

Background

Motivation:

- 785 million people without clean water
- 3.4 million people die from waterborne illnesses each year
- Many communities cannot afford water quality testing

Mission:

- Create an **interactive tool to evaluate potential risks** in water sources to **help low-socioeconomic communities** address exposure risks with appropriate treatment options

Literature Review

Scope:

- 132 papers were reviewed for India
- 52 papers were included in the database

Inclusion criteria:

- The paper is relevant to chemical contamination in drinking water (groundwater and surface water)
- The paper links chemical occurrence to the source of contamination (e.g., nearby industry/agriculture)
- An intervention or treatment method for specific chemical toxins is recommended

Next Steps

- Expanding functionality of CHRIS through a web or application
- Inclusion of additional contaminants, risks, and interventions through continued literature review
- Expanding database to include additional countries in literature review
- Improving risk prediction and recommended interventions based on literature review and water quality data

Excel VBA – Fully-Functional Alpha Version

Input

Region
Location
Source
Source of water
Urban Zone
Population density
Nearby Industries
Industrial facilities

Source

Surface

Ground

Rain

Other

Urban Zone

Urban

Peri-Urban

Rural

Other

Region

North

North East

Central

East

West

South

Nearby Industries

Cultivation	<input type="checkbox"/>	Power Generation	<input type="checkbox"/>
Animal Feed	<input type="checkbox"/>	E-Waste Recycle	<input type="checkbox"/>
Pharmaceuticals	<input type="checkbox"/>	Fire Training	<input type="checkbox"/>
Textiles	<input type="checkbox"/>	Water (Uncovered)	<input type="checkbox"/>
Oil/ Gas	<input type="checkbox"/>	Airport	<input type="checkbox"/>
Personal Care	<input type="checkbox"/>	Recycling Facility	<input type="checkbox"/>
Mining	<input type="checkbox"/>	Hospital	<input type="checkbox"/>
Food Industry	<input type="checkbox"/>	Hydrological	<input type="checkbox"/>
Paint/ Dye	<input type="checkbox"/>	Geogenic	<input type="checkbox"/>
Pesticide	<input type="checkbox"/>	Wastewater	<input type="checkbox"/>
Brick/ Ceramic	<input type="checkbox"/>	Natural Combustion	<input type="checkbox"/>
Conflict Zone	<input type="checkbox"/>	Other	<input type="checkbox"/>

Output

Contaminants
Potential contaminants in drinking water source
Risks
Risks from contact with contaminants
Interventions
Treatments for contaminants
Costs
Cost of interventions

Contaminants

- Uranium
- Trichloroethane
- Trichloroethane and benzotriazole
- SO4
- Rock Mineral
- Pharmaceuticals (Anti-inflammatory, anti-epileptic and anti-microbial drugs)
- Pharmaceuticals
- PFCs (PFOS, PFOA)

Risks

- Uranium: Chronic kidney disease, lung cancer and other health problems.
- Polycyclic aromatic hydrocarbons (PAHs): Risk assessment shows that an incremental life time cancer risk and risk index were ranged from 0.02 × 10⁻¹⁰ to 4.93 × 10⁻¹⁰ for children and 0.01 × 10⁻¹⁰ to 2.98 × 10⁻¹⁰ for adult.
- Pharmaceuticals and personal care products: Antibiotics, NSAIDs, Gabapentin, Paracetamol, Cotinine, Trichloroethane, Trichloroethane, Carbamazepine, Atenolol, Trimethoprim, Sulfamethoxazole, Ciprofloxacin, Anti-inflammatory, an
- Pesticides: Organochlorine pesticide, DDT (Dichlorodiphenylchloroethane), OCPs (Organochlorine pesticides), Durox, Endosulfan sulfate, Lindane: High presence of Organochlorine pesticides in drinking water is a risk fact
- PCBs (polychlorinated biphenyls): Probable human carcinogens that target human systems like the nervous system, endocrine system, reproductive system, cardiovascular system, immune system.
- Nitrate: Can cause blue infant disorder, increase cancer risk in adults like stomach tumors, colorectal cancer, hypertension, thyroid dysfunction.
- Heavy metals: Arsenic, Mercury, Cadmium, Zinc, Copper, Lead, Cobalt, Iron, Boron, Nickel, Manganese, Chromium: Consumed high levels can lead to acute, chronic toxicity, liver, kidney and intestinal damage, anemia and ca
- Halides: Bromine, Chlorine, Fluoride: Adverse effects include tooth decay, causes noncancerous health effects.

Interventions

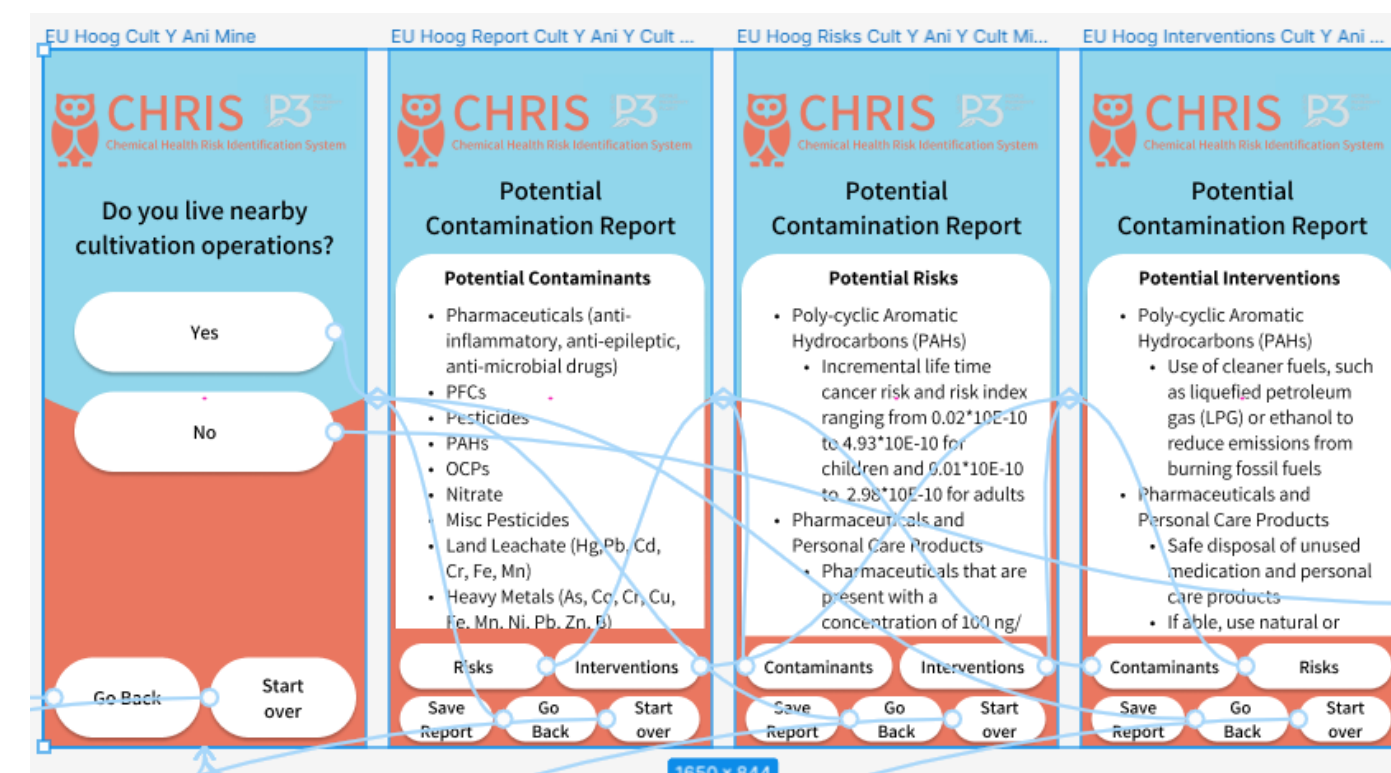
- Uranium: Ion exchange, distillation, water monitoring programs
- Polycyclic aromatic hydrocarbons (PAHs): The use of cleaner fuels, such as liquefied petroleum gas (LPG) or ethanol, to reduce PAH emissions from burning fossil fuels.
- Pesticides: Organochlorine pesticide, DDT (Dichlorodiphenylchloroethane), OCPs (Organochlorine pesticides), Durox, Endosulfan sulfate, Lindane: Natural pest control methods
- PCBs (polychlorinated biphenyls): Reverse osmosis
- Nitrate: Distillation, ion exchange
- Landfill Leachate (Hg, Cd, Cr, Fe, Mn): Physical and chemical treatment of wastewater.
- Heavy metals: Arsenic, Mercury, Cadmium, Zinc, Copper, Lead, Cobalt, Iron, Boron, Nickel, Manganese, Chromium: Practice Safe disposal of batteries and electronic waste
- Halides: Bromine, Chlorine, Fluoride: Bleach and cleaning products

Costs

- Uranium: \$1.5 per household boiling drinking water per day
- Pharmaceuticals and personal care products: Antibiotics, NSAIDs, Gabapentin, Paracetamol, Cotinine, Trichloroethane, Trichloroethane, Carbamazepine, Atenolol, Trimethoprim, Sulfamethoxazole, Ciprofloxacin, Anti-inflammatory, ar
- Pesticides: Organochlorine pesticide, DDT (Dichlorodiphenylchloroethane), OCPs: \$33.8 per liter of organic pesticide (Organochlorine pesticides), Durox, Endosulfan sulfate, Lindane: \$88 (\$950 /year)
- Endocrine-disrupting chemicals (EDCs): Benzotriazoles (BTRs), benzothiazoles (BThs), benzophenones (BPs), Bisphenol analogues (BPs), H-benzotriazole, Artificial sweeteners (ASWs), PFCs (PFOS, PFOA): \$10.97 per day

Figma – Interactive Prototype

Prototype View



The prototype view shows a sequence of four screens:

- Do you live nearby cultivation operations?** (Yes/No buttons)
- Potential Contamination Report** (List of potential contaminants)
- Potential Risks Contamination Report** (List of potential risks)
- Potential Interventions Contamination Report** (List of potential interventions)

Navigation buttons like 'Go Back', 'Start over', 'Save Report', and 'Go' are visible between screens.

User View of Application



The user view shows a mobile interface with the following elements:

- Start Water Assessment** button
- Review Old Reports** button
- List of Contaminants** button
- Add New Data** button
- Potential Contamination Report** screen showing:
 - Potential Contaminants: Pharmaceuticals (anti-inflammatory, anti-epileptic, anti-microbial drugs), PFCs, Pesticides, OCPs, Nitrate, Misc Pesticides, Land Leachate (Hg, Pb, Cd, Cr, Fe, Mn), Heavy Metals (As, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn, B).
 - Risks and Interventions buttons.