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# Toxic Fashion: Evaluation of Chemicals in Clothing and Recommendations for the Amended TSCA

Gregory Zajac
gazajac@dons.usfca.edu

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Gregory Zajac

University of San Francisco

School of Nursing and Health Professionals

Advised by: Dr. Zahra Goliaei

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# Abstract

The fashion industry is one of the largest polluting industries in the world and its rising environmental impact is partly due to the dominance of fast fashion business models. Recently researchers and advocates have found that large amounts of chemicals are used by textile manufacturers to produce clothing, some proven to be toxic in other applications. The risk of exposure to these classes of chemicals is a growing concern. With the risk management model, a qualitative examination was conducted on existing policies in the United States that regulate chemicals used by the industry. Despite some policy changes regarding chemical exposure in clothing, the burden of proof to determine if a chemical poses a health or environmental risk remains on the EPA. Real reform should shift the burden of proof onto chemical manufacturers, require chemicals to have safety information to enter and remain in the market, shift away from case-by-case hazard assessments, and provide a label that informs consumers of more sustainable products. This review contains recommendations to address gaps in the regulation of chemical in clothing that may prevent further injury to human health and environmental harm from the unreasonable risk. The findings of this study can guide policymakers to develop and implement stronger protections against chemicals that pose serious health risks.

Keywords: Chemicals, Clothing, Exposure, Regulation, United States

# Introduction

More than 15,000 chemicals can be used in the manufacturing process of clothing, including dyes, solvents, detergents, flame retardants, stain repellents, softeners, and carriers (Palacios-Mateo, 2021). Many of these chemicals can be toxic to humans. Once inhaled, ingested, or have prolonged contact with skin, substances on clothing can be absorbed into the body. Exposure is influenced by characteristics of clothing, such as fiber material, structural components, dyeing process, and post-production chemical treatments. The toxicity of a substance depends on a variety of factors: chemical structure, concentration, duration, and the body's ability to detoxify and eliminate compounds ("Understanding Toxic Substances…", 1986).

There are not enough studies that examine the risk of exposure from the fashion industry and the limitations on chemicals. This paper will review the current literature to identify some of the hazardous chemicals that are commonly used, their health and environmental effects outside of clothing, and examine the current policies regulating the chemicals worldwide. The environmental impact will be explored as some residues can be easily removed during the laundering or decomposing process.

The findings of this paper will support policymakers and stakeholders in development advancements to current United States chemical regulations through risk management theory. Further research on this topic is necessary to increase awareness, educate consumers, influence policy to limit exposure and promote stronger health outcomes.

# Background

## Fashion Industry Impact

Clothing plays a central role in our society and the demand for fashion is continuously rising with the global market expected to be worth $2.25 trillion by 2025, up from $1.5 trillion in 2020 (Centobelli, 2022). To keep up with a growing world and ever-changing styles, retailers have begun adopting the dominant business model dubbed “fast fashion”. The term “fast” refers to how quickly retailers can introduce cheap, trendy clothing into the market at the height of popularity. Yet as clothing becomes more accessible and affordable, environmental costs continue to rise. The fashion industry annually produces 4-5 billion tonnes of $CO_2$ emissions, uses 79 trillion liters of water, contributes roughly 500,000 tonnes of oceanic microplastic pollution, and is responsible for roughly 20% of industrial water pollution (Niinimäki, 2020; “UN launches,” 2019). Because of the short life cycle of trends, there are vast amounts of textile waste and unsold products that end up in landfill or burnt, over 92 million tonnes (Niinimäki, 2020). In addition to the staggering environmental impact, there is growing evidence and concern that the phenomenon could potentially expose people to many toxic chemicals.

## The Burden of Chemicals

There are two main types of fibers: natural (cotton, linen, bamboo, denim, wool, and silk) and synthetic (nylon, polyester, rayon, and spandex). All textiles are made up of fibers that are arranged and processed with large amounts of chemicals to give the garment a desired color, durability, texture, or style. Depending on each chemical's ability to migrate from textiles and absorb through the skin, chemically-treated clothing can be a significant source of daily human exposure. Chemical pollution has the potential to pose one of the largest environmental threats to humanity, the estimated release is as high as 220 billion tonnes per year (Naidu, 2021). Not to say that the textile industry is entirely responsible, but an obvious contributor to the event. Estimates by the World Health Organization in 2019 identified that two million lives and fifty-three million disability-adjusted life-years were lost due to chemical exposure (Rayasam, 2022). While not all chemicals used in clothing are harmful, consumers should be made aware of any potential risks associated with substances applied to garments.

## Common Chemicals in Clothing

Despite the large contact surface area and duration of exposure, there is generally no information on what chemicals are (intentionally or unintentionally) on finished clothing. For instance, natural fibers such as cotton require large amounts of water and pesticides to grow (Bick, 2018). Pesticides are also used during storage and to improve the characteristics of the final textile products (Iadaresta, 2018). Pesticide residue can still be identified in cotton, even after processing (Hrouzková, 2021). With the global shift of textile and garment production to lower labor-cost countries, it can be difficult for manufacturers to know how raw materials were processed (Niinimäki, 2020). Often each step of garment production occurs in a different country, which has differing regulations on the use and production of chemicals used in clothing

(Niinimäki, 2020). Many of these chemicals can be grouped into classes to better understand their uses, functions, and health effects outside of clothing.

### Flame Retardants

Flame retardants are commercial chemicals that are added to inhibit or delay combustible material from burning when exposed to a spark or open flame (Pantelaki, 2019). Unlike wool or synthetic fibers, untreated natural fibers are very easy to ignite and data suggests textiles are responsible for one-third of all fire accidents in the world (Ling, 2023). So introducing fabrics with flame retardancy could protect human safety and property, although the benefits may not outweigh the risks. A once widely used flame retardant in children's sleepwear, Tris(2, 3-dibromopropyl) phosphate, a mutagen, and carcinogen, was found in urine samples of those in contact with treated clothing (Blum, 1978). Other flame retardants have been reported in biota and human breast milk (Abou-Elwafa Abdallah, 2016). They are widely used in clothing, motor vehicles, fabrics, toys, electronics, and other fields, but can easily release into the environment because they are not chemically bound to the material to which they are applied (Ling, 2023). Commonly used compounds, particularly brominated and organophosphate, are persistent and have been shown to bioaccumulate, causing negative effects on the nervous, reproductive, and endocrine systems (Kim, 2014; Bekele, 2019).

### Phthalates and Bisphenols

Phthalates, often called plasticizers, are a class of industrial chemicals that makes the plastic more durable and are widely used in textiles as chemical solvents, adhesives, and stabilizers (Tang, 2020). Another class of chemicals that are often used to manufacture plastics is bisphenol, which is employed in textile finishes to improve lifespan, in the manufacture of dyes, and in textile processing of synthetic fabrics, like polyester (Xue, 2017). While their use is widespread, outside of clothing both have been shown to alter hormone levels, impede neurological development, and disrupt the reproductive system function (Wang, 2019; Li, 2019). The presence of phthalates has been reported in new children and infant clothing, with some concentrations exceeding acceptable levels (Tang, 2020; Li, 2019). However, like PFAS, phthalates can exist in household air or dust and are easily absorbed into cotton, a preferred material for infants, which can contribute to exposure. In the case of bisphenol, Xue et all found measurable levels of Bisphenol A (BPA) and similar chemicals on unwashed textiles worn by infants and newborns, showing the potential risk for exposure. (Xue, 2017). Additionally, the use of products that contain Benzophenone-3, a suspected endocrine disruptor added to sunscreens and plastics to filter UV radiation, showed positive correlations with increased urinary concentrations (Morrison, 2017). Considering the toxic health effects that have been reported outside of clothing, early exposure to endocrine disruptors could impact development and increase the likelihood of childhood diseases. While material composition is an important factor, as higher levels appear in synthetic clothing, chemicals like BPA can cross-contaminate used clothing through laundering and repeated wash cycles could distribute the concentration in other clothes (Wang, 2019).

**Per- and Polyfluoroalkyl Substances (PFAS)**

Per- and polyfluoroalkyl substances (PFAS) are a group of over 4600 man-made chemicals that have been used to make products resist grease, water, and oil, but there is little to no data available on most of their biological effects (PFAS chemicals overview, 2022; Bonato, 2020). Items most often containing PFAS are weather-proofed items including snowsuits, sleeping bags, skiwear, boots, hats, and jackets for water resistance (Miljøstyrelsen, 2015). A large number of studies have suggested high concentrations of better-known PFAS compounds may lead to increased cholesterol levels, decrease vaccine response in children, increased risk of high blood pressure in pregnant women, and increased risk of certain cancers (Sunderland, 2018). One study tested 72 North American children's school uniforms labeled as stain or water-resistant and discovered that PFAS levels were similar to those measured in outdoor equipment (Xia, 2022). This fact can be concerning as school uniforms are worn continuously and are more likely to have direct contact with skin, unlike outdoor wear. Dermal absorption was calculated by an equation for ethical considerations, although acceptable daily intake levels are only available for certain derivatives (Xia, 2022). According to a laundering simulation, there were no detectable levels of PFAS after washing once (Zheng, 2020). However, the high release rate suggests clothing could be an important source of PFAS being released into surface water. Particularly long chains of PFAS are highly mobile when introduced to an aquatic environment, bioaccumulative, are not removed by conventional wastewater treatment, and most are non-biodegradable (Bonato, 2020). Current studies suggest the consumption of contaminated food or water is the major source of PFAS exposure in humans, which is a growing area of concern in seafood and drinking water (Christensen, 2017; US EPA, 2023b).

## Regulation in the United States

The Environmental Protection Agency (EPA) safeguards human health and the environment from chemicals within the United States through the Toxic Substances Control Act (TSCA). However, due to limited authority and various barriers, the EPA has regulated fewer than 10 of over 86,000 registered chemicals since its enactment in 1976 until 2016 (Rayasam, 2022). During the same 40-year span, the EPA only made safety determinations for approximately 20% of new chemical substances (US EPA, 2023c). This could be partially explained by the fact that the original TSCA gave the EPA no authority to require chemical companies to provide exposure data in the event of insufficient information. Safety determinations also had to be considered and exercised to not impede unduly or create unnecessary economic barriers to technological innovation (“Public Law…”, 1976). A ruling that appears to heavily favor the chemical manufacturing industry. Following a 2016 amendment, several changes were implemented to revise the process and requirements for regulatory action. The EPA is mandated to review every new substance and determine if an unreasonable risk to human or environmental health is present. If the EPA determines that a compound poses an unreasonable risk of injury to health or the environment, then a full risk evaluation can begin (H.R.2576, 2016). To address the backlog, the EPA must have 20 “High-Priority" chemical risk evaluations ongoing at any given time (US EPA, 2016). Table 1 provides more insight into the process of evaluating existing chemicals. Despite the changes, the amended law could be further improved by implementing some health-protective policies available to international agencies.

Unlike the European Union's Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH), nearly all of the burden relies on an underfunded EPA to determine if a chemical poses a risk (Rayasam, 2022). This process contradicts standards of proof similarly used in pharmaceuticals and pesticides, which require manufacturers to conduct pre-market testing for toxicity. To supplement federal protection, some states have proceeded to address perceived gaps, observed in Table 2. Although, the scattershot approach could leave millions exposed in states missing similar protections.

There is some overlapping jurisdiction in other government agencies, but they are limited in their ability to offer health-protective standards against chemicals in clothing. The Consumer Product Safety Commission (CPSC) has regulatory and enforcement tools through the Consumer Product Safety Improvement Act (CPSIA) and the Flammable Fabrics Act (FFA). The CPSIA sets allowable level standards for children's products for lead content and specific phthalates in childcare articles due to the harmful health effects upon ingestion ("The consumer product…", n.d.). On the other hand, the FFA was passed to protect human health and property from highly-flammable clothing. Mandating all wearing apparel not to have burning characteristics that are deemed unsuitable for clothing and include fabrics that have undergone further processing (I.e. dyeing), in garment form, or for consumer use (16 CFR part 1610, 2023).

## Conclusion

People have an intimate relationship with clothing and textile manufacturers are using toxic substances. After evaluating the current literature on how clothingmediated exposures to chemicals threaten human and environmental health, it seems wise to use current scientific data to implement stronger health-protective policies. While not a complete list, the remainder of the paper will list my recommendations for the amended TSCA and advocate for a more comprehensive policy in the United States. This paper will act as a benchmark for policy-makers, bureaucrats, citizens, and other interested groups interested in addressing the gaps in chemical regulation.

## Methods

The literature review was conducted to map out existing literature that identifies chemicals currently found in clothing. EBSCO, PubMed, and Google Scholar databases were utilized to find peer-reviewed articles. Search strategies included various combinations of terms synonymous with the topic including textiles, fabric, clothing, chemical, health risk, potential exposure, environment, transdermal, absorption, and contamination. Studies were selected for review if they were published in English and within the last 10 years. Then, titles and abstracts from the resulting search were screened to determine whether the inclusion criteria were met. To make the findings more generalizable, clothing articles had to be commercially available and not personal protective equipment or occupation-specific (I.e. chemical protective clothing) where exposure could be an expected risk factor. Many studies examined did not conduct direct measurements from treated garments, so some earlier research was included to show historical events of percutaneous chemical absorption. Some government websites were included for supplemental data to highlight the current understanding of chemical properties and toxicity. Identified federal laws and regulations regarding the use or regulation of chemicals on clothing in the United States were evaluated using the information found on their respective government websites. Any previously proposed bills were not examined so long as that regulation had not passed. Each public law was read in its entirety, including some additional documents regarding procedures provided under the power of the act. Several gaps were identified in the Legislative text. Recommendations were thought out using a risk management model to identify potential hazards, analyze and evaluate risks, and manage risks, illustrated in figure 1. Several peer-reviewed articles referenced existing policies enacted in other countries, primarily REACH, which was also reviewed. Such articles were discovered through Google Scholar with search terms including, TSCA regulation, TSCA amendment, and TSCA gaps.

## Recommendations

Based on the evaluation and the conclusion of the literature review, adjustments should be made to the amended TSCA to better manage the risk of exposure to harmful chemicals. While a perfect policy does not exist, the TSCA could be further amended to better achieve the goals of protecting human health and the environment. My recommendations are based on policies that exist worldwide that could potentially fill in some gaps and perceived limitations presented in the reformed TCSA text. This paper provides the following recommendations to the identified problems:

Problem: definitions for several terms are provided within the TSCA text to reduce uncertainty on how the words or phrases should be understood. Potentially exposed, guidance, conditions of use and mercury are amongst those clarified terms.

However, perhaps one of the most significant, recurring phrases the law never clarifies is “unreasonable risk”. Even under the newly amended law in 2016, there still is no definition. While not discussed in the Legislative text, the first ten risk evaluations conducted by the EPA offer insight and rationale on what an “unreasonable risk” may look like. In the case of Trichloroethylene (TCE), the substance was thought to not pose an unreasonable risk under the original conditions of use. It is stated relevant risk factors include: the effects of the substance on health, human, and environmental exposure under the conditions of use, the population exposed or potentially susceptible, the severity, and uncertainties (US EPA, 2022). Roughly two years afterward, a review reevaluated the ruling because the EPA reconsidered aspects of the procedure for chemical risk evaluation. First, the EPA would not only look at the specific conditions of use but the chemical as a whole. Second, would be no assumption that personal protective equipment is provided for occupational safety.

Recommendation: define “Unreasonable Risk” Criteria and Determine Appropriate Approach for Risk Assessments. Standard benchmarks should be stated within the TSCA. Clear boundaries between what is and is not considered reasonable could prove significant in eliminating such risk. Otherwise, the meaning behind the term could be left open to interpretation and could present an unnecessary risk to the public or the environment. Furthermore, the Legislative text regarding the procedures for chemical risk evaluation should state the most comprehensive approach when conducting risk assessments to avoid unnecessary exposure.

Problem: before medications can enter the market in the United States, drug companies must conduct rigorous testing to discover how the drug works and whether it is likely to be safe in humans (FDA, 2022). In short, there is the assumption that a drug is unsafe until conclusively proven by the manufacturer with relevant evidence. Yet under the amended TSCA, the burden remains on the EPA to determine if an action should be taken. The chemical regulation in the United States uses a reactive approach, meaning chemicals of concern often remain in use for decades after initial concerns emerge (Cordner, 2016). Chemical industries have taken advantage of this system by concealing evidence, using independent groups to influence public opinion, calling for additional but irrelevant or unnecessary scientific exploration, or gathering paid experts to cultivate public uncertainty (Cordner, 2016).

Many chemicals in the TSCA Inventory still lack safety data. Conducting risk assessments and determining hazards posed by chemicals is a complex process to understand the full nature, magnitude, and likelihood of adverse health effects of a substance. With an annual average of 500 chemicals introduced, the EPA is also encumbered by an ongoing record of 86,685 chemicals that are manufactured or processed in the United States called the TSCA Inventory (US EPA, 2023a; US EPA, 2023e). Considering the backlog, the EPA must screen substances by known conditions and use predictive models to prioritize which chemicals should be designated as high or low-priority for risk evaluation. Although, even in the latest Annual Plan for Chemical Risk Evaluation, dated back to December 2021, the report mentions that the EPA cannot successfully meet the deadlines for 10 chemical evaluations (US EPA, 2021). Not requiring full toxicological data from manufacturers on new chemicals has limited the agency's effectiveness. This process could lead to large data gaps for chemicals that are not immediately flagged for review.

*Recommendation: no data, no market.* At the current budget and resource constraints, fulfilling the task of assessing tens of thousands of existing chemicals could take decades, maybe longer. Additionally, rulings are based on the currently available science and agreed approach so a review of rulings might be necessary as our understanding evolves. Chemical manufacturers should be required to provide hazard information for chemicals to enter and remain in the market. The precautionary principle places the burden on the industry to identify and manage risks, one value demonstrated by the European Union's Regulation, Evaluation, Authorization of Chemical (REACH) regulation (Botos, 2019). With testing information already being compiled by companies, the EPA can emulate similar testing requirements or criteria set by REACH for risk assessment evaluation to reduce industry burden. This would allow the agency to quickly fill in data gaps for potential hazards on chemicals that are manufactured, produced, imported, and distributed into our communities through clothing.

*Problem*: the linkage between the environmental effects and the textile industry was briefly explored at the beginning of this paper. Carbon emissions, water usage, pollution, and waste were cited as major areas of concern. With increasing threats to the environment, there is a growing interest in sustainability and reducing pollution (Hazaea, 2022). For example, 71% of millennials expressed that they want brands to be more environmentally friendly and consumers are willing to pay premium prices for bio-based products (Adamkiewicz, 2022). To capitalize on the growing demand, some companies and brands have resorted to a practice known as "greenwashing" or eco-labeling. Greenwashing refers to vague, misleading, or false reporting of environmental practices to present them as more sustainable (Adamkiewicz, 2022). In the case of the fashion industry, greenwashing can be observed as promoting negligible claims of being more sustainable, while obscuring the larger impact to garner trust (Adamkiewicz, 2022). Deception is largely prohibited by laws and regulations, however, marketers can still use broad, unqualified environmental claims (i.e. no chemicals or eco-) on their products because they are difficult to substantiate (FDA, 2012). Clear definitions of sustainable fashion should be made to include the entire lifecycle of clothing and could inadvertently reduce exposure to harmful chemicals.

*Recommendation: create government-backed "eco-labels" on textiles.* Several government-backed symbols inform customers about greener products and services developed by the EPA (US EPA, 2023d). For example, EnergyStar is highly trusted on appliances for highlighting energy efficiency. Although, there is no eco-label in the United States for information regarding clothing. The EU has an eco-label that certifies garments that follow strict restrictions on chemicals, are more sustainable in fiber production, and are produced with a lower carbon footprint than other comparable products (2014/350/EU, 2014). Regulated eco-labels that cover the entire lifecycle of clothing could alleviate some intention-behavior gaps, encourage sustainability, and could further reduce chemical exposure (Hyatt, 2020).

Problem: Chemical toxicity is not new, many chemicals now considered pollutants were considered beneficial at the time of discovery (Naidu, 2021). However, the regulation of chemicals primarily occurs on individual compounds or for the specific condition of use (Cordner, 2016). Several government agencies have composed lists of chemicals of concern or high priority for safe and feasible substitution (Jacobs, 2016). For the EPA, a list of 90 chemicals can be found in the TSCA Work Plan for Chemical Assessments: 2014 Update (US EPA, 2014). If the EPA decides to prohibit or restrict a substance, an alternative that benefits human health or the environment can be considered. The lag between discovering a chemical's benefits and potential harms causes an urgent search for replacement chemicals (Naidu, 2021). Substitutions are frequently made by chemicals in the same class that are less studied and equally or more hazardous (Rahman, 2013; Fantke, 2015; Rochester, 2015; Le Fol, 2017; Sackmann, 2018; Blum, 2019; Tickner, 2019; Ubaid ur Rahman, 2021). The phenomenon is known as a regrettable substitution. Focusing on chemicals on a case-by-case basis ignores the functional use of the chemical. Ultimately, the failure to predict potential hazards increases the burden upon both human health and the environment.

Recommendation: regulate chemicals by class. To use PFAS as an example, I mentioned before there is little to no data on the biological effects on many of the thousands of compounds. In 2016, the FDA revoked the regulations of long-chain PFAS in food packaging (Cordner, 2016). The decision linked the data from a few well-studied compounds to substances with closely similar structures and inferred they could pose similar hazards or toxicity. State-level agencies, such as Minnesota and California, have also begun banning PFAS in specific products on a class basis (Sec. 325F.075 MN, n.d.; "Food Packaging…", n.d.). These examples show the potential for the EPA to regulate chemicals by classes, rather than rely on case-by-case methods.

Several agencies work together in the United States to make sure that consumer products are safe for the public. Yet there is a lack of progress in terms of chemicals allowed in clothing production, processing, and manufacturing. Overall, the current amended TSCA cannot quickly close information gaps and could pose a risk to human health and the environment from chemical exposure through clothing. Every government has differing approaches to managing chemicals, but the variance provides the potential for shared learning. The pervasive knowledge of chemical exposure through clothing is undervalued as overarching restrictions and bans can help accomplish systemic change. If alternatives to a current issue have been proven successful elsewhere, decision-makers can implement a similar policy.

## Implications and Discussion

After conducting research, chemical-treated clothing was found to be a source of unintended exposure because the chemicals do not always stay on the fabric. While not a complete list, recommendations were made to the amended EPA to provide clarity, increase understanding of safety information, increase consumer awareness, and reduce chemical exposure. However, as with every policy, there are limitations.

Many states have chemical safety agencies, much like the EPA. However, in the United States, regulations made at the federal level supersede or control over state law. A waiver can be made if a state uses supporting studies to provide a higher level of protection for health or the environment (H.R.2576, 2016). Shifting the burden of proof to chemical manufacturers and increasing the amount of safety information, could lead to more unreasonable risk rulings and potentially limit state regulatory authorities. As states are not allowed to establish or continue to enforce a chemical that the EPA finds to not present an unreasonable risk (H.R.2576, 2016).

Predicting and controlling exposure relies on the complex understanding of different environmental and human factors. Risk assessments can determine toxicological information and daily exposure limit estimates. However, exposure limits are based on high-level testing and would not necessarily be protective from chronic low-dose exposures (Smith, 2019). Many of these chemicals are widely used in other products and are being found in water, land, food, and human blood (Sinclair, 2020). Although some measures have been taken, our knowledge about the widespread occurrence and risk of exposure is incomplete. Even with global efforts, it is estimated that it will take over 100,000 years to evaluate all existing synthetic chemicals for human and environmental safety, and an additional 2,000 years to observe new products (Naidu, 2021). Thus, modeling recommendations off of international efforts to address toxic chemicals may not address all necessary information gaps.

The fashion industry has a complex supply chain and different chemicals are released during each stage of production. Unfortunately, none of my recommendations would address the chemicals already introduced into the environment. Estimates suggest that 6% of global pesticide production is applied to cotton and there is heavy use of agrochemicals (Niinimäki, 2020). Their use is most strongly associated with habitat collapse and has resulted in over 700 dead zones in oceans and lakes (Naidu, 2021). While alarming, many of the substances used are also applied during the manufacturing and processing of textiles. For instance, a single European textile finishing company uses over 466g of chemical per kg of textile, or 7.456 oz/lb (Niinimäki, 2020). Roughly 280,000 tons of synthetic dyes are discharged into the environment globally (Kishor, 2021). Compounds used to waterproof textiles, mostly fluoropolymers, a subset of PFAS, are found within polar bears and seals in the Arctic (Niinimäki, 2020). And microfibers from synthetic clothing make up a significant source of plastic pollution and can be a source of chemical contaminants for marine habitats (Montoto-Martínez, 2021).

Although there are limitations, strengthening the TSCA regulation can prevent chemical exposure through clothing and its health effects. Further knowledge is needed to understand how chemicals on clothing mix and their associated toxicity. Recommendations can aim to regulate the creation of hazardous compounds and promote sustainable chemistry practices.

## Conclusion

This paper synthesized existing literature to observe the health risks that chemicals in clothing pose to humans and the environment. It also observed how chemical regulation has transformed in the United States. The EPA has made great strides in protecting human health and the environment, but even under the amended TSCA, there are limitations with a risk-based approach. Shifting the proof of safety to those that stand to profit financially can alleviate safety information gaps on the tens of thousands of chemicals in the market. Creating government-regulated clothing labels can help consumers identify clothing that is more sustainable, and contains fewer chemicals. Additionally, creating a process to regulate classes of chemicals can reduce unnecessary chemical exposure from regrettable substitutions and create stronger health protections.

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## Appendix

Figure 1: Risk Management Model

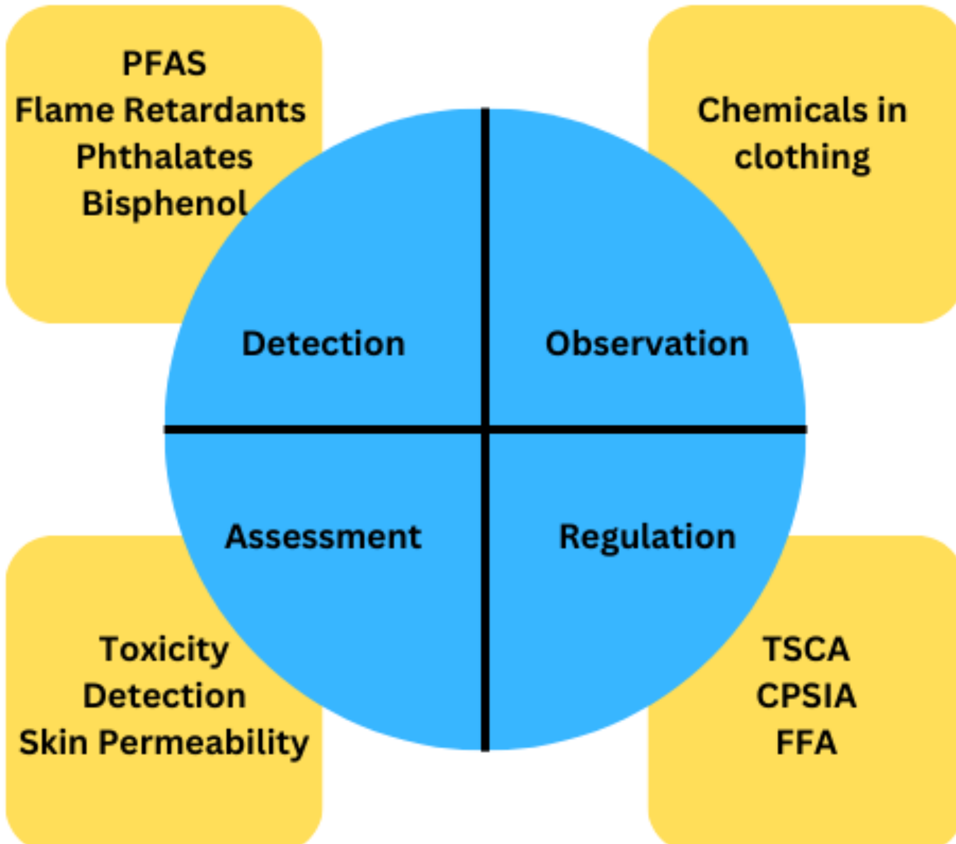
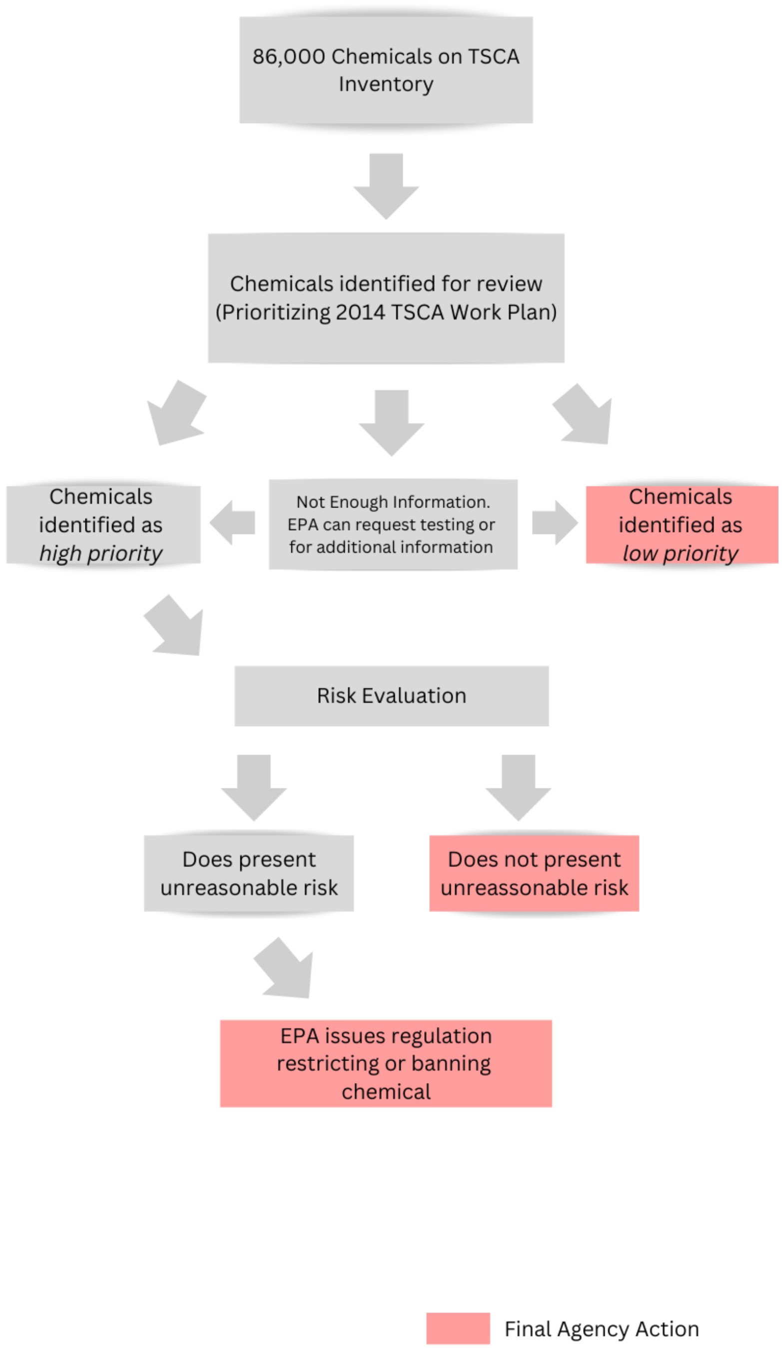


**Table 1: TSCA Steps to Evaluate Exisiting Chemicals**




Source: Adapted from Schmidt, 2016

Table 2: Current and Adopted State Policies for Chemical Regulation or Mitigation

| State | PFAS | Flame Retardants | Phthalates /BPA | Total Number of Policies |
|---|---|---|---|---|
| **Alaska** | S.B. 67, H.B. 166, H.B. 51 | | | **3** |
| **Arizona** | H.B. 2765, H.B. 2810, S.B. 1526, S.B. 1720 | | | **4** |
| **California** | S.B. 72, A.B. 221, A.B. 246, A.B. 496, S.B. 414, A.B. 1423, A.B. 347, A.B. 101, A.B. 727, **A.B. 1879, A.B. 756, S.B. 312, S.B. 1371, A.B. 652, A.B. 1200, S.B. 170, S.B. 343, A.B. 1201, A.B. 1817, A.B. 2771, S.B. 154, A.B. 178, A.B. 180, S.B. 101** | A.B. 267, **A.B. 1879, A.B. 127, A.B. 302, A.B. 2587, S.B. 1019, A.B. 2998** | A.B. 496, A.B. 1347, **A.B. 1319, A.B. 1879, A.B. 1108** | **36** |
| **Colorado** | **H.B. 19-1279, H.B. 20-1119, S.B. 20-218, H.B. 22-1345, H.B. 1348** | | | **5** |
| **Connecticut** | S.B. 101, H.B. 5250, H.B. 6070, S.B. 980, **H.B. 5518, S.B. 837, H.B. 6666, H.B. 6690, S.B. 100** | H.B. 6369 | **H.B. 6572, S.B. 210** | **12** |
| **Delaware** | **H.B. 8** | | **S.B. 70** | **2** |
| **Florida** | **H.B. 5001 (2020), S.B. 2500, H.B. 1475, H.B. 5001 (2022)** | | | **4** |
| **Georgia** | H.B. 257, H.B. 390 | H.B. 803 | H.B. 390 | **4** |
| **Hawaii** | S.B. 504, H.B. 748, S.B. 1459, S.B. 1584, **H.B. 1644** | **H.C.R. 235, S.R. 107, H.B. 2013** | | **8** |
| **Illinois** | S.B. 0088, S.B. 0066, S.B. 144, S.B. 1696, S.B. 1927, H.B. 3128, H.B. 3092, **S.B. 0561, H.B. 4818, H.B. 3508** | **H.B. 2572** | **S.B. 2950, H.B. 2076** | **13** |
| **Indiana** | H.B. 1530, S.B. 0482, **H.B. 1219, H.B. 1341** | | | **4** |
| **Iowa** | H.F. 18, H.F. 62, H.F. 145 | | | **3** |
| **Kentucky** | H.B. 197, **S.B. 104** | | | **2** |

| State | PFAS | Flame Retardants | Phthalates /BPA | Total Number of Policies |
|---|---|---|---|---|
| **Maine** | L.D. 73, L.D. 75, L.D. 132, L.D. 188, L.D. 606, L.D. 1006, L.D. 1488, L.D. 1471, L.D. 1537, **L.D. 2048, L.D. 1129, L.D. 1433, L.D. 129, S.P. 64, L.D. 264, L.D. 363, H.P. 261, L.D. 558, L.D. 1505, H.P. 1115, L.D. 1503, H.P. 1113, L.D. 1600, H.P. 1189, L.D. 780, H.P. 585, L.D. 221, H.P. 156, L.D. 1733, L.D. 1875, L.D. 1911, L.D. 2019, L.D. 206, L.D. 1248, L.D. 217, L.D. 1591** | **L.D. 2048, L.D. 1129, L.D. 1568, Executive Order 12, L.D. 1790, L.D. 1790, L.D. 1658, L.D. 182, L.D. 1662, H.P. 1233** | L.D. 1908, **Board of Environmental Protection Action, L.D. 412, L.D. 902, L.D. 2048, L.D. 1129, L.D. 1433** | **53** |
| **Maryland** | H.B. 0031, S.B. 0225, H.B. 0499, **H.B. 0643, H.B. 0275, S.B. 0273, S.B. 0158, H.B. 0319, H.B. 0848** | **S.B. 556, H.B. 83, H.B. 229, H.B. 99, S.B. 0447** | **H.B. 33, S.B. 213, S.B. 151** | **17** |
| **Massachusetts** | H. 863, S. 445, S. 39, S. 1556, H. 845, H. 2339, H. 101, S. 1559, S. 2053, S. 175, H. 2317, H. 318, S. 588, S. 524, H. 853, H. 2197, S. 1431, S. 523,, S.1502, S. 1356, H.D. 3565, H. 767, S. 525, H.D. 3912, H.D. 958 | S 145, H 767, S 525, H.D. 3912, **H 4900** | S 957, H.D. 3565, H 767, S 525, H.D. 3912, H.D. 3120, **S 2250** | **37** |
| **Michigan** | S.B. 0327, **H.B. 4389, H.B. 4390, S.B. 0565, S.B. 0082, H.B. 5783, H.B. 4437** | **S.B. 1458, H.B. 4406** | S.B. 0327 | **10** |
| **Minnesota** | S.F. 73, H.F. 172, H.F. 372, S.F. 450, S.F. 442, H.F. 552, H.F. 742, S.F. 669, S.F. 787, S.F. 776, S.F. 834, S.F. 871, H.F. 960, H.F. 1000, H.F. 1152, H.F. 1150, H.F. 1283, S.F. 1721, H.F. 2096, H.F. 2005, S.F. 2222, S.F. 2438, H.F. 2571, H.F. 2586, S.F. 2882, S.F. 2842, S.F. 2939, S.F. 3198, H.F. 3163, H.F. 3115, S.F. 3342, **H.F. 2123, H.F. 359, S.F. 20, H.F. 3765, H.F. 2310, H.F. 100** | S.F. 2438, **H.F. 2123, S.F. 2096, S.F. 1215, H.F. 359** | **H.F. 459, S.F. 247, H.F. 2123** | 45 |
| **Nevada** | S.B. 76, **A.B. 97** | **A.B. 97** | **A.B. 354** | **4** |

| State | PFAS | Flame Retardants | Phthalates /BPA | Total Number of Policies |
|---|---|---|---|---|
| **New Hampshire** | H.B. 398, H.B. 414, H.B. 242, H.B. 465, H.B. 614, H.B. 212, S.B. 138, S.B. 169, H.B. 205, **S.B. 309, H.B. 737, S.B. 257, H.B. 1264, H.B. 271, H.B. 236, H.B. 256, H.B. 1547, H.B. 1546, H.B. 1185, H.B. 391** | **S.B. 193** | | **21** |
| **New Jersey** | AB 1554, S 2145, A 4125, A 4760, A 4759, A 4761, A 4762, A 4758, S 3178, S 3179, S 3176, S 3180, S 3177, S 2712, S 3582, A 5211, A 5301 | | A 162, A 1434, A 2794, S 1523 | **21** |
| **New York** | S 227, A 773, S 992, A 952, S 1650, S 2438, A 3296, S 4246, A 3571, S 4171, A 3556, S 4265, A 4600, A 5363, A 5322, S 5648, A 5979, A 5990, S 7041, S 7136, A 6969, **S 439, A 6296, S 7167, S 8817, S 6291A, A 09279** | A 787, S 2133, S 2438, S 4246, A 5322, **Executive Order 4, S 7621, A 6195, S.B. 3703, A 6296, S.B. 4630** | A 432, A 773, A 787, S 1786, S 2438, S 2332, S 4246, S 4265, A 5322, A 6932, A 6969, **A.B. 354, S 3296, A 6296** | **52** |
| **North Carolina** | H.B. 279, H 349, S 350, S 658, S 495, H 832, H 829, H 732, H 660, H 610, H 864, **S 99, S 105** | H.B. 279 | | **14** |
| **Oklahoma** | S.B. 877, S.B. 874 | | | **2** |
| **Oregon** | H.B. 3123, S.B. 1001, S.B. 478, H.B. 3472, S.B. 737, S.B. 546, S.B. 543, **S.B. 478, H.B. 3473, S.B. 737, S.B. 546, S.B. 543** | **S.B. 596, S.B. 962, S.B. 478, H.B. 3473** | **S.B. 478, H.B. 3473, S.B. 546** | **19** |
| **Pennsylvania** | H.B. 112, H.B. 1541, **H.B. 1410** | | H.B. 721, H.B. 853 | **5** |
| **Rhode Island** | H.B. 5086, S.B. 16, S.B. 196, H.B. 5673, **S.B. 2044, H.B. 7233, H.B. 7438, S.B. 2298, H.B. 5861, S.B. 724** | **H.B. 7917, H 5082** | | **12** |
| **South Carolina** | H.B. 3499 | | | **1** |
| **Tennessee** | S.B. 0573, H.B. 0550 | S.B. 0573, H.B. 0550 | S.B. 0573, H.B. 0550 | **6** |

| State | PFAS | Flame Retardants | Phthalates /BPA | Total Number of Policies |
|---|---|---|---|---|
| **Texas** | H.B. 4577 | | | **1** |
| **Utah** | S.B. 286 | | | **1** |
| **Vermont** | S.D.S. 25, H. 152, S. 82, H. 421, H. 422, H.B. 1011, **S 239, S 10, S 49, H 955, S 20, S 113, H 740, H 446, H 145, S 73** | **H 444, S 109, S 81** | H 152, **S 247, S 239, S 261** | **23** |
| **Virginia** | H.B. 1011, S.B. 800,, H.B. 1855, S.B. 1013, **H.B. 1257, H.B. 586, H.B. 919, H.B. 2189** | | | **8** |
| **Washington** | S.B. 5245, **H.B. 2658, S.B. 6413, S.B. 5135, H.B. 2265, H.B. 1080, H.B. 1694, H.B. 1047** | **H.B. 1024, Executive Order 04-01, H.B. 2545, S.B. 5135** | **S.B. 6248, S.B. 6086, S.B. 5135, H.B. 1047** | **16** |
| **Washington D.C.** | | **B 21-0143** | | **1** |
| **West Virginia** | S.B. 485 | | | **1** |
| **Wisconsin** | A.B. 43, S.B. 312, A.B. 312, **S.B. 70** | | **S 271** | **5** |
| **Key**<br><br>Current Policy<br>**Adopted Policy** | Resource<br>*Toxic flame retardants*. (n.d.). Safer States. Retrieved August 12, 2023, from https://www.saferstates.org/toxic-chemicals/toxic-flame-retardants/<br>*PFAS*. (n.d.). Safer States. Retrieved August 12, 2023, from https://www.saferstates.org/toxic-chemicals/pfas/<br>*BPA, phthalates, and chemicals used in plastic*. (n.d.). Safer States. Retrieved August 12, 2023, from https://www.saferstates.org/toxic-chemicals/bpa-phthalates-and-chemicals-used-in-plastic/ | | | |

UNIVERSITY OF SAN FRANCISCO | School of Nursing and Health Professions

## MPH Competencies Checklist
## Integrative Learning Experience - ILEX

**Directions**: One of the purposes of this course is to allow students to strengthen, integrate, and demonstrate mastery of public health competencies gained throughout the MPH program. The list of CEPH Foundational Competencies and the individual Concentration Competencies follows. You will draw on and demonstrate these skills in writing your paper and giving your final presentation.

Please review these lists and identify at least 2 Foundational Competencies and at least 2 Concentration-specific Competencies that you will be applying or addressing in your ILEX paper and oral presentation. This is required to fulfill CEPH accreditation requirements for schools and programs in public health.

All students will be demonstrating and should select Competency #19, "Communicate audience-appropriate public health content, both in writing and through oral presentation." If you are successful in this course, it means you are proficient in this skill.

Try not to let the exact wording of the competency constrain you. For example, if you have reviewed literature to identify community needs, you could choose "Apply qualitative methods to assess community assets for addressing public health and environmental issues" even though that competency mentions "assets" rather than "needs".

Here is an example of a how one CPHP student writing about barriers to access to cancer care selected competencies relevant to her ILEX:

- We have already said that all students should choose **Foundational Competency #19**, "Communicate audience-appropriate public health content in writing and through oral presentation."
- As she looks at policies appropriate for overcoming the access barriers, she'll consider their differential impact on under-represented groups, such as Latinx adults. Thus, the student will draw on skills described in CEPH **Foundational Competency #15**, "Evaluate policies for their impact on public health and health equity," and **CPHP Concentration Competency #2**, "Analyze how issues of power, race and ethnicity, sex and gender identify, and socioeconomic factors affect the development, implementation, and evaluation of community-based projects."

- In her literature review, to analyze data she'll apply **Foundational Competency #4**, "Interpret results of data analysis for public health research, policy and practice."
- The student will build a figure for the paper, to map the interactions between different types of barriers to access at different levels of the socio-ecological model. This shows application of **Foundational Competency #22**, "Apply systems thinking tools to a public health issue."
- In discussing the public health implications of her paper, she will be recommending ways to increase access to care that demonstrate **Concentration Competency #4**, "Apply project management strategies to improve the quality of programs and services in public health settings."

At times it may be challenging to figure out how to integrate and apply the competencies to what you plan to do. There are alternative ways to demonstrate that you are applying and synthesizing competencies. Your ILEX professor can provide additional guidance.

**CEPH Foundational Competencies**

| Competency | Choose at least 2 foundational competencies and briefly note why you feel it is relevant to your ILEX paper or presentation.<br>(Note: all students can choose Competency #19, and mention your specific audience) |
|---|---|
| **Evidence-based Approaches to Public Health** | |
| 1. Apply epidemiological methods to the breadth of settings and situations in public health practice | |
| 2. Select quantitative and qualitative data collection methods appropriate for a given public health context | |
| 3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate | |
| 4. Interpret results of data analysis for public health research, policy and practice | |
| **Public Health & Health Care Systems** | |
| 5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings | |
| 6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and societal levels | |
| **Planning & Management to Promote Health** | |

| | |
|---|---|
| 7. Assess population needs, assets and capacities that affect communities' health | |
| 8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs | |
| 9. Design a population-based policy, program, project or intervention | |
| 10. Explain basic principles and tools of budget and resource management | |
| 11. Select methods to evaluate public health programs | |
| **Policy in Public Health** | |
| 12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence | |
| 13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes | |
| 14. Advocate for political, social and economic policies and programs that will improve health in diverse populations | I will be advocating for a policy change surrounding what chemicals should be required/allowed on textiles/clothing |
| 15. Evaluate policies for their impact on public health and health equity | I will be evaluating the current laws surrounding chemical use on clothing/ textiles and the potential exposure for the public |
| **Leadership** | |
| 16. Apply principles of leadership, governance and management, which include creating a vision, empowering others, fostering collaboration and guiding decision making | |
| 17. Apply negotiation and mediation skills to address organizational or community challenges | |
| **Communication** | |
| 18. Select communication strategies for different audiences and sectors | |
| 19. Communicate audience-appropriate public health content, both in writing and through oral presentation | I will be doing a presentation on Health Professionals Day |
| 20. Describe the importance of cultural competence in communicating public health content | |

| Interprofessional Practice* | |
|---|---|
| 21. Perform effectively on interprofessional teams | |
| **Systems Thinking** | |
| 22. Apply systems thinking tools to a public health issue | |

**MPH - Community and Public Health Practice Competencies**

| Competency | If CPHC is your program concentration, choose at least 2 competencies you plan to draw on and mention how it is relevant. |
|---|---|
| 1. Apply qualitative methods to assess community assets for addressing public health and environmental issues | I will be reviewing literature to identify community needs and address environmental issues. |
| 2. Analyze how issues of power, race and ethnicity, sex and gender identify, and socioeconomic factors affect the development, implementation, and evaluation of community-based projects | |
| 3. Develop a research project proposal using mixed methods to address a public health problem | |
| 4. Apply project management strategies to improve the quality of programs and services in public health settings | |
| 5. Identify environmental health risks in vulnerable communities and examine strategies to reduce exposures | The goal of the paper is to understand the potential exposure to humans, evaluate current laws surrounding chemicals required and allowed on clothing/textiles, in the United States, and to look at the potential impact on the environment. |

**MPH – Health Policy Leadership Competencies**

| Competency | If HPL is your program concentration, choose at least 2 competencies you plan to draw on and mention how it is relevant. |
|---|---|

| | |
|---|---|
| 1. Predict how health policies may impact risks and drivers of health outcomes at the health system and public health sector level | |
| 2. Synthesize evidence from literature review and/or databases to write a policy paper for a specific audience, identifying a problem and proposing alternative approaches to meet health needs in underserved communities | |
| 3. Design a leadership plan and strategies to manage stakeholders and related political processes, addressing conflict, resistance, and cooperation in the implementation process | |
| 4. Communicate recommendations to improve organizational strategies and capacity to implement health policy | |
| 5. Advocate and make recommendations on legislation or regulation related to a current environmental health issue, drawing on risk assessment evidence | |

**MPH – Behavioral Health Competencies**

| Competency | If BH is your program concentration, choose at least 2 competencies you plan to draw on and mention how it is relevant. |
|---|---|
| 1. Plan a health education training, curriculum, or workshop including stakeholder identification, resource planning and timeline, volunteer recruitment and marketing, strategy selection, and monitoring process. | |
| 2. Effectively deliver evidence-based health education and behavior change intervention skills such as motivational interviewing, health coaching, peer education, mindfulness, or social media messages to individuals or groups. | |
| 3. Analyze the impact of chronic conditions and propose strategies to address prevention and management across all levels of the Socioecological Model. | |
| 4. Formulate strategies for mental health and substance abuse prevention and treatment in community settings. | |
| 5. Develop a data collection and analysis plan including measures and methods for research on behavioral health. | |