The Exigent Need for Disinfecting and Protecting Mobile Phone Against Bacteria and Viruses with Legionella-X Viral Shield a Self-Disinfecting Coating.

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Abstract

This transfer of pathogens on mobile phones poses a serious health concern. The risk is that infectious pathogens may be spreading via phones within the community, in workplaces including medical and food-handling settings, and in public transport, cruise ships and aeroplanes. Research has varied on just how many germs are crawling on the average cell phone, but a recent study found more than 17,000 bacterial gene copies on the phones of high school students. Scientists at the University of Arizona have found that cell phones carry 10 times more bacteria than most toilet seats [1,2]. According to London School of Hygiene and Tropical Medicine, Fecal matter can be found on 1 out of every 6 smartphones, according to a 2011 study done by researchers [3]. Mobile phones have become an essential commodity in man's day-to-day life. It is carried by the doctors during visits to the hospital and is extensively used within the hospital premises including areas like Operation theatres and Intensive care units. If proper infection control practices especially hand hygiene are not followed this device can serve as a reservoir of infection According to the study, 90% of the mobile phones and hands of all (100%) the health care workers were contaminated with organisms known to cause hospital acquired infections

(HAIs) [4]. Almost everyone always remembers to wash their hands multiple times a day after visiting the toilets, but many times neglect their mobile phone-screen. The reason your mobile phone holds so many germs is because it remains warm throughout the day because of how often we use it. This article presents the exigent need to disinfect and protect smartphone against bacteria and enveloped viruses during this current Covid-19 Pandemic and using JIS Z 2801:2010/A1:2012 to ascertain the 60 days residual efficacy of Viral Shield Self-Disinfecting Coating [24]

Key Words

Mobile phone, Covid-19, Legionella-X Viral-Shield, Residual Inactivation Efficacy.

Introduction

There is currently no vaccine to prevent coronavirus disease 2019 (COVID-19), the best way to prevent illness is to avoid being exposed to this virus. Clean and disinfect frequently touched surfaces daily including tables, doorknobs, light switches, faucets, handles, mobile phones, etc.

There are billions of mobile phones in use around the globe. They are present on every single continent, in every single country and in every single city. This technical journal reviewed the research on how mobile phones carry infectious pathogens such as bacteria and viruses, and how they are likely to contribute to community transmission in epidemics and pandemics.

Currently mobile phones are largely neglected from a biosecurity perspective, but they are likely to assist the spread of viruses such as influenza and the novel coronavirus responsible for the COVID-19 pandemic. Contaminated mobile phones pose a real biosecurity risk, allowing pathogens to cross borders easily [12].

Viruses can live on surfaces from hours to days to weeks [13]. If a person is infected with Covid-19, it is highly likely their mobile phone will be contaminated. The virus may then spread from the phone to further individuals by direct or indirect contact.

Mobile phones and other touchscreen systems – such as at airport check-in counters and in-flight entertainment screens – may have contributed to the rapid spread of COVID-19 around the globe.

Since mobile phones are radically becoming an essential means of communication worldwide and are common, beneficial, and user-friendly. Although mobile phones have more benefits side compare with the harmful side, the cell phones have been identified as one of the media by which bacteria pathogens could be transmitted [5]. Mobile phones also act as important origins of nosocomial infections among hospitalized patients [6,7]

Recently, mobile phones have become a potent vector for the transmission of pathogens. In hospitals, the use of the mobile phones by healthcare workers in an unhygienic manner accelerates the spread of nosocomial infection. Presence of Multidrug-Resistant Bacteria on Mobile Phones of Healthcare Workers Accelerates the Spread of Nosocomial Infection and Regarded as a Threat to Public Health in the developing world [8]. Hospital-acquired infections (HAI) appearing more than 2 days after enrollments in hospitals and which do not exist or during admission are generally known as nosocomial Infection [9]

The mobile phone can breed more microorganisms than a man's lavatory seat, the sole of a shoe, or a door handle [10]. We usually use our phones not just to talk but also to take pictures, surf the net, chat, etc. All these involve touching the screen. Every time we do so, we transfer more germs on to it.

Mobile phones are one of the most highly touched surfaces according to the Centers for Disease Control and Prevention (CDC), along with counters, tabletops, doorknobs, bathroom fixtures, toilets, keyboards, tablets, and bedside tables [11].

While government agencies are providing guidelines on the core practices for effective hand hygiene, there is little focus on practices associated with the use of mobile phones or other touch screen devices. People touch their mobile phones on average for three hours every day, with super-users touching phones more than 5,000 times a day. Unlike hands, mobile devices are not regularly washed [14].

Hence, mobile phones are almost ideal carriers of disease. We speak into them regularly, depositing microbes via droplets. We often have them with us while we eat, leading to the deposit of nutrients that help microbes thrive. Many people use them in bathrooms and on the toilet, leading to fecal contamination via the plume effect.

Albeit mobile phones are exposed to microbes, most of us carry them almost ubiquitously: at office, at home, while shopping, on holidays. They often provide a temperature-controlled environment that helps pathogens survive, as they are carried in pockets or handbags and are rarely switched off.

Besides, we barely clean or disinfect them. Research data suggests almost three-quarters of people have never cleaned their phone at all [14].

A group of doctors from the AIIMS, Raipur has recommended restrictions on use of mobile phones in healthcare institutions amid the COVID-19 pandemic, warning that such devices can be a potential carrier of the virus and lead to infection among healthcare workers[15]. In a commentary published in the BMJ Global Health journal, the doctors stated that mobile phone surfaces are a peculiar 'high-risk' surface, which can directly come in contact with the face or mouth, even if hands are properly washed and one study indicates that some healthcare workers use phones every 15 minutes to two hours.

These decontamination processes should be enforced especially in key servicing industries, such as in food-handling businesses, schools, bars, cafes, aged-care facilities, cruise ships, airlines and airports, healthcare. We should do this all the time, but particularly during a serious disease outbreak like the current COVID-19 pandemic.

Few factors that make our mobile phone contaminated with microorganisms.

Using it after meals: Do you wash your hands after meals? If you do not, you not only transfer bacteria but also other things such as oil, food particles on the screen and other parts.

Using it in/after using restrooms: Using your phone after going to the restroom or worse, in the restroom is an open invitation to millions of germs. Especially if you use a public toilet, you are likely to pass on germs from other people who have touched that surface before you.

Using it in public transport: If you often commute via public transport, you perhaps have more germs on your phone. This is because you touch surfaces such as the pole, seat handles, etc. which a thousand others have touched, most likely without washing their hands. These then pass on to your screen when you touch it.

Your sweat: When you talk on your phone for a long time, you tend to sweat and deposit the germs on your phone s screen.

While playing with pets: Love playing with your pets? I'm sure you wash your hands after touching them before you sit down for a meal, but do you wash them before you touch your phone too? Probably not. This means you now have germs from an animal or bird too on your phone.

When other people use it: Your phone may be your prized possession but it is quite rare that no one else; except you touches it. You may often pass it on to others to take pictures, make a call, show something, etc. They too pass on germs from their hands on your phone s screen. Harmful microorganisms can be transferred to hands from contaminated surfaces people come into contact in daily life. Contaminated hands can transmit disease to oneself as well as to other [16].

When you keep it on other surfaces: You are likely to keep your phone on surfaces such as the table, desk, bag, pocket, drawer, etc. These often have germs, dust particles, etc. which get transferred on your phone.

Can you really keep your phone clean? Your phone harbors thousands of germs but is it possible to clean it? Here a few methods but they too have their shortcomings [17].

Perhaps the best way to get rid of germs from your phone is with soap and water. You can practically do it anywhere and quite frequently. It is also economical and does not take much time. But unless your phone is waterproof, it is not feasible to do so.

In view of the above, Legionella-X Viral Shield a self-disinfecting coating with high residual inactivation efficacy was developed to combat Covid-19 Virus. The said product was developed to protect all inanimate surfaces of mobile phone up to 60 days against the Covid-19 Virus.

Legionella-X Viral Shield is a water-based broad-spectrum self-disinfecting coating containing synergistically blend of twin-chain quaternary ammonium compound, colloidal silver and copper nanoparticles, and another proprietary compound.

Legionella-X Viral Shield Self-Disinfecting Coating inactivates viruses by denaturation and reactive oxygen specimen (ROS) [18]. It employs said dual mechanisms to inactivate both viruses and bacteria.

Its residual inactivation efficacy of 60 days was validated using JIS Z 2801:2010/A1:2012 Antibacterial Activity. The said test calls for antibacterial activity and efficacy of antibacterial products on plastic products, metal products, ceramics, excluding textiles and the photocatalyst products. The said standard is corresponding to ISO 22196:2007 for the measurement of antibacterial activity on plastic surfaces [19,20,21,22,23]. The details of JIS Z 2801:2010/A1:2012 is herein described below.

Testing method

Bacteria to be used for the test

The species of bacteria to be used for the test shall be as follows, and the test shall be carried out on the respective bacteria.

a) Staphylococcus aureus

b) Escherichia coil

Examples of bacterial strain to be used for the test are shown in table 1. If the bacterial strain is contributed by the agency of culture collection other than that shown in table 1, it shall be obtained from member agencies of World Federation for Culture Collections (WFCC) or Japan Society for Culture Collections (JSCC), and it shall be the bacterial strain of the same series as that shown in table 1.

Table 1 Bacterial strain used for the test

Type of bacteria	Preservation number of bacterial strain	Agency of culture collection
Staphylococcus aureus	ATCC 6538P FDA 209P NBRC 12732 CIP 53.156 DSM 346 NCIB 8625	American Type Culture Collection Food and Drug Administration Bioresource Information Center, Department of Biotechnology of National Institute of Technology and Evaluation Collection des Bacteries de l'Institu t Pasteu r Deutsche Sammiung von Mikroorgs.nismen und Zellkulturen Gmbh National Collection of Industrial and Marine Bacteria Ltd.
Escherichia coli	ATCC 8739 NBRC 3972 CIP 53.126 DSM 1570 NCTB 8545	American Type Culture Collection Bioresource In formation Center, Department of Biotechnology of Nations I Institute of Technology and Evaluation Collection des Bacteries del'insti tut Pasteur Deutsche Sammlung von Mikroorganismen und Zellkulturen Gmbh National Collection of Industrial and Marine Bacteria Ltd

Preparation of test inoculum

One platinum loop of bacteria of the test bacteria preincubated in a) shall be dispersed evenly in a small amount of 1/500 NB, and the bacteria concentration shall be estimated with direct microscopic observation or other appropriate methods. This inoculum shall be diluted with 1/500 NB appropriately and adjusted so that the bacteria concentration becomes 2.5 x 10.^{5} to 10 x 10^{5} cells/ml, and this shall be used as the test inoculum. if the test inoculum is not used immediately, it shall be cooled on ice (0°C) and shall be used within 2 h after storage.

The inoculation with test inoculum shall be as follows.

1) Each test piece shall be placed in a sterilized petri dish making the test surface up. The test surface shall be the surface of the product on which antibacterial treatment is performed. Even when the antibacterial treatment is processed to depth, the cross-section shall not be used as the test surface.
2) Exactly 0.4 ml of test inoculum of shall be taken with a measuring pipette and instilled onto each test piece in the petri dish. The volume of inoculated inoculum on the test piece whose size is other than the standard size shall. be proportionally divided by the ratio of the area of covering film. Even if the test piece is of the standard size when the volume of inoculum based on the provision is inoculated on the test piece of very good wettability such as ceramics, tile, enamel, and glass, the film may move at a small slant and the inoculum may escape from the edge of the film. In this case, the volume of inoculated inoculum may be reduced up to 1/4 of the specified volume. However, even when the volume of inoculated inoculum is reduced, the bacteria concentration inoculated on the test piece shall he 6.2 X 10^{3} to 2.5 x 10^{4}cells/cm ^{2}.

3) The instilled test inoculum shall be covered with a film; the film shall be gently pressed so that the test inoculum spreads across the film while paying attention so that it does spillover from the edge or film, and the lid of the petri dish shall be placed (see, figure 1 and 2). The standard size of the film shall be the square of 40 mm ± 2 mm. If the test piece is not that of the standard size, the size shall be adjusted so that that the film can be placed within 2.5 mm to 5 mm from four sides of the test piece, but the size of the film shall not. be reduced to less than 400 mm^{2}. Further, if it. It is difficult to adhere to the film closely since the shape of the test piece is not flat if the test inoculum spreads over the test piece without covering the

film since the test piece is hydrophilic or water-absorbent or the like, the process of covering the film may be omitted. When the covering process of film is omitted, the standard size of the test piece shall be the square of 40 mm ± 2 mm (within. 10 mm in thickness).

On the inoculation with test inoculum if it is difficult to prevent the leakage beyond. the edges of the film on the case where the surface of the sample is very hydrophilic and the like, the volume of inoculum may be reduced tip to 0.1 ml. In this case, the concentration of bacteria cells in inoculum shall be increased to provide the same number of bacterial cells as that of inoculated inoculum of normal volume.

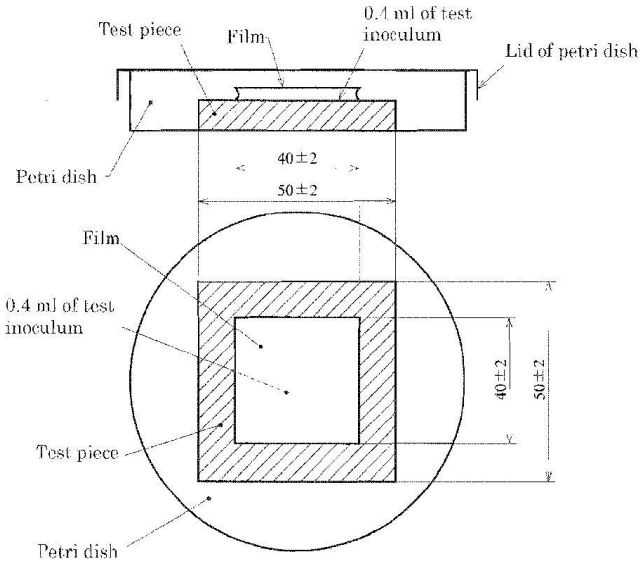

Figure 1

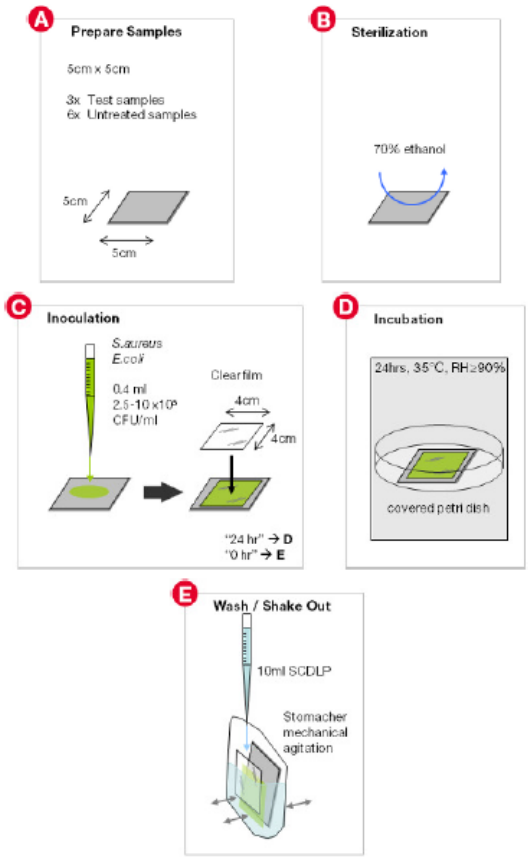

Figure 2

Incubation of inoculated test piece with test inoculum. The petri dish containing the inoculated test piece with the test inoculum (three untreated test pieces and three antibacterial test pieces) shall be incubated at a temperature of 35 °C ± 1°C and relative humidity of 90 % or more for 24 h ± 1h.

NOTE: The antibacterial effectiveness of a product is evaluated from the antibacterial activity obtained from the test at the incubation temperature specified here; however, the test at the temperature established. considering the actual use of the antibacterial product (such as room temperature) may be carried out together if agreed upon all parties concerned with delivery.

The wash-out of test bacteria inoculated shall be as follows.

1) **Test piece immediately after inoculation with test inoculum**. For three untreated test pieces immediately after inoculation with test inoculum, the covering film and the test piece shall be placed on another petri dish respectively with caution so that the inoculum does not spill. By adding 10 ml of SCDLP broth, the inoculum on the untreated test piece shall be washed out, with a measuring pipette at least four times, and this wash-out inoculum shall be recovered completely. The washings shall be immediately proceeded to the measurement of the number of viable bacteria.

2) **Test piece after incubation**. For the test piece after the incubation of the test bacteria shall be washed out. The washings shall be immediately proceeded to the measurement of the number of viable bacteria.

3) **For the wash-out of test bacteria** the method such that the covering film and the test piece are placed in a sterilized stomacher pouch by using sterilized tweezers with caution so that the inoculum does not spill, 10ml of SCDLP broth is added with a measuring pipette and the test piece and the covering film are kneaded sufficiently with hands or an extractor (such as stomacher) for the microbial test is applicable. Or if other methods show a recovery rate equivalent to or superior to the method. above, such methods may be used. If it is difficult to wash out the test bacteria with 10 ml of SCDLP broth because of the size and characteristics of the test piece, the volume may be increased.

Measurement of the number of viable bacteria by agar plate culture method

Exactly 1 ml of the wash-out of test bacteria inoculated shall be taken with a measuring pipette and added in a test tube containing 9.0 ml of phosphate-buffered physiological saline of and sufficiently mixed. Then, 1 ml shall be taken from this test tube with a new measuring pipette and add in another test tube containing 9.0 ml of phosphate-buffered physiological saline, and sufficiently mixed. These procedures shall be repeated to prepare 10-fold serial dilutions. 1 ml each of the washings and each dilution shall be dispensed into two sterilized Petri dishes. To each petri dish, 15 ml to 20 ml of the plate count agar warmed at 46°C to 48°C shall be added and sufficiently mixed. By placing the lids, the Petri dishes shall be left as they are at room temperature. After solidifying the culture medium,

the Petri dishes shall be turned over, and incubated in the incubator at a temperature of 35°C ±1°C for 40h to 48h. After incubation, the number of colonies in a serially diluted petri dish in which 30 to 300 colonies appear shall be measured, as a rule. If the number of colonies is less than 30 in the agar plate dispensed with 1 ml of the washings, the number of colonies shall be measured for this plate. If there are not any colony formations in an agar plate, then "< 1" shall be recorded. Further, if the number of colonies is not inversely proportional to the dilution ratio since it is considered that the formation of colonies is inhibited by the effects of the antibacterial agent, the number of viable bacteria shall be determined using a method which forms colonies without being affected by the antibacterial agent with the use of an inactivating agent or dilution.

Calculation of the number of viable bacteria

The number of viable bacteria shall be obtained by counts of colonies measured according to equation (1).

$$N = \frac{C \times D \times V}{A} \quad \text{..... (1)}$$

where,

N: number of viable bacteria (per 1 cm^2 of test piece)

C: count of colonies (average count, of colonies of two Petri dishes adopted)

D: dilution factor (that of dilution. dispensed into Petri dishes adopted)

V: volume of SCDLP broth used for wash-out (ml)

A: surface area of covering film (cm^2)

In the case where the covering film is omitted. *A* shall be the surface area (cm^2) of the antibacterial test piece or the untreated test piece.

The number of viable bacteria shall be expressed with two significant figures y. rounding off the third significant figure. When the count. of colonies, *C is* "<]." *C* is taken as "1", and the number of viable bacteria shall he calculated corresponding to *V*, *A, D* at that time. For example. when *V* is 10 ml, *A* is 16 cm^2, and *D* is 1, it shall be expressed as "<0.63".

Test results

The test: results shall be as follows.

a) Determination of conditions of test validation When the following three test conditions are all satisfied, the test, shall be determined to be valid. Unless all the conciliators are satisfied, the test shall be determined to be not valid, and a retest has to be carried out.

1) The following equation (2) is established for the logarithmic value of the number of viable bacteria immediately after inoculation on the untreated test piece.

$$\frac{L_{max} - L_{min}}{L_{mean}} \leq 0.2 \quad \text{..... (2)}$$

where,

L_{max}: maximum logarithm number of viable bacteria

L_{min}: minimum logarithm number of viable bacteria

L_{mean}: average of logarithm numbers of viable bacteria of three test pieces

2) The average of the number of viable bacteria immediately after inoculation on the untreated test piece shall be within the range of 6.2×10^3 to 2.5×10^4 cells/cm^2.

3) The number of viable bacteria on the untreated test piece after 2-4 h shall be not, less than 62 cells/cm^2 for all three test pieces. When a film is used for the untreated test piece: however, the number of viable cells of bacteria after 24h shall be not less than 6.2×10^2 cells/cm^2 for all three test pieces.

b) Calculation of antibacterial activity When the test has been determined to be valid, the antibacterial activity shall be obtained according to equation (3). The value shall be recorded to the first decimal place by rounding the second decimal place down. When the number of viable bacteria is "<0.63", it shall be taken as "0.63" and the average of logarithm numbers shall be calculated.

$$R=(U_t - U_0) - (A_t - U_0) = U_t - A_t \quad \text{.....(3)}$$

where,

R: antibacterial activity

U_0: average of logarithm numbers of viable bacteria immediately after inoculation on untreated test pieces

U_t: average of logarithm nu m hers of viable bacteria after inoculation on untreated test pieces after 24h

A_t: average of logarithm. numbers of viable bacteria after inoculation on antibacterial test piece after 24 h

Record of test results

The following matters shall be listed. in the test results of antibacterial products such as plastic products.

a) Number or title of this Standard
b) Commencement date of the test
c) Type, size, shape, and thickness of antibacterial-treated test piece and untreated test piece
d) Type, size, shape, and thickness of the film

Conclusion

Based on the said JIS Z 2801:2010/A1:2012 Test Method, the residual inactivation efficacy of Legionella-X Viral Shield against Positive-gram stained and Negative-Stained is 99.9998% and 99.99995% respectively.

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Dr. Ernesto Alonso Valdez Salas

Dr. Ernesto Alonso Valdez Salas is a passionate and renounced physician based in Mexicali Baja California. He has a medical degree and a master's degree in surgery with a specialization in gastroenterology at the Universidad Autonoma de Guadalajara, he received his of Doctor of Sciences from Universidad Autonoma de Baja California.

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He has participated and published many articles on NanoMedicine in International Scientific Journals, in addition to collaborating with the engineering institute of the Autonomous University of Baja California in projects involving areas of health.

He is the founder and director of Ixchel Medical Center and is the Medical Adviser of the Magna Think Tank Group.