SURFACE HYGIENE IN HOSPITAL ENVIRONMENT

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1 INTRODUCTION

The current COVID-19 situation challenges and highlights the importance of hygiene and cleaning expertise and skills in all operation environments. The actors of the hygiene and cleaning sector as well as their customer companies face today various new challenges in different crisis situations, which must be responded acutely by changing materials, chemicals and working procedures. In addition, the hygiene and cleaning industry actors are in key roles not only during the crisis and extraordinary circumstances such as pandemic waves but also when the restrictions are removed, ensuring the safe return to normal conditions e.g., in terms of quality surface cleaning.

In the hospital environment cleanliness and clean surfaces must be self-evident. Surfaces are always contaminated with dirt, dust, micro-organisms and condensed matter. This is why cleaning has a long history, but the criteria for what we want to obtain by cleaning differ: to obtain an acceptable perception both visual and tactile, for hygienic and health concern reasons, and to prevent surface degradation (Dancer, 2011; SFS 5967, 2010).

There are several studies concerning persistence of coronavirus (SARS-CoV-2) in surfaces in the hospitals and for example Wu et al. (2020), Ye et al. (2020) and Zhou et al. (2020) all had similar conclusions of the need to strict environmental surface hygiene practices and enhanced hand hygiene to prevent the spread of the virus.

Assadian et al. (2021) compiled a review focusing on routine environmental cleaning and disinfection including areas with a moderate risk of contamination, such as general wards. The review provides expert guidance for healthcare workers in their daily practice. Boyce (2021) has been studied different wipes and wiping techniques and their effect on cleaning quality.

Kampf et al. (2020) assume that virus in not likely spread though surfaces if there is no external secretion so that is why we are not supposed to use disinfectants unnecessarily. According to CDC Science Brief on April 5th 2021 cleaning surfaces just with daily used detergent should be enough and disinfection should be used only in risk situations. So, the risk of fomite transmission is easily reduced with normal hygiene procedures used in this situation.

An article in the Lancet magazine has summarized studies that have investigated the C_t (Cycle threshold) values of coronavirus findings. The C_t value gives an idea of the amount of virus in the sample. The lower the C_T value, the greater the number of viruses and the chance of infection. The authors consider the spread of the virus through surfaces to be minimal unless there are secretions on the surfaces. Therefore, they would limit the use of disinfectants only to those situations (Kampf et al., 2021).

2 MATERIALS AND METHODS

The purpose of the study was to determine whether COVID-19 patients secrete SARS-CoV-2 virus into their environment and whether cleaning removes the spread of virus contamination from surfaces. The study was carried out at Tampere University Central Hospital in the emergency, intensive care, infection, and children's emergency departments. The samples were collected from the surfaces with a moistened cotton swab into a sample tube with salt buffers. The collection was carried out before and after cleaning from a total of 48 patient rooms.

Samples were collected from different parts of the patient room, e.g., from door handles, windowsill, air conditioning duct, different parts of the patient bed, treatment equipment, floor, toilet facilities, e.g., toilet seat, sink and faucet. Totally 921 samples were taken, and 465 samples were examined before cleaning and 456 after cleaning.

The swab samples were analyzed using the SARS-CoV-2 specific nucleic acid amplification method (RT-qPCR). The nucleic acid contained in the samples was isolated with Qiagen's Viral RNA putty according to the instructions. Potential virus positivity was tested using SARS-CoV-2 specific RT-qPCR methods targeting the N1 and N2 genes. The reactions were made with QuantiTect Probe RT-PCR putty (Qiagen) according to instructions with 900mM CoV2019 N1 F primer, 900mM CoV2019 N1 R primer and 200mM CoV2019 N1 P probe. In the N2 gene method, the template was amplified and identified using a 300mM CoV2019 N2 F primer, a 900mM CoV2019 N2 R primer, and a 200mM CoV2019 N2 P probe. RT-qPCR conditions were as follows: The RT-PCR reaction was done at 56°C for 30 minutes. In the qPCR method, initial

denaturation was done at 95°C 5min and amplification at 94°C for 15 seconds, the adhesion of the primers to their target was done for 60°C 15 seconds and amplification at 72°C for 1 minute, there were 50 cycles in the method.

3 RESULTS

A total of 921 samples were examined 465 before cleaning procedures and 456 after cleaning. There were 48 patient rooms, and no virus was found in 32 patient rooms. At least one virus positive sample was found in 15 rooms. The viral numbers in the samples were very low, the samples contained from a single to a few dozen viruses. An exceptionally high number of virus-positive samples were found in two patient rooms. In the first room 18 samples were tested and 11 were positive and in the other room 8 of the 18 samples were viral positive. In those rooms exceptionally high amounts of viruses were found and three of the samples contained an estimated thousands of viruses. Ten positive samples were also tested for the ability to infect viruses. No indication of infectious viruses was found in the samples tested. SARS-CoV-2 virus was found in 32 samples collected before cleaning, 13 of these sample points were positive even after cleaning. In addition, after cleaning, 2 positive sample points were found, which were negative before cleaning. An example of the results of a one-person patient room is in the table 1.

Table 1. The presence of coronavirus on the surfaces of the patient room. Coronavirus was found in the patient's room before cleaning on seven surfaces and after cleaning on four surfaces.

	Before cleaning	After cleaning
Patient room door handle	NEG	NEG
Floor next to the bed	POS	NEG
Sideboard of the bed	POS	POS
Footboard of the bed	POS	NEG
Bedside table	POS	POS
Toilet faucet handle	POS	POS
Toilet door handle	POS	NEG
Inner side of the toilet seat cover	NEG	POS
Toilet seat ring	POS	NEG

4 IN CONCLUSIONS

Cleaning reduced the amount of viruses on the surfaces of the hospital environment but did not always remove them completely. However, the amount of virus was so low that it no longer caused the disease. More studies of cleaning efficiency, cleaning procedures and usage of cleaning detergents is needed.

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BIBLIOGRAPHY

Assadian, O., Harbarth, S., Vos, M., Knobloch, J. K., Asensio, A., & Widmer, A. F. (2021). Practical recommendations for routine cleaning and disinfection procedures in healthcare institutions: A narrative review. *Journal of Hospital Infection*, 113, 104–114. https://doi.org/10.1016/j.jhin.2021.03.010

Boyce, J. M. (2021). A review of wipes used to disinfect hard surfaces in health care facilities. *American Journal of Infection Control, 49*(1), 104–114. https://doi.org/10.1016/j.ajic.2020.06.183

Cai, J., Sun, W., Huang, J., Gamber, M., Wu, J., & He, G. (2020). Indirect virus transmission in cluster of COVID-19 cases, Wenzhou, China, 2020. *Emerging Infectious Diseases, 26*(6), 1343-1345. https://doi.org/10.3201/eid2606.200412

Dancer, S. J., & Kramer, A. (2018). Four steps to clean hospitals: look, plan, clean and dry. *Journal of Hospital Infection, 103*(1) e1– e8. https://doi.org/10.1016/j.jhin.2018.12.015

DIN 13063 (September 2021). *Hospital cleaning - Requirements for cleaning and disinfection cleaning in hospitals and other health care facilities*.

Finnish Institute of Occupational Health. (2021). *Cleaning guidelines for the prevention of COVID-19 infections*. https://hyvatyo.ttl.fi/en/koronavirus/cleaning-guidelines-for-the-prevention-of-covid-19-infections

Kampf G., Bruggemann Y., Kaba H. E. J., Steinmann, J., Pfaender, S., Scheithauer, S., & Steinmann, E. (2020). Potential sources, modes of transmission and effectiveness of prevention measures against SARS-CoV-2. J*ournal of Hospital Infection 106*(4) 678-97. https://doi.org/10.1016/j.jhin.2020.09.022

Kampf, G., Lemmen, S., & Suchomel, M. (2021). Ct values and infectivity of SARS-CoV-2 on surfaces. *The Lancet. Infectious Diseases, 21*(6), e141. https://doi.org/10.1016/S1473-3099(20)30883-5

Suomen Standardisoimisliitto (SFS). (2010). *Puhtausalan sanasto; Vocabulary of cleaning industry* (SFS 5967).

Wu, S., Wang, Y., Jin, X., Tian, J., Liu, J., & Mao, Y. (2020). Environmental contamination by SARS-CoV-2 in a designated hospital for coronavirus disease 2019. *American Journal of Infection Control, 48*(8), 910-914. https://doi.org/10.1016/j.ajic.2020.05.003

Ye, G., Lin, H., Chen, S., Wang, S., Zeng, Z., Wang, W., Zhang, S., Rebmann, T., Li, Y., Pan, Z., Yang, Z., Wang, Y., Wang, F., Qian, Z., & Wang, X., (2020). Environmental contamination of SARS-CoV-2 in healthcare premises. T*he Journal of infection, 81*(2), e1-e5. https://doi.org/10.1016/j.jinf.2020.04.034

Zhou, J., Otter, J.A., Price, J.R., Cimpeanu, C., Garcia, D.M., Kinross, J., Boshier, P.R., Mason, S., Bolt, F., Holmes, A. H., & Barclay, W. S. (2020). Investigating SARS-CoV-2 surface and air contamination in an acute healthcare setting during the peak of the COVID-19 pandemic in London. *Clinical Infectious Diseases, 73*(7), e1870–e1877, https://doi.org/10.1093/cid/ciaa905