

THE PUBLIC HEALTH IMPACT OF IRRITANT CONTACT DERMATITIS

Boris D. Lushniak, MD, MPH

MEASURES OF PUBLIC HEALTH IMPACT

The public health impact of a disease can be measured several ways, including the use of statistical, clinical, and economic measures. The statistical measures include morbidity or mortality information, commonly used in descriptive epidemiology, that describe the magnitude of the disease, such as the absolute number of cases, the incidence rate, the point prevalence rate, and the period prevalence rate. Clinical measures include information on the severity, the prognosis, and the preventability of the disease. Finally, economic measures include direct costs of disease diagnosis and therapy, wage losses, worker's compensation (WC) and disability payments, and indirect costs of lost work time, loss of productivity, and costs of lifestyle or vocational changes.

Although irritant contact dermatitis (ICD) is considered a "common" disease, knowledge of this disease entity and its public health impact is somewhat limited. Reasons for this include inadequate diagnostic test methods, often resulting in the diagnosis of ICD being one of

*Portions of this manuscript were previously published in *Dermatologic Clinics* 13:671-680, 1995

From the United States Public Health Service, Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH); Division of Surveillance, Hazard Evaluations, and Field Studies, Hazard Evaluations and Technical Assistance Branch, Cincinnati, Ohio

IMMUNOLOGY AND ALLERGY CLINICS OF NORTH AMERICA

exclusion, and the confusion resulting from ICD often being a contributory factor in other types of dermatitis.⁴ This results in a relative lack of published reports on ICD (e.g., only 8% of the papers published in Volume 13 [1985] of *Contact Dermatitis* dealt with irritancy).⁴

STATISTICAL DATA AND LIMITATIONS

Statistics on the magnitude of ICD come from a variety of sources. It can be difficult to obtain accurate epidemiologic data for ICD, and all sources have their limitations. First, although a case definition is a prerequisite for the gathering of epidemiologic data, there is no standard case definition for ICD. In ICD the case definition can vary from one data source to another. Because of the importance of ICD in occupational health, much of the information about ICD comes from occupational studies. Cases may be diagnosed as dermatitis, contact dermatitis, eczema, or occupational dermatitis. Often, both in data sources and studies, no distinction is made between irritant and allergic contact dermatitis (ACD), and distinguishing the proportion of these designations attributable to irritants remains a matter of conjecture.

The accuracy of the diagnosis of ICD is related to the skill level, experience, and knowledge of the medical professional who makes the diagnosis. The diagnosis is based on the medical and exposure history and physical findings. In ICD there are no additional confirmatory tests. Patch tests or provocation tests are discouraged because of a high false-positive rate. The lack of a standard case definition and the difficulty of diagnosis lead to potential misclassification of ICD, which can result in either over- or underestimation of disease frequency.

There are other problems in assessing the epidemiology of ICD³⁷:

ICD is not a reportable disease (except in states that require reporting of all occupational diseases). This makes health department data sources useless for monitoring ICD.

ICD is not a disease that commonly leads to mortality or hospitalization. Thus, death certificates or hospital records are not potential data sources.

ICD is a disease seen and treated (though not always specifically diagnosed) by medical professionals in multiple specialties, making review of physician-based data sources inefficient.

ICD is a disease that often goes untreated and undiagnosed. Thus, many cases may never be documented in any data source.

Once a diagnosis of ICD is made, a case does not necessarily elicit a public health response.

Individuals with ICD who seek medical care may be a unique

subset of the population. Through this self-selection bias, the information obtained may not reflect the epidemiology of the disease in the general population.

Unique exposures may occur in different populations and different industries, making the epidemiology of ICD in one population not necessarily generalizable to other populations.

The evaluation of past exposures causing ICD may be exceedingly difficult, often relying on historical information and patient recollection, which are subject to recall and information bias.

Cross-sectional studies of working populations, a common epidemiologic study design, are subject to survivor bias. Those with severe skin disease may leave the workforce, leaving only those who are not affected or less affected to be included in the studies.

An occupational ICD case, especially if treated by a company's own occupational health personnel, may not involve lost wages or any costs to the worker. Thus, there would be no WC claim, reducing the use of this already limited data source.

As in epidemiologic studies of other diseases, the epidemiologic terms used in the published literature on ICD are sometimes used incorrectly (e.g., the term *incidence* is often used to describe *prevalence*). The reader should evaluate the epidemiologic literature with a discerning eye.

MAGNITUDE OF ICD

General Population and United States National Data

A review of international prevalence studies for eczema due to all causes conducted with general populations in five countries (England, The Netherlands, Norway, Sweden, United States) showed point prevalence rates of 1.7% to 6.3%, and 1- to 3-year-period prevalence rates of 6.2% to 10.6%.¹² The study in The Netherlands showed that of 3140 persons examined, the point prevalence for irritant-induced eczemas was 3.6%¹¹; this included point prevalences of 2.6% for irritant dermatitis, 0.6% for irritant dermatitis plus allergic dermatitis, and 0.4% for irritant dermatitis plus atopic dermatitis. A follow-up study, conducted 3 years later, of 1992 participants from the original cohort found a point prevalence of 5.3% for irritant-induced eczemas (3.5% for irritant dermatitis, 1.1% for irritant dermatitis plus allergic dermatitis, and 0.6% for irritant dermatitis plus atopic dermatitis).³⁵

In a Swedish study, of 16,584 respondents to a questionnaire, 11.8% reported a 1-year-period prevalence of hand eczema.⁴⁸ Of those who reported hand eczema, 71% attended a skin examination and, of the

examined group, 59% had eczema at the time of the examination.⁴⁸ This resulted in a calculated population point prevalence of 5.4% for current hand eczema. Among the different hand eczema diagnoses, the most common were ICD (35% of those examined), atopic hand eczema (22%), and ACD (19%).⁴⁹ This resulted in a calculated population point prevalence for ICD of 1.5%.

In the United States, the initial National Health and Nutrition Examination Survey (NHANES I) of 1971 to 1974, which examined over 28,000 individuals from ages 1 through 74 years in 61 different geographic locations across the United States, revealed that contact dermatitis was the sixth most commonly encountered skin condition, with a prevalence of 1.4%. Based upon this data, it was projected that contact dermatitis affected 2.6 million people in the United States.^{28, 29}

Data from the 1989 National Ambulatory Medical Care Survey (NAMCS), a national probability sample survey of nonfederal office-based physicians in the United States, showed that from March 1989 to March 1990, skin rash was the principal reason in 12.3 million patient visits¹⁴; this represents 1.8% of the total visits for that 12-month period, and was the ninth most common reason for a physician visit. The diagnosis of contact dermatitis and other eczema was the principal diagnosis in over 6.5 million visits (0.9% of the total visits for that 12-month period).¹⁴ From January 1989 to December 1990, the NAMCS showed that of all visits to dermatologists, a skin rash was the principal reason for the visit in over 2.9 million visits (11.8% of the total visits for that 24-month period).⁵⁴ The diagnosis of contact dermatoses and other eczema was the principal diagnosis in over 2.1 million visits (8.6% of the total visits for that 24-month period).⁵⁴

In 1988, the National Health Interview Survey (NHIS) included a component in the Occupational Health Supplement that asked about skin conditions. The survey consisted of personal interviews of randomly selected households. Because there was no further confirmation or validation of reports of skin conditions, the sensitivity and specificity of self-reported conditions in such a survey is questionable. One study showed that the self-reporting of current skin conditions in a questionnaire had a sensitivity of 31% and a specificity of 94%.⁴⁷ Individuals participating in the survey were asked about dermatitis, eczema, or other red-inflamed skin rash occurring for 3 or more days during the 12 months prior to the interview. Prevalence rates for dermatitis, dermatitis due to contact with substances, and dermatitis due to contact with substances at work (*see* occupational section) were calculated. For 30,074 people participating in the NHIS, the period prevalence rate was 11.2% for dermatitis occurring in the preceding year and 2.8% for dermatitis due to contact with substances. Projecting these results to the United States working population resulted in an estimate of 13.7 million people

with dermatitis and 3.09 million people with dermatitis due to contact with substances.⁵

United States National and State Occupational ICD Data

Specific United States occupational ICD data are limited. At best, rough estimates of the incidence of ICD can be obtained from some of the national data sources. For example, it is estimated that occupational contact dermatitis (OCD) constitutes 90% to 95% of all occupational skin diseases^{8, 12, 18, 30, 43} whereas ICD constitutes approximately 70% to 80% of all OCD.^{9, 19, 20, 21, 52}

National occupational disease and illness data are available from the U.S. Bureau of Labor Statistics (BLS). The BLS conducts annual surveys of approximately 250,000 employers, selected to represent most private industries in the United States.⁶ The survey results are then projected to estimate the numbers and incidence rates of occupational injuries and illnesses in the American working population. All occupational skin diseases or disorders are tabulated in this survey, but data for ICD are not specifically obtained. BLS data are limited in that they exclude several groups, including self-employed individuals, small farms, and government agencies; depend on misinterpretable definitions of reportable occupational injuries and illnesses; rely to a large extent on employees reporting conditions to the employer; and do not provide information on the cause of the skin disease.^{45, 46, 51, 64}

In 1993, BLS data estimated 60,200 cases of occupational skin diseases or disorders in the United States workforce⁶; however, because of BLS survey limitations, it has been estimated that the number of actual occupational skin diseases may be on the order of 10 to 50 times higher than reported by the BLS.⁵¹ This would potentially raise the number of occupational skin disease cases to between one half million and 2.9 million per year. BLS data showed an annual incidence rate of 76 cases per 100,000 workers in 1993.⁶ The incidence of occupational skin diseases in several other countries is similar, with a range of 50 to 70 cases per 100,000 workers per year.¹²

As mentioned previously, in 1988, the NHIS included an Occupational Health Supplement. For 30,074 people participating in the NHIS, the period prevalence rate was 1.7% for OCD occurring in the preceding year. Projecting these results to the United States working population resulted in an estimate of 1.87 million people with OCD.⁵

Using WC data, one may calculate the number of claims per number of eligible workers, or the "claims rate." Under the assumption that claims filed are new cases for the period under study, the claims rate

could be considered an incidence rate.⁴⁶ An analysis of WC claims reported an average annual claims rate for occupational skin diseases of 24 per 100,000 employees for Ohio (1980–1984),⁴⁶ and a rate of 108 per 100,000 employees for South Carolina (1978–1979).³⁰ A similar retrospective analysis of Oregon WC files (1988–1992) showed an annual claims rate for OCD of 12 per 100,000 eligible workers.⁵⁷ Selection bias prohibits these data from being generalizable to the United States working population because not all workers are covered by WC and not all workers seek compensation for work-related illnesses. In one study, only 43% of eligible workers applied for WC benefits for occupational skin diseases.²⁶ In addition, data from different states are not comparable because WC systems, worker eligibility, and case definitions for compensable illnesses vary. Furthermore, rates may differ between states because of differences in the mix of industries. It is also important to stress that the numbers and rates in the BLS survey, NHIS survey, and WC data are not directly comparable, as they rely on different information sources and case definitions.

Clinic Patient Population Studies

Studies of dermatology or occupational health clinic populations can measure the proportion of ICD cases in the clinic population, a clinic-based prevalence rate. Such clinical data cannot be interpreted as general population data because of selection bias, referral bias, and local differences in industrial and other exposures. In a United States study of 1199 patients referred for patch testing (1984–1985) 25.4% were diagnosed with ICD.⁶³ Similar United States studies conducted from 1985 to 1989 showed that of 4055 patients, 19.9% had ICD,⁵⁵ and from 1992 to 1994, of 3549 patients, 24.9% had ICD.⁴⁰ In Singapore, of 721 patients seen with hand eczema at a contact dermatitis clinic over a 2-year period, 55% had contact dermatitis; of these, 59% were diagnosed with ICD.¹⁹ Of 496 Scottish patients referred to a patch test clinic, 15.3% had ICD.⁶⁶ A 10-year study of 9765 patch test clinic patients in Belgium showed that 22% had OCD along with other dermatitis, and 11% had OCD alone.¹⁵ Of this latter group, 67% had ICD and 41% had ACD (half of the ACD patients also had ICD).

Industry-Based Studies

Extensive lists of irritants and allergens are available in reference books.^{1, 17} The most frequent causes of ICD include soaps/detergents, fiberglass and particulate dusts, food products, cleaning agents, solvents,

plastics and resins, petroleum products and lubricants, metals, and machine oils and coolants.⁴³ There is a myriad of occupations that have unique exposures that result in OCD, and many of these are well described in the literature.^{2, 39} There are many examples of cross-sectional studies of OCD in specific workplaces or industries which allow the calculation of a point or period prevalence of dermatitis in that workplace. These prevalences vary based upon different populations and differing exposures. This type of data may be helpful in identifying high-risk jobs, workplaces, or exposures.

In an Australian study of 117 cement workers, the ICD prevalence was 4.2% and the ACD prevalence was 2.6% whereas 972 rubber tire workers had an ICD prevalence rate of 3.4% and an ACD prevalence rate of 0.3%.⁶⁵ For workers cleaning up a pesticide spill in California, the ICD prevalence rate (deemed an attack rate for this acute incident) was 64%.³⁴ In a cross-sectional study in The Netherlands comparing the prevalence of hand dermatitis in several occupations with that of the general population, significantly higher prevalence ratios were found in nurses, manual workers in a chemical company, workers in an electric company, and public works employees.⁶² The prevalence of hand eczema varied by occupation; the highest prevalence was found in nurses (32%), and the lowest among office workers (4.2%).⁶² In a study of over 2000 Swedish house painters, 337 (16.7%) reported a current dermatosis.²⁵ Of 267 of the painters who were examined, 87 (33%) had an occupational skin disease. Of these, 39 (45%) had ICD and 27 (31%) had ACD.

PROGNOSIS AND PREVENTABILITY

Studies investigating the severity and prognosis of ICD are limited. If one uses time off of work as a potential measure of severity, then conflicting information comes from existing studies. In one study of hand dermatitis in Dutch workers, 2% to 10% of the cases took sick leave for hand dermatitis, and 15% to 30% sought medical attention.⁶² This led to a conclusion that "although the relatively high prevalence of hand dermatitis . . . emphasizes the need for preventive measures, the proportion requiring medical attention and sick leave suggests that the symptoms were relatively mild in the majority of cases"⁶²; however, a study of 1496 Swedish patients with contact dermatitis found that 42% had taken sick leave because of the condition.¹⁸ In several studies, a consistent 20% to 25% of the workers with occupational skin diseases lost time from work, staying out an average of 9 to 11 days per lost workday case.^{6, 8, 30, 67} A follow-up study of 235 Canadian workers with occupational skin diseases showed that 35% had been away from work for greater than 1 month, 14% between 1 week and 1 month, 17% less

than 1 week, and 33% did not lose workdays because of the skin condition.²⁶

It is widely accepted that patients with OCD generally have a poor prognosis for clearing their condition. Of patients with OCD followed over a 3- to 10-year period, only 25% had complete healing of dermatitis whereas approximately 75% had chronic eczema or recurrences of dermatitis.^{7, 18, 22} Of 555 patients completing a follow-up questionnaire 2 to 3 years after diagnosis, only 26% of the women with ICD had complete healing (22% had permanent symptoms, 52% had periodic symptoms) and only 31% of the men had complete healing (29% had permanent symptoms, 40% had periodic symptoms).¹⁸ Another study showed that 30.8% of 188 questionnaire respondents with ICD reported complete healing.³² A telephone survey of 235 occupational skin disease patients conducted a mean of 4 years after diagnosis showed that 40% had continuing dermatitis, although of this group, 76% reported an improvement in their skin condition.²⁶ Of those with skin diseases other than ACD (therefore including ICD), 47% reported dermatitis at follow-up compared with 32% of those with ACD. Other studies are contradictory as to whether ACD or ICD has a better prognosis.^{18, 24, 26}

Outcomes may or may not be influenced by a change in occupation away from the dermatitis-provoking job.^{18, 22, 26} In one study, no difference was found between 64 workers with ICD of the hands who left their jobs and 124 who continued to work.³² Other skin diseases, such as atopic dermatitis, may predispose an individual to develop ICD, and may affect the prognosis.^{18, 59, 60, 61} In addition, preexisting ICD results in a breakdown of the epidermal barrier and allows for sensitization to develop more readily, leading to potential problems with ACD and a worse prognosis.¹⁶ Finally, the longer an ICD persists, the worse the prognosis for complete healing.^{13, 23, 24} Yet, there are no definitive studies on the effectiveness of pharmacologic treatment on the prognosis of ICD.²³

Although most cases of occupational ICD will not permanently clear, most workers should be able to continue to work with the identification and minimization of ICD factors²³; however, because patients with ICD have a poor prognosis for clearing their condition, primary prevention of ICD is key.^{13, 24}

Strategies in the prevention of ICD include identifying irritants; substituting chemicals that are less irritating; establishing engineering controls to reduce exposure; using personal protective equipment, such as gloves and special clothing; using barrier creams; emphasizing personal and occupational hygiene; establishing educational programs to increase awareness in the workplace; and providing health monitoring.^{44, 52} The introduction of personal protective equipment must be considered carefully, as it may actually create problems by occluding

irritants or by directly irritating the skin. Similarly, the excessive pursuit of personal hygiene in the workplace may actually lead to overuse of soaps and detergents and resulting ICD.⁴² The effectiveness of gloves depends on the specific exposures and the types of gloves used. Among solderers in the electronics industry, glove use decreased the period prevalence rate of work-related skin rashes from 15.4% to 3.4%.³³ The effectiveness of barrier creams is controversial,⁵⁶ and at times workers using barrier creams may have higher prevalence rates of OCD than those who do not use the creams.⁶⁵ Other interventions, which included providing advice on personal protective equipment and educating the workforce about skin care and exposures, were beneficial for workers constructing the English Channel tunnel.²⁷

COSTS

The economic impact of a disease can be measured by the direct costs of medical care and WC or disability payments, and the indirect costs associated with lost workdays and loss of productivity. An analysis of 1984 BLS occupational skin disease data estimated annual medical costs of over \$4.7 million (\$67 per case) and WC claim awards of over \$6.3 million (\$1590 per case).⁴¹ The estimated annual indirect cost of lost productivity due to occupational skin diseases in 1984 was \$11 million (\$700 per case).⁴¹ Thus, in 1984 the estimated annual direct and indirect costs exceeded \$22 million; however, considering that the actual annual incidence figures may be 10 to 50 times greater than reported in the BLS data, the total annual cost of occupational skin diseases may range from \$222 million to \$1 billion.⁴¹

These estimates do not include costs of occupational retraining or costs attributable to the effects on the quality of life. Workers who stop their normal work because of occupational dermatitis suffer financial loss.^{7, 22} Little information is available on ICD and quality of life issues. In a telephone survey of 235 workers with occupational skin diseases, the disease interfered with work activities in 37% of respondents, with household work in 29% and with leisure activities in 23%.²⁶

CONCLUSION

Three factors point out the importance of ICD as a disease having a public health impact: (1) ICD is common, (2) ICD often has a poor prognosis, and (3) ICD results in a noteworthy economic impact for society and for an individual as it affects vocational and avocational activities. It is also a disease amenable to public health interventions.

The major risk factor for ICD is exposure to an irritant. If an irritant does not contact the skin, there will be no ICD. Controlling this exposure makes ICD a potentially preventable disease.

The goal of the United States Public Health Service for the year 2000, as established in its *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*, is to reduce national occupational skin disorders or diseases to an incidence of no more than 55 per 100,000 full-time workers.⁵⁰ Both ICD and ACD are considered priority research areas, as outlined in the National Occupational Research Agenda (NORA) introduced in 1996 by the National Institute for Occupational Safety and Health (NIOSH).⁵³ Information on the prevalence and incidence of ICD, the individual and occupational risk factors, the causal agents, the prognosis, and the available preventive measures are important research topics, knowledge of which will assist in achieving the national public health goals.

ACKNOWLEDGMENTS

The author wishes to acknowledge Mitchell Singal, MD, MPH, and Patricia Cusumano, MD, for their review of the manuscript, and Patricia C. McGraw for assistance in typing.

Glossary^{3, 10, 31, 36, 38, 58}

Bias Error that occurs if there is a difference between what a study is actually estimating and what it is intended to measure

Confounding A situation in which the effects of two processes are not separated, resulting in the distortion of the apparent effect of an exposure on risk brought about by the exposure's association with other factors that can influence the outcome.

Cross-sectional study Comparison of disease prevalence or exposures among groups of individuals at one period of time or over a short interval

Incidence rate Frequency of occurrence of new cases during a time period; the number of new cases during a given time interval divided by the population at risk.

Information bias A flaw in measuring exposure or outcome that results in differential quality of information between compared groups

Misclassification The erroneous classification of an individual or an attribute into a category other than to which it should be assigned

Period prevalence rate The number of cases, new and old, present at any time during a given time interval divided by the population

Prevalence rate (point prevalence rate) The number of cases, new and old, at a specific point in time divided by the population

Recall bias Error due to differences between groups in accuracy or completeness of recall of prior events or experiences

Referral bias A type of selection bias whereby individuals who are referred and ultimately included in the study population differ with respect to relevant characteristics from those not referred

Selection bias Error due to systematic differences in characteristics between those who are selected for study and those who are not selected

Sensitivity The proportion of truly diseased persons in the screened population who are identified as diseased by the screening test

Specificity The proportion of truly nondiseased persons who are so identified by the screening test

Survivor bias An error introduced when diseased or affected workers leave the workforce because of their condition, leaving behind less affected or unaffected workers (survivors) to be studied

References

1. Adams RM: Occupational Skin Disease, ed 2. Philadelphia, WB Saunders, 1990
2. Adams RM: Job descriptions with their irritants and allergens. In Adams RM: Occupational Skin Disease. Philadelphia, WB Saunders, 1990
3. Ahlbom A, Norell S: Introduction to Modern Epidemiology. Newton Lower Falls, Epidemiology Resources Inc, 1990
4. Andersen KE, Benezra C, Burrows D, et al: Contact dermatitis: A review. *Contact Dermatitis* 16:55-78, 1987
5. Behrens V, Seligman P, Cameron L, et al: The prevalence of back pain, hand discomfort, and dermatitis in the U.S. working population. *Am J Public Health* 84:1780-1785, 1994
6. Bureau of Labor Statistics (BLS): Occupational Injuries and Illnesses in the United States. U.S. Department of Labor, BLS, published annually since 1972 to 1993; data for 1993 published August 1996 in Bulletin 2478.
7. Burrows D: Prognosis in industrial dermatitis. *Br J Dermatol* 87:145-148, 1972
8. California Department of Industrial Relations: Occupational Skin Disease in California. San Francisco, Division of Labor Statistics and Research, 1982
9. Centers for Disease Control: Leading work-related diseases and injuries: Dermatologic conditions. *Morb Mortal Wkly Rep* 35:561-563, 1986
10. Checkoway H, Pearce NE, Crawford-Brown DJ: Research Methods in Occupational Epidemiology. New York, Oxford University Press, 1989
11. Coenraads PJ, Nater JP, Van der Lende R: Prevalence of eczema and other dermatoses of the hands and arms in the Netherlands: Association with age and occupation. *Clin Exp Dermatol* 8:495-503, 1983
12. Coenraads PJ, Smit J: Epidemiology. In Rycroft RJG, Menne T, Frosch PJ, et al (eds): Textbook of Contact Dermatitis. New York, Springer-Verlag, 1992
13. Cooley JE, Nethercott JR: Prognosis of occupational skin disease. In Occupational Skin Disease: State of the Art Reviews—Occupational Medicine. Philadelphia, Hanley and Belfus, 1994
14. DeLozier JE, Gagnon RO: National Ambulatory Medical Care Survey: 1989 Summary. Vital and Health Statistics of the National Center for Health Statistics, Number 203, July 1, 1991
15. Dooms-Grossen A, Drieghe J, Dooms M: The computer and occupational skin disease. In Adams RM: Occupational Skin Disease. Philadelphia, WB Saunders, 1990
16. Epstein WL, Kligman AM: Some factors affecting the reaction of allergic contact dermatitis. *J Invest Dermatol* 33:231-243, 1959
17. Fisher AA: Contact Dermatitis, ed 3. Philadelphia, Lea & Febiger, 1986
18. Fregert S: Occupational dermatitis in a ten-year study. *Contact Dermatitis* 1:96-107, 1975
19. Goh CL: An epidemiological comparison between occupational and non-occupational hand eczema. *Br J Dermatol* 120:77-82, 1989
20. Goh CL, Soh SD: Occupational dermatoses in Singapore. *Contact Dermatitis* 11:288-293, 1984
21. Harvell JD, Lammintausta K, Maibach HI: Irritant contact dermatitis. In Guin JD (ed): Practical Contact Dermatitis. New York, McGraw-Hill, 1995

22. HELLIER FF: The prognosis in industrial dermatitis. *Br Med J* 1:196-198, 1958
23. HOGAN DJ: The prognosis of irritant contact dermatitis. *In* van der PGM abd Maibach HI: *The Irritant Contact Dermatitis Syndrome*. New York, CRC Press, 1996
24. HOGAN DJ, DANNAKER CJ, MAIBACH HI: The prognosis of contact dermatitis. *J Am Acad Dermatol* 23:300-307, 1990
25. HOGBERG M, WAHLBERG JE: Health screening for occupational dermatoses in house painters. *Contact Dermatitis* 6:100-106, 1980
26. HOLNESS DL, NETHERCOTT JR: Work outcome in workers with occupational skin disease. *Am J Ind Med* 27:807-815, 1995
27. IRVINE C, PUGH CE, HANSEN EJ, et al: Cement dermatitis in underground workers during construction of the Channel Tunnel. *Occup Med* 44:17-23, 1994
28. JOHNSON ML: Discovery of the burden of skin disease in the United States. *Masters in Dermatology* 12:8-13, 1995
29. JOHNSON ML, ROBERTS J: National Center for Health Statistics: Prevalence of dermatological disease among persons 1-74 years of age: United States. *Vital Health Statistics* 4, HRA 77-1250, January 1977
30. KEIL JE, SHMUNES E: The epidemiology of work-related skin disease in South Carolina. *Arch Dermatol* 119:650-654, 1983
31. KELSEY JF, THOMPSON WD, EVANS AS: *Methods in Observational Epidemiology*. New York, Oxford University Press, 1986
32. KECZKES K, BHATE SM, WYATT E: The outcome of primary irritant hand dermatitis. *Br J Dermatol* 109:665-669, 1983
33. KOH D, LEE S, CHIA HP, et al: Skin disorders among hand solderers in the electronics industry. *Occup Med* 44:24-28, 1994
34. KOO D, GOLDMAN L, BARON R: Irritant dermatitis among workers cleaning up a pesticide spill: California, 1991. *Am J Ind Med* 27:545-553, 1995
35. LANTINGA H, NATER JP, COENRAADS PJ: Prevalence, incidence and course of eczema on the hand and forearm in a sample of the general population. *Contact Dermatitis* 10:135-139, 1984
36. LAST JM: *A Dictionary of Epidemiology*. New York, Oxford University Press, 1988
37. LUSHNIAK BD: The epidemiology of occupational contact dermatitis. *Dermatol Clinics* 13:671-680, 1995
38. MACMAHON B, PUGH TF: *Epidemiology, Principles and Methods*. Boston, Little Brown, 1970
39. MARKS JG, DELEO VA: *Contact and Occupational Dermatology*. St. Louis, Mosby Year Book, 1992
40. MARKS JG, BELSITO DV, DELEO VA, et al: North American Contact Dermatitis Group Standard Tray Patch Tests Results (1992 to 1994). *Am J Contact Derm* 6:160-165, 1995
41. MATHIAS CGT: The cost of occupational skin disease. *Arch Dermatol* 121:332-334, 1985
42. MATHIAS CGT: Contact dermatitis from use or misuse of soaps, detergents, and cleansers in the workplace. *In* *Occupational Skin Disease: State of the Art Reviews-Occupational Medicine*. Philadelphia, Hanley and Belfus, 1986
43. MATHIAS CGT: Occupational dermatoses. *J Am Acad Dermatol* 6:1107-1114, 1988
44. MATHIAS CGT: Prevention of occupational contact dermatitis. *J Am Acad Dermatol* 23:742-748, 1990
45. MATHIAS CGT, MORRISON JH: Occupational skin disease, United States. *Arch Dermatol* 124:1519-1524, 1988
46. MATHIAS CGT, SINKS TH, SELIGMAN PJ, et al: Surveillance of occupational skin disease: A method utilizing workers' compensation claims. *Am J Ind Med* 17:363-370, 1990
47. MCCURDY SA, WIGGINS P, SCHENKER MB: Assessing dermatitis in epidemiologic studies: Occupational skin disease among California grape and tomato harvesters. *Am J Ind Med* 16:147-157, 1989
48. MEDING B, SWANBECK G: Prevalence of hand eczema in an industrial city. *Br J Dermatol* 116:627-634, 1987
49. MEDING B, SWANBECK G: Occupational hand eczema in an industrial city. *Contact Dermatitis* 22:13-23, 1990
50. National Center for Health Statistics: *Healthy People 2000 Review*, 1992. Hyattsville,

- MD US Department of Health and Human Services, DHHS Publication (PHS) 93-1232-1, 1993
51. National Institute for Occupational Safety and Health (NIOSH): National Occupational Survey: Pilot study for development of an occupational disease surveillance method. Rockville, MD, US Department of Health, Education, and Welfare, HEW Publication (NIOSH) 75-162, 1975
 52. National Institute for Occupational Safety and Health (NIOSH): Proposed national strategy for the prevention of leading work-related diseases and injuries: Dermatological conditions. Cincinnati, US Department of Health and Human Services, DHHS Publication (NIOSH) 89-136, 1988
 53. National Institute for Occupational Safety and Health (NIOSH): National Occupational Research Agenda (NORA). Cincinnati, US Department of Health and Human Services, DHHS Publication (NIOSH) 96-115, 1996
 54. Nelson C: Office visits to dermatologists: National Ambulatory Medical Care Survey, United States 1989-90. Vital and Health Statistics of the Centers for Disease Control and Prevention/National Center for Health Statistics, Number 240, March 10, 1994
 55. Nethercott JR, Holness DL, Adams RM, et al: Patch testing with a routine screening tray in North America, 1985 through 1989: I-IV. *Am J Contact Dermatitis* 2-4:122-134, 198-201, 247-254, 1991
 56. Orchard S: Barrier creams. *Dermatol Clin* 2:619-629, 1984
 57. Oregon Health Division: A new program to reduce occupational dermatitis in Oregon. CD Summary, Center for Disease Prevention and Epidemiology, Oregon Health Division, 42, No. 21, 1993
 58. Rothman KJ: Modern Epidemiology. Boston, Little, Brown, 1986
 59. Rystedt I: Contact sensitivity in adults with atopic dermatitis in childhood. *Contact Dermatitis* 13:1-8, 1985
 60. Rystedt I: Factors influencing the occurrence of hand eczema in adults with a history of atopic dermatitis in childhood. *Contact Dermatitis* 12:247-254, 1985
 61. Rystedt I: The role of atopy in occupational skin disease. In Adams RM: Occupational Skin Disease. Philadelphia, WB Saunders, 1990
 62. Smit HA, Burdorf A, Coenraads PJ: Prevalence of hand dermatitis in different occupations. *Int J Epidemiol* 22:288-293, 1993
 63. Storrs FJ, Rosenthal LE, Adams RM, et al: Prevalence and relevance of allergic reactions in patients patch tested in North America: 1984 to 1985. *J Am Acad Dermatol* 20:1038-1045, 1989
 64. Taylor JS: Occupational disease statistics: In perspective. *Arch Dermatol* 124:1557-1558, 1988
 65. Varigos GA, Dunt DR: Occupational dermatitis: An epidemiological study in the rubber and cement industries. *Contact Dermatitis* 7:105-110, 1981
 66. Vestey JP, Gawkrödger DJ, Wong WK, et al: An analysis of 501 consecutive contact clinic consultations. *Contact Dermatitis* 15:119-125, 1986
 67. Wang CL: Occupational skin disease continues to plague industry. *Monthly Labor Review* 102:17-22, 1979

Address reprint requests to

Boris D. Lushniak, MD, MPH
National Institute for Occupational Safety and Health
4676 Columbia Parkway, R-10
Cincinnati, Ohio 45226