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Review Article

The influences of the COVID-19 pandemic on medical service behaviors

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ABSTRACT

The outbreak of the novel coronavirus (COVID-19) has greatly impacted medical services worldwide. In addition to changing the processes used by hospital medical services, it has also changed the behaviors of medical staff, resulting in a completely different appearance. Fear of being infected with COVID-19 makes patients fear entering hospitals, and hospitals must repeatedly screen patients prior to entry in order to confirm that they are not infected. Patients are then separated according to their symptoms and travel, occupation, contact and cluster histories (TOCC), which seriously affects them. In addition, hospitals have invested a lot of money into the whole visiting process and into the equipment required to prevent the spread or lessen the impact of COVID-19.

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Objective

Understanding the behavior of COVID-19 has become a regular part of life for medical staff. The far impacts of the pandemic to hospitals, including hospital admittance processes and medical service, leads to also an important changes for the responded behaviors of medical staff, and adjustments must be made in order to meet the needs of the patients.

Preface

The pandemic caused by COVID-19 has spread globally. In order to avoid infection, many people have chosen to avoid crowds or places with a high number of ill people, such as hospitals. At present, almost all people wear masks when they go out, even to places with few people. Many people also avoid excessive contact with each other, wash their hands frequently, and maintain social distance practices [1–3]. Recent observations of hospital emergency treatment have shown that there are very few patients, indicating that the medical treatment behaviors toward Taiwanese patients

have gradually changed [4–6]. Since the pandemic situation is quite tense, and since the number of hospitalized patients has been reduced, hospitals also hope to encourage patients who are not suffering from serious ailments to avoid coming to the hospital as much as possible [7]. It is worth noting that the flow of people entering hospitals not only includes fewer non-emergency patients but also fewer emergency patients. This indicates that patients' medical behaviors have changed quite a bit in response to the pandemic [8–10].

Problems related to and impacts on hospital behavior changes

As COVID-19 continues to spread, many people suffering from minor illnesses are trying to avoid going to medical institutions. According to health insurance statistics, the number of medical treatments in Taiwan decreased by 4.45 million in the first quarter of 2020 compared to the same period in 2019, a decrease of 14%. Western medical clinics have had the biggest impact. The decrease in the number of patients coming to internal medicine, family medicine, pediatrics, otolaryngology, and rehabilitation departments is the most obvious. In comparison, the impact on dental visits and Chinese medical clinic visits has been relatively minor. Dental visits dropped from 2.65 million last year to 2.47 million this year, a decrease of only 7%. In Chinese medical clinics, visits fell

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from 3.08 million last year to 3.06 million this year, a decrease of about 1%. Dental patients have not decreased significantly, which can potentially be attributed to the severity of the pain caused by toothaches. Even if a patient is afraid of infection, they must go to the dentist to relieve the pain. It is also worth noting that Traditional-Chinese medicine (TCM) services can be less invasive than Western medicine and may feel safer to patients [11,12].

The decrease in the number of hospital patients in the United States is also quite obvious. Professor David M. Cutler of the Harvard University Department of Economics published an article called “The Business of Medicine in the Era of New Crown Times” in the latest issue of *The Journal of the American Medical Association* (JAMA), which pointed out that the number of hospital services in the United States has dropped significantly, and some services have decreased by 50% or more [13]. This situation has posed two major financial challenges for hospitals and physicians treating most COVID-19 patients. Hospitals need to provide individual safety spaces to properly care for patients and must stretch normal patient care resources, so the reduction in medical income is understandable [14]. Many patients with COVID-19 do not have medical insurance, or the medical expenses accrued by patients exceed their insurance costs, causing great losses for medical insurance companies [15]. Additionally, many patients with COVID-19 have no way to pay their hospital bills, and the remaining hospital gains cannot be compensated enough, causing many hospitals to suffer financial losses [16].

There is literature suggesting that in the health care industry, some hospitals with relatively weak financial constitutions are in great crisis [17,18]. The operating margin of rural hospitals is generally lower than that of urban hospitals, especially in the southern United States [19–21]. The governors there have been slow to respond to preventative measures, and many states have not expanded Medicaid [22,23]. Over the past decade, nearly 100 hospitals in the South have shut down. It is conceivable that other hospitals have been similarly affected by the outbreak [24,25].

According to statistics from the Taiwan Health Insurance Agency, since the outbreak of COVID-19 in December 2019, the number of medical outpatient visits from January to March has decreased by 5.334 million compared to the same period last year. Additionally, the number of visits in April was even lower, decreasing by 51,600. Furthermore, the number of patients in hospital outpatient clinics has fallen as much as 5%–16% [26,27]. People in the medical profession believe that individuals have a tendency to like visiting hospitals or repeat medical treatments to see if other problems exist. Scholars emphasize that in order to reduce wasteful behaviors and expenditures, it is necessary to shift some of the self-paying burden [28,29]. Zhu Yihong, chairman of the Taiwan Community Hospital Association, believes that the threat of the pandemic has reduced the number of people seeking medical treatment [7]. This may reduce infections by good protection, and patients who are not in a hurry may avoid going to the hospital first. In response to non-essential medical treatments, some self-paying burdens can be shifted in the future, allowing unnecessary waste to be reduced. The adjustment of health insurance premiums can also reduce the impact caused by the number of infected population increasing as a whole.

Epidemic prevention behaviors in response to hospital processes

There is some potential that medical staff will have too much anxiety over the risk of COVID-19 infection, despite wearing heavy protective equipment [30–32]. Lacking of medical attended caring with warmth, keeping of interpersonal social distancing measures, and wearing-no-taking-off protective equipment in necessary have

resulted in the change of overall medical behaviors [33,34]. It is possible that, even after COVID-19 is contained, pandemic prevention measures will still be carried out. This would directly cause pandemic prevented medical behaviors (such changes as wearing a mask to see a doctor, disinfecting and washing hands frequently, being continue to ask patients about their contact history, and maintaining proper social distance) to be maintained naturally. Patients may also change their behaviors in relation to seeing a doctor. For instance, patients may avoid walking around the hospital as a main activity or try to avoid going to the hospital altogether [35]. At the same time, they may instead try to inquire about relevant health issues by phone and only attempt to see a doctor in the event of a serious illness [36]. Due to complicated pandemic prevention processes, the wait time to see a doctor could increase, making the patient's stay time longer [37]. All of this would affect the overall quality of medical treatment. Indeed, COVID-19 has brought great changes to the relationships between medical staff and patients [38,39]. However, through this change, we can make medical treatment more transparent and shift the use of medical services toward urgent and critical needs.

In order to reduce the risk of exposure, almost all hospitals have set up outdoor fever-screening stations and viewing areas outside the emergency room to separate patients who are potentially infected with COVID-19 from the general patient area [40,41]. However, the medical staff in the emergency room is still responsible for the treatment of all patients, which includes performing consultations, providing examinations, and prescribing medicine. In response to this information, emergency physician Xiao Yawen said, “It takes a lot of time to see a suspected case because the emergency doctors and nurses must immediately put down their emergency work, and then dress from head to foot (head covers, eye masks, masks, protective clothing) ... to help patients, take X-rays, take tests, and finally return to the emergency department to continue their work.” “In a designated emergency hospital, medical staff have to go through this above process more than 10 times a day.” [42].

Complicated pandemic prevention processes, impatient patients, patients in urgent situations, and long wait times could cause patients to suffer from emotional complaints. After the long working hours and high pressure endured by emergency medical staff, such complaints could harm the relationships between doctors and patients and could even cause quarrels and disputes [40,43]. Medical staff can understand a patient's urgency when forced to come to the hospital for treatment, but patients isolated from the outside could suffer from feelings of abandonment. When this occurs, both sides should try to learn to understand each other [44,45].

Physicians must provide face-to-face treatment but this prejudice needs to be renewed

In order to allow all patients to see a doctor during the COVID-19 pandemic crisis, the US government has created some programs to improve medical processes [46]. Although the medical payment system has not been changed since the beginning of the pandemic, US medical payment policies have been extended to enable long-distance payments, which has loosened the restrictions requiring doctors to provide face-to-face personal treatment [47]. During the crisis in the United States, the use of telemedicine has increased substantially throughout the entire health care system. For example, the Cleveland Hospital in Ohio reported that it planned to complete more than 60,000 telemedicine services in March compared to an average of about 3400 before the pandemic [48]. Similarly, the number of virtual visits on the Jeff Connect telemedicine platform of Jefferson Health in Philadelphia,

Pennsylvania, has increased from 60 visits per day before the pandemic to 2000 visits per day. These are just two examples out of many increases in the use of telemedicine worldwide [49–51].

Psychological issues and fears caused by COVID-19

From November 2019 to June 2020, COVID-19 has caused a global pandemic during which more than 6.3 million people have been infected, and more than 360,000 people have died. This has had a profound impact on people's mental health [52]. The psychological effects of being infected with COVID-19 could seriously interfere with daily behaviors, which may also extend the negative impacts of this situation into the future, causing further complications [53]. Psychiatrists and psychologists have emphasized the need to start research on the mental stress caused by COVID-19 as soon as possible [54–58]. A psychiatrist published in *The Lancet Psychiatry* said that using smartphones helps instantly monitor the mental health of isolated patients. She also emphasized the need to develop assistance specific to different groups of people, such as children and frontline medical staff, to address the complexities involved [59,60].

Surveys have shown that during the spread of COVID-19, suspicion, anxiety, and isolation have had a profound impact on the public [54]. Mind, a mental health charity based in England and Wales, has warned the public that they will face many difficulties in obtaining the resources they need during this pandemic situation [61]. Twenty-four top mental health experts want to be able to monitor the mental health of the public at all times in order to design effective tools and support methods as soon as possible to support people who dare not go out or who are isolating themselves at home [62–64]. Professor Rory O'Connor has pointed out that increased social isolation, loneliness, anxiety, and stress, along with a poor economy, may deprive people of their mental health and happiness [60,65]. The literature mentions that if people do nothing, they risk an increase in anxiety and depression and are more likely to drink, use drugs, or become hooked on gambling. Such behaviors could lead to negative consequences, such as fighting with others and homelessness. The author believes that it is imperative to monitor those at risk for anxiety, depression, self-mutilation, suicide, and other mental health issues in advance in order to provide appropriate support immediately [66,67].

Two online surveys conducted by the Academy of Medical Sciences in March present a picture of people's current mental health. One of them, conducted by the British charity MQ, studied the mental health of more than 2100 people and discovered that they were worried about the deterioration of the support and services needed for life during the global pandemic. Additionally, it showed that the subjects of the survey were afraid of their health issues becoming worse [68].

Discussion

COVID-19 affects whose behaviors change

Studies have shown that the COVID-19 pandemic will cause changes in ethnic behavior. A previous study lists several categories of people whose behaviors changed after the start of the pandemic [69,70]. The study suggests that the pressures of the global pandemic may be different for the following groups compared to the general public:

1. Children, young people, and families (due to school closures, domestic violence, lack of free school meals, etc.)
2. Seniors and people with potential health issues (due to isolation, loneliness, bereavement, etc.)

3. People who already have mental health issues (due to loss of support services, relapses in depression or anxiety, etc.)
4. Frontline medical staff and emergency medical technicians (due to fear of infection, work pressure, etc.)
5. People with learning difficulties (due to changes in schedule and support methods)
6. Low-income people (due to work and financial instability)
7. Prisoners, homeless people, and refugees (due to social isolation)
8. People with difficulties in social care, patients living alone, and foreign workers (due to charities being unable to meet demands because more people are relying on distributed food)

Changes in medical behaviors due to the COVID-19 pandemic

The spread of COVID-19 has caused psychological fears among medical staff, which can cause the following changes in behavior: [71,72].

1. Physicians may be more cautious when examining patients, avoiding close proximity and prolonged contact.
2. Medical staff may avoid enclosed spaces with coworkers, may not supervise each other's physical conditions, may avoid mutual interference, and may strictly maintain a certain distance.
3. Medical staff may triage patients more strictly, follow pandemic prevention protocols, and strictly check patient travel history, contact history, cluster infection history, and occupation.
4. Medical consultations with patients may primarily be held online to reduce the chances of physical contact. Telemedicine could become the primary way to see a doctor in the future.
5. If surgery is necessary, surgeons may not interact with the patients outside of the procedure. Surgeons may also take time to ensure that the result of a fast screening test for COVID-19 is not positive.
6. Medical staff may avoid contact with pharmacists.
7. The way doctors communicate with patients may be more conservative. When the patient's PCR has not succeeded, more reserved words may be used to reduce misunderstandings and disputes about a patient's medical treatment.
8. There could be an increase in distrust in the relationships between doctors and patients.
9. The behavior of public welfare turns to less.
10. Medical staff may prioritize pandemic prevention protocols over first aid.
11. Medical staff may develop the habit of wearing N95 masks and protective clothing for long periods to prevent COVID-19 infections.
12. After treating a patient, disinfection of the space may be more intense, and the patients may be divided into infected and non-infected groups.

In conclusion, the pandemic has had a considerable impact on the medical system, patient care, and the biomedical industry. We are likely to see more digitization of the industry, and there will be three significant changes in the future: [73,74].

1. *Changes in communication:* Due to the cancellation of large gatherings, events, education, and training have been converted into online formats. Medical discussions will follow suit and be carried out online. This remote mode of acceleration will be applied everywhere in medical treatment [75].

2. *Changes in medical behavior*: Due to home isolation periods, information technology (IT) departments will focus on developing remote diagnosis programs, digitalizing data to classify images, developing programs to prescribe and deliver medications, and creating payment methods for medical expenses. The establishment of relevant medical regulations and systems will be a major future focus in the health care industry [76,77].
3. *Changes in medical ecology*: The health care industry will work to establish a link between medical data and industrial information through the combination of online and hospital entities using mobile devices and the Internet to establish an intelligent model of medical precision, operation, and innovation [78].
4. *Enhancement of medical support behavior*: Neighboring countries will be encouraged to exchange technology with each other, since some countries may lack key technologies that would allow them to implement proper pandemic prevention protocols [79]. Exchanging and sharing technology for the good of humanity will allow countries to benefit from each other and to solve the problems they share. It is vital that more people and countries contribute to a win–win situation during this pandemic [80].

Sharing behaviors as related to medical resources: sharing and discussing the disease utilization network platform

The pandemic situation caused by COVID-19 is a common topic for people worldwide. Everyone must apply the concepts of sharing information with each other and thinking about countermeasures to deal with common enemies [81]. Each participating country publishes research on COVID-19, which allows medical staff to immediately see outbreak-related information on Internet media platforms so they can learn about each other's content to jointly fight the spread of the virus. Due to the sharing between different societies, a large amount of new coronavirus information is presented every day, which enables considerable changes to medical approaches related to COVID-19. A lot of affirmation is given to the success of individual countries' pandemic prevention research, and successful results is also provided through various channels to countries with severe outbreaks [82]. These sharing behaviors have had the greatest overall effect on pandemic prevention. Countries around the world are realizing at this time that COVID-19 is a common problem, and everyone needs to work together to stop the spread of the virus. Any country that fails to adopt prevention measures will cause crises and disasters in the world [83].

The severity of the pandemic has reduced the frequency of public welfare behaviors

Although it is too early to see what the impact will be, it is already very difficult for many public welfare organizations to obtain the support they need. The development of the pandemic has reduced the behavior of many public welfare organizations and has also caused many people who rely on public welfare organizations to lose access to needed resources, resulting in increased difficulties in life [84]. Paul Farmer, the CEO of Mind, mentioned that some people are no longer able to get mental health services from the NHS, and appointments with children's and adolescents' mental health services and psychotherapy have been forced to cancel. "Governments and service organizations need to know not only how to support others correctly but also what the long-term impact will be to help people rebuild their lives." [85,86] The longer someone does not receive treatment and support, the more stressful life can become for that person, leading to a decrease in quality of life. If the pandemic continues without improvement, the

expected result will eventually be self-harm and suicide attempt for these vulnerable groups [87–89].

Public health pandemic prevention behaviors have become common habits

According to a report made during the pandemic in China, the virus that causes COVID-19 can be divided into L-type and S-type depending on the nucleic acid sequence. L-type accounts for 70% of the disease symptoms, which is a likely cause of many of the virus-related deaths. S-type accounts for 30% of the disease symptoms and is the source of asymptomatic infections [90,91].

In general, the L-type tests how effective the isolation measures implemented by health care systems are in preventing the spread of the virus. However, as time goes on, S-type may be the main spreader of the virus due to its asymptomatic nature. It is difficult to detect in advance, which makes it more difficult to avoid spreading the virus to others. Asymptomatic patients living around other people could make health care workers less vigilant and cause cross infection through accidental contact or air spreading infection. Therefore, continued pandemic prevention behaviors are essential. The hardest test is no longer following "isolation policy." Rather, it is maintaining "perfect hygiene habits," which include washing hands and wearing masks in public. Additionally, social systems will need to prevent the pandemic as they continue designing their public facilities [92,93].

Medical staff should avoid stress behaviors

The behaviors of those in quarantine due to contact or infection have included poor physical and mental reactions. Under long-term pressure, these people will experience a negative psychological reaction similar to post-traumatic stress disorder, which leaves patients prone to depression, irritability, and can even affect their surrounding interpersonal relationships [94,95]. According to previous research, during the uncontrolled outbreak of a major epidemic or pandemic, the public will be affected by fear of infection or isolation-related depression. Some studies have also pointed out that during isolation periods, isolated people were under pressure, resulting in deteriorating emotional states, family friction, and even domestic violence [96,97].

If medical staff are exposed to patients infected with COVID-19, they may be afraid of becoming infected as well. In addition to checking whether their protective measures have been properly maintained, they may also be afraid of infecting surrounding people, such as family members or colleagues. According to a survey, during the isolation period, medical staff are often worried about their pandemic prevention work not perfect enough if they fail of prevention, it could affect their colleagues' health or increase the burden on their colleagues. After suffering with these fears for a long period, these medical staff members may develop hysteria and blame themselves just for small things. Therefore, before isolation, it is necessary to carefully evaluate the psychological state, formulate complete supporting measures, provide detailed isolation instructions with a caring attitude, and solve relevant work problems to reduce the fear of isolation.

According to an analysis of the sources of stress, people in home quarantine can still maintain most of their daily activities. Stress usually arises from the anxiety about possibly getting sick, the economic pressure of being temporarily unable to work, and treat unfairly by some people intentionally after being separated from them during and after the quarantine period. The latter could even lead to malicious exclusion or a COVID-19 label that causes others to keep their distance with them. Quarantined people should use the decompression method to improve their self-identity, which

includes playing sports, reading, keeping in touch with the outside world, adjusting their own emotions, and maintaining positive thinking.

The dilemma behavior of pandemic prevention protocols and disease safety decisions

Epidemic prevention often leads to many behavioral dilemmas. For example, when someone suddenly falls to the ground, no one dares to help. This is because people are afraid of becoming infected. When facing an uncertain case suddenly, even if it is a very urgent situation, health care workers need to protect themselves with personal protective equipment (PPE) before they dare to the rescue [98]. This may cause patients to lose the “golden rescue time,” but it is a standard step in the process of pandemic prevention. In this way, COVID-19 presents moral challenges to traditional medical treatment. For example, the bodies of patients who died abroad have been burned before their identities were confirmed, and critically ill patients have been prevented from seeing their relatives for the last time before they died. This sacrifice of the ethical bottom line occurs because of the fear of spreading the virus.

Such medical decisions often cause dilemmas for medical staff. Under pandemic prevention as the primary necessity, health care has lost the aspects of mutual social respect of etiquette and ethical constraints. Human beings have turned reservedly to their primitive instincts in order to save their lives, forcing them to forgo etiquette and dignity, which is a sad thing.

Even if family members are very close, they are required to be separated from each other for fear of being infected. This necessary separation has caused many conflicts in family life and has even caused divorces and acts of domestic violence. Even close lovers, because of their fear of infection, may feel a sense of mistrust toward each other and requires additional communication to protect each other's feelings. There is a phrase that states, “To love a person is to stay away from him.” This is a pessimistic pandemic prevention behavior, but it cannot be refuted, and the pandemic provides a good excuse for not abiding by the existing ethical system. In today's society, it is regrettable to sacrifice the ethical norms for the sake of pandemic prevention.

Doctors and nurses often face this dilemma in decision-making. For example, when a patient who may or may not be infected by COVID-19 needs help, if the doctors and nurses do not have the proper PPE, they are not allowed to help. The reason for this is that if they are infected, they may spread the virus to those in other units in the hospital, leaving those units fail to work regarding their duties. In the behavior of endurance from a physical view, we need to have the perseverance to endure physiological discomfort not to take off the protective equipment intentionally. Due to the requirement for uninterrupted protection, medical colleagues must resist any physiological needs, including eating, drinking, and going to the restroom in order prevent an interruption in protection.

The application of artificial intelligence (AI) technology behavior in pandemic control and diagnosis

The rapid screening and collection of information for intelligent innovation and the integration of data to help predict the impact of COVID-19 are the praiseworthy behaviors of this pandemic. For the sake of pandemic prevention, what is needed is not the latest information but rather the most correct information. Through carefully curated information, we can better understand the development of the pandemic. The artificial release of information and the emotional stability of the people need to be unified without undermining integrated pandemic prevention efforts. The principle

is to rely on AI medical treatment to solve the problem of inconsistent information processing. This will help reduce the abuse of emergency resources due to fear of infection and reduce the chance of cluster infections in the emergency room.

Through the function of AI, instant information can be obtained, and various rumors and false information can be refuted immediately to avoid panic and irrational behavior caused by people's fear, which often leads to the hoarding of important resources and even ethnic antagonism and hatred.

In addition, the real role of digital medicine has always been to reduce people's workload. In some countries, AI may not be able to meet the needs of pandemic prevention, but in terms of log-in data identification and tracking, it helps pandemic investigation very much. Due to the use of health insurance cards in Taiwan, there is automatic tracking of all travel contact history, which can also be used as a basis for communities to receive materials, such as masks [99].

In the 21st century, people's work has been greatly increased, but infectious diseases such as COVID-19 have increased social distance, decreased contact frequency between people, and changed people's consumption behaviors. Even after the pandemic, people will not return to their original behaviors [100]. COVID-19 has indeed changed the behavior modes of human interactions with the surrounding environment, resulting in new behaviors toward things such as on-line learning [101,102]. Taiwan's medical experience shows that cross infection in hospitals is often caused by the flow of manpower between different units, so if we consider this flow of manpower and use more robots and smart beds, it will effectively reduce cross infection [103,104].

Conclusion

COVID-19 is a highly infectious disease that challenges the human response to its diffusion ability. Taking the point of view of medical behaviors into consideration, we can set strict pandemic prevention protocols to avoid the spread of COVID-19 and cultivate good pandemic prevention behaviors. We should pay attention to the differences between COVID-19 and past diseases, especially in order to clearly evaluate its impact and to develop good pandemic prevention habits. To establish a complete pandemic prevention management system, formulate good pandemic prevention policies, popularize the telemedicine license system, and maintain the safety of vulnerable groups in society, we should make preparations in advance while considering what may continue to occur in the future.

In the face of severe pandemic situations, whether it is the handling of pandemic information or the sharing of human resources, joint efforts integrated, the pursuit of win-win behavior, and global health diplomacy will be the primary reasons we concern this pandemic from spreading.

Disclaimer

Some of the cited part in this article from web-sites has not been peer-reviewed; it cannot replace the expert's clinical judgment, nor has it examined the credibility of its cited source in detail.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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