

IMPLEMENTATION OF ENVIRONMENTAL SANITATION AND DISINFECTION IN HOSPITALS TO REDUCE THE SPREAD OF COVID19: A LITERATURE REVIEW

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Abstract

Introduction: SARS-CoV-2 is a new variant of virus that attacks the human respiratory tract which was declared by WHO as a Covid19 pandemic. Covid19 transmission through solid surfaces, air, and waste occurring in hospital areas require disinfection and sanitation monitoring to ensure that new clusters are not created and outpatients are not infected with the SARS-CoV-2 virus in hospitals. **Discussion:** Using literature review method, 11 relevant articles that meet the inclusion criteria were selected. In the results of the study, there was a collection of samples in the solid surfaces, air and waste in both medical and non-medical areas containing SARS-CoV-2 RNA. The common objects where SARS-CoV-2 was discovered include doorknobs, toilet bowls, toilet flush buttons, and medical devices. In non-medical areas, the objects include computer keyboards, mice, and monitors. Chlorine-based disinfection for surfaces, monitoring in environmental sanitation by changing pillow and bedsheets and cleaning tables regularly were subsequently implemented. **Conclusion:** The implementation of environmental sanitation and disinfection is effective in eliminating the SARS-CoV-2 virus in hospitals. Studies indicated that disinfection is 95% to 99.99% effective in eliminating the SARS-CoV-2 virus. In addition, the SARS-CoV-2 virus was not discovered in isolation rooms but was located in other public hospital areas.

INTRODUCTION

In December 2019, the discovery of the SARS-CoV-2 or Covid19 virus that affects the respiratory tract was first discovered in the animal market of Wuhan City, Hubei Province, Central China and spread to various countries (1). At the beginning of the Covid19 pandemic, patient care in hospitals jumped drastically, causing hospitals to be filled with patients infected with Covid19. Since the emergence of the virus, the handling of Covid19 in hospitals has become stricter, as demonstrated in April 2020, where one of the hospitals in Germany screened patients and workers, formed an infection control team, carried out patient separation and conducted hygiene training for health workers (2). The treatment of Covid19 in hospitals, as recommended by the World Health Organization (WHO), is through screening and triage for patients suspected of Covid19, the use of PPE (Personal Protective Equipment) for health workers as well as training, the implementation of disinfection and environmental sanitation in hospitals,

waste management and separation of infected and uninfected patients (3).

Indonesia reported 4,223,094 cases of SARS-CoV-2 on October 6, 2021 with the number of recovered patients at 4,052,300 individuals (4). According to reports, reinfection had occurred in patients and health workers who have recovered, with reinfection cases discovered in Hong Kong, USA, Belgium, Ecuador and India where 90-91% of individuals who had been infected with SARS-CoV-2 virus had antibodies detected within 4 weeks after infection (5). In a report, a reinfection case in India occurred in July 2020 where a 23-year-old male health worker at a hospital tested positive for SARS-CoV-2. He recovered on October 9, 2020. On November 9, 2020, a test screening conducted as part of the regulations in the hospital, detected SARS-CoV-2 virus in the person (6).

Transmission of SARS-CoV-2 virus is understood to spread through droplets which then attach to the surface of objects. The positive rate of the surfaces in medical-related areas reached 24.83%, with general

isolation wards and intensive care units at 25.00% and 37.50% respectively. In addition, there are five common locations with SARS-CoV-2 virus detected, namely beepers (call button in patient rooms) (50.00%), water machine buttons (50.00%), elevator buttons (42.86%) computer mice (40.00%), and phones (40.00%) (7). Based on these data, it can be concluded that the virus not only spreads in places where infected patients are located but also in other locations where visitors may mingle and in all parts that are often touched by hospital staff members and outpatients.

Disinfection and environmental sanitation monitoring in hospitals must be carried out to prevent and control the virus so as not to infect other patients who are Covid19 negative. The use of disinfectants using solutions to reduce nosocomial infections in hospitals may be applied with disinfectant-soaked cloth which may reduce bacteria or viruses by 10%. The use of disinfectants may fail if it is not applied properly. An efficiency of up to 100% is achievable by handling disinfection products appropriately (8). Environmental sanitation applied in hospitals include cleanliness in every hospital area, clean water management, and waste management in hospitals (9).

This study aims to examine the implementation of environmental sanitation and disinfection in hospitals to reduce the spread of Covid19. In addition, it also examines areas commonly contaminated with the Covid19 virus in the hospital area and the effectiveness of disinfection application in hospitals. This research takes the form of literature review by using secondary data in the form of literature studies from various databases. The literature used is in the form of articles on “environmental sanitation and “disinfection” in hospitals and “Covid19”. The literature study was carried in 2020-2021.

DISCUSSION

Further research is still being conducted to examine transmission of SARS-CoV-2 virus through air. A study conducted at Shahid Mustafa Khomeini Hospital in Ilam Province, Eastern Iran examined 14 samples extracted from air in the hospital ward using a liquid bio sampler impinge and stated that there were 2 samples in the ICU room that was confirmed positive sars-CoV-2 (10-11). Fomite transmission or transmission from touched surfaces (surfaces of objects) was examined with experiments using aerosols and it was discovered that that the SARS-CoV-2 virus survived in aerosols for a duration of 3 hours. The SARS-Cov-2 virus is more stable in plastic and stainless steel than copper and cardboard, and can live for 72 hours (12). Research on fomite

transmission conducted in 2020 examined health care units by sampling on the surface and wiping the surface of inanimate objects indicated that out of 26 samples, 2 samples were positive SARS-CoV-2, both collected from the outer surface of CPAP helmets (13). Therefore, regular cleaning is required to eliminate SARS-CoV-2 virus from the surface of objects. In addition, another study discovered that liquid waste of patients (urine and feces) was infected with Covid19 (14). However, further research is required to determine the accuracy of transmission through liquid waste. A study indicated that SARS-CoV-2 was detected in feces of Covid19 patients with first symptoms with lasting approximately 28 days. Another study discovered patients who had positive samples for 33 continuous days after the breathing sample became negative (15). In the study, further prevention was implemented by conducting RT-PCR tests on the feces of patients who tested negative for breathing. In addition, disinfection on liquid waste in hospitals was implemented.

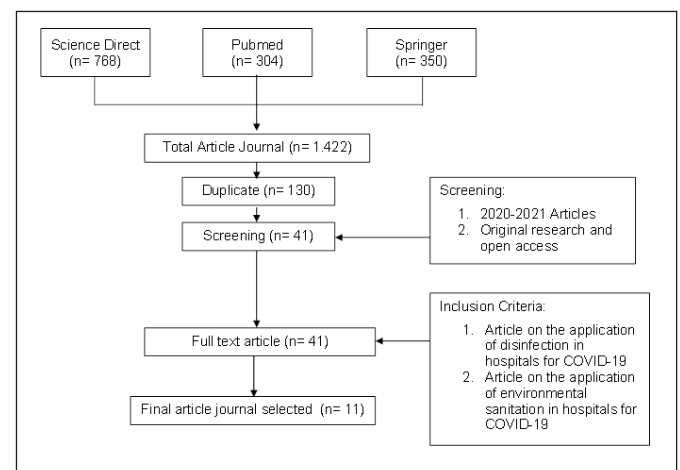


Figure 1. Journal Selection Process

The high rate of transmission encourages the widespread transmission of Covid19 through the formation of clusters or groups, where different types of clusters may emerge, such as family clusters, community clusters, and hospital clusters. This has driven a new cluster classification which now includes a group that has >5 cases (16-17). In South Korea, where 134 clusters with 4,033 cases were identified, the clusters are categorized into: small clusters (type I and II), medium clusters (type III) and large clusters (type IV) (18). Clusters that are susceptible to Covid19 infection are clusters in hospitals. Based on reports, Zhongnan University Hospital in Wuhan stated that, at the beginning of the outbreak, there were 138 cases of transmission suspected to occur in 41% (57/138) patients including 40 health workers (19-20). One of the hospitals in Bukit Tinggi, Indonesia stated that the hospital is a

non-referral hospital for Covid19 patients, but could not avoid patients who do not show symptoms of Covid19 to receive medical services which prompted transmission

from patients without symptoms. Based on these cases, there are 3.84% of hospital employees were infected with Covid19 (21).

Table 1. Summary of Relevant Articles on The Implementation of Disinfection and Environmental Cleaning Procedure in Hospitals

| Author | Title | Population/Sample | Results | Conclusions |
|--|--|--|---|--|
| Jie Wang, Haiting Feng, Sheng Zhang, Zuowei Ni, Lingmei Ni, Yu Chen, Lixin Zhuo, Zifeng Zhong, Tingting Qu (43) | SARS-CoV-2 RNA detection of hospital isolation wards hygiene monitoring during the Coronavirus Disease 2019 outbreak in a Chinese hospital | 1. Collection of patient respiratory and stool samples and staff breathing samples once a week 2. Sampling of environmental surfaces in isolation ICU wards and isolation wards as well as contaminated areas | No SARS-Cov-2 RNA was detected among 36 samples on the surface of the object but 3 waste samples tested positive for SARS-CoV-2 RNA. There are no respiratory specimens in isolation ward staff where there are positive patients. | Data from study showed that strict disinfection and the application of hand hygiene could reduce the risk of COVID-19 transmission infections in hospital environments. |
| Katia Razzini , Marta Castrica , Laura Menchetti, Lorenzo Maggi, Lucia Negroni, Nicola V. Orfeo, Alice Pizzoccheri, Matteo Stocco, Stefano Muttini, Claudia M. Balzaretto (41) | SARS-CoV-2 RNA detection in the air and on surfaces in the COVID-19 ward of a hospital in Milan, Italy | 42 air and surface samples obtained from different zones in contaminated, semi-contaminated and clean areas | 24.3% of swab samples were positive, but none were collected from the clean and systematic area. Positive rates were higher in contaminated sites (35.0%) and semi-contaminated areas (50.0%) and clean should be applied to reduce areas (0.0, Pb 0.05). Contaminated surfaces are hand sanitizer dispensers (100.00%), medical equipment (50.0%), medical device touchscreens (50.0%), medical racks (40.0%), bed rails (33.3%) and door handles (25.0%). | This research shows that strict disinfection and the application of disinfection medical staff. |
| Caijuan Xu, Jingfen Jin , Jianping Song, Yan Yang, Meiqi Yao, Yuping Zhang, Ruiyi Zhao, Zhimei Chen (24) | Application of refined management in prevention and control of the coronavirus disease 2019 epidemic in non-isolated areas of a general hospital | - | The absence of COVID-19 infection in the hospital including hospital staff. From the use of masks, screening of disease history and disinfection debriefing are all 100% in the hospital, the compliance rate of mask use is 73.79% and the hand hygiene compliance rate is 40.78%. | Enhanced management strategies for the prevention and control of COVID-19 infection in non-isolation public hospitals is effective and the accuracy of the mask use and hand hygiene of patients and families need to be further enforced. |
| Tianxiang Ge, Ye Lu, Shufa Zheng, Lixin Zhuo, Ling Yu, Zuowei, Yanan Zhou, Lingmei, Tingting Qu, Zifeng Zhong (42) | Evaluation of disinfection procedures in a designated hospital for COVID-19 | 1. 163 samples were collected from February to April 4. 2. 105 environmental surface samples collected in isolation wards during covid-19 hospitalization of patients 3. 41 waste samples collected from inducts 4. 17 surface sample environments collected from the examination room | A total of 163 samples were collected. Out of 122 surface samples, 2 are positive RNA coronavirus, 2 showed severe acute respiratory syndrome. One of the flush buttons on the toilet and the other collected from the hand basin. 10 waste items detected with positive RNA virus | During the COVID-19 pandemic, the implementation of disinfection and cleaning of the surface of objects needs to be looked into and tightened to reduce the risk from COVID-19 transmission. Implementation should be considered in all areas of the hospital. |
| Byung-Han Ryu, Younghwa Cho, Oh-Hyun Cho, Sun In Hong Sunjoo Kim, Seungjun Lee (27) | Environmental contamination of SARS-CoV-2 during the COVID-19 outbreak in South Korea | 1. Sampling at hospitals A and B. At hospital A, there were 5 patients with pneumonia in the negative pressure room. At hospital B, 8 patients were without symptoms in 2 rooms with 4 beds 2. Some rooms are not cleaned and poorly disinfected. Environmental swabs are taken from indoors and outdoors and tested with real-time RT-PCR to detect SARS-Cov-2 | Hospital A detected SARS-CoV-2 in 10 of 57 (17.5%) samples from indoors including on ambu bags and infusion pumps. Hospital B, 3 of 22 (13.6) samples from inside the room were positive. The areas outside the room, i.e. front areas, corridors, and treatment rooms are all negative in both hospitals. | The hospital surface around the patient was contaminated by SARS-CoV-2. This study refers to strict prevention by carrying out routine cleaning (environmental sanitation) and applying disinfection in the management of COVID-19 management. |

| Author | Title | Population/Sample | Results | Conclusions |
|--|---|--|---|---|
| G. Moore, H. Rickard, D. Stevenson, P. Aranega-Bou, J. Pitman, A. Crook, K. Davies, A. Spencer, C. Burton, L. Easterbrook, H.E. Love, S. Summers, S.R. Welch, N. Wand, K-A. Thompson, T. Pottage, K.S. Richards, J. Dunning, A. Bennett (28) | Detection of SARS-CoV-2 within the healthcare environment: a multi-centre study conducted during the first wave of the COVID-19 outbreak in England | 8 hospital samples were collected across the UK during the first wave of the 2019 coronavirus outbreak. Samples were analyzed using transcription polymerase chain reaction (PCR) and virus isolation test kits. | SARS-CoV-2 RNA was detected in 30 (8.9%) of 336 from the environmental surface. Cycle Threshold values range from 28.8-39.1. The number of bacteria is simultaneously low and suggests that the cleaning that has been done in 8 hospitals is effective in lowering the risk of SARS-CoV RNA. Air samples were detected in 4 of the 55 samples taken <1m from four different patients. | Performing effective cleaning in reducing the risk of fomite transmission, low concentrations in the air supports accurate guidelines on self-protection. |
| Xing-Yi Ge, Ying Pu, Ce-Heng Liao, Wen-Fen Huang, Qi Zenge, Hui Zhouf, Bin Yif, Ai-Min Wang, Qing-Ya Dou, Peng-Cheng Zhou, Hui-Ling Chen, Hui-Xia Liu, Dao-Miao Xu, Xiang Chen, Xun Huang (26) | Evaluation of the exposure risk of SARS-CoV-2 in different hospital environment | Surface samples with 6 different locations from 3 hospitals with different levels of protection were tested for the nucleic acid SARS-CoV-2. | SARS-Cov-2 nucleic acid positive rate is 7.7% in COVID-19 wards and 82.6% ICU with COVID-19 patients | Monitoring and disinfecting SARS-CoV-2 in hospital environments during the COVID-19 pandemic and helping to prevent SARS-CoV-2 transmission and to better protect health workers |
| Guangming Ye, Hualiang Lin, Song Chen, Shichan Wang, Zhikun Zeng, Wei Wang, Shiyu Zhang, Terri Rebmann, Yirong Li, Zhenyu Pan, Zhonghua Yang, Ying Wang, Fubing Wang, Zhengmin Qian, Xinghuan Wang (29) | Environmental contamination of SARS-CoV-2 in healthcare premises | 626 surface samples at Zhongnan medical center in Wuhan swab dakron collected from 13 hospital function zones, 5 main objects and 3 main PPE | Highly contaminated areas include special intensive care units to treat COVID-19 patients (31.9%), obstetric isolation wards with NCP (28.1%) and isolation wards for NCP (19.6%). The most contaminated objects were printers (20.0), desktops/keyboards (16.8) and door knobs (16.0%). Both hand sanitizers (20.3%) and gloves (15.4%) were contaminated PPE. | Good and adequate environmental sanitation and strengthen infection prevention training and improve infection prevention. |
| Li Wei, Wenzhi Huang, Xiaojun Lu, Yantong Wang, Linzhi Cheng, Rong Deng, Haiyan Long and Zhiyong Zong (31) | Contamination of SARS-CoV-2 in patient surroundings and on personal protective equipment in a non-ICU isolation ward for COVID-19 patients with prolonged PCR positive status | <ol style="list-style-type: none"> Air sampling from rooms of 9 COVID-19 patients with the disease or PCR positive >30 days. Sampling before and after a nasopharyngeal/oropharyngeal swab and before and after nebulization treatment. Sampling in the patient's environment and personal protective equipment (PPE) of health workers in non-ICU wards | 88 samples were collected from frequently touched surfaces and floors in patients' rooms and toilets with 2 and 1 SARS-CoV-2 positive toilet. All air (n=34) are SARS-CoV-2 negative. 55 samples collected from PPE were all negative. | Environmental pollution in COVID-19 patients with other patients will be rare if disinfection is carried out and hygiene is strictly applied. Transmission of SARS-CoV-2 in the air is not possible in non-ICU settings |
| Varvara A. Mouchtouri, Michalis Koureas, Maria Kyritsi, Alexandros Vontas, Leonidas Kourentis, Spyros Sapounas, George Rigakos, Efthimia Petinaki, Sotirios Tsiodras, Christos Hadjichristodoulou (30) | Environmental contamination of SARS-CoV-2 on surfaces, air-conditioner and ventilation systems | Environmental sampling from 3 COVID-19 isolation hospital wards and long-term care facilities with asymptomatic COVID-19 cases. | SARS-CoV-2 was detected on swab samples taken from the surface of food and service areas, hospital wards, sewer and AS filters, sewage treatment units and water air samples during research conducted in dealing with the COVID-19 outbreak. | Maintaining hand hygiene and environmental cleaning and disinfection play a very important role and is included as the main key in disrupting the chain of spread of COVID-19. |
| Zhen Ding, Hua Qian, Bin Xu, Ying Huang< Te Miao, Hui-Ling Yen, Shenglan Xiao, Lunbiao Cui, Xiaosong Wu, Wei Shao, Yan Song, Li Sha, Lian Zhou, Yan Xu, Baoli Zhu, Yuguo Li (32) | Toilets dominate environmental detection of severe acute respiratory syndrome coronavirus 2 in a hospital | Sampling in toilet and non-toilet environments was conducted in hospital buildings for COVID-19 patients and other environmental factors analyzed. 107 surface samples, 46 air samples, 2 condensate samples, and 2 expired air samples were collected inside and outside 4 isolation rooms with 3 beds. | <ol style="list-style-type: none"> 107 surface samples were collected, including 37 samples from toilet, 34 from other surfaces in isolation room and as well as 36 from other surfaces outside hospital isolation rooms. There were 4 positive samples including 2 ward door handles, 1 bathroom toilet seat lid, and 1 bathroom door handle. 3 positive but weak i.e. 1 bathroom toilet seat, 1 hard lever bathroom sink and 1 bathroom ceiling grille. 46 air samples included 1 weak sample taken from a corridor that is positively weak. 2 samples of condensate expiration and 2 samples of expiratory air were negative | The study explained the importance of maintaining the cleanliness of surfaces and hands in hospitals. |

Environmental sanitation

Sanitation procedures carried out in the hospitals include cleaning the administrative areas at least once a day (every 24-hour period), the examination or consultation area 2 times a day, while the operating room is cleaned and disinfected before and after a surgery and the sink is cleaned weekly and monthly (22). The procedures are carried out routinely in hospitals by following the applicable rules and have been applied before the Covid19 pandemic. During the Covid19 pandemic, the environmental sanitation procedures are still applied without any difference when handling Covid19 cases in hospitals. Regular environmental sanitation procedures to reduce the spread of Covid19 is carried out on surfaces that are often touched and surfaces that are rarely touched (23). Frequently touched surfaces such as doorknobs, beds, table surfaces, and light sockets should be frequently cleaned with detergent solutions tailored to the level of contamination (24). Rarely touched surfaces such as ceilings, floors, walls and curtains may be cleaned using detergent solutions. Wipes are also used to clean common surfaces and non-patient treatment areas as well as wet mopping, dusty curtain replacement and regular sink clean-up (25).

The difference of the implementation of cleaning procedures in areas contaminated with Covid19 lies in the frequency (26). In one of the hospitals in China, the cleaning the object surfaces and health facilities are carried out using 1000 mg / L of chlorine containing disinfectant 2 times a day, each with an interval of 30 minutes before being wiped with water (27). Hospitals in South Korea perform environmental sanitation procedures by wiping surfaces using 0.1 hypochlorite and clean water but not on a daily basis (28). Hygiene monitoring during the Covid19 pandemic is carried out through control and monitor mechanism in every area of the hospital to avoid transmission to other outpatients and also employees who do not treat positive patients. Applying hygiene protocols to clean surfaces using chlorine for tables, bed rails, and call buttons are recommended to be carried out twice a day (29). The same treatment is conducted by applying environmental sanitation procedures in each area of the hospital by wiping using chlorine liquid (30-31). The implementation of hygiene protocols in hospitals will continue since the pandemic is still present, which means non-Covid19 rooms must be continually monitored as well. The studies discovered positive SARS-CoV-2 RNA in beds and toilet bowls, hence cleaning in the ward areas or patient rooms by replacing sheets and pillows and toilets with 2000 mg / L of chlorine and preparing a handsanitizer in each patient's room were necessary (32). Toilets must

also be maintained since SARS-CoV-2 RNA was also discovered in toilet bowls.

The cleaning procedure conducted by one of the hospitals in China includes daily cleaning of touched surfaces with sodium dichloroisocyanurate solution containing 500 mg / L of chlorine, with janitors in complete PPE to avoid the possible transmission of SARS-CoV-2 (33). The frequency of environmental sanitation procedures differs before and during the Covid19 pandemic. Before the pandemic, cleaning procedures are carried out 1 time a day for administrative areas or waiting rooms and 2 times a day for areas with high touch frequency. However, during the Covid19 pandemic, they are carried out 2 times a day for both high risk and low risk areas to keep all hospital areas in a sterile state.

Disinfection

Disinfection applied in hospitals not only covers surface disinfection but also air and waste disinfection because they need to be monitored more closely. There needs to be a monitoring of areas in the hospital as well as strict screening for all hospital employees (34). One hospital in Purwokerto, Indonesia indicated that the effectiveness of disinfection to reduce the incidence of nosocomial infection reached 96% using chlorine (35). In addition, the use of ultraviolet-C disinfection in Taiwan University hospitals which conducted 48-hour trials resulted in a 100% reduction of bacterial colonies in the observed object, including *bedrails*, the top of the patient's bedside table, telephones, refrigerator doors, and *switches* (network switches) (36). The study indicated that the disinfection to eliminate pathogenic bacteria in hospitals was effective in its application. Another study indicated that the 222 nm UVC method with a time of 30 seconds and effectiveness of up to 99.7% can only be conducted in an empty room because it has a harmful effect on humans (37). In addition, another study examined the use of disinfection in waste by electrochemical oxidation methods and was able to inactivate the SARS-CoV-2 virus with 95% effectiveness in 30 seconds and 99.99% effectiveness for 5 minutes (38).

Based on WHO recommendations, products utilized for disinfection are chlorine-based products which includes formulations of sodium hypochlorite and calcium hypochlorite with concentration of 0.1% for Covid19 treatment and concentration level of 0.5% for blood and body fluids with a large volume of >10mL (39). There were no significant differences in the application of disinfection in hospitals before the Covid19 pandemic and during the Covid19 pandemic in terms of the chemicals and methods. However, the frequency of

the disinfections carried out in each hospital increases to maintain cleanliness and avoid Covid19 clusters in hospitals. Based on the results of research tests, disinfection was conducted using chlorine-containing chemicals with 2 g / L sprayed as much as 4 times a day in the surrounding environment such as floors, tables, and beds around contaminated areas and left unused for 30 minutes. Clothing items, bed linens in outpatients, bed linens of Covid19 patients and other objects in the area are mandatory to be sprayed with 75% ethyl alcohol (40). To ensure safety in the implementation of disinfection, appropriate clothing items must be worn including white coats, N95 face masks, surgical masks, surgical caps, protective glasses and boot covers (41).

Several studies demonstrated differences in the frequency of disinfection, which ranges from 3 times a day, 6 times a day, every 4 hours and every 8 hours (42-43). These studies indicated that the effective frequencies to reduce the SARS-CoV-2 virus are every 4 hours and 8 hours, with 4 hours in the isolation rooms and 8 hours of common areas, waste with negative isolation rooms, negative common areas and only positive waste with weak viruses detected (42-43). The use of disinfection in Indonesian hospitals includes disinfection sprayed directly on the surfaces of objects in all rooms such as waiting rooms, emergency wards and other rooms (44).

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CONCLUSION

SARS-CoV-2 virus spreads through droplets that may stick to the surface of objects. Therefore, the use of masks in every location both inside the hospital and outside the hospital as well as maintaining distance between visitors is critical to prevent transmission. The most widely identified transmission through surface of objects in hospital area is through the often-touched surface of objects, namely door handles, toilet flush buttons, medical devices, medical shelves and other non-medical objects, including computer monitors, keyboards, mice, and sinks. In addition, SARS-CoV-2 virus was also identified in the air and liquid waste, hence the need for air disinfection in the hospital environment and liquid waste. The use of disinfection has an effectiveness of up to 95% to 99.99% in eliminating SARS-Cov-2 virus. Monitoring and prevention by applying the use of disinfection and sanitation of the environment on a regular basis are important since it proved effective in reducing the spread of SARS-CoV-2 virus in hospitals.

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