Procedures for creating a green-zone room using UV-C after discharge of patient with COVID-19 from hospital within 72 hours

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【Summary】

Once the patient with COVID-19 gets discharged, the red-zone room needs to return to a normal hospital room (green-zone room) within 72 hours. In order to create a green-zone room, we used the UV-C ultraviolet irradiation machine and TPP-DIN. Also, we used an EPA registered chemical to disinfect and perform cleaning tasks. The organized disinfection and cleaning tasks are as follows.

Under the supervision of the leader in control, once all the patient left from the hospital ward specially designated for COVID-19, we disinfected and cleaned the common use space (bathroom, toilet, hallway, etc.) within 72 hours in order to create a safe hospital environment. All common use space such as the patient's room, hallways, toilet, shower room, and other common spaces were disinfected by the UV-C. The whole area was irradiated from 2.5m distance for 3 minutes as a baseline. The single patient room with the toilet was irradiated one extra time. We usually irradiate the UV-C at the end, however in order to lessen the psychological burden of the workers, we irradiated the UV-C first, since the SARS-CoV-2 was an unknown virus. Once the area was irradiated, the professional trained worker used TPP-DIN and EPA registered chemical to clean the hospital rooms. The tasks are as follows; remove curtain in the room, and clean frequently touched surface, such as the light switch, bed, floor, bed cabinet, nurse call button, sink, windows, common use shower room and toilet.

【Introduction】

Our company, OKEN Co., Ltd, is an integrated building maintenance company in Hiroshima, Japan, a place where our headquarter is located. We have been specializing in improving the environment for medical facilities. In 2003, we created "I-CoSS®": *Infection Control Support System,* which is our company's one-of-a-kind hospital-acquired infection controlled system registered as a trademark. In 2012, we started up seminars *"I-Coss-jyuku"* to develop human resources of understanding the standard precaution and route transmission based precaution. We have been upgrading our cleaning techniques according to the accomplishments of fast-evolving medical studies. In 2015, once the antimicrobial resistance (AMR)'s sense of threat was announced by WHO, global action

plans were adopted. In recent years, we are facing the issue of how to prevent nosocomial infections caused by AMR, such as MRSA and MDRP that are commonly found in the health-care facilities. In order to deal with the AMR's threat, UV-C 's effectiveness has been proved through many research results.[1)] Our company has been using it in public hospitals since we purchased the UV-C UV irradiator in 2014.

On December of 2019, the new coronavirus (SARS-CoV-2) has created a cause of a newly emerging infectious disease (COVID-19). It has been confirmed in Japan in early 2020, and we were forced to deal with an unknown virus. On March 6th, 2020, the first infected individual was confirmed in Hiroshima City and that individual has been treated at the health-care facility specially designated for COVID-19. From that day onward, we have been working to create ongoing performances to maintain safe hospital environment.

As of End of June 2021 [2)]	Confirmed Individuals with COVID-19	Total Deaths
World	182,153,508	3,946,015
Japan	799,550	14,784
Hiroshima Pref.	11,494	175

Since the first confirmation of the COVID-19, many medical research results have been accumulated. Especially in Hiroshima Pref., there have been studies on the possibilities of environmental contamination at long stay medical accommodations for mildly symptomatic and asymptomatic individuals. There were studies that showed the effectiveness of using the UV-C to be effective when used in the health-care environment.[3)] However, there were little to none researches that reported on how to disinfect and clean the place where the COVID-19 patients get medical attention. In other words, researches on sterilization and cleaning procedures performed after the discharge of patients with COVID-19 were not reported clearly.

There were many unknown things regarding the COVID-19 at that time when SARS-CoV-2 was found. Droplet transmission and contact transmission of COVID-19 were identified. However, the amount of viruses and duration of viruses in the health-care environment were unknown. On the other hand, we wanted to accommodate a request from health-care facilities in creating a safe environment at the same time as a mission as a cleaning company. In order to create a feeling of being safe in such an environment especially for those in the health-care facilities, creating the procedure of cleaning was an urgent matter.

Recently, the details of SARS-CoV-2 have been understood through many study results. The existence of the SARS-CoV-2 became identified on the high frequency contact surfaces. Infectiousness continued for 120 hours on plastic and glasses, and 72 hours on stainless surfaces. Also, the UV-C's effectiveness has been evident in the research.[4] On the top of this, the amount of RNA in the SARS-CoV-2 virus was highly detected in the feces.[5] This shows the importance of maintaining a safe toilet environment.[6]

We have considered, "Safe" and "secure" as the highest priority for working individuals. Since 2003, our company has given health-care professionals' workshops on "standard precaution," "route transmission-based precautions," "the use of gown techniques," and additional job training.[7] Also, we established the new use of UV-C to create a non-touching environment through work procedures.

As the present of July 2021, the fourth declaration of state of emergency was announced, the fifth wave of infection is easily imaginable. The COVID-19 has been an overriding priority. Also, not only the antimicrobial resistance (AMR) is a problem, but handling the new infectious disease pandemic has been issues that need to be dealt with as well.

We as OKEN would like to release "The procedures for creating a green-zone room using UV-C after discharge of patient with COVID-19 from hospital within 72 hours" [8] on our website to fight against the unseen enemy as our base belief.

【Overview】

Cleaning Area:

Hospital rooms for patients with COVID-19, hallway, toilet in 1 location, waste disposal room, pantry, treatment room, rest room, laundry room, shower room, meet-up space, nursing room, etc.

Number of Workers:

Day 1: 3 workers for 2 hours, day 2: 4 workers for 3 hours

Equipment in Use:

2 UV-C ultraviolet irradiation machines (manufactured by Ultra Violet Devices, Inc. UVDI-360®) (Fig. 1)

Chemicals in Use:

VIROX Technologies Inc.'s Accele diluting 17-fold, Accele Prevention Wipes®

〈〈DIN (Canada's drug identification number) registered product Accelerated hydrogen peroxide〉〉[9)]

Sealed Air Corporation's Bath Mate® Cleaner diluting 13-fold.

〈〈EPA (U.S. Environmental Protection Agency) registered product〉〉[10)] (Fig.2)

PPE (Personal Protective Equipment)[11)] in Use:

Protective garments®, disposable shoe cover[12)], face shield mask, and disposable gloves (Fig. 3)

Materials in Use:

1 janitorial cleaning cart, 2 mop handles, 20 microfiber flat mop, 1 janitorial sanitary ware cart (Fig.4), and 1 stepladder.

Day 1	Day 2
Hospital Rooms Room shared by 2 patients…1 room Room shared by 5 patients…2 rooms Shared space Hallways Toilet …1 location	Hospital Rooms Private Hospital Room (with a private toilet)…14 rooms Room shared by 2 patients… 1 room Room shared by 3 patients … 1 room Shared space Hallways, toilet ...1 location, waste disposal room, pantry, treatment room, rest room, laundry room, shower room, nursery room, meet-up space, etc.

Table 1: Range of working area

Fig.1 2 UVDI manufactured by UVDI Device's UVDI-360

Accele prevention wipes and bath mate

Fig.2 Chemicals in use

Fig. 3 PPE in use

Fig.4 Janitorial sanitary ware cart

【Work Preparations】

・Workers thoroughly wash their fingers and wrists with a medicated detergent containing bactericidal ingredients.

・Workers wear face shield masks, protective garments, disposable shoe covers, and disposable gloves (doubled).

《Precautions》

・To secure the workers' "safety," protective garments are worn, but the use of isolation gowns is usable as well.

・It is said that infection does not come from the floor, but disposable shoe covers will be used if there is a request from the health-care facility.

・Disposable gloves is used as double, one to prevent the intrusion of dust and water, and the other disposable gloves to be taped on both wrists.

・Equipment is used in the dedicated red-zone area.

【Work Procedures】

1) Put the UVDI-360 and necessary equipment in the red-zone area.
2) Irradiate the curtains in the patient's room once for 3 minutes.[13] (Fig. 5)

〈〈Precautions〉〉

・The whole room is irradiated with the UV-C from 2.5m distance for 3 minutes as a baseline.

・The UV-C is harmful to human skin and eyes, so it is important to evacuate from the irradiating room.

・Since the UV-C does not go through the curtains, irradiating both sides of the curtain is necessary.

・Since the safety is the utmost priority in working in the hospital wards for COVID-19, the Accele prevention wipes with cleansing and disinfection effects were used after irradiating with the UV-C. However, usually in the hospital wards for infectious disease excluding the COVID-19, the UV-C irradiation operation is used as a complementary cleaning right after wiping the area to eliminate the organic substances and to disinfect.

3) Remove the curtains, put them in the AQUAFILM (water soluble laundry bag made by MORAINE CORP.) and close it. Then, put the laundry bag in the doubled plastic bags and close it. Afterwards, remove the laundry bag outside the red-zone area. (Fig.6)

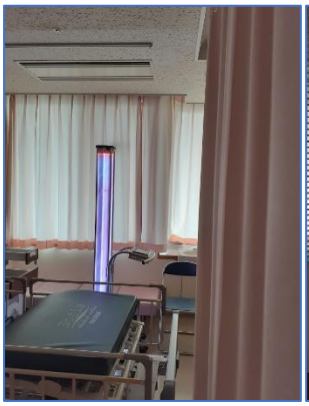

Fig. 5 Irradiation of curtains using the UV-C

Fig. 6 Removal of curtains

4) Irradiate the UV-C to the furniture, fixtures, equipment in the room, and the individual toilet. (Fig.7)

Fig. 7 Irradiating the furniture, fixtures, equipment, and toilet in the room using the UV-C.

5) Irradiate the UV-C at the hallways, shared toilet, and shower room for 3 minutes. (Fig.8,9)

Fig. 8 Irradiation of hallways with the UV-C

Fig. 9 Irradiation of shared toilet, shower room, laundry room and other places were irradiated with the UV-C

6) Once the irradiation of the UV-C is completed, furniture, fixtures, medical equipment, and other equipment are wiped with the Accele prevention wipes. (Fig.10)

〈〈Precautions〉〉

・Accele prevention wipes with cleansing and disinfection effects are used. Wipes used from cleanliness to uncleanliness places and from top to bottom locations.

・Use large-sized Accele prevention wipes folding in 4, changing its' sides every time wiping in the same one direction.

Fig. 10 Cleaning tasks done in the room

7) Use the Accele prevention wipes to wipe the high frequency contact surface at hallways and commonly used spaces once after the place is irradiated with the UV-C. (Fig.11)

Fig. 11 Wiping hallways and the other shared spaces

8) Spray the area with bath mate of 13 -fold after the area is irradiated by the UV-C. First, wipe the high frequency contact surface. Second, use toilet bowl brush to clean the sanitary ware. Third, wipe the area with Accele prevention wipes. (Fig.12)

《Precautions》
- Spray the bath mate of 13-fold before cleaning the sanitary wares.
- Wipe the sanitary wares in order from low degree of infection to highly infected area.
- Use large-sized Accele prevention wipes folding in 4, changing its' sides every time wiping in the same one direction.
- Used toilet bowl brush and sponges in the red-zone area should be discarded as infectious wastes.

Fig. 12 Cleaning the patient's toilet

9) Wipe the floor surface in the order from patient's room, hallway, patient's toilet with the flat mop immersed with Accele of 17-fold in advance. (Fig.13)

《Precautions》
- Microfiber flat mop should be immersed with Accele of 17-fold in advance. Then, wipe the floor surface by making turns in a shape of a "S" and move from only one direction.
- Store old microfiber mops used at the normal cleaning area and use them in the red-zone area. Then, discard the used microfiber mops as infectious wastes.
- Use 1 mop in individual patient's room. The mop used in the hallways and other places should be changed once it covers the same size of the private room.

Fig. 13 Cleaning floor surfaces of the patient's room, hallway, and patient's toilet, etc.

10) Discard the already used Accele prevention wipes, mop, toilet bowl brush and sponges to the infectious waste substance box.

11) Workers disinfect the doubled outer disposal gloves and take off the gloves by turning them inside out. In the same way, disposable shoe covers and protective garments should be turned inside out and discard them into the infectious waste substance box. Then, take off the singled inner disposable gloves inside out into the infectious waste substance box. Finally, sanitize hands with alcohol, take off the face shield mask, and discard them into the infectious waste substance box. (Fig.14)

Fig. 14 Removing the PPE

12) Put on new disposable gloves and use Accele prevention wipes to wipe up the mop handle. (Fig.15)

13) The whole surface of the carried-in materials and equipment should be irradiated by the UV-C. Then, wipe them with Accele prevention wipes to disinfect. Take out the equipment outside the red-zone area. (Fig.16)

Fig. 15 Wiping the mop handle

Fig. 16 The whole surfaces of the carried-in equipment are irradiated by the UV-C

14) Workers thoroughly wash their fingers and wrists with a medicated detergent containing bactericidal ingredients.

【Acknowledgments】

We are deeply grateful to health-care facilities from various quarters in helping us to create this document, “Procedures for creating a green-zone room using UV-C after discharge of patient with COVID-19 from hospital within 72 hours.” Also we would like to appreciate the stakeholders who gave us support.

In order to create this document, many specialists gave us guidance and support to prepare these working procedures. In the early days of March 2020, SARS-COV-2 was an unknown virus. We received many advises related to the SARS-COV-2. For this reason, there are no infected individuals infected in our company up until now. We hope that we can provide some help to COVID-19 related facilities.

We would like to thank our colleague Kei Yamashita for English language editing.

【References】

1) Janet P, Jonathan M, Stephen D, et al. Implementation and impact of ultraviolet environmental disinfection in an acute care setting. *Am J Infect Control*. 2014;42:586-90.
David W, William R, Deverick A, et al. Effectiveness of ultraviolet devices and hydrogen peroxide systems for terminal room decontamination: Focus on clinical trials. *Am J Infect Control*. 2016;44e77-e84
C Protano, V Cammalleri, V Romano, et al. Hospital environment as a reservoir for cross transmission: cleaning and disinfection procedures. *Ann Ig.* 2019;31:436-448.

2) Data Reference：Japan（JX Press Corp.／FASTALERT）、World（Johns Hopkins CSSE,WHO）。The number for Japan excludes those from the cruise ship “Diamond Princess.” The number of individuals who entered to Japan and went through quarantine from the cruise ship, “Costa Atlantica” was counted into the numbers in Japan. However, that numbers were not included to the numbers in Nagasaki Pref.

3) Anna G, Samuele S, Sabrina B, et al. SARS-CoV-2 survival on surfaces and the effect of UV-C light. MDPI journal viruses. 2021;13:408.
Julien M, Pria N, Aisling C. An evaluation of cleaning practices at a teaching hospital. *Am J Infect Control*. 2021;49:40-43.
UV-C effectiveness of 254nm ultraviolet irradiation machine is indicated. For example, Kitagawa H, Nomura T, Nazmul T, et al. Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination. *Am J Infect Control*. 2020;000:1-3.

4) Ibid., Anna G, Samuele S, Sabrina B, et al.

5) Dawei Wang, Bo Hu, Chang Hu, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA.* 2020;323(11):1061-1069.

6) Zhen Ding, Hua Qian, Bin Xu, et al. Toilets dominate environmental detection of severe acute respiratory syndrome coronavirus 2 in a hospital. *Science of the Total Environment*. 2021;753:141710.
The test for coronavirus was positive. It was confirmed through the exhaust damper and the toilet. Byung HR, Younghwa Cho, Oh Hyun Cho, et al. Environmental contamination of SARS-CoV-2 during the COVID-19 outbreak in South Korea. *Am J Infect Control*. 2020;48:875-879.

7) A safe environment in the COVID-19 area is created by those who acquired accurate knowledge of disinfection and cleaning techniques.
Brett M, Philip R, Martin K, et al. Nurses’ and midwives’ cleaning knowledge, attitudes and practices: An Australian study. *Infection, Disease & Health.* 2021;26:55-62.
Cassie C, Philip R, Martin K, et al. Environmental hygiene, knowledge and cleaning practice: a phenomenological study of nurses and midwives during COVID-19. *Am J Infect Control*. 2021;000:1-6.

8) CDC Science brief: SARS-CoV-2 and surface (fomite) transmission for indoor community environments. Updated Apr. 5, 2021.
https://www.cdc.gov/coronavirus/2019-ncov/more/science-and-research/surface-transmission.html

9) EPA List N advanced search page: disinfectants for coronavirus(COVID-19)
https://www.epa.gov/coronavirus/list-n-advanced-search-page-disinfectants-coronavirus-covid-19

10) Bath Mate is a quaternary ammonium salt chemical. There was a committee that assessed the substitute of sterilization used to disinfect the coronavirus. “The effectiveness assessment on the substitute of sterilization to be used to disinfect the coronavirus (Final report)” 新型コロナウイルスに対する代替消毒方法の有効性評価に関する検討委員会「新型コロナウイルスに対する代替消毒方法の有効性評価（最終報告）」
https://www.nite.go.jp/data/000111315.pdf

11) Lorwai Tan, Joshua Kovoor, Penny Williamson, et al. Personal protective equipment and evidence-based advice for surgical departments during COVID-19. *ANZ J Surg*. 2020;90:1566-1572.

12) Collected sample from the surface of the shoe was tested positive. Sean Wei Xiang Ong, Yian Kim Tan, Po Ying Chia, et al. (Letters) Air, surface environmental, and

personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2(SARS-CoV-2) from a symptomatic patient. *JAMA*. 2020 Mar 4.
13) Although the connection between SARS-CoV-2 and privacy curtains are not confirmed, there was a research about the contamination on privacy curtains.
Jennifer Sanguinet, Charles Edmiston. Evaluation of dry hydrogen peroxide in reducing microbial bioburden in a healthcare facility. *Am J Infect Control*. 2021;000:1-6.
Jennifer Sanguinet, Chris Lee. An effective and automated approach for reducing infection risk from contaminated privacy curtains. *Am J Infect Control*. S0196-6553(21)00402-8. https://doi.org/10.1016/j.ajic.2021.06.004.
The contamination of SARS-CoV-2 was examined through privacy curtains, pillow covers, and other linen fabrics. Fa-Chun Jiang, Xiao-Lin Jiang, Zhao-Guo Wang, et al. Detection of severe acute respiratory syndrome coronavirus 2 RNA on surfaces in quarantine rooms. *Emerging Infectious Diseases.* Vol.26, No.9, September 2020. https://doi.org/10.3201/eid2609.201435.

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