CHAPTER 6. ADEQUACY OF THE DATABASE

Section 104(i)(5) of CERCLA, as amended, directs the Administrator of ATSDR (in consultation with the Administrator of EPA and agencies and programs of the Public Health Service) to assess whether adequate information on the health effects of 1,1,1-trichloroethane is available. Where adequate information is not available, ATSDR, in conjunction with NTP, is required to assure the initiation of a program of research designed to determine the adverse health effects (and techniques for developing methods to determine such health effects) of 1,1,1-trichloroethane.

Data needs are defined as substance-specific informational needs that, if met, would reduce the uncertainties of human health risk assessment. This definition should not be interpreted to mean that all data needs discussed in this section must be filled. In the future, the identified data needs will be evaluated and prioritized, and a substance-specific research agenda will be proposed.

6.1 EXISTING INFORMATION ON HEALTH EFFECTS

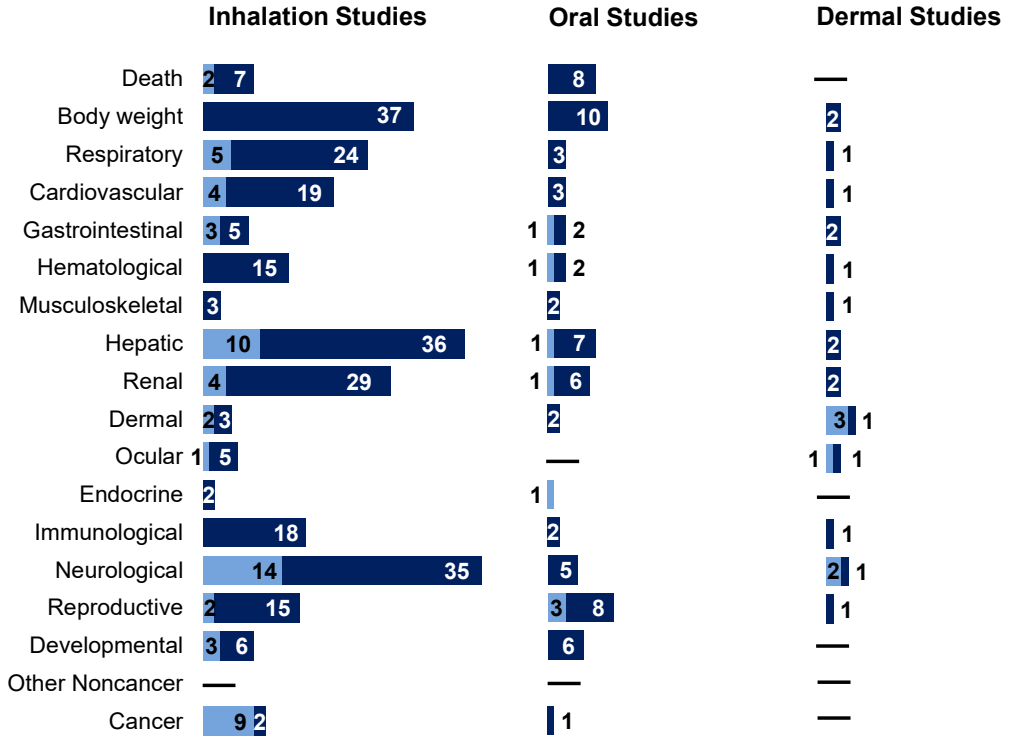
Studies evaluating the health effects of inhalation, oral, and dermal exposure of humans and animals to 1,1,1-trichloroethane that are discussed in Chapter 2 are summarized in Figure 6-1. The purpose of this figure is to illustrate the information concerning the health effects of 1,1,1-trichloroethane. The number of human and animal studies examining each endpoint is indicated regardless of whether an effect was found and the quality of the study or studies.

Several case studies have documented the lethality of high concentrations of inhaled 1,1,1-trichloroethane in humans. Experimental studies in humans, as well as case reports, have reported on acute systemic and neurological effects. Chronic neurological, developmental, reproductive, and cancer effects have been investigated in epidemiology studies. The available evidence in humans points to predominantly neurological effects after inhalation exposure to 1,1,1-trichloroethane, although case studies suggest that death may occur at sufficiently high doses. Carcinogenicity has been studied by a large number of case-control and a few cohort studies, with the vast majority of the studies showing no relationship between many types of cancer and prior exposure to 1,1,1-trichloroethane. However, two studies found a statistically significant relationship between 1,1,1-trichloroethane exposure and multiple myeloma, and one study found a relationship between 1,1,1-trichloroethane exposure and cancer of the nervous system (Anttila et al. 1995; Gold et al. 2011). Health effects caused by the oral and dermal routes of administration have not been as well studied in humans. One case study regarding oral exposure to 1,1,1-trichloroethane reported acute systemic effects and investigated potential neurological effects.

Figure 6-1. Summary of Existing Health Effects Studies on 1,1,1-Trichloroethane by Route and Endpoint*

Potential neurological, hepatic, body weight, renal, and respiratory effects were the most studied endpoints

The majority of the studies examined inhalation exposure in **animals** (versus **humans**)



*Includes studies discussed in Chapter 2, including those finding no effect. Most studies examined multiple endpoints.

Developmental effects and cancer from exposure to drinking water were investigated by epidemiology studies. The effects of dermal exposure are discussed in case reports regarding peripheral neuropathy and dermal sensitization in workers and in controlled studies regarding skin irritation.

6.2 IDENTIFICATION OF DATA NEEDS

Missing information in Figure 6-1 should not be interpreted as a "data need." A data need, as defined in ATSDR's *Decision Guide for Identifying Substance-Specific Data Needs Related to Toxicological Profiles* (ATSDR 1989), is substance-specific information necessary to conduct comprehensive public health assessments. Generally, ATSDR defines a data gap more broadly as any substance-specific information missing from the scientific literature.

Because 1,1,1-trichloroethane is volatile and was used as a solvent in many products, it was most frequently found in the air in occupational settings due to volatilization during production and use. As such, inhalation exposures and toxicity are of primary concern and have been the most studied route of exposure to 1,1,1-trichloroethane. Under Section 604 of the Clean Air Act as amended in 1990, all production and use of 1,1,1-trichloroethane was scheduled to cease as of January 1, 2002. However, while production of 1,1,1-trichloroethane has decreased, it does continue and some facilities still report production and use of 1,1,1-trichloroethane to TRI and CDR. While present-day exposure is less likely, it is still possible. The oral and dermal routes of exposure were less of a potential exposure concern as the predominant fate in the environment is volatilization to the atmosphere, making inhalation the main route of exposure. Researcher consideration of likely routes of exposure may account for the comparatively lower number of publications on oral and dermal exposure to 1,1,1-trichloroethane. Differences in absorption, distribution, and metabolic pathways could lead to differences in toxic response and different target organs following the three routes of exposure.

Acute-Duration MRLs. Data from inhalation studies in humans based on decreased psychomotor performance were sufficient to derive an acute-duration inhalation MRL (Mackay et al. 1987). An acute-duration oral MRL was not derived due to lack of adequate data. The effects of acute-duration oral exposure of 1,1,1-trichloroethane have not been well studied. Six acute oral exposure studies were reported in four publications: two studies reporting LC_{50} data in mice and guinea pigs (Torkelson et al. 1958) and four studies that only evaluated a few toxicity endpoints (Bruckner et al. 2001; Platt and Cockrill 1969; Spencer et al. 1990). None of the available studies examined comprehensive toxicological

endpoints. Acute-duration oral studies evaluating comprehensive endpoints may provide data to derive an acute-duration oral MRL.

Intermediate-Duration MRLs. An intermediate-duration inhalation MRL was derived based on neurotoxicity (increase in GFAP, indicative of astroglioisis) in gerbils (Rosengren et al. 1985). An intermediate-duration oral MRL was developed based on reduced body weight gain in female mice data from the NTP (2000) oral study. While an oral MRL was developed, additional data for other intermediate-duration oral endpoints are lacking. Oral studies designed to assess more subtle neurological effects in animals exposed to 1,1,1-trichloroethane via the oral exposure route may be beneficial. Both NOAEL and LOAEL data are lacking for dermal exposures and since populations residing near hazardous waste sites may be potentially exposed to 1,1,1-trichloroethane, intermediate-duration dermal studies designed to determine values for systemic and other neurological effects would be valuable. An additional useful approach may be to develop route-to-route extrapolation using the existing inhalation PBPK models to assess the health risk from intermediate-duration oral or dermal exposure to 1,1,1-trichloroethane.

Chronic-Duration MRLs. MRL values were not derived for chronic-duration inhalation exposures because the most sensitive effect found in studies is represented by a serious effect; a chronic-duration oral MRL was not derived due to lack of adequate data. Since data needed to develop chronic-duration MRLs are lacking and since residents living near hazardous waste sites may be potentially exposed to 1,1,1-trichloroethane, studies that attempt to identify target organs and effect levels for all three exposure routes would be beneficial. Additionally, chronic-duration inhalation studies at doses <201 ppm could provide additional information regarding hepatic health effects and if they produce foci of hepatic changes, as this level of exposure in female mice led to hepatocellular adenomas/carcinomas, which is considered a serious effect.

Health Effects

Hepatic. Ohnishi et al. (2013) conducted a 2-year cancer bioassay following inhalation exposure. An increase in the occurrence of hepatocellular adenomas in female mice was observed at 201 ppm. However, as adenomas are considered serious effects, a data need has been identified to study hepatic effects of chronic-duration inhalation exposure to 1,1,1-trichloroethane in mice at doses <201 ppm. Conducting chronic-duration inhalation studies with lower concentrations would allow for a more definitive assessment of the minimum levels at which less serious hepatic effects occur after chronic-duration inhalation of 1,1,1-trichloroethane.

Immunological. No studies were identified regarding the immunotoxicity of 1,1,1-trichloroethane in humans and limited information regarding immunotoxicity was available for animals. The only human information available was a report of spleen congestion in subjects acutely exposed to high levels of 1,1,1-trichloroethane (Gresham and Treip 1983; Stahl et al. 1969). A single inhalation exposure to 1,1,1-trichloroethane in mice did not result in an increase in susceptibility to bacterial infection in exposed mice compared to controls (Aranyi et al. 1986). Very limited information exists regarding histology and function of tissues of the lymphoreticular system after 1,1,1-trichloroethane exposure by any route. Histological evaluation of lymph nodes, thymus, and spleen revealed no lesions attributable to 1,1,1-trichloroethane exposure (Adams et al. 1950; Calhoun et al. 1981; Kjellstrand et al. 1985b; Prendergast et al. 1967; Torkelson et al. 1958).

Although available studies do not suggest that 1,1,1-trichloroethane induces immunotoxicity, acute- and intermediate-duration inhalation and oral exposure studies evaluating potential immunotoxicity would provide valuable information regarding potential immunotoxicity.

Neurological. The central nervous system is apparently the primary target organ of 1,1,1-trichloroethane toxicity. In both animal and human studies, behavioral effects, altered electroencephalogram recordings, ataxia, unconsciousness, and death have been reported (Balster et al. 1982, 1997; Bowen and Balster 1996, 1998; Bruckner et al. 2001; Clark and Tinston 1982; De Ceaurriz et al. 1983; del Amo et al. 1996; Evans and Balster 1993; Gamberale and Hultengren 1973; Garnier et al. 1991; Gehring 1968; Kelafant et al. 1994; Mackay et al. 1987; Mattsson et al. 1993; Moser and Balster 1985, 1986; Muttray et al. 2000; Páez-Martínez et al. 2003; Spencer et al. 1990; Stewart et al. 1961, 1969; Sullivan 1994; Torkelson et al. 1958; Warren et al. 1997, 1998; Wiley et al. 2002; Winek et al. 1997; Woolverton and Balster 1981; You et al. 1994). Prolonged inhalation exposure to 1,1,1-trichloroethane in gerbils resulted in neurochemical changes suggested of morphological damage to the brain (Rosengren et al. 1985). Inhalation exposure has resulted in respiratory depression that appears to cause death in humans and animals. There are limited data on adverse effects following oral exposure. Neurological effects were not reported in the offspring of rats treated during gestation and lactation (Dow Chemical 1993) (see Developmental Toxicity). Neurological effects have not been reported after dermal exposure.

Studies designed to evaluate the impact of 1,1,1-trichloroethane exposure on neurological structure and function might provide important information regarding the mechanisms and reversibility of 1,1,1-trichloroethane induced neurological dysfunction. Additional studies on the reported changes in GFAP following 1,1,1-trichloroethane exposure may be helpful. Since information is lacking on the effects of 1,1,1-trichloroethane exposure via the oral route, acute-, intermediate-, and chronic-duration exposure studies designed to evaluate the impacts on the nervous system would provide information regarding the dose-response relationship for this route of exposure. Although available toxicokinetic data do not suggest route-specific target organs, an acute-duration dermal exposure study designed to assess the potential for neurotoxicity by this route would also be useful. In addition, using existing inhalation and oral data in PBPK models and extrapolating to dermal exposure might be a useful approach to assessing the risk of adverse neurological effects following dermal exposure to 1,1,1-trichloroethane. Epidemiological studies of potentially exposed populations, such as those living adjacent to hazardous waste sites or workers in occupational settings, may provide useful information on the potential for 1,1,1-trichloroethane at relevant exposure levels to produce neurological changes in humans.

Reproductive. An epidemiology study of fathers who were occupationally exposed to 1,1,1-trichloroethane during spermatogenesis found no relationship with adverse pregnancy outcomes (Taskinen et al. 1989). Limited information regarding reproductive toxicity in animals was located. Lane et al. (1982) found no reproductive effects in a multigeneration reproduction study of rats exposed to 1,1,1-trichloroethane in drinking water. Data from animal reproductive studies show mixed results. Several studies performing histological evaluations of reproductive organs and tissues in rats did not find lesions after inhalation exposure to 1,1,1-trichloroethane (Adams et al. 1950; Calhoun et al. 1981; Eben and Kimmerle 1974; Quast et al. 1988; Torkelson et al. 1958; Truffert et al. 1977). However, testicular degeneration was observed in guinea pigs exposed to 1,1,1-trichloroethane vapors (Adams et al. 1950). While NTP (2000) noted reduced epididymal spermatozoa concentration in male rats and mice administered 1,1,1-trichloroethane in the diet at a concentration of 80,000 ppm (approximate doses of 4,800 and 15,000 mg/kg/day, respectively) for 13 weeks, there were no other indications of adverse male reproductive effects and no signs of altered estrus in similarly treated female rats and mice (NTP 2000). No studies on the effects of 1,1,1-trichloroethane on reproductive function in humans were identified. As noted above, histopathological effects on reproductive organs have been observed animals but reproductive function (e.g., 2-generation reproduction studies) has not been assessed in animals after inhalation or dermal exposure to 1,1,1-trichloroethane. Although results of available studies

do not suggest route-specific target organs, an inhalation study of reproductive function in animals would be particularly valuable since inhalation is the predominant route of exposure in humans.

Developmental. The results from human epidemiological studies found no relationship between maternal exposure to 1,1,1-trichloroethane and adverse pregnancy outcomes, such as spontaneous abortions/congenital malformations (Deane et al. 1989; Lindbohm et al. 1990; Swan et al. 1989; Taskinen et al. 1989; Wrensch et al. 1990a, 1990b). Some studies in animals indicate that 1,1,1-trichloroethane is a potential developmental toxicant in high doses. Skeletal abnormalities such as delayed ossification and extra ribs in rats and rabbits, respectively, and decreased fetal body weight in rats have been reported after inhalation exposure of pregnant rats or rabbits during major organogenesis (BRRC 1987a, 1987b; York et al. 1982). However, two of the studies used concentrations that produced significant maternal toxicity (BRRC 1987a, 1987b). Late-stage gestational exposure to 1,1,1-trichloroethane vapors at concentrations that did not result in maternal toxicity, resulted in developmental milestone delays (pinnae detachment, incisor eruption, and eye opening) and impaired performance in neurobehavior tests were noted in mouse pups of dams (Jones et al. 1996). Neurological effects were not reported in the offspring of rats gavaged with 1,1,1-trichloroethane during gestation and lactation (Dow Chemical 1993). No teratogenic effects were reported in a multigeneration developmental study of oral 1,1,1-trichloroethane exposure in rats (Lane et al. 1982). Since dermal data are lacking, route-to-route extrapolation of existing inhalation and oral data using PBPK models might be a useful approach to assessing the risk of adverse developmental effects from dermal exposure to 1,1,1-trichloroethane. Additional developmental toxicity studies of inhalation or oral 1,1,1-trichloroethane exposure that investigate neurological effects at lower doses of exposure might be useful.

Cancer. Maltoni et al. (1986) conducted 2-year cancer bioassays following both inhalation and oral exposure. An increase in the occurrence of immunoblastic lymphosarcoma was reported in rats following oral exposure. However, the following limitations of the study preclude the drawing of definitive conclusions: only one dose level was used, only a small number of rats responded, and experimental procedures were compromised. No effects were reported in a well-designed inhalation study at exposure levels ≤1,500 ppm (Quast et al. 1988). Conducting inhalation studies with higher concentrations, conducting oral studies using several dose levels,

using larger study groups, and using more than one species would allow for a more definitive assessment of the carcinogenic potential of 1,1,1-trichloroethane.

Genotoxicity. No studies were identified regarding the genotoxic potential of 1,1,1-trichloroethane in humans. Genotoxicity studies indicate that 1,1,1-trichloroethane may be weakly mutagenic in *Salmonella* (Gocke et al. 1981; Nestmann et al. 1980, 1984; Simmon et al. 1977), induce deletions via intrachromosomal recombination in *Saccharomyces cerevisiae* (Brennan and Schiestl 1998), transform mammalian cells *in vitro* (Daniel and Dehnel 1981; Hatch et al. 1982, 1983; Milman et al. 1988; Price et al. 1978; Tu et al. 1985), and form DNA adducts in the mouse liver *in vivo* (Turina et al. 1986). While studies of other genotoxic effects have mostly been negative, most were not designed to prevent the volatilization of 1,1,1-trichloroethane, which likely resulted in lower than planned for exposures. Studies designed to prevent the loss of 1,1,1-trichloroethane through volatilization would allow genotoxic effects to be more accurately assessed. Additionally, both tests of chromosomal aberrations in peripheral lymphocytes from humans known to have been exposed to 1,1,1-trichloroethane and genotoxicity testing of 1,1,1-trichloroethane metabolites might be useful.

Epidemiology and Human Dosimetry Studies. No health effects associated with exposure to 1,1,1-trichloroethane have been reported for reproductive, developmental, or cancer endpoints in humans. However, these epidemiological studies are limited in design and scope, which limits their usefulness in ascertaining health effects from 1,1,1-trichloroethane exposure. Conducting well-designed epidemiological studies might provide a definitive assessment of the health hazards of chronic-duration 1,1,1-trichloroethane exposure, especially for occupationally exposed populations. Human dosimetry studies may be able to correlate 1,1,1-trichloroethane levels in human tissues or fluids with chronic health effects. Chronic-duration studies of populations living near hazardous waste sites may not be useful because exposures are likely low and the half-lives of 1,1,1-trichloroethane and its metabolites are short. Neurological effects have been demonstrated in humans following acute-duration inhalation exposures. Although potentially exposed subpopulations exist, potential nonoccupational exposure is expected to be reduced due to Title VI of the Clean Air Act.

Biomarkers of Exposure and Effect. Biomarkers of 1,1,1-trichloroethane exposure include blood, breath, and urine levels of the chemical and its two major metabolites, trichloroethanol and trichloroacetic acid. However, the two major metabolites of 1,1,1-trichloroethane are also metabolites of trichloroethylene and perchloroethylene and may therefore not indicate exposure to 1,1,1-trichloroethane

specifically (Monster 1988). Several studies report that environmental 1,1,1-trichloroethane levels are significantly correlated with the blood, breath, and urine levels (Hartwell et al. 1987; Mizunuma et al. 1995; Monster 1986; Wallace et al. 1982, 1984, 1985, 1987a, 1987b, 1987c). While 1,1,1-trichloroethane is rapidly cleared from the body after exposure (Astrand et al. 1973; Monster et al. 1979; Nolan et al. 1984; Stewart et al. 1961), the two metabolites have a much longer half-life in the body than the parent compound. Therefore, 1,1,1-trichloroethane levels in the blood, breath, and urine may be used as biomarkers only if they are measured during or shortly after exposure, whereas the two metabolites may be more useful as biomarkers for a somewhat longer period after exposure; however, they could also indicate exposure to trichloroethylene and perchloroethylene.

No specific biomarkers of effect, including hematological and clinical chemistry parameters, for 1,1,1-trichloroethane were found in the literature. However, since the central nervous system is apparently the most sensitive organ in humans and animals, and neurotoxicity (decreased psychomotor performance, ataxia, and unconsciousness) is observed after short-term high-level exposure, identification of biomarkers of effect may be useful.

Absorption, Distribution, Metabolism, and Excretion. While the absorption, metabolism, and elimination of 1,1,1-trichloroethane have been studied extensively in humans and animals, distribution has not been as well studied. Absorption of 1,1,1-trichloroethane by the lung, skin (under conditions to prevent evaporation), and gastrointestinal tract of humans and animals is rapid and efficient (Astrand et al. 1973; Fukabori et al. 1977; Kezic et al. 2000, 2001; Monster et al. 1979; Nolan et al. 1984; Reitz et al. 1988; RTI 1987; Stewart and Andrews 1966; Stewart and Dodd 1964; Tsuruta 1975). Because 1,1,1-trichloroethane is metabolized at a low rate and steady-state levels in the blood and tissues are reached, the percentage net absorption decreases with increasing inhalation duration. A study with humans equipped with respirators exposed to 1,1,1-trichloroethane vapors in the atmosphere reported that absorbed doses from inhaled 1,1,1-trichloroethane are much larger than doses from dermal absorption (Riihimäki and Pfäffli 1978). In animals 1,1,1-trichloroethane is distributed by the blood to the tissues and organs with preferential distribution to fatty tissues and is also distributed to developing fetuses (Holmberg et al. 1977; Katagiri et al. 1997; Schumann et al. 1982; Takahara 1986a). Human autopsy data from 30 cases reported detectable levels of 1,1,1-trichloroethane in subcutaneous fat, kidney fat, liver, lung, and muscle (Alles et al. 1988). Studies evaluating the effects of 1,1,1-trichloroethane on drug-metabolizing enzymes have conflicting results; additional studies to further define these effects would provide useful information. Regardless of exposure route, exhalation of 1,1,1-trichloroethane is the predominant pathway of elimination by humans and animals (Mitoma et al. 1985; Monster et al. 1979;

Nolan et al. 1984; Reitz et al. 1988; RTI 1987; Schumann et al. 1982). When exposure ceases, 1,1,1-trichloroethane rapidly clears from the body. Only trace amounts of 1,1,1-trichloroethane remained in animal tissues within days of short-term exposure. Since human dermal data are lacking, additional studies in humans that assess the extent and rates of absorption and elimination with dermal exposure to aqueous 1,1,1-trichloroethane solutions or suspensions under conditions allowing evaporation from the skin may provide useful information on dermal contact with contaminated water.

The hepatotoxicity of 1,1,1-trichloroethane is quite low compared to other chlorinated hydrocarbons, including 1,1,2-trichloroethane. The more hepatotoxic halocarbons are extensively metabolized, whereas 1,1,1-trichloroethane has a low rate of metabolism. Whether the mild effects of repeated 1,1,1-trichloroethane exposure are evoked by the parent compound or the limited quantities of metabolites produced is not known. However, the acute effects on central nervous and cardiovascular systems are reportedly caused by 1,1,1-trichloroethane and not its metabolites. The reported acute effects on membrane-mediated processes are due to the lipophilicity of 1,1,1-trichloroethane. Several cellular and biochemical processes appear to be affected by 1,1,1-trichloroethane. Sufficient data exist for absorption, metabolism, and elimination of 1,1,1-trichloroethane and further studies do not appear necessary. The distribution of 1,1,1-trichloroethane has not been as extensively studied and may warrant further investigation.

Comparative Toxicokinetics. Although the toxicokinetic pattern of 1,1,1-trichloroethane is qualitatively similar in humans, rats, and mice, there are major quantitative differences, including a higher blood:air partition coefficient, higher respiratory and circulatory rates, and increased rate of metabolism in mice, indicating that rats may be a better model for humans than mice. PBPK models have been developed to describe the kinetic behavior of 1,1,1-trichloroethane in mice, rats, and humans and have been used to estimate exposure levels that either produce or don't produce toxic effects in humans using interspecies and inter-route extrapolation methods (Bogen and Hall 1989; Dallas et al. 1989; Dobrev et al. 2001, 2002; Leung 1992; Nolan et al. 1984; Poet et al. 2000; Reitz et al. 1988). Further research verifying the metabolic constants and other input parameters used in these models might improve the accuracy and utility of the models in interspecies extrapolations. In addition, verification of the models at lower doses could provide relevant information.

Children's Susceptibility. Data needs related to both prenatal and childhood exposures, and developmental effects expressed whether prenatally or during childhood, are discussed in detail in the Developmental Toxicity subsection above. No information was located regarding potential age-related differences in susceptibility to 1,1,1-trichloroethane in humans. One animal study in mouse pups of dams

exposed to 1,1,1-trichloroethane vapors in the later stages of gestation reported delays in developmental milestones and impaired performance in neurobehavior tests (Jones et al. 1996). These results suggest that developing organisms may be more susceptible than adults to the toxic effects of 1,1,1-trichloroethane (Schumann et al. 1982). Additional well-designed animal studies could assess the potential for age-related increased susceptibility to 1,1,1-trichloroethane.

Physical and Chemical Properties. The physical and chemical properties of 1,1,1-trichloroethane are well documented, and additional information in this area does not appear necessary. Only one BCF for 1,1,1-trichloroethane was located in the available literature (Barrows et al. 1980). This value is, however, consistent with what would be expected based on the other physical and chemical properties of 1,1,1-trichloroethane.

Production, Import/Export, Use, Release, and Disposal. Data on facilities producing 1,1,1-trichloroethane and on releases of 1,1,1-trichloroethane to the air, soil, and water are available through the TRI. Data on the historical uses and production of 1,1,1-trichloroethane are available in the literature. There is uncertainty regarding current domestic production of 1,1,1-trichloroethane. The CDR lists production volumes for years 2016–2019; however, the only domestic production is expected to be for export purposes to developing countries. The USITC has not shown import or export volumes since 2014. While methods of disposal are available in the literature and regulations on the disposal of 1,1,1-trichloroethane exist, information of the amount of 1,1,1-trichloroethane disposed of is lacking.

Environmental Fate. Data on the environmental fate of 1,1,1-trichloroethane are well represented in the literature. The partitioning of 1,1,1-trichloroethane from soil or water to the atmosphere is well established, and there is sufficient evidence to indicate that the compound can leach into groundwater (Lyman et al. 1990; Swann et al. 1983). The relatively slow rate of degradation and the major routes of 1,1,1-trichloroethane degradation in all environmental compartments have been established. The relatively long persistence of 1,1,1-trichloroethane in the atmosphere indicates that a significant portion of this compound migrates to the stratosphere (Prinn et al. 1987; Singh et al. 1992). Data on the biodegradation of 1,1,1-trichloroethane in soil are lacking. Additional data regarding the environmental fate of 1,1,1-trichloroethane do not appear necessary.

Bioavailability from Environmental Media. Numerous toxicokinetic and toxicity studies in humans and animals have demonstrated the bioavailability of 1,1,1-trichloroethane from air and drinking water. Although some data on the bioavailability of 1,1,1-trichloroethane from air to mammalian skin (Mattie et

al. 1994), and from air to other mammalian tissues (blood, muscle, liver) (Connell et al. 1993) are available, no studies on the bioavailability of 1,1,1-trichloroethane from food or soil were identified. Some of the important routes of exposure to 1,1,1-trichloroethane for residents near waste sites will be inhalation of airborne dusts, ingestion of soil (children), and dermal contact with contaminated soil (mostly children). Therefore, it would be helpful to develop reliable data for the bioavailability of 1,1,1-trichloroethane from dust as a result of inhalation of contaminated airborne dust, from soil as a result of ingestion of soil, and from soil as a result of dermal contact with soil.

Food Chain Bioaccumulation. 1,1,1-Trichloroethane is not believed to bioconcentrate in fish and aquatic organisms (Barrows et al. 1980); thus, it is not expected to biomagnify in the food chain. There are limited data regarding food chain biomagnification of 1,1,1-trichloroethane.

Exposure Levels in Environmental Media. Reliable monitoring data for the levels of 1,1,1-trichloroethane in contaminated media at hazardous waste sites are needed to assess the potential risk of exposure in populations living near hazardous waste sites. Recent monitoring data in water, soil, and sediment are available for 1,1,1-trichloroethane. More recent monitoring data for levels in air and other media, such as food, are needed to assess the exposure level for the general population.

Exposure Levels in Humans. 1,1,1-Trichloroethane has been detected in human tissues and expired air. NHANES monitors 1,1,1-trichloroethane in the blood of the U.S. population, and the data indicate that it is present at very low to undetectable levels. This is consistent with expected values, since 1,1,1-trichloroethane use and production has been phased down and has therefore decreased in the United States.

Exposures of Children. No studies were identified that measured the level of 1,1,1-trichloroethane exposures of children. It is expected that exposure will be insignificant. If exposure does occur, it is likely to be through playing near contaminated sources or through accidental ingestion or inhalation. However, more information is needed to accurately assess the potential of 1,1,1-trichloroethane exposure of children.

6.3 ONGOING STUDIES

No ongoing studies were identified in the National Institute of Health (NIH) RePORTER (2023) database.