TERRORISM, Natural and Domestic

EMERGENCIES

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INTRODUCTION

It is unfortunate that in the 21st Century, terrorism has become a prevalent fact of life. Not that terrorism is a 21st Century, or for that matter, a 20th Century 'invention'. It is more likely that we have given a name to it now, whereas in centuries past, it was just a component of war and unrest between the peoples of different regions. Terrorism is considered a politically motivated act, and certainly recent events in the Middle East with now generally well known groups such as Al Qaeda, justifies that view.

What is a 20th and 21st Century feature is that today, terrorism can be so much more lethal and on a grander scale due in no small part to the technological developments in explosives, weaponry, and knowledge of very lethal chemicals, disease causing microbes, and radiological materials. Much of the our experience in domestic acts of terrorism involving chemicals arises from research in more effective insecticides for better agriculture. Previous experience on a large scale originated in the latter years of World War I and saw lethal chemicals used by both the Allies and Axis nations, particularly Germany in what became known as chemical warfare. A further development is the use of microbes such as bacteria and viruses that are also very infectious and lethal to cause disease on a potentially pandemic scale. In World War II, the Japanese conducted a range of experiments using lethal microbes in China and on Allied Prisoners of war.

Terrorism can be organized into several types: conventional, unconventional, and nuclear. Conventional terrorism employs conventional means of force, such as firearms, explosives, or other commonly available weaponry. Unconventional terrorism is subdivided into chemical, biological and radiological, whereas, threats of the use of a nuclear weapon or device is nuclear terrorism. The materials used in unconventional terrorism are jointly classified as weapons of mass destruction, WMD (though nuclear explosions are mass destruction weapons, they destroy property as well as kill people. The use of chemical, biological or radiological agents I prefer a more specific classification as weapons of mass death, as they generally have no impact on inanimate objects such as buildings, cars, etc., but target directly living organisms, people).

TYPES of TERRORISM

CONVENTIONAL

Loosely defined, conventional terrorism is defined as acts directed against people or governments to force societal or political change, employing the usual spectrum of common weapons and means of force. Such weapons as firearms, bombs, and acts such as shootings, beheading or kidnaping on political grounds would fall under such a term. The most infamous example to date of conventional terrorism is perhaps the 11 September 2001 attack on the World Trade Center in New York City employing commercial passenger jet aircraft hijacked by Middle Eastern Fundamentalist Islamic terrorists associated with Al Qaeda. Another example is the Boston Marathon bombing of 15 April 2013 employing pressure cookers packed with explosives and detonated with toy car remote control units. Another example is the beheading of a food plant woman in Moore, Oklahoma on 25 September 2014.

[This incident has been, by some, labeled as a workplace violence incident, though the fingerprint act followed that of the ISIS beheadings of journalists in the Iraq/Syria region.] These acts are conventional terrorism as they do not involve the employment of weapons of mass death.

UNCONVENTIONAL

Clearly any nuclear weapon use by a terrorist group would represent a both an unconventional and strategic act. Such a weapon employment is strategic in that it has long-range effects and goals as well as can encompass considerable land area. The blast effects alone can destroy large tracts of land and structures, homes and industry alike, as well as kill thousands, may be tens of thousands of people depending on the yield of the weapon. The fallout or radiation effects are secondary effects of the weapon, though of no less a magnitude of hazard to people and livestock. The extent to which fallout covers the countryside depends on the yield of the weapon and the winds that carry and disperse the radioactive particles downwind as well as how close to the ground the fireball develops. The winds are high altitude winds even into the stratosphere to which the fireball rises. The area of land so affected is many tens of times the immediate ground zero zone of the fireball effects. As the distance from the ground zero increases, the level of fallout radiation decreases. The problem of radiation beyond its own effects on living tissue is its cumulative effect. The absorbed dose is cumulative in that each absorption adds to the amount the individual was exposed to overall. The radiation covering the landscape for miles and miles down wind can render such terrain and structures therein, uninhabitable for decades to centuries.

Radiological weapons, weapons such as dirty bombs, conventional explosive bombs laced with radioactive materials are essentially tactical weapons and have similar effects on land contamination, but are much less extensive in area covered than a nuclear weapon effect. They are tactical because they have effects only in the immediate area of the explosion and affect a limited number of people and structures within that area. Winds also carry the particulate material down wind, but these are surface winds within a few hundred feet of the ground and in a built up city, the structures can actually limit the reach of such contamination. For the most part such radiological effects are localized, though the immediate area downwind of the explosion site is potentially hazardous to people in the area such as first responders. Similar contamination concerns exist, but on a smaller scale, and arguably, on a more manageable scale as well.

Chemical weapons are tactical weapons. They are limited to the immediate environs of the weapon's deployment and the downwind reach. As the agents generally are aerosolic in nature, the particle sizes tend to be denser than air and so settle out quickly and can only cover significant downwind distances in a strong wind. But winds have the effect of dispersing the agent, a dilution of the air concentration of the agent as it travels with the wind. Shearing forces also act to disperse the agent even in lateral movement perpendicularly out from the wind direction axis. As for hazard duration of such large contaminated areas, weather and sun can reduce much of this if given time before personnel reoccupy the affected zone of the attack. Table 1 offers the time it takes a chemical agent to travel from its release point to a target point 150 meters away as a function of wind speed.

Table 1: Effect of Wind Speed on Time of Arrival of Chemical Agents

Wind Speed in mph (km/hr)	Distance Between Target Site and Agent Release Point in meters (feet)	Time Before Agent Reaches Target Site (seconds)
3 (5)	150 (492)	108
6 (10)		54
9 (15)		36
12 (20)		27
15 (25)		22

Biological weapons present a different level of hazard. They are considered strategic weapons. They don't destroy real estate, but they do infect, and are intended to kill, people. Like chemical weapons, they can be carried on the wind, downwind, and they have the unique advantage of being magnified by the infection feature. People become ill from the agent, travel about and infect others. In principle, this can go one for some time and over vast distances, across national borders. This magnified effect of biological weapons is what makes them strategic. What may start out as a local epidemic can become a pandemic affecting not only the target people and nation, but others. The other feature of biological weapons use is their lack of control. They don't just attack your target. They attack everyone, everywhere. Use of a biological weapon represents a kind of biological chain reaction and for this reason, biological weapons are often referred to as the "poor man's nuclear weapon".

CHEMICAL– History

Chemical terrorism would make use of injurious or lethal chemicals (chemical agents) to injure or kill people. The means of employment are many, but generally comes in two primary modes: aerosol sprays or explosion devices for airborne exposure of the unwary, or by contamination of surfaces with the chemical agent for direct contact exposure and absorption through the skin. Most events in recorded history where and when chemical materials were used to injure or kill people usually occurred pursuant to states of war. As for terrorist use of chemical agents against civilian populations in acts of terrorism, items 9, 13, 14, 15 following are historical examples. Chemical weapons use is not only a modern day occurrence. It is nearly as old as history and warfare themselves. A short, but revealing listing follows:

I. Ancient Times

1. 423 B.C. Spartans burned sulfur and pitch, releasing sulfur dioxide gas (pulmonary agent)

2. 7th Century, Greeks invented "Greek fire" a water resistant incendiary

II. 19th Century

3. 1854, Sir Lyon Playfair proposed using cyanide-filled shells to end the siege at Sebastopol during the

Crimean War

4. 1862, John W. Doughty of NY proposed use of chlorine gas against confederate forces

III. World War I:

5. April 1915, Germans use chlorine gas against French & British forces at Ypres, Belgium

6. December 1915, Germans use phosgene gas

7. July 1916, French employ hydrogen cyanide gas in Somme offensive

8. 1917, Germans use Mustard gas

IV. World War II Era

9. 1936, Italians use phosgene, mustard gas and tear gases against Ethiopians

10. 1936, Germans develop first nerve agent, Tabun

11. 1938, Germans develop second nerve agent, Sarin

V. Post WWII Era

12. 1980s Iraq-Iran War, Iraq used mustard and perhaps nerve agent against Iran

13. 1980s, Iraq used mustard against Kurdish groups in Iraq

V. Terrorist Attacks, Post WWII

14. 1994, Matsumoto, Japan suburb site of nerve agent attack; 7 died, 2000 injured

15. March 1995, Sarin released in Tokyo subway system; 12 died, 5000 injured

BIOLOGICAL– History

Biological terrorism would employ microbial agents, most likely surreptitiously dispersed in and among populations with the clear intention of causing massive spread of a very virulent, and likely lethal disease. The means of doing so are many, but include an aerosol dispersal means, or in a "down and dirty" fashion, a terrorist may infect and thus sacrifice himself, becoming infectious to others and wonder among people in crowded locales such as an airport, train or bus station, or maybe a sporting event arena. As our knowledge of medicine, particularly microbial biology and biochemistry advanced, the ability to direct microbes as weapons emerged. Biological terrorism is not as recent as one may think in light of the emergence of Pasteur's Germ Theory and our knowledge of microbes as the origin of some pathologies. There are a few cases where biological microbes, sometimes transmitted via vectors (carriers of the microbes) were employed against civilian populations. In the list following, examples 4,

9, 10 represent cases of biological terrorism. Most of our experience with disease as a weapon tracts with the human practice of war or natural epidemics or pandemics usually arising from circumstances arising from war. A short list of employments:

1. More Deaths, Injuries & Incapacities to Troops from Disease than Enemy Action

2. First plague pandemic arose in Egypt in AD 541, spread to Europe, North Africa, Central and Southern Asia, killing about 50% to 60% of the population.

3. The second plague, began in 1346 and ran about 130 years. Mongols catapulted plague infested corpses over walls of Kaffa. This incident presumably led to the plague of the 14th century that killed about 1/4 to 1/3 of population or between 20 to 30 million of Europe's Population. It was called the Bubonic Plague, or Black Death.

4. 1767: During French and Indian War, British gave smallpox infested blankets to enemy Indian tribes— with devastating effects. It killed around 50% of the infected tribes. The British General Sir Jeffrey Amherst ordered this action.

5. 19th Century Potato Irish Famine. Though a natural phenomenon, it devastated Ireland, prompting one of the greatest mass emigrations in history. It represents the potential consequences to a population of a direct microbial attack on agriculture.

6. 1916-1918: German agents spread anthrax and glanders among livestock and feed destined for Allied Forces in Europe.

7. The natural outbreak of the Spanish Flu Epidemic of 1918 killed about 600,000 in the US alone, and between 20 to 40 million around the world.

8. 1939: In the Nomonhan Incident, Japanese poisoned Soviet water supply with intestinal typhoid bacteria— first recorded Japanese bioweapons use.

9. 1940: Japanese drop rice and wheat mixed with plague infected fleas over China and Manchuria.

10. 1945: In May the first use of bioweapons by Germans entailed dumping raw sewage into a reservoir in Bohemia.

11. Japan in early years preceding WWII under the direction of its Imperial Army Unit 731 fed botulinum toxin laced ingestibles to prisoners in Manchuria during the 1930s.

12. Between 1990 and 1995, the Japanese cult Aum Shinriky attempted on at least three separate occasions to use botulinum toxin in bioattacks on Tokyo and US military installations in Japan. These attacks failed because of faulty microbiological techniques, deficiencies in aerosol generating equipment, and internal sabotage.

Natural outbreaks of an epidemic or pandemic nature have occurred throughout history. In the listing above, entries number 3 and 7 perhaps more than any other examples have deeply etched our psyche

with fear of massive or pandemic disease outbreaks. With written history recording these events, and thoughts of physicians of the day and others, we have a better "understanding" of the misery, tragedy and suffering such outbreaks have wrought on human populations. Reading what the impact on American daily life was like during those few years of the Spanish flu is amazingly eye-opening as to the consequences and effects such rampant national level disease can have on not only individual daily life, but entire communities across the entire nation. One note on the Spanish flu in America: the death toll was so sudden and great, there was a shortage of coffins for burials, and too many children were, overnight, orphans. Public safety also suffered as what we today call first responders also succumbed to the disease.

RADIOLOGICAL

There have been at this writing, no acts of radiological terrorism. Such terrorism would occur in the use of radioactive materials, most effectively in fine particulate form such as a fine dust or aerosol, dispersed in the air, much as chemical or biological agents, to settle on surfaces or to be inhaled by people. Since radiological materials emit ionizing radiation (alpha, helium nucleus; beta, electron from disintegrating neutron; positron, an anti-electron from a disintegrating proton; or neutron particles, or gamma rays, very high energy electromagnetic radiation originating from within the nucleus), these radiations would cause significant damage to living tissue, and in an accumulation of a lethal dose, eventually death. Such a terrorist weapon would probably employ an explosive device to disperse the radiological agents, and in fact, the explosion would likely be intended to mask the use of such agents for a post event prolonging of the effects well after the blast event.

NUCLEAR

Nuclear terrorism would require the threat and even eventual use of a nuclear device to cause a classical nuclear explosion measured in kilotons of TNT. Though nuclear weapons are a weapon of states, some states today that have nuclear weapon technology are precarious and if they fall into chaos, such weapons could conceivably fall into the hands of terrorist groups. One concern over Iran acquiring nuclear weapon technology is its close association with terrorist groups operating in the Middle East. The concern that Iran herself may use an Iranian nuke, or covertly provide a nuke to a terrorist group is not an unfounded concern. Given the effect even a small nuke has on a city, referring to the WWII nuclear attacks on Hiroshima and Nagasaki, Japan in August 1945, it does not require a great deal of imagination to hypothesize the consequences of a nuke detonated on a large population center of the Middle East, USA or England, or in Europe.

WHY CONVENTIONAL WEAPONRY

The answer to that question sets the stage for the answer to other questions. The simple answer is: it's what's available. At the end of WWII, the most devastating weapon mankind has yet known was the nuclear bomb. Harnessing what may be called one of the most primordial forces of the Universe, nuclear reactions, the most costly war of human history was ended, effectively in two separate instants in blinding kiloton fury on two separate days- 6 August and 9 August 1945. With those two explosions over Hiroshima and Nagasaki, Japan, the US became the supreme world power- the nuclear power at that.

That status didn't last long. Soon, the USSR detonated its own nuclear fission bomb and soon after that event, both the US and the USSR each detonated their first thermonuclear bomb, fusion devices harnessing the very energy of the stars. Today, several other countries are nuclear powers, including England, France, China, India, Pakistan, and though not officially acknowledged, presumably, Israel. At this writing, Iran is actively engaged in efforts to claim its own nuclear weapon capability, masked behind adamant claims of peaceful use nuclear power.

The technology required to fashion and then successfully detonate a nuclear weapon is incredibly complex and exacting in the precision of the components' functioning. One does not simply pack TNT around a fissile lump of uranium or plutonium, and then detonate the TNT and get a million degree fireball and mushroom cloud. And therein lies the heart of the question why terrorism, conventional and unconventional, and the answer.

Since colonial days, western powers, especially those of Europe, have reigned generally supreme in the affairs, both politically and economic, in Asia and Africa. And the facts are that the stewardship of administering such third world countries as they were called, was not always seen as benevolent, and in some cases, it wasn't. Decades, if not a century of living under the rule of western powers left considerable bad feelings among many of those governed from afar countries. The location of today's principal bad blood especially hangs in the air still in the Middle East. The creation of Israel in 1949 didn't help the political and social climate of the region, though it may have salved the consciences of the western world in an attempt to atone for the Holocaust of WWII.

The factional groups and extremist elements have gained some political clout, the riches of oil has provided funding, and the impoverished peoples of those regions, suffering from ineffective governments, corrupt governments, or in some cases, no governments, have begun to assert themselves in the only way they see remaining. Political or religious zealots have gained currency among the hopeless, and have begun organizing themselves. Weapons are a must but simple firearms and knives alone won't win the day, much less the war as they see it and wage it, but conventional weapons awash over the world from WWII's end, and insurgency conflicts aided by the USSR and Maoist China, that's what they have and do have for the present. Something much more effective, spectacular, lethal on a grand scale is called for. They don't have the technical, financial, or requisitioning ability for the components to make a nuclear weapon. The nuclear powers have generally kept a close watch on who attempts to buy the centrifuges necessary for refining uranium (though it seems not to be foolproof as per Iran), uranium ores, and a host of other sensitive components. Even with conventional means, something spectacular is needed to retain followers and recruit.

They turned to conventional explosives as these are ubiquitous throughout the world for any number of legitimate commercial, industrial, and construction businesses, and can be easily acquired by purchase from nefarious dealers, or simply stolen as needed, including from military forces of the region that may sympathize with their cause. But the need for making a lasting political statement, as well as consequence to the western powers, and the US, has morphed their activities to other means of doing so. Hence car bombs, improvised explosive devices (IED), and of course, in their view, the ultimate show of force and cunning, hijacked civilian passenger jet aircraft and fly them into the World Trade Center skyscrapers. Check for them in this lethal chess game. Table 2 illustrates the damage explosives can impart as a function of the over pressure. As the means to attack with explosives and other high impact effects become countered, an alternate means of imposing force and death is required. The conventional

means of killing are in some cases becoming more and more difficult, if not impossible, given explosive detection means, airport screening, no fly lists, tighter controls on explosives sales, storage, etc., and even concrete walls obstructing direct, straight line access to sensitive facilities, rendering the classic car bomb something of a higher risk of discovery and failure. What to do?

Table 2: Comparison of Over Pressure Effects on Objects and People

Over Pressure[a] (psi)[b]	Effects on People	Effects on Objects
` 5	Knocked Down (low end), Rupture of Eardrums (high end)	Window Glass Broken (low end); Buckling of Sheet Metal; Concrete/Cinder Block Walls Ruptured; Wood Telephone poles snapped (high end)
7 to 8	Nose Injuries (?)	Trains Overturned; Failure of Brick Walls
15	Lung Injuries	Massive Wreckage
35	Deaths Possible	Massive Wreckage
50	50% Killed	Massive Wreckage
65	99% Killed	Massive Wreckage

[1] *Counter-Terrorism for Emergency Responders*, Robert Blake, Lewis Publishers, New York, 2000, p. 127 (adapted)
[a] over pressure is the pressure above normal atmospheric pressure.
[b] psi is pounds per square inch. Normal atmospheric pressure is 14.7 lbs/in^2

Well, in some cases seizing a school and killing children has occurred [Russia; 1 September 2004, Beslan School of North Ossetia,of the North Caucasus. Ingush and Chechen Islamic terrorists took 1100 people hostage, including 777 children; 334 died, including 186 children in the course of rescue by Russian security forces]. Another attack on a school occurred in Pakistan on 16 Dec 2014. As of this writing, upwards of 140 children were killed by Taliban terrorists.

Killing individuals, on camera for broadcast over the internet has gained favor among them, and certainly does have a telling impact on those of us who see the news reports of such executions. Though conventional weaponry employment can be sensational from the standpoint of numbers of deaths, its psychological impact is diminishing some because of the routine nature of the attacks. Such attacks are not unique anymore. Such traditional means of killing innocent bystanders lacks the sensationalism that is part and parcel of what terrorists want to achieve. This then brings us to the unconventional weapons. This is an entirely new realm of terrorism. They are tirelessly pursuing acquiring unconventional weaponry to this day.

WHY UNCONVENTIONAL WEAPONRY

The direct answer is: unconventional weaponry not only bring wholesale death, they also bring considerable terror and psychological impact. As a class of weapons, unconventional weaponry encompasses several very different types. They are chemical, biological, radiological. Nuclear weapons are a class onto themselves. Unconventional weapons offer a range of advantages that conventional weapons do not. Perhaps the most telling advantage is stealth. They kill silently. They are a dead man walking weapon. This may seem to violate the previously postulated desire of terrorists to kill in a spectacular fashion, but spectacular does not necessarily mean with a big bang as the calling card. The origin or basis for use of each type has its own historical precedence, and vindicates the elements of terror, wholesale death, and psychological impact.

Chemical Weapons

Modern chemical weapons were an outgrowth of two facets of need: desperation in WWI's stalemated trench warfare, and insecticide research. In WWI, troops were huddled in vast trench lines, miles long. Rain and runoff simply poured into the trenches, creating as one can imagine a misery of prolonged, if not epic proportions. The appearance of trenchfoot was a common and ever present affliction of the troops existing is such squalid, soaking, stinking facilities. When they fought, it was a result of plans dictating an attack *en mass* by the troops all along the trench system. Advancing over mud-slush terrain, becoming impeded in the advance by pounds of mud caked to boots and pant legs, the advancing troops were essentially sitting ducks for the sweeping and raking fire of one of the new weapons of the war, the machine gun. It was *de rigeur* for thousands to be mowed down as though stalks of wheat by the withering fire of the machine guns mass along the enemy's own front trench lines. Sometimes, the casualties ran in the tens of thousands in one battle. Such carnage was bleeding both sides dry and as the war went on, replacements became more difficult to provide, and much younger.

Artillery fire is an indirect weapon. You don't need to actually put sights on a soldier. You fire an explosive shell, with a contact detonator or a timed fuse, and just lob the round into the area of the enemy troops. The shrapnel does the rest as far as any exposed troops are concerned. But in the trenches, troops were still protected unless a shell landed directly within the trench or if a timed aerial burst, came

down right over the top of a trench. An expensive means of attacking troops, in that most shells landed on or over open ground and not in or over a trench. Such back and forth attacks did not advance one side or the other, or the war for that matter, and a means was needed to attack troops hold up deep within the trenches.

Chemical compounds that are somewhat denser than air and poisonous if released close to a trench, with the wind blowing toward the trench, will be pushed by the wind to the trench edge, and then fall by gravity into the trench. Enough such shelling, and considerable chemical material will essentially begin filling the trench. Troops without any respiratory protection will either have to breath the poisonous aerosol, or abandon the trench, placing them then and there in the sights of either machine gun fire, or further high explosive artillery shelling. When chemical weapons attacks first occurred, the impact was devastating. Troops had nothing to protect themselves against the agent. They were helpless and that spawned terror. The psychology of helplessness took over. The first attack was by the Germans employing chlorine gas released from cylinders up wind of the allied troops. So novel an idea and attempt, and so successful the attack, that the Germans could have made a grand sweep of the allied lines but for one fact. They weren't prepared themselves to follow through with the attack's success. So new a concept of actually using a chemical as a weapon that the allies had no preparation for the chlorine or anything else. So desperate were the allied commanders to counter the use of chlorine, that one counter defense to its use was instructing troops to urinate on a cloth and cover their noses and mouths with it, breathing through the urine soaked cloth. Concisely listed, the advantages of chemical weapons are:

1. As or more dense than air
2. Odorless or nearly so
3. Colorless or nearly so
4. Tasteless or nearly so
5. Capable of aerosolization
6. Liquid in normal state
7. Inexpensive
8. Industrially available precursors

Today, under the international authority of the Chemical Weapons Convention, chemical warfare *per se* is outlawed and there are supposedly strict controls on the acquisition of what are called dual use chemicals, chemicals that have both a legitimate industrial use as well as serve as the precursors for the manufacture of chemical weapons. In the case of nations hostile to the western powers, including of course the US, such nations may have legitimate industrial use for such dual use chemicals, but once they are in hand, the monitoring of the use of those chemicals becomes questionable at best. So far, though many of those hostile nations may have a chemical weapons program, Syria as only one example, there does not appear , by virtue of incidents, any evidence that such dual use chemicals have been covertly transferred to any terrorist group, or for that matter, any actual finished, packaged chemical weapons themselves. On the other hand, if a terrorist group such as ISIS takes control of a nation and with it, its military weaponry, they may fall into possession of any chemical weapons or dual use chemicals. If that happens, terrorism as the world has known it, will change.

Biological Weapons

As noted above, the first well defined use of a disease by an army to kill enemy or potential enemy forces was that of the British under orders from General Jeffrey Amherst in 1767 during the French and Indian Wars in the then American colonies. It may also be regarded as the first terrorist employment of biological agents against the "civilian" population which included women and children. The American Indian populations were particularly vulnerable to contact with European diseases. Most diseases, even today, have their origin in animals, both domesticated and wild. Europeans had built an immunity of sorts to a range of problematically arising diseases from time to time, due in part to the practice of raising domesticate livestock. The American Indian had no such history, and so their immune system was quite vulnerable to contracting a disease and having a great deal more difficulty in fighting it off. Most often, they couldn't. This was a salient point advanced by Jared Diamond in his book *Guns, Germs, and Steel: The Fates of Human Societies,* Jared Diamond, W.W. Norton & Co., New York, 1999.

Our experience in war is also revealing. Most troop casualties and fatalities arose from disease. No small wonder. Given the lack of hygiene in the field, under combat conditions, in locales foreign in many cases to the troops themselves, susceptibility to strange bacteria and viruses is the lot of the soldier as much as the bullet. But the realization that disease can be so effective at decimating and even defeating an army was not and is not lost on military leaders of today, and it is not lost on terrorists either.

The disadvantage to use of a biological weapon is multifold, though. There is a lag time from the time a biological weapon is released on a target (here defined as a population, though it could be on a people's agriculture and livestock), and the time it takes for the disease organism to incubate in target hosts, and spread. The disease agent really shouldn't be too virulent, as if it does incubate rapidly, manifest its presence within a few days for example, it is likely to be obvious to medical and government authorities that a serious disease is running about, and in the case of the US, public health protocols kick into place to isolate and counterattack the disease outbreak with some effectiveness. Publicity can actually help in this regard, though it also can cause some panic under various circumstances. Another disadvantage is if the disease causing organism is especially virulent and lethal, it may kill its infected hosts sooner than it can infect others, becoming an aid in its own limiting spread and termination. So, the ideal biological weapon is one that has a week to two week incubation time; doesn't exhibit obvious symptoms early in its development, exhibits no dramatic symptoms such as bleeding from eyes, nose, mouth, and orifices, and does not actually unduly incapacitate the infected hosts from continuing to spread the microbe, say via coughing or sneezing. With today's knowledge of genetics and recombinant DNA techniques, developing a strain of a disease organism that is resistant to currently known and used antibiotics and antiviral medications (of which there are precious few), such a resistant strain of some very nasty diseases could be developed. Chemical weapons to a lesser extent, but biological weapons especially have even been characterized by some as the "poor man's nuclear weapon" because they spread death far and wide, much on a scale of a nuclear detonation.

The international concern over the use of biological weapons also actively exists, and in part is of more concern than chemical weapons since a biological weapon for which the population or the world as a whole has no existing or at best marginal resistence, the disease can easily spread faster than a wildfire so to speak, and with global commerce as it is today, air travel and such being what they are, the disease can cross borders in virtually hours, if not minutes. To combat these and other concerns, the Biological Weapons Convention exists to control the availability of particularly virulent microbes such as specific bacteria and viruses even for medical related research. Though biological warfare is also outlawed by

international treaties, terrorists undoubtedly would not be so hampered in the use of such weapons if they can get their hands on them.

One term that comes up particularly with respect to biological weapons is the term weaponization. There is the misconception that the process of simply using an agent in a fashion for spreading it is weaponization. That is not the case. Weaponization is a technical term, more so an engineering issue that renders the agent in a physical form that makes it effective as a weapon. One does not grab a bottle of chemical X, or a petri dish of bacteria and disperse it by spraying or such and say it is weaponized. Weaponization as a term in unconventional weaponry has generally been used in connection with biological weapons.

Radiological Weapons & A Dirty Bomb

Radiological materials are those materials that undergo radioactive decay. They emit what is called ionizing radiation. Ionizing radiation is very different from nonionizing radiation. Visible light is nonionizing radiation. Ionizing radiation causes ionization of molecules. The principal molecule susceptible to such ionization is water which makes up some 70% by mass of all living cells, including humans. It is the ionized water components, free electrons, hydroxyl radicals, etc., that then affect the most important molecule of life, the DNA, the genetic molecule that makes each of us, us, and unique in many ways from each other. The damage done to other biological molecules such as proteins and membrane lipid molecules can, in lethal dose exposures lead to a range of deleterious effects such as cell lysis (rupture) that ultimately can lead to death from radiation poisoning. The nature of the damage is molecular and encompasses four primary effects on cellular biomolecules. The are:

1. dimerizations
2. dismutations
3. oxidations
4. reductions

Radiological materials emit various kinds of particulate or electromagnetic radiations depending on the source material. The radiations are: alpha particles, □, (helium nuclei), beta particles, ^−, (very high speed electrons), positrons, ^+, (a particle with the size and mass of an electron, but positively charged, also known as an anti-electron), gamma rays, ⌣, (very small wavelength, ⎯, electromagnetic radiation, its essentially energy), and neutrons, n, (neutral, no charge particles of similar mass to the proton). Gamma rays and neutrons, though not charged, can, if striking an atom, destabilize it, leading to secondary effects including emissions and ionizations. These radiations have little or no effect on inanimate materials, but they have potentially powerful and harmful effects on living cells and tissue, particularly if in high doses.

There is no history of radiological weaponry use since radiological materials did not enter the knowledge bank of mankind until such scientific luminaries as Bacquerel discovered ionizing radiation phenomenon in the late 1800s. With the development of nuclear physics, and especially the development of nuclear weapons and from that the advent of nuclear power production, the world has seen an explosion in the accumulation of radioactive materials from nuclear power plants and medical research that to this day presents a serious and frustrating problem of what to do with the refuse. Where do you store this material for the centuries maybe required for it to degrade so it won't be a hazard to all? And

therein lies to problem. With all the nuclear waste from power plants and medical research facilities, government nuclear labs, etc., there's a lot of it around the world. Though under tight controls, both in storage and in shipping, the problem of concern remains, what if a terrorist groups gets their hands on a few hundred pounds of this material?

They likely will find a way to use it. Radiological materials would likely be in particulate form, such as a dust, and could be packed with explosives to create what is called a dirty bomb. A dirty bomb has all the effect of a conventional explosion, but it also adds dimension not inherent in an explosion itself. Laced with radiological material in fine particulate form, at the explosion, the expanding pressure wave carries with it aerosolic radiological material. The air of the vicinity of the explosion and the air some distance, with the aid of any ambient wind or breeze also is peppered with radioactive aerosol. The survivors of the explosion, as well as any bystanders and first responders rushing to the aid of the injured then and there inhale air contaminated with the radioactive material. This is a worst case scenario. Radiological matter on skin can be washed off, a point of decontamination procedures. But radioactive material inhaled, can go deep into the lungs, down to and into the alveoli, the very site of gas exchange between lungs and capillary blood. Depending on the concentration gradient of the air with distance from the ground zero of the explosion itself, the hapless responders inhale fine radioactive debris for their duration within the zone of radiological contamination. The casualty and even the fatality list can easily grow larger with time after exposure, depending upon the effective dose inhaled. Once in the lungs, there is no way to decontaminate the lungs. Unless emergency crews respond with an active, working Geiger counter, a device designed to detect ionizing radiations, they will not know of the greater insidious threat within the area of explosive effects. The characteristics and threat posed by a dirty bomb are summarized as follows:

1. Blast (shock pressure) wave as in any other conventional explosion

2. Localized heat as in any other conventional explosion

3. Propelled shrapnel as in any other conventional explosion

4. Target site debris as in any other conventional explosion

5. Smoke and dust as produced in any other conventional explosion

6. But the added feature of ionizing radiation produced from the radiological filler added to the explosive charge

7. Radiological contamination will travel little further than the explosion smoke, dust, and shrapnel debris itself

8. The radiological component of the dirty bomb presents a primary inhalation hazard, and a lesser contact hazard

9. Radioactive dust debris alighting on clothing and skin can simply be washed off (thoroughly)

10. Breathing through a multi-folded handkerchief or other such cloth material will filter radiological

dust from nasal passage and pulmonary intake

11. Extent of hazard depends upon the size of the bomb, the quantity of radiological material packaged within it, the level of radioactivity of the filler, and the location of the device's detonation, and winds if effects reach outside into the open

Nuclear Weaponry

I ask the obviously rhetorical question here: does anyone think that if terrorists had a working nuclear weapon, they would not use it on the US population? This is the fear born of the post USSR collapse and the increasingly belligerent rise of hostile nations to the western world, and the increasing growth of well funded, well organized, and very dedicated terrorist groups whose only aim is to attack if not outright destroy the US, its people, and its allies. Much has been made of so-called suitcase nukes, nuclear weapons of very compact structure. Small, tactical nuclear weapons on the order of the Hiroshima or Nagasaki bomb, roughly 20 kilotons, today are not necessarily as large as those first two were. Technology has come a long way since those infancy days of nuclear weapons.

The size of the weapon, however, is not the issue. The issue is a nuke in the hands of terrorists. Even a large weapon too large and heavy to be remotely man-portable could certainly be placed aboard a plane, a ship, even a small cabin cruiser boat, or in a truck or car. Such a device in a car would be the ultimate in car bomb. Navigated into a busy, major port or driven to the center of a city and detonated, the destruction and carnage would be orders of magnitude greater than any conventional car or truck bomb. The death toll would only rise with each passing day as the injured began succumbing to the horrible flash burns, and radiation poisoning resulting from exposure to the flash effects and the fallout. Any such ground burst device would create considerable fallout that would follow the prevailing winds and washout down wind from the atmosphere, exposing others well away from the ground zero event and effects. To say it would be a game changer is to utter cruel, insensitive cliches.

There are some defenses, some not as good as perhaps desired against chemical and biological weapons. There is no defense against a detonated nuke, period. It shouldn't require saying, but perhaps it does. No hostile to the US state or group should be allowed to acquire the components, much less an actual nuclear weapon. It is supreme folly and stupidity. We should exhibit unwavering, uncompromising, and absolutely intolerant behavior with regard to same.

There are several types of nuclear weapons. They are fission, fusion (aka thermonuclear), and neutron devices are a specially configured thermonuclear device. As for employment, there are two principal ways to detonate one. The ground burst and the air burst. The point on the ground directly under the fireball (whether a ground burst or air burst) is called ground zero. In a ground burst by definition, the fireball of the burst is in contact with the ground. Thus, the searing heat of tens of thousands of degrees Fahrenheit easily vaporizes dirt, rock, metal, you name it. That material so heated rises in the atmosphere to the stratosphere where prevailing winds, even the jet stream, can transport it down wind for tens and hundreds of miles. As the fireball rises, it expands and it cools as doing so. The heated materials in cooling begin to solidify, and if large enough, begin their descent, or fall (hence the name fallout), back to the ground, essentially sprinkling the land under them in their travel with the wind. The greatest concentration, measured as radiation level, is closest to the ground zero and decreases from there. The level of radiation at a given location also decreases with time by the 7-10 rule. This means

that for every seven hours after the radiation level measured, the new level will be 1/10 what is was seven hours before (see Table 3).

Table 3: The 7:10 Rule for Residual Radiation Decay*		
Time After Contamination (hr)	Amount of Radiation Remaining (%)	Relative Residual Ra (X is the original Ar
0	100	X
7	10	X/10
49	1	X/100
343	0.1	X/1000

* NATO Handbook... FM 8-9, Table 7-III, adapted

As for the types of nukes, the fission device harkens back to the original Hiroshima and Nagasaki bombs of WWII. A fission bomb works by splitting much heavier elements, transuranium elements, into smaller elements. Historically materials used are uranium and plutonium. The means of detonation can of the gun-type (used on Hiroshima, Japan) or the spherical implosion type (used against Nagasaki, Japan). These are bad enough in their own right, but the fusion device, the thermonuclear device, draws on the very power of the stars by fusing hydrogen isotopes, joining them to make heavier elements, specifically helium and maybe a smattering of others. The order of magnitude of energy released from a thermonuclear device compared to a fission device, pound for pound is something around 3. Though fission devices historically were measured in the kiloton energy yield, thermonuclear devices measure the energy yield in megatons, thousands of times more energy.

All nuclear devices exhibit the same general finger prints. They have a fireball, they have a serious blast wave and over pressure front radiating (semispherically for ground burst, spherically for air burst) outwardly from the point of detonation, and a thermal wave (the heat liberated from a thermonuclear device is much, much higher than from a fission device). Thermonuclear devices are said to be cleaner than fission devices owing to the much less radioactive debris generated by them. However, to detonate a fission device, specialized, precision chemical explosives must compress the fissile material to achieve what is called a critical mass for the fission nuclear process to occur. A thermonuclear device must use a fission device to trigger the thermonuclear process yielding the megaton blast.

Then there is the neutron weapon. All nuclear weapons offer the tremendous blast and heat wave upon detonation. But the neutron weapon also offers a much greater neutron flux as the name sake byproduct of this nuke. From a military standpoint, a neutron weapon would be detonated as an air burst. That way, minimal, if any, damage to terrain, buildings, objects such as vehicles would be realized. However, the neutron flux would penetrate the facilities and vehicles, most likely killing the troops manning such facilities, but leave the facilities intact for occupation and use by the nuke using force. This type of nuke is especially useful against tank formations. The very thick armored metal hulls of tanks, so effective in resisting penetration by high explosive anti tank (HEAT) rounds, would tend to shield the occupants from the usual particulate radiation (alpha, beta, and positron) and lessen the penetration of the gamma rays. But the neutrons would penetrate the armor and then penetrate the people and probably kill them.

Which would most likely be used by terrorists? Any one they have. They just want a nuke. They are not discriminate or fussy killers.

The Nuclear Power Plant

Finally, let's consider nuclear power plants. Though the day of nuclear power plant infatuation is clearly on the rock heap of history, there are still a large number of power plants in operation around the world and even in the US. Does the name Three Mile Island (28 March 1079, Dauphin County, PA.) jar your memory? Does Chernobyl (Ukraine SSR of the USSR, 26 April 1986) ring a bell? Or, what about the Fukushima incident on the Northeast coast of Japan on 11 March 2011? In Japan, three of the six units underwent a meltdown, triggered by the TÇhoku earthquake and the resulting tsunami that swept the coast. These are more infamously known reactor facilities because of the accidents that took place at each. Just to clear the air of any potential misconception, a nuclear power plant can not detonate into a nuclear explosion complete with fireball, etc. A nuclear power plant can undergo what is termed a meltdown, and in the movies a China Syndrome, so named because if a meltdown does occur, the incredibly hot fissile material has melted its way through the reactor core, through the containment building concrete floor, and into the ground, as though it were trying to melt its way through the Earth to China.

In a meltdown the real problem is when the molten fissile material hits the ground itself, and the water content of the ground instantly boils up in a super heated steam explosion, spraying radioactive debris into the air, and being spread down wind of the facility across the metropolitan area. It's a radiological hazard and nightmare. For a meltdown to occur, the cooling system, typically water, must fail. Additionally, the control rods of the fissile material and neutron absorbing rod system must also fail to separate the fissile material from near bulk proximity to itself. How that can happen is due to a lot of equipment failures, and maybe some human errors or failures as well and can be the result of natural disaster events such as an earthquake as struck Japan. The point is that no critical mass can ever be achieved in a nuclear reactor. The means for compressing the fissile material together into a super-dense mass just is not there. The real problem is simply a failure of the system to control the nuclear fission process, and the material's fission process, generating considerable heat required to create steam to turn turbines which turn generators to produce electricity, and the process runs away, with the heat climbing toward the melting point of the fissile material. When that happens other things associated with that fissile material also begin to melt, and off it goes to a meltdown if it can not be stopped.

Another feature of the nuclear power plant reactor unit is some of the metals used may also contribute to the disaster. Zirconium is used in components of the reactor and can react at or above 1200␣C (2200␣F) with water to release hydrogen gas. As anyone who has seen films of the explosion and fire on 6 May 1936 at the US Naval Air Station Lakehurst, NJ of the German airship LZ (*Luftschiff Zeppelin*) 129 Hindenburg recalls, hydrogen is very flammable and the resulting hydrogen gas buildup can exacerbate the problems of a nuclear plant failure.

A terrorist attack on a nuclear power plant would be a dream come true to them. Considerable effort is expended by the US Government to monitor both the plants operating protocols for safety, as well as security. But strangely, or maybe frighteningly, every once and a great while, reports come out about problems with nuclear power plan security, access by unauthorized "investigators", what have you. It seems that in security, we are plagued by the age old nemesis of human error or failure or lapse in judgement. Could terrorists gain access to a nuclear power plant, set the process to high operation, then destroy the control systems required to stop it, and push the plant to a genuine meltdown and all that

entails? Perhaps. Let's fervently hope or pray not. But they do wish to do that, nonetheless; plant security protocols and government notwithstanding.

ADVANTAGES of UNCONVENTIONAL WEAPONS USE

Just in wars past, the various types of unconventional weapons have advantages that circumvent the generally direct effects of conventional weapons. For the terrorist, employing them on a civilian population, they also take advantage of the civilian population's lack of understanding, awareness, and training, unlike many military, in how to recognize and respond to such attacks. [Hopefully, after reading this, the reader will be better versed in the issue.] The advantages to unconventional weapons attacks are:

1. Surprise
2. Stealth
3. Remote Attack
4. Rapidity of Effects Before Recognized
5. Pure Terror

TARGETING

Regardless of the agent in question, its use is directed to a target. Each class of agent has specific targets as well as common targets. How and against what a terrorist group would use an unconventional weapon agent may be as varied as the agent they have. The likely targets are listed below.

Chemical Agents

Chemical agents are really useful against people. Any occasion that affords a large crowd would be ideal for use of chemical agents. The more enclosed or contained the environment, the better as far as the effects and outcome of the agent's use. Examples include:

1. public transportation
    - A. airports & planes
    - B. subways
    - C. trains & stations
    - D. indoor gatherings
        - i. meeting centers
        - ii. convention centers
        - iii. government buildings
    - E. low wind open gatherings
        - i. festivals
        - ii. flea markets

How such locations would be attacked is discussed below in a latter section.

Biological Agents

Biological agents certainly can be used against people, and they are the more likely target for immediate effects and consequences to a society. But there are other susceptible targets that have longer-range consequences, though not immediate. Examples include:

1. People
    A. homeless
    B. public & private schools
    C. Nursing homes
    D. Hospitals
    E. public libraries
    F. public events
    G. theaters
2. Livestock (becoming vertebrate vectors)
3. Crops
4. Water Supplies

Biological agents offer a much more diverse target range and have greater effects as the target, people, livestock or even crops, serve as the vectors of the biological agent pathogen, spreading it to more victims than just the initial exposed cases. One of the perhaps seemingly least likely targets would be the homeless. They are not regimented as the rest of us, roaming freely around a community and their contact with others is infrequent, and even haphazard. They may congregate at shelters, especially in colder seasons, and are likely to be easily inoculated with an agent through a seemingly charitable gift of clothing that is itself infected with something very contagious. They would spread it among themselves and to others on casual contacts. Recall above the use of smallpox tainted blankets by British General Sir Jeffrey Amherst in 1767 to attack an American Indian tribes under the guise of "charity".

Radiological Agents

We will look at each of these advantages below for each type in turn, as well as any specifics that apply for a given type. But a point in passing. Nuclear weapons are not part of this treatment for the simple reason that nuclear weapons constitute their own unique class. Additionally, there is nothing subtle about nuke employment. They could be detonated remotely. Their effects are immediate and clearly instantly recognize. It is after all, difficult to hide the mushroom cloud climbing to the stratosphere. And for terror, a nuke would trump any unconventional weapon because of its all encompassing devastating immediacy.

Radiological agents present no more significant notice of themselfs than dust. Though such material can be in a variety of particulate sizes, as likely used in a dirty bomb, the material most likely will be finely ground to aid in its aerosolization on detonation of the dirty bomb, aiding its dispersal into the air, and spread by any breezes or winds. Such material is not destroyed by the blast or heat of an explosion. It remains every bit as dangerous after the blast as it was before the blast. Only after the blast, it is dispersed into the air and can be inhaled by any people close in to the ground zero of the bomb blast as well as for several tens to hundreds of feet down wind. The likely advantage of use of radiological agents in a conventional dirty bomb is the secondary effect of radiation poisoning. Two main hazards are particulate material settling out on the person, clothes, hair, skin, and inhalation. The particulate material, if it is known to be present, can be removed through decontamination procedures. That which is inhaled, there is no recourse to remove it. It is in the lungs. If first responders and other attempting to

help the injured, don't know it was a dirty bomb, they will be within the effects zone of the bomb blast and likely inhaling the aerosolic particles.

It is assumed that in this day and age of terrorism, that any bomb blast to which responders react, they would bring a Geiger counter to test for radiation just on the chance that it was a dirty bomb. If the testing reveals that the area is radioactive, then the response takes on an added dimension in the actions of the responders and the dealing with the scene itself.

The major advantage to radiological agents use is that they can be rather stealthy. Unlike chemical agents, they may offer no odor that penetrates the odor of the conventional explosives used in their dispersal. For the most part, the common citizenry would not suspect anything of radiological in nature. Without a distinctive odor, or immediate symptoms as would be the case in certainly chemical agent employment, radiological agents laced within a dirty bomb would remain undetected for some time until any symptoms of radiological poisoning arose. Many chemical agents would probably exhibit distinctive symptoms within a few minutes to a few hours. The other advantage is on realization of a radiological agent device was used, the inherent fear of the public for all things "nuclear" or "radiation" would trigger the psychological impact superimposed on the physical harm that may attend a harmful dose.

This fear of the words "nuclear" or "radiation" derives from graphic images of the effects of the nuclear weapons used against Japan in the waning days of WWII. When the MRI (Magnetic Radiation Imaging) first came out as a medical imaging tool, it actually was called Nuclear Magnetic Radiation Imaging or NMRI. The word nuclear was the terror word to the public in light of the images of what nuclear weapons can do to the human body. Today, "nuclear" is not used in context with MRI. There is no (ionizing) radiation associated with the MRI, it is magnetic energy, but the early use of "nuclear" in concert with "radiation" scared people considerably. The psychological problems that may accrue from unconventional weapons use are not to be dismissed.

STEALTH

Unlike smalls arms fire, explosives or nuclear arms, unconventional weapons generally are stealthy weapons. They can be disseminated and do their nasty work in complete silence. No one will know they are present and causing casualties until people (or live stock if targeted) begin falling and dying. Use as military weapons generally entails them being disseminated via artillery, bombs or in smoke generator fashion, which is anything but visually unobvious. But as a terrorist weapon, they most likely would be used in a fashion that does not necessarily require such loud means of employment.

As for biological agents, they can easily be used as nature does– spread from individual to individual. And the unfortunate but interesting thing about many biological agents is that for we laymen, the initial symptoms of many microbes can be seen as the symptoms of a severe cold or flu onset. By the time any other egregious symptoms develop, and the patient clearly is suffering from something other than a cold or flu, and medical help is called in, others have been infected as well, and then medical authorities are confronted with tracking down everyone, who came into contact with the initial victim, often referred to as "patient zero".

INEXPENSIVE

Chemical Agents

With the exception of a nuclear weapon, which requires considerable precision physics and engineering to make the thing work, and a not so inexpensive undertaking for even a government, other unconventional weapons generally are quite inexpensive. Chemical weapons are the least expensive to fashion as the components required to make many of the chemical agents themselves are dual use, meaning they have both commercial and military applications and use. This is one of the tricky concerns of the Chemical Weapons Convention– how to allow countries and businesses with legitimate industrial uses of such precursors to buy and receive such components, yet prevent the rogue interests from getting those materials?

Biological Agents

Biological agents are actually common pathogens, though they are very infectious, communicable, and can be found in nature. Some like the smallpox virus are thought and declared to be eradicated from the world, though that is not actually true. The US, and Russia have smallpox virus "on ice" in special facilities for research. The strain or strains on hand are likely in addition to nature's first original brand. Many pathogens can be found in soil. Anthrax is one of many examples. However, natural pathogens generally can be treated with a spectrum of antibiotics. For a biological agent to become a weaponized candidate, it should be a strain selected with traits that make it resistant to antibiotics and more virulent. From the end of WWII to about the early 1970s when then President Nixon outlawed biological warfare on the part of the United States Military, much of the research on biological weapons was to develop strains of pathogens that were resistant and highly more virulent than the natural strain from which they were developed. Since the ban of US research into biological weapons development, US research has centered on examining how pathogens can be developed into new and more resistant strains as well as the weaponization means for their dissemination, and treatment protocols. These efforts have as a focus a defensive posture intended to allow the US military to react to a biological attack against it or the United States. Such research is not cheap, but with the fall of the former Soviet Union and the chaos in its wake for the security of not only Soviet nukes, but also chemical and biological weapons, there has always been a nagging concern that rogue nations or groups may some how acquire former Soviet weapons. With so many Middle Eastern students studying physics, chemistry and microbiology, there is also a potential that such acquired knowledge could be used to develop such weapons and passed on to terrorists. ISIS hacked and broke into the US Central Command's social media cites of twitter and Facebook systems in Mid January 2015, uploading terrorist propaganda materials, not only shows what computer technical knowledge in the wrong hands can do, but makes the concerns of natural science knowledge learned in the West, may yet be put to use to harm the West. The cyber attack of Central Command represents a not so subtle "shot across our bow" in our future vulnerability to cyber-terrorism from the Islamic Fundamentalist terrorists.

The technical knowledge and capabilities to modify bacteria and viruses requires significant knowledge in biochemistry, genetics and microbiology. But to get started at the foundation, so to speak, requires simply a sample of a natural pathogen and then an equipped lab. The Biological Weapons Convention serves the same role with respect to biological weapons as the Chemical Weapons Convention does with chemical weapons. The BWC seeks to keep selected pathogen agents and certain lab equipment out of the hands of rogue states and groups, who should not have such materials in their possession.

Radiological Agents

Radiological agents are cheap in that they are the result of normal industrial/commercial and medical research and activities. This includes of course nuclear power plants where vast quantities of highly radioactive wastes result from daily operations. The cheapness of such materials rests in the ability of a rogue group to steal any of it, probably in transit to a waste facility. Such shipments are done but in unmarked vehicles, closely monitored by tracking communications means, and such shipments are not publicized. But people talk, and as was the saying during WWII, loose lips sink ships, it only takes one slip of the tongue for a group willing to risk all in an attempt to make a quick heist of such material for nefarious intent.

WHAT ARE the UNCONVENTIONAL WEAPONS

CHEMICAL AGENTS

The modern concept of chemical weapons emerged from research in insecticide development and from research in biochemistry to elucidate how nerves work, how they transmit a "signal" and what that signal is. A class of chemical known as organophosphates were known to be very poisonous and to interfere with nerve impulse transmission. Another class of compounds known as carbamates also exhibited the same properties, and form the active ingredient of insecticides such as wasp spray. At one time some insecticides containing organophosphates, such as parathion and diazinon, were commercially available. But these insecticides are very poisonous to humans and are no longer commercially available over the counter. Malathion is still available in some cases, but as it turns out, the human liver can detoxify small amounts that may be absorbed from inattentive usage.

Though chemicals such as cyanides had been known for a few centuries as poisonous to humans, they also were used in fumigating ships to rid them of insect pests from foreign countries as well as perhaps the rodent vermin that seem to always become unwanted stowaways. Research into how cyanide actually kills contributed to understanding the process of ATP production in cells.

What are the chemical agents that could be potentially used on humans as weapons in a terrorist attack? They are classified into the following first four classes:

1. Nerve Agents
2. Blood Agents
3. Pulmonary (Chocking) Agents
4. Blistering Agents
5. Incapacitating Agents
6. psychoactive agents

Incapacitating agents are likely used by law enforcement or individually for self-defense against criminal attack. Such agents as tear gases and pepper gases fit that last or fifth class. The tear gases and pepper gases are generally not particularly poisonous, but for those who may exhibit allergic reactions to them, it can present a problem on exposure. There are others that have been examined by the military for use as nonlethal means of control of enemy troops and comprise the sixth class. BZ is one such chemical. However, as the research has shown, dose level from individual to individual is not consistent

for desired effects, and furthermore, the behavior differed vastly from one individual to another, and this variability in effects created the problem that the use of them could not assure predictable results, and the military needs predictable, reproducible, consistent results for the effective use of them. Terrorists aren't really interested in incapacitating anyone. They want to kill. Thus we will not consider incapacitating or psychoactive agents any further.

As for potential lethality in dose and time of action, the order in which they are given is generally the order of lethality, nerve agents the most to blistering agents the least. However, there are some so-called blood agents that are essentially just as lethal and fast acting as some nerve agents. So, the real way to view the list is nerve/blood agents most lethal, blistering least lethal. But, they all can be lethal under circumstances of exposure and absorption. The time frame over which they actually then do kill the victim is a real important variable, especially as it may concern decontamination, treatment and recovery.

For the most part, the military agents are the ones that may be used. There are other compounds that may be poisonous, but may have a higher or lower lethal dose (LD_{50}). The LD_{50} is one of several measures used to gage lethality of a substance and is the dose to which all who are exposed, about 50% would likely die. Another measure is the LC_{50} which reports the lethal concentration of a substance likely to kill 50% of the test animals (or humans) exposed to it.

Chemical agents also can be classified as persistent and nonpersistent. Persistent agents will remain actively dangerous for some time, and contact with them well after their dispersal presents a real risk of absorbing a lethal dose. Persistent agents generally are liquid in nature, even though dispersed in an aerosol form, they condense to droplet form on surfaces, such as ground, buildings, vehicles, furniture, etc. They are more stable over time than the nonpersistent agents. Nonpersistent agents are those that are not long lasting after dispersal. Generally they are dispersed as an aerosol, but they are diluted with winds and blown away, and can be destroyed by rain (hydrolysis), or sunlight (photoreactive). They leave essentially little or none of the material on surfaces to present any serious contact exposure hazard. As for decontamination, nonpersistent agents do not require decontamination. The persistent agents do require decontamination.

Table 4: PERSISTENCY of MUSTARD vs. the NERVE AGENTS

AGENT	WEATHER CONDITIONS		
	Sunny, 20⌞C, Light Breeze	Wet, Windy, 10⌞C	Calm, Sunny, Lying Snow, -10⌞C
Mustard (HD)	2 - 7 days	½ - 2 days	2 - 8 weeks
Tabun (GA)	1 - 4 days	½ - 6 hours	1 day - 2 weeks
Sarin (GB)	1/4 - 4 hours	1/4 - 1 hour	1 - 2 days
Soman (GD	2 ½ - 5 days	3 - 36 hours	1 - 6 weeks
VX	3 - 21 days	1 - 12 days	1 - 16 weeks

Chemical weapons agents offer several advantages. They are:

1. Hit Covered & Concealed Targets
2. Harassing Weapon
3. Inexpensive
4. Little Defense
    a. Silent
    b. Lethal
    c. Special Protection Required
    d. Decontamination Required

As was learned in WWI, chemical agents can penetrate covered and concealed targets. They diffuse in the air, move to low lying areas, since they are generally a bit denser than air. Even if not effective in killing enemy forces, they will cause some casualties, which will have significant psychological impact on the surviving troops, but the forces must stop what they are doing, even if in the attack, suit up, mask up, etc., each and every time the alert of a chemical attack is sounded. Doing this several times in a day, it does become harassment. Chemical weapons are generally inexpensive. Many of the earliest chemical weapons were simple industrial chemicals. As they are industrial chemicals, they are plentiful and inexpensive. As for the defense against chemical weapons, there are some actions that can be taken to defend the individual against the effects of a chemical weapon. Protective masks, protective over garments that are either impermeable to the agent or absorb and even neutralize it. But if you don't know that a chemical attack is in progress, you may not be prepared. That brings up the stealth feature of chemical weapons.

In WWI, many chemical attacks entailed the use of chemical artillery munitions. The artillery attack itself was obvious. Only those who were wise to the differences in regular high explosive rounds and the muffled or muted pop of a chemical round recognized the beginning of a chemical attack and sounded the alarm. If a fine spray up wind of the target is used, the wind will carry the agent into and across the target area, and if no one is alert to such, the agent may begin its injury and killing of troops as the first sign a chemical attack is underway.

Most military chemical weapons are lethal. They are intended to be lethal. Special protection clothing and equipment is required to protect personnel, and generally after a chemical attack, troops must decontaminate themselves, their equipment and facilities if they wish or need to remain on location.

Nerve Agents

The historical nerve agents are Sarin, Tabun, and VX. The first two harken back to WWII and German research and are nonpersistent agents, the last one is persistent and is a post WWII development. VX is more poisonous, meaning a smaller dose is required to kill a person. It is relatively non volatile, being a liquid at room temperature, and posing no inhalation hazard. However, if you make contact with it on the skin, it will be absorbed and bring about its lethal effects if enough is in contact with you.

Treatment & Symptoms

Treatment of nerve agent poisoning involves (1) reducing the involuntary muscular contractions associated with the continuing acetylcholine binding to the receptors, (2) destroying or otherwise rendering the organophosphate ineffective in binding to the enzyme acetylcholine esterase, and (3)

maintaining blood oxygen levels as breathing may be impaired. There are two historical drugs of use in these efforts.

1. atropine (injector or intramuscular, intravenous)
2. pralidoxime (injector, intramuscular)

The patient may require oxygen in the early stages of exposure and treatment. Do not touch the patient with bare skin hands as agent may be on the patient.

General Nerve Agent Symptoms are of two kinds, mild, or severe, and are consistent with two degrees of exposure/absorption.

Early stage of exposure, mild agent poisoning may include:

1. unexplained runny nose
2. sudden headache
3. excessive salivation
4. tightness in the chest
5. difficulty seeing
6. muscular twitching around areas of exposed skin (called fasciculation)
7. stomach cramps
8. nausea
9. excessive sweating

Many of the symptoms will occur simultaneously and/or arise rapidly in succession. Severe agent poisoning may include many or all of the mild symptoms early and any or all of the following:

1. strange and confused behavior
2. gurgling sounds made when breathing
3. severely pin-pointed pupils
4. red eyes with tearing
5. vomiting
6. severe muscular twitching or tremors
7. involuntary urination and/or defecation
8. convulsions (in under 2 minutes)
9. cessation of breathing
10. flaccid paralysis

Blood Agents

The classical blood agents were so named because it was thought that they interfered with oxygen uptake into blood. That isn't the way they actually work. The classical blood agents are prussic acid or hydrogen cyanide (HCN) and cyanogen chloride (CNCl). What they have in common is the cyanide group (CN). Cyanide is an inhibitor of the mitochondrial electron transport chain enzyme cytochrome c oxidase. This enzyme transfers electrons to oxygen to form water. The oxygen is an electron sink, a place to dispose of the electrons derived from food you eat. Our bodies also extract a lot of hydrogen in ionic form as acidic hydrogen (H^+ in water) and those hydrogens combine with the electrons and oxygen

to make the water. Cyanide inhibits these simultaneous processes.

Treatment & Symptoms

Generally blood agents will be inhaled. If indoors, the patient should be moved to fresh air. If difficulty in breathing, CPR is called for. Use child CPR on children, adult CPR on adults. Do not administer mouth-to-mouth CPR or resuscitation. Avoid touching skin as the agent may be on the skin.

Contact lenses or eyeglasses should be removed and placed in a plastic bag. Generally, medical personnel will have the medications to counteract the agent. The antidotes include:

1. hydrocobalamin
2. sodium thiosulfate (intravenous)
3. sodium nitrite (intravenous)

Some blood agents may not manifest any symptoms for as long as 24 hours after exposure. The patient may also require oxygenation.

Blood agent poisoning may exhibit non-specific indications. For less than the lethal dose, casualties may undergo few symptomatic effects. Interim effects may encompass

1. an increased breathing rate
2. some dizziness

additionally,

1. Hemoglobin binding of oxygen is not inhibited by blood agent (cyanide) poisoning, and it is not uncommon for the skin and lips to be flushed a cherry-red color. However, this is not always a present symptom.

2. A few specific blood agents can cause irritation of sensitive tissues such as the eyes, or the nose and throat. This appears to mimic tearing agents.

3. If pulmonary edema (fluid-filled lungs) develops (from some halogenated blood agents), it may be delayed in its onset for several hours. This tracks similar to inhalation injuries of blistering or pulmonary (choking) agents.

4. As blood agents are inhalation active agents, high concentrations can trigger rapid and deep breathing. If this occurs, convulsions and unconsciousness can soon follow.

5. Breathing can cease within 4 minutes, and death is virtually assured within 8 minutes following lethal exposure. Mild Symptoms of Blood Agent Poisoning may include:

a. irritation of nose, throat and eyes
b. coughing
c. tightness of the chest

d. headache
e. vertigo
f. nausea

Severe symptoms of blood agent poisoning may include any or all of the mild symptoms and any or all of the following:

a. vomiting
b. unconsciousness
c. convulsions
d. involuntary urination and defecation
e. failing respiration
f. coma

Pulmonary Agents

The traditional pulmonary or chocking agent is phosgene. Pulmonary or chocking agents act in the lungs, causing in most cases, if not all, pulmonary edema, a result of damage and destruction of the alveoli lining, and subsequent bleeding into the lungs. The historical classification was chocking agent, as the afflicted individual can exhibit chocking responses.

Phosgene has an everyday civilian dimension. It is chlorinated. As many household products are chlorinated, they present a phosgene source in a fire. This is one of the reasons for crawling on hands and knees in a fire as any phosgene produced as well as the general smoke and ash are heated and rise to the ceiling and below. On your hands and knees you are below the bulk of it. Anyone caught in a fire and having been forced to breath the smoke laden air, can likely be hospitalized for observation, in part to look for any signs of phosgene inhalation and poisoning.

Treatment & Symptoms

There is no specific antidote to administer against pulmonary (chocking) agents. Some like chlorine gas or phosgene have characteristic odors; chlorine smells like bleach, and phosgene smells something like fresh cut grass or hay. The real hazard to the patient is pulmonary edema, the lungs filling with fluid, due mostly from the small capillary blood vessels of the lung's alveoli rupturing and blood leaking into the air ways. The treatment is supportive in nature. Generally a patient is hospitalized for observation and reactive measures taken designed to combat the edema and alleviate difficulty in breathing.

Low concentration exposure will probably catalyze little or nor immediate symptomatic effects. Some common symptoms exhibited by choking agent poisoning are irritation of

1. the eyes including tearing
2. respiratory tract passages
3. coughing
4. choking
5. wheezing
6. tightness of the chest

7. shortness of breath
8. nausea
9. headache
10. occasional vomiting
11. pulmonary edema

Some halogenated choking agents may cause redness of the skin, and chemical burns.

Blistering Agents

Mustard agent was widely used toward the end of WWI, in principle to counter the use of protective masks. It is a persistent agent and presents a contact hazard in the main, though inhalation only complicates the effects. Skin contact with the agent led to serious blistering of the skin and inflamation of exposed mucous membranes. Its name was by legend derived from the claimed odor of the agent, reminiscent of mustard or garlic. All blistering agents are a persistent agent and thus require decontamination procedures to render the area and surfaces of object and facilities safe for human occupation.

Other blistering agents are the N-Mustards, so named because they replace the sulfur of traditional mustard-like agents with nitrogen. N-mustards as far as a western military agent, have not enjoyed any favor, being rather compounds of limited medical/biochemical research interest.

A final subclass of blistering agents are certain arsenicals, compounds based upon the element arsenic. One WWI era arsenical blistering agent is Lewisite. Lewisite reportedly has an odor reminiscent of geranium flowers.

One secondary effect of blistering agents is the susceptibility of the injured to secondary infection. In today's world that may not be much of a concern, given our wealth of antibiotics, though there is a real concern in the bio-medical fields that too many bacteria are developing resistence to too many of our antibiotics. But understand that when blistering agents were first used in WWI, antibiotics were essentially unknown. If a blistering would became infected, and that was a real high probability outcome, the individual could end up fighting a systemic infection as well as a chemical burn, which are worse and harder to heal than some thermal burns.

The sulfur mustards present a potential second threat. They are considered potential carcinogens.

Treatment & Symptoms

Mustard gas itself, is a skin irritant of supreme effect. The blisters may start out as separate small isolated blisters, but can merge across large area of skin to cause huge blisters, several inches in diameter. Moist areas of the skin are particularly susceptible such as areas around the nose, eyes, mouth, underarms, groin and behind the elbows and knees. The first issue is to decontaminate the skin to prevent further injury. A major concern of blister agent affliction is secondary infection of the blisters. Today, that is not a major problem as we have a spectrum of antibiotics with which to treat infection. Recent research has offered some promising means of treating sulfur mustard agent inhalation and subsequent pulmonary challenge. A class of compound known as curcuminoids has shown some

promise against pulmonary complications (Panahi, Y; Ghanei, M; Bashiri, S; Hajihashemi, A; and Sahebkar, A; "Short-term curcuminoid Supplementation for Chronic Pulmonary complications due to Sulfur Mustard Intoxication: Positive Results of a Randomized Double-blind Placebo-controlled Trial", **Drug Res (Stuttg)**, 30 Septemeber 2014, PMID 25268878).

A variant sulfur mustards are the arsenicals such as Lewisite. In addition to the blistering, they present a potential systemic arsenic poisoning dimension. Arsenic poisoning treatment regimens are called for in such a case in addition to the blister issues.

As much as 24 hours may pass after exposure to blistering agents before symptoms appear. For sulfur-based agents such symptoms of the skin start with:

1. reddening of the skin
2. inflammation
3. blisters

If the eyes made contact with agent, then

1. a gritty feeling may ensue
2. eyes may exhibit inflammation
3. eyelids may swell depending upon dose
4. pain of the eyes suggests significant vapor exposure, leading to spasms and closure of eyelids

Respiratory tract symptoms arise in direct proportion to the level of inhalation Symptoms vary from

1. nasal irritation
2. sinus pain
3. scratchy or burning throat, laryngitis
4. shortness of breath
5. severe exposure exhibiting nausea, stomach pain, vomiting, bloody diarrhea, pulmonary edema for high dosages is not an unexpected result
6. high absorption may also mimic nerve agent-like effects on muscles.

For nitrogen-based blistering agents as with the sulfur-based agents noted above, exposure to nitrogen-based agents may not exhibit symptoms for as much as 24 hours after contact. Low dose vapor exposure to these vesicants may not stimulate skin reactions. Generally productive exposure triggers redness of the skin, inflammatory responses, and blistering. Affects on the eyes of nitrogen vesicants can be immediate with initial irritation, tearing and light-sensitivity. Other eye and respiratory effects generally track the same as with the sulfur-based vesicants.

The arsenical-based agents come as vapor or liquid vesicants. They cause immediate irritation and pain upon exposure. Eyes respond nearly immediately with tearing and pain. Affects on skin such as pain and reddening can arise as soon as 5 minutes after exposure, but blistering may be delayed for as long as 18

hours. Vomiting is not an uncommon side-effect of arsenicals. As with sulfur and nitrogen-based vesicants, arsenical vesicants display similar consequences on the respiratory tract and associated tissues.

Decontamination of Chemical Agents

It is doubtful that a terrorist attack employing chemical weapons agents would entail a significant quantity of the agent to contaminate a significant outside area of a community. Most likely, such an attack would be initiated against an enclosed facility, using A/C or heating duct works to help spread the agent throughout the facility. But for the sake of argument and completeness of the issue's treatment, the reader is directed to the Appendix of this work for an eye-opening insight into just what decontamination of a residence and environs would entail.

Table 5 offers the likely route of hazards posed to people exposed to various chemical agent weapons.

Table 5: Summary of General Threat Presented by Likely Chemical Agents[1]

Agent Class/ Specific Agent	Likely Risks of Exposure			Likely Means of Dispersal	
	Inhalation	Skin Contact	Ingestion	Aerosol	Droplets
NERVE					
Sarin, GB (NP+)	X	X		X	
Soman, GD (NP+)	X	X		X	
Tabun, GA (NP)	X	X		X	
GF, GF (NP)	X	X		X	
VX, VX (P)		X			X
V_x, - (P)		X			X
BLOOD					
Hydrogen Cyanide, AC (NP)	X			X	

Cyanogen Chloride, CK (NP)	X			X	
PULMONARY (CHOKING)					
Phosgene DP (NP)	X			X	
Diphosgene DP (NP)	X			X	
BLISTERING (VESICANTS)					
S-Mustard, HD (P)	X	X		X	X
N-Mustards, HN1 (NP)	X			X	
N-Mustard, HN2 (NP)	X			X	
N-Mustard, HN3 (P)	X	X		X	X
Phosgene Oxime, CX (P)	X	X		X	X

[1] (P)= persistent agent (require decontamination); (NP)= non-persistent agent (no decontamination required); (NP+)= likely more than non-persistent

Table 6 summarizes the indications of exposure to various lethal chemical agent classes.

Table 6: Signs and Symptoms of Lethal Agent Exposure

Physiological Reaction	Nerve	Blood	Sulfur Blister	Nitrogen Blister	Choking	Arsenicals
Prostration w/o signs of physical injury	X	X	X	X		
Involuntary muscular twitching, jerking, trembling	X	X				
Convulsions	X	X			X	
Reddening of lips, skin		X	X	X		
Graying of skin, no blistering			X	X		
Sunburn appearance of skin			X	X		
stinging, pain of eyes or skin			X	X		
Pinpointing of pupils	X					

Inability to open eyes, involuntary closure			X	X		
Tearing		X	X	X	X	
Severe coughing, sneezing		X	X	X		X[1]
Nose Bleeding		X	X	X	X	X[1]
Severe Runny Nose	X		X	X		X[1]
Breathing Difficulty, Shortness of Breath	X		X	X	X	X[1]
Very Dry Mouth, Throat, Severe Headache	X	X			X	X[1]
Involuntary Defecation, Urination	X					
Nausea, Vomiting	X	X	X	X	X	X[1]
Localized, Excessive Sweating	X					
[1] Vomiting agents cause this also.						

BIOLOGICAL AGENTS

Biological weapons are as varied in nature as the types of biological agents. For practical purposes in regards to general lethality, virulence and difficulty in treatment, there are three major classes of biological agents of particular importance. They are:

1. Bacteria
2. Viruses
3. Toxins

Only bacteria are prokaryotic cellular organisms, lacking a cell nucleus for housing the genetic DNA. Bacteria can be treated in principle with antibiotics, many antibiotics having their historical origin from fungi (molds which are eukaryotic cellular organisms possessing a cell nucleus like plant and animal cells). Molds secrete antibiotics in their own chemical warfare against bacteria, a means presumably by which the molds kill and eliminate bacteria as competitors for nutrients. Bacteria can be subdivided into two major subclasses known as Gram positive and Gram negative bacteria. Gram positive bacteria respond to one type of antibiotic, while Gram negative bacteria respond to a different type of antibiotics. The problem confronting medicine today is that antibiotics for all too long have been prescribed all too freely, even in cases where a viral infection is the disease causing culprit. Such practices have selected the resistant strains for life and proliferation, while killing the non-resistant strains. Today we have to deal with a number of bacterial infections that have developed through these selection means and are quite resistant to a number of our most potent antibiotics.

Viruses require a host cell for their propagation, and in simple terms consist of genetic material (DNA or RNA) encased in a protein coat. Viruses are perhaps the most intractable microbes to eradicate or treat. There generally are no “antibiotics” called antivirals to use against viral infections. There are a few

antivirals, but they are not effective on any others but a particular kind and even strain of virus. Since viruses infect living healthy cells via a process that can be explained simply as like a hypodermic needle injection through the cell membrane, antivirals must either act in a fashion to inhibit this infection mechanism, or attack the viral reproduction methods within the cell. Unfortunately, many potential chemical medications that may show some effect against the virus, also prove to be as poisonous to the body cells.

Toxins are generally molecular substances or compounds, several are proteins. There are antidotes called antitoxins for some toxins. Botulinum and tetanus toxin are today routinely treated with such antitoxins for each. Toxins are basically poisons made by a cell, typically a bacterial cell. Such toxins are among the most ultra-poisonous substances known. Let's examine briefly representative members of historical importance as potential biological weapons agents as seen by the military certainly, and thus, likely candidates for use by terrorists if they can acquire these nasty materials in quantity as well as the technology to even concoct a crude weaponized form. Table 7 lists the primary biological agents of historical concern. Table 8 lists several bacterial and viral biological agents and their potential threat to humans. Tables 9 and 10 address specifics of the toxins of historical concern to military and counter-terrorism homeland security forces.

Table 7: Historical Biological agents of Concern as Weapons

Bacterials	Virals	Toxins
Anthrax Brucellosis Cholera Glanders Plague Tularemia Q-Fever	Smallpox Venezuelan Equine Encephalitus Viral Hemorrhagic Fevers: Ebola Lassa Congo-Crimean Argentine Bolivian Yellow Dengue Rift Valley Hantavirus	Botulinum Staphylococcal Enterotoxin B Ricin T-2 Mycotoxins

Bacteria

Bacteria are more numerous than animals. Our bodies harbor billions of bacteria, many and perhaps

most of which are actually necessary for digestion and our general health. Others are employed in various food manufacturing processes such as in the manufacture of cheeses. These constitute the beneficial bacteria. Another type are the pathogens. They cause no end of trouble for us in being responsible for the diseases that they inflict on us, our pets, livestock, and even our agricultural crops. However, it isn't that pathogenic bacteria purposely target us for disease, but rather, the outcome of a disease state from them reflects a conflict or incompatibility of their biochemistry with ours. Among this latter type are some of the most harmful and lethal bacteria. As for the bacteria of biological weapon potential, all are considered persistent agents, and require decontamination of the facility, area, and surfaces. However, the ultraviolet light (UV) of the sun can be an aid in decontamination as the UV can kill many different types of bacteria. The more troublesome ones even in holding up to UV light are those that can form spores, thick, nearly impenetrable protective capsules that encase the dehydrated organism. Very high, moist heat such as superheated steam is generally necessary to kill these kinds of bacteria. That is one of the reasons that medical facilities employ the autoclave, a kind of pressure cooker that heats water up under pressure above its normal 100␣C (212␣F) temperature. The high heat and pressure enables the steam to penetrate the spore coating to basically kill the organism.

Viruses

Viruses are not cellular organisms. They are basically only genetic material, RNA or DNA, wrapped in a protein coat. Their shapes are as varied as the number of viruses. Some are rod-like, while others are spherical. Still others are curly-que like in shape. Viruses tend to be specific for certain species of animals and even for certain type tissue cells. Antibiotics don't affect them as they are not "alive", independent living organisms. Viruses survive and propagate via infecting a cell, commandeering the replicative machinery of the cell to make more virus DNA or RNA as well as any other components required to make a complete virus. The viruses are then discharged to the environment which for the cell could be the blood stream or adjacent cells to infect others and continue the process. Since they don't have their own reproduction infrastructure, they are not susceptible to antibiotics that otherwise kill prokaryotes, bacteria, or for that matter, eukaryotic cells such as human cells.

One of the more scary viral infections is that of what are classified as hemorrhagic fevers. So named because of the prominent symptoms of high fever and hemorrhaging of blood vessels these infections attack and destroy the immune system and organs in part due to the breakdown of the blood clotting mechanism of the body. The bleeding seen often oozes out through the nose, eyes, ears, mouth and urinary and anal orifices. Some bleeding through pores may be seen. Considerable organ damage and destruction attends lethal infection.

The 2014 eruption of Ebola hemorrhagic fever in Liberia and its subsequent travel to Texas in early October has raised concerns and fear across the US of one of the most deadly viruses known. This virus can kill upwards of 90% of those infected with it. Those that recover are certainly supremely lucky. There are no antibiotics (effective only on bacteria) and no FDA-approved antiviral agents (at this writing) that can treat the infection. Treatment consists of a three-stage process:

(1) Provide intravenous fluids and maintain a balanced electrolyte level,
(2) maintain oxygen and blood pressure levels, and
(3) treat any opportunistic secondary infections that may arise. Additionally, there an experimental serum that destroys infected cells may also be used.

General symptoms of Ebola infection are

1. high fever
2. headache
3. joint and muscle aches
4. sore throat
5. weakness
6. stomach pain
7. lack of appetite

These are the symptoms before the generalized hemorrhaging makes itself known. For those who are infected and recover, they harbor antibodies against the virus and remain immune for at least ten years.

Currently, medical experience shows that it is easier to catch a cold or the flu as these are airborne transmitted infections, sneezing and coughing. Ebola so far has required close contact with infected body fluids which includes certainly blood.

Toxins

Toxins are "poisons" that are made by a living cell. Many toxins are proteins though not all toxins are proteins. Toxins can be hundreds or thousands of times more lethal than some of the more lethal chemical poisons. Some toxins are made by bacteria, or molds. It is believed that these substances are made and used by the microbial cells against other microbes to eliminate competition for resources or as defensive or counter attack weapons against assaults by other microbes. Regardless of why microbes make toxins, they can be very deadly to humans. A few examples are botulinum toxin, tetanus toxin, and diphtheria toxin. As it turns out, many of the toxins effective against other microbes also prove very injurious and lethal to humans. Some toxins are made by multicellular animals such as the puffer fish toxin (actually by bacteria it harbors), arrow poison frog toxin, or ricin from castor bean. While the LD_{50} of chemical agents or inorganic poisons are generally measured in milligrams (mg) dosages, the LD_{50} of toxins is measured in micrograms (~g, 1/1000 mg) to nanogram (ng, 1/1,000,000 mg) dosages. Thus a very general characterization of toxins compared to chemical poisons is that the toxins are roughly a thousand to a million times more lethal from the standpoint of dose required.

Toxins generally act on biological systems of humans such as interfere with nerve action or muscular actions by binding to receptors that mediate critical functions in neuromuscular action of the animal or human body. The bacteria *Clostridium botulinum* and *Clostridium tetani* are anaerobic bacteria and their toxins are some of the most dangerous and deadly known. The species name *botulinum* comes from the Latin *botulus* meaning sausage as the disease and its causative organism were initially ascribed to tainted sausage. The species name *tetani* derives from the Latin *tetanus* meaning to stretch as before an antitoxin treatment was available, those infected and succumbing to the disease often exhibited an apparent stretching and tautness to the back bone arched backwards similar to that of a bow. There are some antitoxins that can be used to treat some toxin exposures. Though there is an antitoxin for each of botulism and tetanus, others remain without a specific antitoxin treatment. The puffer fish is one of several marine creatures that release the tetrodotoxin which is actually produced by the bacteria *Vibrio alginolyticus*. There is no antitoxin for ingestion of this toxin.

Use of toxins would represent the use of a biological weapon two or three orders of magnitude more deadly to humans, but these substances are produced in very small quantities by the organism producing them, and gathering and concentrating such toxins would be a significant effort. Additionally, they would probably be more effectively used as additives to ingested foods or other means that leads to intramuscular insertion or perhaps in some cases, inhalation. Even today, improper canning procedures can lead to botulism for ineffective sterilization of materials used to do the canning of foods and a common means of contracting tetanus is from working in soils or with objects exposed to and in soil for some time such as rusty nails and suffering a puncture wound. The *Clostridia* bacteria are anaerobic bacteria and are found in poorly aerated soils or in animal manures. Another very dangerous member of this bacterial genus is *Clostridium perfringens*, the causative microbe of gas gangrene. With this bad boy, myonecrosis, death of muscle tissue on a progressively large scale is the issue. Gas gangrene is a medical emergency, and if untreated, either by antibiotics, hyperbaric chamber use, or amputation in the final extreme case, death is assured.

Ricin is a lectin, a carbohydrate-binding protein. A quantity the size of a few grains of table salt is sufficient to kill a human if injected or inhaled. Inhalation is the likely mode of employment of ricin in a terrorist attack, though weaponizing it is easier said than done. Ricin comes from the seeds of the castor oil plant *Ricinus communis*.

An example of a non protein toxin is aflatoxin. There are several variants of aflatoxin, but all are a polycyclic mycotoxin compound produced by *Aspergillus flavus* and *Aspergillus parasiticus*, both fungi or what are commonly called molds. The organism is a soil microbe, and is one of the organisms in soil that breaks down vegetation matter as part of the process commonly known as decay. The organisms can contaminate some foods and particularly susceptible to infection are corn, sorghum and groundnuts. This contamination can occur before harvest or in storage. Contamination is facilitated by high humidity or moisture and in drought conditions with high temperatures. The toxin can be found in milk of animals such as cows when fed contaminated feed. Several commercial oils have been found contaminated including olive, peanut and sesame oils, as well as peanut butter. Other food products include cassava, chillies, cotton seed, millet, rice, sunflower seeds, tree nuts, and wheat. The toxin is particularly active on the liver and is a potential hepatic carcinogen. The active form of most concern is the oxidized epoxide form of the mycotoxin resulting from normal detoxification processes found in the liver. One of the major functions of the liver is to detoxify small quantities of otherwise poisonous or toxic materials ingested. Some detoxification processes of the liver however, can actually convert the target of detoxification into something far worse.

Decontamination

Decontamination of biological agents traditionally entails the use of the same cleansing agents as used on chemical agent decontamination. Household bleach is very effective on bacteria, viruses and other microbial agents. Generally a stronger bleach solution would be used to penetrate the defensive barriers that some microbes possess. Clearly any biological agents outside in the open, exposed to direct sunlight are susceptible to destruction by the sun's ultraviolet (UV) light. This works well on so-called vegetative cells, cells that are actively absorbing nutrients and discharging wastes to the environment. Non vegetative cells are cells that are in a kind of suspended animation. They are not metabolizing and generally are enclosed in a very chemically tough and impervious coating, the covering and the

microbial works within are referred to as spores. Many potential bioagent microbes have the potential when circumstances become untenable for continued life, to become inactive in the spore form. These cases can be somewhat difficult to decontaminate. What is important to recognize about biological agent decontamination is the difference between disinfection and sterilization. The two terms sometimes are used incorrectly interchangeable.

Disinfection means rendering a surface or object safe for handling by killing the vast majority of pathogens. One can say their dead bodies are still on the objects, but they and the few live microbes are not sufficient in numbers to present an infection hazard. For example, one study asserts that to contract anthrax, one would have to be infected with a minimum of some 10,000 anthrax spores, which would within the body germinate quickly. Tularemia only requires about 10 cells to infect a person. The point is, disinfection does not necessarily remove the pathogens, but it kills sufficient numbers of them that they are not a threat.

Sterilization means the complete killing of all pathogen microbes, and the physical removal of their "dead bodies" from the surface or object. Sterilization is what hospitals and medical and pathology labs do to clean instruments. This generally requires the use of what is called an autoclave which super heats water to super heated steam in excess of the normal 100␣C (212␣F) boiling point of water. Temperatures run as high as 121␣C (250␣F) and are held for 15 to 20 minutes. Autoclaves increase the pressure within as well which enhances the penetration of the very hot steam into the microbes, even their spores. The autoclave is something like a special pressure cooker. So, what we do around the home in our cleaning chores is disinfection, not sterilization. Decontamination is at best a very through disinfection process.

Table 8: Summary of General Threat Presented by Various Biological Agents[1]

Microbe Type/ Agent	Possible Means of Exposure			Likely Means of Dispersal	
	Inhalation	Cutaneous[2]	Ingestion	Aerosol	Vector[3]
BACTERIAL					
Anthrax	X	X	X	X	
Plague	X	X		X	X, H
Tularemia	X	X	X	X	X, R
VIRAL					
Crimean-Congo Fever		X			X
Dengue Fever		X		X	X

Ebola	X	X		X	?, H
Flu-1918	X			X	H
Japanese Encephalitis		X			X
Lassa	X	X		X	H
Marburg	X	X		X	?, H
Rift Valley Fever		X			X
St. Louis Encephalitis		X			X
Smallpox	X	X		X	?, H

[1] All Microbial Biological Agents are considered persistent agents. They require decontamination procedures
[2] Could mean by direct contact such as injection or vector means (including puncture) or through lesion in skin, and secretions
[3] insect or arthropod such as mosquitos and ticks; ?= no known vector; H= human-to-human; R= rabbits, hares

Table 9 lists several toxins of concern as potential biological weapons agents.

Table 9: Lethality and Mode of Action of Selected Biological Toxins[1]

Toxin & Time to Symptoms	LD_{50}[a] (~g/kg body mass) [oz/lb body weight]	Toxin Type & Effects
Very Rapid Acting, ` 5 minutes		

Anatoxin-A: Blue-green Algae	(170 to 250) [$2.7x10^{-6}$ to $4x10^{-6}$]	neurotoxin, acetylcholine receptor agonist; chemical nerve agent symptoms
Conotoxins: Marine Cone Snail	(3 to 6) [$4.8x10^{-8}$ to $9.6x10^{-8}$]	neurotoxin, blocks voltage-sensitive calcium channels, voltage sensitive sodium channels, acetylcholine receptors; bleeding at injection site, muscular weakness
Palytoxin: Marine Soft Coral	(0.08) [$1.3x10^{-9}$]	neurotoxin, activates sodium channels; muscular paralysis, collapse
Rapid Acting, 5 minutes to 1 hour		
Diphtheria Toxin (Bacterium)	(0.03) [$4.8x10^{-10}$]	sore throat, swollen glands
Batrachotoxin: Arrow-poison Frog	(0.1 to 2) [$1.6x10^{-9}$ to $3.2x10^{-8}$]	neurotoxin, prevents sodium channel closure; neuromuscular blockage
Ricin (injection): Castor Bean	(0.1 to 3.7) [$1.6x10^{-9}$ to $5.9x10^{-8}$]	cytotoxin
Taipoxin: Elapid Snake	(2) [$3.2x10^{-8}$]	neurotoxin

Saxitoxin: Marine Dinoflagellate	(5 to 12) oral [$8x10^{-8}$ to $1.9x10^{-7}$] oral; (1) aerosol [$1.6x10^{-8}$] aerosol	blocks sodium channels; numbness, muscle weakness, incoordination, respiratory distress
Tetrodotoxin: Puffer Fish	(30) oral [$4.8x10^{-7}$] oral (8) injection [$1.3x10^{-7}$] injection	blocks sodium channels; neuromuscular blockage, numbness, loss of muscle control, loss of voice
□-latrotoxin: Black Widow spider	(10) [$1.6x10^{-7}$]	neurotoxin, enhances acetylcholine release; paralytic nerve agent symptoms
[a] in mice if no other data available; 1 ~g (microgram) is 1 millionth of one gram [b] human [1] *Chemical, Biological, Radiological (CBR) Personal Protection & Decontamination (Individual)*, A494-0008, Trainee Guide, Naval Construction Training Center, Gulfport, MS, October 1997, sec. 1-3, p. 15		

Table 10 lists the modes of action of several of the toxins of concern as biological weapons.

Table 10: Lethality and Mode of Action of Selected Biological Toxins[1]		
Toxin & Time to Symptoms	LD_{50}[a] (~g/kg body mass) [oz/lb body weight]	Toxin Type & Effects
Rapid Acting, 5 minutes to 1 hour		

Notexin: Snake	(20) [$3.2x10^{-7}$]	neurotoxin; paralytic
ˆ-bungarotoxin: Krait snake	(20) [$3.2x10^{-7}$]	neurotoxin, inhibits acetylcholine release at neuromuscular junction, blocks potassium channels; paralytic
Cobrotoxin: Cobra	(75) [$1.2x10^{-6}$]	neurotoxin, blocks nicotinic receptors; paralytic
Microcystin: Blue-Green Algae	(50 to 100) [$8x10^{-7}$ to $1.6x10^{-6}$]	cytotoxin; shivering, stupor
Delayed Action, 1 hour to 12 hours		
Ricin: Castor Bean	(3) oral [$4.8x10^{-8}$] oral	cytotoxin; nausea, vomiting, cramps
Staphylococcus enterotoxin B: Bacterium	(20) injection [$3.2x10^{-7}$] injection (200) aerosol [$3.2x10^{-6}$] injection	Incapacitant; acute food poisoning symptoms
Botulinum toxin: Bacterium	(0.0003 to 0.01) oral [$4.8x10^{-12}$ to $1.6x10^{-10}$] oral	neurotoxin, blocks acetylcholine release; drooping eyelids, double vision, dilated pupils, fever, paralysis

T-2: Fungal Mycotoxin	(50 to 240) aerosol [$8x10^{-7}$ to $3.8x10^{-6}$] aerosol	Incapacitant, cytotoxin; reddening skin, rash, blistering, nausea, bloody vomit, diarrhea
Very Delayed Action, 12 hours		
Tetanus Toxin: Bacterium	(0.0025)[b] [$4x10^{-11}$]	neurotoxin; painful muscular contractions, "lockjaw"
[a] in mice if no other data available; 1 ~g (microgram) is 1 millionth of one gram [b] human [1] *Chemical, Biological, Radiological (CBR) Personal Protection & Decontamination (Individual)*, A494-0008, Trainee Guide, Naval Construction Training Center, Gulfport, MS, October 1997, sec. 1-3, p. 15		

Botulism is still a concern since it can arise from improper canning. The following presents some points about botulism toxication.

Epidemiology, Microbiology, Pathology

1. Botulism is a disease caused by the toxin produced by *Clostridium botulinum*, a spore-forming, obligate anaerobic bacterium that naturally inhabits soil. There are 4 genetically diverse groups. They all produce the toxin.

2. Two other bacteria produce the toxin: *C. baratii* and *C. butyricum.*

3. The toxin itself comes in 7 antigenic variations designed A through G.

4. Toxin is colorless, odorless, and presumed tasteless.

5. Heat (85␣C for 5 minutes) inactivates the toxin.

6. The toxin is rapidly inactivated by potable water treatment means. In untreated water (such as beverages), the toxin can remain stable for several days.

7. The toxin is a protein, consisting of two simple chains, one "heavy" 100 kd chain, and a "light" 50 kd chain, linked together by a disulfide linkage. The light chain is a Zn^{2+} endopeptidase metalloenzyme that blocks acetylcholine-containing vesicles from fusing with the terminal membrane of the motor neuron, leading to a flaccid muscle paralysis.

8. Lethal dose in humans is "guestimated" from doses given to primates. For a 70 Kg (154 lb) human, the following doses are postulated:

A. iv or im; 0.09 to 0.15 ~g
B. inhalation; 0.70 to 0.90 ~g
C. orally; 70 ~g

9. Therapeutic botulinum toxin is packaged at about 0.0024~g (0.3% of the inhalation dose) or as 0.0035~g (0.005% of the oral dose).

10. Three forms of affliction: foodborne, wound, and intestinal.

11. All botulinum intoxication arises from the absorption of the toxin through either a wound or the mucosal lining of the gut or lungs into the circulatory system. Botulinum toxin does not penetrate intact skin.

12. Wound and intestinal botulism occurs within anaerobic tissues (dead tissue of wounds or the intestinal lumen).

13. Once absorbed, the circulatory system transports the toxin to the peripheral cholinergic synapses, primarily the neuromuscular junctions, where irreversible binding of the toxin occurs.

14. The toxin enters the interior of the synapse and enzymatically blocks the release of the neurotransmitter acetylcholine. This leads to a flaccid paralysis.

15. In foodborne botulism, the symptoms of abdominal cramps, nausea, vomiting and/or diarrhea arises from other bacterial metabolites thought to also be simultaneously present.

16. If botulinum toxin is deliberately placed into food or is aerosolized, these secondary symptoms associated with "food poisoning" may likely be absent in terrorist employment.

17. The illness itself is an acute, afebrile (feverless), symmetric, descending flaccid paralysis always arises in bulbar musculature. This invariably leads to cranial nerves palsies. Thus sense of smell, vision, eye muscles, face muscles and control is impaired or lost. These expressions of the toxin's effects may or will vary from patient to patient. The extent of effects and the extent of debilitation depends upon the size of the absorbed dose in circulation.

18. Typically patients exhibit difficulty seeing, speaking and swallowing. Prominent expressions of botulism include: ptosis (drooping); diplopia (double vision); blurred vision; enlarged, sluggish reactive pupils; dysarthria (difficulty articulating); dysphonia (difficulty speaking); and dysphagia (difficulty swallowing).

19. As paralytic effects of toxin progress beyond bulbar musculature, loss of head control, hypotonia and general weakness become obvious. Loss of protective gag reflex may necessitate intubation and probably as well, mechanical ventilation.

20. Deep tendon reflexes diminish or disappear over the following days, and constipation may arise.

21. Untreated, death results from airway obstruction(pharyngeal paralysis) and inadequate tidal volume from diaphragmatic and accessory muscle paralysis.

22. Toxin does not penetrate brain parenchyma.

23. Depending upon the dose, symptoms can develop as fast as 2 hours after absorption, to 8 days later. Typical cases develop between 12 to 72 hours after ingestion.

24. Diagnosis of botulism to distinguish between natural vs. terrorist origin requires careful travel, activity, and dietary histories be taken.

Above adapted from *J. American Med. Assoc.* **285(8)**, 1059-2081 (2001)

RADIOLOGICAL AGENTS

Radiological weapons are invisible, though any odor or taste that may be ascribed to them may be more due to the nuclear chemical reactions they have with biomolecules of the nose, tongue and associated sensory tissues. The real hazardous culprits are the ionizing particles such as alpha, beta and positron particles and neutrons and the gamma rays- the most penetrating and dangerous of the ionizing radiations. Various transuranium and a select few lesser elements are the matter that undergo decay, emitting these ionizing radiations. The most likely means of use and dispersal would probably be via conventional bomb explosion in which the chemical explosive and radiological material are mixed in the bomb itself. Upon detonation, the radiological material is dispersed at the speed of the blast wave and debris to be aerosolized in the air of the immediate vicinity as well as to the outer limits of the debris cloud.

The hazard posed to personnel is one of most particularly inhalation. Once inhaled, a serious damaging dose in the lungs can not be removed or decontaminated. Any debris on the hair, skin or clothing can be removed by removal of the clothing, and washing thoroughly- a decontamination process.

What is particularly important to realize about radiological threats, is that though in some cases (noninhalation) the hazard can be washed free of objects and surfaces, it can not be destroyed. The wash and rinse waters then harbor the hazard and it must be treated as such and disposed of in an appropriate fashion. It is also true that radiological materials are not destroyed by fire or explosion. It is also important to recognize that in any conventional explosion event of a terrorist nature (though it may not necessarily be known in the early aftermath), it may not be known that the explosion was from a so-called dirty bomb. If caught in the vicinity of an explosion, it is best to first of all, get away and out of the area, particularly, not going down wind of the blast. Secondly, if any debris dust is in the air around you, immediately cover your nose and mouth with a handkerchief or other suitable cloth and breath through it, as you make your egress from the area. This also useful in avoiding inhalation of pulverized or aerosolized building materials that may also be harmful if inhaled.

Treatment & Symptoms

As noted above, the amount of ionizing radiation absorbed is a function of both distance and time of exposure to the source of that radiation. One additional factor is if you have the radioactive debris and dust on you, the source is in direct contact with you in this case. Your are getting the full effect regardless of how low or high a level of radiation it is. The usual measure of radiation is the gray (Gy). An X-ray typically is less than 0.1 Gy and not of significant dose. [X-rays arise from energy released by electrons that fall to a lower energy level, orbit, about the atom's nucleus.] However, radiation absorption is cumulative, which means each subsequent exposure adds to what you already previously absorbed over your life to that point of the most recent exposure.

Deleterious effects begin appearing when the absorbed dose over the entire body reaches about 1 Gy. Medically, if the whole body absorbs 6 Gy, there is little by way of treatment that can delay, much less prevent eventual death within about two days to two weeks depending upon how much was absorbed and over what time frame. Two areas of the body appear most susceptible to damage from ionizing radiation. They are the digestive tract (intestines) and the stomach and the bone marrow. Table 11 summarizes the time of onset of symptoms based upon the level of absorbed radiation.

Table 11: Time of Radiation Poisoning Effects to Show up in Exposed Patient*

Symptom\ Exposure Level	Mild Exposure (1 - 2 Gy)	Moderate Exposure (2- 6 Gy)	Severe Exposure (6 - 8 Gy)	Very Severe Exposure (^ 8 - 10 Gy)
Nausea & Vomiting	` 6 hours	` 2 hours	` 1 hour	` 10 minutes

Diarrhea		` 8 hours	` 3 hours	` 1 hour
Headache		` 24 hours	` 4 hours	` 2 hours
Fever		` 3 hours	` 1 hour	` 1 hour
Dizziness & Disorientation			` 1 week	immediate
Weakness & Fatigue	` 4 weeks	` 1 - 4 weeks	` 1 week	immediate
Hair Loss, Bloody Vomit & Stool, Infections, Slow Wound Healing, Low Blood Pressure		` 1 - 4 weeks	` 1 week	immediate
* Adapted from Mayo Clinic, Disease-conditions, Radiation-Sickness, Basics; mayoclinic.org; itself adapted from "Radiation Exposure and Contamination, The Merck Manuals: The Merck Manual for Healthcare Professionals				

The onset of nausea and vomiting are generally taken as indications of treatable exposure to ionizing radiation, and the time elapsed between exposure and onset of the nausea and vomiting is taken indicative of the level of exposure endured. Additionally, the afflicted person will exhibit an initial display of brief symptoms, followed by a period of no symptoms, and then the onset of more significant symptoms. Consequently, determining the level of exposure is critical in assessing the treatment to be applied as well as assessing the patients prospects for survival. Medical personnel will seek to know:

1. the distance of the patient from the source
2. the time of exposures at that distance

3. the time between the exposure and the onset of vomiting
4. a series of blood tests over several days to assess white blood cell count
5. if the patient wore a dosimeter, dose information can be gleaned from such a device
6. A Geiger counter may be used to check for radioactive debris and particles on the person and to assess the extent of damage to various regions of the body
7. the type of radiation encountered (alpha [□] or beta [^] particles, gamma rays [⌣], or neutron [n])

Medical personnel will check for residual radiation and initiate decontamination procedures to prevent further injury to the patient as well as to themselves and others. They will address issues that are life-threatening such as trauma, bleeding, breathing, as well as reduce symptoms and alleviate pain. Medications can be administered and one is granulocyte colony-stimulating factor. This protein promotes white blood cell growth and also attends administration of two other white blood cell growth medications, filgrastim and pegfilgrastim. With enhanced white blood cell growth, secondary infections can be controlled or prevented. Other medications can treat any ingested radioactive elements. These medications include potassium iodide (counters radioiodine to protect thyroid gland); prussian blue, a dye also binds certain metals (cesium, thallium); and diethylenetriamine pentaacetic acid, a chelating agent (binds to plutonium, americium, and curium).

The source of radiation exposure can be any one of the following:

1. an industrial nuclear facility accident
2. the result of an attack on a nuclear facility (terrorism)
3. Explosion of a radioactive device
4. a dirty bomb (terrorism)
5. a nuclear weapon detonation

Radiation Sickness Effects are demonstrated as follows:

Red Blood Cell Formation (hematopoietic, hemopoietic) Effects

1. Low to mid-level radiation exposure and absorption leads to a failure of red blood cell production coupled with a reduction in all types of white blood cells and platelets in blood (*pancytopenia*).

2. Demonstrable changes in blood can arise within 24 hours after exposure.

3. Lymphocytes appear the first cell types to suffer from radiation exposure, the red blood cells (erythrocytes) the slower.

4. Cell production by marrow will vary with the extent of exposure. Such attendant problems as hemorrhage, increased susceptibility to infection, and anemia can vary from as short a time as 10 days after exposure to as long as 8 weeks after exposure.

5. Clinically, the average time frame for onset of these latter consequences is about two to three weeks.

6. Lethal exposure levels can remain obscure until some six weeks after exposure. The inflammatory response, a feature of the body's response to infection, may be depressed. The patient will experience weight loss, possibly hair loss, and death will come as an overwhelming infection (compromised immune system) and the hemorrhaging of blood vessels.

Gastrointestinal Syndrome Effects

1. Gastrointestinal (GI) effects require greater ionizing radiation doses than are required to trigger the associated bone-marrow effects.
2. The doses required to generally induce the GI syndrome always trigger the bone-marrow effects as well.

3. Additionally, the GI effects arise earlier than the bone-marrow effects.

4. There is a latent period of a few days to about a week. But then the effects materialize as a severe fluid loss, hemorrhage and diarrhea. These effects arise from damage to the cells of the GI themselves (epithelium) and a degradation of the mucosal lining of the GI tract.

5. There are no real definitive indicators of GI involvement, though severe bone-marrow involvement generally is a clue that GI effects seen are due to the syndrome effects.

Neurovascular Syndrome

1. Only very high, acute doses of ionizing radiation trigger the neurovascular syndrome.

2. Low blood pressure (*hypotension*) is a factor, though low doses can trigger this effect as well.

3. The latent phase of neurovascular syndrome is short-lived, varying from several hours to one to three days.

4. Neurovascular involvement typically manifests itself as a progressively deteriorating level of consciousness, leading to coma and finally death.

5. During this progression of consciousness, convulsions may or may not be present.

6. There is no antidote that can be given by medical personnel to reverse the effects of radiation poisoning.

7. Essentially the treatment is a supportive regimen designed to guard against or react to secondary, opportunistic infection, dehydration, and other tertiary consequences of the affliction.

8. For lethal doses absorbed, essentially all that can be done is to make the patient as comfortable as possible, and fight to keep them alive, help the body struggle to recover. This is not much considering the overwhelming assault the body has sustained.

Decontamination

A critical point about decontamination of radioactive materials is that there is no way to destroy them as is the case with chemical and biological agents. They must be physically removed from the patient, or the facility or objects on which they have settled. The material must be packaged, marked as radioactive, and eventually securely transported to some location or facility licensed to receive and store radioactive materials. The process becomes a HAZMAT matter. One can characterize this process as the "dust pan and vacuum cleaner" approach, though that suggests a rather sloppy method that is far from the truth of the process in actual practice. Those engaged in any decontamination of radioactive agents will wear protective masks of some kind designed to filter out any dust and aerosolic particles lest they enter the individuals lungs and cause no end of trouble. In cases where the radioactivity is somewhat high, personnel would likely wear dosimeters to keep a measure of their exposed absorbed dose and be rotated out to avoid reaching the minimum "safe" level of exposure. The real danger is and always has been the gamma radiation. The alpha and beta radiation is particulate and generally can easily be washed off the PPE the individual(s) wear before they remove the PPE. Also the PPE material will stop such particulate radiation from penetrating the PPE and the wearer's skin. Gamma radiation, being very ultra-high energy electromagnetic radiation (very, very small wavelength, invisible light, much smaller than X-rays), is not encumbered by PPE.

HOW and WHEN UNCONVENTIONAL WEAPONS COULD BE USED

Let me begin this section with a real life event that underscores the problem with the public responding to an unusual event out of "fear" of embarrassment or an unwillingness to appear to be "rocking-the-boat". The identity of the person, location, and function will remain anonymous. But this did happen.

Back in the late 1990s (as I recall) there was a meeting of employees of an agency in a town for training purposes. The employees gathered in a classroom early in the morning and awaited the instructor to arrive. Several minutes into the wait, some of the individuals began experiencing itchy eyes, nose, watering of the eyes, and some irritation of the throat. Nothing dramatic, mind you, but noticeable as apparently no one noticed any particular odor. A few compared their reactions with each other, but essentially, no one, not one person, rose up from the chair in which sitting to investigate or see any official or custodian about the problem with the air in the room. The attendees remained seated in the room, and endured. As it turns out, some time later, someone had exhibited some interest and it was learned that a security guard wearing a teargas canister on a belt had been sitting in a chair, with the canister against the main air intake. In the process of becoming comfortable, somehow and unknown to the security guard, the canister was triggered and discharged its contents directly into the air intake, and the classroom noted was one of the rooms in the direct path for receiving that distributed air. It was teargas. What if it were not teargas?

There are a few basic ways to expose a target to an unconventional weapon. Airborne is the best as the target people simply inhale the agent. Ingestion can be an effective way more so for some chemical agents and biological agents such as certain bacteria and even toxins. Viruses generally would be best for inhalation, much like happens with common colds and flu, though contact can be an effective means for some chemical agents and bacteria, some toxins and viruses.

How Chemical Weapons

How a chemical weapon would be used depends on the weapon, the nature of the target, indoors or outdoors, and if outdoors, the weather and wind considerations. If indoors, the most likely means of disseminating the agent would be through air distribution systems, the A/C or heating ducts. Depending on the volume of the building serviced by the air system, and where the human target gathering is relative to the intake through which the agent is fed, a sizeable amount may be required. The best type agent for such distribution would be the nonpersistent agents as they are generally gaseous or vaporous in nature and would easily remain in an aerosol form for distribution along the system. A terrorist would want to use something that is quite lethal when inhaled and he would also want something that doesn't have a particular odor as this could trigger suspicion in someone, especially if the odor is of something that just doesn't seem to belong in that environment and there is nothing obvious around to benignly explain that odor's presence. The advantage of an indoor attack is the enclosed nature of the environment. And employing the air system, if the terrorist can gain access to it, is using his enemy's facility against him. It spreads death efficiently and quickly, coupled with most people's reluctance to call attention to any strange odor, most people will likely endure it..... until it is too late to act to remove oneself.

The disadvantage that may exist in using the facility's air system is that the terrorist may not know how close that particular room is to the intake where the agent was inserted, and thus can not know how concentrated the forced air will be in agent. Of course an aerosol-like spray device can be employed to discharge agent directly into a room full of people, but it is likely that this approach will be observed and questions asked. This is particularly likely if the agent released sprays into the air like most any spray-can products exhibiting the telltale foggy or misty aerosolic cloud. It will likely evoke a "hey buddy, what are you doing?" from someone.

Nonpersistent chemical agents could be used outside by spray devices as well as low grade explosive devices that put the agent into the air and wind. The experiences of both allied and German troops in WWI attests to the effectiveness inherent in such dissemination means taking advantage of winds blowing the agent from the point of release to and through the area of the personnel targeted.

Another means of dissemination is to use a persistent agent. Such agents generally are not intended to be in vapor like form. Rather, they are liquid and can be applied through most any means to surfaces which people will likely come into contact. Objects like chairs, tables, sinks and facets and the like. They offer no odor, adhere well and can be near impossible to see, but are also generally very poisonous in very small amounts. One good example is the organophosphate nerve agent known only by its military designation, VX. The agent will remain on the surfaces for some time, days or weeks. It can be applied before anyone shows up and let the event and the people do the rest to expose themselves.

Finally, the third and last means would be by ingestion, though this means is more so an accidental means due to ignorance of chemical agent presence, or contamination of foods and containers. The effects would likely be slower in onset compared to inhalation, and may even be somewhat lessened in the early stages of ingestion exposure.

How Biological Weapons

Biological weapons entail an added concern that does not arise with chemical or even radiological

agents. Biological agents are for the most part living microbes or viruses, and how you use and disperse them is important so you don't kill them, but rather infect and kill the intended victims. This is where the term weaponization comes into play. A weaponized biological agent can be dispersed as an aerosol and is the most effective means of dosing the target for inhalation of the agent. Such agent weapon use would be favored during night time as sunlight's UV radiation is lethal to most biological microbes. This in fact was and still is one of the reasons that air drying laundry outside on a sunny day was and still is so effective at drying and disinfecting clothes on a line outside. It does suffer from inconvenience and in periods of rainy weather, isn't practical. Today, with dryers, one very seldom if at all ever sees cloths hanging outside on a line.

Aerosol dissemination of biological agents can be performed with pressurized spray devices such as those used around the home for spraying for pests or garden and lawn use. The spraying could be performed from the air with low flying aircraft, and in the weeks following the 11 September 2001 attack on the World Trade Center in New York City, and the appearance of anthrax in the US Mail, there was some concern about low flying aircraft being used to spray biological agents about.

When Used

The time of day is critical in the use and dissemination of any chemical or biological agent. Weather plays a significant role as well. Release of an agent during a rain storm simply permits nature to wash the agent out of the air, and the accumulating run-off simply dilutes the agent and washes it toward streams and rivers. Rain also can destroy some chemical agents that are susceptible to hydrolysis (react with water and maybe even acidity of the rain due to industrial gases such as sulfur dioxide, sulfur trioxide and nitrogen dioxides produced in the air also via lightning energy acting on nitrogen and oxygen). Winds during the day can be significant and can disrupt the concentration of agent in the air, also diluting it and dispersing it. Low level winds can aid in driving the concentrated agent cloud down wind into and through the target area. Such winds are more likely to arise and aid in the attack within a few hours of sun rise or sundown and immediately after sundown.

Releasing agent in an open area is more effective than releasing it within a city street because winds in a city are disordered by the buildings and can actually flush agent from the air as it is buffeted about against buildings and other structures and objects. The immediate vicinity is dosed, but the down wind reach is decreased.

HOW CAN YOU TELL THAT SOMETHING IS in The AIR THAT IS HARMFUL

This question is the hardest to address and there is no firm, definitive answer. The answer is a complex consideration of many environmental factors in play as well as any societal issues that may be in play at the time. Additionally, it is easier to assess the potential for a likely attack if there are overt indications of some effort by an attacking group to do so, coupled with the standing of a target being a "high value" target. In absence of any of the defining traits, unusual occurrences may or may not indicate a potential attack is in progress. So let's look at some general points by which to judge that one may or may not be in the midst of a WMD attack. This is a very general guide and should not lead one to panic if something "odd" occurs.

High Value Target

I have not come across any official definition of what a high value target is. I have seen examples of high value targets. Location, location, location. If you live in or work in or near a major metropolitan center, you are in or near a high value target (to the terrorists!). Examples include New York City, Chicago, Washington, DC for perhaps obvious reasons. Other locales include San Francisco, Los Angeles, Baltimore, Philadelphia, Boston, New Orleans and ports and industrial premises around these cities and along major highways running into and through them. If I have not mentioned your locale, no insult is intended. There are many, too numerous to list here.

New York City of course was the first major high value target picked by terrorists and unfortunately for us, successfully attacked. High value target is not just a major city. The infrastructure of a major city is also. The World Trade Center is one example. Ports for maritime commerce also are high value targets. Major, may I say, world famous facilities such as Grand Central Station in NYC is also. Boston as a city is, but it also was a high value target for the Boston Marathon which also was the scene of a terrorist attack. So as location goes, major, even world famous, events are high value targets. This brings us to another qualifier of high value target.

National economic centers also are high value targets. Examples include the New York Stock Exchange, or the one in Chicago. Ports again fit this characteristic of economically high value target. Any coastal community with a major world utilized port for maritime trade is a high value target.

Any locale that is the center of national cultural and historical importance is a high value target to the terrorists. An attack on such a target attacks our culture, our history, our heritage. Such an attack makes a big political statement (terrorism is in part defined as a political act).

Centers of government and obvious power are high value targets. The Pentagon was attacked on 11 September 2001 because it is the symbol of power and power projection by the United States around the world. Clearly the White House, the Capitol Building, the Supreme Court are also high value targets. They are the legal, political and judicial powers and authority of our nation's government. There are other locales that also fit the high value target for our cultural and historical identity, such as the Smithsonian Institutes. Philadelphia was the seat of our fledgling Continental Government of our American Revolution and there are important historical locales there such as the Liberty Bell. To a lesser extent to our national locales are our state capitols and historical infrastructures in each.

So location becomes the first item on the "list" for assessing the likelihood that you are in a "ground zero" target on the radar screens of terrorists.

Warnings & Alerts

The second item necessary in accessing one's potential for being in the midst of a terrorist attack is: are there any warnings or alerts issued by responsible, credible government sources that so-and-so group is determined or suspected to be in the process of planning an attack on the homeland? Historically, since 11 September 2001 anyway, government is very reluctant to elaborate on the nature or identity of any alert or warning they may issue concerning a possible terrorist attack. It is likely that they will not reveal any particular location (don't want to trigger a panic among the populous of the locale), or the nature of the mode or means of a possible attack, and they may not have any time frame (day, month, or time of

day) to release. Many times the lack of definitive information given to us is justified under the rubric of not wanting to reveal sources which such information may permit terrorists to figure out how and from whom we presumably learned of the possible attack. So here, you may have to operate blind, as the saying goes, be like a mushroom... All one can do is be vigilant about your surroundings and what is going on around you.

The Odd Occurrence(s)

Here one must be very careful in how you respond to the odd happening or put another way, what seems out of place from normal circumstances. Example: say you are in a building, a room for a meeting, and you smell what seems like onions. You look around and no one is eating anything let alone anything that would have onions as part of the food. That may be unusual. But it could also be that someone close to you forgot to brush their teeth that morning. The next reasonable course to follow (other than moving to a different seat if it is someone orally challenged that morning) is to be aware of how you feel as the time passes as well as how others behave. Do you begin sneezing after a while? Do you have any allergies that cause you to sneeze? Does anyone else begin sneezing? Or coughing, or eyes begin watering, whatever? Do you begin feeling other unusual physiological responses, such as vision becoming blurry, can't focus your eyes? Do others indicate vision problems? And so on. If you and others begin exhibiting the same body responses, then it is likely that there is something in the air, because you and others would not be reacting the same way, the same time, in the same place. It is worthwhile to error on safety and leave the room, find some authority of the building to inform them of what is happening. Under such a scenario, it would be considerate if not responsible of you to advise others to leave the room also.

The reaction to some stimulus, whatever it may prove to be, not only by you but importantly by others, is very strong evidence, maybe circumstantial in some people's mind, that there is something unusual, and just perhaps potentially harmful, happening. The military uses a similar stimulus-response relationship in training troops to recognize a possible chemical attack in progress.

Clearly, if you hear what sounds like an explosion, or gunshots, etc., you would act in an abundance of caution for your own safety. It is no less important in collating a series of occurrences of time, place, and unusual events to error on safety. But herein is the caution. It can't necessarily just be you that feels something. In this case it may just be an allergy that you may not even be aware of. But if others are having the exact same responses, it likely is something wrong, though it may not be a terrorist attack. It could be as the story opening this section noted, an innocent error that may not be a serious problem, but you don't know this at the time.

LIKELIHOOD YOU MAY BE CAUGHT in a TERRORIST ATTACK of ANY KIND

This is a very good question, and one that has at its heart, your personal risks. Don't panic. An examination of the history of terrorist attacks in the US can shed reasonable light on the answer. Most terrorist attacks are planned and executed for high profile, high psychological targets. It is true that some acts have been isolated, so-called lone wolf attacks against individuals such as in Moore, Oklahoma, though that has been ascribed to workplace violence by authorities, and may be a (controversial) political decision in the view of some.

The 11 September 2001 attack on the World Trade Center in New York City with jet airliners is perhaps a very good example of the statement above of a target of high profile and high psychological value.

Since 11 September 2001, much effort and treasure has been spent by government at all levels, to make attacks on major, high profile targets much more difficult. As the American counter terrorism agencies become better versed in the operations and methods of terrorists and as our intelligence gathering capabilities improve, terrorists will find it increasingly more difficult to execute an attack in the more obvious target locales. They won't necessarily stop trying. They may also switch some of their effort to secondary or even tertiary targets that may be less obvious and less "hardened". If one compiles a listing of likely high profile targets, a lists of secondary profile targets, and a list of tertiary profile targets, the length of the lists dramatically increase at the secondary and especially the tertiary targets level. Even in such targets, the object of the terrorists is the same- maximum deaths, destruction and psychological mayhem. What's the probability? I have no idea. Don't even know where to start to even try to come up with a calculated number.

But, targets of extreme psychological impact as well as deaths are what they would aim for. It is not unreasonable to assert that as the more obvious high profile targets become increasingly more hardened (as viewed by officialdom), the increased likelihood of failure in attacking those targets would likely prompt terrorists to seek and select other secondary or tertiary targets, and to capitalize on the lessened alertness of officials and citizens residing in those locales. This potential vulnerability requires each citizen to be alert and aware of the environment around them and to assess and maybe even react to occurrences that are or seem "out of the ordinary."

Having noted the above, the terrorist attack on 7 January 2015 (USA date) in Paris, France against the satirical media *Charlie Hebdo* only goes to prove how sudden and seemingly random terrorists can strike. It also goes to show they will look for the weakness in security. A news media outlet may not seem a high value target, but in the case of *Charlie Hebdo*, they published pictures and cartoons of the prophet Mohammed, a cardinal no, no in Islamic circles. They abhor free speech among other things.

HOW DECONTAMINATION WORKS

Actually, we all practice rudimentary decontamination around the house or at work in washing our hands, bathing or showing, dishes, clothes, vacuuming, etc. But in unconventional weapons agent decontamination, the process is much more exacting and specific. There are several means for decontamination. They are applying high heat, oxidation, strong detergents, and UV light.

HEAT

Heat application is as old as fire use itself. Cooking among other things, kills any microbes on the surface, or within the food material. Heat performs a process known in biochemistry as denaturation. Denaturation is a process in which various chemical forces responsible for holding biomolecules together are disrupted. As an example, proteins have a specific form and shape so they can perform their biological function to the cell or the body of a multicellular organism such as humans. Disrupt that form and shape, and the protein becomes biologically useless. Heat of the order of boiling water disrupts what are called hydrogen bonds. These are actually rather weak forces of the dipole-dipole type. Though a single hydrogen bond is quite weak, they occur multiply in molecules and their combined strength is

then significant. It is hydrogen bonds acting between many water molecules that is the reason why at normal atmospheric pressure, water has such a high boiling point for such a seemingly small, chemically "insignificant" molecule.

Very high heat, well above the boiling point of water is destructive of molecules because it leads to pyrolysis, what we commonly call burning. The charring of meat on the grill is an example of pyrolysis of the surface of the meat in direct, immediate, radiant contact with the heat source. This, however, is not denaturation. It is destruction of the chemical identity of the material subject to the very high heating. [A paper titled: "Domestic Thermodynamics or How Not to Burn the Brownies", published in the *J. Culinary Sci. & Tech.*, **11(4)**, 309-321 (2013), explains what burning actually is chemically speaking.]

Another chemical force is the London Dispersion forces or as known in biochemistry, the hydrophobic forces. These are the weakest of chemical forces operating between molecules and good examples of these forces are in gases as well as gasoline. Typically, the larger the molecule, the stronger the London forces, but they are still very weak compared to others. Heat also disrupts these forces. Heat causes molecules to vibrate (twitch) faster as well as move faster. This increased thermal motion as it is called, causes the molecules to separate from each other and in extreme cases, they do not reassociate as they normally were, and again the molecule structure (say a protein) loses its function property to the cell or organism.

Enough heat is certainly going to kill microbes, or pyrolyze chemical agents. However, other materials and certainly human skin do not hold up well to high heat. Other means are called for then.

OXIDATION

Anyone who has washed clothes, the whites in particular probably has used either bleach or some other non-bleach stain remover. Oxidizers are also used in water treatment facilities. They use chlorine initially, and generally follow that treatment up with a final treatment of spraying the water into the air where is comes into contact with the air's oxygen, a much better oxidizer than chlorine, and the oxygen exposure also removes any remaining odorants or excess chlorine that may still be present in the treated water. Bleach and other such cleaners such as Oxy-Clean (a peroxide-sodium carbonate mixture) are oxidizers. These formulations chemically react with materials and oxidize them (remove electrons), and in the case of a stain, the stain's color is transformed to colorless. Oxidizers can also render a chemical substance more soluble in water as well, making it dissolve. That is how the stain is removed, and if the material being subjected to the oxidizer is a bacterium or a virus, it too is oxidized, and this treatment kills it. [The human liver possesses many oxidizing systems that are designed to oxidize various substances, render them more soluble in water, the blood, and permitting them to be filtered by the kidneys and removed from the body via urine.] The oxidation is generally of the proteins that are part and parcel of the bacterial or viral coat. The resulting change in chemical identity and properties of the oxidized proteins renders them biologically useless to the bacterial cell or virion, and the microbe is then rendered harmless (dead). However, the time of exposure to the oxidizer depends to some extent on the concentration of the oxidizer solution (see Appendix on How To Decontaminate). Bleach is a very good decontamination material and by far a preferred means for destroying chemical and biological agents, though some materials may not react well to bleach use.

DETERGENTS

Some materials may be useful to retain for later or further use, and also may not react well with say bleach. Other means may be called for in treating those materials. Detergents and what we can call boosters here are useful in such cases. The boosters are supplemental cleaning aids such as washing soda (sodium carbonate; Na_2CO_3), or borax (sodium borate; $Na_2B_4O_7$). In a strong solution of these materials, a different process acts to remove the weapon agent.

Detergents (and soaps) interact with water in an interesting fashion. They form what are called micelles. A micelle is a spherical or ball shaped entity in which the hydrophobic portions of many, many detergent molecules are within (inside) the ball entity. The surface of the ball entity is covered with the hydrophillic or water soluble components of the detergent molecules. Any hydrophobic material, which we can generally call here a dirt particle, will naturally and chemically prefer the hydrophobic components of the detergent molecules clustered within the micelle. This is essentially how washing clothes and such works in removing what we call "dirt" or the soiling material that we wish to remove from the clothes or such. Chemical agents are in many respects also hydrophobic and so they tend to be solubilized (dissolved) within the micelle. In an analogous sense, so are bacterial cells or virions. Sufficient detergent will enhance micelle formation and therefore the "solubilizing" of such components for removal from the material sought to be "cleaned" of these harmful substances. The boosters added to the detergent help to enhance the cleaning by any chemical action they may bring about on the chemical agents.

UV LIGHT

The mortal bane of microbial life is UV light. One of the reasons that life on the Earth's surface could happen and take off as it did, ultimately to us, is that cyanobacteria in the primordial oceans began doing photosynthesis, and oxygen was their waste product, which as a gas bubbled to the surface and entered the atmosphere. Over millennia, that busy work of the cyanobacteria is generally believed to have given us today's oxygen atmosphere. Oxygen and its variant form, ozone, filter much of the sun's deadly UV radiation that kills cells. It is the sun's UV radiation that causes the sunburns, and that should offer the reader a glimpse into the hazard UV light presents to living tissue.

Generally, the energy of UV light on molecules (referred to a photoreactive) is broad in its specific effects, but can be an aid in decontamination of outside surfaces that are exposed to sunlight. Chemical and biological agents, both, are subject to photoreaction in the presence of UV light. All that is required of us is to leave it alone and let the sun do its thing. It does take some time. Anything shielded from the sun's light will likely not be exposed to much if any UV light, though.

UV light also attacks weak chemical forces acting between molecules such as the hydrogen bonding and London Dispersion forces noted about under the HEAT subheading. On biological systems, the UV light also attacks the DNA, leading to what are called pyrimidine dimers, and this can interfere with replication of the DNA and if so, from that cell growth and other biological processes dependent on a normal DNA molecule likely may be stopped. Cell Dead.

OTHER EMERGENCIES and YOU

Terrorist attacks are a more reported event of manmade origin. Other hazards to life and/or property, manmade or natural are:

1. tornados
2. hurricanes
3. tropical storms
4. earthquakes
5. forest fires
6. blizzards
7. severe snowstorms
8. floods
9. severe thunder storms
10. epidemics/pandemics
11. refinery explosions
12. chemical plant explosions
13. municipal fires of various types
14. economic depressions
15. civil disorders/riots
16. home invasions

As destructive and on occasion as lethal as natural disasters can be in their own right, it appears that what nature can do to us pales in comparison what we seem readily to easily to do to ourselves. What nature does is impersonal, random and without malice of forethought. What we do to ourselves too often is very personal, with malice of forethought, and perhaps random in many cases only by happenstance of in the wrong place at the wrong time. Regardless if natural or by human hand, we must confront and respond to an emergency immediately and with reason and caution, too. Preparedness is the watch word of all emergency response agencies, federal, state and local. They all provide lists of one kind or another of items that we should have on hand to "endure and support" ourselves for at least five days after the emergency occurred. And yes, even the often derisively cited duct tape has a potential value and use in some emergencies.

The point overlooked in such comic dismissal of things like duct tape is that one must "anticipate" in advance of knowing what the emergency will be, "what may I need to get along without help for some period of time?" In today's world, it is not just food, water, clothes, medications, family. It may be tools, hand, powerless, and operable by you. It may be materials to secure your residence against the weather, provide warmth, sanitation, personal hygiene. And in some cases, maybe even security of self and family. Preparedness is not a three-days-before matter. It is a months long forethought before an emergency strikes. It is having time to gather the items and materials not in excess but in reasoned nature and quantity to be self sufficient for at least five days, a week, maybe two weeks, for what may be practically isolated existence and survival until the "mitigation" efforts of emergency agencies and government organs take hold again. If you wait to plan your needs until a disaster strikes or three days before a disaster arrives, you may well find yourself and your family not only up the proverbial creek without a paddle, you may not have the implied proverbial boat either.

Important papers are a must such as auto, home and medical insurances, not to mention (I am now) car registration and insurance cards, and car titles, and home papers, if you don't have them in a safe deposit

box at your bank. Any critical medications that any family member must take each day should be easily grabbed for retention by the person or adult family member. A list of family and close friend phone numbers is a must. Arrangements must be made for school-age children and well versed with them so they know who to go to if you or you home are not present. They should know the phone numbers of immediate family and friends to call as well as yours. In the event of a home fire, they should know how to get out of their bedroom at night, and where around the house or neighborhood they should go as a rally or meeting point maybe some close neighbor's house. If you have pets, they must be considered in your plans not only for sheltering in place, but also if you must evacuate. The pets will need food, water and any medications they require. All of this requires advanced thought, planning and a written plan that can be retrieved and gone over in preparation of any actions you may need to take in the face of an emergency.

Further consideration must be given to such daily routine matters as cooking, and food preparation as well as hygiene. As a minimum, each person will require one gallon of water each day. Food reserves should be those that are non-perishable, such as sealed packages that need only water to rehydrate the contents, or can goods. The food sources should provide protein, vegetables, carbohydrates, and fruits. A can opener for cans will be essential, but don't rely on an electric 110v kitchen unit. You may not have electrical power. A battery can opener may work– so long as you have batteries for it, but a hand mechanical can opener avoids dependence on any electrical energy source to operate it. Hot food is better for digestion, and also for moral. A means to heat up food is useful. A small propane burner or two burner stove such as those used in camping is fine. But you will need an appropriate propane fuel source such as the 12 or 16 ounce canisters that will attach to the burner unit. There are propane lanterns available which can be attached to the small propane canisters and used to provide light (OUTDOORS ONLY) if electricity is still down. This can be a security aid as long as it is placed and used in a safe location so it won't present a fire hazard or a carbon monoxide hazard. Using these units outside can supplement battery operated light sources used within the home. There are a number of issues that need to be thought out well in advance of any natural disaster and prepared for in advance.

OFFICIAL EMERGENCY RESPONSE and YOU

Government Aid and Assistance

Government from the Federal through State and down to local levels are geared up to respond to any number and type of emergency events, disasters, calamities, and terrorism. As tax payers, we pay taxes in part for these services and preparedness on the part of government at all levels. If you go through your local phone book, if you still have one in today's cellphone and internet culture, you will see listings for not only the local police and sheriff's office, but the municipality's, state's and federal government's emergency management agencies. The federal level most everyone knows by its initial- FEMA, Federal Emergency Management Agency. The state level agency generally adopts a similar handle- "State Name" Emergency Management Agency. Local agencies vary, but generally along the lines of "Municipality Name" Office of Emergency Management.

Our general experience with such organizations arises with natural disasters such as hurricanes, tornados, earthquakes, floods, tropical storms and wildfires to name several of the more common and prominent natural disasters. Most federal emergency response organs and personnel are now headquartered under the US Department of Homeland Security. The effectiveness of response since that

reorganization after the 11 September 2001 terrorist attack on the World Trade Center has been the focus of much debate and finger pointing, Hurricane Katrina being one high profile example. Here's what you should keep in mind about government emergency response and assistance.

If you are of the mind that government will come to your immediate aid after a disaster in your region, like the US Cavalry of the movies, then you are betting on human error, frailty, and oversight in the face of a massive emergency. As was starkly plain to all who were caught in the aftermath of hurricane Katrina, emergency response can not be any better than the infrastructure in place in the disaster's wake. This includes not only roads, but communications, coordination, chain of command, etc. Disaster response begins at the local level, every time! That means the most local preparation begins with YOU. Only if the local authorities are overwhelmed, then they call on the state authorities for help. If the magnitude of the disaster exceeds the state's ability to handle it, then the Governor of the state calls the President of the United States and asks for a federal declaration of emergency, and if granted, then and only then, does the federal effort mobilize under the authority and control of FEMA in assisting stae and local authorities. Local authorities in theory still are in charge.

In any event, what should your preparations be in advance of any disaster or domestic emergency? FEMA has offered advice and lists of supplies and materials to have on hand. These lists are general, and provide suggested materials to have on hand for nearly any emergency where one may have to operate under a survival basis until near normal local life, order, etc. are re-established. One of the suggested items to have on hand is medication. If you have any prescription medicinals that you must have on a daily basis, you are advised to have an extra supply on hand. After all, pharmacies or your physician may also be adversely affected by the disaster and not reachable. As it is not likely that you can get a prescription from the issuing physician for an extra supply to have on hand for "emergencies", and also not likely that you can get insurance to pay for an extra supply even a few days before a known impending disaster to come, this advice seems unlikely at best to work. Many medications today are becoming increasingly under the ever watchful eye of the DEA (Drug Enforcement Agency) and any attempt to get extra is suspect. Furthermore, many of today's physicians would be reluctant to issue prescriptions for more than the necessary one-time 30 day quantity (or whatever the refill supply quantity is) in part because of the DEA looking over their shoulders. This is particularly true in the case of any controlled medications. You can try it. Good luck.

The point to be made here, if not hammered, is that you must think about what you must have to live through each day, until "normalcy" returns. Get what you can together, packaged in an emergency bundle, store it where it is easily retrievable and periodically check it out for being up-to-date. Batteries for flashlights and portable radios don't last long and so they should be replaced at intervals throughout the year so those in emergency storage are as fresh as possible.

Medications should not be stored as you would batteries or other nonperishable needs, but there may be a small way to game the system to build up a reserve supply of medications. If you use something each day and it is issued in a 30-day supply, one can often phone in a renewal two or three days before the last pill is used. If you do this each month, over the coming year you may find you have a dozen or two pills accumulated. Though you should use them in sequence, you will find that you have a few extra each month remaining with the current renewal. This is a way to have extra on hand and in an emergency, even if you may not be able to get a renewal very quickly, the extra that you have accumulated may last until pharmacies are themselves up and running again. Some prescriptions are

able to be issued on a 90-day supply basis. That may or may not solve the problem of running out of medication during an emergency depending on how close the emergency occurs to when you would use the last pill in that issue.

This is an example of the pre-planning that you must do for yourself and your family. It can't be done within days of a natural disaster coming your way. Though FEMA and other emergency response agencies have many lists of emergency materials to have on hand, there is one item they are conspicuously silent on. It seems to be a taboo subject, but one that sometimes comes up. And there is no official advise that considers the dimension of the issue and concerns that some may have.

WHAT EMERGENCY PREPAREDNESS OFFICIALS DON'T DISCUSS

The Taboo Question: *SHOULD I HAVE A GUN?*

In any emergency, even a natural disaster, such as hurricanes, tornadoes, earthquakes, etc., there is the ancillary event of criminal predation on the vulnerable and helpless. A review of all the lists of emergency supplies and equipment the American citizen is advised to have on hand, the one glaringly absent mention is anything that offers personal or family security. They don't discuss the issue of a gun for self defense against predators taking advantage of the ensuing chaos in the wake of a disaster. Be it clearly understood, **I am not advocating nor discouraging any citizen, who is an otherwise honest, law-abiding, non-criminal record citizen to have a gun.** I don't know you. There are entirely too many factors about you of which I have no knowledge to make such a pronouncement either way.

There are people I know who though they are legally eligible to own a gun, that I personally don't think they should have one. I will not go into the reasons here. I will say here that under the following three conditions, you should not have a gun: (1) you have always felt and still do, that no private citizen should own a gun, then you should not have one; (2) you are and have always been afraid of guns, then you should not have a gun; (3) the only reason you want a gun is to have one in case you need to shoot some one, then definitely, you should not have one.

BUT, if you are contemplating getting a gun, then understand up front, owning a gun brings with it, a great deal more responsibility in exercising that Second Amendment Right, more so than the others, and as much and perhaps more so than even owning a car. And there in is the issue with a gun. Many people want or think they should have a gun for emergency self defense purposes. That's the only reason they feel the issue comes up.

Look at the issue of only having a gun for an emergency like needing a car for only an emergency. Having a car for emergency needs, going to the hospital emergency room (ER) for example, is certainly very handy. But, if the only reason you own a car is for an emergency, and you don't learn how to drive it, or don't drive it at all, then when an emergency comes up for which you need to drive it, that's not the time to learn or figure out how to drive it or try to remember how to drive it! And under the adrenaline pressure of the emergency, the attempt to use the car may prove as dangerous as the harm faced in an emergency needing to get to the hospital ER.

Owning a gun for self defense is the same matter, in spades, or on steroids, however you wish to emphasize the magnitude of responsibility in owning a gun. If you do not intend to learn its safe

handling, how to use it, how to load and unload it, how to aim and squeeze the trigger, control your breathing while doing so, never practice with it at the target range to insure that you can hit what you point it at, then it will not only do you little if any good in an emergency, it may be as great a danger to you and your loved ones as not having it. And a gun in the home is a serious curiosity to children and teenagers. Forbidding them to ever touch it only heightens their curiosity of the "forbidden fruit". They need to be educated on its inherent dangerousness if mishandled, and if you do have a gun and practice its use, they should be instructed in that also. Their curiosity will be satisfied and if they can go target shooting with you, it will become less and less a novelty, a norm perhaps, that will be less likely to trigger mischief in your absence.

Whether one decides to get a gun or not is a personal decision that must be thought out very carefully in advance of executing the decision. If you get one, then you must resolve to learn how to use it, handle it, aim it, shoot it, and PRACTICE shooting it regularly. You must practice loading it and unloading it (with spent cases!) even in the dark, as you may need to do so in an emergency. Simulating the dark can be done blindfolded (as the military does) or just keep your eyes closed until you have a problem doing something. Knowing how to handle you gun in the dark is important as criminals may not only cut any phone lines (if you have a land line phone still), but many homes now have the circuit breaker boxes located outside, and criminals may trip the main power so you are in the dark. Only through regular practice, and familiarity with the gun can you even hope to be able to use it safely for yourself and family under the adrenaline pressure of an emergency with any degree of confidence and expertise to do so, night or day. The military does this with troops. It's called "muscle training", repetitive actions over and over that become "second nature". It is also a psychological training that has NO SUBSTITUTE for safe handling and use, PERIOD.

And don't forget to look into local and state laws on firearms possession in your locale. If you are reluctant to call the police on questions about gun ownership, then talk to a criminal attorney about it. If you are afraid of guns, don't intend to practice with it, don't intend to have other family members learn safe handling as well, probably you should forget any thought of having a gun.

If deciding to own a gun, there are many different types, calibers, etc. If at all possible, go to a dealer with an experienced gun owner friend or family member, who you know well and trust his or her judgement and opinion, to look at the different types. A gun is much like golf clubs, in that they are not generic, universal sizes, weights and fit. Hold it. Make sure you can hold it in your hand completely, comfortably, and securely. It shouldn't be too big or too small in the grip (handle) in your hand to hold. Much of the weight of a handgun is before your hand, the frame and barrel assemblies. It should not be overly heavy there to pull your hand down by its torque from gravity's pull and become difficult to maintain its hold when extended out by your arm while aiming along the sights, through muscle fatigue. And if you get a gun, get a cleaning kit for that caliber and barrel length. A gun should be cleaned as soon as possible after firing it. A dirty gun is prone to jamming. In an emergency, that won't help you. It should be cleaned and lightly oiled.

You should be able to operate any safety feature on the gun without having to look at it to do so. This is particularly important if you need to operate it in the dark of night. Simply put, you should know the gun as you know the back of your hand. Have someone you know and trust who is experienced in shooting a gun or better yet, a certified instructor go with you to the range. Have them teach you how to use your gun, coach you through its use as you perform the various actions required to fire it. And emphasize and

pay attention to the safety rules, for yourself and anyone else in the family you decide to also be introduced to learning and knowing how to use the gun.

A real gun is not a toy. It can be a useful tool just as a knife, saw, hammer, or a screwdriver. It can also be a very deadly tool if mishandled or in the wrong hands just as the others can be.

ADVICE on USE of WEBSITES

There is no question that websites harbor a wealth of information all at the fingertips of the surfer. The "web" is not called the "information super highway" for nothing. But just like a real automotive highway, there are some questionable "drivers" out there, and some are just plain loose if not careless with the "facts". All websites are not necessarily authoritive, accurate or complete in the information they put forward. The information on a company website may be a bit questionable, at least in the sense that a company wants to convince you of the value of their product and wants you to buy it. When it comes to over-the-counter medications and preparations, in many cases, there is no hard scientific data that supports some or all of the claims they may make. And one should not be convinced of a product's efficacy by some "testimonial" offered by a using customer. There are no scientific controls or data applied behind the use of the product. As the saying goes, "let the buyer be ware".

As for medical websites, they offer a wealth of information, and some can be quite detailed in what they explain or convey in their topic you are searching. BUT! Medical websites are to be used ONLY as a GENERAL guide, NOT as a DEFINITIVE last word. You can use the information as a basis for consulting with your physician for an explanation from him (her) as it applies to your specific medical case at hand. That includes prescription drugs you may see advertised on TV, on the radio or in magazines. Your particular medical case, your immune system's standing and a host of other issues may not favor the use of such medications and for reasons that your physician well knows and should be able to explain to you.

Use websites as a guide for information such as general explanations, key or medical terms and phrases that you can look up on other sites and cross reference what several say as well as discuss the matters with your physician. Some of the more useful sites may be .gov, and .edu sites and many good ones are .org sites such as hospitals and professional and licensing groups and such. One of the reasons for this is that (1) they aren't trying to sell you something, and (2) they often back up their statements and pronouncements with references and citations to the scientific and medical literature or adhere to professional standards and law as the case may be. Even there, be careful. There have been some fraudulent research publications that have been renounced, but the article still in print may not so indicate that refutation of the work. Be careful. The information super highway has its reckless writers as the highway has its reckless drivers.

GLOSSARY

The definitions of medical terms were adapted from the definitions obtained from Stedman's Medical Dictionary, 25th Ed., Ed. William R Hensyl, Williams and Wilkins, Baltimore, MD, 1990. The chemical names cited herein are taken from The Merck Index, 9th Ed., The Merck & Co., 1976.

Absorption- the process of taking up a substance or material into and within another material or

substance [a sponge absorbs water throughout the sponge]

Adsorption- the process of a substance or material taking up another on its surfaces

Aerosol(s)- fine particulate material suspended (generally) in air. Fog or household sprays are examples of aerosols.

Alpha particle(s)- an ionizing radiation particle that is a helium nucleus (without electrons)

Alveoli- (alveolus, singl.) the terminal sac-like structures (like grapes on the stalk) of the alveolar duct in the lungs (this is where gas exchange takes place between the lungs and the capillary blood system of the lungs)

Anthrax- generally refers to the disease state caused by the microorganism *bacillus anthracis*

Antibiotic(s)- a substance derived from fungi (molds) or bacteria that inhibits the growth of other microorganisms such as other bacteria or fungi

Antipersonnel- any weapon system or object that is specifically designed to inflict injury or death on people

Antiterrorism- a range of diplomatic, legal, and defensive policies and approaches to understand the root causes of terrorism and means taken to preempt terrorist acts

Antiviral- of or pertaining to interfering with a virus' life cycle. It "kills" the virus.

Arsenical(s)- of or pertaining to compounds that contain the element arsenic

ATP- Adenosine Triphosphate, the energy molecule of living cells. Everything your body does, it made possible and doable by paying for it with ATP. It is the currency of life.

Autoclave- a special type of "pressure cooker" that super heat water steam under pressure to kill and wash away bacteria, viruses, etc. It is the means for sterilization of objects placed in it.

Bacteria (pl.) prokaryotes, microbes of one cell, with DNA, no cell nucleus, and some are pathogenic (cause disease) and others are beneficial to animal life such as humans

Bacterium (s.)- a single cell of the bacteria persuasion

Beta particle(s)- an electron that originates from the atomic nucleus, results from the disintegration of a nucleus neutron leaving a proton behind in the nucleus as the electron is ejected under high velocity from the nucleus. This is an ionizing radiation.

Biological Weapon(s)- Any microorganism or microbial byproduct specifically used to bring about direct injury or death to personnel, either by direct infection or by

the toxicity of the microbial byproduct

Biomolecules- molecules found in living cells and generally only in living cells; this includes nucleic acids, certain lipids, certain carbohydrates, and amino acids and proteins.

Bleach- a commercial household cleaner, an oxidizer, consisting of sodium hypochlorite, NaClO, in water. At this writing two concentrations were available. The gallon bottles were 5.25% sodium hypochlorite, and the half-gallon bottles were 6% sodium hypochlorite.

Blistering Agent(s)- a class of chemical agent weapons that cause extensive chemical blistering of the skin

Blood Agent(s)- a class of poisonous chemical substance(s) that interferes with the utilization of oxygen within the mitochondrion of a eukaryotic (animal) cell, generally halting the electron transport system necessary for ATP synthesis

Carbamate(s)- a non-organophosphate chemical agent that similarly interferes with nerve impulse transmission; commonly found in insecticides such as wasp and hornet spray preparations

Carcinogen(s)- generally and broadly, any chemical, biological or physical substance that can cause cancers.

Chemical Weapon- Any chemical substance specifically used to bring about direct injury or death to personnel

China Syndrome- a term used in a Hollywood movie, and means a catastrophic meltdown of a nuclear reactor core, resulting in the fuel elements melting through the core to the ground as though melting its way to China

Chocking Agent(s)- a class of chemical agent weapons that attack the lungs, generally leading to pulmonary edema, resulting in coughing and chocking as a result of damage to the lungs and the ensuing fluid buildup therein

Conventional Terrorism- terrorism acts in which conventional weapons such as bombs, firearms and the like are used to cause injury and death

Counter Terrorism- offensive actions in pursuit of terrorists, actions taken to thwart or limit terrorist actions in progress

Critical Mass- generically meaning the minimum mass of fissile material necessary to sustain a chain reaction, but it actually is a mass of a fissile element that leads to a super density for a nuclear explosion to occur

Cyanide- an aqueous chemical anionic specie consisting of one carbon and one nitrogen atom and chemically designated by the formula CN^-

Cyanogen Chloride- A chemical blood agent with the formula ClCN

Cytotoxic- destructive to cells

Cytotoxin- a substance, generally with reference to antibody, that inhibits or prevents the function of cells, causes destruction of cells, or both

Decontamination- the process of specific actions taken in series to remove or otherwise render harmless a surface, object, or person of any hazardous material that is injurious to people or other animal life.

Deoxyribonucleic Acid- The genetic material of all living cells, and often just written as DNA

Dimerization- the chemical process of two smaller, identical molecules combining to form one larger molecule

Dismutation- a disproportionation reaction, particularly seen in a biological system, in which both oxidized and reduced forms of a chemical substance simultaneously result as products

Dirty Bomb- a conventional explosive device in which is laced or embedded radioactive materials to create a radioactive hazard in addition to the usual explosive effects of an explosion.

Disinfection- the process of killing the vast majority of pathogenic microbes contaminating a surface, object or person so as to present no longer a hazard to health and safety

DNA- see Deoxyribonucleic Acid

Ebola- a hemorrhagic viral fever causing virus originally observed arising in Africa

Edema- (swelling) a build up of fluid in cells, tissues or serous cavities (related to serum or a substance having a watery consistency)

Electrolyte(s) (med.)- ions of elements of complex ions necessary for life and found in blood. They are electrolytes in the chemical sense as they conduct electrical current.

ER- Emergency Room of Hospital; (biol.) endoplasmic reticulum

Eukaryotic- of or pertaining to animal and plant cells which have organelles (smaller packaged regions within the cell) among which is a nucleus which houses the DNA

Eukaryote(s)- (also eucaryotes) cells or organisms that consist of cells with a distinct organelle nucleus

Fasciculation(s)- involuntary contraction or twitching of groups of muscle fibers

FEMA- Federal Emergency Management Agency

Fission (nuclear)- the splitting and a heavy element such as uranium (U) into two or more smaller, lighter elements with the release of energy

Fusion (nuclear)- the combining of lighter elements such as hydrogen (H) to form heavier elements with the release of considerable energy. This is the process that fuels the stars such as the sun

Gamma ray(s)- electromagnetic energy of very small wavelength and extremely high penetrability of otherwise seemingly solid, dense materials. This is one of the ionizing radiation types. It is the most dangerous type.

HEAT (explosive)- High Explosive Anti Tank, a large caliber shell fired by a tank that will penetrate the armor of an enemy tank.

Hemorrhagic Fever- a class of disease typifying both a high fever and uncontrolled, generalized bleeding in and of various parts and regions of the body

Hydrogen Cyanide- gaseous compound of hydrogen, carbon and nitrogen, extremely poisonous, extreme inhalation hazard, a historical blood agent war gas

Ionizing Radiation(s)- radiation that can cause molecules to form ions, positively charged (cations) or negatively charged (anions)

Kiloton(s)- a unit of energy and means of measuring the explosive energy of generally fissile nuclear weapons. The standard is one kiloton is equivalent to 1000 tons (2,000,000 pounds) of TNT

Lewisite- an arsenical blister agent, chemical name dichloro(2-chlorovinyl)arsine

Megaton(s)- a unit of energy and means of measuring the explosive energy of thermonuclear (H-bomb) weapons. The standard is one megaton is equivalent to one million tons (2,000,000,000 pounds) of TNT

Meltdown- the process typically a potential hazard of nuclear reactors wherein the reaction if out of control results in the fuel rods melting and the molten material collecting on the bottom of the core

Microbe(s)- microscopic organisms not visible with the naked eye. A broad classification which includes bacteria, molds, protozoa, and viruses.

Mustard Gas- a specific sulfur based chemical and blistering agent used in WWI, chemical name 1,1'-thiobis[2-chloroethane]

Nerve Agent(s)- a class of chemicals that affect and interfere with neuromuscular action. Two types are carbamates (some are insecticides such as wasp spray formulations), and others are organophosphates, which are much more poisonous and lethal to humans

Neutron(s)- a neutral subatomic particle found in the nucleus of all atoms heavier than the hydronium isotope of hydrogen. It consists of a combined proton (positive charge) and an electron (negative charge) and the sum of the charges is zero or neutral

N-Mustard(s)- a class of blistering agents similar in effect to the sulfur mustards, but are based on a nitrogen atom as the bridging atom in the chemical structure

Nonpersistent- referring to chemical agents that are typically in the gaseous state and do not linger, but are dispersed by air, wind, rain, etc., rendering their hazard to personnel eventually non existent

Nuclear Terrorism- the use of a nuclear weapon by terrorists

Nucleus (biol.)- an organelle of a eukaryotic cell which houses the genetic or gene molecules of DNA and all the chemical processing reactions to produce DNA, nascent RNA

Nucleus (phys.)- the center most region of an atom, where the vast majority of mass is centered, housing the protons and neutrons of the atom

Organophosphate(s)- a class of organic compounds possessing phosphate in a specific chemical linkage with other active chemical groups (such as fluorine or the cyano group) attached to the phosphorous atom, rendering the structure very reactive and poisonous to animals and humans

Overpressure- the pressure above normal atmospheric pressure caused by an explosion, either by chemical explosives or a nuclear detonation, or some other agency. Overpressure can cause injury to the lungs and ears

Oxidation- the chemical process in which a molecule or atom loses one or more electrons; this can lead to a molecule or atom with a positive charge, or a radical specie with an unpaired electron

Pathogenic- causing disease or abnormality

Persistent- related to WMD weapons agents, the characteristic of remaining viable and dangerous under environmental conditions

Phosgene- a choking chemical agent used in WWI, Chemically it is carbonyl chloride, $COCl_2$, chemical name carbonic dichloride

Poison- any substance ingested or externally applied that is injurious to health or dangerous to life

Poisonous- possessing the properties and effect of a poison

Positron(s)- an ionizing radiation particle similar in size and mass as an electron, but with a positive charge (anti electron).

PPE- Personal Protective Equipment, refers to over-garments worn over street clothes, and gloves, protective masks, protective booties, gloves, head covering, etc.

Prokaryotic- of or pertaining to prokaryotes

Prokaryote(s.)- (also procaryote) a cellular organism such as bacteria or blue-green algae, that lack a defined, membrane bound nucleus to contain and confine the genetic material (DNA).

Pulmonary Agent(s)- chemical substances that on inhalation into the lungs, damage lung tissue of the alveoli, leading to fluid seepage including blood from alveolar capillaries, and leading to pulmonary edema

Pulmonary Edema- a fluid build up in the lungs [see edema]

Radiation- the propagation of waves or particles, such as light, heat, or radioactive particles emitted from unstable elements. Light and heat are examples of nonionizing radiation (they do not cause ions to form in living tissue), while particles emitted from radioactive elements do cause ions to form in living tissue

Radical- in chemistry, a molecule or atom with an unpaired electron

Radioactive (Radioactivity)- the property of some substances to emit particles (□, ˆ, positron) or energy (◡-rays) that causes ionizations of living tissue and potentially severe damage and/or death

Radiological Agent(s)- substances that are themselves radioactive, and potentially used to cause injury or death to people

Reduction- the chemical process in which a molecule or atom gains one or more electrons; this can lead to either a negatively charged specie, or a radical

Ribonucleic Acid- the nucleic acid polymers comprising such biomolecules as m-RNA, t-RNA, or r-RNA, and involved ultimately in the biosynthesis of proteins

RNA- see Ribonucleic Acid

Sarin- organophosphate nerve agent, lethal dose human, about 0.01 mg/kg body mass, more poisonous than parathion, chemical name methylphosphonofluoridic acid 1-methylethyl ester

Secondary Infection- an infection, generally bacterial, that arises as a result of a weakened condition in a person suffering some other primary and serious major assault to his (her) health

Soman- organophosphate nerve agent, more poisonous than parathion, chemical name methylphosphonofluoridic acid 1,2,2-trimethylpropyl ester

Sterilization- the process of killing and cleansing an objects surface of any and all microbes through the means of superheated steam under pressure in a device called an autoclave

Tabun- organophosphate nerve agent, chemical name dimethylphosphoramidocyanidic acid, ethyl ester

Terrorism- the use of violence against a people to achieve a political end, essentially forced on a government

TNT- one of the more common explosives in use, TriNitroToluene, is chemically known as 2,4,6- trinitrotoluene

Toxic- poisonous, pertaining to a toxin

Toxin- simply, a poisonous substance produced by a living cell in microorganisms or higher plant and animal species

Ultraviolet- of or pertaining to the portion of the electromagnetic spectrum with wavelengths below 400 nm. Such energy light is invisible to the human eye, and is in part responsible for the effects of sun burns

Unconventional Terrorism- terrorism actions that draw on the use of unconventional weapons such as chemical, biological, or radiological agents

Unconventional Weapon(s)- weapons that do not rely on the conventional means of inflicting injury or death (such as firearms, explosives, blades), but use chemicals, microbial agents or radiological substances to injure or kill

UV- see ultraviolet

Vector- in biol. and medicine, technically an invertebrate animal (tick, mite, mosquito) that carries and transmits a disease (generally a pathogenic microbe).

Venom- a poisonous fluid secreted by some snakes, spiders, scorpions, etc., that consists of several separate biochemical compounds, and in toto, is injurious to health or dangerous to life

Viral- of or pertaining to a virus

Virus- a class of microorganisms that are not cellular, incapable of independent existence outside of a cell, and generally consists of two types, RNA and DNA, enclosed in an otherwise protein coat. The common cold and flu is caused by certain viruses

VX- persistent organophosphate nerve agent, liquid contact hazard, virtually no vapor inhalation hazard

Weaponization- Erroneous Meaning: the use of a biological microbe as a weapon to injure or kill people.
Correct Meaning: the specific formulation of a given microbe or toxin in physical form, consistency, particle size, packaging means, protection against clumping, humidity/moisture, sunlight, etc.

Weapons of Mass Destruction (Weapons of Mass Death)-

WMD- Weapons of Mass Destruction (Death)

WWI- World War I, 1914-1918
WWII- World War II, 1939-1945

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APPENDIX

Chemical Weapon Agent Decontamination Procedures and Materials

There are some publications that outline decontamination procedures. Some are military and some of those may be difficult to acquire (especially in light of 11 September 2001), some are civilian and may be related to emergency response subjects. These publications note the cleansers and the materials such as mops and pails that are useful in decontamination methods.

Historically, the military employed bleach-based mixtures known as STB [calcium hypochlorite and 6% calcium oxide] and DS2 [70% diethylenetriamine, 28% ethylene glycol monomethyl ether, 2% sodium hydroxide]. These are very strong cleaning agents, and generally, have been replaced with other environmentally friendly alternatives. As a civilian citizen, confronted with chemical agent terrorism, you really have no business trying to deal with such contamination yourself as you have likely no training in the procedures of decontamination. However, for the nonpersistent agents, no decontamination is required as the wind and sun or rain will perform that for you. The persistent agents are the class that require decontamination. For the civilian, the best cleaner for that is probably household bleach. Bleach is an oxidizer so it will chemically react with the agents, oxidizing them to substances that are less dangerous, generally more water soluble and capable of being flushed away in rinse water. Another bleach agent similar to the STB (Super Tropical Bleach, rated at about 30% chlorine) is HTH used to chlorinate swimming pools. HTH probably is too strong an agent to use for "incidental" contamination purposes. The household bleach in 20% dilution is probably good to use.

A critical issue in decontamination of persistent agents is not to get the agent on you as you decontaminate the exterior of your home, driveway, outside furnishings and children's playsets, etc. This is not easily done, especially without detailed training. Most likely, you won't need to be so engaged. But, if you are in the path of the down wind travel of such chemical agents, there is a potential that you may have some agent settled to your outside facility surfaces. There is no way you will know how exposed you have been. And the injurious and lethal dose of chemical agents does depend on body mass (or weight), and children have less body mass than adults. So a level that may not be particularly harmful to an adult could be serious to a small child. Generally, chemical tests are run to determine if any such chemical agents have settled to the ground, etc. If so, then decontamination is called for. For decontamination one must wear protective gear. What is available to civilians isn't the best suited gear, but it is far better than nothing. The PPE materials you can use are:

1. good rubber boots
2. thick rubber gloves
3. a rubberized rain coat
4. rubberized pants (fishing coverall waders would do)

5. rubberized rain hat
6. goggles such as what you may wear for swimming under water
7. a protective mask to minimize any inhalation of any aerosolic material kicked up into the air around you as you perform the decontamination. The best type you can get easily available on the market probably is an activated charcoal painters mask.
8. latex or nitrile "surgical type gloves"
9. buckets, 2.5 and 5 gallon
10. garden hose, 100 ft
11. garden hose attachable fertilizer or weed spray attachments for liquid preparations

You want to close off all cuffs at the wrists and ankles to seal against any splashed material making contact with the skin. Button up the collar and seal as best you can for the same reason. Cover the remainder of you face and ears also to avoid contaminated splash material contacting the skin. You should wear (2 layers) latex or nitrile gloves under the outer heavy rubber gloves, for reasons presented below. [If you are allergic to latex, use nitrile gloves.]
A garden hose with a reservoir bottle such as is used for spraying plant foods and weed killers is useful. It will contain the bleach. Use the bleach full strength from the store bottle as it will be diluted with the hose water in application. There are two concentrations of household bleach available. One is about 5.25% (usually a gallon bottle), the other is about 6% (usually the half gallon bottle). You will need a large trash can with a strong bleach solution (20%) in it standing aside for depositing your contaminated outer protective garments after you are finished with overall decontamination. Another solution of household bleach should be about 10% and this concentration can be used to wash your bare hands and then rinse afterwards.

I know, this sounds like a very big, involved project. Exactly right. That's one of the reasons, chemical weapons are regarded by the military also as harassing as well as lethal. Every time you encounter them, you either abandon the premises, or you go through the trouble of decontaminating it. [For large expanses of terrain, the military is not going to decontaminate the area. They will determine where the outer limit of contamination is, post signs warning troops to not enter, and wait for nature to do the job.] Additionally, "suiting" up for this process can be very uncomfortable, especially in warm weather, high humidity. Chemical weapons use capitalizes on a number of features of the agent's inherent danger to make activity very uncomfortable, troublesome and time consuming even if the target against which it is used, responds in an effective defensive way.

Other cleaners that may be useful for clothing or surfaces that can not be exposed to bleach are:

1. oxyclean (sodium percarbonate: $2Na_2CO_3 \triangleq 3H_2O_2$)
2. hydrogen peroxide (H_2O_2)
3. washing soda (sodium carbonate: Na_2CO_3)
4. laundry borax (sodium tetraborate: $Na_2B_4O_7$)
5. laundry detergent
6. vegetable oil
7. linseed oil
8. pine oil

9. Lysol

Laundry detergent in very strong concentration solution may be useful for prophylactic cleaning of clothes worn under the PPE used to perform the direct decontamination. Vegetable oil, linseed oil, and pine oil may be useful as solvents to wipe down surfaces that can't bear bleach treatment (such as the car). The cloth so used must be treated with a strong bleach solution to decontaminate the cloth(s). The last four items (5-8) basically are solvents for water insoluble materials (technical term is hydrophobic materials), which some chemical agents are not very soluble in water. These solvents can dissolve the agent from surfaces, but the agent is not itself destroyed. the cloth or other material used to wipe the surfaces is itself contaminated and must be decontaminated. It is not a good idea to simply discard these materials in the trash. Anyone coming alone and handling that trash may become exposed to the chemical agent or its vapors (on a hot day) and become ill at the least. The same risk confronts you and your family while awaiting the next trash pickup.

Approach to Decontamination

I'll say it again. You probably have no business engaging in any decontamination of your residence, and it may not be necessary under the circumstances of a local terrorist attack, but if absolutely necessary, most likely by emergency concern or direction of authorities, who may not be able to do it for you or help you given circumstances, decontamination of your property with result in a lot of runoff and contaminated materials. Much of the runoff may end up in drainage ditches. Let's go from the standpoint that you need to decontaminate.

Begin decontamination at the buildings (house, garage, etc.) windows and doors by hosing down the roofs, sidings, windows and exterior doors. Clearly all such windows and doors must be closed tightly before starting and they should not be opened if at all possible in the immediate wake of any such attack. Avoid going in and out as you may be tracking agent indoors. If you need something inside, have someone inside hand it to you outside, but don't touch them. Nothing brought outside goes back inside until it is thoroughly decontaminated. If you have a sandbox for the kids, you will need to hose that down as well, and the kids can't play near or in it until you no longer smell any bleach odor. Clean the vehicles first with solvent (not bleach unless you want to make your local body shop happy and rich) soaked cloth(s), at least twice over. Place those cloths into the large trash can with the 20% bleach solution. Don't get into the car to move it. You are "contaminated". Hose the driveway down starting where it is closed to you buildings, careful about the hose spray soaking the car's sides or undersides, and work your way toward the street and any drainage ditches.

Once that is done, disconnect the spray bottle unit from the hose, deposit it into the large trash can with the 20% bleach, bottle and contents all. Use the hose now with only water. Go back and start where you first started by hosing the roofs, sidings, windows and exterior doors surfaces. Hose the driveway surfaces including under the car(s), hose the car(s) down, body and under side, and work from them down to the street again. That's about the best you can do. It is better than doing nothing. Now for you and your PPE you are wearing.

Use a ten percent bleach preparation (1 unit of bleach out of the bottle added to nine units of water; units can be ounces, cups, quarts or gallons as needed) in a bucket, say 2.5 gallon. Use a brush such as dustpan brush to dip into the pail of bleach solution and swap over the rubberized overgarment (raincoat

or poncho) dipping the brush into the bleach and swabbing the outer garment downward to the footwear, swabbing those as well. Rinse with fresh water from the hose using a fine, low pressure stream (don't splash it all over you, especially upward to your face and neck areas). Repeat the process twice more. A shallow pan large enough to step one foot into with the footwear on, for both feet. Rinse footwear with fresh water from the hose, and repeat twice again. Remove outer clothing from headgear first down to footwear, placing each as removed into the large cans or buckets of 10% bleach. Remove the outer layer rubberized gloves and discard. Your hands should still be covered with nitrile gloves that are clean. Using a fresh 10% bleach solution, and a clean fresh cloth, moisten it in the solution so it isn't dripping, swab face and neck downwardly only and finally hands (now with clean nitrile gloves on each hand) with the cloth. Rinse with fresh water and a fresh cloth and repeat twice more. Discard cloths and remove and discard outer layer of nitrile gloves. The last rinse should use two or three fresh cloths with fresh water to remove the residual bleach solution nearly completely. If there is a breeze or wind, remain facing into the breeze or wind. The 10% bleach solution will not cause any harm for the minute or so that it is in contact with the epidermis (outer skin surface) as this is dead skin. But do exercise caution by using a cloth that is not dripping to avoid getting the solution in your eyes or the interior mucous surfaces of the nose.

Now you only have to dispose of anything that is not retainable by removing from the bleach soaking solutions, letting them drip excess liquid, and place in plastic trash bags for the trash. Anything else such as raincoats, ponchos, rubber boots, etc. can be allowed to soak for ten or twenty minutes and rinsed with fresh water and cleaned further latter by washing.

Seems involved and laborious. Yes it is. It isn't likely that you would have to do this, but it is a good idea to have the directions and know what to do. The bottom line is that in whatever you handle, it must be regarded as contaminated until you have actually treated it with the decontamination solutions and rinsed them. You also want the run off to move away from you, the house and other objects that you have previously decontaminated while suited up.

Biological Agent Decontamination and Materials

For decontamination of biological agent weapons a number of cleansers can be used, though the material to be decontaminated may dictate certain cleaning agents not be used. Of course these cleaners are disinfectants. What may be of importance here is how do you decontaminate skin? The US Military had among its protocols, the use of a 10% household bleach solution. The recipe above under chemical agent decontamination is fine.

Of course, for decades and even today, rubbing alcohol was and is used to disinfect skin before vaccinations, injections, and blood tests and donations. There are some iodine based disinfectants, but a number of people have an iodine allergy and so the use of iodine preparations is waning, and rubbing alcohol is coming back to save the day so to speak. A caution about rubbing alcohol use (chemical name 2-propanol), the fumes are very overpowering, and use should not be used around the face. Inhalation of significant amounts can lead to respiratory difficulties and in the extremes, unconsciousness, coma, and death. Use sparingly, on small localized areas of skin, away from the face or in well ventilated circumstances. If outside, face into the wind.

Some disinfectants that may be used if necessary, especially on inanimate objects as appropriate are:

a. Lysol
b. phenol (very go antibacterial, formerly used widely in hospitals, but now considered a potential carcinogen)
c. Rubbing Alcohol (50%, 70%, 90%)
d. bleach (out of the bottle, and 10% solution for skin decontamination)

Decontamination of suspected biological agents is really little different from thorough cleaning around the house, say the bathroom for example. And in cleaning the bathroom, one uses some kind of protective gloves. The same type of cleansing agents would be used, though for biological weapons agents, a very strong bleach solution is the generally recommended cleanser. The approach is little different from what is followed in decontamination of chemical weapons agents above.

Radiological Agent Decontamination

Radiological agents present a very different problem. Unlike chemical or biological agents which are inactivated or destroyed by the decontamination agents and methods (oxidizers, UV light, fire, etc.), radiological agents remain active, though essentially diluted. Since radiological agents arise from reactions deep in the nucleus of certain element atoms, no chemical reaction will affect them. You can't even burn them to destruction. That will generally vaporize some if not all of the radioactive material, and actually, in some cases, that may be a workable means of decontaminating if the material to be decontaminated is not subject to burning itself. The decontamination process applied to radiological agents, then, is essentially a process of removing them from the surfaces of objects that people will come into contact with, and this usually entails detergents that solubilize the agents and wash them clear of the surfaces. Of course, the wash and rinse water goes somewhere and it is contaminated with those now diluted, but still active agents.