

Research on Public Hand Disinfection Equipment Based on the Needs of Daily Life Disinfection

Ting Song¹, Yong Liang^{1*}

¹ School of Foreign Languages and Cultures, Xihua University, China

ABSTRACT: Since modern times, with the rapid advancement of public health, people all over the world have given disinfection work an increasing amount of attention. The disinfection mechanism has been greatly enhanced in the fields of medical treatment, sewage treatment, and other fields, but the necessity of hand disinfection in daily life has received less attention. Based on the survey, this paper first examines and evaluates the hand sanitizers that are currently available on the market. Second, it displays a public hand disinfection device designed by the authors that highlights the benefits of the currently available disinfection products and describes how to operate it. Finally, it is shown that this hand-disinfection device can successfully meet people's daily hand-disinfection needs.

1. INTRODUCTION

The goal of hand disinfection is to get rid of any transient bacteria and lessen the amount of bacteria that remains on the hands[1]. Keeping up with hand hygiene is an excellent way to avoid getting sick from bacterial infections[2]. Disinfection is the primary method for preventing diseases in people's daily lives, as well as a vital tool for hospitals to control infection[3]. Keeping clean hands is one strategy to eliminate the source of infection because the new coronavirus is mainly spread through respiratory droplets (airborne transmission) and contact transmission[4].

Hand disinfection is a closely concerned issue in the development of health undertakings in modern times. The relationship between hand hygiene and the spread of disease has been summarized in a lot of literature [5-6]. With the COVID-19 pandemic outbreak in 2020, awareness of proper hand hygiene has reached a new peak, and sales of hand sanitizer have increased globally [7]. To make the disinfection machine more appealing to the general public and increase its appeal to users, Zeyu Guo's team innovated its appearance through design [8]. The research mentioned above, however, has the following issues:

(1). The traditional disinfection machine only has disinfection function, however, disinfection machine can also be used as human flow monitoring equipment;

(2). The traditional device often ignores the different disinfection needs of different age groups;

(3). It also pays little attention to the effect of external conditions on the equipment.

With such a high demand for hand disinfection, the goal of this paper is to tackle these inconveniences and deficiencies, so as to efficiently increase the frequency of

usage of disinfection devices.

2. COMPARISON OF THE EXISTING HAND DISINFECTION PRODUCTS ON THE MARKET

2.1. Features of the Existing Hand Disinfection Products on the Market

(1) Strong sterilization and disinfectant properties: Chemical fungicides like nonylphenol (OPP) and trichlorohydroxyphenyl ether (DP300) are commonly added to antibacterial hand sanitizers on the market to achieve their antibacterial functions [9]. The antibacterial effect has been experimentally confirmed.

(2) Meet the needs of daily hand disinfection: soap is often placed at home to disinfect family members for hand disinfection, which is convenient to use. At the entry to public spaces like shopping centres, spray pump or open-cover hand sanitizers are frequently positioned to offer consumers quick and easy disinfection services. Extractive alcohol cotton sheets are lightweight. Therefore, it may meet disinfection demands without time or space restrictions, like outdoor dining. Ordinary hand disinfection machines on the market are often placed at subway entrances, hospitals, and other places with a large flow of people. It has initially realized contactless hand disinfection.

2.2. Disadvantages of the Existing Disinfection Products on the Market

(1) Soap: Due to the special use method of soap, it is easy to cause secondary pollution and cross-infection for

*Corresponding author. Email: lukeliangnew@gmail.com

different users. Furthermore, soap is exposed to a lot of air, making it possible for dust and bacteria to accumulate and diminishing its effectiveness to disinfect [10]. To accomplish the disinfectant effect of soap, the skin must be regularly rubbed. Long-term soap use can cause signs of ageing in the hands as tension, peeling, dry cracking, and roughness.

(2) Spray pump / open cover hand sanitizer: Although the contact area of the hand is reduced compared with soap, using the hand sanitizer requires pressing down on the pump head, which makes it easy for bacteria to transfer from one user to the next. Additionally, the sterilization power is limited, and it cannot remove dust, soil, etc., from the small cracks in the skin.

(3) Extraction of alcohol cotton pads: The principle of alcohol cotton pads is mainly to disinfect with alcohol. However, when alcohol is exposed to air, it is quite easy to volatilize and lose its disinfectant properties.

(4) Traditional disinfection machines: these are more prevalent in hospitals, public restrooms, and other areas that are open to the public. Because their delivery sites rely largely on a steady atmosphere, they are always installed indoors. The effect of disinfection will be influenced by temperature and light intensity. Therefore, the popularizing rate and disinfection effectiveness of the traditional devices at outdoor public gathering areas are both poor. It is not helpful for raising public awareness of health and safety.

3. FUNCTIONAL DESCRIPTION OF THE NEW DISINFECTION MACHINE

(1) The disinfection device employs face recognition technology to identify the user's age based on their facial features and to regulate the volume of fluid it emits.

(2) The disinfection machine automates the discharge

of the disinfection machine using sensor technology, which is convenient and intelligent. Because of its small size and light weight, a disinfection machine can be installed outside in a range of locations, bridging the gap in the provision of effective sterilization in outdoor crowd-gathering areas.

(3) The disinfection machine realizes the installation without restriction of environment. Through the use of isolation plates and other techniques, the device motor is kept isolated from the outside world. The device's internal temperature is constant, and the internal tank's material is insulated. As a result, the gadget is not easily impacted by high or low temperatures, and its maintenance costs are minimal.

(4) The disinfection machine realizes the independence of the disinfection process. A one-way valve controls the flow of the substance. The piston is driven to move by a gear that is attached to the crank connecting rod cam, enabling the machine to operate independently. The replacement inner tank and the motor are also isolated from the isolation plate. They can be disassembled to ensure the normal operation of the disinfection work.

(5) The disinfection machine realizes the high efficiency of the disinfection work. The machine connects to the motor through Bluetooth to control the amount of fluid according to the characteristics of the user. At the same time, the user can directly operate the mobile phone, reducing waste and improving efficiency. So the machine can be used as a human flow monitoring equipment.

(6) The disinfection machine realizes the reusability of the disinfection device and the universality of the disinfection work. The device has a built-in isolation layer to keep the internal temperature of the device stable and closed. The early warning device intelligently monitors the operation status of the device. The suspension design reduces the restrictions on the placement place.

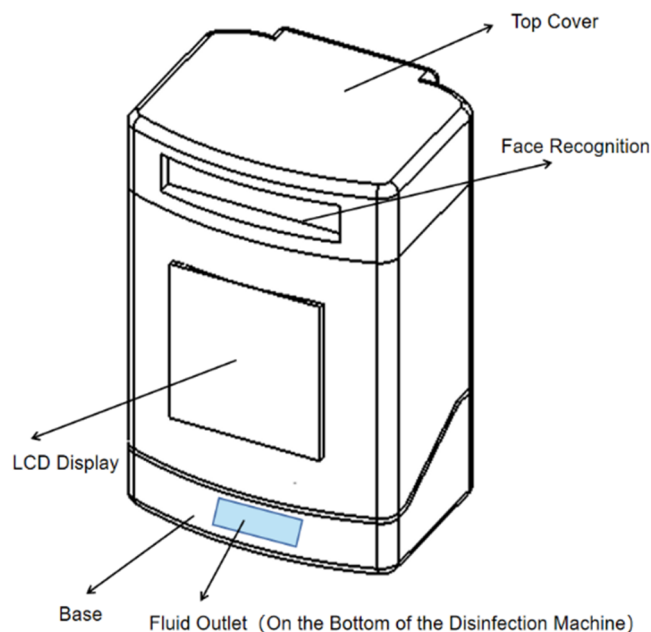


Figure 1 New disinfection machine model designed by the authors

4. DISCUSSION

4.1. Design Concept of the New Disinfection Machine

(1) Easy to use: users only need to put their hands underneath the disinfection machine to finish the disinfection service within a short time. Furthermore, there is zero touch throughout the entire disinfection process. Users do not need to wash their hands.

(2) Cost saving: the remaining storage of disinfectant can be observed through the LCD screen, which is convenient for staff to replace it so that the disinfection machine remains in good functioning condition. Face recognition enables the appropriate amount of fluid to be managed according to the user's age, reducing the need for disinfectant and lowering operating costs.

(3) Flexible placement: the disinfectant container is replaced with a replacement core, which is safe and contactless. The replacement core adopts light-proof and thermal insulation materials to minimize the impact of the environment on disinfectant and retain the effect of the disinfectant to the greatest extent. So it can be used outside as well as inside.

4.2. It is of great significance to the production and life in the post-pandemic era

4.2.1. Hand Sterilization to Prevent Infection

After the outbreak of COVID-19, virtually everyone pays much attention to the operations and tasks involving hand contacts in daily life. Keeping one's hands clean at all times can help her or him get rid of the infection effectively and reduce the possibility that the virus spreads from hand to mouth. As a result, it can lower the number of infected individuals and lower the demand on epidemic prevention and control.

4.2.2. Raise Awareness of Hand Hygiene

Since the COVID-19 pandemic in 2020, China's policy of requiring people to wear masks in public places has not only been efficacious in containing virus, but also significantly decreased the number of influenza illnesses in the spring and fall. The new coronavirus is still circulating today. Taking China as an example, although the prevention and control of the epidemic in China have begun to bear fruit, we also find that the epidemic is still scattered globally. Wearing masks, maintaining social distancing, home isolation, and other protective means are still part of people's normal life in times of emergency [11].

Similarly, in daily life, hand contact is frequent, such as work handovers and handshakes. Bacteria is easily spread through the hands; therefore, keeping the hands clean is of great significance to prevent diseases. For the time being, the new device can prevent the novel coronavirus from spreading through the hands, which can further play a certain protective role in preventing

infectious viruses in the long run. People will progressively develop an awareness of hand cleanliness through the regular hand sanitization job, turning it into a daily habit. Then the overall social health awareness will be improved.

5. CONCLUSION

This paper proposes a new type of hand disinfection machine, which maximizes the advantages of existing disinfection products, efficiently provides people with hand disinfection services and minimizes drawbacks.

The significance of this paper is to provide a solution on how to improve the efficiency of hand disinfection in the post-pandemic era. Also, it can better meet people's daily disinfection needs and help people to establish awareness of disinfection. Limitations of this study include that the actual use effect of the disinfection machine needs to be further tested and improved, even though it avoids some of the drawbacks of several current disinfection products.

An improved hand disinfection equipment that overcomes the drawbacks of conventional hand disinfection devices can better meet people's everyday disinfection demands and advance the advancement of public hand health.

ACKNOWLEDGEMENTS

This project is funded by the 2022 National Undergraduate Innovation and Entrepreneurship Training Program of China at Xihua University with the title "A Disinfection Equipment Based on Public Health Management in the Post-pandemic Era" (Grant No. 202210623024). The instructor of this article is Dr. Liang Yong of Xihua University.

REFERENCES

1. Hua, Wei. The development trend of hand disinfection technology. *China Medical Device Information*, 2011, 17(05): 46+62.
2. E. Tartari et al. The global hand-sanitizing relay: promoting hand hygiene through innovation. *Journal of Hospital Infection*, 2016, 95(2): 189-193. DOI: 10.1016/j.jhin.2016.11.003. PMID: 28081910.
3. Meng Zhai and Huifen Jiang. The transmission route and the prevention of novel coronavirus pneumonia COVID-19. *Genomics and Applied Biology*, 2020, 39(10): 4895-4898.
4. Meiling Li, et al. The application effect of hand hygiene intervention combined with air disinfection in the closed psychiatric ward. *Chinese Medical Science*, 2020. 10(13): 170-174.
5. Liang Chen, et al. Evaluation of preventive medicine in hand hygiene intervention in Changping Town, Dongguan City. *Prevention of Medical Science of Huanan*, 2021. 47(02): 179-183+187.

6. Hedin Göran, Blomkvist Annika, Janson Marianne, Lindblom Anders. Occurrence of potentially pathogenic bacteria on the hands of hospital patients before and after the introduction of patient hand disinfection. *APMIS: acta pathologica, microbiologica, et immunologica Scandinavica*, 2012,120(10).
7. Jun Gu. After COVID-19, will the daily chemical washing industry still usher in new changes? *Daily Chemicals Science*, 2020. 43(02): 26-27.
8. Zeyu Guo, Chao Zhang, and Jiabin Luo. The design of nuo mask in the hand disinfection machine[J]. *Design*, 2021. 34(15): 129-131.
9. Yuan Gao, Xuan Fu and Rui Yuan, et al., Tea saponin hand sanitizer. *Daily Chemical Industry*, 2021,51 (01): 28-31 + 37.
10. Khairnar Mahesh R, G Anitha, Dalvi Tanushri M, et al. Comparative Efficacy of Hand Disinfection Potential of Hand Sanitizer and Liquid Soap among Dental Students: A Randomized Controlled Trial. *Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine*, 2020,24(5):336-339.
11. Bixue Ren. Research of the presentation and change of the concept of health communication based on *Yi Shi Bao*. 2021, Hebei University.