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COVID-19 and thermoregulation-related problems: Practical recommendations

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ABSTRACT

The COVID-19 pandemic started in the cold months of the year 2020 in the Northern hemisphere. Concerns were raised that the hot season may lead to additional problems as some typical interventions to prevent heat-related illness could potentially conflict with precautions to reduce coronavirus transmission. Therefore, an international research team organized by the Global Health Heat Information Network generated an inventory of the specific concerns about this nexus and began to address the issues. Three key thermal and covid-19 related topics were highlighted: 1) For the general public, going to public cool areas in the hot season interferes with the recommendation to stay at home to reduce the spread of the virus. Conflicting advice makes it necessary to revise national heat plans and alert policymakers of this forecasted issue. 2) For medical personnel working in hot conditions, heat strain is exacerbated due to a reduction in heat loss from wearing personal protective equipment to prevent contamination. To avoid heat-related injuries, medical personnel are recommended to precool and to minimize the increase in body core temperature using adopted work/rest schedules, specific clothing systems, and by drinking cold fluids. 3) Fever, one of the main symptoms of COVID-19, may be difficult to distinguish from heat-induced hyperthermia and a resting period may be necessary prior to measurement to avoid misinterpretation. In summary, heat in combination with the COVID-19 pandemic leads to additional problems; the impact of which can be reduced by revising heat plans and implementing special measures attentive to these compound risks.

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Introduction

Following repeated calls for improvements and harmonization of the decision tools for managing the health risks of extreme heat and rising temperatures, the Global Heat Health Information Network (GHHIN) was launched. The formation of GHHIN in June 2016 was spearheaded by the World Health Organization and World Meteorological Organization Joint Office for Climate and Health, and the United States National Oceanic and Atmospheric Administration (NOAA) and brought together experts from over a dozen of these founding institutions. As one of its activities, GHHIN initiated a workshop that was held on March 9–13 in 2020 at the Lorentz center of Leiden, the Netherlands, under the title "Hot but Habitable" (https://www.lorentzcenter.nl/hot-but-habitable.html). During this workshop, an interdisciplinary team of 20 practitioners and researchers who work on the management of extreme heat risk, as well as technologists, designers, and data scientists, gathered to identify transdisciplinary digital systems-based solutions to minimize the impact of heat waves on the habitability of cities across the globe, the health of their populations, and

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their enjoyment of the outdoors. Shortly after the meeting the Coronavirus Disease 2019 (COVID-19) exploded in Europe and several questions emerged on how to cope with SARS-CoV-2 during times of heat and vice versa. The “Hot but Habitable” workshop participants, and other members of the GHHIN network, organized a rapid response team to systematically analyze and respond to questions coming in from public health and emergency management agencies around the world. This paper describes the procedure that was followed specifically with regard to the questions related to thermal physiology and discusses the answers that were assembled based on the available scientific evidence. The website www.GHHIN.org updates the information.

The questions related to thermal physiology primarily focused on the following issues:

(1) **Heat strain in medical personnel caused by wearing personal protective equipment (PPE)**: In several countries, triage is performed outside of hospitals in tents that are hard to cool. Thus, health workers are exposed to heat stress from the thermal environment which is exacerbated due to reduced heat loss that arises from wearing PPE. These combined factors cause an increase in body heat storage that can have detrimental consequences.

(2) **Conflicting behavioral recommendations for the general public on how to cope with heat and how to cope with COVID-19**: Measures from many governments (e.g. stay at home, self-isolate) counteract the advice issues by most heat health action plans (e.g. go to a public cooling center), thus potentially increasing the risk of heat-related mortality. Additionally, those most vulnerable to heat illness are also most vulnerable to COVID-19 (i.e. elderly, preexisting conditions).

(3) **Distinguishing heat strain from fever when monitoring body core temperature**: As the pandemic continues into the summer months, body core temperature will increase and it will become hard to determine if the elevated body core temperature is due to an infection (fever) or other causes like work or external heat. Fever is the most frequently reported symptom from infection with the coronavirus [1,2]. It is often not clear how to interpret the readings from the most prominent devices that are used in the field to assess fever: forehead temperature and infrared tympanic temperature.

The three questions were selected for their large impact on the health of medical personnel and general public.

Procedure

Initial concerns about heat and interference as a result of the Coronavirus Disease 2019 (COVID-19) and with the risk-management strategies for containing the spread of the virus (SARS-CoV-2) were raised in March 2020 in several countries. The first issues focused on conflicting recommendations such as “go to cool public areas” in the heat versus “stay at home” during the pandemic and “reduce clothing insulation” in the heat versus “wear protective clothing” while dealing with people potentially infected with COVID-19. Dr. Stephan Bose-O’Reilly sends out a request for an inventory on this topic March 27, 2020 based on discussions in Germany within KLUG (German Alliance Climate Change and Health). The issue was recognized by other members of the GHHIN team, and Dr. Joy Shumake-Guillemot of the World Health Organization (WHO) and the World Meteorological Organization (WMO) facilitated the movement. A plan was made on April 4 2020 to ensure a fast response to the unprecedented situation:

- April 4 to mid-April: Decide on time plan, plan weekly tele-meetings, collect possible questions, decide on key issues/questions to answer, identify expert teams (incl. lead and co-leads) for each Q&A, start drafting core content;
- Mid-April to mid-May: Drafting of Q&As + Internal review + Identification and contacting external reviewers, revisions, prepare publication of outputs, website development;

Mid-May to end-May: Final reviews, final revisions, copy-editing, web-publication, promotion.

The aim was to address global concerns on how to co-manage heat and COVID-19 and disseminate findings to the target audience. The findings were based on the expertise of the members after gathering scientific evidence to support of refute concerns.

Weekly group conference meetings facilitated development and progress. During the first week, the most prominent or frequently asked questions (FAQ) were collected using the contacts that existed with field workers. Most questions originated from front line responders and from various countries/partners who had developed heat health action plans. The COVID-19/heat action team then selected 19 out of more than 30 questions that we felt were either the most important to address or the ones we felt we could address based on our scientific expertise. Several similar questions were also collapsed into an overarching key question. The resulting questions selected for response are shown in Appendix 1.

To address the questions, the following four work groups (WG) were formed with each group addressing 2–5 FAQs:

- WG1: Cross-cutting information (including seasonality and environmental connections of COVID-19);
- WG2: Occupational health (including personal protective equipment and staff management);
- WG3: Physiology and clinical case management (including hyperthermia versus fever, sweat, how to avoid heat injuries, cooling homes and cooling centers, air conditioning);
- WG4: Heat action plans, city governments, and social services.

Heat impact, preventive measures and COVID-19 interactions

Heat impact

Although mild cold is the dominating cause for temperature-related mortality [3], heat waves are accompanied by markedly increased mortality rates (e.g. [4]). Climate change is increasing the frequency, intensity, and duration of heat waves (Perkins-Kirkpatrick et al., [5]) and therefore heat-related illness and death are increasingly important health outcomes to mitigate [6]. Even in countries with a temperate climate such as The Netherlands, it is estimated that in the year 2085 the economic costs of heat-related mortality due to climate change may exceed those of benefits from reduced cold- related mortality under high warming scenarios [7].

To reduce the impact of heat waves on mortality, national heat plans were introduced by several countries, particularly in response to the 2003 heat wave in Europe [8]. In the EU project SCORCH (Supportive Risk Awareness and Communication to Reduce impact of Cross-Border Heat waves), national heat plans were evaluated and an overview of heat plans world-wide was made available [9]. Other EU projects such as HEAT-SHIELD also recently evaluated heat warning systems within and beyond Europe [10].

Preventive measures for heat strain and the relation with COVID-19

Common preventive measures against heat-related mortality and morbidity in the heat health action plans include drinking sufficient amount of fluids, going to cool places such public cooling centers, limiting exercise to cooler parts of the day and taking care of vulnerable people in your neighborhood. Table 1 summarizes such recommendations and relates these measures to the impact for COVID-19 patients and medical personnel.

Physical training and heat acclimation reduce the risk of heat-related problems and enhance heat tolerance [11]. The maximum body core temperature tolerated by highly fit people is about 0.5°C higher than in moderately fit people [12]. Aerobic fitness is also a key factor in limiting the age-related decline in heat tolerance [13]. General health/chronic medical conditions, specific medications, sleep deprivation, previous incidences of heat-related illness, and alcohol/drug consumption may negatively impact the response to heat stress and should be controlled for accordingly [14]. Physical training also changes the shape of the human body favorably; less subcutaneous fat and a reduced body mass result in a higher body surface to volume ratio. This provides considerable advantage for wet and dry heat loss [15,16].

Table 1. Tentative list of measures prior to and during extreme heat and COVID-19 infection written from heat strain perspective. Shaded lines indicate that a certain measure has the opposite effect mitigating the risk of heat and COVID-19. The evidence for the statements is discussed in the text.

Topic	Heat for general public	COVID-19 patients	COVID-19 medical personnel
		Preparation	
Be physically fit	Higher heat tolerance	Lower risk for infection from most viral infections	Lower infection risk and higher heat tolerance
Heat acclimation	Reduces heat strain in the heat		Reduces heat strain in the heat
Reduce body fat	Higher surface/volume ratio enhances heat loss	Overweight subjects may be at larger risk	Higher surface/volume ratio enhances heat loss
Precool prior to heat	Internal (cold drinks) and external cooling reduces heat strain		Internal (cold drinks) and external cooling reduces heat strain
		During heat/COVID-19 infection	
Skin coverage with clothing	Low percentage of skin covered enhances heat loss		Low percentage of skin covered enhances heat loss but increases infection risk
Clothing insulation	Low insulation enhances heat loss		Low insulation enhances heat loss
Clothing water vapor resistance	Low resistance enhances sweat evaporation and heat loss		High resistance gives better protection from COVID-19 but reduces evaporative heat loss
Exercise	Do not exercise or exercise at low intensity. Exercise during cooler parts of the day.		Work with low and steady pace, frequent breaks
Move to	Cooling centers/cool park	Stay at home. Quarantine or self-isolate. Breaks in cool rooms.	
Social interaction	Keep a close eye to each other	Keep a close eye but stay at 1–2 m from other persons (WHO)	Keep distance from patients when possible
Air-conditioning	Reduces heat strain	Reduces heat strain/higher risk for contamination?	Reduces heat strain/possible higher risk of staff contamination
Drinking	Cold water or ice reduces heat strain; no alcohol		Drinking cold water cools, but may lead to contamination while wearing PPE
Monitoring	(Rectal) temperature	(Rectal) temperature (85% of COVID-19 patients has fever symptoms), virus test	(Cognitive) performance, (rectal) temperature, virus test
		Treatment	
Field	Aggressive cooling when heat stroke	Antipyretics for life threatening fever may be considered	Aggressive cooling when heat stroke
Hospital	Aggressive cooling when heat stroke	Intensive care treatment	Aggressive cooling when heat stroke

Heat acclimatization is a powerful method to increase wet and dry heat loss: at similar work rates, heat-acclimatized individuals have lower heart rates, lower body core temperatures, and increased sweat rates [17]. Since the reliability of heat wave warnings increases with decreasing number of days prior to the heat wave, attempts have been made to construct short-term heat acclimation programs to adjust people to the expected heat. Although a program of 5 days may lead to adaptations in thermoregulation [18–20], it is recommended to use more days to have more effective adaptations [21]. It is recommended to give extra attention to heat acclimation adaptions in females since they are more vulnerable in the heat than men [22]. Studies including elderly females in heat acclimation are scarce but there is some evidence showing that sweat rates and cooling overall seem to fall in line with the latter recommendation [23,24].

The benefits of physical training and heat acclimation extend to medical personnel involved in treating COVID-19 patients in the heat [25]. It can be argued, however, that the increased sweat production generally observed in heat acclimation is of limited use since PPE may hamper sweat evaporation. Therefore, attempts should be made to reduce the water vapor resistance in protective clothing without compromising protection against the virus.

Obese patients appear to be at greater risk of developing severe or fatal symptoms of COVID-19 [26–28]. There is evidence to suggest that obese patients are two times more likely to go to intensive care units than non-obese patients [29]. Extracellular superoxide dismutase is produced during exercise and this free radical scavenger is suggested to prevent the acute respiratory distress syndrome observed under the condition of COVID-19 infection [30]. Thus, there are indications that being fit is not only beneficial for dealing with the heat, but also for patients with COVID-19. There is no study yet available that investigated if heat acclimation may lead to a reduced risk of contracting or reduced symptom severity, of COVID-19.

Precooling is an effective way to reduce heat strain. The combination of external precooling such as the use of a cool-vest [31] and internal precooling, such as ingesting cold drinks [32] or ice-slurry [33] lowers the body heat content, thus providing a heat sink [34]. Ice slurry ingestion studies have not addressed patterns of consumption in habitual users of this strategy but typically assessed it as an intervention amongst athletes/workers that are accustomed to drinking cold water but less accustomed to large volumes of ice slurry. Field data in Australia (unpublished) from workers including medical personnel show ice-slurry ingestion can rapidly increase over short periods (1–2 weeks) with regular consumption. Although ice-slurry generates lower temperatures, cold water can be consumed in larger amounts, potentially providing more cooling [35]. Precooling with a cold drink or ice slurry reduces body core temperature by about 0.5°C [36] and heat acclimation lowers the body core temperature by about 0.3°C [37], thus enhancing the capacity of the body to store heat that is generated during work. It is recommended to cool down, hydrate, and recover between shifts, as heat stress can increase with consecutive days of exposure [38].

Heat strain reduction during heat exposure and the relation with COVID-19

Medical personnel

PPE is worn by medical and other exposed personnel who are in close contact with COVID-19 patients (WHO/2019-nCoV/IPC/2020.3). These garments generally consist of a hazmat suit or impermeable apron, face mask, visor/goggles, and latex gloves. While essential for protecting workers from the virus, these items make it more difficult to lose body heat; in particular, because sweat cannot evaporate easily. Working in protective clothing not only reduces a person's endurance and physical performance, the increase in body core temperature can also reduce cognitive performance [39]. In February/March 2020, Australia experienced the problems of combination of COVID-19 and heat stress. A large-scale workers camp in a tropical region was adapted to accommodate two groups of repatriated travelers for respective quarantine periods. Medical facilities were established within the camp, with responders exposed to both air-conditioned areas and outdoor shaded areas while performing duties. Responders completed an online questionnaire post-shift that monitored subjective heat stress and well-being [40]. The first observation was that the COVID-19 field response is likely to increase workload above normal for medical responders (46% of work shifts were classified as higher than normal workload). Secondly, the working conditions were hot (77% of work shifts were classified as "hot" or "too hot"). The combination of workload, heat, and PPE resulted in widespread heat stress (body temperature was classified as "moderately hot" or "severely hot") for 67% of work shifts.

To minimize heat strain, it is recommended to minimize the clothing insulation and water vapor resistance. However, the latter conflicts with protection against the SARS-CoV-2 virus. Impermeable garments isolate the human skin from particles and viruses in the ambient air and from droplets, and thus prevents infection. On the other hand, wearing impermeable PPE for a prolonged period causes skin damage [41] and heat strain [42].

The heat that humans produce during work depends on work intensity and is estimated to be 125–235 W for light manual work and 235–360 W for hand and trunk work [ISO_8996, 43]. In the heat, while wearing PPE, heat loss mechanisms cannot compensate this produced heat and heat will be stored in the body. To reduce the resulting increase in body core temperature, work intensity, frequency, and duration may be adapted. Reduction in the weight of clothing reduces metabolic heat production and thus enhances work capacity [44]. Also, the increased inspiratory resistance of face protection adds to the metabolic load [45]. During heat exposure, efforts should be directed toward reducing heat storage or in other words to flattening the core temperature curve. To optimize endurance and cognitive performance while wearing PPE, workers should seek to lower their body's core temperature at the onset of work and also to attenuate it during work [46].

Drinking cold fluids attenuates heat storage during work/rest cycles. A progressive attenuation in body core temperature responses is reported with increasing levels of fluid replacement during work [47]. However, it also enhances the risk of contamination. Therefore, drinks should be supplied outside of the contaminated area.

Measures to reduce heat strain in PPE

In summary, the recommendations of the GHHIN group, taken the evidence presented before into account, are:

- Under some circumstances, it may be possible to supply PPE that is less likely to lead to heat stress in health workers and other responders.
- Learn how to identify symptoms of heat-related illness in yourself and others [48].
- Become heat acclimatized to lower your starting body core temperature. You become heat acclimatized when you work in the heat for more than an hour each day for at least 7 days.
- Cool down, hydrate, and recover between shifts, as heat stress can increase with consecutive days of exposure.

During work: reduce rises in body core temperature through adaptation of work intensity.

- Stay hydrated and eat regularly. In case of heavy or prolonged sweating ensure electrolyte balance is maintained.

Reduce clothing layers underneath PPE.

- Reduce additional heat from exertion: minimize the equipment you carry, be efficient in your movements, pace yourself.

Cool down: drink cold fluids or ice slurry during breaks, find cool spots to rest in.

Use work/rest schedules to minimize an excessive rise in body heat.

- Consider using cooling devices under your protective garment like a vest with phase change materials, ice, etc.
- Recognize signs of heat stress in yourself and do not wait to feel unwell before taking a break; protect yourself first of all or you cannot care for others.

In general:

- Be aware of your individual vulnerability level as a result of your age, physical condition, health problems, medications, pregnancy, or lack of heat-acclimatization.

Engage in acclimatization activities.

Maintain or improve your aerobic fitness where possible.

Levels of heat acclimatization, thermal tolerance, environmental conditions, workload, and PPE will vary significantly within and between workforces wearing PPE. As such, these are general principles to be considered in light of your specific context and requirements.

General public

Heat plans generally advocate to go to cool places and to physically check on vulnerable people in your neighborhood during periods of extreme heat. However, these are not desirable behaviors in times of COVID-19. Some potential solutions include: the use of social media may provide a solution for monitoring vulnerable people and calling homebound vulnerable people daily by telephone during heat waves has been demonstrated to lower death rates [49]. Air-conditioning is a controversial solution: it cools, but the enhanced ventilation may lead to the spread of the virus [50]. Furthermore, air-conditioning systems are energy-intensive and thus can exacerbate heating at the neighborhood and city scale [51] as well as contributing to emissions responsible for climate change and should therefore be recommended with caution. Please visit the GHHIN website http://www.ghhin.org/heat-and-covid-19/ac-and-ventilation on this topic for more in-depth coverage.

For at-home cooling strategies, electric fans are highly effective for cooling young adults [52,53]; however, fans are less effective in the elderly due to their diminished sweating responses [54]. The reduced efficiency of fans is likely true for other vulnerable groups with diminished sweating responses, such as type 2 diabetics [55]. To overcome this sweating impairment, externally wetting the skin has been demonstrated to be effective, either by sponge [56] or by wearing wetted clothing [57]. Additionally, submerging limbs in water has been demonstrated to be an effective cooling method as well [56,58] although hand cooling may compromise dexterity [59].

Similar to medical personnel, the general public is advised to drink sufficient fluids in order to maintain the required hydration level so that sweating is not compromised. Drinking cold fluids help to lower the body heat storage and resulting body core temperature [60].

Treatment after heat injury and the relation with COVID-19

When body core temperatures exceed 40°C, a serious neurologic phenomenon may occur called heat stroke. In such cases, aggressive cooling is required in the field and in hospitals [61]. This also applies for medical personnel that are subject to heat stroke. COVID-19 patients with fever should not be cooled this way. Antipyretic drugs may be supplied, but there is an ongoing discussion as to whether the temperature should be lowered [62].

Body core temperature in the heat confounding with fever

A distinct symptom of viral infection is a marked elevation of the internal body (core) temperature. Fever is the most common symptom of SARS-CoV-2 that is present in 85% of the individuals affected [1]. When people with fever can be detected reliably, spreading of the SARS-CoV-2 virus can be prevented saving thousands of lives. Unfortunately, being in a hot environment also increases body core temperature, in particular after exercise. In cases of heat strain caused by physical work and/or heat exposure, the elevated body core temperature can, in extreme cases, affect respiration and well-being [63]. A febrile person will likely try to defend the elevated core temperature (by shivering) as opposed to someone with exertional hyperthermia. The latter is however not fever and should not be confused as a sign of viral infection.

Measurement of body core temperature

There is no single true body core temperature. The temperature is different in every site of the human body and the result of a local balance between heat production and heat loss [64]. Axilla, infrared tympanic, or forehead thermometers should be interpreted carefully since they may seriously underestimate the core temperature as measured in the pulmonary artery. Most of these types of thermometers are poor tools for assessing the body core temperature [65].

Fever is defined as a body core temperature exceeding 38°C. Fever screening is used extensively worldwide. It should be quick and reliable. The latter, however, is not the case and this is a major problem. A recent review of mass screening for fever showed the ineffectiveness of fever screening although some authors reported concomitant positive effects like discouraging travel of ill persons [66]. The temperature measuring devices used to measure the body temperature of travelers are electronic handheld or fixed/stationary non-contact thermometers, and ear or oral thermometers. These systems may be as much as 1–2°C higher or lower than actual body temperature [65,67,68]. Thermal imaging has emerged as an option for mass fever screening as it is quick and can be conducted on mass; however, there is a distinct lack of evidence regarding efficacy. The alternatives, such as rectal thermometers are less suited for mass screening but show excellent agreement with the gold standard – pulmonary artery catheters [65].

Although some measures like infrared tympanic measurements are not reliable, they still have some value. When a threshold of 37.5°C is used for fever detection, less than 5% with fever ≥38.0°C will remain undetected [69]. Table 2 shows the results in percentages. However, one-fifth of the subjects needs a follow-up with a rectal temperature measurement to exclude fever [69].

Table 2. Confusion matrix of screening fever using infrared tympanic thermometry with a threshold of 37.5°C. Fever is defined as a rectal temperature exceeding 38°C [69]. Values are percentages.

	Fever	No fever
Fever according to screening protocol	6.5	15.7
No fever according to screening protocol	0.3	77.5

Therefore, a good screening protocol for fever does not rely on simple infrared tympanic or forehead measurements but should make the next step for instant rectal measurements to exclude a large number of false-positive subjects.

Measures to separate fever from hyperthermia

In order to separate fever from hyperthermia after exercise or exposure to heat, it is recommended to determine the body core temperature after 30 minutes of rest in a cool environment and after removal of any protective or insulating clothing in particular. If body core temperature remains elevated during this time, it may be fever – a health expert should be consulted immediately and explain the person's condition. If a substantial drop in body core temperature (of 0.5°C or more, toward the normal 37°C) is observed, and the individual feels better after resting in a cool environment, it is more likely to be heat-stress-related. In this case, ensure that the individual is rested and hydrated and has no other indications of COVID-19 infection.

Recommendations for the public as well as health, occupational, and sports/exercise specialists should stress the difference between hyperthermia induced by the environment or exercise, and fever.

Conclusions

In conclusion, additional problems are expected to occur in fighting the COVID-19 pandemic during heat waves. First, medical personnel may suffer from heat strain which compromises task performance. Dedicated (pre)cooling protocols have been shown to alleviate heat strain. Second, the recommendations provided in national heat plans partly conflict with the measures to prevent the spreading of the virus. Therefore, a revision of the heat plans is necessary during times of a pandemic. Third, hyperthermia due to heat and exercise may be mistaken for fever, one of the most common symptoms of COVID-19. Resting in a cool environment may help to identify whether patients are experiencing fever or hyperthermia. The GHHIN network has been shown to be instrumental in defining the issues, searching for scientific evidence of possible solutions, and dissemination of the results.

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Appendix 1 Frequently Asked Questions resulting from survey

(1) Does weather and climate affect SARS COV2 transmission?

(2) How is COVID-19 linked to environmental conditions?
(3) What effective strategies can be employed to protect medical staff and other essential workers from heat-related illness? How best can they be informed of these protective measures? Is there existing guidance, recommendations, or best practices?
(4) How can I manage my heat stress while wearing PPE?
(5) What strategies exist for protecting workers from heat stress in health facilities that are hot, such as temporary facilities like converted arenas, uncooled field hospitals, and small clinics or surgeries?
(6) How not to mistake fever with heat-stress (environmental or exercise-induced) hyperthermia and heat-illness?
(7) Do air conditioning, ventilation, or other climate control systems increase the risk of SARS-CoV-2 transmission? If yes, how can this be managed?
(8) What considerations should be made for opening and managing cooling centers?
(9) What is the risk of SARS-CoV-2 spreading via sweat?
(10) What strategies can be provided to the public on ways to cool down within their homes if self-isolating/physical distancing without air conditioning? Do strategies differ for vulnerable groups such as the elderly, those recovering from COVID-19 at home, those without access to air-conditioning units or others?
(11) What alternative cooling strategies can be used to support vulnerable residents (e.g. in apartment towers) who are self-isolating at home without air conditioning? (should A/C's be provided) Are there different recommendations based on the group (e.g. people with A/C vs. those without, elderly, young)?
(12) How can outdoor cooling/relief be provided as an alternative/addition to at-home strategies? (Considerations around public spaces including drinking fountains, seating in parks, disinfection?)
(13) How can you do outreach during the pandemic on heat waves? How to reach people who have difficulty using technology?
(14) How to do a home safety check for heat-risks during COVID-19? (ensure there are plans in place to do this in a safe way)
(15) Are there any unique considerations for heat health in areas of high urban density in the context of COVID-19 (e.g. given inaccessibility to some cooling strategies, such as cooling centers or rooms and reduced access to parks and green space)?
(16) Which populations are vulnerable to both heat and COVID-19?
(17) What considerations should be made for the management of "cooling centers" while COVID-19 transmission precautions? Should cooling centers be operated during the pandemic? If so, how/under what considerations? (e.g. most vulnerable people, people prioritized, screening, social distancing, timing, best practices)
(18) What social services need to be updated/trained for dealing with combined exposure of heat and COVID-19?
(19) What specific considerations apply for heat waves in informal settlements during the COVID-19 outbreak?