<table>
<thead>
<tr>
<th>Sources of Exposure</th>
<th>Toxicokinetics and Normal Human Levels</th>
<th>Biomarkers/Environmental Levels</th>
</tr>
</thead>
</table>

**General Populations**
- Exposure of the general population to 3,3'-dichlorobenzidine is not likely as it is no longer used to manufacture soluble dyes in the United States. Additionally, its use in other manufacturing, processing, or other uses for commercial purposes has markedly decreased in the U.S.
- Exposure of the general population to 3,3'-dichlorobenzidine may occur through contaminated water or soil near hazardous waste sites or near facilities where 3,3'-dichlorobenzidine is used and/or discharged.
- Exposure to trace amounts of 3,3'-dichlorobenzidine can occur in cosmetics sold abroad that use certain synthetic dyes as colorants, and in other foreign consumer skin care and personal hygiene products such as cosmetic facial masks.

**Occupational Populations**
- Workers in industries where 3,3'-dichlorobenzidine is used (dyes, plastics) may be exposed.
- Occupational exposure is most likely to occur through inhalation or dermal contact.

**Toxicokinetics**
- 3,3'-Dichlorobenzidine is rapidly absorbed in rats.
- In animals, 3,3'-dichlorobenzidine is thought to be widely distributed throughout the body.
- Evidence in humans and animals suggest that 3,3'-dichlorobenzidine undergoes metabolism through N-acetylation resulting in the metabolites N-acetyl-3,3'-dichlorobenzidine and N″N′-diacetyl-3,3'-dichlorobenzidine.
- Evidence in humans suggests 3,3'-dichlorobenzidine and its metabolites are excreted in urine. In animals, evidence suggests bile/feces as the route of excretion followed by urine.

**Normal Human Levels**
- No information on urine or blood levels of 3,3'-dichlorobenzidine representative of the general U.S. population were identified.

**Biomarkers**
- 3,3'-Dichlorobenzidine levels in urine and the detection of hemoglobin adducts are biomarkers of exposure.
- There are no established baseline or “normal” human values for either urine or hemoglobin adduct levels for 3,3'-dichlorobenzidine.

**Historical Environmental Levels**
*See ToxProfile Chapter 5 for sampling dates*

**Air**
- Ambient: 7.6x10^-16 µg/m³ (modeled)
- Indoor: Range: <0.6-2.5 µg/m³ in occupational settings

**Water**
- Surface water and groundwater: Range 0.65-270 µg/L
- Wastewater effluent: Range 0.013-654 µg/L

**Sediment and Soil**
- Median <1 µg/kg in dry sediment.
- Wet sediment: Range: not detectable to 69.66 mg/kg near U.S. lake from 1993 to 2003, with the highest concentration measured 6 km from the source.

**Other Media**
- Dry municipal sludge: Range: 3.13-16 mg/kg

**Reference**
### Chemical and Physical Information

**3,3’-Dichlorobenzidine** is a white or gray to purple crystalline solid.

- The 3,3’-dichlorobenzidine salts, 3,3’-dichlorobenzene dihydrochloride, 3,3’-dichlorobenzene dihydrogen bis(sulphate), and 3,3’-dichlorobenzene sulphate are a white to light-gray crystalline powder.
- 3,3’-Dichlorobenzidine and its salts have relatively low solubility in water but are soluble in alcohol and slightly soluble in hydrochloric acid.
- 3,3’-Dichlorobenzidine and its salts are not volatile.
- 3,3’-Dichlorobenzidine has low mobility in soil and binds strongly to solid phases in soil, sediment, and sludge. Previously, 3,3’-dichlorobenzidine and its salts were used in the manufacturing of dyes in the United States.
- Currently, 3,3’-dichlorobenzidine dihydrochloride is used in pigments in the United States. The manufacture of 3,3’-dichlorobenzidine has largely ceased in the United States, however it is still imported.

### Routes of Exposure

- **Inhalation** – Exposure to 3,3’-dichlorobenzidine in air is a minor route of exposure for workers and populations near industrial waste sites.
- **Oral** – The primary route of exposure to 3,3’-dichlorobenzidine for the general population may occur through ingestion of contaminated water.
- **Dermal** – Dermal contact via cosmetic products is a potential route of exposure to minute levels of 3,3’-dichlorobenzidine for the general population. Dermal contact is a minor route of exposure for workers.

### 3,3’-Dichlorobenzidine in the Environment

- In air, 3,3’-dichlorobenzidine is emitted as a vapor, but reacts with sunlight, with an estimated half-life of 10 hours.
- It is photolabile in water and susceptible to rapid photolysis in sunlit surface water and may yield benzidine. Its half-life in water when exposed to natural sunlight is approximately 90 seconds.
- 3,3’-Dichlorobenzidine binds to soil and sediment and can be transported relatively long distances.
- 3,3’-Dichlorobenzidine has the potential to concentrate in aquatic animals.

### Relevance to Public Health (Health Effects)

**Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.**

#### Minimal Risk Levels (MRLs)

**Inhalation**
- No acute-, intermediate-, or chronic-duration inhalation MRLs were derived for 3,3’-dichlorobenzidine.

**Oral**
- No acute-, intermediate-, or chronic-duration oral MRLs were derived for 3,3’-dichlorobenzidine.

#### Health Effects

- **Workers** exposed to 3,3’-dichlorobenzidine may be at a higher risk of developing bladder cancer, and cancer appears to be the most sensitive effect of exposure.
- Limited evidence in workers has also observed dermatitis as an effect.
- 3,3’-Dichlorobenzidine is genotoxic in animals. There is strong evidence that 3,3’-dichlorobenzidine exposure results in gene mutation in animal cells and DNA damage in human cells when metabolized in the body.

#### Children’s Health

- It is not known if children exposed to 3,3’-dichlorobenzidine would be expected to experience effects similar to adults. There is insufficient evidence to determine if developmental effects occur in the fetus or the offspring of individuals exposed to 3,3’-dichlorobenzidine.

**Health Effects**

- One study in dogs noted the development of liver tumors.
- The U.S. Department of Health and Human Services (HHS) has classified 3,3’-dichlorobenzidine as reasonably anticipated to be a human carcinogen. The International Agency for Research on Cancer (IARC) classified 3,3’-dichlorobenzidine as possibly carcinogenic to humans, and the EPA classified it as a probable human carcinogen.