The Breakdown (or not) of Certain Pharmaceutical Metabolites in Water

- There are many chemical compounds that find their way into water; whether that be drinking water, groundwater, or surface water. Oftentimes those compounds break down into their various member parts, either through human consumption, or through chemical processes. These are known as metabolites, and they can be either "active" or "inactive."

- Active pharmaceutical metabolites can still carry out the intention of the original drug or chemical compound they were a part of, even after consumption by humans. Thus, in cases where metabolites of the drug or compound are active, once it cycles through the liver it can still work in the body (or other bodies) to facilitate the action the chemical or drug was designed to do. These metabolites can be found in urine or feces, and then find their way into the wastewater system.

- Many studies have been conducted on the effects pharmaceutical metabolites can have after they are secreted by the body and end up in water, or in agricultural and industrial settings where metabolites end up in runoff, to see to what extent and degree their original purpose still survives.

- Pharmaceutical metabolites of chemicals can end up in a wide range of water sources, after either human consumption or other human activities such as the application of herbicides, pesticides, and fungicides.

- Because of this, the FDA and USDA have required extensive study into chemical products to determine the extent to which they may impact the environment, and oftentimes this specifically relates to groundwater and surface water, when they are applied in commercial settings.

- Similarly, studies have been conducted on the impact of pharmaceutical metabolites on ecology and the environment; many of these have focused on the parent drug itself and not the active metabolites it breaks down to, but the tide has been shifting in recent years to study this aspect of pharmaceutical metabolite impact on the environment.

- In fact, more recent studies of the impact pharmaceuticals have had on the environment shows that wastewater treatment plants (WWTPs) are unable to entirely treat the water and remove the active metabolites from human waste. What this in turn means is that through human consumption and transmission into waste, many potentially harmful pharmaceuticals are finding their way into our waterways.

- Wastewater, once it is treated at the WWTP and sent back into the environment in the form of effluent, could very likely still contain the active metabolites of whatever drugs were filtered into it by humans along the way. The FDA and EPA do not attach other regulation on the amount of potentially harmful chemicals that enter our waterways.

Sources:

1. Scientific article concerning Pharmaceuticals of Emerging Concern in Aquatic Systems: https://pubs.acs.org/doi/pdf/10.1021/acs.chemrev.8b00299
2. The OECD's response to pharmaceuticals in freshwater: https://www.oecd.org/environment/resources/Pharmaceuticals-residues-in-freshwater-policy-highlights-preliminary-version.pdf
3. Scientific article on pharmaceutical metabolites in the water and their possible risks: https://setac.onlinelibrary.wiley.com/doi/pdf/10.1897/09-173.1
4. The U.S. Geological Survey's webpage concerning pharmaceuticals in water: https://www.usgs.gov/special-topics/water-science-school/science/pharmaceuticals-water
5. Scientific article on emerging pesticide metabolites in water: https://www.sciencedirect.com/science/article/abs/pii/S0043135413005228