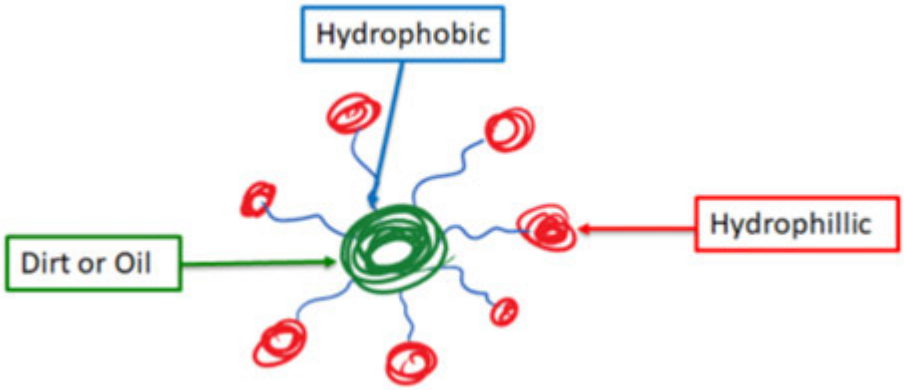
Why does handwashing with soap work so well to prevent COVID-19?

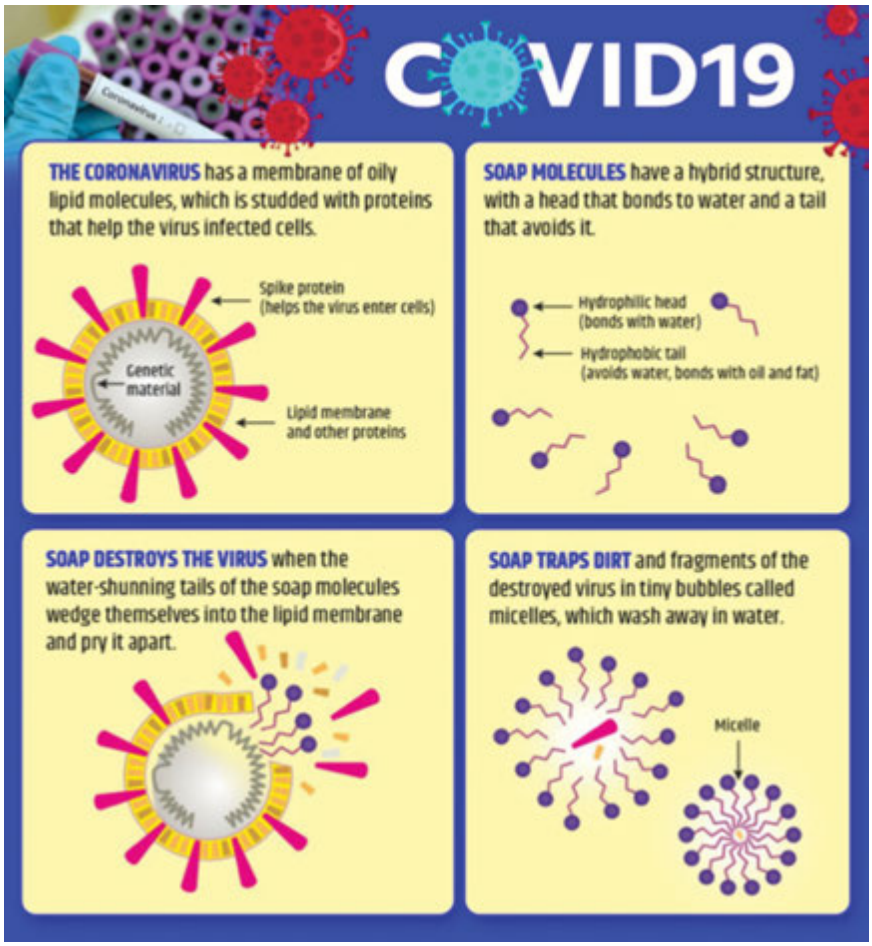
Handwashing with soap, together with **other public health interventions,** will be key to curbing the transmission of **COVID-19**. To understand why handwashing is so effective in killing and removing SARS-CoV-2 it is necessary to understand how soap works at a microscopic level.

In the image below the green dot represents some dirt or oil that may be on your hand. Pathogens typically reside in the natural oils and moisture **on your hand.** In the image below, the soap molecule is depicted in red and blue. One side of the soap molecule (the blue part) is hydrophobic, this means that it does not like water, so when you lather soap on your hands this side of the molecule attaches to the oil and dirt. The other side of the soap molecule (the red part) is hydrophilic, meaning that it loves water, so as you apply water to your soapy hands this side of the molecule attaches to the water. As the water washes the soap bubbles away it effectively picks up all the dirt, oil and pathogens from your hands and washes them away. This is why soap is such an effective defence against all pathogens. It is important to remind people that they need to rub hands thoroughly and create a lot of lather so the soap can get into all the cracks and crevices in skin where the virus likes to hide.



However, soap not only removes SARS-CoV-2 it also deactivates it. This is because SARS-CoV-2 is an encapsulated virus meaning that its outer layer is made up of a fatty membrane. So when the hydrophobic end of the molecule comes in contact with this fatty membrane it causes it to dissolve and fall apart, thus destroying the virus. For more on how soap works **read this article.**

The image below shows how soap removes and kills SARS-CoV-2.



Source:
Dr Harsh Vardhan

Can ash be used for handwashing?

Ash can be used effectively for **hand cleaning in general.** However, soap and water in combination are particularly effective for **killing and removing SARS-CoV-2.** Ash is thought to remove germs from hands in a different way to soap - primarily through friction. It is unclear if ash would have the same effect as soap on the coronavirus as no studies have been done on this.

However in settings where soap is really scarce handwashing with ash is likely to be more effective than handwashing with water alone. If recommending ash to households make sure that they are using the white ash from the centre of a fire once cooled. This white ash is likely to be the most sterile as it was heated at the highest temperature. Be aware that handwashing with ash does not feel very nice and does not leave hands feeling and smelling nice in the way that soap does, as such promoting ash may actually discourage people from practicing handwashing. We recommend also reminding people that soap of any type can be used for handwashing. See our section on *Are some types of soap more effective than others?* for more information.

Recommendation:

- There is no evidence on the effectiveness of ash for removing or killing SARS-CoV-2.
- In settings where soap is really scarce, remind people that any type of soap is effective for handwashing.
- Where there are no other options, handwashing with ash should be encouraged as it is more effective than handwashing with water alone.

Are some types of soap more effective than others?

All types of soap will effectively remove and kill coronaviruses. So whether you buy expensive or cheap soap, **bar soap** or liquid soap, or if you use laundry powder or dishwashing liquid you will still end up with clean hands. The more soap you use the better.

Antibacterial soap is **not more effective** in **community-settings** and under normal use conditions (i.e. when hands are not washed for as long and thoroughly as in laboratory experiments). This is thought to be because of the way soap works at a microbiological level (see *Why does handwashing with soap work so well to prevent COVID-19?*) and because it takes a while for the antimicrobial properties to be activated and by this time most pathogens have already been removed from hands. Antimicrobial soap is recommended in health care facilities since it is important to ensure that sinks and drains don't become reservoirs for pathogens in these settings.

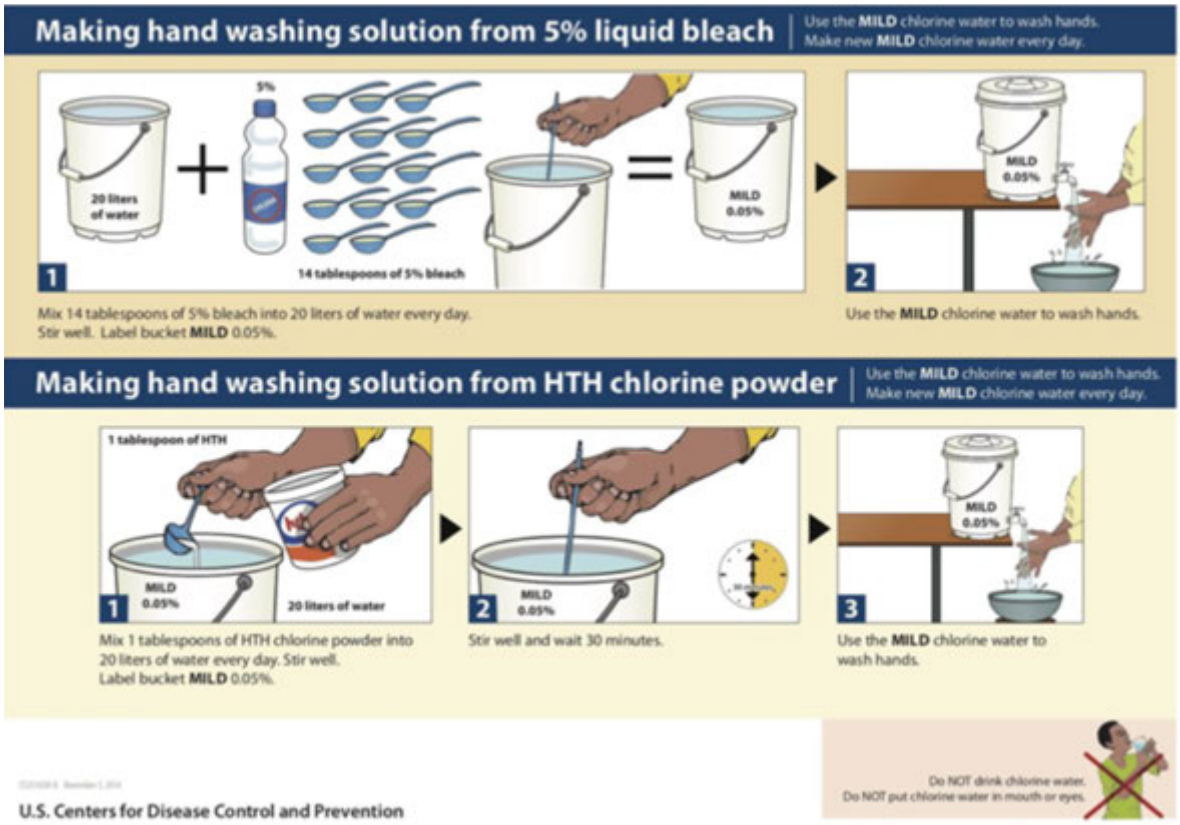
Using nicer soap may make handwashing **more desirable** and therefore contribute to the development of good habits. In particular liquid soap is considered more desirable in many settings.

Should we be promoting handwashing with chlorinated water?

It is not necessary to use chlorinated water for handwashing during this COVID-19 outbreak as soap and water is highly effective in killing and removing SARS-CoV-2 from hands (see *Why does handwashing with soap work so well to prevent COVID-19?*). Using chlorinated water does **kill viruses** but may also cause skin or eye irritations so **currently the WHO recommend** using soap and water or alcohol based hand sanitiser as both are gentler on skin.

In some settings, such as those recently affected by Ebola outbreaks, there may be a precedent for handwashing with chlorine to combat the spread of disease. In these settings, it might be more acceptable to promote the use of chlorinated water at public handwashing facilities (but only if it proves challenging to promote handwashing with soap). Chlorinated water may also be considered in locations where soap supplies are limited. Chlorinated water should not be promoted as an option for handwashing at home. Chlorine can be a **dangerous chemical** and so it is important that it is stored and handled with care.

If preparing chlorinated water for handwashing then a 0.05% solution should be used. Follow the instructions from the CDC as shown below.



Source: CDC

Summary of recommendations:

- Handwashing with chlorinated water (0.05%) is effective against SARS-CoV-2 but not necessary.
- Handwashing with soap or alcohol-based hand gel should be encouraged.

What can we do where soap is scarce?

It is rare that people have no soap at all, rather the soap that they do have is prioritized for **other tasks** such as bathing, laundry or dishwashing. If this is the case try implementing activities that remind people of the power of soap. Also remind people in your area that any type of soap can be used for handwashing (see *Are some types of soap*

Photo of a **public handwashing facility in Tanzania** where they have created a laundry powder dispenser from a bottle.

more effective than others?) including cheap soap that is often used for laundry. You can also suggest that people create soapy water (see *Can soapy water be used?*). If you are working in an area where soap is unaffordable for people or is unavailable then using ash may be better than handwashing alone (see *Can ash be used for handwashing?*).

Can soapy water be used?

Soapy water has been shown to effectively remove pathogens from hands and be an acceptable and affordable alternative to bar or liquid soap. It can be used in households where soap is limited and can be a particularly practical solution for promoting soap use at public handwashing facilities. This is because people will often feel uncomfortable sharing bar soap in public locations so liquid or soapy water is more acceptable. However if using soapy water in these settings someone may need to be appointed to refill the soap water regularly.

Soapy water can be created by diluting powdered laundry soap or liquid soap. However, be careful not to dilute any soap too much as this will make it less effective. If you choose to dilute soap make sure that it is still soapy enough that it is able to create a good lather within seconds as this is important in order to effectively remove soap from hands (see *Why does handwashing with soap work so well to prevent COVID-19?*).

Here is a pictorial example of how to create soapy water from laundry detergent powder and how to create dispensers.

1.5L plastic reclaimed bottle and 30g detergent

Pour the detergent into the bottle

Shake well

Make a hole in the cap

Soapy water

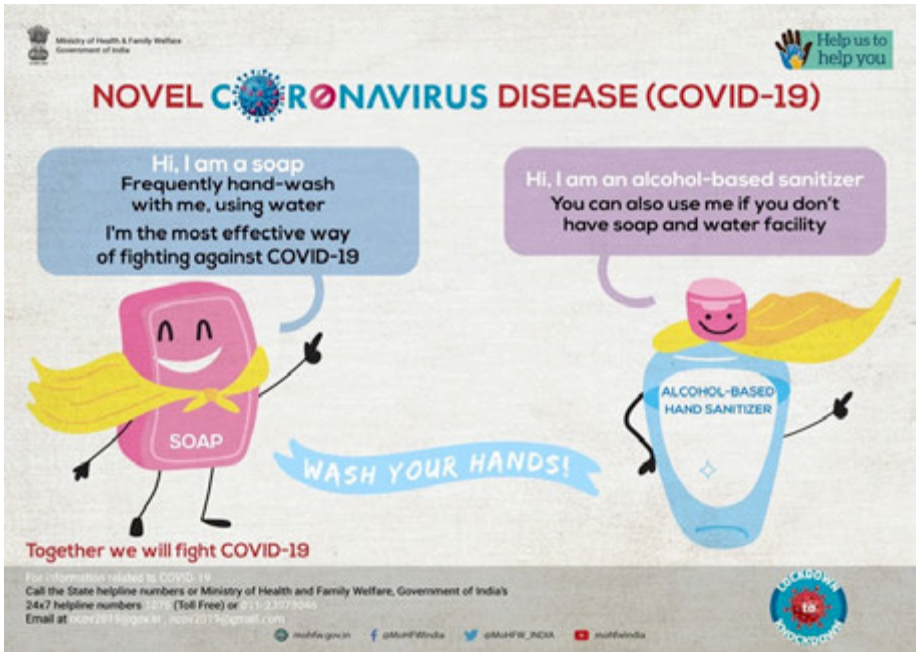
Wah your hands

Source: icddr,b

Is alcohol-based hand rub better than soap?

Handwashing with soap is the most commonly recommended method for removing SARS-CoV-2 from hands. This is because soap is effective in removing and killing the virus and because soap is cheap and affordable. It is also gentle on hands so repeated use should not cause irritation. Alcohol-based hand rub is as **effective against the virus** but is less widely available and is often more expensive. It is recommended that alcohol-based hand rub be a back-up solution, for when handwashing with soap is difficult or impractical (such as when a person is outside their home).

Alcohol-based hand rub must contain at least **60% alcohol** in order to be **effective** (check the back of the bottle for information). Modern alcohol-based hand rubs rarely cause skin irritation because they normally contain skin softeners to prevent skin drying. For this reason, it is not recommended to promote home recipes for alcohol-based hand rub. For more about perceived risks associated with hand sanitisers read this **article from the WHO.**



Example from the **Ministry of Health & Family Welfare,** India.

Should we be promoting handwashing at different times during the COVID-19 outbreak?

Normally at a community-level we focus on the following critical handwashing occasions:

- Before food preparation
- Before eating or feeding a child
- After using the toilet
- After cleaning a child's bottom.

Handwashing at these critical occasions should continue to be promoted during the COVID-19 outbreak. However to interrupt transmission of COVID-19 you should also encourage handwashing at the following additional times:

- After coughing or sneezing
- When entering or leaving the household or any other building
- After coming into physical contact with anyone outside your household
- After touching surfaces when outside the home (e.g. door knobs, railing, money etc)
- After visiting a public space, including public transportation, markets and places of worship
- Before, during and after caring for a sick person

There may also be additional times that are relevant in your context. If it is not possible to wash hands immediately after contacting any of the above (e.g. whilst in a public place), care should be taken to avoid touching the face. Hands should be washed immediately after returning home.

Source: Global Handwashing Partnership

What can we do in areas with real water scarcity?

When water is scarce people typically prioritise water for **tasks other than handwashing** – things like drinking, bathing, laundry, **and dishes.** In such settings, people may just **rinse their hands with water** rather than using soap because using soap is perceived to increase the amount

of water required. A key behavioural task in areas that are water-scarce will be to reposition handwashing with soap as more important than other household tasks at this time.

There is the potential for handwashing to consume lots of water but hands can be washed with a relatively small amount of water. Wet hands first. Then apply soap. If you are using piped water from a tap make sure to switch the water off while you lather-up your hands. Rinse your hands until all the soap is visibly removed. In some countries people reuse handwashing water to water flowers. It is also possible to design activities to show people that washing hands with soap consumes less water than they might expect by comparing it to another task that is performed regularly in the home e.g. making tea or coffee.

There are also some simple add-on handwashing technologies that reduce the flow of water allowing hands to be washed with a minimal amount of water. These include the **SpaTap,** the **Oxfam Handwashing Tap** and **the Drop** as pictured below from left to right. Even a simple bucket-style container with a tap has been shown to use less water than pouring from a jug.



Alternatively there are simple DIY ways of restricting the stream of water. One example is using a jerry can and a nail as shown in the images below.


It is also possible to use greywater for handwashing (see *Can I use greywater or water that is not clean for handwashing?*).

Can I use greywater or water that is not clean for handwashing?

Yes, water for handwashing **does not have to be as clean** as water for drinking. **Studies** have shown that if you wash your hands with soap and relatively highly contaminated water, your hands will still be left clean. This shows just how effective soap is at removing pathogens from hands (see 'Why does handwashing with soap work so well to prevent COVID-19?' for more information). So if water is scarce where you work, you may be able to convince people to keep the water they use for laundry, for example, and store this for handwashing use. However it's important to note that in many places **reusing water** like this is not considered to be **culturally acceptable,** particularly if water is soapy.

Is it safe for people to share handwashing water?

Using unclean water for handwashing is still effective for removing pathogens (see 'Can I use greywater or water that is not clean for handwashing?' for more information). Currently there are no studies about reusing handwashing water in the context of COVID-19 so it is difficult to assess the risk it may pose. Currently we know that **water is not a source of transmission** for COVID-19 but that SARS-CoV-2 can **persist in water** for 2 days if untreated. Therefore we would recommend people err on the side of caution and that handwashing water is not reused at this time. It is not necessary to take any special measures to treat handwashing water, but chlorine has been shown to deactivate SARS-CoV-2 in **wastewater.**

Do public handwashing facilities pose a risk?

Some public handwashing facilities do pose a small risk of re-contamination. However, the absence of them would create a much greater concern for transmission. Hand re-contamination is possible because at the end of handwashing, when your hands are clean, the tap has to be turned off - but this tap may be dirty from when you initially touched it. There have been some **great examples** of no-touch handwashing facilities to mitigate this issue. Most of these use **foot pedals** to control the water and soap. Others have created **touch-free adjustments** for standard handwashing facilities. A more simple and well known touch-free handwashing device is the tippy tap. Instructions on tippy tap construction have been made available in a r**ange of languages here.**

Even if you are using bucket-style handwashing facilities, these normally come with an on/off lever to dispense water. The good thing about this (as opposed to a tap that turns on and off) is that it can be pushed with an elbow to switch it off, thus mitigating the contamination risk. Watch **this video** to see an example.

In several countries, we are also seeing that individuals are setting up handwashing stations near markets as small money earners or that organisations are paying 'hygiene monitors' to ensure that soap and water are always available at the public facilities they construct. In these situations, the person monitoring the station can switch the tap on and off for each person so that it is effectively touch-free. If your organisation is planning on paying people to monitor handwashing facilities, please do consider the sustainability of this approach or how you will phase this out. In addition, you may wish to promote regular cleaning of taps on public facilities.

Can bar soap spread COVID-19?

At the moment there is lots of concern around surfaces being contaminated by the virus so it is reasonable to be concerned about whether bar soap could also be a source of potential infection. It is true that bacteria and viruses can transfer onto bar soap during handwashing. **Some studies** have found that most bars of soap have an average of 2-5 microorganisms on them at any one time. Interestingly when these contaminated bar soaps are used, **studies have shown** that hands have no traces of these pathogens afterwards and that hands are equally as clean as compared to using a brand new bar soap. Studies like this indicate that there is no infection risk posed by sharing bar soap at this time. The reason for this is likely to be because of the way that soap works at a microscopic level (see: 'Why does handwashing with soap work so well to prevent COVID-19?').

What kinds of handwashing facilities should we construct?

Simple handwashing designs are fine at this time. As recommended by the WHO, the most important thing at this time is that they are **widely available**. The WHO are currently recommending that handwashing facilities with soap and water should be located in the following public places:

- At the entrance to every building, for use on entry and exit.
- At all major bus and train stations, airports, and seaports.

We recommend that handwashing facilities are also stationed at all markets, food vending locations, and water points.

We recommend considering the following factors when selecting or designing handwashing facilities:

- What designs are easiest to produce at scale quickly?
- What designs will be accessible for all people to use (including children, adults and people with disabilities)?
- Which designs are 'touch free' or minimise the likelihood of re-contamination?
- How can you ensure that soap and water is regularly replaced and the handwashing facility and taps are regularly cleaned?
- Which designs are robust and will continue to function under high-use conditions?

This **guide by Wash'em** was developed before the COVID-19 outbreak but provides some examples of handwashing facilities and describes how to work with communities to design handwashing facilities that improve behaviour.

Are tippy taps ok?

Designs like the **tippy-tap** are easy to replicate quickly. However, tippy-taps are prone to breaking easily. So if you are setting up tippy-taps you should also establish mechanisms for the water and soap to be regularly replenished. Tippy taps are appropriate to promote for household use during this time because they are affordable to construct.

How should hands be dried?

Hand drying plays an important role in getting clean hands and preventing recontamination. In high income settings paper towels or electric air dryers can be used to **effectively dry hands.** However, these are not available or feasible in many low- and middle- income settings so often people recommend just shaking hands dry. However, if people go straight back to their day-to-day activities after handwashing, this can be problematic because **wet hands** tend to pick up more pathogens from the surfaces they touch. The good news is that a study in **Zimbabwe** found that drying hands on clean towels or even on dirty clothes can be more effective at removing any remaining bacteria from hands than simply air drying (shaking hands dry).

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