Sys Rev Pharm 2021;12(2):1-9
A multifaceted review journal in the field of pharmacy

Contagious Viral Diseases in the Operating Room: A Review of Evolving Safety Protocols at Three Levels

Li Zihan

School of interdisciplinary studies
University of Glasgow, United Kingdom

ABSTRACT

The prime aim of this study is to provide an integration of the existing and available studies on the safety protocol and measures for the prevention and control of the contagious viral diseases. Using a systematic literature review, as many as 65 articles and publications were used from the notable medical data base, such as Pub Med, PMC (NIH) US, Europe PMC, the Lancet and other scientific reports. After a detailed screening of the articles using the exclusion criteria, the articles from 2010 or later have been used for the review process. Some of the key words that were used include 'contagious viral disease', 'safety protocol', 'patient', 'doctor', 'surgical staff', 'operation theatre'. Several articles pertain to the incidence of the safety precautionary measures for the times when there was outbreak of Ebola, SARS, MERS and Corona virus were used. The novelty of the study is that it discusses the safety control measures and protocol at three levels, instead of general surgical interventions: namely, at the patient, doctor and the surgical staff level. All the studies have suggested that only urgent surgeries must be conducted and the elective one be delayed. Hospitals have devised SOPs to be followed so that these can be protected from the infection and the spread rate of infection transmission can be reduced or minimized.

Keywords: Contagious viral disease, safety protocol, patient, doctor, surgical staff, operating room.

Correspondence:
Li Zihan
School of interdisciplinary studies
University of Glasgow, United Kingdom
Corresponding Author: zihanli786@gmail.com

INTRODUCTION

The human race has been suffering from various types of infectious and contagious viral diseases over the years, some of which had badly affected the wellbeing and health of people, causing a vast number of deaths owing to the disease. The most prominent among these contagious diseases include SARS (Severe Acute respiratory Syndrome), Ebola and Covid – 19. SARS started in the year 2002 – 2003 from Southern China and spread to 26 countries, changing the entire way by which the public health system of China and many other countries of the world respond to treating the zoonotic viral diseases as can be seen in the effective control exhibited by China for the management of H1N1, H7N9 and H5N1 influenza spreads and outbreaks [1]. The first case of Ebola virus was confirmed by the Center for Disease Control and Prevention on 30th September, 2014 in the Dallas city of the Texas State in the US and later spread to West Africa, which frightened the entire system of the American Government and the healthcare professionals owing to the high mortality rate and the need for taking precautions very carefully as a requirement for the effective management of the Ebola patients and the disease. A number of rigorous guidelines and protocols had to be developed for the safety of the patients and those healthcare staff and doctors who were providing the treatment to these patients who were already diagnosed with the viral disease or were suspected of carrying the virus [2]. Taking into account, the recent outbreak of the COVID – 19, which was declared as a pandemic on the 11th March, 2020 and has affected millions of people [3] and has caused more than 800,000 deaths at the time of this writing. This viral disease presents a very heterogeneous clinical profile [4]. Initially, the health care staff was dealing with only the patients with severe symptoms and emergency conditions as the number of cases worldwide in the respective countries was far beyond the capacity of their health care systems [5]. This shows that whether the nature of the viral disease, its management poses challenge for the countries and there is a high risk of spread attached as the virus can be transmitted via air, respiratory droplets, mucous and surface or in other ways from people to people, which must be reduced or stopped to eradicate the spread of the disease among the masses of the country's population. Hence, generally speaking, precautions and protocol for safety are necessary for the patients, nurses, doctors and the paramedic staff. So, precisely these safety precautions and protocol need to be taken and adopted at three levels: namely, patients, doctors and staff.

There have been instances in which the virus positive people have to be operated. Inspite of the fact, that only the emergency cases in virus positive patients are treated, the contagious virus is still spreading among the masses. Cheney C has highlighted that as per the guidelines provided by the Center for Disease Control and Prevention, only the emergency surgery must be carried out and all elective surgeries must be delayed while the outbreak is still going by. These guidelines have been formulated by the hospital authorities and government keeping in view the country's level of infrastructure and the volume of health care staff, although comparing the increasing number of patients suffering from the viral disease is usually far beyond than the available health care staff [6]. However, meanwhile, it is important that when the virus is spreading fast in the population, two main points must be considered. Firstly, there may be a rise in the number of COVID positive patients coming to the hospitals for emergency cases that require surgical treatment and intervention. Secondly, while the outbreak is going by, there can be inevitability in starting the elective surgical procedure. Since the virus are of infectious nature and the chemistry of virus in terms of its effect and side effects are still not widely known and understood, immense safety must be exercised in the surgeries as much as possible [4].

Hence, the chances of counteracting the virus from the hospital is quite evident and likely as shown by the rising number of health care providers who are getting infected with the disease and becoming virus positive inspite of setting strict control measures [7]. Therefore, the main aim of this paper is the integration of the existing and available literature regarding how safety protocols and measures can be taken at the patient, doctor and staff levels when surgically treating the patients with positive virus in the operating rooms of the hospital.

This study has significance as scholars have suggested that the scientific literature on the safety protocols in operating rooms of the hospitals for virus positive people are limited and scanty. Also, when considering the main safety precautions for viral diseases, usually it is taken in the form of PPE (Personal Protective Equipment) and ICU (Intensive Care Unit), but specifically for the surgeons and the personnel staff helping him/ her for the surgical procedures, no guidelines have been mentioned for them regarding the methods, risks and the safety precautions in the operation theatre [6]. Along with the rapid transmission of the virus among the community, new information is required hand in hand, as information keeps on evolving off and on. For this reason, the scholars have suggested that continuous investigation on the contagious viral diseases and their prognosis in terms of the safety measures is important so that the previous studies remain up to date [8]. Therefore, there must be an evolving discussion on the methods and measures for carrying out safe surgical procedure during the times of pandemic that must be published and available for reading widely for the benefit of the community. Especially, after the outbreaks experienced by the countries of the world in the current century, it is recognized that they pose an occupational hazard for not only the doctors, surgeons, nurses and other staff involved in the health care of the patients, but also their families are in danger for the anticipation of the virus. This study attempts to fill this gap in the literature by presenting a systematic literature review using a combination of numerous studies through the integration of the relevant information and data provided by them to discuss various strategies and measures that can help in the identification of the safety protocols at the three levels of patients, doctor and staff.

METHODOLGY

This paper is a systematic literature review of the existing and available studies on the safety measures for the patients of the contagious viral diseases in the operating room. For this purpose, a systematic search strategy was used in which the literature search was carried out using a number of eminent and notable databases for the medical journals, such as mainly from Pub Med, US National Library of Medicine PMC (NIH) and Europe PMC. Some articles were also taken from the Lancet and other scientific reports, such as WHO (World Health Organization). These were thoroughly explored and used for finding the relevant studies. All the publications and articles that were generated from this search were evaluated using a certain exclusion criterion. Under this specific criterion, the articles which were published in the medical journals in or after 2010 in the English language were selected. In addition to this, the contagious viral disease generally or with names of the diseases was present in either the abstract or the title. The search terms were 'contagious viral disease', 'operating room', 'safety protocols', 'safety measures', 'Ebola virus', 'corona virus', 'Covid – 19', 'SARS', 'patients', 'doctors', 'health care', 'operating theatre' and 'surgeons' for the identification of publications. Only those articles and publications were included and considered in the review of literature, which had been initially peer- reviewed by their respective journals and their references were reviewed before the articles were finally selected for the review.

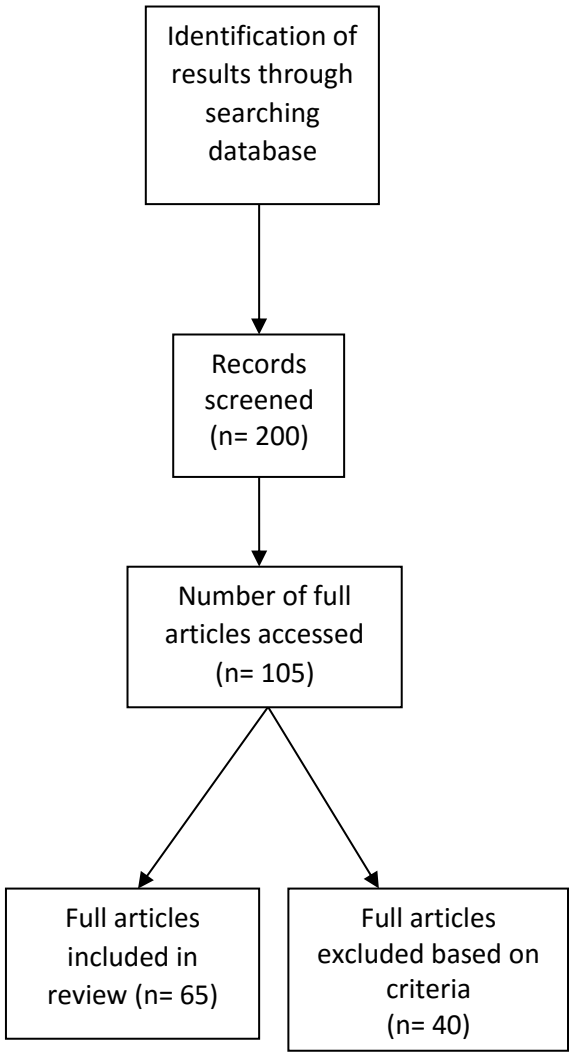

Figure 1: How studies were selected for inclusion in the systematic literature review

For this purpose, the studies, articles, trials, case reports and reviews were also included in the systematic review. In the identification phase, after the search of the databases, 250 studies were found, out of which 200 articles and publications were personally checked and screened, in the next phase of screening. After this step, eligibility was checked for the articles that were screened and for this purpose; abstract and full text of a total of 105 articles was viewed and accessed. Out of these, 40 articles that were not according to the criteria defined previously were excluded and the remaining articles, which were 65, were included as final articles for conducting the systematic literature review. Hence, a total of 65 articles

were identified from the overall search of the literature for the review and synthesis of the relevant studies for the final article.

LITERATURE REVIEW

Table 1: Search strategy used for the systematic literature review

Sr. No.	Name of database	No. of articles taken	Total
1	Pub Med	7, 10, 12, 13, 14, 17, 18, 19, 20, 21, 22, 24, 25, 29, 31, 33, 36, 37, 41, 42, 43, 44. 46, 47, 48, 50, 52, 54, 57, 59, 62, 63, 64, 65, 66	36
2	PMC NIH	2, 3, 6, 8, 11, 15, 16, 27, 34, 55, 56, 60	12
3	Europe PMC	26, 38, 40	3
4	The Lancet	1, 23	2
5	Other scientific reports	4, 5, 9, 28, 30, 32, 34, 35, 39, 45, 51, 58, 61	13
Total articles			**65**

The majority of the studies included in the review were taken from the esteemed data bases of. Since the current pandemic is in full swing, a vast number of studies were seen recently to be part of the data bases involving that of corona virus. However, the specific studies which highlighted the safety measures and protocols taken for the safety of the patient, surgeon and other surgical staff were chosen. Most studies on SARS and MERS were conducted in the coming years after 2002 – 2003, which was prior to 2010 and hence, they were not included in the reviewed articles. Moreover, compared to Ebola virus, it was seen that the recent studies are more rigorously investigating the patients of COVID -19. The following table shows the list of references with the name of the virus particularly investigated for surgical safety protocols by them:

Safety protocol for the patient

The patients who have contracted the virus and have to be operated for some reason are considered to be at a high risk and they can suffer from more complications as compared to the normal people who do not have any infectious disease [3]. Before proceeding to the operation, it is important for the surgeon to understand the notion of viral load in the viral diseases. If the patient had only mild symptoms of the viral disease, then they may be given an early clearance from the virus and may test negative on PCR tests after the 10th day of the virus onset. However, those patients who had severe symptoms of the viral disease will mostly test positive even beyond the 10th day of the onset. Regarding SARS, patients had lower viral load and the period for virus- shedding was considerably less than that of the current patients suffering from COVID – 19. This assures that the viral load of diseases can serve as an important marker in order to evaluate the severity of the viral disease and may help the surgeons in identifying the prognosis [4]. The Centers for Disease Control and Prevention has given a number of precautionary steps or guidelines that have also been approved by the American College of Surgeons. They have suggested to delay or post pone any elective surgery and take all the necessary precautions for surgery [9]. For the surgery of laparoscopy, an important part of the procedure involves establishing and maintaining the artificial pneumo-peritoneum and poses a risk for the exposure of the team, including the doctor and staff, to the aerosol exposure. In these types of surgery, the ultrasonic scalpels or other electrical equipment is very commonly put to use, and this can produce a large volume of the surgical smoke. In addition, the aerosol from the low temperature from the ultrasonic scalpels does not prove very effective for deactivating the cellular components of virus in the patients suffering from contagious viral diseases. The early studies have shown that the other viruses, such as papillomavirus, corynebacterium and HIV were discovered in the surgical smoke. After the use of the ultrasonic or electronic equipment even for as less as ten minutes, the smoke in the laparoscopic surgery gets higher than in the traditional open surgery [10]. This shows that the risk for virus spread is far higher in the laparoscopic surgery as compared to the open surgery, causing an outbreak which presents a clinical challenge for the patients and the surgeons [11]. Patient care has been endorsed in the studies for the pre- operative, operative and post-operative care [12]. Adequate studies can be found on the surgical practices aimed at infection control and prevention of corona virus [13-16] and SARS [17, 18]. In addition to this, the patient management has been highlighted for the anaesthesia as well for the e-bola patients when in intensive care unit in need for surgery [19, 20].

Philip F. Stahel have given information about how to distinguish between the essential and elective procedures, due to which there are higher negative and adverse outcomes in case the surgery can be postponed or delayed for an indefinite period of time. It means that the outcomes are not sensitive to the time regarding the surgery. In order to explain his point of view, he gave forward an algorithm for effective and accurate decision making. In deciding, the time, which is most suitable and appropriate time for the surgery can be proceeded with surgery on an elective basis according to the indications of the surgery and the need for the critical resources. This also includes predicted days for stay in the hospital, blood product transfusions and the need for ventilation after the operation in the operation theatre and the ICU [21]. In another study, the patients who were known to be tested positive for any viral disease or are suspects of the virus must be considered as carrying the virus and being infected from it while they need to be operated or need surgical treatment. In this regard, the necessary precautions must be taken so that the virus and infection can be minimized and PCR must be done to identify the patient as negative or positive before the surgery [22]. In another study, total of 34 patients were analysed who had to undergo a surgery on an elective basis in the incubation period of viral disease in three hospitals and all of them developed the viral disease after short time the surgery was done. This highlights that patients also need ultra and intensive care after operation as they developed the disease. Moreover, the study reported that such patients have higher mortality rate [23]. In another study, among the surgeries, 5 of them were in the specialist area of orthopaedics. Among patients post-operation, it is important to develop defence and immunity against the virus as the operations lower the cell – mediated immunity [24]. More studies have focused on the prognosis of the patients, which have to undergo surgeries in

gastrointestinal tumor, colorectal cancer and ophthalmology [25-27]. For the e- bola virus patients, the systematic assessment is performed initially and immediately after the patient has been admitted in the hospital. This is followed by regular assessments keeping in mind the clinical symptoms, signs and especially checking the vital signs is very necessary for the identification of the patients with having complications for e-bola and are also at a high risk for complications when in surgical theatre [28]. Even for the COVID – 19, the hospitals need to establish SOPs for being prepared and ready to cope with the challenges for protecting and taking care of the patients in surgical interventions [29].

Safety protocol for the doctor

For the safety of the doctor and the surgeon, there are other factors that must be taken care of. These include staff sickness, when the surgical resources and materials are inadequate in supply.

The anesthesiologists should also take intensive precautions if they are intubation of the patients [3]. Another study on the patients of severe acute respiratory syndrome - related coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV), their lungs that are infected with the virus and disease can cause a rise in the volumes of macrophage. This leads to an infiltration of the neutrophils and up surges the quantity of chemokines and cytokines that can trigger severe inflammation [30]. Since SARS occurred in 2002, many studies were carried out in that time and they reinforced the same findings of the studies [31]. Hence, in case of the epidemic, awareness must be created so that the rate of transmission that can be used as guidelines for all surgeries [32]. The scrubbing routine of the surgeons must also change their clothes when they have to enter the wards and the operation theatres set assigned for the virus struck patients. There must be a disposable suit for carrying out the surgical scrub, the surgical and waterproof boots and an apron which is also waterproof. The surgical hand preparation must be routinely and carefully done using a solution of chlorhexidine gluconate and water. In addition, the surgeon must make use of and wear surgical masks. For instance, the N95 masks are under the high recommendation of the Center of Disease Control and Prevention for stopping the spread of corona virus. These masks are regarded as safe to be worn when they are around people that are known to have or are suspects of the viruses [33]. The powered air purifying respirators is more advisable for the operations that are longer in duration. Even the surgeons can also use double surgical masks; however, this must not be used when the staff is carrying out procedures for the aerosolized blood. In addition, there must be eye equipment which must provide protection for the eyes and this is also vital for the aerosol-generating procedures. In addition to this, goggles or shields for full face can also be used, rather they are highly recommended [34, 35].

In the operation theatre, a second layer of the protective clothing which must be sterile or even a surgical space suit or surgical shield or masks must be used by the doctors and the surgeons [36]. For the purpose of scrubbing, a solution of aqueous alcohol is best and advisable. The surgeons must dispose of the first pair of gloves used by them and this step must be followed by surgical scrub suit and then this must be replaced by a second pair of gloves [3]. The surgical gowns or coveralls must be given priority over the surgical and the generating procedures for the aerosolized blood. Surgeons must use the surgical caps according to the safety protocol, while the surgical hood must have attached ties with it, and they must ideally be used for both the head and the neck for these procedures. The boots and shoes used must also be resistant to the fluid and they must use double surgical gloves with high cuffs [34]. The surgeons who do the procedure for laparoscopy must be very particular for the safety in terms of the retention of the virus in the smoke and the procedure for aerosolization and resurfacing of the virus from there. The National Institute for Occupational Safety and Health Administration has provided the guidelines in terms of the requirement for the smoke filtering and evacuation during the surgery or the laparoscopy. There are greater concerns regarding the surgeon and the surgical staff for their protection and safety for the AGP (aerosol generating procedures) for the corona virus. The virus of hepatitis B has initially been proved to settle in the surgical smoke from 10 out of 11 patients who are positive in Hepatitis B virus. So, it is very important that the virus must be disposed of during this procedure, especially for the surgeons and the staff as it can potentially infect them with the virus [37]. For the robot assisted surgeries, use of disposable surgical cap is necessary and inspite of all the precautions, the spread of the virus cannot be totally eliminated [38]. Even the minimally invasive surgery also carries a risk with it for the surgeons, anesthetics and other staff. For most of the times, the elective operations are also being either delayed or cancelled due to the spread of the virus and hence, the surgeons are entitled to carry only those surgeries which are either urgent or are very intense, such as the carcinological surgery. Hence, precautions must be taken when the surgeons operate such patients who are proven or suspected COVID-19 positive [11].

Taking the instance of orthopaedic surgery, there are also challenges attached as the number of asymptomatic patients is very large and the operation theatre acts as a viral lab as there are many types of tools and other instruments which can serve as the source of spread. Since the spread of MERS and SARS is through airborne transmission [39]. Similar study showed the care required in the procedures done for the confirmed or suspected cases of corona virus [40]. In an experiment, the transmission of the aerosolized respiratory secretions can be a contamination site, which was checked using ultraviolet light. The results showed that there was considerable contamination with virus on the neck, wrist, pants and shoes in the spine surgery [41]. For safety of staff, minimum personnel must be brought in the operating room. For lavageing, bulb syringes and disposable medical equipment must be used. Care must be taken that no sharp injury occurs on the PPE. The blood, secretions, body fluids and pathological specimens must be disposed using double and sealed biohazard bags to the labs and they must be labeled as “Covid positive” [42]. Those surgeries longer in duration may have more intense postoperative complications than the routine ones, hence for the post- operative care, staff and surgeons must share equal responsibility [43]. When there is a biological concern which could harm the community, then extreme caution must be taken for the standardization of practices [44]. Also, for corona virus patients, the surgical services have to kept at a balance that would support the entire hospital and lessen the risk

nosocomial spreading of the COVID-19 virus so that care must be continued when handling acute surgical conditions and when they have to manage any elective surgery on an urgent basis [36, 45, 46]. The key domains included in these are not limited to providing training to the staff, such as donning and doffing PPE, the patient transfers, identifying and managing COVID-19 infection. This also includes the support for hospital response to the virus, such as reducing the non-urgent outdoor activities, like endoscopy, clinics and other non- urgent elective surgery. Teams must be established so that the emergency services can be run, and the virus can be managed for the surgery. Backlog of procedures must be kept so that in further situations, the hospitals can plan for the best possible outcomes in treating the patients with surgical intervention and protecting the doctors as well [29]. Further recommendations and importance for the care for the patient and health staff is provided in these studies as well for the lung surgery, operation for esophagus cancer, malignancies in the digestive system and aortic acute syndrome [47-50].

Safety protocol for the staff

The surgeons have a full team of personnel who help them with the surgical procedures and treatments when the patients are taken in for an elective and emergency operation. All the recent and the latest safety protocols and measures must be communicated to the surgical staff and team for complete assurance of their safety in the surgical and operation theatres so that the staff can be prevented from the virus and reduced transmission of the virus, such as e- bola, SARS and COVID - 19. It is very important that during the surgery, proper and careful measures should be taken for protecting the staff against the viral disease as they are at increased risk of the exposure to the virus. The staff can suffer from the viral contamination from the patient to the helping staff of the surgeon during the procedure of surgery, either it is done in an open way or laparoscopic. Even in the various types of robotic surgery, care must be taken for strictly adhering to the SOPs and wearing the protective gear, surgical masks or shield. In order to maintain a fully working and functional staff, their safety is undeniable [3].

The Indian Society of Neuro- anesthesiology and the Critical Care (ISNACC) have developed a position statement which has been endorsed by the Indian Society of Anesthesiologists because the anesthesiologists have a higher level of risk regarding the transmission of viral diseases from the active and positive patients. This is for the reason that they are mostly engaged in the procedures for the generation of aerosol in the operative patients. This complication arises since there are many patients of viral diseases who are asymptomatic and they cannot be diagnosed on the basis of the history of the medical conditions taken by the doctors when they meet at the first point during their pre- anesthetic checkup at the doctor's clinic. So, it is important to take the precautions for such health care staff and for this purpose, such devices can be used which filter the carbon- di- oxide released from the breathing of the patient for the aerosolized particles [51].

Another study has shown the value of an isolated and separated operation theatre which has a separate area for access with negative environmental pressure for the patients which have been known as virus positive [42]. With the method of negative pressure, there are restrictions in the induction room and the anteroom. However, on the contrary, main operation room and the scrub area both have positive pressures. In the main room for operation, there is kept above 25 air exchange cycles in one hour because with this airflow, the risk of infection id greatly reduced which is critical and crucial for the operation theatre. This way the intra- operative contamination is removed and prevented [12]. Usually the virus is very small in diameter and so, there is an almost 100 percent of the proportion of the virus particles that can be accounted for by the filters having high efficiency particulate air (HEPA). In combination with the air exchanges of high frequency, the risk and probability for virus dissemination can be reduced [52, 53]. These mechanisms are good enough to protect the staff working in the operation theatres. The operation complex can be divided effectively in terms of the zones, which also ensure lesser dissemination of the germs and the virus, such as e-bola, corona virus and the SARS virus. A path way can be made and assigned so that the exposure to the virus of the staff can be minimized through lesser chances of exposure and contact as they move from the triage to the induction room and from the induction room to the recovery room. All these places must be adequately and frequently cleaned so that they are disinfected and rendered free from the virus [34].

When the surgery is done and complete, then the staff must only exit after all the doffing is completely done, where they must remove the scrub suit and do their bathing. It is very important that there must be frequent and strict segregation of the staff as those members of the

staff exposed must report immediately if they feel any symptoms or signs of illness. They must be given off from their duty on an immediate basis. Additionally, all points of contact among the staff and the patients should be recorded and immediately a contact tracing must be done to control the infection. These measures and steps must be taken quickly and further precautions must be taken in the case of any member of the staff is suspected or they test positive [54, 55]. Studies focusing on the precautions and control for the spread of the various infectious virus entails the health care staff engaged in the surgeries of colorectal cancer, general surgery and otolaryngology head and neck surgery [26, 56, 57]. Also, similar care and control was endorsed by the studies concerning the anesthesia procedure [58].

There is an increased risk for the Health care workers when there is an outbreak of the Ebola virus disease and for this, they are acquainted with a number of different challenges for responding to the disease and its management in terms of preventing the infection from spreading and taking the control measures. As a response, Ministry of Health and Sanitation has partnered and has developed standard operating procedures to stop the infection from spreading at multiple points for the protection of health care staff. These include keeping the patient and burial isolated, hiring trained staff for the prevention and control of infection, the procurement of required equipment and commodities, provision of personal protective equipment and the vehicles which are required for the transport of Ebola patients and dead bodies safely, the reconstruction and renovation of the care facilities for Ebola. All these measures tend to lessen the risk for transmission and also evaluate the situation and monitor the control and prevention of infection. If new cases

of Ebola show up in the Health care staff then the discrepancy must be identified so as to see where the ongoing prevention measures have failed [59]. Other studies have also been given for cardiac operations and general surgical intervention for patients with MERS in [60, 61] and for e-bola patients in obstetric health care, caesarean sections, oral and maxilla facial surgery [62-66].

Table 2: Consideration of virus investigated with reference No.

Sr. No.	Virus investigated	Ref. No. of related articles
1	Ebola virus	2, 19, 20, 28, 59, 62, 63, 64, 65, 66
2	SARS	1, 17, 18, 31.
3	MERS	23, 30, 60, 61.
4	COVID	3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 21, 23, 25, 26, 27, 29, 33, 34, 36, 37, 38, 39, 40, 42, 43, 44, 45, 46, 47, 48, 49. 50, 51, 52, 54, 55, 56, 57, 58.
5	General surgical intervention for other infectious diseases	10, 24, 32, 41
Total No. of articles reviewed		**65**

DISCUSSION

Findings

The discussion above presents to us important evolving protocols and guidelines regarding the surgical care and treatment of the infected patients in terms of the time for operation, place for the operation, care in the operation theatre, transfer of patient, anaesthesia and the intra-operative care. The previous and current situation of the viral disease outbreak highlights the importance of the meticulous and careful ways by which the human and financial resources are to be utilized effectively and efficiently so that the manpower is protected and preserved for working at its best. In order to minimize the spread rate of the infectious illness, it is vital to protect the health care staff, nurses, surgeons, clinicians, doctors and other medical professionals. The health care staff is among the front liners in the times of outbreak or pandemic, however the surgeons, surgical specialists and staff helping them for the surgeries, do not lie among those. No proper guidelines were developed specifically for them, in addition to the patients to save and protect them from being infected from the viral disease. Whenever there is a pandemic or outbreak of an infectious disease, then both the patients and the surgeons need to make very important decisions and difficult choices, which they use to manage and control the spread of the disease. Especially if there is an injury or a situation of emergency, then the actions have to be very careful and accurate. For this purpose, the clinicians and doctors have to conduct an analysis of the condition of the patient and the clinical safety of patient and staff both. Hence, an important balance of the injury of the patient with the safety of people has to be kept in consideration to make the final decision for treating the patient with surgical procedure or not.

Implications

This study has significant implications to theory, practice and policy. Theoretically, this study has attempted to integrate the literature in the form of peer reviewed articles and publications in the esteemed medical journals in or after the year 2010 to date. So, the novelty of this study is that it has provided an insight into the safety protocol and practices when operating the patients suffering from contagious viral diseases through a synthesis of the available literature not from a general perspective, but at three specific levels; namely, at the patient, the doctor and the level of the staff providing the health care service to the patients in the operating rooms of the hospitals. Moreover, this study has practical implications to the hospitals and the health care systems. The information which has been obtained after the review has provided guidelines that can be used by the hospitals for adaption so that they apply safety precautions and measures for protecting the doctors, nurses and the paramedic staff working in the hospitals that are involved in the surgical practice and intervention of the patients suffering from infectious viral diseases with a high transmission rate. This will enable the hospital authorities and administration to take care of and protect their patients and health care staff, which may also serve as a source of spread of the virus to their own families and the community as a whole, thus trying to reduce or eradicate the outbreak. Hence, this way the virus can be transmitted very rapidly to huge masses of the population in the world countries. Therefore, in order to lessen the spread rate of the viral diseases, the guidelines given in the study are also able to protect the clinicians, staff and doctors from being infected so that they remain in good health and working condition and can take care and treat their patients. If the hospital staffs themselves are infected and are not well, they will not be able to treat their patients.

Furthermore, this study offers huge implications to the policy making in that the government can quickly recognize the importance of taking safety measures and precautions and can be taken accordingly for the public health and administration. It is also important that these guidelines be in line with every country's local rules and regulations. In addition to this, the prevalence of viral disease along with to what extent the surgical and medical equipment are available is important to consider. These guidelines can prove very useful for the policy makers who can develop their health care policies according to the situation of the pandemic and the number of patients infected. It can help the governments establish SOPs (standard operating procedures) for the outbreaks for both the current and the future times. In case any other viral disease up surges in the society, these guidelines can be referred to for proper and efficient control and management of the viral disease. These SOPs can be applied in other sectors of the country in such times with modification as required so that the viral disease can be stopped from spreading too much among the masses.

Limitations

This study has a few limitations, which are given as ahead. Firstly, the views provided to the audience through this article are based on the opinions of the researchers and the experts in the field of medicine and contagious diseases. The evidence has been provided as a support as well; however, there are other rigorous studies that may explain these diseases in

totality. Secondly, some research articles, which were in the press or were delayed for some reason was not available so they could not be reviewed in the systematic analysis although, search for online repositories and search engines was done multiple times. Finally, there may be an instance that some of the articles may not be available and search engines for articles, publication delays could have made some reports unavailable to us at the time of this writing, and not all articles from the prominent medical community globally were available in the repositories searched for this study.

Recommendations for future research

Since in the times of pandemic, the data and information evolve very rapidly along with the spread of the virus and learning is very important. Hence, the information may stand obsolete or may require up- gradation. So, the scholar are suggested to conduct a study in line with the objectives of this study so that any obsolete information may be discarded and new information can be made available in the form of improved guidelines for further benefit and wellbeing of the society to come out of the disappointing times of virus outbreak. Moreover, this study has discussed the generic safety measures for contagious viral diseases for the virus struck and positive patients, doctor and the health care staff. Future studies can focus on providing the safety protocol and measures in detail individually for these people at their levels and its implications for each viral disease can be investigated for proper and more effective management of the disease.

REFERENCES

1. Li, Z. and G.F. Gao. (2017). Infectious disease trends in China since the SARS outbreak. The Lancet Infectious Diseases, 17(11), 1113-1115. https://doi.org/10.1016/S1473-3099(17)30579-0
2. Blais, C.M. and J.L. White. (2015). Bioethics in Practice-A Quarterly Column About Medical Ethics: Ebola and Medical Ethics-Ethical Challenges in the Management of Contagious Infectious Diseases. Ochsner Journal, 15(1), 5-7.
3. Rodrigues-Pinto, R., R. Sousa, and A. Oliveira. (2020). Preparing to perform trauma and orthopaedic surgery on patients with COVID-19. The Journal of Bone and Joint Surgery. American Volume. https://dx.doi.org/10.2106%2FJBJS.20.00454
4. Guan, W.-j., et al. (2020). Clinical characteristics of coronavirus disease 2019 in China. New England journal of medicine, 382(18), 1708-1720. https://doi.org/10.1186/s13037-020-00254-6
5. England, N. (2020). Clinical guide for the management of trauma and orthopaedic patients during the coronavirus pandemic. 2020 Trans.). In (Ed.),^(Eds.), (ed., Vol. pp.). (Reprinted from.
6. Prakash, L., S.A. Dhar, and M. Mushtaq. (2020). COVID-19 in the operating room: a review of evolving safety protocols. Patient Safety in Surgery, 14(1), 1-8. doi:10.1001/jama.2020.1585
7. Wang, D., et al. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. Jama, 323(11), 1061-1069.
8. Matava, C.T., et al. (2020). Pediatric airway management in Coronavirus disease 2019 patients: consensus guidelines from the society for pediatric anesthesia's pediatric difficult intubation collaborative and the Canadian pediatric anesthesia society. Anesthesia and Analgesia. https://dx.doi.org/10.1213%2FANE.0000000000004872
9. Chen, X., et al. (2020). Perioperative care provider's considerations in managing patients with the COVID-19 infections. Transl Perioper Pain Med, 7, 216-24. DOI: 10.31480/2330-4871/116
10. Li, C.-I., J.-Y. Pai, and C.-H. Chen. (2020). Characterization of smoke generated during the use of surgical knife in laparotomy surgeries. Journal of the Air & Waste Management Association, 70(3), 324-332. https://doi.org/10.1080/10962247.2020.1717675
11. Zheng, M.H., L. Boni, and A. Fingerhut. (2020). Minimally invasive surgery and the novel coronavirus outbreak: lessons learned in China and Italy. Annals of surgery. https://dx.doi.org/10.1097%2FSLA.0000000000003924
12. Ti, L.K., et al. (2020). What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. Canadian Journal of Anesthesia/Journal canadien d'anesthésie, 1-3. https://doi.org/10.1007/s12630-020-01617-4
13. Soltany, A., et al. (2020). A scoping review of the impact of COVID-19 pandemic on surgical practice. Annals of Medicine and Surgery. doi: 10.1016/j.amsu.2020.07.003
14. Bresadola, V., et al. (2020). General surgery and COVID-19: review of practical recommendations in the first pandemic phase. Surgery today, 1-9. https://doi.org/10.1007/s00595-020-02086-4
15. Gong, Y., et al. (2020). Anesthesia Considerations and Infection Precautions for Trauma and Acute Care Cases During the Coronavirus Disease 2019 Pandemic: Recommendations From a Task Force of the Chinese Society of Anesthesiology. Anesthesia and Analgesia. https://dx.doi.org/10.1213%2FANE.0000000000004913
16. Viswanathan, V.K., S. Subramanian, and A.K. Rao. (2020). Principles for Managing Patients with Spinal Ailments in the Coronavirus Disease 2019 Era: What Do We Know So Far? An Evidence-Based, Narrative Review. Asian Spine Journal. https://dx.doi.org/10.31616%2Fasj.2020.0248
17. Kaye, K., et al. (2020). Elective, Non-urgent Procedures and Aesthetic Surgery in the Wake of SARS–COVID-19: Considerations Regarding Safety, Feasibility and Impact on Clinical Management. Aesthetic Plastic Surgery, 1. https://doi.org/10.1007/s00266-020-01752-9
18. Cárdenas-Camarena, L., et al. (2020). Elective Surgery during SARS-Cov-2/COVID-19 Pandemic: Safety Protocols with Literature Review. Plastic and Reconstructive Surgery Global Open, 8(6). https://doi.org/10.1097/gox.0000000000002973
19. Missair, A., et al. (2015). Anesthetic implications of Ebola patient management: a review of the literature and policies. Anesthesia & Analgesia, 121(3), 810-821. https://doi.org/10.1213/ane.0000000000000573
20. Dubost, C., et al. (2015). Preparation of an intensive care unit in France for the reception of a confirmed case of Ebola virus infection. Anaesthesia Critical Care & Pain Medicine, 34(6), 349-355. https://doi.org/10.1016/j.accpm.2015.10.002
21. Stahel, P.F. (2020). How to risk-stratify elective surgery during the COVID-19 pandemic? Trans.). In

(Ed.),^(Eds.), (ed., Vol. pp.). Springer. (Reprinted from. https://doi.org/10.1186/s13037-020-00235-9
22. Coccolini, F., et al. (2020). Surgery in COVID-19 patients: operational directives. World Journal of Emergency Surgery, 15, 1-7. doi.org/10.1186/s13017-020-00307-2
23. Lei, S., et al. (2020). Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. EClinicalMedicine, 100331. https://doi.org/10.1016/j.eclinm.2020.100331
24. Amodeo, G., et al. (2018). Immune function after major surgical interventions: the effect of postoperative pain treatment. Journal of pain research, 11, 1297. https://doi.org/10.2147/jpr.s158230
25. Chen, Y. and J. Peng. (2020). Treatment strategy for gastrointestinal tumor under the outbreak of novel coronavirus pneumonia in China. Zhonghua wei chang wai ke za zhi= Chinese journal of gastrointestinal surgery, 23(2), I-IV. https://doi.org/10.3760/cma.j.issn.1671-0274.2020.02.001
26. Hu, X., et al. (2020). Thinking of treatment strategies for colorectal cancer patients in tumor hospitals under the background of coronavirus pneumonia. Zhonghua wei Chang wai ke za zhi= Chinese Journal of Gastrointestinal Surgery, 23(3), E002-E002. https://doi.org/10.3760/cma.j.cn441530-20200217-00058
27. Lai, T.H., et al. (2020). Stepping up infection control measures in ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. Graefe's Archive for Clinical and Experimental Ophthalmology, 1-7. https://dx.doi.org/10.1007%2Fs00417-020-04641-8
28. Organization, W.H. (2019). Optimized supportive care for ebola virus disease: clinical management standard operating procedures.
29. Collaborative, C. (2020). Global guidance for surgical care during the COVID-19 pandemic. The British journal of surgery. https://doi.org/10.1002/bjs.11646
30. Zhou, J., et al. (2014). Active replication of Middle East respiratory syndrome coronavirus and aberrant induction of inflammatory cytokines and chemokines in human macrophages: implications for pathogenesis. The Journal of infectious diseases, 209(9), 1331-1342. https://doi.org/10.1093/infdis/jit504
31. CHIEN, J.Y., et al. (2006). Temporal changes in cytokine/chemokine profiles and pulmonary involvement in severe acute respiratory syndrome. Respirology, 11(6), 715-722.
32. Zheng, M., J. Ma, and C. Wu. (2020). Twenty year progression and future directions of minimally invasive surgery. Chin J Pract Surg, 40, 23-26.
33. Covid, C. and R. Team. (2020). Severe outcomes among patients with coronavirus disease 2019 (COVID-19)—United States, February 12–March 16, 2020. MMWR Morb Mortal Wkly Rep, 69(12), 343-346. https://doi.org/10.15585/mmwr.mm6912e2
34. Awad, M.E., et al. Perioperative Considerations in Urgent Surgical Care of Suspected and Confirmed Coronavirus Disease 2019 Orthopaedic Patients: Operating Room Protocols and Recommendations in the Current Coronavirus Disease 2019 Pandemic. The Journal of the American Academy of Orthopaedic Surgeons. https://doi.org/10.5435/jaaos-d-20-00227
35. Kinross, J. Sterile PPE Donning and Doffing Video for SURGICAL Aerosol Generating Procedures; 2020 Trans.). In (Ed.),^(Eds.), (ed., Vol. pp.). (Reprinted from.
36. Di Saverio, S., et al. (2020). Coronavirus pandemic and Colorectal surgery: practical advice based on the Italian experience. Colorectal Disease. https://doi.org/10.1111/codi.15056
37. Mintz, Y., et al. (2020). A Low-cost, Safe, and Effective Method for Smoke Evacuation in Laparoscopic Surgery for Suspected Coronavirus Patients. Annals of Surgery. https://doi.org/10.1097/sla.0000000000003965
38. Kimmig, R., R.H. Verheijen, and M. Rudnicki. (2020). Robot assisted surgery during the COVID-19 pandemic, especially for gynecological cancer: a statement of the Society of European Robotic Gynaecological Surgery (SERGS). Journal of Gynecologic Oncology, 31(3). https://doi.org/10.3802/jgo.2020.31.e59
39. Raphael, T. (2020). Why surgeons don't want to operate right now. Bloomberg. Available at URL: https://www.bloomberg. com/opinion/articles/2020-03-24/the-coronavirus-crisis-is-putting-surgeons-at-risk-too (accessed April 3 2020).
40. Lockhart, S.L., et al. (2020). Simulation as a tool for assessing and evolving your current personal protective equipment: lessons learned during the coronavirus disease (COVID-19) pandemic. Canadian Journal of Anesthesia/Journal canadien d'anesthésie, 1-2. https://doi.org/10.1007/s12630-020-01638-z
41. Nogler, M., et al. (2001). Aerosols produced by high-speed cutters in cervical spine surgery: extent of environmental contamination. European Spine Journal, 10(4), 274-277.
42. Firstenberg, M.S., et al. (2020). Isolation protocol for a COVID-2019 patient requiring emergent surgical intervention: case presentation. Patient Safety in Surgery, 14(1), 1-5.
43. Søreide, K., et al. (2020). Immediate and long-term impact of the COVID-19 pandemic on delivery of surgical services. The British journal of surgery. https://doi.org/10.1002/bjs.11670
44. Cohen, S.L., et al. (2020). Perspectives on surgery in the time of COVID-19: safety first. Journal of minimally invasive gynecology, 27(4), 792-793.
45. Mary, B. and G. Atul. (2020). Managing COVID-19 in surgical systems. Ann Surg. DOI: 10.1097/SLA.0000000000003923
46. Spinelli, A. and G. Pellino. (2020). COVID-19 pandemic: perspectives on an unfolding crisis. The British journal of surgery. https://doi.org/10.1002/bjs.11627
47. Xin, L., et al. (2020). Preliminary recommendations for lung surgery during 2019 novel coronavirus disease (COVID-19) epidemic period. Zhongguo Fei Ai Za Zhi, 23(3). https://doi.org/10.3779/j.issn.1009-3419.2020.03.01
48. Li, Y., et al. (2020). Surgical treatment for esophageal cancer during the outbreak of COVID-19. Zhonghua zhong liu za zhi [Chinese journal of oncology], 42, E003-E003. https://doi.org/10.3760/cma.j.cn112152-20200226-00128
49. Ma, F., H. Hu, and Y. Tian. (2020). Surgical treatment strategy for digestive system malignancies during the outbreak of novel coronavirus pneumonia. Zhonghua

zhong liu za zhi [Chinese journal of oncology], 42, E001-E001.
50. Si, Y., et al. (2020). Countermeasures and treatment for aortic acute syndrome with novel coronavirus pneumonia. Zhonghua wai ke za zhi [Chinese Journal of Surgery], 58, E002-E002. https://doi.org/10.3760/cma.j.issn.05295815.2020.0002
51. Jangra, K., et al. (2020). Indian Society of Neuroanaesthesiology and Critical Care (ISNACC) Position Statement and Advisory for the Practice of Neuroanesthesia during COVID-19 Pandemic Endorsed by Indian Society of Anaesthesiologists (ISA). Journal of Neuroanaesthesiology and Critical Care. DOI https://doi.org/ 10.1055/s-0040-1714186 ISSN 2348-0548.
52. Fehr, A.R. and S. Perlman. (2015). Coronaviruses: an overview of their replication and pathogenesis Trans.). In (Ed.),^(Eds.), Coronaviruses (ed., Vol. pp. 1-23). Springer. (Reprinted from. https://doi.org/10.1007/978-1-4939-2438-7_1
53. Perry, J.L., J. Agui, and R. Vijayakimar. (2016). Submicron and nanoparticulate matter removal by HEPA-rated media filters and packed beds of granular materials.
54. Forrester, J.D., et al. (2020). Precautions for operating room team members during the COVID-19 pandemic. Journal of the American College of Surgeons. https://doi.org/10.1016/j.jamcollsurg.2020.03.030
55. Kooraki, S., et al. (2020). Coronavirus (COVID-19) outbreak: what the department of radiology should know. Journal of the American college of radiology. https://doi.org/10.1016/j.jacr.2020.02.008
56. Xu, K., X. Lai, and Z. Liu. (2020). Suggestions for prevention of 2019 novel coronavirus infection in otolaryngology head and neck surgery medical staff. Zhonghua er bi yan hou tou jing wai ke za zhi= Chinese journal of otorhinolaryngology head and neck surgery, 55, E001-E001. https://doi.org/10.3760/cma.j.issn.16730860.2020.0001
57. Tao, K., et al. (2020). Recommendations for general surgery clinical practice in 2019 coronavirus disease situation. Zhonghua wai ke za zhi [Chinese Journal of Surgery], 58(3), 170-177. https://doi.org/10.3760/cma.j.issn.05295815.2020.03.003
58. Wen, X. and Y. Li. (2020). Anesthesia procedure of emergency operation for patients with suspected or confirmed COVID-19. Surgical infections, 21(3), 299-299. DOI: 10.1089/sur.2020.040
59. Kilmarx, P.H., et al. (2014). Ebola virus disease in health care workers—Sierra Leone, 2014. MMWR. Morbidity and mortality weekly report, 63(49), 1168. https://pubmed.ncbi.nlm.nih.gov/25503921/60.
60. Nazer, R.I. (2017). Outbreak of Middle East respiratory syndrome-coronavirus causes high fatality after cardiac operations. The Annals of thoracic surgery, 104(2), e127-e129.
61. Park, J., et al. (2020). Infection prevention measures for surgical procedures during a Middle East respiratory syndrome outbreak in a tertiary care hospital in South Korea. Scientific reports, 10(1), 1-8. https://doi.org/10.1038/s41598-019-57216-x
62. Badia, J.M., et al. (2016). Surgical protocol for confirmed or suspected cases of Ebola and other highly transmissible diseases. Cirugía Española (English Edition), 94(1), 11-15. https://doi.org/10.1016/j.ciresp.2015.05.013
63. Brolin Ribacke, K.J., et al. (2016). The impact of the West Africa Ebola outbreak on obstetric health care in Sierra Leone. PloS one, 11(2), e0150080. https://doi.org/10.1016/j.ciresp.2015.05.013
64. Drevin, G., et al. (2019). " For this one, let me take the risk": why surgical staff continued to perform caesarean sections during the 2014–2016 Ebola epidemic in Sierra Leone. BMJ global health, 4(4), e001361. https://doi.org/10.1136/bmjgh-2018-001361
65. Haddad, L.B., et al. (2018). Ebola infection in pregnancy: a global perspective and lessons learned. Clinical obstetrics and gynecology, 61(1), 186. https://doi.org/10.1097/grf.0000000000000332
66. Reichart, P.A., et al. (2016). Ebola virus disease: any risk for oral and maxillo-facial surgery? An overview. Oral and maxillofacial surgery, 20(2), 111-114. https://doi.org/10.1007/s10006-015-0542-1