

The Role of Temperature on the Global Spread of COVID-19 and Urgent Solutions

Indrani Roy
University College London (UCL), UK
(indrani.roy@ucl.ac.uk)

**Article in: International Journal of
Environmental Science and Technology**
Publisher: Springer Nature

Motivation

**More than 530,000 people died
till 4th of July 2020.**

- Economy and mental health suffered tremendously.
- No proven cure for the disease is found yet.
- Popular known methods to treat disease are Plasma therapy, Vaccine development, Medication etc. But those are not yet comprehensively tested. In addition, time consuming and with potential side effects.
- With that **Emergency Situation** in mind some **Urgent, Simple Solutions** were proposed on **17th March (Roy, 2020a)** purely based on **Science**.
- These are without side effects, no funding required, no vested interest, can be practiced in own home.

Background: Scientific Analyses

This family of viruses is very sensitive to Temperature.

- True for this virus **SARS-CoV-2 responsible for COVID-19**: Scafetta N., (2020); Paulo M et al., (2020); Roy I., (2020).
- Paulo M. et al. (2020) in a review work presented seventeen recent papers on COVID-19 and almost all found strong connections of temperature.
- True for similar generic category Coronavirus SARS and MARS (Van Doremalen N., 2013; Chan et al., 2011).
- True for other similar Seasonal air-borne Flu viruses (Lowen et al., 2007).

Temperature Sensitivity: **Clinical Trials**

- **Seasonally dependent endemic virus (Lowen et al., 2007):** Temperature of 5 °C and Relative Humidity (RH) 35% to 50%, infection rate was very high (75-100%). Whereas, when RH was still kept at 35%, but **only temperature was increased to 30°C, infection rate surprisingly reduced to zero.**
- **True for similar Coronavirus genus SARS and MARS:** Virus remain active for a long time in low temperature (Van Doremalen N., 2013). **Low temperature significantly contributes** to the survival and transmission of the virus (Casanova et al., 2010; Chan et al., 2011; Seung et al., 2007).
- **Typical Air-Conditioning Temperature:** SARS could be active for at **least five days in typical airconditioned environments** which has relative humidity 40-50 % and room temperature 22 -25°C (Chan et al., 2011).
- **Similar generic Coronavirus (viz. SARS-CoV) using a variable Temperature (Casanova et al., 2010):** **Inactivation of virus** was faster at all humidity level if temperature was simply raised to 20°C from 4°C, **more rapid if the temperature was further increased to 40°C from 20°C.**

Transmission of Disease and Temperature

COVID-19 is extremely **contagious** and invaded most of the globe in less than two months.

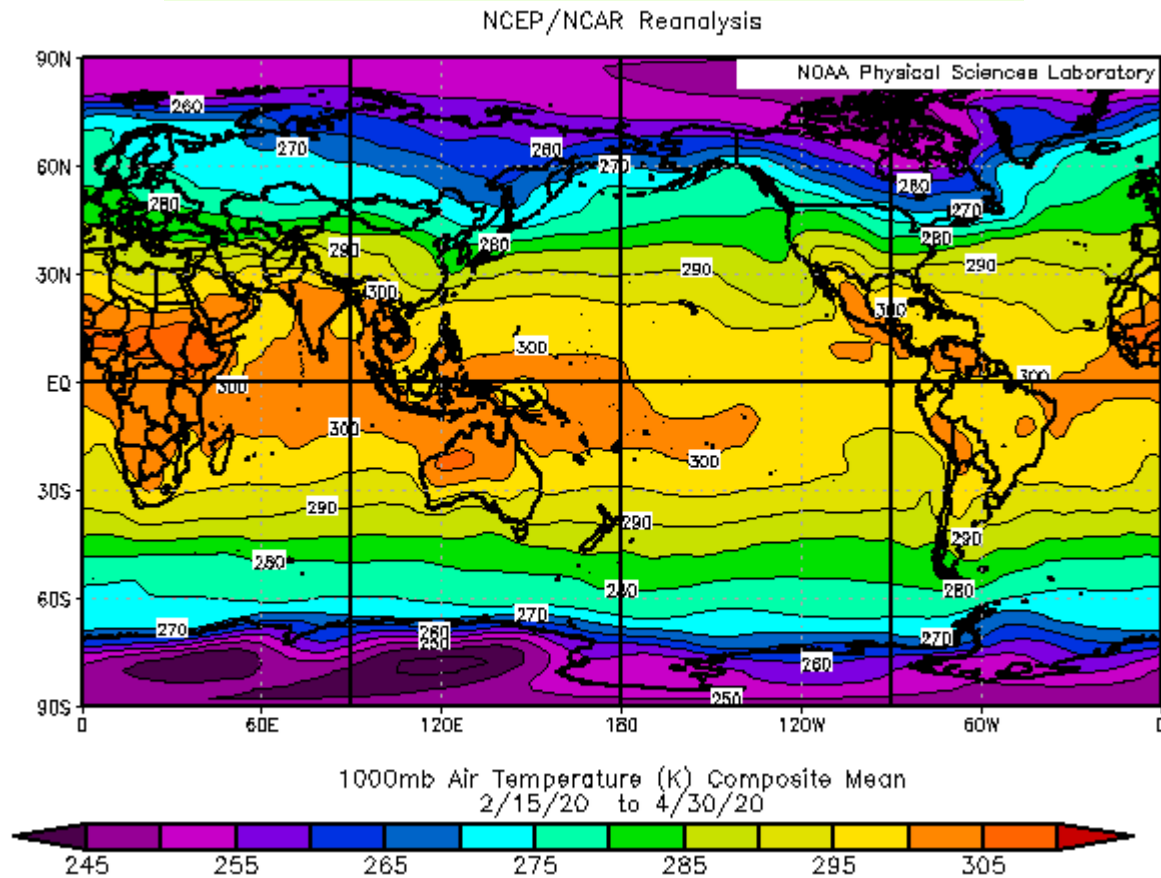
Attention: Understand nature of its transmission under variable temperature condition.

- **Lab experiment with Guinea Pigs (Lowen et al., 2007):**

Using similar seasonal air-borne virus, it studied effect of temperature on ***Airborne Transmission as well as Contact Transmission***. Increasing temperature prevented airborne transmission but not contact transmission. When guinea pigs were kept in separate cages at temperature of 30°C for 1 week, no recipient guinea pigs were infected. But if those were kept in same cage to simulate contact transmission, between 75% and 100% became infected. No role of humidity is found in these experiments.

Hence Contact Transmission plays role in all Temperature.

Global Air Temperature: Mid-February to April 2020



Monthly average air temperature ($^{\circ}\text{K}$) from mid-February to April 2020.

(Plot generated: <https://psl.noaa.gov/data/composites/day/>)

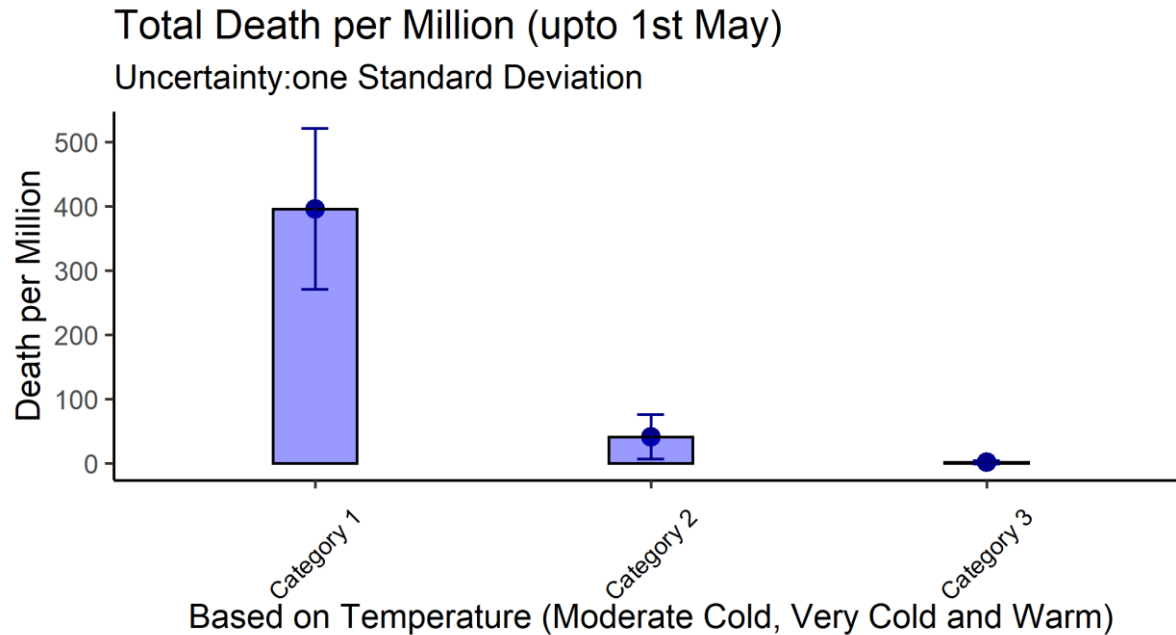
[Source: Roy, (2020)]

Temperature sensitivity of the virus SARS-CoV-2 and Global transmission

Global Temperature analyses: till 1st May
Vulnerability measured in: Deaths per Million

- **Moderately cool** [$275^{\circ}\text{K}(2^{\circ}\text{C})$ to $290^{\circ}\text{K}(17^{\circ}\text{C})$] environment was the most favourable state for susceptibility of virus. Countries like USA, UK, Spain, Italy etc.
- Countries with **very cold temperature** [$< 275^{\circ}\text{K}(2^{\circ}\text{C})$] were moderately affected in March-April (e.g. Canada, Russia, Scandinavian countries).
- **Warm countries** and places [$>300^{\circ}\text{K}(27^{\circ}\text{C})$] were likely to be **less vulnerable**. e.g., SAARC, South East Asian countries, African continents and Australia.
- **Risks from the virus were reduced** significantly in very **high temperature** environment [$>305^{\circ}\text{K}(32^{\circ}\text{C})$]. Parts of African continents and Australia.

Vulnerability measured in: Deaths per Million (till 1st May)



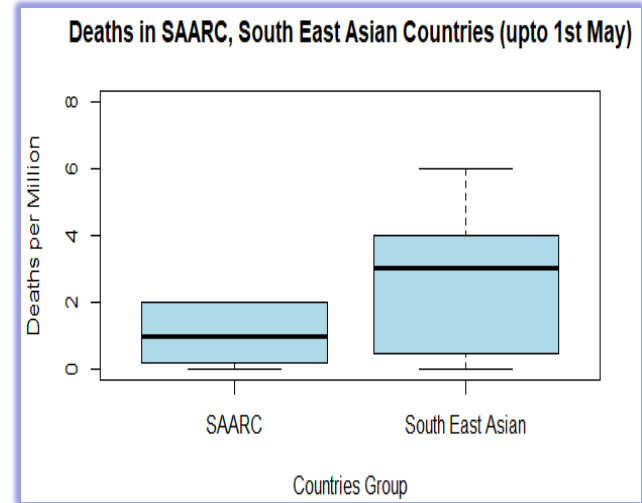
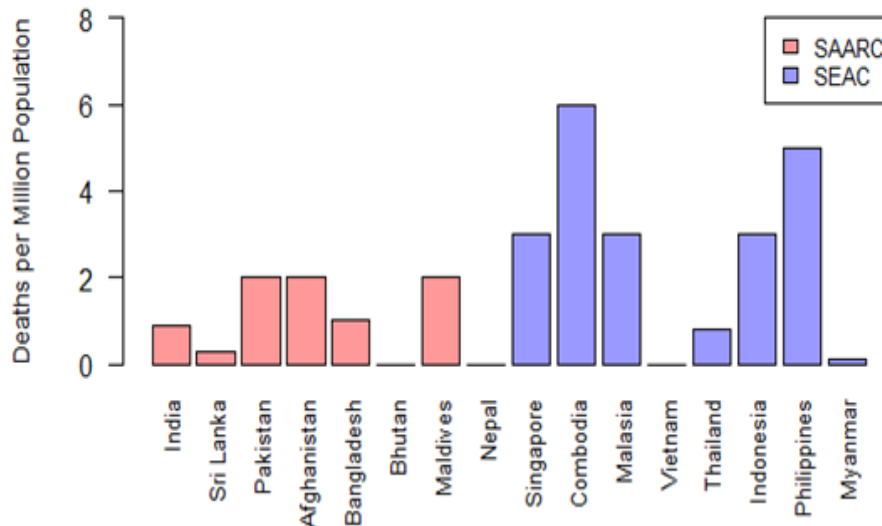
[Source: Roy, (2020)]

Difference among Category 1 (**Moderate Cold**), Category 2 (**Very Cold**) and Category 3 (**warm**) were Statistically Significant.

Moderately Cold: USA, UK, Italy, Spain, France
Very Cold: Canada, Russia, Finland, Iceland
Warm: SAARC, South East Asian Countries, African Continents, Australia.

Temperature Sensitivity – Proof for all countries from SAARC and SEAC

Death in SAARC, South East Asian countries (upto 1st of May)



[Roy, (2020)]

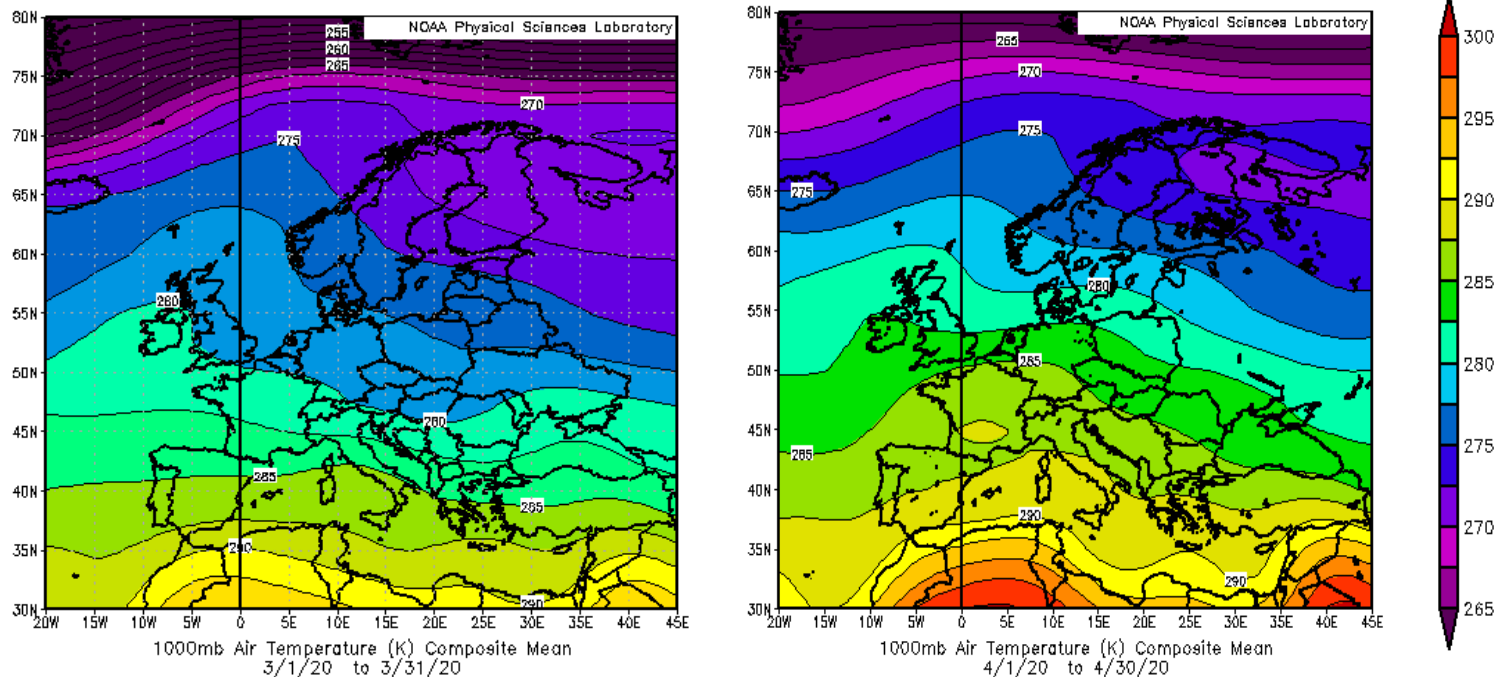
- **Varied characteristics:** popular tourist spots, international business hubs with more foreign travellers, level of testing, infrastructural facility, population density, different degree of lockdown restrictions.
- **In spite of all dissimilarities still one common factor:** **Death per Million for all those countries from SAARC and SEAC were much less** and the pattern is still maintained. It was lesser than **8** till 1st of May, while in Spain it was 531, Italy 467 and UK 405.

Because of **large populations**, India was one of the **highest** ranked during August, in **overall counts of total Deaths, as well as total Cases**.

Transition: Countries can switch from one vulnerability state to another, **based on Variability of Temperature**

South American countries, like Brazil turned warm to cooler in June, while Canada and Russia from very cold to moderate cold.

Death rate increased in those countries.



Mean Air temperature in March (left) and April (right) for Europe in NCEP/NCAR Reanalyses. [Source: Roy, (2020)]

(Plot generated: <https://psl.noaa.gov/data/composites/day/>)

Europe tuned warmer from moderately cold and death rate decreased from March to April 2020. The same pattern is observed till August.

Solutions : General Measures

- **Using Sauna facilities:** Usually hotels, gyms, leisure centres contain existing Sauna facilities. Also, mobile and Caravan Sauna facilities can be thought of in future. After Sauna, if surfaces in public places are touched, hand washing is advisable.
- **Portable Convector Room Heater:** Stay close to a convector room heater and inhale hot air at least two times a day for around half an hour each time (keeping comfort level). It would be very useful at the initial stages of the disease.
- **Disinfect any place using High Temperature:** Before start of office, school or business, temperature of premises may be kept very high, (say, 60°C) for half an hour. For airports, train and bus, the same method of disinfecting could be thought of. *Optimum temperature and duration can be tested easily.* For any external object or material, disinfecting using high temperature could be a useful solution.
- **Using Blow Dryer/ Hair Dryer:** For minor symptoms, inhaling hot air intermittently through the nose (keeping comfort level) even for five minutes, say two/three times a day, will also be useful to kill virus in the nasal cavity.
- **Hot Drinks:** For very mild symptoms, take hot drinks (could be tea, coffee, warm milk, hot water with lemon etc.) few times a day to destroy virus in the mouth and throat. Gargle with warm salt water at least three/four times a day will be very beneficial. Hot soup will also be useful.

Why: The virus is very sensitive to **Temperature**. It mainly enters through the **Nose** (WHO). Testing is done with swabs from the nasal cavity and the back of the **Mouth**.

Important: Only even Convector Room Heater and Warm Salt Water gargle, Hot Drinks can serve the main purpose.

Solutions: Options for Lower income groups, Rural and Remote locations

The virus is **very sensitive to Temperature**.

- **Green House (glass):** In winter, it would be useful in poor countries and rural places without electricity. During the day, bright sunshine can provide heat by Green House effect (substitute of Sauna). Sufficiently high temperature can be attained and duration can be adjusted to peoples' comfort level.
- **Outside Raw Fire:** In underdeveloped countries and rural places, people usually sit in a circle round a camp-fire in winter. They use dry leaves and spare woods for a small fire. That heat in winter could be useful.
- **Substitute of Blow Dryer and Room Heater:** While cooking, all members of the household could be, in turn, stay close to the heat source, for, say, half an hour a day. Also, each individual can use separate folded cotton cloths to take heat from the cooking container and use on the nose.

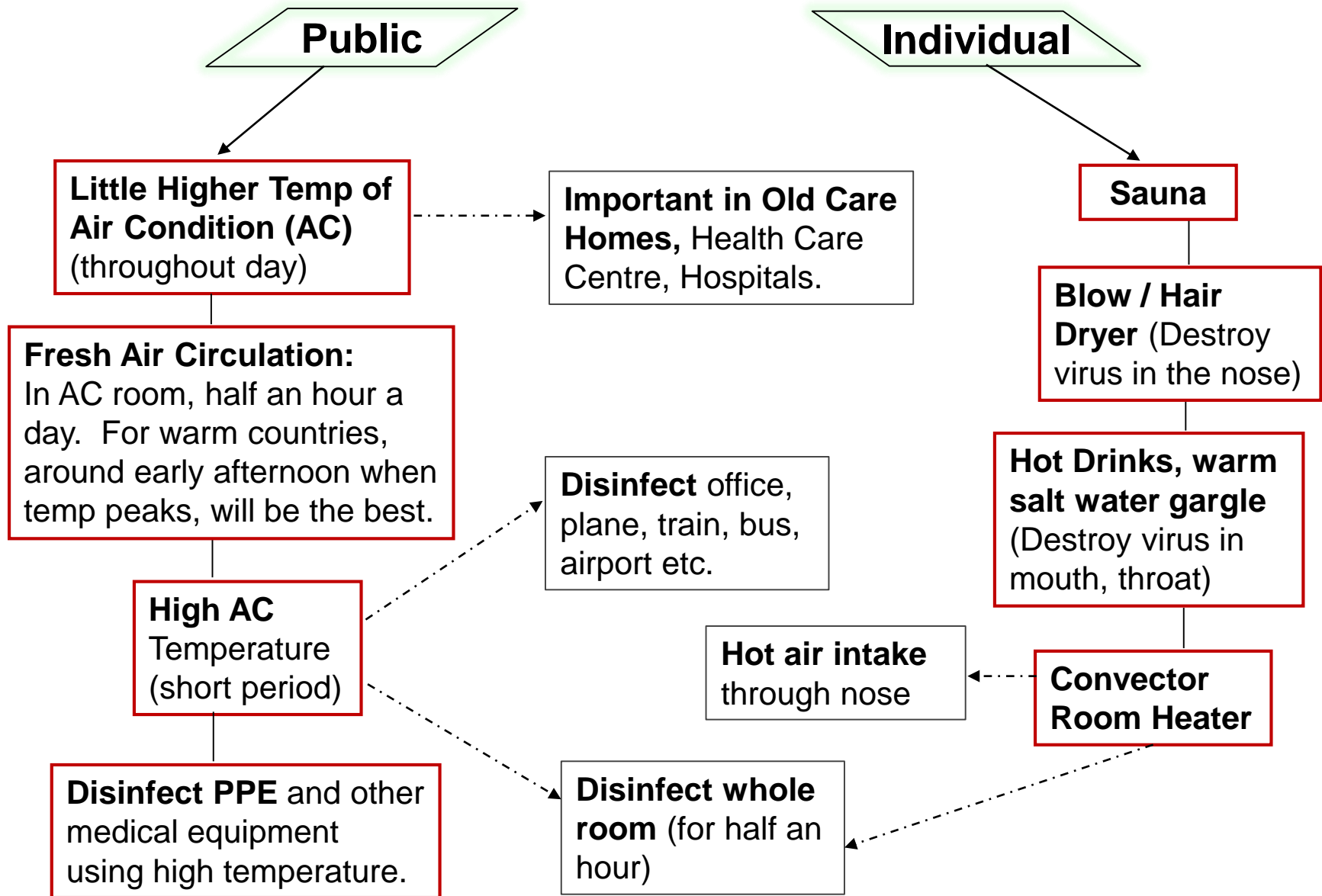
Caution and Additional Points

Caution: If people already developed major symptoms, then all these methods discussed will not be effective and proper medical advice need to be solicited.

Additional Points:

- **Water Shortage:** Whether frequent Hand Washing can be replaced by sensor-based hand dryer (normally found in washroom), temp controlled.
- **Plastic Disposal:** Personal Protective Equipment (PPE) are single use. World is already under stress due to problems of disposing Plastic. If PPE can be disinfected using heat-based solutions and reused. It can be tested in laboratory and could prove very beneficial.
- **Face Shield /Visors:** In busy public places, mass gathering, and cold premise, face shield will give additional protection. The virus can also enter through eyes (ECDC).
- **Contact Transmission:** For warm, highly populated countries, contact transmission can play important role and appropriate measures are required. Hand washing is useful; Air Conditioned (AC) premises, where mass gathering happens need disinfecting on a regular basis.
- **Very Warm Countries:** Some countries reached temperature more than 40°C in July-August. In that uncomfortable temperature, people use more AC. That low temperature in confined space can increase transmission.

Solutions: The virus is very sensitive to **Temperature**



Interested in Details

- Roy, I. (2020a), Combating recent pandemic of COVID-19 - An urgent Solution. dt 17th March 2020, (doi: [10.13140/RG.2.2.22632.83208](https://doi.org/10.13140/RG.2.2.22632.83208))
- Roy, I. (2020b), Atmospheric Variables and Additional Urgent Solutions for Combating COVID-19 dt 9th April. (doi: [10.20944/preprints202003.0366.v2](https://doi.org/10.20944/preprints202003.0366.v2))
- Roy, I. (2020c) Influence of Temperature on the Global Spread of COVID-19. *Preprints*, dt 22nd June. (doi: [10.20944/preprints202003.0366.v3](https://doi.org/10.20944/preprints202003.0366.v3))
- Roy, I. (2020d) Combating COVID-19: Temperature could be a key. *Authorea*. July 07, 2020. (doi: [10.22541/au.159415142.20637179](https://doi.org/10.22541/au.159415142.20637179))

References

- **Casanova** L. et al., (2010). Effects of Air Temperature and Relative Humidity on Coronavirus Survival on Surfaces, *Appl Environ Microbiol.* 76(9): 2712–2717.
- **Chan** KH et al., (2011). The Effects of Temperature and Relative Humidity on the Viability of the SARS Coronavirus. *Adv Virol*; 2011:734690.
- **Lowen** A. C. et al., (2007). Influenza virus transmission is dependent on relative humidity and temperature. *Plos Pathogens*, 3 (10), 1470–1476, [10.1371/journal.ppat.0030151](https://doi.org/10.1371/journal.ppat.0030151)
- **Paulo** M. et al. (2020), Effects of temperature and humidity on the spread of COVID-19: a systematic review, *Plos One*, [doi: 10.1371/journal.pone.0238339](https://doi.org/10.1371/journal.pone.0238339)
- **Roy** I., (2020), Influence of Temperature on the Global Spread of COVID-19, [doi: 10.20944/preprints202003.0366.v3](https://doi.org/10.20944/preprints202003.0366.v3) and [doi: 10.22541/au.159415142.206371.79](https://doi.org/10.22541/au.159415142.206371.79)
- **Scafetta** N., (2020), Distribution of the SARS-CoV-2 pandemic and its monthly forecast based on seasonal climate patterns. *Int. J. Environ. Res. Public Health*, 17(10), 3493. <https://doi.org/10.3390/ijerph17103493>
- **Seung** W. K. et al., (2007). Effects of humidity and other factors on the generation and sampling of a coronavirus aerosol. *Aerobiologia*. 23. 239-248.
- **Van Doremalen** N. et al., (2013). Stability of Middle East respiratory syndrome coronavirus (MERS-CoV) under different environmental conditions. *Euro Surveill*, 18(38), <https://doi.org/10.2807/1560-7917.ES2013.18.38.20590>

Thank You