SECOND ARTICLE: WHAT AE WE EXPOSED TO, WHAT IS TESTED, AND WHO IS PROTECTING US?

So how many chemicals are we exposed to? We don't really know. Are all new chemicals tested for toxicity before they are released into the environment? Absolutely not. According to the 1976 Toxic Substances Control Act a new chemical must be tested for toxicity before its use only if it is "KNOWN TO BE TOXIC". However, a new chemical is usually not known to be toxic before it is tested. In other words, a new chemical is innocent until proven to be guilty. As an example PCB's were commonly used by industry and discharged in rivers and lakes. PCB's are chemically related to dioxins (think agent orange), and they were not rigorously tested, but then later found to cause reproductive abnormalities, neurological disorders, and cancer in lab animals. We banned them in 1976. Currently we all have PCB's in our bodies, and cleanup efforts in rivers in the US continue, as the PCB's remain in the river sediments. Do you eat foods that contain PCB's? If you eat salmon you do. No matter where the salmon was caught. How many chemicals are we currently releasing that are toxic? We have no idea. Of the 82,000 chemicals currently in use in the US only 25% have EVER been tested for toxicity.

Recently scientists have demonstrated that the chemical BPA, used in many plastics, has some multiple harmful effects in multiple animal lines. It is felt likely to interrupt normal human endocrine (think hormonal) function. This BPA can leach out of the plastics and be absorbed into humans through our food, baby pacifiers, etc.. Consumer awareness has driven a tsunami of products that are now advertised as "BPA free", particularly for infants and children. Unfortunately the chemicals used to replace the BPA are very very similar to BPA. The significant difference is that these chemicals haven't been tested yet. Consumers think they are being very safety conscious with their children, but we don't know yet if these new chemicals will be safer or even worse that the BPA!

Switching gears, I believe it would be foolish to think we can exist in a world without herbicides or pesticides. We have a hungry planet to feed. If we are smart, however we should be able to minimize our risk. Getting rid of all chemicals released into the environment will never happen.

I am not convinced that all chemicals are bad, and obviously some are massively helpful and lifesaving. i believe sometimes we misplace our trust in the food supply. Everywhere I look in the grocery store I see products that are labeled "non-GMO" and many people are afraid of GMO foods. I however, don't see a problem with GMO. A known gene is placed into a plant or animal. This may allow earlier harvest, disease resistance, enhanced nutritional value, or herbicide resistance. This allows for using fewer or safer use of herbicides, and increases the nutritional value and availability of food at a lower price. People say that there is danger with manipulating the genome of the things we eat. In my opinion, however the GMO may be safer the the non-GMO produce.

In contrast to GMO, growers have developed bigger, sweeter faster produce with a much less sophisticated form of genetic modification. They subject seeds to radiation to produce genetic mutations, and then they choose the results that are most favorable in yield etc. They have no idea if other mutations have occurred in the process of radiating the seeds. In addition the radiation process continues on a yearly basis, striving for higher yields etc. These foods are considered "natural" These foods don't have to go through the rigorous testing process of the GMO's. The GMO process is a known commodity, and in addition some of the GMO produce has been out there for over 25 years, tested up and down, and found to be quite safe. There is a new technique for GMO called Crispr which is even more sophisticated and might only

change 1 or 2 amino acids in a plant genome with significant accuracy. In my opinion these products are at least as safe as non-GMO that has undergone radiation changes to its genome. As mentioned, there is another benefit to the GMO in my opinion. Be giving a product genetic resistance to a specific herbicide, it allows for the use of herbicides designed to be as safe as possible, and yet able to increase yields dramatically. Naturally I think that planting precautions etc need be strict, but the world cannot produce enough food to feed everybody without using SOME herbicides and pesticides. The whole world cannot eat organic. I believe GMO foods many times are the safest option available based on the above considerations.

Much of what I have said so far is alarming! However all is not doom and gloom. Clearly we are exposed to many chemicals. However, many of them are not retained in the human body, so toxicity if any would be temporary. In addition, in toxicology "DOSE IS EVERYTHING". This means that small doses of many toxins can be harmless. The human body has evolved in a world with many natural toxins, so or bodies have many ways of dealing with many toxins in low dose. However, we have to consider that some of the new toxins we are exposed to are not small doses, and some accumulate in our body over our lifetime. So how are we approaching toxic chemicals in the US? If we are being smart about our toxic exposures we would be using chemicals that 1) break down quickly in the environment, and 2) don't degrade into other toxic products, and 3) are quickly eliminated from the human body, and 4) don't show signs of major toxicity

Where can we expect help in avoiding serious harmful exposures to the environment and ourselves? To answer this we have to look at several responses. Governmental, industry, and our own personal response. Governmental response obviously is an issue. I can't imagine anybody thinking that 75% of the new chemicals we use and put into the environment don't need to be tested, particularly with the increasing numbers of cancers, decreasing sperm counts, and increasing incidence of autism and ADHD that have no obvious explanation. In addition there is no doubt in my mind that the EPA needs to be more aggressive at protecting us from "the next big toxin". It would be a disaster if the next big toxin caused changes to our DNA (this can happen, see epigenetics) which would be passed down to subsequent generations. As far as we know this has not happened yet. In short, I don't believe we do enough testing of the chemicals we produce, particularly before humans are exposed to them..

While initial testing of new chemicals may sometimes be non-existent, There are ongoing studies looking for warning signs. These are observational studies ,that are very large, looking for signals of a toxin. Again, although tough to interpret, in general this is the most important tool we have to detect a potential problem before it is a national disaster. Collecting tons of long term data following people, monitoring their health and any chemicals they might be exposed to, looking for the "canary in a coal mine".

A government success would be the NIH study that identified chlorpyrifos (a herbicide) as toxic to developing fetuses and infants. Animal studies supported these findings. Infants exposed to chlorpyrifos were found to have more autism, ADHD, and consistently lower IQ's. The EPA found that there was no safe exposure limit for chlorpyrifos, and banned it's use in the US. A federal judge then ruled that the EPA had to restudy the herbicide for safety with different methodology after a lawsuit by Dow. The EPA again concluded that there was no acceptable safe limit of exposure. In 2017, however, with a new head of the EPA, the EPA reversed the ban and again allowed the use for agricultural purposes, although home use continued to be restricted. The American Academy of Pediatrics stated "there is a wealth of science demonstrating that detrimental effects of chlorpyrifos exposure to developing fetuses, infants, children, and pregnant women.....the risk to the health and development of infants and children is unambiguous". The children most at risk are children of the agricultural workers of America, but chlorpyrifos was present in California air, and over 90% of people in California had

chlorpyrifos detected in their urine. (If children switched to completely organic, chlorpyrifos levels dropped significantly) Subsequently the EPA has defunded this large NIH study that had been in progress for over 20 years, threatening all the valuable toxicity data that had taken so long to put together, and threatening any further discoveries. In summary, government studies have been very valuable, but can be trumped by political /philosophical differences..Unfortunately if a large observational study is stopped, it has to be restarted from the beginning, and the American people will have lost 20 years of potential warnings. Chlorpyrifos toxicity data was a major triumph of the NIH study. Now that ongoing study is threatened by government action.

It should be clear to most people that I am alarmed by the current political administration's views on environmental regulation through current EPA rulings. I say this as a non political statement, noting that Richard Nixon, a Republican, signed the Clean Air ACT, and the Endangered Species Act. The Clean Waters Act was only possible because of an override of a presidential veto with a majority of Republican congressman and senators voting to override. Clean water, air and food should be a non-partisan issue in my opinion, and it has been in the past.

The next question is private industry. Can we count on them? Interestingly 2 months ago Dow announced that they would stop making chlorpyrifos, despite the EPA now stating that there is "no credible danger" in its use. Most peculiar, given that Dow argued recently to the EPA that it was an essential herbicide and should not be banned. Perhaps an unreleased study by Dow painted a more dismal picture, but I personally view this as a victory for science and all children no matter the reason.

Are there other examples of industry doing the "right thing" (no matter the reason). How about Johnson and Johnson announcing this week that they would no longer produce talcum powder after multiple studies pointed to increased genital cancers in women who's mothers used the powder on their bottoms. (Note that there are currently MULTIPLE lawsuits relating to talcum).

The other side of the coin is however, uglier. Take the tobacco industry. Not only did they deny that smoking caused cancer and death despite their own data, but the companies collectively had a secret working group whose whole purpose was to hide data from the American public. Although there are now warnings on American cigarettes, and commercials due to multi billion dollar American lawsuit settlements, they continue to market cigarettes internationally as they had before the lawsuits, for great profit and great loss of human life. I have personal experience as a physician with opioids. I can say that drug reps for the makers of OxyContin lied to me or misled me repeatedly about addiction potential and dosing when I was in practice. Unfortunately, now the opioid epidemic is apparent to all of us as a significant cause of mortality in young people in America. In summary, sometimes industry can be responsive to toxicity concerns, but it is difficult to dissect out the motivations given the litigation issues.

In conclusion, the issue of toxicity of the chemicals we manufacture is extremely difficult to dissect. Studies are expensive and difficult to interpret. Our tests for toxicity are hard to apply to humans, and we are still improving our testing. Meanwhile we continue to invent new chemicals and put them into the environment. Laws have major loopholes. Different political philosophies lead to different approaches to testing and prevention. Obviously given the above examples, we can't count completely on the government or industry. However as individuals it is easy to ignore the risks we face if we don't see them or feel them ourselves. The EPA has recently announced that they intend to make major changes to the Clean Waters Act, allowing more discharges into the nations rivers and lakes. I wonder how we would react if there were a factory on Forest Lake and the EPA made the same announcement? I suspect my reaction and yours would be of a much more significant nature. On the other hand while it is easier to ignore toxins being placed into the environment in other locations, it has become quite clear

that the toxins we are releasing into the environment are spreading around the globe very easily. There is no place on earth safe from environmental toxins, even the pristine arctic. What an industry releases into the rivers on the west coast soon lead to exposure everywhere.