Water
in Disasters and Catastrophes

Steve Aberle

WA7PTM

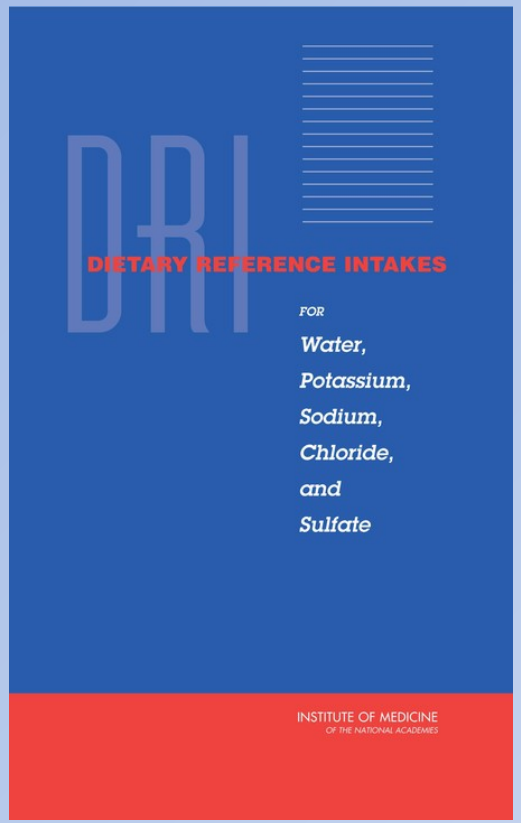
Learning Objectives

- Minimum body hydration
- Importance of water during a disaster or catastrophe event
- Options for storing emergency water
- Risks of drinking untreated and unfiltered water
- Disinfecting drinking water (after your stored water runs out)

How much water do you need each day for minimum body hydration?

- Urban Legend – 8 glasses (64 oz.)
- NASA Apollo 13 – 6 oz.
  - All three crew members during this 1970 spaceflight emergency became severely dehydrated
    - https://solarsystem.nasa.gov/missions/apollo-13/in-depth
- International Space Station – 2 liters (67.6 oz.)
    - https://humanresearchroadmap.nasa.gov/Evidence/reports/Nutrition.pdf (*pages 35, 229*)

How much water do you need each day for minimum body hydration?



Institute of Medicine. 2005. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*, pgs. 6&7. Washington, DC: The National Academies Press.

https://doi.org/10.17226/10925

How much water do you need each day for minimum body hydration?

Adequate Water Intake (ounces of water per day)

Age	Male		Female	
	From Foods	From Beverages	From Foods	From Beverages
0 mo. – 6 mo.	0	24	0	24
7 mo. – 12 mo.	7	20	7	20
1 yr. – 3 yr.	14	30	14	30
4 yr. – 8 yr.	17	41	17	41
9 yr. – 13 yr.	20	61	17	54
14 yr. – 18 yr.	24	88	17	61
19 yr. and up	24	101	17	74
Pregnancy			24	78
Lactation			24	105

https://doi.org/10.17226/10925

How much water do you need each day for drinking, food preparation, and basic hygiene?

- 11 liters (3 gallons) {International Space Station}
  - https://education.jsc.nasa.gov/explorers/p9.html
- 1 gallon
  - https://www.cdc.gov/healthywater/emergency/drinking/creating-storing-emergency-water-supply.html
  - https://www.ready.gov/water
  - http://www.redcross.org/get-help/how-to-prepare-for-emergencies/survival-kit-supplies

Water Storage

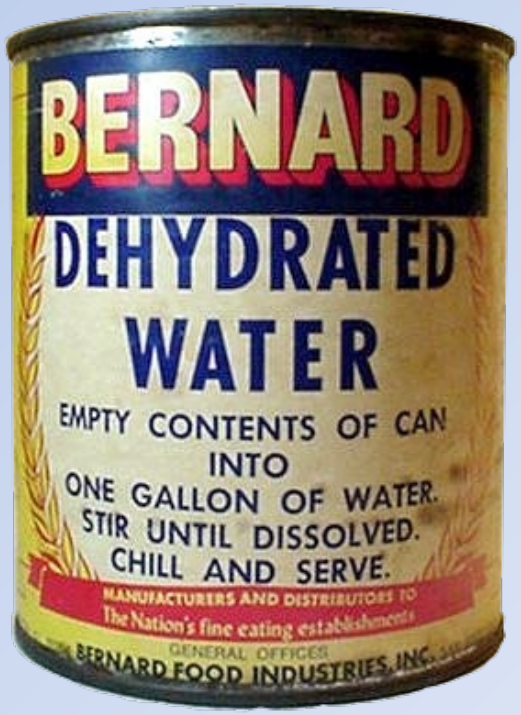
- Bottled Water
  - Container(s): included in price
  - Water Cost: $1.50 per gallon
    (Costo 48-case pallet)
  - Quality: difficult to verify
  - Consumption: easy
  - Storage: convenient (so long as the cardboard cases remain dry)
  - Shelf Life: limited, 6 months to a year

Water Storage

- Specialty – 125ml. Water Pouches
  - Container(s): included in price
  - Water Cost: $8 to $15 per gallon (on-line prices)
  - Quality: difficult to verify
  - Consumption: easy
  - Storage: convenient (can be stored in plastic bins)
  - Shelf Life: 5 years (manufacturer's claim)

Water Storage

- Specialty – Dehydrated Water
  - Container(s): included in price
  - Water Cost: low
  - Quality: high
  - Consumption: need can opener
  - Storage: convenient
  - Shelf Life: indefinite



Water Storage

- Specialty – Water Supply Boxes
  - Container(s): 5-gallon mylar bags
    expensive ($75+)
  - Water Cost: inexpensive (fill with a hose)
  - Quality: same as home water system
  - Consumption: easy with spigot
  - Storage: convenient (so long as the cardboard box remains dry)
  - Shelf Life: 5 years (manufacturer's claim)

Water Storage at Home

- Larger Containers
  - Container(s): 55-gallon FDA food grade polyethylene barrels ($67–$70)
  - Water Cost: inexpensive (fill with a hose)
  - Quality: same as home water system
  - Consumption: need to mount spigot or pump water out
  - Storage: over 450 lbs. when full
  - Shelf Life: 5 years with treatment (manufacturer's claim)

Water Storage at Home

- Other home water sources

Water Storage at Home

- Other home water sources
  - Note: water from this source will need to be treated and filtered if it is needed for drinking

How much water should you store?

- At home
  - As much as possible
- At work
  - Enough to get you home or to an evacuation shelter

    (if you have to walk)
- In your vehicle
  - Enough to get everyone in the vehicle out of harm's way

    (if you all have to walk)

Water Storage Notes

- All stored water has to be rotated at regular intervals
- Allowing stored water to freeze can split the container(s)
- Make sure the water in all storage containers is topped off approximately 30 days before the disaster strikes ☺

At Some Point …
You Will Run Out of Stored Water

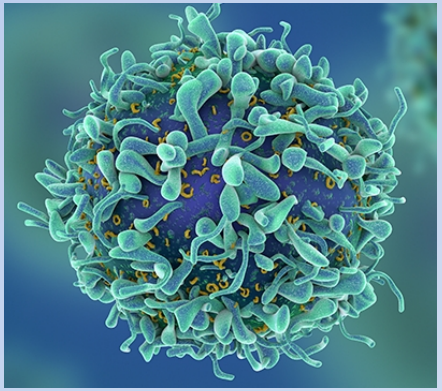
- You then become your own water utility
- What will you do to ensure your survival and the survival of your family?
- Can you avoid playing intestinal roulette?
- Your preparedness in water treatment and water filtering is about to pay off!

What A Public Utility Does to Deliver Drinking Water

- Locates and develops a water source
- Filters and treats the water as needed to meet EPA standards
  - Safe Drinking Water Act (Public Law 93-523) https://www.epa.gov/sdwa
- Maintains a system of pipes to bring the water into homes, schools, and businesses

What do the EPA Standards Cover?

- Microorganisms
  - cryptosporidium, giardia lamblia, legionella, coliform bacteria, and enteric viruses



- Disinfectants
  - chlorine, chloramine, and chlorine dioxide
- Disinfection Byproducts
  - bromate, chlorite, haloacetic acids, and trihalomethanes

What do the EPA Standards Cover?

- Inorganic Chemicals
  - antimony, arsenic, asbestos, barium, beryllium, cadmium, chromium, copper, cyanide, fluoride, lead, mercury, nitrate, nitrite, selenium, and thallium
- Organic Chemicals
  - 53 organic compounds
- Radionuclides
  - alpha particles, beta particles and photon emitters, radium, and uranium

Does the SWDA Protect Me?

- U.S. EPA Enforcement and Compliance History database (ECHO)
  - https://echo.epa.gov/facilities/facility-search

- Environmental Working Group's tapwater database
  - https://www.ewg.org/tapwater

Does the SWDA Protect Me?

- And, there is the political component

White House, EPA headed off chemical pollution study

By Annie Snider – 05/14/2018 12:43 PM EDT

[The] EPA and the White House sought to block publication of a federal health study on a nationwide water-contamination crisis, after one Trump administration aide warned it would cause a "public relations nightmare," newly disclosed emails reveal.

The intervention early this year — not previously disclosed — came as HHS' Agency for Toxic Substances and Disease Registry was preparing to publish its assessment of a class of toxic chemicals that has contaminated water supplies near military bases, chemical plants and other sites from New York to Michigan to West Virginia.

The study would show that the chemicals endanger human health at a far lower level than EPA has previously called safe, according to the emails.

https://www.politico.com/story/2018/05/14/emails-white-house-interfered-with-science-study-536950

Does the SWDA Protect Me?

- And, there is the political component

Reporter Shoved, Others Barred From EPA Meeting On Water Contaminants

By Sebastian Murdock – 05/22/2018 11:56 am ET

A reporter was grabbed and shoved by a security guard at the EPA headquarters in Washington on Tuesday while trying to attend a meeting on water contaminants. Reporters from multiple organizations were barred from attending.

The meeting took place after recently discovered emails from the agency showed that the White House and the EPA hoped to block a federal study on a water-contamination crisis after a Trump aide said it would cause a “public relations nightmare.”

But reporters from The Associated Press, CNN and the environmental news organization E&E were barred from the meeting, the outlets said.

https://www.huffingtonpost.com/entry/reporters-barred-1-shoved-out-of-epa-meeting-on-water-contaminants_us_5b042d12e4b0c0b8b23e7219

Untreated and Unfiltered Water
(especially in disaster and catastrophe situations)

- Analogous to developing world concerns …

HOW MANY ARE AT **RISK**?

1.1 billion lack access to an "improved" drinking water supply; many more drink water that is grossly contaminated.

Source: World Health Organization & International Network to Promote Household Water Treatment and Safe Storage. (2007). *Combating waterborne disease at the household level* / International Network to Promote Household Water Treatment and Safe Storage, World Health Organization, pg. 7. Geneva : World Health Organization. http://www.who.int/iris/handle/10665/43621

Untreated and Unfiltered Water
(especially in disaster and catastrophe situations)

- Analogous to developing world concerns …

HOW MANY ARE GETTING **SICK**?

4 billion cases of diarrhoea occur annually, of which 88% is attributable to unsafe water, and inadequate sanitation and hygiene.

- *Source:* World Health Organization & International Network to Promote Household Water Treatment and Safe Storage. (2007). *Combating waterborne disease at the household level* / International Network to Promote Household Water Treatment and Safe Storage, World Health Organization, pg. 7. Geneva : World Health Organization. http://www.who.int/iris/handle/10665/43621

Untreated and Unfiltered Water
(especially in disaster and catastrophe situations)

- Analogous to developing world concerns …

HOW MANY ARE **DYING**?

1.8 million people die every year from diarrhoeal diseases, the vast majority children under 5.

- *Source:* World Health Organization & International Network to Promote Household Water Treatment and Safe Storage. (2007). *Combating waterborne disease at the household level* / International Network to Promote Household Water Treatment and Safe Storage, World Health Organization, pg. 7. Geneva : World Health Organization. http://www.who.int/iris/handle/10665/43621

Avoiding Intestinal Roulette
(in disaster and catastrophe situations)

- Your water treatment and filtration needs (after your stored water runs out) will be similar to those in a developing county
- A combination of treatment and filtration technologies can meet your health needs

Avoiding Intestinal Roulette
(in disaster and catastrophe situations)

- Emergency Disinfection of Drinking Water
  - Boil the water for one minute, let it cool, and store it in clean containers with covers
  - If boiling is not available, disinfect the water using household bleach
    - Note: chlorine and iodine may not be effective in controlling more resistant organisms, like Cryptosporidium

https://www.cdc.gov/healthywater/drinking/travel/emergency_disinfection.html

Avoiding Intestinal Roulette
(in disaster and catastrophe situations)

- Emergency Disinfection of Drinking Water
  - What about iodine treatment?
    - For short term use only
    - Read the warnings on the labels
      - Example, from the cartridge inside an old Exstream "purifier" …

PRECAUTIONARY STATEMENTS
Hazards to Humans & Domestic Animals
CAUTION: This cartridge contains PentaPure® penta-iodide resin. Persons with allergies to iodine, thyroid problems and pregnant women should consult their doctor before using this device, because small amounts of iodine may remain in the treated water. This device is intended for shortterm, limited or emergency use only and is not intended for long term use.

Disinfecting Water Using Household Bleach

Treat this much water	With this much bleach
1 pint	1 drop
1 quart	2 drops
1 gallon	⅛ teaspoon
55 gallon barrel	6⅞ teaspoons
100 gallon RV water tank	¼ cup
250 gallons	⅔ cup
750 gallons	2 cups
6,155 gallons	1 gallon

{ calculated from CDC recommendations }

Selecting a Drinking Water Treatment Unit

- There are thousands of water filters on the market
- Are the manufacturer's claims accurate?
- Do any standards exist to compare units?
  - Yes … look for drinking water treatment units which have been certified by NSF International
    - http://info.nsf.org/Certified/DWTU

Certifications

- NSF/ANSI Standard 42
  - Drinking Water - Aesthetic Effects
    - Chloramine, Chlordane, Chlorine, Hydrogen Sulfide, Zinc, others

- NSF/ANSI Standard 55
  - Ultraviolet Microbiological Water Treatment
    - Disinfection Performance, Class A or Class B

Certifications

- NSF/ANSI Standard 53
  - Drinking Water - Health Effects
    - 1,2,4-Trichlorobenzene, 2,4-D, 2,4,5-TP (Silvex), Alachlor, Arsenic (Pentavalent)<=50 ppb, Asbestos, Atrazine, Benzene, Cadmium, Carbofuran, Carbon Tetrachloride, Chlordane, Chlorobenzene, Chromium (Hexavalent), Chromium (Trivalent), Copper, Cyst, Dibromochloropropane, Endrin, Ethylbenzene, Ethylene Dibromide, Heptachlor Epoxide, Heptachlor, Lead, Lindane, Mercury, Methoxychlor, Monochlorobenzene, MTBE, O-Dichlorobenzene, P-Dichlorobenzene, PCB, Radon, Simazine, Styrene, Tetrachloroethylene, Toluene, Toxaphene, Trichloroethylene, Trihalomethanes (TTHM), Turbidity

Certifications

- NSF Protocol 231
  - Microbiological Purifier
    - Bacteria, Live Cyst, Virus

- NSF/ANSI Standard 401
  - Emerging Compounds/Incidental Contaminants
    - Asbestos, Atenolol, Bisphenol A, Carbamazepine, DEET, Estrone, Ibuprofen, Linuron, Meprobamate, Metolachlor, Naproxen, Nonylphenol, Phenytoin, TCEP, TCPP, Trimethoprim

A Walk Through the Local Stores

May 2018

	Dick's Sporting Goods	Home Depot	Lowes	REI	Sports-man's Ware-house
water filters	8	15	12	30	19
water purifiers	1		1	13	1
chemical water treatments	3			12	6
water filter accessories	7	2		12	5
replacement filters	1	23	14	18	5

Very few drinking water treatment units had a NSF certification

Selecting a Drinking Water Treatment Unit

- Be cautious of these claims:
  - Words like “removes” and “destroys”
    - The proper terminology is “reduces” or “reduction”
  - “Tested to NSF Standards”
    - but manufacturer and/or product certification is not found when searching the NSF website
  - “100,000 Gallons”

The Bottom Line …

(When You Run Out of Stored Water)

Option #1 – Multiple People

price equivalent:
entry-level HF radio

Category	Examples	Chlorine & Chloramine	Ultraviolet Light	Granular Activated Charcoal	Distillation	Hollow Fiber Membrane (HFM)	Ceramic	Reverse Osmosis (no pre-filter)	Solid Carbon Block	Microbiological Water Purifiers
		Drinking Water Treatment Technology								
Microorganisms	bacteria, viruses	☻	☻							☻
Microscopic Cysts	giardia, cryptosporidium					☻	☻	☻	☻	☻
Volatile Organic Chemicals	pesticides, herbicides								☻	☻
Heavy Metals	lead, mercury				☻			☻	☻	☻
Disinfection Byproducts	trihalomethanes, haloketones								☻	☻
Endocrine Disruptors	PCBs, chlordane, toxaphene								☻	☻
Inorganics	arsenic V				☻			☻	☻	☻
	asbestos, turbidity						☻	☻	☻	☻
Aesthetic Effects	chlorine			☻					☻	☻
	chloramines								☻	☻
	particulate matter			☻	☻	☻	☻	☻	☻	☻
Healthful Minerals	calcium, magnesium, potassium				☹			☹		

The Bottom Line …
(When You Run Out of Stored Water)

- Drinking Water Treatment – Package #1
  - Coffee filters (for large particulate straining)
  - Container for untreated water
  - Hand pump (or method to elevate untreated water container)
  - Hardware adapters for hand pump or gravity feed
  - Microbiological purifier
  - Containers (with covers) for drinking water

The Bottom Line …

(When You Run Out of Stored Water)

Option #2 – Multiple People

price equivalent:
mid-level VHF/UHF mobile radio

Category	Examples	Drinking Water Treatment Technology								
		Chlorine & Chloramine	Ultraviolet Light	Granular Activated Charcoal	Distillation	Hollow Fiber Membrane (HFM)	Ceramic	Reverse Osmosis (no pre-filter)	Solid Carbon Block	Microbiological Water Purifiers
Microorganisms	bacteria, viruses	☻	☻							☻
Microscopic Cysts	giardia, cryptosporidium					☻	☻	☻	☻	☻
Volatile Organic Chemicals	pesticides, herbicides								☻	☻
Heavy Metals	lead, mercury				☻			☻	☻	☻
Disinfection Byproducts	trihalomethanes, haloketones								☻	☻
Endocrine Disruptors	PCBs, chlordane, toxaphene								☻	☻
Inorganics	arsenic V				☻			☻	☻	☻
	asbestos, turbidity						☻	☻	☻	☻
Aesthetic Effects	chlorine			☻					☻	☻
	chloramines								☻	☻
	particulate matter			☻	☻	☻	☻	☻	☻	☻
Healthful Minerals	calcium, magnesium, potassium				☹			☹		

The Bottom Line …
(When You Run Out of Stored Water)

- Drinking Water Treatment – Package #2
  - Coffee filters (for large particulate straining)
  - Container for untreated water
  - Bleach (with eyedropper) to kill microorganisms
  - Hand pump (or method to elevate untreated water container)
  - Hardware adapters for hand pump or gravity feed
  - Solid carbon block filter unit
  - Containers (with covers) for drinking water

The Bottom Line …

(When You Run Out of Stored Water)

Option #3 – One Person

price equivalent:
mid-level VHF/UHF handheld radio

Category	Examples	Drinking Water Treatment Technology								
		Chlorine & Chloramine	Ultraviolet Light	Granular Activated Charcoal	Distillation	Hollow Fiber Membrane (HFM)	Ceramic	Reverse Osmosis (no pre-filter)	Solid Carbon Block	Microbiological Water Purifiers
Microorganisms	bacteria, viruses	☻	☻							☻
Microscopic Cysts	giardia, cryptosporidium					☻	☻	☻	☻	☻
Volatile Organic Chemicals	pesticides, herbicides								☻	☻
Heavy Metals	lead, mercury				☻			☻	☻	☻
Disinfection Byproducts	trihalomethanes, haloketones								☻	☻
Endocrine Disruptors	PCBs, chlordane, toxaphene								☻	☻
Inorganics	arsenic V				☻			☻	☻	☻
	asbestos, turbidity						☻	☻	☻	☻
Aesthetic Effects	chlorine			☻					☻	☻
	chloramines								☻	☻
	particulate matter			☻	☻	☻	☻	☻	☻	☻
Healthful Minerals	calcium, magnesium, potassium				☹			☹		

The Bottom Line …
(When You Run Out of Stored Water)

- Drinking Water Treatment – Package #3
  - Coffee filters (for large particulate straining)
  - Container for untreated water
  - Ultraviolet light unit to kill microorganisms
    - Solar flashlight with USB port to recharge UV unit
  - Personal filter unit certified to reduce cysts (giardia, cryptosporidium, etc.)
  - Container (with cover) for drinking water

The Bottom Line …
(When You Run Out of Stored Water)

- Drinking Water Treatment – Package #3
  - Example components

$20

$80

$85

Summary (1)

- Don’t forget the importance of water during a disaster or catastrophe event
  - You cannot be an effective emergency communications volunteer if you become dehydrated
- Store quarts of water in your vehicle and at your normal destinations (work, school, etc.)
  - Keep a backup personal use drinking water treatment unit in those places as well
    - Treatment of microorganisms and cysts

Summary (2)

- Store many gallons of water at home
  - Enough for at least a week
- Acquire a certified (solid carbon block) drinking water treatment unit for your home
  - For when you run out of stored water
- Plan on an alternate source for your water
  - Examples: lake, stream, rainwater collection system
    - But NOT floodwater

Questions