International Journal of Frontiers in
Chemistry and Pharmacy Research
Journal homepage: https://frontiersrj.com/journals/ijfcpr/
ISSN: 2783-0462 (Online)

(Review Article)

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Studies on emerging chemical risks on Living beings in a chemical world

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International Journal of Frontiers in Chemistry and Pharmacy Research, 2025, 06(01), 001-013

Publication history: Received on 13February 2025; revised on 25 March 2025; accepted on 27 March 2025

Article DOI: https://doi.org/10.53294/ijfcpr.2025.6.1.0021

Abstract

Emerging chemical risks may arise from intentional or unintentional contamination of the food chain either by anthropogenic or 'natural' chemicals. More than 160 million chemicals are known to humans. About 40 000 to 60 000 of them can be found in commerce; 6000 of these account for more than 99% of the total volume of chemicals in commerce globally. Chemicals, whether of natural origin or produced by human activities, are part of our environment. Manufactured chemicals include industrial and agricultural products such as pesticides, petroleum products and processed metals. Some chemicals are manufactured for specific uses, while others are unwanted by-products, including wastes, or products of combustion such as toxic gases and particles from industrial emissions and burning of fuel. Emerging chemical risks are new or unforeseen chemicals that may pose a threat to human, animal, or plant health. These chemicals can be synthetic and may alter a living being's metabolism. They can enter the body through consumer products, food, or the environment. The review of this manuscript is reveals that the Exposure to chemicals can have a wide range of health effects.

Keywords: Chemical risks; Health effects; Environment; Toxicity; Pollutants

1 Introduction

Every day we learn more about how exposure to pollutants in air, water, soil, and food is harmful to human health, All people come in contact with chemicals as part of normal life – through the food and drinking-water they consume, the products they use or are surrounded by at home or the workplace, through the contact with the environment (e.g. through breathing air, touching the soil, and swimming in recreational waters) or as a result of a chemical incident. Many of the chemicals people use and are exposed to are harmless or even beneficial; others pose a threat and are hazardous to people's health and the environment. Levels of exposure and resulting health impacts are determined by social as well as biological factors. Men, women and children are exposed to different kinds and levels of chemicals and are exposed with different frequency. In addition, men, women and children vary in their physiological susceptibility to health effects from exposure to hazardous chemicals [1-3]. Many chemicals have inherent properties that can negatively impact the human body and its functions. The hazards of some chemicals are extensively studied, well-understood, and have been published in the literature or in textbooks. These chemicals are assigned hazards that are communicated to the researcher through pictograms and hazard statements. However, it is important to keep in mind that new experimental compounds and compounds that are derived from well-studied chemicals may pose unknown or unexpected health hazards and should be handled as such. If you are handling a new and untested substance, treat them as potentially harmful, and minimize any exposure through absorption, inhalation, or ingestion. Approximately 800 substances are known or suspected to be endocrine disruptors and many of them are present in everyday products, such as metal food cans, plastics, pesticides, food and cosmetics. Endocrine disruptors include bisphenol A (BPA), dioxins, polychlorinated biphenyls (PCBs) and certain types of phthalates. Phthalates, for example, are used to soften plastic for use in a wide range of consumer goods, such as vinyl flooring, adhesives, detergents, air fresheners, lubricating oils, food packaging, clothing, personal care products and toys. Consuming food and drinks from containers

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that include phthalates is one way to become exposed. Inhaling indoor dust contaminated with phthalates that are released from plastic products or polyvinyl chloride (PVC) furnishings is another. (This is one of the reasons why airing our rooms regularly is important.) Children playing with toys that contain these substances are also at risk and, since phthalates can also be found in consumer products, such as soaps and suntan lotions, exposure can also occur through the skin [3-5].Exposure to chemicals can have a wide range of health effects, including: Skin and eye irritation: Chemicals can irritate or burn the skin or eyes. Organ damage: Chemicals can damage organs. Cancer: Chemicals can cause cancer. Reproductive problems: Chemicals can cause reproductive problems and birth defects. Weakened immune system: Chemicals can weaken the immune system. Allergies or asthma: Chemicals can cause allergies or asthma. Developmental issues: Chemicals can affect the mental, intellectual, or physical development of children. Chronic diseases: Chemicals can cause chronic diseases. Neurological disorders: Chemicals can cause neurological disorders. Genetic damage: Chemicals can damage genetic material. Fertility issues: Chemicals can affect fertility by disrupting the endocrine system. Chemicals can affect any system in the body, including the respiratory, digestive, circulatory, nervous, and reproductive systems. Chemicals can be absorbed into the body through inhalation, absorption, or ingestion. Pregnant women and young children are particularly vulnerable to exposure to hazardous chemicals [6]. A basic classification of types of toxicities from chemicals should not be limited to drugs, but rather should be applicable to all chemicals. Such a classification could be based on the fact that toxicity is essentially an unwanted effect that is produced on a biologic specimen by a chemical. All toxic effects can be conveniently divided into two principal types based on whether or not the effect is one that involves preconditioning of the biologic specimen.

2 Toxicity

Some substances are more toxic than others. The toxicity of a substance is described by the types of effects it causes and its potency.

- **Types of Effects:** Different chemicals cause different effects. For example, Chemical A may cause vomiting, but not cancer. Chemical B may have no noticeable effects during exposure, but may cause cancer years later.
- **Potency:** Potency (strength) is a measure of a chemical's toxicity. A more potent chemical is more toxic. For example, sodium cyanide is more potent than sodium chloride (table salt) since swallowing a smaller amount of cyanide can poison you.

The potency and, therefore, the toxicity of a chemical can be affected by its breakdown within the human body. When a substance is absorbed into the body, its chemical structure may be changed or metabolized to a substance that is more toxic or less toxic. For example, carbon tetrachloride, once a commonly used solvent, is changed by the body into a more toxic chemical that causes liver damage. For some other chemicals, metabolism changes the chemical into a form that is more easily eliminated by the body [7].

- **Exposure:** A chemical can cause health effects only when it contacts or enters the body.
- **Routes of Exposure:** Exposure to a substance can occur by inhalation, ingestion or direct contact.

Inhalation (breathing) of gases, vapors, dusts or mists is a common route of exposure. Chemicals can enter and irritate the nose, air passages and lungs. They can become deposited in the airways or be absorbed by the lungs into the bloodstream. The blood can then carry these substances to the rest of the body. Ingestion (swallowing) of food, drink or other substances is another route of exposure. Chemicals that get in or on food, cigarettes, utensils or hands can be swallowed. Children are at greater risk of ingesting substances found in dust or soil because they often put their fingers or other objects in their mouths. Lead in paint chips is a good example. Substances can be absorbed into the blood and then transported to the rest of the body. Direct contact (touching) with the skin or eyes is also a route of exposure. Some substances are absorbed through the skin and enter the bloodstream. Broken, cut or cracked skin will allow substances to enter the body more easily. The route of exposure can determine whether or not the toxic substance has an effect. Breathing or swallowing lead can result in health effects, but touching lead is not harmful because lead isn't absorbed through the skin [8].

- **Dose:** The amount of a substance that enters or contacts a person is called a dose. An important consideration in evaluating a dose is body weight. If a child is exposed to the same amount of chemical as an adult, the child (who weighs less) can be affected more than the adult. For example, children are given smaller amounts of aspirin than adults because an adult dose is too large for a child's body weight. The greater the amount of a substance a person is exposed to, the more likely that health effects will occur. Large amounts of a relatively harmless substance can be toxic. For example, two aspirin tablets can help to relieve a headache, but taking an entire bottle of aspirin can cause stomach pain, nausea, vomiting, headache, convulsions or death[9].

- **Exposure medium:** Exposure to chemicals occurs when we breathe, eat or touch soil, water, food or air that contains chemicals. The amount of a chemical in the medium is called its concentration. Common ways of reporting concentrations are parts per million, milligrams per liter or milligrams per cubic meter. These and other units of measure are defined in the Glossary of Environmental Health Terms available from the New York State Department of Health.

A person's dose can be determined by multiplying the concentration of the chemical times the amount of the water, air, food or soil that a person takes in. For example, the average adult drinks about 2 liters (roughly quarts) of water and breathes about 20 cubic meters (roughly cubic yards) of air a day. If drinking water contains 1 milligram of lead per liter, then the person would take in a total of 2 milligrams of lead in a day.

- **Length of exposure:** Short-term exposure is called acute exposure. Long-term exposure is called chronic exposure. Either may cause health effects that are immediate or health effects that may not occur for some time.

Acute exposure is a short contact with a chemical. It may last a few seconds or a few hours. For example, it might take a few minutes to clean windows with ammonia, use nail polish remover or spray a can of paint. The fumes someone might inhale during these activities are examples of acute exposures. Chronic exposure is continuous or repeated contact with a toxic substance over a long period of time (months or years). If a chemical is used every day on the job, the exposure would be chronic. Over time, some chemicals, such as PCBs and lead, can build up in the body and cause long-term health effects. Chronic exposures can also occur at home. Some chemicals in household furniture, carpeting or cleaners can be sources of chronic exposure[10-11]. Chemicals leaking from landfills (dumps) can enter the groundwater and contaminate nearby wells or seep into basements. Unless preventive measures are taken, people may be exposed for a long time to chemicals from their drinking water or indoor air.

2.1 Toxicity endpoints

The chemically induced adverse effects are known as endpoints (Fig. 1). To examine the specific potential endpoints of test chemicals, various tests are developed for determining carcinogenicity, genotoxicity, neurotoxicity, and reproductive and developmental toxicity. Different types of toxicity caused by chemical agents[12].

Figure 1 Chemically induced adverse effects as endpoints

3 Physiological Classification of Materials

This classification identifies toxic materials on the basis of biologic action.

- **Irritants** – refers to some sort of aggravation of whatever tissue the material comes in contact with. e.g. ammonia, nitrogen dioxide.
- **Asphyxiants** – exert their effects through a depletion of oxygen to the tissues e.g. simple asphyxiants – carbon dioxide, nitrogen, methane, hydrogen chemical asphyxiants – carbon monoxide, hydrogen cyanide, hydrogen sulphide.
- **Narcotics or Anaesthetics** – the main toxic action is the depressant effect upon the Central Nervous System. e.g. – many organics, chloroform, xylene.
- **Systemic Poisons** – the main toxic action includes the production of internal damage e.g. Hepatotoxic agents – toxic effects produce liver damage. eg. carbon tetrachloride.

e.g. Nephrotoxic agents – toxic effects produce kidney damage eg. some halogenated hydrocarbons

- **Carcinogens** – agents/compounds that will induce cancer in humans. e.g. benzene, arsenic, inorganic salts of chromium, nickel, beryllium[13].
- **Mutagens –** agents that affect the cells of the exposed people in such a way that it may cause cancer in the exposed individual or an undesirable mutation to occur in some later generation. e.g. radiation, variety of chemical agents that alter the genetic message.
- **Teratogens –** Agents or compounds that a pregnant woman takes into her body that generate defects in the fetus e.g. Thalidomide, possibly steroids
- **Sensitizers –** Agents that may cause allergic or allergic-like responses to occur.

After an initial exposure to a substance an individual may become sensitized to that substance. Subsequent exposures to the same substance, often at a much lower concentration than before, produce an allergic response. This response may be a skin rash (dermatitis) or an asthmatic-like attack, depending on the route of exposure. e.g. cutting oils, isocyanates in polyurethane foam operations and paint spraying operations, some laboratory solvents[14-15].

4 Health and Ecological Hazards Caused by Hazardous Substances

Emergency response efforts must consider the health and ecological hazards of a hazardous substance release. These hazards impact emergency responders and effected communities. In some cases, hazardous substances may irritate the skin or eyes, make it difficult to breathe, cause headaches and nausea, or result in other types of illness. Some hazardous substances can cause far more severe health effects, including:

- Behavioral abnormalities,
- Cancer,
- Genetic mutations,
- Physiological malfunctions (e.g., reproductive impairment, kidney failure, etc.),
- Physical deformations, and
- Birth defects.

Impacts on the environment can be just as devastating: killing organisms in a lake or river, destroying animals and plants in a contaminated area, causing major reproductive complications in animals, or otherwise limit the ability of an ecosystem to survive. Certain hazardous substances also have the potential to explode or cause a fire, threatening both animals and human populations [16]. Some hazardous substances produce toxic effects in humans or the environment after a single, episodic release. These toxic effects are referred to as the acute toxicity. Other hazardous substances produce toxic effects in humans or the environment after prolonged exposure to the substance, which is called chronic toxicity [17].

5 Types of exposure to chemicals and pollutants

There are 3 ways to be exposed to chemicals and pollutants:

- Inhaling (breathing in)

- Absorption (skin and eye contact)
- Ingesting (eating or drinking)

5.1 Inhaling (breathing in)

People are exposed to chemicals and pollutants when you inhale (breathe in). They take over 20,000 breaths a day. This number can be much higher for infants and children. The chemicals and pollutants you inhale can end up in your lungs and blood stream. Sometimes, you can smell or taste harmful chemicals, but it isn't always so easy. Some chemicals, like radon or carbon monoxide, are odorless, tasteless and invisible [18].

5.2 Absorption (skin and eye contact)

People can be exposed to chemicals and pollutants by coming into contact with them through their skin and eyes. These organs can be more sensitive to chemicals and may react more quickly than the rest of your body.

5.3 Ingesting (eating or drinking)

People are exposed to chemicals and pollutants when you eat and drink. Chemicals and pollutants are found in both our food and water sources.

5.4 Potential health effects

Accidents or incorrect use of household chemical products may cause immediate health effects, such as skin or eye irritation or burns, or poisoning. There can also be longer-term health effects from chemicals. When these occur, they're usually the result of exposure to certain chemicals over a long period. Depending on the chemical, longer-term health effects might include: cancer, organ damage, weakening of the immune system, development of allergies or asthma, reproductive problems and birth defects, effects on the mental, intellectual or physical development of children

Follow these tips to lower your exposure and help protect yourself and your family from chemicals and pollutants [19-20].

6 Factors that affect health risks of chemicals and pollutants

The health risks of chemicals and pollutants depend on several factors, including:

- The amount people are exposed to
- The type of chemical or pollutant
- When and how long people are exposed
- People age and general state of health
- How people are exposed (through air, products, food, water and soil)

People that may be more sensitive to or more harmed by exposures from chemicals and pollutants include: children, seniors, pregnant people, Indigenous Peoples [21-24]. A chemical exposure can produce a health effect directly at the site of contact (local) or elsewhere in the body (systemic), and that effect can be either immediate or delayed. Area of the Body Affected: Chemicals can affect any system in the body, including respiratory (nose, air passages and lungs), digestive (mouth, throat, stomach, etc.), circulatory (heart, blood), nervous (brain, nerve cells) and reproductive (sperm, egg, etc.). Some chemicals, like acids, are nonspecific and cause damage on direct contact. Other chemicals, like gasoline, can be absorbed into the blood, and carried throughout the body. Some chemicals affect only certain target systems or target organs. Every organ system has different functions and physical characteristics. So the effect of chemicals on each system has to be evaluated slightly differently. As an example, consider three ways that chemicals can affect one system: the reproductive system. First, chemical exposure can affect a man's or woman's reproductive system by making the production of normal sperm or eggs more difficult [22]. Second, the chemical may act directly on an unborn baby (fetus). Since chemicals can be transferred from the mother's blood to the unborn baby's blood, the fetus can be affected when the mother is exposed to certain chemicals. A pregnant woman who drinks alcohol can have a baby with fetal alcohol syndrome. The health effects can range from birth defects to learning disabilities. And finally, some chemicals can have indirect effects on the development of the fetus. For example, smoking during pregnancy can reduce the amount of oxygen to the fetus. The lack of oxygen can affect the baby's growth. Not all chemical exposures affect reproduction, but it is best to minimize exposure to all toxic substances during pregnancy [25-28]. They can occur directly at the site of contact or elsewhere in the body. For example, inhaled ammonia can irritate the linings of the nose, throat and lungs. Alcohol can cause dizziness. Immediate health effects are sometimes reversible and may disappear soon after the exposure stops. However, some immediate health effects do not go away; acute exposure to a corrosive substance, such as battery acid, may cause permanent damage to skin or eyes[29-30]. Delayed health effects may take months or years to appear and can result from either acute or chronic exposure to a toxic substance. The delay between the exposure and the appearance of health effects is called the latency period. Delayed health effects can be reversible or permanent. Permanent effects don't go away when the exposure stops. For example, breathing asbestos over a period of time may cause lung disease. Once the lung disease begins, it will continue even if the exposure stops or decreases. Cancer is an example of a delayed health effect. Cancer is the uncontrolled growth and spread of abnormal cells in the body. There are many kinds of cancer. Cancer can be caused by a number of things, including exposure to toxic substances, ultraviolet sunlight and ionizing radiation. Exposure to some chemicals, such as benzene and asbestos, can produce cancer in humans. Some chemicals produce cancer in animals, but whether they will in humans is unknown. Because cancer may not appear until 5 to 40 years after exposure, determining the cause of cancer is difficult [30-33].

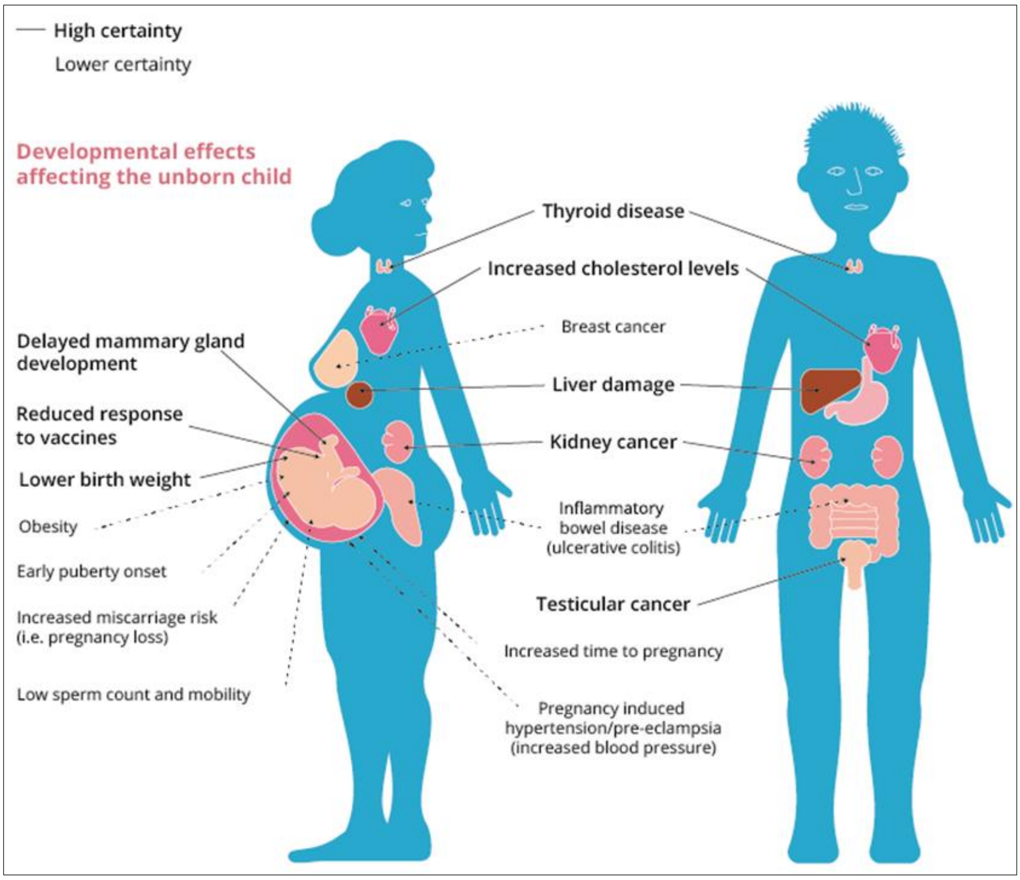

Figure 2 Factors that affect health risks of chemicals and pollutants

7 Types of Health Effects

A chronic health effect is an adverse health effect resulting from long-term exposure to a substance. Symptoms do not usually subside when the exposure stops. Examples of chronic health effects include asthma and cancer [34-36]. Acute health effects can be observed immediately or soon after an exposure; often a large, brief exposure. Many times the symptoms will subside after the cause is removed, however, depending on the amount/dose, permanent damage or even death can occur from a single exposure. Examples of acute health effects include dizziness, skin irritation, and throat irritation. Keep in mind that a chemical may cause both acute and chronic effects. Health effects can vary depending on the organ, the dose level, frequency, duration, and route of exposure (inhalation, skin contact, etc.). Ethanol is an excellent example of a compound that causes varied health effects based on the parameters mentioned above. A small amount of ethanol (from alcoholic beverages) over several hours results in loss of coordination and impaired judgment large one-time consumption leads to vomiting, unconsciousness, or even death; consumption over several days by a pregnant person can lead to birth defects; and chronic consumption over many years can lead to cirrhosis of the liver[37-40].Some chemical hazards that negatively impact human health are identified in the table 1 below (this list is not all-inclusive)

Table 1 Chemical hazard that negatively impact human health

Systemic Effects	Target Organ Effects	Other Health Hazards
Carcinogens Toxic agents Highly toxic agents Corrosives Irritants Sensitizers	Hepatotoxins Nephrotoxins Neurotoxins Blood/hematopoietic toxins Respiratory toxins Reproductive toxins Cutaneous hazards Eye hazards	Cardiovascular toxicity Gastrointestinal toxicity Immunotoxicity Skeletal/muscular effects Connective tissue effects Endocrine system toxicity Sensory organ toxicity (sight, hearing, taste)

8 Signs and symptoms of chemical exposure

Signs of an exposure are external and can often be seen by you or others in the laboratory. They are objective and can sometimes be measurable. Signs of exposure sometimes include hives, puffiness, sneezing, etc. They are often temporary and can go away when the source of the exposure is removed [40-43].Symptoms are internal and are not visible to the naked eye. They are only felt by the person feeling them and examples include pain, dizziness, numbness, etc. Sometimes a sign can indicate a symptom. For example vomiting is a sign than indicates someone is feeling nauseated (symptom). There are different signs/symptoms of exposure to chemicals based on their hazards, reactivity, and the route of exposure. Many of the signs and symptoms of exposure to chemicals are similar, but there are some specific signs which are indicative of particular compounds. For example, osmium tetroxide vapors damage the cornea of the eye, can make your eyes feel gritty, and even turn them black. It is important to know the signs and symptoms of the chemicals with which you work and other chemicals in the laboratory to which people could potentially be exposed as shown in table 2. .

Table 2 Signs and symptoms of chemical exposure

Skin Absorption	Ingestion	Inhalation	Eye Contact
Itching Redness Burns Blisters Rash/Hives	Abdominal Pain Nausea Vomiting Diarrhea Awarm sensation in the stomach (halogenated hydrocarbons) Dark-colored (black water) urine (arsenic) Dehydration	Drowsiness Dizziness/Vertigo Headache Confusion/Lethargy Clear drainage from nose Cough Dry/Scratching/Burning Throat Blurred vision Shortness of breath Rapid breathing (tachypnea) Rapid heart rate (tachycardia)	Redness of the eyes Burning sensation in eyes Constant tear production Mucous discharge from tear ducts Blurred vision / blindness (partial or complete)

This list is not comprehensive—those researchers with sensitivities or allergies to certain compounds may experience different or more severe symptoms. If you experience one or any combination of these symptoms after one-time or continued exposure to hazardous chemicals, seek medical attention according to the procedures found in the Lab Safety Guide/Chemical Hygiene Plan [44-45].

9 Effect of chemicals on health

Generally, no one doesn’t know all the effects of exposure to every chemical. Every one learns about the health effects of many chemicals from human exposures and animal studies.

- **Human Exposures:** Information about human exposures that have occurred at work or by accident is very useful, even though it may be incomplete. For example, if a person has been exposed to more than one substance, it may be hard to find out exactly which substance caused a health effect. Also, some health effects (such as cancer) don't appear until many years after the first exposure, making the cause of the disease hard to determine. Even when the substance that caused the health effect is known, the exact dose that caused the effect may not be. Sometimes a human population that has been exposed to a toxic substance (usually at work or from an environmental source) is compared with a population that has not been exposed. If the exposed population shows an increase in a certain health effect, that health effect may be related to the chemical exposure. However, these studies often cannot determine the exact cause of a health effect [46].
- **Animal Studies:** Many toxicity tests are done on animals. Animal tests are often good indicators of chemical toxicity in humans even though animals may not react exactly like people. Many things are considered when applying the results of animal toxicity tests to humans. For example, animals are smaller, they have shorter lifespan and their bodies sometimes handle chemicals differently from humans. Large doses are used in the animal studies to see if there will be any effect. When guidelines or standards for human exposure to chemicals are developed, these differences and others are taken into account.

10 Protect our self

Even though chemicals we use or are exposed to every day can be toxic, People can protect themselves and their family from chemical exposures. No matter how toxic a substance may be, if you are not exposed to the substance, it cannot affect your health. The important rule to remember is: minimize your exposure.

- Before we use a product, read the label carefully and follow the instructions. Pay attention to warnings on the label.
- Use proper ventilation. Ventilation means getting fresh air into your home or workplace. When using strong chemicals, open your doors and windows whenever the weather permits. When you use a toxic chemical indoors, you may wish to blow air out the window with a fan. Have another window or door open to let fresh air into the room. If we use chemicals in your hobbies, use them outdoors or in a well- ventilated area away from our living space.
- Wear appropriate protective gloves when handling chemicals. If you use substances that are harmful to breathe (like fiberglass which can lodge in the lungs), use an appropriate mask.
- Store chemicals safely and out of the reach of children. Label all containers and do not store liquids in commonly used household containers such as soda bottles or food cans.
- If clothes become soiled while handling chemicals, change the clothes as soon as possible to reduce exposure. Wash soiled clothes separately; then run the machine through a rinse cycle to clean it before washing more clothes.
- If you must use a toxic substance, buy only the amount needed so there will be less material left for storage or disposal.
- Try to avoid using a toxic substance. If that is not possible, choose products that have less toxic ingredients. For example, water-based paints are generally less toxic than oil-based paints.
- Indoor air can contain chemicals from outside air, soil or water. Radon, a naturally occurring radioactive gas, can affect your health. It enters homes through holes or cracks in basement floors or walls. Learn how to test for radon. If the radon levels in your home are elevated, take corrective steps as soon as possible.
- Drinking water can contain harmful chemicals. Lead can leach from (dissolve out of) lead pipes or lead solder. Reduce the amount of lead in your water by using cold water and by running the water for a minute or two before using it for drinking or cooking. Filters can take out some chemicals from drinking water. Filters should only be used when necessary; be sure that the one you use takes out the chemical you are concerned about, and maintain the filters regularly [47].

11 Emergency Procedures

The identification of emerging chemicals is challenging due to the scarce existing information on the hazard they pose and their occurrence in food, feed and environmental compartments. In addition, detection and quantification methods are not developed for most of them. For these reasons, in addition to desk-based sources, analytical methodologies have been developed and tested for chemicals screening purposes (suspect screening for “known unknowns”, non-target analysis for “unknown unknowns”, target analysis for “known”). They have addressed the challenge of developing analytical methodologies flexible enough to detect and quantify in food samples, without prior occurrence data, a large variety of chemicals with different physico-chemical properties (e.g., molecular weight and n-octanol–water partition coefficient) and toxicity, still accurate enough to detect chemicals at very low concentrations. To manage emerging chemical risks, it is necessary to anticipate, characterize and possibly prevent risks, which are trans boundary, highly uncertain, and systemic [48].

11.1 Skin Contact

Remove contaminated clothing and rinse off affected skin immediately with copious amounts of water at a shower station for 15 minutes or until pain is relieved. Seek medical attention, especially if skin is irritated or damaged.

11.2 Eye Contact

Use the eyewash to rinse the eyes thoroughly for at least 15 minutes, occasionally lifting upper and lower eyelids, moving the eyeballs around. Seek medical attention.

11.3 Inhalation

Move to fresh air immediately. Seek medical attention if symptoms persist. Provide the medical team with the SDS for the chemical to which you were exposed [49].

11.4 Spills

If the spill requires evacuation (complicated spill), first evacuate and then call 108 immediately. Contact DRS to report the spill. Spills should only be cleaned up by personnel wearing suitable PPE. Any spills should be cleaned up immediately, using absorbent pads or other absorbent material such as sand or cat litter. Have enough material readily available before working with the chemicals. Do not use paper towels to soak up liquids if the compound is also flammable. Place the used absorbent material into a heavy-duty plastic bag (if the solvent will not dissolve the plastic) or sealable container and dispose of as hazardous waste through DRS. More information is outlined on our Chemical Spill page.

11.5 Fires

Take the campus Fire Extinguisher Training. Have a fire extinguisher readily available when working with flammable materials. Consult the SDS for the appropriate fire extinguisher before you begin working with the chemical [50].

12 Conclusions

1. Preventive or control actions such as regulations, guidelines or codes of practice, are then considered for any aspect of the substance's life cycle from the research and development stage through manufacture, use, storage, transport and ultimate disposal or recycling.

2. Overall, climate change is likely to drive the (re)emergence of new hazards, increases the exposure or the susceptibility to known hazards and changes the levels of micronutrients and macronutrients in food and feed items. Moreover, climate change may elevate severity, duration and/or frequency of the potential effects of the hazard considered in the identified issue. A notable effect appears on the likelihood of emergence, for which the confidence level is higher. In the area of contaminants, an impact on the occurrence, intensity, and toxicity of blooms of potentially toxic marine and freshwater algae and bacteria was identified. Furthermore, climate change may affect transport pathways in the environment, fate (including bioaccumulation and elimination) and toxicity of and exposure to toxic compounds. The importance of extreme weather events (heat waves, drought, heavy rainfall, and flooding) as driver of emerging chemical issues was emphasized.

3. Systems approach is adopted with the use of Big Data and Artificial Intelligence techniques that will support the delivery of early warning and risk prediction systems. Develop and validate targeted and non-targeted detection methods for existing and emerging hazards. Develop tools and holistic risk assessment methods (cost-benefit analysis) of the food system that will take into account, not only positive and negative health considerations, but also environmental, and economic dimensions. Improve data and knowledge-sharing infrastructures by developing an Integrated European Data and Knowledge Exchange Infrastructure that will be able to power an ecosystem of decision support systems. Integrate consumer and user requirements using Living Labs and a multi-actor engagement approach to involve all stakeholders (e.g., authorities, food producers, and citizens).

4. Particular attention should be devoted to the identification of a common set of algorithms, software, models, technologies and tools for identifying and monitoring emerging chemicals, screening large numbers of substances, prioritising and characterising those of emerging concern or requiring early regulatory action. The main challenges suspect screening and non-targeted analysis (blind spots, unidentified chemicals etc) pose to the identification of emerging chemicals should be discussed and appropriate computational methods identified
that could contribute to address them.

5. The knowledge gaps that arise from the identification of emerging chemical issues should provide insight for research prioritisation for emerging chemical risks for which information is scant. For example, future research should focus on optimised efforts in detecting the 'unknown unknowns', which constitute unknown markers of exposure and for which non-target screening is required for their detection. In order to limit the inherent limitations posed by non-target screening, methodological harmonisation is suggested among laboratories. This is among the most challenging endeavours and is a promising approach to advance our knowledge in emerging chemical risks. Moreover, optimal combinations between bio-based methods (effect-based methods) and chemical screening methods could also be explored in future research.

Compliance with ethical standerds

Acknowledgements

The author is thankful to Almighty God for the wisdom, grace, and strength he gave me to complete this manuscript. The special thanks are presented to Dr. M. Sasidhar – Principal, Dr. K. Sai Manoj -CEO, Sri K. Rama Mohana Rao Secretary and Correspondent, Sri K. Lakshmi Karthik President and Sri K. Ramesh babu- Industrialist, Chairman of Amrita Sai Institute of Science and Technology whose candor, patience, understanding, and demonstration of empathy inspired me throughout this challenging journey of writing this manuscript. The author also gratefully acknowledges all the members of the S&H, & CRT departments.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' Contributions

The author has contributed to data analysis, drafting, and revising of the article and agreed to be responsible for all the aspects of this work.

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