Quantifying the Disease Impact of Alcohol With ARDI Software

JAMES M. SHULTZ, MS, PhD
DOROTHY P. RICE, MS, ScD (Hon.)
DAVID L. PARKER, MD, MPH
RICHARD A. GOODMAN, MD, MPH
GEORGE STROH JR., MPH
NANCY CHALMERS

Dr. Shultz is Assistant Professor, Department of Epidemiology and Public Health, University of Miami School of Medicine. Dr. Rice is Professor, Department of Social and Behavioral Sciences, School of Nursing, University of California, San Francisco. Dr. Parker is a staff physician in Occupational Medicine for Park Nicollet Medical Center and Medical Epidemiologist, Minnesota Department of Health, Minneapolis. Dr. Goodman is Assistant Director; Mr. Stroh is Assistant Director, Division of Field Services; and Ms. Chalmers is Program Analyst; all with the Epidemiology Programs Office, Centers for Disease Control, Public Health Service.

Portions of this paper were presented at Prevention 90, Atlanta, GA, April 19–22, 1990.

Development of Alcohol-Related Disease Impact (ARDI) Software was supported by contract No. 200-88-0653 from the Centers for Disease Control to Park Nicollet Medical Foundation, Minneapolis, MN.

Tearsheet requests to Dr. James M. Shultz, P.O. Box 016069 (R-669), Miami, FL 33101.

Synopsis

Alcohol-Related Disease Impact (ARDI) Software has been developed for the Centers for Disease Control (CDC) to allow States to calculate mortality, years of potential life lost (YPLL), direct health-care costs, indirect morbidity and mortality costs, and nonhealth-sector costs associated with alcohol use and misuse. The mortality related measures—mortality, YPLL, and indirect mortality costs—are computed for 35 diagnoses related to alcohol use and misuse.

A review of clinical research studies and injury surveillance studies was conducted to produce estimates of the alcohol-attributable fraction (AAF) for each diagnosis. For these measures, age-specific and age-adjusted rates are also calculated. Health care costs, morbidity costs, and nonhealth-sector costs are prorated from national studies to the State or locality.

This multiple-measure approach to quantifying a health problem is termed "disease impact estimation." National estimates of the disease impact of alcohol use and misuse have been produced using ARDI software and State-specific estimates are in preparation. Designed to CDC specifications, ARDI is completely menu-driven and operates within Lotus 1-2-3 software as a set of linked spreadsheets.

ARDI adapts national epidemiologic and health economics methods for use by State and local health agencies. ARDI produces data on the health consequences of alcohol use and misuse for use by locally based policymakers, public health professionals, and researchers, while permitting comparison and compilation of these data across jurisdictions.

ALCOHOL USE AND MISUSE are associated with both preventable injuries as an outcome of acute exposure to alcohol and chronic diseases as an outcome of long-term exposure to alcohol. These injury and disease outcomes incur human costs that can be quantified in epidemiologic terms, including excess disease, disability, diminished on-the-job productivity, and premature death. The economic costs associated with the health consequences of alcohol use can also be estimated. Health effects can be assessed using such measures as alcohol-related mortality, years of potential life lost (YPLL) (*1*), direct health care costs, indirect morbidity costs, indirect mortality costs, and nonhealth sector costs (*2,3*). This multiple-measure approach to analyzing the constellation of disease outcomes associated with a health-compromising behavior is termed "disease impact estimation" (*4*).

Epidemiologists and health economists have estimated the disease impact of alcohol use and misuse for the United States. Their findings indicate that alcohol use is associated with substantial premature mortality, excess morbidity throughout the lifespan, and extraordinary decrements in national productivity and output (*2–5*). These findings support the contention that concern over the use and

'Their findings indicate that alcohol use is associated with substantial premature mortality, excess morbidity throughout the lifespan, and extraordinary decrements in national productivity and output.'

misuse of alcohol must be high on the national health agenda, as outlined in "Healthy People 2000" (*6*).

A concerted public health response requires both national leadership and proactive involvement of State and local public health professionals and policy makers. This multi-level approach to alcohol use and misuse requires the capability to produce locally relevant, alcohol-related, disease impact estimates.

With specific reference to the 1990 Objectives for the Nation (*7*) and with recognition that alcohol use and misuse are major contributors to both chronic diseases and injuries, the Centers for Disease Control (CDC) of the Public Health Service requested the development of computer software to enable State and local health agencies to estimate the health impact of alcohol use and misuse. Alcohol-Related Disease Impact (ARDI) software is the product of this specific request (*8*).

Methods

Alcohol-related diagnosis list. Alcohol use and misuse are risk factors for a broad spectrum of disease and injury outcomes. Previous studies (*2,3,5,9,10*) have compiled and refined lists of diagnoses linked to alcohol use and misuse. The diagnosis set in ARDI has been developed from these previous studies, supplemented with an independent review of the current research literature (see table). In selecting diagnoses for inclusion, one criterion was a consensus in the literature regarding the importance of alcohol exposure to the disease or injury outcome. The second consideration was the existence of data-based studies on which to estimate the alcohol-attributable fraction (AAF).

Alcohol-attributable fractions (AAFs). The attributable fraction among the population is the proportion by which disease cases, injury events, or deaths would be reduced if alcohol use and misuse were eliminated. For each alcohol-related diagnosis, the AAF represents the proportion of disease cases, injuries, or deaths that can be causally linked to alcohol use and misuse.

Two types of diagnoses are distinguished. A number of diagnoses are definitionally related to alcohol use and misuse. Examples include alcohol abuse, alcohol-dependence syndrome, and alcoholic cirrhosis. All morbidity, mortality, YPLL, and economic costs from these diagnoses are ascribed to alcohol involvement; the AAF is set to 1.0 (100 percent). For the remaining diagnoses, the AAF is a value between 0.0 and 1.0 and corresponds to the alcohol-attributable proportion of disease-injury occurrences or deaths based on extensive review of clinical case series studies, injury surveillance studies, and available epidemiologic investigations.

Disease Impact Measures

Alcohol-attributable mortality, YPLL, indirect mortality costs. ARDI calculates three mortality-related measures of disease impact. During data entry, the user supplies numbers of deaths for men and women by 5-year age groups (ages 0-85 and older) for each alcohol-related diagnosis. For each age group and sex, deaths are multiplied by the corresponding AAF value.

$$\text{Alcohol-related mortality} = \text{Deaths} \times \text{AAF}$$

For alcohol-related YPLL, an additional term is added to the product, the number of YPLL for that age at death.

$$\text{Alcohol-related YPLL} = \text{Deaths} \times \text{AAF} \times \text{YPLL}$$

ARDI permits calculation of YPLL prior to age 65 or to age 75; and YPLL prior to life expectancy using age-, race-, and sex-specific life expectancy estimates.

For alcohol-attributable indirect mortality costs—the economic analog of YPLL—the present value of future earnings (PVFE) for the age at death is substituted in the product. PVFE values are estimates of the amount of future earnings lost due to premature death from alcohol-related injury or illness, discounted to present-value dollars. ARDI options are 4-, 6-, or 10-percent discount rates (*2,3,11*).

$$\text{Alcohol-related indirect mortality costs} = \text{Deaths} \times \text{AAF} \times \text{PVFE}$$

For all three measures, ARDI calculates subtotals by diagnosis, by sex, and by age category (0–34,

35–64, 65 and older) and the total of all diagnoses for both sexes, for all ages combined.

ARDI also calculates age-specific and age-adjusted rates for the three mortality-related measures by the direct method (*12*). For this option, the user is asked to enter population data for the State or locality (numbers of men and women by 5-year age groups).

Alcohol-related direct health care costs. Direct costs include expenditures for the treatment of alcoholism and alcohol-dependence syndrome as well as the prevention, diagnosis, and treatment of alcohol-related diseases and injuries (*2,3*). In the national estimates produced by Rice and coworkers, the following direct costs were computed: short-stay hospitalization costs, specialty institution costs (for example, alcohol treatment centers), Federal institution costs, office-based physician services, other professional services, nursing home costs, and support costs (*2,3*). Among these cost measures, age- and sex-specific estimates were available for short-stay hospitals, specialty institutions, office-based physicians, and nursing home care.

ARDI calculates a prorated estimate of the alcohol-related portion of each cost using age and sex strata identical to those of Rice and colleagues (*2,3*). The ARDI user supplies population data and the following cost data for the State: total personal health expenditures, hospitalization costs (short-stay hospitals, specialty institutions), physician fees, nursing home costs, health professional fees, and support costs. Alcohol-related direct care costs are prorated to the State or locality as follows:

Alcohol-related direct health care costs (for each component cost, for each age and gender stratum) = Total United States alcohol cost ÷ United States population × State population × Direct cost-adjustment factor × Inflator

For each type of cost, the first step is estimation of per capita alcohol-related costs for each age and sex stratum from available national data, computed by dividing the 1985 alcohol-related cost for the United States by the 1985 United States population (*2,3*). These average per person alcohol-related costs are then multiplied by the corresponding State (or locality) population figures.

This direct proration of national costs can then be modified by coefficients optionally supplied by the ARDI user. First, to adjust for regional variations in any of the component health-care costs, the user may enter a "direct cost-adjustment factor," defined as the ratio of average per patient costs for the State relative to national costs. For example, if average daily short-stay hospital costs for the nation were $600, but were $660 for the State, a cost-adjustment factor of 1.10 ($660 ÷ $600) would be entered. The user may also insert an "inflator," calculated as the ratio of national direct health care costs for the study year relative to the baseline year, 1985.

Alcohol-related indirect morbidity costs. Indirect costs measure the value of goods or services *not* produced for reasons attributable to alcohol use and misuse (*2,3*). Indirect morbidity costs are alcohol-related output losses for persons who are disabled from nonfatal disease and injury outcomes of alcohol use and misuse. Indirect morbidity costs also include on-the-job decrements in productivity due to alcohol impairment.

Recognizing that alcohol use and misuse bear a complex relationship to reduced output, Rice and colleagues developed an estimate of alcohol-related indirect morbidity costs by performing a regression analysis on data from the 1980 National Institute of Mental Health (NIMH) Epidemiologic Catchment Area Survey (*2,3*). The impact of alcohol abuse was explored in a model that controlled for age, sex, race, personal income, marital status, history of drug abuse, and history of mental illness. ARDI software applies the age- and sex-specific regression coefficients from this model to the population for the group under study to calculate group-specific indirect morbidity costs.

Alcohol-related indirect morbidity costs (for each age and sex stratum) = Alcohol-abuse prevalence rate × State population × Alcohol regression coefficient × 1.402 × Annual income cost-adjustment factor × Inflator

For each age and sex stratum, the first two terms in the product estimate the number of alcohol-abusing persons in the State; this number is then multiplied by the regression model coefficient (signifying the annual decrement in income for an alcohol-abusing person) (*2,3*). All age and sex groups are totaled. For consistency with other cost measures in ARDI, this sum, in 1980 dollars, is inflated to 1985 dollars using the rate of growth of per capita personal income, a factor of 1.402 (*13*).

Two optional user-supplied cost-adjustment factors can be added to the calculation. One is the "annual income cost-adjustment factor," the ratio

Design Features of ARDI Software

Hardware specifications: IBM PC/XT, PC/AT, PS/2 or compatibles

Hard drive memory: 640 kilobytes (1 megabyte recommended)

Spreadsheet software: Lotus 1-2-3 version 2.0 or higher

ARDI software menus (completely menu-driven design):
- Automatic loading from Lotus 1-2-3
- "Seamless" integration of menus across all spreadsheet files
- User is restricted to the menu structure

ARDI software program control: all operations are directed by "macros" written in Lotus 1-2-3 macro codes

ARDI software spreadsheet files: 19 (filename.WK1) files
- Files are task-specific—
  Data entry files
  Disease impact calculation files
  Data transfer files
- Files are linked—data arrays and codes are passed among spreadsheets automatically
- File retrieval is completely automatic

ARDI software graph files: 22 (filename.PIC) files
- Updated during calculation
- Printed using Lotus Print-Graph

ARDI print files: 2 (filename.PRN) files
- Mortality data for males in ASCII format
- Mortality data for females in ASCII format

of average annual earnings for the State relative to the nation for the selected study year. The "inflator" is calculated as the ratio of United States annual income for the study year relative to the baseline year, 1985.

Alcohol-related nonhealth-sector costs. Nonhealth-sector costs include public and private expenditures for crime, motor vehicle crashes, social welfare program administration costs, and costs associated with the destruction of property. Other related indirect costs include the value of productivity losses due to victimization by crime and incarceration for a criminal offense (*13*).

Each of the alcohol-related nonhealth-sector costs is calculated as follows:

Alcohol-related nonhealth sector cost = Total United States costs ÷ United States population × State population × Annual income cost-adjustment factor × Inflator

The first two terms estimate per capita costs at the national level for each type of nonhealth sector cost. These national estimates are multiplied by the corresponding population for the State. The resulting product may be optionally adjusted through inclusion of two coefficients in the calculation. The "annual income cost-adjustment factor" is the ratio of average annual earnings for the State relative to the nation for the selected study year. The "inflator" is calculated as the ratio of United States annual income for the study year relative to the baseline year, 1985.

Alcohol exposure prevalence. ARDI calculates two measures of the prevalence of alcohol-related risk behaviors. Using the national population prevalence estimates of Williams and colleagues, ARDI estimates the numbers of alcoholics and alcohol abusers in the State (*14*). ARDI options also permit individual States that participate in the Behavioral Risk Factor Surveillance Survey (*15*) to compute sex-specific estimates of numbers of persons who engage in three types of problem drinking behaviors: drinking and driving, binge drinking, and chronic heavier drinking.

Description of Software

Design features. ARDI is a microcomputer software application that operates within Lotus 1-2-3, a spreadsheet software package that is currently used by State and local health agencies (*16*). ARDI is completely menu-driven, and 19 spreadsheet files are linked through the menus and command sequences. The user remains within the ARDI menu structure during the entire work session. All ARDI operations are controlled by means of Lotus "macros."

Summary tables are printed during the course of the work session. During program execution, ARDI updates and saves 22 graphs for optional printing using the Lotus 1-2-3 Print-Graph function. Details of the design features are listed in box a.

Notes on data entry. ARDI permits users to expand the diagnosis list (box b). The user is asked to supply ICD-9-CM codes, diagnosis name, and AAF values. ARDI inserts the diagnosis into the existing diagnosis list in order by ICD-9-CM code.

Alcohol-related diagnoses, alcohol-attributable fractions (AAFs), and age ranges used in ARDI calculations

ICD-9-CM codes	Diagnoses	AAF percent	Age range
	Infectious diseases		
011–012	Respiratory tuberculosis	25	35–85 or older
	Malignant neoplasms		
140–149	Cancer of the lip, oral cavity, pharynx	50	35–85 or older
150	Cancer of the esophagus	75	35–85 or older
151	Cancer of the stomach	20	35-85 or older
155	Cancer of the liver- intrahepatic bile ducts	15	35–85 or older
161	Cancer of the larynx	50	35–85 or older
	Metabolic disorders		
250	Diabetes mellitus	5	35–85 or older
	Mental disorders		
291	Alcoholic psychoses	100	15–85 or older
303	Alcohol dependence syndrome	100	15–85 or older
305.0	Alcohol abuse	100	15–85 or older
	Cardiovascular diseases		
401	Essential hypertension	7.6	35–85 or older
425.5	Alcoholic cardiomyopathy	100	15–85 or older
430–438	Cerebrovascular disease	6.5	35–85 or older
	Respiratory diseases		
480–487	Pneumonia and influenza	5	35–85 or older
	Digestive diseases		
530–537	Diseases of esophagus, stomach, duodenum	10	35–85 or older
535.3	Alcoholic gastritis	100	15–85 or older
571.0	Alcoholic fatty liver	100	15–85 or older
571.1	Acute alcoholic hepatitis	100	15–85 or older
571.2	Alcoholic cirrhosis of the liver	100	15–85 or older
571.3	Alcoholic liver damage, unspecified	100	15–85 or older
571.5–571.6	Other cirrhosis of the liver	50	35–85 or older
577.0	Acute pancreatitis	42	35–85 or older
577.1	Chronic pancreatitis	60	35–85 or older
	Unintentional injuries		
E810–E825	Motor vehicle accidents	42	0–85 or older
E826,E829	Other road vehicle accidents	20	0–85 or older
E830–E838	Water transport accidents	20	0–85 or older
E840–E845	Air-space transport accidents	16	0–85 or older
E860.0,.1	Alcohol poisonings	100	15–85 or older
E880–E888	Accidental falls	35	15–85 or older
E890–E899	Accidents caused by fires	45	0–85 or older
E910	Accidental drownings	38	0–85 or older
	[1]Other alcohol-related injuries	25	15–85 or older
	Intentional injuries		
E950–E959	Suicide	28	15–85 or older
E960–E969	Homicide	46	15–85 or older
	Other alcohol-related diagnoses		
357.5	Alcoholic polyneuropathy	100	15–85 or older
790.3	Excess blood alcohol	100	15–85 or older

[1]Other injuries: ICD–9–CM codes 901, 911, 917–919, 920, 922, 960.

The ARDI user is asked to supply mortality data from alcohol-associated causes, population data for the group under study, and annual health care costs. The user may also modify the AAF values. For each alcohol-related diagnosis, ARDI can accommodate separate AAFs by sex for every 5-year age group (ages 0–85 and older). The user may also enter coefficients to adjust the cost estimates as previously described.

For entering mortality data, the user has several options—data entry on a diagnosis-by-diagnosis basis guided by menus, importation of a rectangular array of mortality data in ASCII format, or retrieval of mortality data from save files.

Notes on disease impact calculations. ARDI uses the same worksheets to calculate alcohol-attributable mortality, YPLL, and indirect mortality costs (box c). For each of these measures, ARDI computes age-specific and age-adjusted rates.

Software: Data Entry and Modification of Calculation Parameters

Diagnosis list: references *2,4,8,9* and current literature
- option to review diagnoses
- option to add diagnoses

Data entry

Mortality data: user-supplied mortality data
- Diagnosis-specific
- Sex-specific
- 5-year age group-specific (ages 0–85 and older)

Mortality data-entry options—
- Data entry using menus
- Importing data from ASCII-format files
- Retrieving data stored in save files

Population data

Group under study: user-supplied group population data

Standard population: user-supplied population data *or* standard population options
- United States, 1980 all races
- United States, 1980 whites
- United States, 1980 blacks
- United States, 1980 other races

Alcohol-attributable fractions (AAFs): references *2,4,8,9* and current literature
- Diagnosis-specific
- Sex-specific
- 5-year age group-specific (ages 0–85 and older)

Health care costs: user-supplied health care cost data for
- Total personal health expenditures
- Hospital costs
- Physician fees
- Nursing home costs
- Other professional costs
- Support costs

Cost-adjustment factors: User-supplied coefficients for
- Group direct health costs relative to United States national
- Group annual income relative to United States national
- Inflator for direct costs
- Inflator for annual income

Per capita costs: per capita costs for all measures

Alcohol exposure indicators:
- Prevalence of alcoholism
- Prevalence of alcohol abuse
- Prevalence of problem drinking behaviors:
  - drinking and driving
  - binge drinking
  - chronic heavier drinking

ARDI includes race-specific life expectancies for use in YPLL calculations and race-specific United States population data for use in the calculation of rates. These features anticipate interest in comparing alcohol-related disease impact by race. The user would supply race-specific mortality and population data for the State.

For economic cost estimates, ARDI prorates the national costs to the State population. Group-specific cost-adjustment factors help to fine-tune the local estimates. Results are presented in detail tables, summary tables, and graphs. All economic measures are presented in both dollar values and per capita cost estimates.

Discussion

ARDI software has been developed to adapt current national expertise in the estimation of alcohol-related disease impact for use at local levels (*8*). ARDI has been used to estimate alcohol-related mortality for the United States (105,095 deaths in 1987) and YPLL (1.53 million YPLL prior to age 65; 2.72 million YPLL prior to full life expectancy) (*17*). CDC has now distributed ARDI to State health departments, and Wisconsin is the first State to report alcohol-related disease impact estimates produced by ARDI (*18*). California has recently released a report on alcohol-related mortality for 1979-88, based on ARDI calculations (*19*).

ARDI shares design features with similar software developed for CDC for the calculation of the disease impact of cigarette smoking, SAMMEC II (*20,21*).

An additional purpose of the software development effort is to enlist the users of the software—primarily State-based epidemiologists—in the task of improving the current methodology and the health data systems needed for accurate assessment of alcohol-related disease impact.

Calculation of alcohol attributable fractions (AAFs). The major methodologic limitation in the determination of the disease impact of alcohol use and misuse is the inability to compute AAFs directly for most alcohol-related diagnoses. Computation of AAF values relies on the availability of two additional measures.

This first measure is the prevalence of alcohol use in the population under study. No consensus has been reached regarding an appropriate and standardized measure of alcohol-exposure prevalence. In the few studies that have stratified disease outcomes by level of alcohol exposure, exposure

measures have not been consistent.

The second measure is the diagnosis- and sex-specific relative risk estimate, the ratio of disease incidence for alcohol users to disease incidence for nonusers of alcohol or low-level users. Many alcohol-related diagnoses await prospective epidemiologic studies that will provide true estimates of relative risks. Where epidemiologic studies already provide relative risk values for a particular alcohol-related medical condition, inter-study comparisons are difficult because of disparities in the definition of alcohol exposure.

At this time, AAFs for chronic diseases are estimated from clinical case series; use of such nonrandom, noncontrolled clinical populations permits the operation of biasing factors of unknown magnitude. For injury diagnoses, AAFs are based on injury surveillance studies and injury reporting systems of variable quality and accuracy.

Given these limitations of extant alcohol research, ARDI users should regard AAFs as "best estimates" of the proportion of disease cases, injuries, and deaths related to alcohol. Disparities among studies do not permit systematic estimation of error bounds. Use of ranges of AAF estimates, attempted in earlier work (*9*), does not add precision while magnifying the complexity of the estimation process. ARDI is intentionally designed, however, to accommodate modification of sex- and age-specific AAFs for all diagnoses in anticipation of future refinement of these values.

The following unresolved research needs, all bearing on the future potential for directly calculating AAFs, should be addressed:

1. a consensus on the definition of alcohol consumption or exposure for studies of chronic diseases,
2. a consistent baseline (abstinence or low-level habitual consumption?) group for comparison of alcohol exposure,
3. a consensus on levels of blood alcohol or behavioral impairment for injury surveillance studies,
4. a definition of the causal role of alcohol in injury occurrences—should all injuries involving a blood alcohol content in excess of a given threshold be regarded as alcohol-related? should adjustment be made for the rates of injuries involving nondrinkers?
5. a clarification of the alcohol link to suicide and homicide,
6. a definition of the role of alcohol use in potentiating the transmission of sexually transmitted diseases including HIV-AIDS,

ARDI Software: Calculated Disease Impact Measures

Mortality: calculated measure

Mortality rates:
- Age-specific rates for 5-year age group (ages 0–85 and older)
- Age-adjusted rates

Years of potential life lost (YPLL): calculated measure

YPLL rates:
- Age-specific rates for 5-year age group (ages 0–85 and older)
- Age-adjusted rates

YPLL options:
- To age 65
- To age 75

Life expectancies—
- United States, 1985 all races
- United States, 1985 whites
- United States, 1985 blacks
- United States, 1985 other races

User-supplied life expectancies

Indirect mortality costs: calculated measure

Indirect mortality cost rates:
- Age-specific rates for 5-year age group (ages 0–85 and older)
- Age-adjusted rates

Indirect mortality cost options: present value of future earnings (reference *2*)
- United States, 1985 4 percent discount rate
- United States, 1985 6 percent discount rate
- United States, 1985 10 percent discount rate

Direct health care costs: prorated from reference *2*
- Short-stay hospital costs
- Specialty institution costs
- Office-based physician fees
- Nursing home costs
- Other professional costs
- Support costs
- Alcohol-related fraction of costs for each cost component

Indirect morbidity costs: prorated from regression model in reference *2*

Nonhealth sector costs: prorated from reference *2*

Special conditions: fetal alcohol syndrome—prorated from reference *2*

Sum of total costs:
- Indirect mortality costs
- Direct health-care costs
- Indirect morbidity costs
- Nonhealth sector costs
- Fetal alcohol syndrome costs

7. a consistent definition of the levels of alcohol exposure for conducting prospective studies that develop relative risk values,

8. prospective injury surveillance studies with adolescent and young adult populations,

9. prospective studies of alcohol-related chronic diseases with middle-aged adults with different baseline alcohol consumption patterns,

10. refinement of analyses of the synergistic effects of alcohol and cigarette smoking for cancers of the oral cavity, esophagus, larynx, and other sites,

11. refinement of age-, sex-, and race-specific estimates of alcohol exposure, and

12. refinement of age-, sex-, and race-specific relative risk estimates.

Future Directions

ARDI has been distributed by CDC to State health agencies, State-level reports are in progress, and compilation of State-level data to produce a national report is contemplated. Disease impact estimation methods can be applied to other types of lifestyle-related health behaviors, such as drug abuse and AIDS-HIV diseases. Software products can also be designed for exploring the interrelationships among multiple lifestyle factors in relation to multiple disease outcomes, essentially an expansion of the health risk-appraisal concept to large populations.

ARDI provides a data-based tool for quantifying the disease impact of alcohol use and misuse. ARDI adapts national methods for use by State and local policy makers and public health professionals and for use by researchers conducting special studies. Data produced by ARDI can be used to inform health policy initiatives to confront the health consequences of alcohol.

References

1. Premature mortality in the United States: public health issues in the use of years of potential life lost. MMWR 35: (suppl 2S), 1986.
2. Rice, D. P., Kelman, S., Miller, L. S., and Dunmeyer, S.: The economic costs of alcohol and drug abuse and mental illness, 1985. Office of Financing and Coverage Policy, Alcohol, Drug Abuse, and Mental Health Administration, Public Health Service, Rockville, MD, 1990.
3. Rice, D. P., Kelman, S., and Miller, L. S.: Estimates of economic costs of alcohol and drug abuse and mental illness, 1985 and 1988. Public Health Rep 106: 280–292 May-June 1991.
4. Shultz, J. M.: Quantifying the disease impact of cigarette smoking: the development and application of computer software for estimating the health and economic consequences of smoking. Doctor of philosophy dissertation. University of Minnesota, June 1988.
5. Harwood, H. J., Napolitano, D. M., Kristiansen, R. L., and Collins, J. F.: Economic costs to society of alcohol and drug abuse, and mental illness, 1980. Research Triangle Institute, Research Triangle Park, NC, 1984.
6. Public Health Service, Office of Disease Prevention and Health Promotion: Healthy people 2000. National health promotion and disease prevention objectives. DHHS Publication No. (PHS) 91-50212, U.S. Government Printing Office, Washington, DC, 1990.
7. Public Health Service, Office of Disease Prevention and Health Promotion: Promoting health/preventing disease. Objectives for the nation. U.S. Government Printing Office, Washington, DC, fall 1980.
8. Shultz, J. M., Parker, D. L., and Rice, D. P.: ARDI: alcohol-related disease impact software and documentation. Epidemiology Program Office, Centers for Disease Control, Public Health Service, Atlanta, GA, 1989.
9. Parker, D. L., et al.: Review and cost of alcohol abuse in Minnesota. Division of Disease Prevention and Health Promotion, Minnesota Department of Health, Minneapolis, July 1985.
10. Parker, D. L., et al.: The social and economic cost of alcohol abuse in Minnesota, 1983. Am J Public Health 77: 982–986 (1987).
11. Hodgson, T. A.: The state of the art of cost of illness estimates. Adv Health Economics and Health Serv Res 4: 129–164 (1983).
12. Lilienfeld, A. M., and Lilienfeld, D. M.: Foundations of epidemiology. Oxford University Press, New York, 1980.
13. Bureau of the Census: Money income of households, families, and persons in the United States, 1985. Current Population Reports, Series P-60, No. 156, U.S. Government Printing Office, Washington, DC, 1987.
14. Williams, G. D., et al.: Demographic trends, alcohol abuse, and alcoholism, 1985–1995. Alcohol, Health, and Research World 11: 80–84 (1987).
15. Remington, P. L., et al.: Design, characteristics, and usefulness of state-based behavioral risk factor surveillance, 1981–87. Public Health Rep 103: 366–375, July–August 1988.
16. Lotus 1-2-3. Lotus Development Corp., Cambridge, MA, 1987.
17. Alcohol-related mortality and years of potential life lost—United States, 1987. MWWR 39: 173–178, Mar. 23, 1990.
18. Alcohol-related disease impact—Wisconsin, 1988. MMWR 39: 178–180, 185–187, Mar. 23, 1990.
19. Sutocky, J. W.: Alcohol-related mortality, California, 1979–1988. Department of Health Services, Sacramento, CA, October 1990.
20. Shultz, J. M., Novotny, T. E., and Rice, D. P.: SAMMEC II: Smoking-attributable mortality, morbidity, and economic costs: computer software and documentation. Office on Smoking and Health, Centers for Disease Control, Public Health Service, Rockville, MD, 1990.
21. Shultz, J. M., Novotny, T. E., and Rice, D. P.: Quantifying the disease impact of cigarette smoking with SAMMEC II software. Public Health Rep 106: 326–333, May-June 1991.