circulated regarding remdesivir and steroids use in COVID-19. Remdesivir was one of the effective options with steroids and anticoagulation. Rational was created as per extrapolation of social media would be 'demand supply' discordance as noted during the second wave due to rapid evolution of Pandemic and more than three lakhs' cases daily. Shortage of Remdesivir created more distress in the community in such a way that Remdesivir was black-marketed in the country with exaggerated rates of ten to twenty times of marketing price. Remdesivir was used right left in all COVID-19 cases irrespective of disease severity and irrationally used even after National Task force recommendations to use only in selected cases with desaturation and advanced disease according HRCT severity. This stage of shortage and demand supply issue is the main culprit for more misinformation spread to prevent irrational use whenever it is not required and to maintain adequate supply where there is actual need. This misinformation of

Remdesivir use and possible long covid symptoms is still as of today, causing more wastage of time in counselling in patients facing long covid manifestations in post covid care setting regarding its link to COVID-19 and not to remdesivir.

Misinformation regarding the potential role non-allopathic medicines including multivitamins, zinc and ayurvedic medicines. This leads to aversion to allopathic medicines available and evidence-based protocols in controlling and curing COVID-19. Misinformation spread to such level that many peoples are self-medicating with non-evidence based ayurvedic and herbal medicines which has no scientific proof as they are effective against this pandemic virus. This misinformation and self-medication have resulted in to worsening of illness and presented to hospital in advanced stage which ultimately has increased cost of care, requirement of aggressive interventions in intensive care units and lastly the altered outcome in terms of increased mortality which has been observed in many centers of the country. Self-medication and underestimation have also increased risk of transmission to other household members as they thought that they will receive allopathic medicines if they were hospitalised in covid care centers.

Misinformation regarding use and benefit of various herbal remedies labelled as 'kadhas drops and solution' were irrationally used during COVID-19 pandemic with or without allopathic universally accepted protocols. Scientific evidence for actual benefit of these kadhas were not known or established in clinical studies and trials as of today. Various misinformations were circulated stating that kadhas are superior to allopathic medicines, kadhas will decrease need for hospitalization, kadhas will not have any side effects as documented with allopathic medicines. Main 'driving factor' for this misinformation and exuberant use of kadhas during COVID-19 pandemic was 'fear of poor outcome' and anxiety to use allopathic medicines which has created 'blind faith' in herbs and kadhas over allopathic medicines. Another plausible reason for misinformation was allopathic medicines have not shown dramatic results during early phase of pandemic due to evolving nature of COVID-19 and as a new disease globally, peoples are keeping 'faith' on these scientifically unproven or remedies with unknown efficacy as frontline treatment. Kadhas are more popular due to their no known or unknown adverse events reported or notified by patients and community.

This misinformation was causing more emotional harm to treating physicians and nurses, and common peoples were asking more non-scientific queries regarding spread of virus, symptoms, diagnostic techniques and treatment options. In a few places, hospital paramedic staff were not allowed to enter in their housings due to rumor of spread of disease by these healthcare professionals.

3.5. Vaccination

Since start of COVID vaccination, more misinformation was spread in 'speed of light' due to ultrafast electronic social media. Misinformation and myths documented during vaccination program were recorded many. Few of them are as, The COVID-19 vaccine is unsafe because it was developed so quickly, The COVID-19 vaccine will alter my DNA, The COVID-19 vaccine includes a tracking device, The COVID-19 vaccine has severe side effects such as allergic reactions, The COVID-19 vaccine causes infertility in women, I've already been diagnosed with COVID-19, so I don't need to receive the vaccine, Once I receive the COVID-19 vaccine, I no longer need to wear a mask, You can get COVID-19 from the vaccine, Once I receive the vaccine, I will test positive for COVID-19, I'm not at risk for severe complications of COVID-19 so I don't need the vaccine, If I receive the COVID-19 vaccine, I am at a greater risk to become sick from another illness, Certain blood types have less severe COVID-19 infections, so getting a vaccine isn't necessary.

Another vaccine related misinformation which was circulated is of less benefit of protection offered after one dose and requirement of frequent dose due to short lasting immune memory. Few cases were reported as 'breakthrough disease' during the first two week of vaccination and more havoc is created by propagating the message as 'vaccine is causing COVID-19 and all vaccinated individuals test RT PCR positive'. These non-scientific comments have caused more instability in the community regarding those willing to get covid vaccine. Few cases received vaccine before second wave; and those received covid vaccine were required intensive care unit hospitalizations as 'breakthrough infections' with more virulent delta variant. That was real turnout and aversion to vaccines from the community and majority were nodding for vaccination. Few cases received covid vaccine developed minor allergic reactions and some documented major adverse events. Reversible rheumatological disease without life threatening emergencies were documented after covid vaccination [45-46]. Few cases were observed of life-threatening events which has created a panic stage which has negative effects on vaccination.

Another misinformation is that COVID vaccine has very short-lasting memory, which will remain for three to six months. Main concern of protection from acquiring infection starts after two weeks after vaccination and remains for three months. Hence, common peoples are reluctant to take vaccine shots due to short protection with each dose from two weeks to twelve weeks. They also self-interpreted that, what is real benefit of vaccine if potential adverse vents considered and importantly efficacy is not 100 percent even after two to three doses. There was another misinformation

that vaccine was prepared in short time without much research and trials. Hence this covid vaccine is less effective, more adverse events and less potent to protect from acquiring infection.

4. Scientific evidence and reality of COVID-19 pandemic

4.1. Origin of pandemic

Scientific evidence of corona virus strain causing COVID-19 is still unknown in spite of three years of pandemic. Medical experts, microbiologists and researchers now come to conclusion that animal contaminant from seafood wholesale animal market. In two February preprint papers, first reported by the New York Times, researchers traced the spread of the SARS-CoV-2 virus, the pathogen that causes Covid-19, in 2019 in Wuhan. One study looked at initial infections at the Huanan Seafood Wholesale Market, where the first cases were detected. The other examined the genomes of the earliest strains of the virus. Around the same time, researchers from the Chinese Centers for Disease Control and Prevention published their own findings from virus samples they collected from animals and the environment around the market in early 2020. [47] The latest round of research does have its limitations. Scientists noted that they may have missed some infections, since many Covid-19 cases don't cause any symptoms at all. "For every one of the COVID-19 cases who became ill enough to be among the 174 hospitalized patients with illness onset in December of 2019, there were likely more than ten milder cases that went unnoticed," researchers wrote in one of the preprint papers, neither of which has been peer-reviewed yet. They are also working more than two years out from the initial outbreak, limiting what they could examine. And while they traced the virus to a specific area with live animals, the Chinese CDC observed that "no SARS-CoV-2 was detected in the animal samples from the market." The SARS-CoV-2 virus likely stems from a virus found in bats, and the most similar known bat virus was found last year in Laos [47].

Possible Pathways of Emergence- [48] In summary, the joint team considered the following ranking of potential introduction pathways, from very likely to extremely unlikely: (1) through an intermediate host; (2) direct zoonotic introduction; (3) introduction through cold/ food chain; and (4) introduction resulting from a laboratory incident.

To further investigate possible direct zoonotic introduction, detailed trace-back studies of the supply chain of the Huanan market (and other markets in Wuhan) have provided some credible leads to be followed. These leads can be followed to develop further surveys of potential reservoir hosts, including genomic surveys and serosurveys of high-risk potential reservoir hosts and their human contacts. Given the geographic range of the animal species in which closest relatives of SARS-CoV-2 have been found, such surveys should be expanded to include other countries, guided by knowledge on ecology and smuggling routes [48].

Given the literature on the role of farmed animals as intermediary hosts for emerging diseases, further surveys including further geographic range are needed. Studies of the supply chain of the Huanan market (and other markets in Wuhan) have not found any evidence for presence of infected animals, but the analysis of supply chains has provided potential information that will inform a targeted design of follow up studies. For instance, there was evidence for supply chains leading to wild-life farms from provinces where the higher prevalence of SARSr-CoVs have been detected in bat surveys. While this does not prove a link, it does provide a meaningful next step for surveys, as model for similar studies in neighboring regions. Meanwhile animal products from areas outside southeast Asia where more distantly related SARSr-CoVs circulate should not be disregarded. Surveys should be designed using a One health approach in larger areas and more countries, including genomic surveys and structured serosurveys of high-risk potential reservoir hosts and their human contacts [48].

In order to further study the potential for (frozen) food as a source of infection or the cold chain as an introduction pathway of SARS-CoV-2, case-control studies of outbreaks in which the cold chain product and food supply is positive would be useful to provide support for cold chain products and food as a transmission route. There are some preliminary reports of SARS-CoV-2 positive testing in other parts of the world before the end of 2019. There is also evidence of more distantly related SARSr-CoV in bats outside Asia. Some producers located in these countries were supplying products to the markets. If there are credible links to products from other countries or regions with evidence for circulation of SARS-CoV-2 before the end of 2019, such pathways would also need to be followed up. Screening of leftover frozen cold chain products sold in Huanan market from December 2019 if still available is needed, particularly frozen animal products from farmed wildlife or linked to areas with evidence for early circulation of SARS-CoV-2 from molecular data or other analyses [48].

Although rare, laboratory accidents do happen, and different laboratories around the world are working with bat CoVs. When working in particular with virus cultures, but also with animal inoculations or clinical samples, humans could become infected in laboratories with limited biosafety, poor laboratory management practice, or following negligence.

The closest known CoV RaTG13 strain (96.2%) to SARS-CoV-2 detected in bat anal swabs have been sequenced at the Wuhan Institute of Virology. The Wuhan CDC laboratory moved on 2nd December 2019 to a new location near the Huanan market. Such moves can be disruptive for the operations of any laboratory. In view of the above, a laboratory origin of the pandemic was considered to be extremely unlikely [48].

4.2. Disease of concern

Timely global announcement by WHO and declaring COVID-19 as pandemic has helped in preparedness of health planning for preventions of evolution of pandemic by various disease control strategies. 'Lock down' is first time reported in history of mankind and showed significant impact on decreasing mortality by allowing more time for health sector planning for care of COVID-19 cases. Lock down not only decreased case burden, but slowly evolving pandemic by decreasing case surge have documented help in preventing paralysis of health sector due to exaggerated case burden and shortage of hospital beds and ventilators, oxygen across the world irrespective of population.

Authentic information regarding mode of transmission, methods for control, treatment options variable, need of efficient vaccine and daily global and local burden as reported and right information available freely in electronic media has helped in strategic planning and framing national guidelines by National task force teams. Useful, scientific, evidence-based information which is shared on data base created by WHO has shown significant impact on practice changing points in managing these cases, especially those facing dengue covid overlap in second wave of COVID-19. [48-50] Also COVID-19 cases with concurrent comorbid illnesses such as stroke, cardiovascular issues, hyponatremia and concurrent infections were also notified during this pandemic. [51-53] This scientific timely information has helped treating physicians and intensivists in triaging of cases during management in outdoor and indoor units.

4.3. Role of laboratory markers, HRCT thorax

Inflammatory markers such as CRP, LDH, Ferritin, D-Dimer and IL-6 were used globally during this pandemic during management of COVID-19 cases. Markers are easily available, sensitive, reliable, cost effective, and universally acceptable inflammatory marker in COVID-19 pneumonia [54-57]. All inflammatory markers (CRP, LDH, Ferritin, and IL-6) has very crucial role in COVID-19 pneumonia in predicting severity of illness, especially 'follow up titres' have significant role in step-up or step-down interventions in critical care setting. Correlating all inflammatory markers (CRP, LDH, Ferritin, and IL-6) with variables as duration of illness, oxygenation status and timing of BIPAP/NIV has important role in predicting outcome [58-63]. All inflammatory markers (CRP, LDH, Ferritin, and IL-6) has significant association in predicting progression of pneumonia and we have documented that proportionate number of COVID-19 cases with mild variety on CT thorax with normal initial CRP has progressed to critical course [58-63]. Studies have also documented that serial or follow up inflammatory markers (CRP, LDH, Ferritin, and IL-6) titers has played crucial role along with other inflammatory markers. Studies have observed rising CRP titers, especially in second week of illness indicates nosocomial bacterial infection and guided in targeting antibiotic treatment accordingly [61-67]. Inflammatory markers (CRP, LDH, Ferritin, and IL-6) follow-up titer can help in predicting progression of COVID pneumonia and assessing risk of post-COVID lung fibrosis [61-67]. Correlating D-dimer with variables like duration of illness, oxygenation status and timing of BIPAP/NIV at entry point is important to have satisfactory treatment outcome. D-Dimer follow up titer has documented role in predicting lung fibrosis and deep vein thrombosis and pulmonary embolism [68-70].

Radiological phenotypes are radiological patterns or observable characteristics of COVID-19 pneumonia. Robust data is available regarding role of HRCT in COVID-19 pneumonia and we have evaluated role of radiological phenotypes in assessing severity, predicting response to therapy and final outcome in COVID-19 pneumonia. Radiological patterns or phenotypes have documented important role in assessing disease severity in COVID-19 pneumonia. Easy to treat and Difficult to treat phenotypes help in triaging the cases at entry point in correlation with clinical and laboratory inflammatory markers analysis. Phenotypic categorization is simple, sensitive and guided during treatment planning in indoor units. Presence or absence of GGOs, consolidations and crazy paving with necrosis were key radiological markers in categorizing these phenotypes. Radiological phenotyping should be correlated with clinical and laboratory parameters for accurate analysis of severity assessment, duration illness prediction and inflammatory markers workup. Phenotyping will also help in monitoring of COVID-19 pneumonia cases and guide for necessary timely interventions in indoor units to have successful treatment outcome. Post covid fibrosis is reversible and should be labelled as sequelae due to near total reversible nature [71-72].

4.4. Treatment options

COVID-19 is first *corona virus related* global pandemic caused by *novel SARS-Cov-2* (severe acute respiratory syndrome-corona virus-2), and rapid evolution of pandemic has resulted in fast-track developments in antivirals, medical

management and vaccination for use to prevent morbidity and mortality. As of today, different institutional treatment protocols and respective national guidelines have been evolved all over the world with team of medical experts and recommended for combinations of antiviral, antibiotics, steroids, anticoagulants with variable outcomes. Combination therapy has documented better outcome with significant reduction in mortality and morbidity and considered as frontline protocol during this pandemic.

Remdesivir is a nucleotide prodrug of an adenosine analog. It binds to the viral RNA dependent RNA polymerase and inhibits viral replication by terminating RNA transcription prematurely. Remdesivir has been approved by U.S. Food and Drug Administration (FDA) on 1st may 2020 and Central Drugs Standard Control Organization (CDSCO) India on 20th June 2020 for its emergency use in COVID-19 in adults and children's above 12 years of age exclusively in indoor care facility. As per ministry of health and family welfare (MOHFW) and Indian Council of medical Research (ICMR) India on 23 April 2021, Remdesivir should be used only in select moderate/ severe hospitalized COVID-19 patients on supplemental oxygen as it is a reserve drug approved under Emergency Use Authorization only based on limited scientific evidence globally; and should not use in mild COVID-19 patients who are in home care/ Covid Care Centers.[73] Remdesivir use in COVID-19 has been evolved over last one year and research data from trails is available suggesting its use and also of no benefit; clinching overall clinicians' decision to use in indoor setting. 'Adaptive COVID-19 Treatment [GM1] Trial' found that Remdesivir is useful in cases of COVID-19 with SpO₂ < 94% on room air (moderate to severe cases) if it is administered within 7 to 10 days of illness. Remdesivir led to a shorter median time from randomization to recovery (10 days, vs. 15 days with placebo) and may have reduced the time to hospital discharge (12 days vs.17 days) but did not show a mortality benefit [74]. The 'Solidarity Trial' conducted by WHO in 30 countries from March 2020 at 405 hospitals; 11330 adults underwent randomization; 2750 were assigned to receive Remdesivir. The interim results of the 'WHO Solidarity trial' published on December 2020 showed that Remdesivir had little or no effect on hospitalized patients with COVID-19, as indicated by overall mortality, initiation of ventilation, and duration of hospital stay [75]. Remdesivir was the first FDA-approved drug for the treatment of patients with COVID-19 but its effectiveness is disputed, emphasizing the need to develop new antiviral drugs.

Methylprednisolone and Dexamethasone were used globally in management of COVID-19 pneumonia with different dosages, durations and treatment outcomes. Methylprednisolone has higher lung penetration; thus, it can act as a better immunosuppressive agent in the treatment of COVID-19 and in improvement of respiratory complications in comparison to dexamethasone. In one study authors documented mortality rates were lower in patients who received methylprednisolone than those who received dexamethasone (8 vs. 15), though this did not reach statistical significance [76]. In a retrospective cohort study done by Wang et al., evaluating the treatment of patients suffering from COVID-19 with low dose methylprednisolone with short term duration, patients who received 1-2 mg/kg/day methylprednisolone for 5-7 days had shorter hospital course duration, less need for mechanical ventilation [77]. In a randomized clinical trial done by Edalatfard et al. documented Pulse methylprednisolone 250 mg/day for 3 days had a lower mortality rate and higher survival time than the control group, observed an increase in O₂ saturation, lesser clinical findings such as myalgia, chest pain, cough, and gastrointestinal symptoms and reduction in the CRP level and an increase in the platelet count in those who were treated with methylprednisolone compared to those who received standard care [78]. In the current trial by the COVID STEROID 2 Trial Group, patients with COVID-19 and severe hypoxemia, 12 mg/d of dexamethasone compared with 6 mg/d of dexamethasone did not result in statistically significantly more days alive without life support at 28 days [79].

In COVID-19 pneumonia, thromboembolic events documented in increased proportion to other pneumonias due to prothrombotic pathway activation as a result of exaggerated inflammatory response, endothelitis, stasis of blood due to deconditioning and activation of coagulation cascade in critical care setting as mentioned in Virchow triad i.e., endothelial injury, stasis of blood flow and hypercoagulable state resulting into thrombosis and embolism. [80] The American Society of Hematology (ASH) & The American College of Cardiology suggests using prophylactic-intensity over intermediate intensity or therapeutic-intensity anticoagulation for patients with COVID-19-related critical illness who do not have suspected or confirmed VTE and there is no specific contraindication such as active bleeding exists [81]. All the guidelines recommend heparin in therapeutic doses only in diagnosed or highly suspected macrothrombi (PE/DVT), while ignoring the issue of undiagnosable microthrombi. Although significantly elevated levels of d-dimer are more likely to be associated with VTE, it is difficult at this point to identify the threshold that can only be used to diagnose thrombus non-invasively [82]. Low molecular weight heparin (LMWH) i.e., Enoxaparin or Fondaparinux is preferred due to easy to use, lesser side effects, wheel tolerability, lesser risk of bleeding and no need to aPTT monitoring. Decisions regarding post-discharge prophylactic anticoagulation should be individualized, Routine administration of oral anticoagulants in all patients with COVID-19 at the time of discharge is not recommended. The American College of Chest Physicians guidelines published in CHEST as well as the American College of Cardiology guidelines published in the Journal of the American College of Cardiology (JACC) do not elucidate on post-discharge thromboprophylaxis [83].

Although antibiotics play crucial role in bacterial pneumonia, antibiotics were prescribed in majority of cases in COVID-19 pneumonia across the globe. Two types of pneumonia have been documented in COVID-19 cases, primary viral pneumonia and secondary bacterial pneumonia. Proportionately large number of COVID-19 cases were having secondary bacterial pneumonia due to cytokine induced immune suppression, concurrent use of steroids during treatment of these cases resulting in immune suppression or and COVID-19 or steroid associated hyperglycemia leading to immunosuppression resulting in secondary bacterial infection. Secondary bacterial infection also documented in ICU setting due to contamination of nebulization kits and chambers, oxygen humidifiers ports, ventilator masks and circuits and other accessories used during handling of these cases. A systematic review on bacterial and fungal co-infections in coronaviruses reported an overall percentage of 8% co-infections in COVID-19 patients at any time during hospitalization [84]. Exact information about use and beneficial role of these combinations in preventing mortality would make more sense in preventing infodemic. Rational use of these combinations will prevent long term effects on lung functions in these cases recovered from COVID-19 pneumonia [85-86].

4.5. Vaccination

Coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has led to an unprecedented setback for global economy and health. Vaccination is one of the most effective interventions to substantially reduce severe disease and death due to SARS-CoV-2 infection. To date, treatments for COVID-19 are mainly targeted symptomatic treatment and supportive therapy. Currently, one of the most effective strategies for mitigating COVID-19 pandemic is global vaccination that can create an immune barrier among population to attenuate the speed and scope of SARS-CoV-2 transmission.

Most vaccines reduce, or probably reduce, the number of people who get COVID-19 disease and severe COVID-19 disease. Many vaccines likely increase number of people experiencing events such as fever or headache compared to placebo (sham vaccine that contains no medicine but looks identical to the vaccine being tested). This is expected because these events are mainly due to the body's response to the vaccine; they are usually mild and short-term. Many vaccines have little or no difference in the incidence of serious adverse events compared to placebo. There is insufficient evidence to determine whether there was a difference between the vaccine and placebo in terms of death because the numbers of deaths were low in the trials. Most trials assessed vaccine efficacy over a short time, and did not evaluate efficacy to the COVID variants of concern. [87]

SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) is the virus that causes COVID-19 disease. Not everyone infected with SARS-CoV-2 will develop symptoms of COVID-19. Symptoms can be mild (e.g., fever and headaches) to life-threatening (e.g., difficulty breathing), or death. While vaccines work slightly differently, they all prepare the body's immune system to prevent people from getting infected with SARS-CoV-2 or, if they do get infected, to prevent severe disease. [87]

Corona virus is less studied respiratory virus till date as of other respiratory viruses. Vaccination is key step and that too with most updated genetic makeup vaccine which is prepared by analyzing 'global viral genomic data' as in influenza is the only option to protect mankind from these smarter virions, and they will live with us and we should make adjustments according to them because they were present before we on this planet.

5. Main results of vaccinations done globally from WHO approved covid vaccines: [87]

We report below results for three main outcomes and for 10 World Health Organization (WHO)-approved vaccines (for the remaining outcomes and vaccines, see main text). There is insufficient evidence regarding deaths between vaccines and placebo (mainly because the number of deaths was low), except for the Janssen vaccine, which probably reduces the risk of all-cause deaths.

5.1. People with symptoms

- The Pfizer, Moderna, AstraZeneca, Sinopharm-Beijing, and Bharat vaccines produce a large reduction in the number of people with symptomatic COVID-19.
- The Janssen vaccine reduces the number of people with symptomatic COVID-19.
- The Novavax vaccine probably has a large reduction in the number of people with symptomatic COVID-19.
- There is insufficient evidence to determine whether CoronaVac vaccine affects the number of people with symptomatic COVID-19 because results differed between the two studies (one involved only healthcare workers with a higher risk of exposure).

5.2. Severe disease

- The Pfizer, Moderna, Janssen, and Bharat vaccines produce a large reduction in the number of people with severe disease.
- There is insufficient evidence about CoronaVac vaccine on severe disease because results differed between the two studies (one involved only healthcare workers with a higher risk of exposure).

5.3. Serious adverse events

- For the Pfizer, CoronaVac, Sinopharm-Beijing, and Novavax vaccines, there is insufficient evidence to determine whether there was a difference between the vaccine and placebo mainly because the number of serious adverse events was low.
- Moderna, AstraZeneca, Janssen, and Bharat vaccines probably result in no or little difference in the number of serious adverse events.

6. Vaccine effectiveness for full vaccination: [88]

The effectiveness (VE) of COVID-19 vaccines against a range of SARS-CoV-2 outcomes was estimated. A total of 35 articles reported VE against SARS-CoV-2 infection among fully vaccinated people, and the summary VE was 89.1% for the prevention of SARS-CoV-2 infection. In addition, 15 of the included studies estimated VE against COVID-19-related hospitalization, four studies estimated VE against COVID-19-related ICU admission or severe disease, and eight studies estimated VE against COVID-19-related death. The results showed 97.2% VE for the prevention of hospitalization, 97.4% VE for the prevention of ICU admission or severe disease, and 99.0% VE for the prevention of COVID-19-related death

6.1. Vaccine effectiveness for partial vaccination [88]

Regarding individuals with a partial immunization status, 38 included studies reported VE against SARS-CoV-2 infection, 12 reported VE against COVID-19-related hospitalization, three reported VE against COVID-19-related ICU admission or severe disease, and eight reported VE against COVID-19-related death. The summary VE was 68.8% for the prevention of SARS-CoV-2 infection and 67.8% for the prevention of hospitalization, 66.4% for the prevention of admission to the ICU and severe disease, and 58.4% for the prevention of COVID-19-related death.

This review, including 51 up-to-date studies from 14 countries, reporting on the effectiveness of COVID-19 vaccines, provides estimates of the VE against disease with laboratory-confirmed SARS-CoV-2 infection, and COVID-19-related hospitalization, admission to the ICU, and death. Estimates of VE against infection in subgroup analyses for vaccine brand, vaccinated population, and vaccination status are presented. The results suggest that the vaccines currently approved for use have a good protective effect against the major outcomes related to COVID-19, especially for critical outcomes. [89]

In this systematic review and meta-analysis of 18 peer-reviewed studies, which included nearly 7 million individuals, we found evidence of waning immunity against SARS-CoV-2 infection from a high of 83% at one month to 22% at five months or longer after being fully vaccinated. Similar trends were observed for symptomatic COVID-19. VE against SARS-CoV-2 infection declined more rapidly in individuals \geq age 65 years but was less than 50% in all age groups by month five. [89] The impact of temporal waning of vaccine effectiveness against SARS-CoV-2 infection raises concern that initially effective vaccination strategies will not be sufficient to mitigate the individual and population level effect of COVID-19 long-term. Historically, waning immunity for other infectious diseases has been addressed by administering subsequent doses of vaccine, e.g., booster doses. [90] When considering only the highest quality studies, VE was 83%, 93% and 91% for infection, symptomatic, and severe COVID-19, respectively.

7. Myths should be replaced with facts of current information with scientific evidence

- The vaccines are proven safe and effective. Although they were developed in record time, they have gone through the same rigorous Food and Drug Administration process as other vaccines, meeting all safety standards. No steps were skipped. Instead, we can thank the unprecedented worldwide collaboration and investment for the shorter timeframe on the development of the vaccines. The clinical trials and safety reviews actually took about the same amount of time as other vaccines.
- The Pfizer and Moderna vaccines in use contain messenger RNA (mRNA), which instructs cells to make the “spike protein” found on the new coronavirus. When the immune system recognizes this protein, it builds an

immune response by creating antibodies — teaching the body how to protect against future infection. The mRNA never enters the nucleus of the cell, which is where our DNA (genetic material) is kept. The body gets rid of the mRNA soon after it's finished using the instructions.

- Some participants in the vaccine clinical trials did report side effects similar to those experienced with other vaccines, including muscle pain, chills and headache. And although extremely rare, people can have severe allergic reactions to ingredients used in a vaccine. That's why experts recommend people with a history of severe allergic reactions — such as anaphylaxis — to the ingredients of the vaccine should not get the vaccination.
- Misinformation on social media suggests the vaccine trains the body to attack syncytin-1, a protein in the placenta, which could lead to infertility in women. The truth is, there's an amino acid sequence shared between the spike protein and a placental protein; however, experts say it's too short to trigger an immune response and therefore doesn't affect fertility.
- Masking, handwashing and physical distancing remain necessary in public until a sufficient number of people are immune. Fully vaccinated people can meet with other fully vaccinated people without wearing masks.
- You cannot get COVID-19 from the vaccine because it doesn't contain the live virus.
- Viral tests used to diagnose COVID-19 check samples from the respiratory system for the presence of the virus that causes COVID-19. Since there is no live virus in the vaccines, the vaccines will not affect your test result. It is possible to get infected with the virus before the vaccine has had time to fully protect your body.
- Regardless of your risk, you can still contract the infection and spread it to others, so it's important you get vaccinated. Once the vaccine is widely available, it's recommended that as many eligible adults as possible get the vaccine. It's not only to protect you but your family and community as well.
- There is no evidence to suggest that getting the vaccine heightens your risk to become sick from another infection such as the flu.
- Research has shown there is no reason to believe being a certain blood type will lead to increased severity of COVID-19. By choosing to get vaccinated, you are protecting not only yourself and your family but your community as well.

7.1. Measures to control Infodemic

Infodemic has very poor impact on physical, social, economic and personal well beings/ Infodemic can be controlled with joint and collaborative efforts of medical, social and political team involvement in co-ordinated manner. Basic components of knowledge, attitude and practice trends dissemination with active involvement of medical professionals, government agencies and social media.

7.1.1. Medical Team

Includes Medical experts such as pulmonologists & critical care physicians, Research scientists, and chairpersons of National medical bodies including medical association and physician association

7.1.2. Social Media

Includes Journalists, editors or chairpersons of national newspapers, TV channels, Facebook or twitters CEOs

7.1.3. Judiciary team

Including cyber cell department of local, district, state and National (central) team for urgent action if required in scenario with misinformation and to halt the process of rapid dissemination by means blocking the Facebook, twitter, emails accounts those spreading misinformation. Cybercrime cell department should work actively to tackle rampant spread of misinformation & necessary judiciary actions against those spreading misinformation.

7.1.4. Government organizations and political commitment

Involvement of medical experts and health scientist actively during policy making and national guidelines for timely preparedness pandemic and framing the guidelines for universal and rational treatment across the country during guidelines.

7.1.5. Nongovernment organizations

Involvement of NGOs will help in managing all components such as medical, social and policy makers and increase awareness by spreading right information by coordinating journalists.

7.1.6. Trust Organizations

Including trust organizations in dispersing right information based on available scientific evidence and global research and enrolling them in basic training sessions as local health center will play major role in controlling infodemic. Diverse cultural trends, societies and populous countries like India is having cluster of these trust organizations as per cast, religion and language. Dharmgurus or Presidents if these organizations are working as 'role model' to communities irrespective of literacy, economy and social status. Trainings of them and then knowledge dispersion in community is their basic role in halting spread of misinformation at large geographical area.

7.2. Role of the social media during pandemics

7.2.1. Fighting false news and misinformation

- Using diagnostic and referral health tool (Example: Facebook Preventive Health tool)
- Individualized approach for evaluation, testing, counselling based on reported symptoms
- Highlighting and debunking rumours, providing relevant data
- Integrating data from search engines (like Google) to understand and study trends of misinformation
- Prevent information-overload and content related to xenophobia, stigma and prejudice

7.2.2. Enabling digital health literacy

- Video-conferences and webinars
- Live platforms (like Facebook, Instagram) for awareness campaigns
- Liaison between journalists and physicians

7.2.3. Helping research during crisis

- Search data can be pooled and studied to understand the unmet needs
- Community public health research

7.2.4. Resource and psychological preparedness during pandemics

- Liaising with public health platforms (WHO, CDC, ICMR, etc.) and forums like “worldometer” to update statistics and trends of ongoing infection
- Integrating essential service location and contact tracing using special applications
- Counselling, mental health crisis intervention and suicide prevention

7.2.5. Crisis communication

- Identifying priorities, providing relevant facts and precautionary measures

7.2.6. Fighting stigma

- Assisting community awareness campaigns through advertisements and promotion
- Incorporating popular/public figures in the media
- Information-Education-Communication (IEC) activities
- Socio-culturally and linguistically sensitive infographics

7.2.7. Facilitating public health needs

- Geo-location facilities for identifying hotspot zones and case loads
- “COVID-free” content for recreational purpose
- Special services for those in quarantine
- Training and health-communication between tertiary and primary health care

7.2.8. Addressing mental health

- Social connectedness in community and enhancing mutual support
- Mitigating loneliness
- Increasing “COVID-free” content to reduce panic
- Fostering optimism and hope

- Humanizing mental illness
- Providing authentic information of mental disorders and treatment
- Advocating and promoting mental wellbeing through media programs (especially for the vulnerable groups and those with pre-existing psychiatric disorders)
- Counselling using cyberspace Sensitive reporting of suicides (including celebrity suicides)

7.2.9. Aiding healthy use of media

- Advocate healthy use of technology
- Regulated timelines and content

A psychosocial community-based toolkit for COVID-19 proposed by Banerjee and Nair based on the Zika virus model also incorporates the integration of media, influential social figures and primary healthcare workers into the public health framework for better preparedness during the pandemic [91].

7.3. **Trust organizations, health professionals, Journalists, social & digital media and policy makers should take active participation in following agendas**

- **Disease knowledge:** COVID-19 knowledge regarding agent, mode of transmission, symptoms and outcome. Seriousness of illness if timely control measures not taken. Outcome measures of early and late diagnosed cases in such a way that self-medication is avoided. Self-medication and use of herbal remedies for control of symptoms and later on chances of progression and possible poor results should be educated.
- **Diagnostic modalities:** COVID-19 available diagnostic modalities with sensitivity, specificity and reliability of these tests. Role of laboratory and imaging methods and importantly limitations of these techniques. Outcome deciding role when implemented early and role in preventing poor outcome. Sensitivity of rapid antigen tests and RT-PCR tests should be correctly informed along with their specificity. Chances of false negative tests in spite of suffering from COVID-19 should be told in all platforms. HRCT thorax is important element of 'Composite index' which included clinical and laboratory parameters. Importance of composite index in analysing during treatment initiation and planning for interventions should be counselled.
- **Treatment options:** Available treatment options for COVID-19 such as steroids, remdesivir, anticoagulants, oxygen, ventilatory support in intensive care unit. Role of these treatment options with lifesaving role in pandemic with minimal permissible adverse events. Risk benefit ratio of these medicines and treatment options when timely used without adverse events and favourable outcome and decreasing mortality should be counselled. Role of Remdesivir use and its timely application in good clinical outcome should be educated. All treatment options which are framed by National task force should be adequately dispersed to health professionals and patients care takers to prevent misunderstandings and to prevent irrational use.
- **Outcomes:** Outcome in COVID-19 is short term and long term and this should be propagated by all Trust organizations, health professionals, Journalists, social & digital media and policy makers. Short term outcome is complete recovery in clinical and radiological COVID-19 disease. Long term outcomes are sequels of COVID-19 which is now called as Long COVID. 'Cure and mortality' outcomes should be correctly informed and counselling done in all platforms. Limitations of medical treatments whenever disease is advanced and refractory to medical treatments in intensive care units should be propagated in large scale to prevent circulation of misinformations. Long COVID is because of COVID-19 illness and not because of treatment options such as steroids and remdesivir should be actively educated to community.
- **Role of vaccination:** Principle of Vaccinations is the best method for preventing infection and decreasing severity whenever infection occurs by developing immunity in host. Same will be applicable in COVID-19. Large scale counselling with inclusion of important figures in social media with slogan as 'The COVID-19 vaccines are highly protective against SARS-CoV-2-related diseases in real-world settings.' Misinformation and myths should be replaced with exact knowledge of facts from scientific evidence which can be very well explained by medical experts and research scientists in social media. Timely involvement of multidisciplinary team will definitely help in increasing vaccination rate and prevention aversion and fear in general community. Safety measures, efficacy and potency of vaccines as per doses which increases with each dose, protective role life threatening illness as severity is definitely less in vaccinated individuals and ultimately ventilator requirement and final outcome is good should be counselled.

Disciplinary actions against misinformation: Necessary disciplinary actions against those spreading misinformation about COVID-19 includes blocking the Facebook, twitter, emails accounts those spreading misinformation. Cybercrime

cell department should work actively to tackle rampant spread of misinformation & necessary judiciary actions against those spreading misinformation. Misinformation can be corrected and right information can be shared through same media on large scale to prevent rapid propagation of infodemic.

8. Conclusion

Infodemic is pandemic of misinformation of 'global threat' and evolved in parallel to actual viral corona virus related COVID-19 pandemic. Infodemic has evolved rapidly due to 'ultrafast electronic media' which acted as 'dangerous weapon' during COVID-19 pandemic and called as double edge sword. Infodemic looks like 'hypothetical' due to invisible damage and has done significant impact on global loss in personal, social, medical and economic outcomes. Due to uncountable damage caused by 'Infodemic' in last three years since evolution of COVID-19 pandemic, now considered as 'real'.

COVID-19 pandemic is not ended up till today due to various mutants and genetic structural recombination's, and main hurdle is no effective treatment is available in spite of fast-track developments. Medical evidence suggests the beneficial role of '*combo therapy*' as combination of antiviral, anticoagulants and steroids has shown mortality and morbidity benefit across the globe.

Vaccination is one of the most effective interventions to substantially reduce severe disease and death due to SARS-CoV-2 infection. Minimal systemic adverse events known to occur with all viral vector vaccines, but its occurrence is rare and it should not impact on routine vaccinations; as vaccination is key step in this pandemic to protect mankind.

As of now, we are in waning phase of COVID-19 pandemic, and impact of infodemic occurred to such level that 'social stigma' of COVID-19 remains with us for decades ahead. We are having measures to control Infodemic but 'all should work together' to end infodemic and eradicate to affect from future generations. Infodemic can be tackled with understandings and timely shared right information of basics of epidemiology as 'covid appropriate behavior', early diagnosis, isolation of infected cases, Vaccination, and treatment of cases with available resources and preventive methods.

Compliance with ethical standards

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