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## Memorandum

### THREE ADDITIONAL ACTIONS RECOMMENDED FOR INDIVIDUALS AND PUBLIC AND PRIVATE ENTITIES TO REDUCE COVID-19 TRANSMISSION BASED ON DATA ANALYSIS

By Terry Rajasenan, Chief Scientist and Executive Board Member  
High Reliability Organization Council (HROC)

Date: March 24, 2020

This memorandum proposes that individuals, and public and private entities, add to the safety checklists that they are currently using (e.g., hand washing, wearing mask if ill, etc.), the following three additional items:

1. Raise humidity (with sub-tasks on how, in the form of “if this, then this” decision tree)
2. Reduce footwear risk (with sub-tasks on how)
3. Reduce phone or other communication device risk (with sub-tasks on how)

These three recommendations address some of our concerns about the ongoing transmission risk between healthcare staff and patients, and their potential to serve as vectors for the SARS-COV-2 virus so as to infect more persons in the community with the Covid-19 disease.

A significant part of the mission of our research council, HROC, is to educate on public safety. Thus, we are providing these additional proposed checklist items based on our research from literature searches as well as observations, empirical evidence, and scientific study.

HROC researchers' most recent work with the U.S. Army's Telemedicine and Advanced Technology Research Center (TATRC) and the U.S. Air Force (USAF) concentrated on creating and increasing the effectiveness of **safety checklists**, including during the **2014 Ebola pandemic**, wherein the response heavily involved the Dept. of Defense. (More on HROC's team can be found at [thinkhro.org/whoweare.html](http://thinkhro.org/whoweare.html))

Our three additional recommended checklist tasks have minimal or negligible costs. While their efficacy has not yet been proven in peer reviewed studies, they differ significantly from other as-yet unproven solutions (e.g., Chloroquine) because their trade-off costs, side effects, and mortality risks are extremely low.

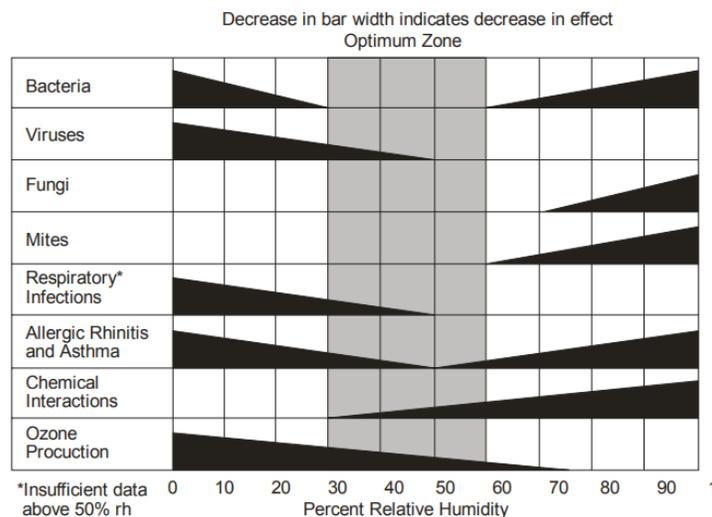
In the remainder of this memorandum, we describe each recommended principle, why it is being recommended, and how it can be implemented in the quickest and least expensive manner.

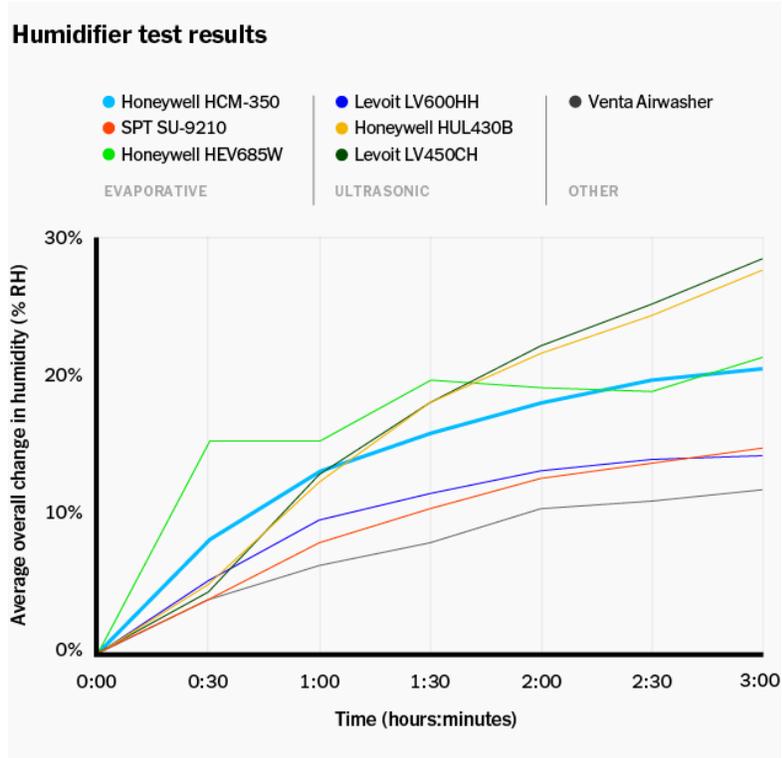
### THREE KEY CHECKLIST ITEMS

- **Raise Humidity**
  - *Humidity enables our body's first line of defense against microbes, which is mucus, to work. In low humidity settings, our mucus dries out [1]*
  - *However, humidity also for various viruses, such as flu, appears to “deactivate” the infectiousness of the virus dramatically. For example, in one study on flu viruses, to simulate flu transmission in a health care setting, researchers used “coughing” and “breathing” mannequins that were placed about 6 feet apart. Flu virus particles were released during a “cough,” and devices throughout the room and near each “breathing” mannequin's mouth captured the particles. The particles were then collected and tested for their ability to infect human cells. At*

humidity levels of 23%, 70 to 77% of the flu virus particles were still able to cause an infection an hour after the coughing simulation. But when humidity levels were raised to 43%, just 14% of the virus particles had the ability to infect. Most of the flu particles became inactive 15 minutes after they were released into the humid air. "The [flu] virus just falls apart," at high humidity levels, said a study researcher at the CDC's National Institute for Occupational Safety and Health [2]

- The challenge is in assuring that the desired level of humidity is attained quickly, while not doing a one-size fits all approach in a facility, since higher heat and humidity can increase bacterial and mold growth. Below is a graph of the "sweet spot" for humidity to enhance health [3]
- Empirical evidence (i.e. beyond anecdotal experience) appears to support this. In the Indian state first affected by SARS-COV-2 virus [4], more foreign nationals fell ill from Covid-19 than Indians. Indians' homes are typically hotter and more humid than the offices/hotels of non-Indians. And though Indians contracted Covid-19, they appear to do so at slower rates, relative to their population density, indicating that high humidity reduces, not eliminates, risk
- How this can be implemented in Hospitals/Nursing Homes/Other Healthcare Facilities: Have a "hot room" in the facility where healthcare workers interact with the patients in a space that has higher heat and at least 45%-50% humidity. The heat and humidity should be constantly measured by hygrometer to ensure these levels are maintained.
- How this can be implemented in Home Health / Hospice at patients' homes: In the event patients do not have humidifiers they can move and set up before a home health visit, ask patients to boil water on their stove before the home health worker arrives, and have the home health worker measure the humidity with a portable hygrometer (or each patient can be given one, depending on cost constraints for the ~\$20 device) before beginning high transmission risk interactions with the patient or their family. If commercial humidifiers are used, the amount of time to increase humidity from 25% to 45% is typically 2 hours [5]. But we believe boiling water should take approximately the same amount of time





- **Reduce Risk from Footwear**

- *It is clear that water alone does not kill viruses (which is why soap is needed, but even then, soap and water act more to dislodge viruses than to wash them away, experts have noted) [6]*
- *What most people do not realize however is that viruses can be moved from one location to another via water, and then remain viable for infecting humans and animals (and SARS-COV-2 does appear to be transmissible from animals to humans). Given fecal contamination, the risks to water and surfaces is high [7]*
- *This hypothesis is being supported by empirical evidence in India, wherein at least 5 Indian Physicians (not just single examples, but doctors citing multiple examples, including a Physician specializing in microbiology in Coimbatore, Tamil Nadu, India) note that rains seem to increase the spread of Covid-19. Again, this seems reasonable given that water does not kill the virus, but can displace and move it to other areas that are not being disinfected, such as from doorknobs to doorways where people can step on virus particles and walk indoors with their shoes on, which is not as common in India, but is common in the U.S.*
- *Most people will wash hands but not the soles of their shoes. However, the SARS-COV-2 virus appears to remain infectious on both hard and soft surfaces for between 3 hours to up to 9 days in laboratory settings [8]*
- *How this can be implemented in Hospitals/Nursing Homes/Other Healthcare Facilities: Disinfect shoes of both patients and healthcare workers before they enter the aforementioned hot room in checklist item 1, to reduce the risk of transmission from an interaction, AND recommend that patient and healthcare worker alike remove their shoes when they arrive home at their doorstep or*



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- garage, not bringing them inside unless they are disinfected throughout the exterior
- How this can be implemented in Home Health / Hospice at patients' homes: Home health workers must remove their shoes at the doorstep (not enter the home) with their shoes (as described in the hospital item above)
- **Reduce Risk from Phones/Smartphones/Notebook Computers**
  - *As noted above, the SARS-COV-2 virus appears to remain infectious on both hard and soft surfaces for between 3 hours to up to 9 days in laboratory settings [8]*
  - *In research published in the Journal of Hospital Infection, researchers found that a related coronavirus that causes SARS can persist up to 9 days on nonporous surfaces such as stainless steel or plastic [9]*
  - *And according to reports including one published in JAMA, SARS-CoV-2 has been detected in feces, suggesting the virus could be spread by people who don't properly wash their hands after using the bathroom [10]*
  - *According to the CDC, only 31% of men and 65% of women wash their hands after using the bathroom [11]*
  - *Thus, there is significant risk of people touching a surface outside, then a healthcare worker touching that same surface much later and getting infectious "virus particles" that can be inhaled into the nose when fingers and phone are brought close to the mouth and nose when conversing on the phone [12]*
  - *Based on our observations, though people will clean their phones, it is rare that they will **both** wash their hands **and** clean their phone thoroughly **before** answering it when they are outside the home and it rings or notifies of texts*
  - How this can be implemented in Hospitals/Nursing Homes/Other Healthcare Facilities: Doctors inside the hospital or facility should try and use Bluetooth earpieces (only the ones placed in the ear, not with microphones wrapped around the face toward the mouth). Otherwise they can answer the speakerphone at a distance from their face of no less than 1 foot, and also pointed away from the patient. Final recommendation would be to avoid answering the phone and let it go to voicemail, until the phone user can wash their hands to then call people back
  - How this can be implemented in Home Health / Hospice at patients' homes: Home health workers should also do what is mentioned above about using Bluetooth, speakerphone, or waiting until after handwashing

Assuming the validity of the empirical evidence from the Indian Physicians of higher transmission during the rainy season in India, in Pennsylvania, there should be a greater sense of urgency to reduce transmission as we know springtime in this region typically produces higher rainfall as well.

We are also concerned that there could be an acceleration of cases (i.e., an even more upward inflection point in the curve) due to the loss of the polar vortex [13], which meteorologists expect will increase the temperature fluctuations over at least the next month (with even faster runoff). Experts opine that this loss favors wild temperature swings and severe weather over the Lower U.S. 48. As we have seen here in Pittsburgh, it has already led to stronger, more chilling winds and also temperature declines of up to 50 degrees within 36 hours in just the past week.

These large temperature swings present two problems related to the immune response of humans. As noted in a Harvard publication, some of this may have to do with a few infectious organisms, like flu viruses, thriving in colder temperatures. There is also evidence that exposure to cold temperatures suppresses humans' immune system, so the opportunities for infection increase. A study published in The New England Journal of Medicine in the late 1970s famously



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debunked the belief that the common cold is linked to [simply] cold exposure, but British cold researchers have maintained that there is a cold-to-common cold connection. Their hypothesis is that cold air rushing into the nasal passages makes infections more probable by diminishing the local immune response in the nose [14]. Yale University has also found when the core body temperature inside the nose falls by 5C (i.e., 9 degrees Fahrenheit), the immune system does not work as well to fight at least the cold virus [15]. The anticipated wild swings in temperature may also mean many more remaining days in April and even May of days being cold, requiring indoor heating. Conversely, temperature swings may also return as early as September – leading to the humidity challenge noted earlier as important in our checklist.

The presence of higher humidity, while it may reduce infectiousness, does not bring the infectiousness down to zero. There remains a clear risk of transmission, both in India, given its population density, and in Florida, because of its older demographics. There still may well be a significant growth cases in India, and for that matter, Florida, over the next few weeks, given the population density of India and the aged demographic of Florida. If Pennsylvania’s “snowbirds” return from Florida, they may bring with them infections with the virus.

In summary, the current checklist we propose to add to all the other safety checklist items now being proposed in the medical community (e.g., hand washing, wearing mask if ill, etc.) is:

1. Raise humidity (with sub-tasks on how, in the form of “if this, then this” decision tree)
2. Reduce footwear risk (with sub-tasks on how)
3. Reduce phone or other communication device risk (with sub-tasks on how)

HROC will be attempting to determine both additional checklists and checklist tasks to add, as well as evaluate in peer reviewed studies how effective each of these items may be.

## REFERENCES / KEY PASSAGES CITED AS SUPPORTING DETAIL

[1] <https://www.sciencedaily.com/releases/2015/11/151106062716.htm> - "White blood cells are among other places located in the oral mucosa, and they represent the body's first line of defence against infectious agents."

[2] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3583861/>

[3] <https://www.condair.com/m/0/2553856-a-hum-load-calculation.pdf>

[4] *(Analysis table that we can present of our findings and interviews)*

[5] <https://thewirecutter.com/reviews/the-best-humidifier/>

[6] <https://www.nytimes.com/2020/03/13/health/soap-coronavirus-handwashing-germs.html>

[7] <https://www.karger.com/Article/Fulltext/484899> - Water, a frequent vehicle for the transmission of viruses...virus survival is higher in sterile water. Pathogens, including viruses, are able to spread and be transmitted by environmental routes... (the fecal-oral route frequently includes water as one of the vehicles)... Considering the high numbers of viral particles shed by infected individuals (for example, 1 g of feces from an infected individual may contain as high as 1010 rotaviruses [3]) and the low infectious dose of some viral diseases (estimated at 1-10 particles for some viruses), gaining knowledge on the ability of viruses to survive in water is particularly important; [https://en.wikipedia.org/wiki/Human\\_viruses\\_in\\_water](https://en.wikipedia.org/wiki/Human_viruses_in_water) - Different viruses can have different routes of transmission; for example, HIV is directly transferred by contaminated body



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fluids from an infected host into the tissue or bloodstream of a new host while influenza is airborne and transmitted through inhalation of contaminated air containing viral particles by a new host. Enteric viruses primarily infect the intestinal tract through ingestion of food and water contaminated with viruses of fecal origin. Some viruses can be transmitted through all three routes of transmission; <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4482390/> - Nearly 25% of the global population (1.8 billion people in 2012) is consuming fecally-contaminated water... The impact on public health is staggering. Unsafe water, inadequate sanitation, and poor hygiene are responsible for about 90% of diarrheal deaths worldwide. Not surprisingly, diarrhea is the second leading cause of death for children under the age of five globally (1.2 million deaths in 2012). ...The lack of access to improved water disproportionately affects those living in poverty in rural, developing regions; however, even populations living in countries with state-of-the-art water and waste treatment facilities are prone to waterborne disease outbreaks. For example, there were at least 33 outbreaks associated with drinking water reported in the United States of America during 2009–2010. Regardless of the socioeconomic status of a country, illnesses due to contaminated drinking water are considered significantly underreported because people do not seek medical attention for self-limiting infections and because of the current limitations on clinical detection of virus infections ... It is well known that bacteria are major causes of diarrhea transmitted through unsafe drinking water. What is less appreciated are viruses in these same drinking water sources and their impact on human health; <https://www.medpagetoday.com/infectiousdisease/covid19/85315> - New research from China indicates that the novel coronavirus is also spread by fecal-oral transmission, not just by respiratory droplets or environmental contact; <https://www.medscape.com/viewarticle/926856> - Fecal evidence of COVID-19 raises transmission concerns; <http://www.cidrap.umn.edu/news-perspective/2020/03/study-covid-19-may-spread-several-different-ways> - Using real-time reverse transcriptase polymerase chain reaction (RT-PCR), investigators detected COVID-19 RNA in lung wash (14 of 15 samples; 93%), sputum (72 of 104; 72%), nasal swabs (5 of 8; 63%), lung biopsy (6 of 13; 46%), throat swabs (126 of 398; 32%), feces (44 of 153; 29%), and blood (3 of 307; 1%). The 72 urine specimens all tested negative...Twenty patients had two to six specimens collected at the same time. Viral RNA was detected in single specimens from six patients (respiratory specimens, feces, or blood). Seven patients shed live virus in respiratory specimens, 5 in feces (2 of whom did not have diarrhea), and 2 in blood.

[8] <https://www.sciencemag.org/news/2020/03/does-disinfecting-surfaces-really-prevent-spread-coronavirus>

[9] [https://www.journalofhospitalinfection.com/article/S0195-6701\(20\)30046-3/fulltext](https://www.journalofhospitalinfection.com/article/S0195-6701(20)30046-3/fulltext)

[10] <https://jamanetwork.com/journals/jama/fullarticle/2762997>

[11] <https://www.cdc.gov/handwashing/handwashing-corporate.html>

[12] <https://www.businessinsider.com/how-long-can-coronavirus-live-on-surfaces-how-to-disinfect-2020-3>

[13] <https://www.washingtonpost.com/weather/2020/03/14/polar-vortex-spring-weather/>

[14] <https://www.health.harvard.edu/staying-healthy/out-in-the-cold>

[15] <https://nationalpost.com/health/why-do-we-catch-more-colds-when-the-temperature-drops-blame-our-immune-system>



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## Appendix 1: HROC Background

THINK

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**High Reliability Organization Council (HROC)**  
 940 Peach St., Ellwood City, PA 16117  
 Contact: Terry Rajaseenan, Executive Board Member, (412) 398-0121  
[www.thinkhro.org](http://www.thinkhro.org)

**MISSION:**

- We are a 501(c)(3) with a charter to urge and enable Healthcare Delivery Organizations to seek efforts to become High Reliability Organizations (HRO's).
- Achieving HRO status improves patient safety and overall economics for troops, veterans, and nation.
- We believe and have demonstrated that solving Task Saturation can improve patient safety and outcomes, and is missing piece to attaining HRO status.

**VISION:**

- Implementation of HRO's across all industry sectors has been challenged by a lack of feasibility. Built on a foundation of Research with the U.S. Department of Defense and U.S. Air Force, our approach has proven effective at improving the safety and economics of healthcare.
- The HRO Council serves as a platform for education and collaboration, supporting the implementation of HRO's in healthcare, government, and nonprofit entities.
- The MHS and VA Health Systems are working to further prove this solution, in conjunction with key academic medical centers and teaching institutions.

**APPROACH:**

- Offer reliability methods and expertise on a no-cost basis to organizations that work exclusively for the Public Good, by providing educational seminars, webinars, and content to organizations and teams that can benefit.
- Offer royalty-free access to patented methods, intellectual property, and models and tools based on the Military Acuity Model (MAM), and combined with other Defense Department advances (see table below), to organizations that qualify.
- Publish findings from our research projects to advance the mission and improve patient care at Military and VA facilities, and in healthcare as a whole. This showcases how initiatives by Dept. of Defense help advance healthcare and other areas.

**Military-led Advances That Have Improved Reliability in Healthcare and Other Industries**

Initiative	Advancement
Safety Checklist (U.S. Army Air Command, 1935)	First safety checklist; Made aviation more reliable
Weather Radar (DoD developed, 1943)	Led to highly reliable aviation, detecting unsafe weather patterns to redirect flights
ENIAC Computer (DoD funded, 1944)	World's first "Digital Computer"
ARPANET (DARPA project, 1969)	Turned into modern-day Internet
Crew Resource Management (NASA, 1979; NASA replaced DoD's NACA)	Principle that everyone on aircraft equally responsible for mission outcomes/safety
Helicopter MedEvac (US Air Forces, 1944), leading to Critical Care Air Transport Team (1988), and related CENTCOM Clinical Practice Guidelines	Helicopter medical evacuation, evolved into Intensive Care Units on aircraft; Led to highest battlefield trauma survival rates in history (91%); Helped civilian care in polytrauma, major hemorrhaging, physiologic monitoring, transplants, even vaccines.
Military Acuity Model (Air Force initiated, combined w/ ProcessProxy Corp. patents, 2012)	Task Saturation prevention to enable reliability, won the Military Health System Innovation Award in 2013 for patient safety
Cooperative HRO (Wright-Patterson AFB 88th Medical Group, 2014) based on MAM to help Time-to-Treatment	Requires much less human redundancy (i.e. less FTEs) to sustain HRO's zero tolerance policy toward preventable errors

**HROC Charter**

"To provide education, to provide a platform for collaboration and to support the implementation of high reliability standards within health care."

"To improve the safety of patients, including, but not limited to, active duty servicemen and women and veterans and their families, and the public in general."

Pedro A. Cortes  
Secretary of the Commonwealth of Pennsylvania  
Entity: 6300731

**IRS Approval**

Officially approved as a 501(c)(3) on 12/8/2015 (ID# 31954) by Jeffrey I. Cooper, Director, Exempt Organizations Rulings and Agreements Internal Revenue Service Cincinnati, OH

Focus is on: Education, Scientific Study, and Public Safety

Date Filed/Effective Date of Exemption: 9/28/15 updated 10/2016

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