SEAPAC.WATER

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SEAPAC

Common Saying

- Humans can live:
- Three minutes without air
- Three hours without shelter, in adverse conditions
- Three days without water, on average and still function, survival is 8-10 days, unless in extreme heat
- Three weeks without food
- Water will become very important soon after a disaster happens

Normal Human Body Hydration Level

- The average adult human body is about 60% water by weight
- The average infant is about 75% water by weight
- Newborns at birth are born with “extra water weight”, they will generally drop below birth weight the first few days and then come back up to their birth weight
- That is our starting point with normal hydration

Dehydration Can Happen After A Disaster Because…

- 1) You are losing water faster than normal because you are working harder (your in rescue mode?)and you could be exposed to some high temperatures
- 2) You are getting dehydrated simply because you have no water to drink, water deprivation
- 3) You get sick and lose water from diarrhea and vomiting?

Impacts Of Mild Dehydration On The Human Body

- Researchers found that athletes who lost fluid equal to 2% of their body weight took a cognitive hit
- 2% fluid loss is considered to be mild dehydration
- Dehydration led to **impairment** in tasks like **map reading**, **grammatical reasoning**, **mental math**, and **proofreading**…tasks that you want to do well in during a disaster
- A loss of ~2% body mass is commonly reported as the threshold for cognitive impairment

How Quick Can Dehydration Happen?

- With an hour of moderately intense activity, with a temperature in the mid-80s, and moderate humidity, it's not uncommon to lose a little over 2 pounds of water, for a 200Lb person, that is a 1% weight loss
- 2 hours with the same conditions = 2% drop
- 12 hours of nothing by mouth like for like a medical test = 1.5% weight loss, (low activity)
- 24 hours of nothing by mouth = 3% weight loss

Expected Days Of Survival Without Water And No Activity, Just Staying Still…Military Source

Max Daily Temp In The Shade	No Water- Expected Days Of Survival	1 Quart- Expected Days Of Survival	2 Quarts- Expected Days Of Survival	4 Quarts- Expected Days Of Survival	10 Quarts- Expected Days Of Survival	20 Quarts- Expected Days Of Survival
120 F	2	2	2	2.5	3	4.5
110 F	3	3	3.5	4	5	7
100 F	5	5.5	6	7	9.5	13.5
90 F	7	8	9	10.5	15	23
80 F	9	10	11	13	19	29
70 F	10	11	12	14	20.5	32
60 F	10	11	12	14	21	32
50 F	10	11	12	14.5	21	32

Four Steps To Getting And Storing Clean Water

- 1) **Source**…you will need to find a water source
- 2) **Treatment**…you will most likely need to treat the water to make it safe
- 3) **Storage**…you will need to safely store the water you have treated
- 4) **Distribution**…you may need to consider how you will transport that water if you have to relocate or want to provide some water to assist others

Sources Of Water After A Disaster

- Your local municipal water company
- Your private well
- Surface water source such as streams, rivers, a pond, or a lake
- Rain water

Water Source…Local Community Water System

- Large earthquake happens and you are supplied water by a local community water provider
- Two likely outcomes
- A) They are able to provide some water under pressure to your location **for the moment**, but you are told to **boil the water** due to possible damaged pipes
- B) They are unable to provide any water to your location…you will have to **fetch your own water**

Water Source…Private Well

- Large earthquake scenario again and the power grid has failed
- Your private well system appears to be intact, hopefully no underground pipes were damaged?
- You have a generator
- Fuel to run the generator will be limited in supply
- Run the generator long enough to fill up water containers and turn it off…save your precious fuel
- May consider some water treatment if unsure about the underground pipes in your system

Damage To Water Systems Can Also Damage Sanitation Systems

- Earthquakes, extended power outages, and flooding can affect both water and sanitation systems
- When people no longer have a functioning place for sanitation, no toilets working, open defecation can happen
- Oh look, there is a stand of brush right next to the creek, the brush will give me some privacy while I do my business…the rain comes down, guess what is slowly flowing into the creek now?

Water Sources…Surface Water Stream Or A River

- You do want to be aware of what human and animal activity has been happening upstream from where you will draw some water
- Is the stream you are looking at, is it at the edge of a forest that goes up a hill and has a short water shed?
- Does it meander through several neighborhoods first with lots of human activity upstream?
- Does the water appear to be clear? It is easier to treat water that is more clear

Water Sources…Surface Water Ponds And Lakes

- Your situation will determine what choices you have for collection of your water source
- You will have to be the judge of how much **human** and **animal** activity has been happening at the edge of the pond, and then consider any streams that flow into the pond, do you travel up a stream that feeds the pond?
- You do want to be **very careful near any industrial areas** that could have spilled/discharged **chemicals** into the local surface water supply…stay away from those areas

Water Sources…Rain Water

- One cubic foot of water = 7.5 gallons
- One **cubic foot** = 12” x 12” x 12” = **1,728 cubic inches**
- If 1” of rain falls on a **4’ x8’ piece of plywood** and you were able to collect every drop…how many gallons would that be?
- 4’ = 48”, 8’ = 96”, therefore **1” high x 48” wide x 96” deep** = 4,608 cubic inches of water collected
- 4,608 cubic inches/ 1,728 cubic inches = **2.67 cubic feet**
- 2.67 x 7.5(gallons per cubic foot) = **20 gallons of water**

You Found A Place To Collect Your Water, Is It Contaminated?

The major water contaminants are:

1) Pathogens…the organisms that cause disease
2) Organic and inorganic chemicals
3) Physical contaminants like sediment and debris

“Fresh Water” Fetched From The Field May Have Pathogens

- Common pathogens are:
- **Protozoa**, most need a host to grow and multiply
- **Bacteria**, can multiply without a host
- **Viruses**, need a host to grow and multiply
- They all can make you rather sick with diarrhea and stomach cramps

Viruses Are The Smallest Pathogens

- Viruses are 0.004 to 0.1 microns in size
- Viruses are **generally host specific**
- **Humans get one type of viruses**
- **Animals get a different type of viruses**
- Viral infections are not treatable with antibiotics

How Big Are The Pathogens In Water?

- Average **human hair is about 50 microns**

- 1/10th of that size is the size of protozoa
- 1/10th smaller is the size of bacteria
- 1/10th smaller again is the size of viruses

- You **can not see the pathogens** with the naked eye

Fecal-Oral Route Spreads Pathogens

- When the local population no longer has a properly functioning sanitation system, people will be forced to find somewhere else to defecate
- One of the **7 most common US fecal-oral pathogens** could be present in the feces of some citizens
- If the feces comes in contact with a local stream, river or pond…that water source could become infected with pathogens and then infect you when you drink it or get it on your hands and touch food

7 Most Common Waterborne Diseases Spread By The Fecal-Oral Route In The US

- 1) Campylobacteriosis
- 2) Cryptosporidiosis AKA “Crypto”
- 3) E coli
- 4) Giardiasis
- 5) Hepatitis A
- 6) Salmonella
- 7) Shigellosis

Campylobacteriosis

- Campylobacter causes an estimated 1.3 million infections each year in the US from water and food contamination
- One of the most common causes of food poisoning
- Is a bacteria that is 0.2 to 0.5 microns in size
- You get diarrhea, fever and cramps
- Symptoms within 2-5 days after exposure, can last about 1 week

Cryptosporidium…Crypto

- 9,313 reported cases in the US in 2011, and 8,008 cases reported in 2012 (MMWR May 1, 2015 / 64(SS03);1-14)
- Is a protozoa that is 4-6 microns in size
- You get watery diarrhea, cramps, fever, nausea and vomiting
- First symptoms of infection occur within a week and can last for up to 2 weeks

E. Coli

- About 100,000 illnesses, 3,000 hospitalizations and 90 deaths per year in the US due to contaminated food and water
- The worst strain is **E. coli** O157:H7 which causes about 73,000 infections and an estimated 61 deaths annually in the US
- Is a bacteria that is 1-2 microns in size
- You get diarrhea, cramps, fever, nausea and vomiting

E. Coli

- First symptoms of infection occur within 1-4 days
- Infection can last about 1 week
- Young children and older adults have a greater risk of developing a life-threatening form of kidney failure called hemolytic uremic syndrome
- Most common way of getting the infection is from eating contaminated food

Giardia Cases In The US

- CDC reports that 15,223 cases of Giardiasis were submitted in 2012 in the US
- Largest demographic was children 0-4 years of age
- Largest number of cases were reported in the northwest US
- In developing countries, about one third of population has been infected in their life time
- The most frequent parasite identified in stool samples submitted in the US

Giardia

- Nearly half of people infected with Giardia are asymptomatic
- Giardia is a protozoa that is about 6-14 microns in size
- The incubation period (time interval between ingestion and the first appearance of symptoms) can range from 3 to 25 days
- Symptoms include abdominal pain, nausea, flatulence, and large volume of foul-smelling, greasy stools

Giardia

- Rarely does Giardia infection cause death, but each year 4,600 persons with giardiasis are estimated to be hospitalized in the United States
- Hospitalized cases are primarily children under five years of age, and dehydration is the most frequent co-diagnosis

Giardia And Chlorine Treatment

- Giardia cysts are relatively resistant to chlorination, particularly if the water is cold, and, the amount of chlorine used routinely in drinking water is not sufficient to kill Giardia

Giardia

- Due to the large amount of stool, dehydration is a concern
- In otherwise healthy people, symptoms of giardiasis may last 2 to 6 weeks
- Occasionally, symptoms last longer
- Medications can help decrease the amount of time symptoms last

Giardia Cyst Survival

- **Giardia** cysts can **survive for long periods** of time in cool and moist conditions
- Giardia cysts have been shown to survive in **tap or lake water** for **about 2 months** at 0-8 C, **32 to 46 F**
- Survival in **tap water** for **2 weeks** at 20-28 C, **68 to 82 F**
- In **lake water** for **1 month** at 17-20 C, **63 to 68 F**
- In **river water** for **nearly 3 months** at 0-4 C, **32 to 39 F**
- In **river water** for **1 month** at 20-28 C, **68 to 82 F**

Giardia

- Giardia cysts are **highly infective**
- As few as **ten human-source Giardia cysts** produced infection in a clinical study of male volunteers
- Infected persons have been reported to shed 10^8–10^9 cysts in their stool per day and to excrete cysts for months, that is 100 million to 1 billion cysts per day shed into the environment from one individual
- Think of the one person going to bathroom close to a stream

Hepatitis A

- 1,390 cases were reported to the CDC in 2015
- Hepatitis A is a virus that is about 0.05 microns in size
- Hep A is vaccine-preventable
- Most adults have fatigue, low appetite, stomach pain, nausea, and jaundice
- Incubation period is 15 to 45 days
- Symptoms usually get better in about 2 months

Salmonella

- CDC estimates about 1.2 million illnesses (1 million were food related), 23,000 hospitalizations, and 450 deaths each year in the US
- Salmonella is bacteria about 1 to 2.5 microns size
- First symptoms happen 6-72 hours later, can be later onset
- There are two main types, typhoid type and non-typhoidal type

Salmonella

- Salmonella induced gastric inflammation causes diarrhea, cramps, fever, chills, headache and muscle pain
- Lasts about 4-7 days
- Millions of Salmonella bacteria can be released in a single bowel movement from an infected human or animal

Shigellosis

- CDC reports about 500,000 cases of Shigella in the US each year
- Shigella is a bacteria about 1-3 microns in size
- First symptoms can happen in about 12 to 72 hours
- You get diarrhea (sometimes bloody), stomach cramps and fever
- Symptoms last for about 5-7 days

Methods To Treat Unsafe Water In The Field

- Boiling
- Filtration
- Chemical treatment
- UV light exposure

Boiling Water That May Have Pathogens

- If the water is cloudy, let it settle and then filter through a cloth or coffee filter
- Boil the water for one minute, boil the water for three minutes if your elevation is above 5,000’
- Let the boiled water cool down naturally
- To improve the taste, you can pour it back and forth between two containers so it will not taste as flat

Boiling Water Is The Gold Standard, But Will You Have Enough Fuel To Heat Water?

- **Boiling water kills all three types of pathogens**
- Kills protozoa
- Kills bacteria
- Kills viruses

What To Do If No Fuel To Boil Water

- A combination of **filtration** and **chemical** treatment will almost always be needed in order to kill **all** pathogens
- **Giardia**…plan to use a water filter to remove Giardia, because it is **resistant to chemical treatment**
- **Crypto**…plan to use a water filter to remove Crypto, because it is **very resistant to chemical treatment**
- **Viruses**…plan to use chemical treatment to kill viruses, because nearly all water filters will not remove something as small as a virus

Water Filtration Effectiveness

- Water filtration effectiveness is usually described in two ways
- 1) What is the **filter pore size** in microns (1 millionth of a meter)…you want the **absolute filter pore size**, **not** the **nominal filter pore size**…some nominal 1 micron filters will let 20-30% of >1 micron particles through…such as Crypto
- 2) Log reduction value (LRV)

Log Reductions

- 1 log reduction means the number of germs is 10 times smaller…90% reduction
- 2 log reduction means the number of germs is 100 times smaller…99% reduction
- 3 log reduction means the number of germs is 1000 times smaller…99.9% reduction

Log Reductions

- 4 log reduction means the number of germs is 10,000 times smaller…99.99% reduction
- 5 log reduction means the number of germs is 100,000 times smaller…99.999% reduction
- 6 log reduction means the number of germs is 1,000,000 times smaller…99.9999% reduction
- 7 log reduction means the number of germs is 10,000,000 times smaller…99.99999% reduction

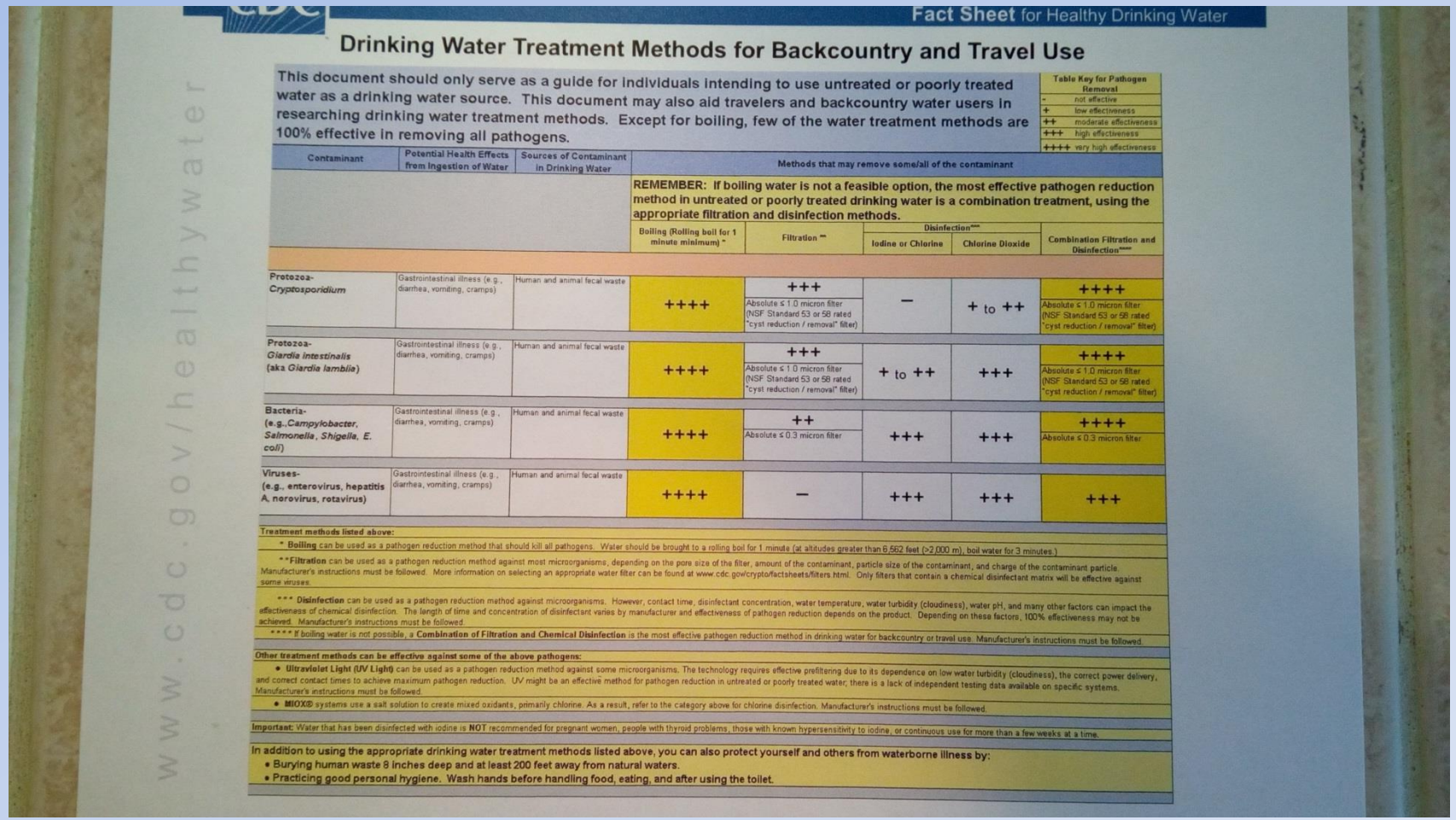
Log Reductions

- A "5-log reduction" means lowering the number of microorganisms by 100,000-fold
- If a surface has **100,000 pathogenic microbes** on it, a 5-log reduction would reduce the number of microorganisms to **one**

Water Filter Absolute Pore Size Effectiveness

- **To remove Giardia…must be <= to 1.0 micron**
- **To remove Crypto…must be <= to 1.0 micron**
- **To remove all bacteria…must be <= to 0.2 micron**
- Filters used in pharmacy applications for IV fluids use to be 0.45 microns, then it was discovered that the smallest bacteria that could be suspended in solution passed through 0.45 micron filters, new standard developed was the 0.2 micron filter…ASTM F838-05 standard

CDC Drinking Water Treatment Methods For Backcountry And Travel Use



Fact Sheet for Healthy Drinking Water

Drinking Water Treatment Methods for Backcountry and Travel Use

This document should only serve as a guide for individuals intending to use untreated or poorly treated water as a drinking water source. This document may also aid travelers and backcountry water users in researching drinking water treatment methods. Except for boiling, few of the water treatment methods are 100% effective in removing all pathogens.

Table Key for Pathogen Removal	
–	not effective
+	low effectiveness
++	moderate effectiveness
+++	high effectiveness
++++	very high effectiveness

Contaminant	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water	Methods that may remove some/all of the contaminant				
			REMEMBER: If boiling water is not a feasible option, the most effective pathogen reduction method in untreated or poorly treated drinking water is a combination treatment, using the appropriate filtration and disinfection methods.				
			Boiling (Rolling boil for 1 minute minimum) *	Filtration **	Disinfection*** Iodine or Chlorine	Disinfection*** Chlorine Dioxide	Combination Filtration and Disinfection****
Protozoa- *Cryptosporidium*	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	++++	+++ Absolute ≤ 1.0 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter)	–	+ to ++	++++ Absolute ≤ 1.0 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter)
Protozoa- *Giardia intestinalis* (aka *Giardia lamblia*)	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	++++	+++ Absolute ≤ 1.0 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter)	+ to ++	+++	++++ Absolute ≤ 1.0 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter)
Bacteria- (e.g., *Campylobacter, Salmonella, Shigella, E. coli*)	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	++++	++ Absolute ≤ 0.3 micron filter	+++	+++	++++ Absolute ≤ 0.3 micron filter
Viruses- (e.g., enterovirus, hepatitis A, norovirus, rotavirus)	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	++++	–	+++	+++	+++

Treatment methods listed above:

* **Boiling** can be used as a pathogen reduction method that should kill all pathogens. Water should be brought to a rolling boil for 1 minute (at altitudes greater than 6,562 feet (>2,000 m), boil water for 3 minutes.)

** **Filtration** can be used as a pathogen reduction method against most microorganisms, depending on the pore size of the filter, amount of the contaminant, particle size of the contaminant, and charge of the contaminant particle. Manufacturer's instructions must be followed. More information on selecting an appropriate water filter can be found at www.cdc.gov/crypto/factsheets/filters.html. Only filters that contain a chemical disinfectant matrix will be effective against some viruses.

*** **Disinfection** can be used as a pathogen reduction method against microorganisms. However, contact time, disinfectant concentration, water temperature, water turbidity (cloudiness), water pH, and many other factors can impact the effectiveness of chemical disinfection. The length of time and concentration of disinfectant varies by manufacturer and effectiveness of pathogen reduction depends on the product. Depending on these factors, 100% effectiveness may not be achieved. Manufacturer's instructions must be followed.

**** If boiling water is not possible, a **Combination of Filtration and Chemical Disinfection** is the most effective pathogen reduction method in drinking water for backcountry or travel use. Manufacturer's instructions must be followed.

Other treatment methods can be effective against some of the above pathogens:

- **Ultraviolet Light (UV Light)** can be used as a pathogen reduction method against some microorganisms. The technology requires effective prefiltering due to its dependence on low water turbidity (cloudiness), the correct power delivery, and correct contact times to achieve maximum pathogen reduction. UV might be an effective method for pathogen reduction in untreated or poorly treated water; there is a lack of independent testing data available on specific systems. Manufacturer's instructions must be followed.
- **MIOX®** systems use a salt solution to create mixed oxidants, primarily chlorine. As a result, refer to the category above for chlorine disinfection. Manufacturer's instructions must be followed.

Important: Water that has been disinfected with iodine is **NOT** recommended for pregnant women, people with thyroid problems, those with known hypersensitivity to iodine, or continuous use for more than a few weeks at a time.

In addition to using the appropriate drinking water treatment methods listed above, you can also protect yourself and others from waterborne illness by:

- **Burying human waste 8 inches deep and at least 200 feet away from natural waters.**
- **Practicing good personal hygiene. Wash hands before handling food, eating, and after using the toilet.**

www.cdc.gov/healthywater

https://www.cdc.gov/healthywater/pdf/drinking/Backcountry_Water_Treatment.pdf

Are All Water Filters About The Same?

- Water filters are not the same
- Some are tested and meet standards that will protect you
- You will need a water filter with an **absolute** filtration down to at least 1 micron to remove Crypto and Giardia which are protozoa (Cysts)
- It is very important to know if a water filter will remove Crypto and Giardia since they are difficult to kill with chemical treatment
- Crypto is the smaller protozoa and is usually mentioned when describing a filter's ability to remove protozoa

Purifier Versus Filter

- A **purifier** reduces **all** pathogens to a **safe level**, which is as follows:
- **Bacteria** to log-6 protection 99.9999% removed
- **Cryptosporidium** to log-3 protection 99.9% removed
- **Viruses** to log-4 protection 99.99% removed
- Most water filters just remove protozoa (i.e. Crypto) and bacteria, the larger sized pathogens
- Above meets the US EPA Guide Standard

Water Filters That Have Been Tested And Certified To Remove Crypto

- Water filters certified to remove Crypto should have this wording on their label, certification is expensive
- “Tested and certified to NSF/ANSI Standard 53 or NSF/ANSI Standard 58 for **cyst removal**”
- “Tested and certified to NSF/ANSI Standard 53 or NSF/ANSI Standard 58 for **cyst reduction**”

Water Filter **Only Labeled** With These Words **May Not Remove Crypto per CDC**

- *Nominal* pore size of 1 micron or smaller
- One micron filter
- Effective against *Giardia*
- Effective against parasites
- Carbon filter
- Water purifier

Water Filter **Only Labeled** With These Words **May Not Remove Crypto per CDC**

- EPA approved (*Caution: EPA does not approve or test filters)*
- EPA registered (*Caution: EPA does not register filters based on their ability to remove Cryptosporidium)*
- Activated carbon
- Removes chlorine
- Ultraviolet light

Water Filter **Only Labeled** With These Words **May Not Remove Crypto per CDC**

- Pentiodide resins
- Water softener
- Chlorinated

Water Filters

- Be aware that it is costly to have a water filter tested and some manufactures may decide what parts of a test they will pay for
- The manufacturer can list what standard the filter passes or show evidence of an independent lab performing a test

Water Filters For A Single Person

- Straw type filters…easy to carry, not convenient if no collection container, do not let freeze, can be back flushed to clear debris build up
- Water bottle with built in filter…can be carried in a backpack, do not let freeze…might be difficult to fill in the field

Water Filters For A Group

- Gravity feed **bladder systems**…allow water to be collected and then carried to a location to then filter the water, can be carried in a backpack, filter can be back flushed to cleared
- Gravity feed **bucket systems**…not really a backpack option, filter can be back flushed to clear debris
- **Pump filters**…ok for a backpack, can be cleaned in the field, filters can be scrubbed to clear debris
- MSR Guardian filter uses constant water flow back flush and removes viruses…expensive…costs $350

Storage Bag For Portable Water Collection, Treatment, And Filtration

Portable Water Collection, Treatment, And Filtration Kit

Portable Folding 10 Liter Bucket From Sea To Summit

Portable 10 Liter Bucket With Water…Let The Water Settle, Then Filter…The Bucket Can Not Have Bleach Added…Will Destroy The Bucket

Now Add An Aquatab To The One Liter Water Bottle And Wait 30 Minutes…If You Need To Kill Viruses

Chemical Treatment Of Water…Iodine

- Iodine…Because iodine has physiologic activity, WHO recommends limiting iodine water disinfection to a few weeks, not for pregnant women, or those with an allergy to iodine
- **Iodine has a very disagreeable taste**
- Water pH and temperature have a large impact on the efficacy of Iodine

Chemical Treatment Of Water…Chlorine

- Chlorine type product…can disinfect water and kill viruses, some filters have a carbon filter which can help remove the chlorine taste
- Chlorine bleach is easily available
- Chlorine bleach has a limited shelf life

Chemical Treatment Of Water…Purification Tabs Or Solutions

- Aquatabs…can be carried in the field till needed
- Aquamira Chlorine Dioxide Part A and Part B solution for mixing when needed
- Aquamira Chlorine Dioxide tablets
- Micropur MP1 Chorine Dioxide tablets

Aquatabs

- Effective against bacteria, viruses, and Giardia cysts
- Not effective against Crypto
- Used in combination with a 1 micron filter, you can then filter out Crypto
- Remove suspended material by filtration or allowing the water to settle in a container…transfer to another container

Aquatabs Directions

- Treating water from rivers and ponds outdoors
- Water temp > 40F, remove one tab from the packaging and add to 0.75 liters of water
- Mix for 10 minutes, wait 30 minutes, then ok to drink
- If treating water from a water system, then add one tablet to 2 quarts of water
- Mix for 10 minutes, wait 30 minutes, then ok to drink

Micropur MP1 Water Purification Tablets

- Effective against Giardia, Crypto, bacteria and viruses
- In order to be effective against **Crypto**, requires a **four hour treatment time**
- One tablet per quart of water
- Active ingredient is Chlorine Dioxide

2-Step Process After Pre-filtering

- A 2-step process of chlorine and microfiltration can assure removal of parasites, bacteria and viruses
- Cloudy water can contain substances that might interfere with disinfection, so it will require higher concentrations or contact times or, preferably, clarification through settling, or filtration before disinfectant is added
- Plan to pre-filter with a coffee filter

Pre-Filter With 6” Strainer Holding A Coffee Filter Over A Two Quart Container

Recommendation Regarding the 2-Step Process

- MSR rep says to treat the water **chemically first** and then filter, that should decrease the number of live organisms trying to be filtered out and with a carbon stage in the filter, could remove some chlorine taste
- Pre-filter first to remove debris that can clog the microfilter…treat chemically…then the final microfiltration step

Making Water Safe To Drink With Bleach

- Use unscented 5-6% household liquid chlorine bleach
- 2 drops of bleach per quart of water or 8 drops per gallon
- The bleach should be no more than 1 year old

Pre-filter Your Water Before Using Bleach

- Pour the water through a cloth or a coffee filter
- Do not use bleach that is scented, color safe, or has any added cleaners
- Bleach can be used for up to one year if stored at room temperature

EPA Recommended Amount Of Bleach To Add To Water In An Emergency

Volume of Water	Amount of 6% Bleach to Add*	Amount of 8.25% Bleach to Add*
1 quart/liter	2 drops	2 drops
1 gallon	8 drops	6 drops
2 gallons	16 drops (1/4 tsp)	12 drops (1/8 teaspoon)
4 gallons	1/3 teaspoon	1/4 teaspoon
8 gallons	2/3 teaspoon	1/2 teaspoon

EPA Recommended Amount Of Bleach To Add To Water In An Emergency

- Double the amount of bleach if the water is cloudy, colored, or very cold
- Stir and let stand for 30 minutes. The water should have a slight chlorine odor. If it doesn't, repeat the dosage and let stand for another 15 minutes before use

Chemical Treatment With Coagulation/Flocculation

- Coagulation…liquid turns into a solid
- Flocculation…the “floc” or flakes of material in the water combine and form a mass that drops to the bottom
- Products that use coagulation/flocculation could also have chemical treatment to kill viruses

Coagulation/Flocculation Products

- Chlor-Floc
- P & G Pur
- Both products claim to remove Crypto and Giardia, I would be inclined to do a final microfiltration step to make sure

Chlor-Floc

- Does clarification and disinfection
- One 600 mg packet added to each liter of water provides 1.4% available chlorine for disinfection and flocculating agent to clarify the water
- Note the expiration date
- Packets are being sold on the internet that are getting close to the expiration date

Chlor-Floc Water Temp Guidelines

- 77F (25C) - Add 1 Packet to 1 Liter - Wait 7 Minutes
  58F (15C) - Add 1 Packet to 1 Liter - Wait 15 Minutes
  50F (10C) - Add 1 Packet to 1 Liter - Wait 15 Minutes
  41F (5C) - Add 2 Packets to 1 Liter - Wait 15 Minutes
- 1 Liter = 1.1 Quart

Chlor-Floc Directions

1) Add 1 or 2 Packets (600 mg /each) to 1 liter (1.1 quart) of water
2) Shake for 1 minute to make sure that the Packets dissolve completely
3) Wait for 7 to 10 minutes (or the necessary time) then strain through a piece of broadly woven cloth (t-shirt material, etc.) into clean container

Chlor-Floc Directions

4) The clarified water is now ready for drinking
5) If water is still murky add an additional one-half Packet and repeat steps 2 and 3

P & G Pur

- Calcium hypochlorite: a chlorine disinfectant for killing bacteria
- Ferric sulfate: an iron salt coagulant for removing suspended matter
- Also includes a buffer of clay and polymer to help with coagulation and flocculation
- Makes a claim to remove Crypto and Giardia?
- Also claims to help reduce levels of heavy metals and pesticides?

UV Light

- Steripen…needs to have a certain amount of contact time
- Water should not have particles that can interfere with the light intensity
- Requires power, batteries could get low, and intensity of the light could be affected?

UV Light

- With UV lights there is no real way to know for sure everything worked ok
- **Not recommended in professional reviews** regarding best methods to treat water to make it safe
- Too many variables that might go wrong

Storage…Preparing To Store Water In Your Containers

- If you must prepare your own containers of water, purchase food grade water storage containers
- Before filling with chlorinated water, thoroughly clean the containers with dishwashing soap and sanitize the bottles by cleaning with a solution of 1 teaspoon of non-scented liquid household chlorine bleach to a quart of water

Storing Water

- Water that has not been commercially bottled should be replaced every six months
- The chlorine in your water loses it bactericidal properties after about six months
- Plan on storing 1 gallon of water/ per person/ per day

Water Storage Containers

- Try to limit size of hand carry containers to 6 gallons
- Store away from light
- Plan to have small and large water storage containers
- If you have to go out and search for water, the smaller containers will really make it easier, water is very heavy, about 8Lbs per gallon
- Use food grade plastic containers, **never old milk jugs**

Commercial Products That Store And Can Filter Water As Needed When Disaster Strikes

- **Water Basics 60 Gallon Home Emergency Water Kit + Filter**
- https://www.aquamira.com/wp-content/uploads/documents/PDS-67260-Water-Storage-Kit-60gal-w-Filter.pdf

Solar Pasteurization Info

- Solar pasteurization method using clear plastic water bottles
- https://sswm.info/sites/default/files/reference_attachments/ANDREATTA%202007%20A%20Summary%20of%20Water%20Pasteurization%20Techniques.pdf

NGO Video About Water Showing Impacts To Children

- https://www.youtube.com/watch?v=VCfy24dSkfM

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