Pertussis—
United States, 1997-2000

MMWR. 2002;51:73-76

1 table omitted

PERTUSSIS WAS A MAJOR CAUSE OF MORTALITY AND MORTALITY AMONG INFANTS AND CHILDREN IN THE UNITED STATES DURING THE PREVACCINE ERA (I.E., BEFORE THE MID-1940S). FOLLOWING THE INTRODUCTION AND WIDESPREAD USE OF WHOLE-CELL PERTUSSIS VACCINE COMBINED WITH DIPHTHERIA AND TETANUS TOXOIDS (DTP) AMONG INFANTS AND CHILDREN IN THE LATE 1940S, THE incidence OF REPORTED PERTUSSIS DECLINED TO A HISTORIC LOW OF 1,010 CASES IN 1976 (FIGURE 1). HOWEVER, SINCE THE EARLY 1980S, REPORTED PERTUSSIS incidence HAS INCREASED CYCLICALLY WITH PEAKS OCCURRING EVERY 3-4 YEARS.1 IN 1996, LESS REACTOGENIC ACCELERAL PERTUSSIS VACCINES (DTaP) WERE LICENSED AND RECOMMENDED FOR ROUTINE USE AMONG INFANTS.2 THIS REPORT SUMMARIZES NATIONAL SURVEILLANCE DATA FOR PERTUSSIS DURING 1997-2000 AND ASSESS THE EFFECTIVENESS OF PERTUSSIS VACCINATION IN THE UNITED STATES DURING THIS PERIOD. THE FINDINGS INDICATE THAT PERTUSSIS INCIDENCE CONTINUES TO INCREASE IN INFANTS TOO YOUNG TO RECEIVE 3 DOSES OF PERTUSSIS-CONTAINING VACCINE AND IN ADOLESCENTS AND ADULTS. PREVENTION EFFORTS SHOULD BE DIRECTED AT MAINTAINING HIGH VACCINATION RATES AND MANAGING PERTUSSIS CASES AND OUTBREAKS.

STATE HEALTH DEPARTMENTS REPORT WEEKLY TO CDC THE NUMBER OF PERTUSSIS CASES, INCLUDING DEMOGRAPHIC INFORMATION, THROUGH THE NATIONAL ELECTRONIC TRANSMITTAL SYSTEM FOR SURVEILLANCE. MORE DETAIL INFORMATION ABOUT PERSONS WITH PERTUSSIS, INCLUDING CLINICAL CHARACTERISTICS AND VACCINATION HISTORY, IS REPORTED TO CDC THROUGH THE SUPPLEMENTARY PERTUSSIS SURVEILLANCE SYSTEM. PROBABLE AND CONFIRMED PERTUSSIS CASES ARE REPORTED. A CLINICAL CASE IS DEFINED AS AN ACUTE COUGH ILLNESS LASTING ≥14 DAYS IN A PERSON WITH AT LEAST ONE PERTUSSIS-ASSOCIATED SYMPTOM (I.E., PAROXYSMAL COUGH, POST-TUSSIVE VOMITING, OR INSPIRATORY WHOOP) OR ≥14 DAYS OF COUGH IN A PERSON IN AN OUTBREAK SETTING. A CONFIRMED CASE IS DEFINED AS A COUGH ILLNESS OF ANY DURATION IN A PERSON WITH ISOLATION OF BORDETELLA PERTUSSIS, OR A CASE THAT MEETS THE CLINICAL CASE DEFINITION AND IS CONFIRMED BY POLYMERASE CHAIN REACTION (PCR) OR BY EPIDEMIOLOGIC LINKAGE TO A LABORATORY CONFIRMED CASE. A PROBABLE CASE MEETS THE CLINICAL CASE DEFINITION BUT IS NOT LABORATORY CONFIRMED OR EPIDEMIOLOGICALLY LINKED TO A LABORATORY CONFIRMED CASE.

VACCINATION COVERAGE DATA ARE OBTAINED FROM THE NATIONAL HEALTH INTERVIEW SURVEY (NHIS) AND THE NATIONAL IMMUNIZATION SURVEY (NIS). NHIS IS AN ANNUAL CROSS-SECTIONAL HOUSEHOLD SURVEY OF THE U.S. CIVILIAN POPULATION THAT COLLECTS DATA ON VACCINATION STATUS OF CHILDREN AGED <6 YEARS.1 VACCINATION STATUS IS BASED ON VACCINATION RECORDS OR, WHEN NO RECORDS ARE AVAILABLE, ON PARENTAL RECALL. NIS IS A NATIONAL TELEPHONE SURVEY OF THE NONINSTITUTIONALIZED CIVILIAN POPULATION THAT ESTIMATES VACCINATION COVERAGE AMONG U.S. CHILDREN AGED 19-35 MONTHS.4 VACCINATION HISTORIES ARE VERIFIED BY VACCINE PROVIDERS.

THE EFFECTIVENESS OF PERTUSSIS VACCINE (VE) AMONG CHILDREN AGED 7-18 MONTHS IN 1998 AND 1999 WAS CALCULATED USING THE SCREENING METHOD.2 DURING THIS TIME, MOST CHILDREN RECEIVED DTaP RATHER THAN DTP. THE FORMULA VE = 1 - [PCV/(1-PCV)][(1-PPV)/PPV] was used; PCV is the proportion of children vaccinated and PPV is the proportion of the population vaccinated. ALL CONFIRMED AND PROBABLE PERTUSSIS CASES WERE INCLUDED. CHILDREN WERE CONSIDERED VACCINATED IF THEY HAD RECEIVED ≥3 DOSES OF PERTUSSIS-CONTAINING VACCINE. CHILDREN WHO WERE PARTIALLY VACCINATED (E.G., RECEIVED 1 OR 2 DOSES OF VACCINE) WERE EXCLUDED FROM CALCULATIONS OF PCV AND PPV. SURVEILLANCE DATA DURING 1998-1999 WERE USED TO DETERMINE PCV, AND DATA FROM NHIS FOR 1998 WERE USED TO ESTIMATE PPV. DATA FROM NIS WERE USED TO DETERMINE THE PERCENTAGE OF DTP, DTaP, AND PEDIATRIC DIPHTHERIA AND TETANUS TOXOIDS (DT) ADMINISTERED TO CHILDREN AGED 7-18 MONTHS DURING 1998-1999. PCV AND PPV WERE CORRECTED FOR ESTIMATED USE OF DT.

DURING 1997-2000, A TOTAL OF 29,134 PERTUSSIS CASES WERE REPORTED TO NETSS (6,564 IN 1997; 7,405 IN 1998; 7,298 IN 1999, AND 7,886 IN 2000), FOR A CRUDE AVERAGE ANNUAL INCIDENCE RATE OF 2.7 PER 100,000 POPULATION. AMONG 29,048 PERSONS WITH PERTUSSIS FOR WHOM AGE WAS KNOWN, 8,390 (29%) WERE AGED <1 YEAR, 3,359 (12%) WERE AGED 1-4 YEARS, 2,835 (10%) WERE AGED 5-9 YEARS, 8,529 (29%) WERE AGED 10-19 YEARS, AND 5,935 (20%) WERE AGED ≥20 YEARS. AVERAGE ANNUAL INCIDENCE RATES WERE HIGHEST AMONG INFANTS AGED <1 YEAR (55.5 CASES PER 100,000 POPULATION) AND LOWER IN CHILDREN AGED 1-4 YEARS (5.5), CHILDREN AGED 5-9 YEARS (3.6), PERSONS AGED 10-19 YEARS (5.5), AND PERSONS AGED ≥20 YEARS (0.8).

DATA ON RACE WERE AVAILABLE FOR 17,308 (75%) OF 23,113 PATIENTS AGED <20 YEARS. OF THESE, 15,124 (88%) WERE WHITE, 1,438 (8%) WERE BLACK, 316 (2%) WERE ASIAN/PACIFIC ISLANDER, AND 359 (2%) WERE AMERICAN INDIAN/ALASKA NATIVE. DATA ON ETHNICITY WERE AVAILABLE FOR 16,543 (72%) OF PATIENTS AGED <20 YEARS. OF THESE, 2,715 (16%) WERE HISPANIC. IN COMPARISON, THE NATIONAL POPULATION ESTIMATES FOR PERSONS AGED <20 YEARS IN 1998 WERE 79% WHITE, 16% BLACK, 4% ASIAN/PACIFIC ISLANDER, AND 1% AMERICAN INDIAN/ALASKA NATIVE. NATIONALLY, FOR ALL RACES, 15% OF PERSONS AGED <20 YEARS WERE HISPANIC. AMONG PERSONS WITH PERTUSSIS AGED <20 YEARS, MALES AND FEMALES WERE REPRESENTED EQUALLY; HOWEVER, 67% OF PATIENTS AGED ≥20 YEARS WERE FEMALE.

SUPPLEMENTARY CLINICAL DATA FOR PERSONS WITH PERTUSSIS WITH KNOWN AGE WAS
available for 28,187 (97%) cases. The proportion of pertussis patients who were hospitalized or had complications of pertussis was highest among infants aged <6 months, and decreased with increasing age. Among infants aged <6 months, 63% were hospitalized, 12% had radiographically confirmed pneumonia, and 1% had seizures. Among all age groups, 26 cases of encephalopathy and 62 pertussis-related deaths were reported.

According to NHIS data from 1998, 73% of children aged 7-18 months were vaccinated with ≥3 doses of DTP, DTap, or DT vaccines. Surveillance data for 1998 and 1999 indicated that 58% of patients aged 7-18 months were vaccinated with ≥3 doses of DTap, DTP, or DT. Compared with no doses of pertussis-containing vaccine, the VE for children aged 7-18 months receiving 3 doses was 88% (95% confidence interval [CI]=79%-93%). The VE was 91% (95% CI=82%-95%) for hospitalized patients, and 86% (95% CI=75%-92%) for non-hospitalized patients. Data do not now allow for separate estimation of VE for DTap and DTP. According to NIS, use of DTap, DTP, and DT in children aged ≤18 months during 1998-1999 was 66.3%, 33.1%, and 0.3%, respectively.

CDC Editorial Note: The increase in reported pertussis first noted in the 1980s continued throughout the 1990s.¹,² Compared with surveillance data for 1994-1996, the pertussis incidence rate among adolescents and adults has increased, 62% and 60%, respectively.³ The rate increased 11% among infants. In comparison, the incidence rate decreased 8% among children aged 1-4 years and remained stable among children aged 5-9 years. These increases could reflect a change in reporting or a true increase in incidence. In 1995, criteria for reporting a pertussis case changed in two ways: PCR became a method of confirmation, and data collection began for pertussis cases epidemiologically linked to another pertussis case. These changes primarily affected the reporting among patients aged ≥10 years. Although underreporting of mild or atypical disease is common,¹ increased recognition and diagnosis of pertussis among older age groups probably contributed to the large increase of reported cases among adolescents and adults.⁷ Conversely, an increase in pertussis among infants too young to receive 3 doses of pertussis-containing vaccine suggests a true increase in pertussis circulation.⁸ Infants have been a well-recognized high-risk group; changes in diagnosis or reporting patterns in this age group are unlikely. Despite recent changes in pertussis diagnostic methods, the proportion of culture-confirmed cases among infants has increased.⁸

The screening VE estimate of 88% reflects the effectiveness of the overall vaccination program that, according to NIS, used approximately two thirds DTap and one third DTP in children aged 7-18 months. This estimate is similar to the VE of 77%-90% previously estimated using the screening method for whole cell vaccine during 1992-1994 and to VEs observed in clinical trials for acellular pertussis vaccines.² The incidence of pertussis among children aged 6 months-4 years has remained stable throughout the 1990s,⁶ suggesting that protection offered by vaccination has continued with the introduction of DTap. Thus, the increase in reported pertussis cases is not related to low VE or the introduction of acellular pertussis vaccines.

Despite the effectiveness of vaccination, pertussis continues to occur in the United States among all age groups. The burden of disease remains highest in infants, who also have the highest rates for complications and death. In addition to maintaining high vaccination rates among preschool-aged children, prevention efforts should be directed at treatment of pertussis cases to prevent further spread of disease, use of antimicrobial prophylaxis in contacts of pertussis cases, and minimizing infant exposures to children and adults with cough illnesses.¹⁰ Studies among older children, adolescents, and adults examining pertussis disease burden and transmission of disease to infants might guide future policy decisions on the use of acellular pertussis vaccines among persons aged ≥7 years.

Acknowledgement
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In 1994, THE U.S. PUBLIC HEALTH SERVICE (PHS) issued guidelines for maternal and neonatal zidovudine (ZDV) use to reduce perinatal human immuno deficiency virus (HIV) transmission.1 These guidelines recommend maternal ZDV use during the second and third trimesters of pregnancy and during labor and delivery (L&D) and administration of ZDV to the neonate for the first 6 weeks of life. In 2001, PHS updated 1995 guidelines for routine HIV counseling and voluntary testing of pregnant women.2,3 The Michigan Department of Community Health (MDCH) requires reporting of all children who are perinatally exposed to HIV and follows up these children to monitor their infection status and record demographic, clinical, and laboratory characteristics of infected children. The reporting of perinatally HIV-exposed children enables MDCH to monitor the effectiveness of public health efforts to prevent perinatal HIV transmission1 and assists in the targeting of prevention programs and activities. This report summarizes surveillance data collected through December 31, 2001, on children born to HIV-infected women in Michigan during 1993-2000. The report highlights rapid adoption of PHS guidelines that resulted in the reduction of perinatally acquired HIV infection to historically low levels in Michigan. Improving levels of prenatal care (PNC) for HIV-infected pregnant women, especially substance users, and routine HIV counseling and voluntary testing for all pregnant women are needed to further reduce perinatal HIV infection.

MDCH collects testing and treatment data on all children born to HIV-infected mothers through routine completion of case reports by state health department staff in cooperation with health-care providers, hospitals, and clinics. To ensure complete reporting of mother-infant pairs and to identify possible factors that can improve outcomes for HIV-infected mothers and their infants, additional case ascertainment and public health follow-up activities are conducted. To identify recent births to HIV-infected women who were previously reported as having HIV infection or acquired immunodeficiency syndrome (AIDS), the Michigan HIV/AIDS Registry (HARS) was matched to the Michigan Birth Registry for birth years 1993 through 1999 using standard matching algorithms. Maternal records (i.e., PNC, clinic, and L&D records) and pediatric records (i.e., birth and clinic records) were reviewed to complete and supplement information collected on the routine case-report form. Timing of maternal HIV testing, number of PNC visits received, maternal use of alcohol and illegal drugs during the most recent pregnancy, and the frequency of sexually transmitted disease (STD) diagnoses during pregnancy were abstracted from available medical records.

For birth years 1993-2000, data were abstracted for 512 mother-infant pairs and for six HIV-exposed infants for whom maternal information was unavailable. The HARS-birth registry match identified 146 (95%) of 153 perinatally exposed infants when compared with available data for that period from the Survey of Childbearing Women, an anonymous serologic survey of the presence of maternal antibodies in all newborns. Maternal ZDV use prenatally and/or during L&D increased significantly from 27% in 1993 to 85% in 2000 (p<0.01; chi square for linear trends), and peaked at 95% in 1998. Neonatal ZDV use increased from 12% in 1993 to 93% in 2000 (p<0.01; chi square for linear trends). Of six women who refused ZDV treatment during both pregnancy and L&D, five gave birth before 1996, and four of their infants received neonatal ZDV. The percentage of mothers who received other antiretroviral medications in addition to ZDV during pregnancy increased from 5% in 1993 to 71% in 2000. On the basis of follow-up of children for at least 12 months, the number of children known to be perinatally HIV-infected decreased from 19% to 3% from 1993 to 2000 (p<0.01; chi square for linear trends). Although there has been insufficient follow-up time to determine infection status definitively for children born in 1999 and 2000 who are of indeterminate status, most had one negative polymerase chain reaction test before age 4 months and are not likely to be infected. Medical records were reviewed for 488 HIV-infected women who gave birth during 1993-2000. Of these women, information on receipt of PNC was missing for 57 (12%). Of the 431 women...
with documented PNC information, 45 (10%) received no PNC. Overall, 49% of women were tested for HIV before their most recent pregnancy. Of women who had zero PNC visits, 58% had been tested before or during their most recent pregnancy compared with 94% and 93% who had 1-2 and ≥3 PNC visits, respectively. Additional information on illegal drug use, alcohol, and STDs was available on 344 (80%) of these women. Of these, drugs and alcohol were used more frequently by women who had zero or 1-2 PNC visits, compared with those who had ≥3 (p=0.02 and p=0.06, respectively). For all categories of PNC care, cocaine and/or crack were the most frequently used illegal drugs (62%). A higher proportion of women who had ≥3 PNC visits were diagnosed with one or more STD (gonorrhea, chlamydia, syphilis, primary genital herpes, pelvic inflammatory disease, and trichomonas) (49%), compared with women with <3 visits (26%) (p=0.09; chi square).

To allow time for health-care providers to adopt the 1994 PHS guidelines for ZDV use and to examine their impact on perinatal HIV transmission, the characteristics and infection status of children born during 1995-2000 were examined. Of the 381 perinatally HIV-exposed children born during these years, 31 (8%) became HIV-infected. Of these, nine (29%) were infected before or during L&D. Of the 17 mothers of infected children who had ≥3 PNC visits, seven (41%) were not tested for HIV until after L&D.

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CDC Editorial Note: The findings in this report indicate that a high proportion of health-care providers in Michigan are following PHS guidelines for maternal and neonatal ZDV use to reduce perinatal HIV transmission. Since 1994 in Michigan and in other states, an increasing proportion of pregnant women received HIV counseling and testing and ZDV therapy, resulting in a dramatic decrease in the number of children with perinatally acquired HIV/AIDS.6 The use of other antiretrovirals increased following the 1996 introduction of combination highly active antiretroviral therapy (HAART), which lowers maternal HIV viral load and contributes to the decreasing transmission rate.Promoting access to PNC, acceptance of HIV testing, and ZDV use are necessary to sustain these trends and to achieve further reductions.

Since 1989, Michigan law has required testing of pregnant women at the time of initial examination for HIV, hepatitis B, and other STDs unless they do not consent to the test or it is contraindicated. In 1994, Michigan law was expanded to include this voluntary testing at the time of delivery or immediately postpartum if no previous testing is documented in her medical records. To comply with these laws, obstetric providers should offer all pregnant women HIV counseling and voluntary testing regardless of their race, age, or marital or socioeconomic status. The findings in this report indicate that most Michigan obstetric providers who care for HIV-infected women are complying with the law. Despite high rates of compliance, opportunities are being missed for perinatal HIV prevention. When women present for delivery to high-prevalence hospitals without documented HIV test results, counseling and voluntary rapid testing should be provided at L&D and results returned to the patient and her obstetric provider as soon as possible so that, if appropriate, timely initiation of intrapartum antiretrovirals or neonatal ZDV is possible within 48 hours after birth.9 At lower prevalence hospitals, expanded use of standard EIA tests and rapid turnaround of test results at the time of delivery to allow time for administration of intrapartum and neonatal ZDV for women whose HIV status is unknown might be another way to enhance these efforts.

Continued efforts are needed to assist pregnant women to obtain PNC and to provide them with HIV counseling and testing. In Michigan, 10% of HIV-infected women received no PNC, compared with 1% in the general population.10 The high prevalence of STDs and illegal drug and alcohol use among HIV-infected women giving birth in Michigan suggests that medical practitioners need to provide treatment or appropriate care referrals for HIV-infected women to manage their HIV infection, substance abuse, and other co-morbid conditions and to prevent perinatal HIV transmission.1,8

HIV-infected infants continue to be born to women who receive both HAART and the recommended prevention protocol. Factors that might contribute to continued transmission include incomplete adherence to medication regimens, advanced maternal disease stage or high viral load, obstetric factors surrounding L&D, or treatment-resistant virus.

The findings in this report are subject to at least two limitations. First, although completeness of reporting was high for HIV-exposed infants in 1993 and 1994 compared with the number of HIV-positive mothers known to have given birth, comparable data on the total number of infected women giving birth are not available for 1995-2000. Second, the HARS-birth registry match cannot account for unreported maternal cases and would fail to properly identify a match for a woman reported to HARS and birth registries with more than two reported surnames.

CDC provides funds to 21 states to collect expanded perinatal surveillance data as part of a comprehensive public health effort to further reduce
Hypothermia is a medical emergency that is completely preventable. Hypothermia occurs when persons are exposed to ambient cold temperatures without appropriate protection for extended periods of time. The clinical definition of hypothermia is a core body temperature ≤95°F (35°C). This report describes cases of hypothermia-related deaths in Utah during 2000 and describes unintentional hypothermia-related deaths in the United States during 1979-1998. The Utah cases illustrate risk factors and environmental conditions associated with hypothermia.

**Case Reports**

**Case 1.** In February 2000, a man aged 50 years was found dead in an alley behind local businesses in urban Utah. The high temperature that day had been 50°F (10°C), and the low temperature had been 36°F (2°C) with 0.1 inch of precipitation. The decedent was a transient who overused alcohol. His post-mortem blood alcohol level was 0.36 g/dL. The death certificate listed the cause of death as hypothermia attributed to acute and chronic alcoholism.

**Case 2.** In March 2000, a man aged 27 years with a history of schizophrenia was found dead in a remote area of Utah. An investigation determined that his vehicle had become stuck in mud and he had become wet and cold while attempting to extricate the vehicle. The death certificate listed the cause of death as hypothermia.

**Case 3.** In October 2000, a boy aged 2 years was left alone by his father in a vehicle in a remote area of Utah for approximately 45 minutes. When the father returned, the child was missing. Six days later, the child was found dead. During the 6 days the child was missing, snow and rain fell in the area. The high temperature on the first day the child was missing was 54°F (12°C), and the low temperature was 27°F (-3°C). The death certificate listed the cause of death as hypothermia attributed to exposure to low environmental temperatures.

**Case 4.** In December 2000, a woman aged 74 years with Alzheimer disease wandered away from her nursing home in Utah. She was wearing her nightgown, was last seen alive at 6:30 AM, and was found dead 3 hours later. The high temperature that day was 15°F (-9°C), and the low temperature was -2°F (-19°C) with snow on the ground. The death certificate listed the cause of death as hypothermia attributed to exposure to low environmental temperatures.

**United States**

U.S. data were obtained from the Compressed Mortality File (CMF), maintained by CDC’s National Center for Health Statistics, and were prepared in accordance with the external cause-of-death codes from the International Classification of Diseases, Ninth Revision (ICD-9). CMF contains information from death certificates filed in the 50 states and the District of Columbia. During 1979-1998, a total of 13,970 deaths were attributed to hypothermia (ICD-9 codes E901.0, E901.8, and E901.9; excludes human-made cold E901.1). The death rate attributed to hypothermia for males is approximately three times that for females for every age group except for persons aged <15 years, and the elderly have the highest rates of death attributed to hypothermia.

During 1979-1998, Utah reported 91 deaths attributed to hypothermia, with an age-adjusted rate of 0.4 per 100,000 population. During the same period, Illinois reported the most deaths (859), with an age-adjusted rate of 0.4. Alaska had the highest age-adjusted rate of 2.9, with 250 deaths attributed to hypothermia.

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**CDC Editorial Note:** The findings in this report indicate that hypothermia-related deaths in the United States increase with age and that rates are highest among men. In the cases presented in this report, all decedents had one or more risk factors for hypothermia-related death (e.g., aged ≥65 years, alcohol use, homelessness, and mental illness).
The warning signs of hypothermia include shivering, confusion and disorientation, memory loss, drowsiness, exhaustion, fumbling hands and poor coordination, slurred speech, and numbness. Shivering is a sign that the body is losing heat and shivering decreases as body temperature falls; a person who shivers persistently should return indoors. Severe hypothermia results in unconsciousness, shallow breathing, weak pulse, and death. Warning signs of hypothermia in an infant include bright red, cold skin and lethargy.

Persons with signs or symptoms of hypothermia should seek medical attention immediately. Until medical care becomes available, the person should be moved into a warm room or shelter and wet clothing removed. The center of the body should be warmed first, including the chest, neck, head, and groin using an electric blanket or skin-to-skin contact under loose, dry layers of blankets, clothing, towels, or sheets. Warm, nonalcoholic beverages can help increase body temperature, but they should not be given to an unconscious person. If the person does not appear to be breathing, does not have a pulse, and appears to be unconscious, cardiopulmonary resuscitation (CPR) should be administered in conjunction with warming efforts until the person responds or medical attention is available. Even if the person appears to be dead, CPR should be provided because, in some cases, persons with hypothermia who appear dead can be resuscitated.

Alcohol use, homelessness, vehicle breakdown, psychiatric disorders, and Alzheimer disease are all risk factors associated with hypothermia. Factors such as neuromuscular disease, arthritis, hypothyroidism, malnutrition, beta-blocker use, neuroleptic use, and alcohol use decrease the body’s ability to produce heat. Factors that can result in increased body heat loss include psoriasis, dermatitis, burns, dehydration, decreased subcutaneous fat, and alcohol use. Loss of body temperature regulation can occur with central nervous system pathology, trauma, stroke, Parkinson disease, neuropathies, and spinal cord injuries. Elderly persons are more likely to have one or more risk factors, placing them at especially high risk for hypothermia. Children are particularly susceptible to hypothermia. Infants need sufficient blankets and clothing for insulation. Persons participating in outdoor activity might have impaired judgment from hypothermia, causing them to remain unprotected in situations of dangerous cold.

An extremely cold environment is not necessary for hypothermia. Persons who participate in outdoor activities during cold weather should take precautions to avoid hypothermia. Persons can maximize heat production by voluntary muscular activity, shivering, eating to maintain calorie intake, and drinking nonalcoholic beverages to stay hydrated. Heat loss can be minimized by wearing a hat that does not retain moisture, a scarf or knit mask to cover the face and mouth, sleeves that are snug at the wrist, mittens, water-resistant coat and shoes to stay dry, and several layers of loose-fitting clothing. The outer layer of clothing should be tightly woven and wind resistant to reduce body heat loss caused by wind. Wool, silk, or polypropylene inner layers of clothing will hold more body heat than cotton. Persons who feel too warm should remove extra layers of clothing because excess perspiration will increase heat loss. In high wind, use of goggles can protect the corneas from freezing. Persons should avoid overexertion and overheating because of potential dehydration and the wetting effect of perspiration. Swimmers need insulating swimwear in cold water.

Vehicle-safety precautions also can help prevent hypothermia. Vehicles should be equipped with cold weather gear for use during a breakdown. Travelers stranded during a winter storm should remain in their vehicle, stay awake, and wrap their entire bodies in extra clothing, blankets, or newspapers to stay warm. The motor and heater should be run for approximately 10 minutes per hour and one window should be opened slightly to let in air while making sure that snow is not blocking the exhaust pipe to reduce the risk for carbon monoxide poisoning. Persons should move their arms and legs to improve circulation and stay warmer, and avoid eating unmelted snow because it will lower body temperature.

Public health prevention strategies for reducing hypothermia-related deaths include educating the public and health-care providers about heat preservation strategies and providing outreach programs that identify and protect persons at risk (e.g., the elderly, young children, mentally and physically disabled persons, persons with psychiatric disorders, and homeless persons). Community outreach programs should check on these risk groups frequently to discourage prolonged exposure to cold and to ensure properly heated dwellings. Many hypothermia-related deaths might only be prevented with improvement in overall medical and social support services for vulnerable populations. Public health prevention strategies for reducing hypothermia should be part of a broader social support program to provide support services to populations at risk.

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