AAC (actual acquisition cost), 77
Abridged life tables, 180, 182–184, 318
  quality-adjusted, for total U.S. population, 380–381
  for total U.S. population, 379–380
Absorbing state, 143, 148, 308
Abstracts:
  of articles, 231
  of scientific meetings, 295
Accuracy, 254
Actual acquisition cost (AAC), 77
Acute conditions, HRQL scores for, 165–167
Additive utility independence, 191
Adjusted incidence rate, 249–250
Adjusting costs, 86–95
  discounting future costs, 91–95
  expenditures, 89–90
  hospital charges, 87–89
  for inflation, 90–91
  journal article description of, 233
Adjusting data, 54
Affordability of treatments, 2–3, 11
Africa, 13, 59
Age:
  and HRQL scores, 168
  and incidence rate, 248–250
  and life expectancy calculation, 137–138
Agency for Health Research and Quality, 64
Agent-based simulation, 130–131
Age-specific incidence rate, 248–250
ALOS (average length of stay), 83, 97
Alternatives, see Competing alternatives
American Cancer Society, 60, 109
American College of Obstetricians and Gynecologists, 109
American Journal of Preventive Medicine, 238
Analytical horizon, 62
  and discounting of future costs, 91–92
  journal article description of, 234
Annual physicals, 22
Annual probability of death, 325
Appropriate technology utilization, 12
ASP (average sales price), 76, 77
Assessment of Quality of Life (AQLoL), 49
Assumptions, journal article description of, 235
Attributes (HRQL scores), 161
Audience:
  for journal articles, 238
  for studies, 60, 61
AUGE (Universal Access with Explicit Guarantees) program, 20
Australia, 20, 22, 87
Authors of studies, contacting, 295
Average cost-effectiveness ratio, 9
Average length of stay (ALOS), 83, 97
Average sales price (ASP), 76, 77
Average wholesale price (AWP), 75–77
Baseline value, 203, 263
Behavior Risk Factor Surveillance System, 266
Benchmark prices, pharmaceutical, 76–77
Beta distribution, 216, 217
Bias, 254–257. See also Nonrandom error
Cochrane risk of bias tool, 284
misclassification, 295
in prospective studies, 268
recall, 256
in retrospective studies, 267–268
systematic, 255
Billed cost, 80
Bivariate sensitivity analysis, see Two-way sensitivity analysis
Branches, in decision analysis models, 111
Break-even point, 204
Bridges, C. B., 296
Burden-of-disease analysis, 48–49, 195–196
Canada, 20, 22, 289
Capturing costs, 33–35
Capturing quality, 35–40
Case-control studies, 266–267, 283
Category-specific incidence rate, 248–250
CCS codes, see Clinical Classifications for Health Policy Research
CEA, see Cost-effectiveness analysis
CEA Registry, 40
Centers for Disease Control and Prevention, 297
International Health Data Reference Guide, 288
WONDER system, 292, 293
Centers for Medicare and Medicaid Services (CMS), 76–77
Chance nodes:
in decision analysis models, 111
on decision trees, 119
expected costs and outcomes for, 125–127
Changes in costs, measuring, 99. See also Adjusting costs
Charge(s):
actual costs compared to, 87
cost-to-charge ratios, 87–89
defined, 87
by DRG code, 387–422
Charitable care, 89, 90
Chart of events, 65–69
decision nodes, 68–69
event pathways, 67–68
in identifying costs, 78–80
CHEERS (Consolidated Health Economic Evaluation Reporting Standards), 226–230
Chile, 20
China, 87
CHOosing Interventions that are Cost–Effective (CHOICE), 18, 288
CINAHL (Cumulative Index to Nursing and Allied Health Literature), 282
Clinical Classifications for Health Policy Research (CCS codes), 84, 85, 88–89
Clinical practice guidelines, 64
CMS (Centers for Medicare and Medicaid Services), 76–77
Cochrane Collaboration, 272, 282, 284
Combined Health Information Database, 288
Comma-separated values (CSV) file format, 294
Common Drug Review (Canada), 22–23
Community-derived preferences, 157, 171
Comparative-effectiveness research, 22, 23
Comparator(s):
defining, 41–42
in research development, 57–59
Competing alternatives, 5
comparing net costs and benefits of, 9.
See also Incremental cost-effectiveness ratio (ICER)
in decision analysis, 116–120, 129
defined, 4
quality-adjusted life expectancy for, 189
in research development, 58–59
Complement rule, 111, 113
Complex systems dynamics, 24
Complex systems models, 131
Conceptual models, 62
Conflicts of interests, disclosing, 238–239
Confounding:
in prospective studies, 270
in retrospective studies, 267–268
Consolidated Health Economic Evaluation Reporting Standards (CHEERS), 226–230
Consumer price index (CPI), 90–91
Consumer Price Index for Urban Consumers (CPI-U), 90
Contingency tables, 285
Cost(s), 11–13, 73–103. See also specific types of costs
adjusting, 86–95
assessing “relevancy” of data, 98
assigning variables to, 204
associated with pain and suffering, 95–98
capturing, 33–35
in CEA, 8–9
of competing alternatives, 5
and diagnosis codes, 84–86
diagnostic code cost-to-charge ratios, 387–422
direct, 34, 61
expected, 123–125
fixed, 99
friction, 101
gross, 80–82
identifying, 77–80
indirect, 34, 38, 61
intangible, 34, 95
interpreting incremental changes in, 43
key driver of, 75
measuring changes in, 99
micro-costing, 80–82, 99–101
morbidity, 34
mortality, 34
obtaining cost data, 82–84
as payoff, 124
pharmaceutical benchmark prices, 76–77
relevant, 62
savings associated with premature death, 101–102
of strategies, calculating, 122–123
transfer payments, 101
uniform discounting for, 190
variable, 99
Cost-benefit analysis, 44, 46–48
Cost-effectiveness, 1–4. See also specific topics
average cost-effectiveness ratio, 9
and future medical care, 22–24
of health insurance in the U.S. (example), 335–346
incremental cost-effectiveness ratio, 9–10
sensitivity analysis on U.S. health insurance model (example), 347–360
usefulness of, 2–4
Cost-effectiveness acceptability curve, 219–222
Cost-effectiveness analysis (CEA), 29–50
and burden-of-disease analysis, 48–49
capturing costs for, 33–35
capturing quality for, 35–40
and cost-benefit analysis, 46–48
cost-effectiveness ratio interpretation, 40–41
and cost-minimization analysis, 48
and cost-utility analysis, 44
defining the comparator in, 41–42
elements of, 4–9
future of, 22–24
interpreting incremental changes in cost and effectiveness, 43
Cost-effectiveness analysis (CEA),
(continued)
methodological standards for, xxiii
nonreference-case, 44–45
perspectives of, 29–33
and policy, 17–22
reasons for conducting, 11–14
reference case analysis, 15–17
standardizing, 15–16, 32
theory behind, 33
worked example of, see TreeAge Pro
Software
Cost-effectiveness plane, 218–220
Cost-effectiveness ratio:
average, 9
incremental, see Incremental
cost-effectiveness ratio (ICER)
interpretation of, 40–41
Cost-effectiveness table, 236–237
Cost-minimization analysis, 48
Cost-to-charge ratios, 87–89, 387–422
Cost-utility analysis, 44, 169
Counterfactuals, 42
CPI (consumer price index), 90–91
CPI-U (Consumer Price Index for Urban
Consumers), 90
Cross-sectional studies, 264, 266
Cross-tabulation, 285
Crude incidence rate, 248
CSV (comma-separated values) file
format, 294
Culture, effects of, 161
Cumulative incidence, 246–248
Cumulative Index to Nursing and Allied
Health Literature (CINAHL), 282
Current medical practice, 42, 57

DALY, see Disability-adjusted life-years
Data, 245
adjusting, 54
assessing relevancy of, 98
finding, 82–84. See also Data sources
grading, 283–284
journal article description of, 234
organizing, 297
unpublished, 295
DATA 2010 system, 293
Data collection, 54, 65, 82–84
Data extraction tools, 285, 292–295
DataFerret, 295
Data repositories, 282
Datasets, see Electronic datasets
Data sources, 281–298
for costs, 82–84, 88–89
data extraction tools, 292–295
for drug prices, 75–76
electronic datasets, 284–292
expert opinion, 296
grading published data, 283–284
medical literature, 281–283, 291–292
for mortality, 135–136
organizing data, 297
piggybacked studies, 296
unpublished data, 295
Death(s):
annual probability of, 325
calculating mean age of, 137–138
excluding/including, in research, 62
in HRQL score, 95
mortality rate, 142, 144
premature, cost savings associated
with, 101–102
in QALY calculation, 177
trade-off between life and, 35
Decision analysis, 105–113
competing alternatives in, 129
defined, 105
expected value and expected payoff in,
105–108
probabilities in, 108–113
Decision analysis models, 58, 114–131
basic components of, 111
building, 54
calculating cost of strategies,
122–123
calculating probabilities of strategies,
120–122
competing alternatives in, 116–120
complex systems models, 131
defined, 114
discrete event (agent-based) simulation, 130–131
expected cost in, 123–125
expected value in, 106
guidelines for, 114–116
Markov models, 130
parameters of, 201–202
probabilities in, 107, 108–113
purpose of, 114
rating scales, 156
rollback method, 125–130
sensitivity analysis as “stress test” of, 201–203. See also Sensitivity analysis
simple decision analysis tree, 130
standard gamble technique, 155–156
state transition model, 130
structure of, 201
testing, 54
time trade-off method, 156
types of, 130–131
Decision analysis software packages, 302. See also TreeAge Pro Software
Decision nodes, 68–69
in decision analysis models, 111
on decision trees, 119
Decision tree, 106, 107, 119–120
defined, 119
saving backup copy of, 215
Decision tree model, 119–124, 130
calculating cost of strategies, 122
calculating probabilities of strategies, 120–122
defined, 119
and rollback method, 125–130
Decision utility, 157
Delphi method, 296
Delphi panel, 218
Demographics of research population, 55–56
for data extraction tools, 292
matching research/datasets with, 136
Denial of medical care, 13
Dependent events, 111
Designing cost-effectiveness analysis, 64–69. See also Medical study designs
chart of events in, 65–69
clinical practice guidelines in, 64
event pathways in, 67–68
Developing countries:
access to information in, 59
cost-effectiveness in, 18
data extraction tools for, 293
disability-adjusted life-year in, 45–46
infrastructure/resources for treatments in, 59
need for cost-effectiveness analysis in, 13
time costs in, 96
WHO data repository for, 289
Dewey, John, 140
Diagnosis codes, 84–86
cost-to-charge ratios for, 387–422
for data extraction tools, 292
Diagnosis-Related Groups (DRGs), 84–86
charges, reimbursement, length of stay, and cost-to-charge ratios by, 387–422
converting codes to costs, 88–89
Differential error, 255
Dimensions (HRQL scores), 161–162
Direct costs, 34, 61
Direct price, 77
Direct standardization method, 250
Disability-adjusted life-years (DALY), 8, 171–172
in burden-of-disease analysis, 48
Disability-adjusted life-years (DALY),
(continued)
calculating, 195–196
converted to HRQL scores, 195
in developing countries, 45–46
in health-adjusted life-years, 44
problems with, 45
uses of, 177
Disclosure statements (in articles),
238–239
Discounting:
defined, 91–92
of future costs, 91–95
of future values, 149
of health benefits, 189–190
Discount rate, 93, 190, 233–234
Discrete event simulation, 130–131
Discussion section (of articles), 238
Disease(s):
change in QALE with, 184
defining, in research question, 57–58
diagnosis codes for, 84–86. See also
Diagnosis-Related Groups (DRGs)
HRQL scores and stage of, 169
Disease-specific HRQL instruments, 170
Distribution costs (drugs), 75
Disutility, 169
Diverse populations, HRQL scores in, 170
Domains (HRQL scores), 161
Dominant interventions, 43
Dominated interventions, 43
Do-nothing comparator, 42, 57
Double-blinded studies, 271
Double-counting costs, 82
DRGs, see Diagnosis-Related Groups
Drug treatments, see Pharmaceutical treatment
Duration of physician contact, 97
Economic crises, 92–93
Education:
as health expenditure, 12
and learning by doing, 140
Effectiveness:
assigning variables to, 203–204
defined, 14
efficacy vs., 13–14
interpreting incremental changes in, 43
Effect size, 262
Efficacy:
defined, 13
effectiveness vs., 13–14
as payoff, 124, 125
vaccine, 67, 69, 207–208
Electronic datasets, 284–292. See also
individual datasets
adjusting costs from, 86
choosing sources, 290–292
data extraction tools, 285, 292–295
for diagnosis codes, 84–86
error in, 284, 290
finding the right data, 289–290
international, 288
organizing data from, 297
themes of, 289–290
U.S. datasets, 286–288
EMBASE, 231, 282, 295
Epidemiology concepts, 245–277
cross-sectional studies, 266
error, 254–260, 276
generalizability, 274–275
incidence, 246–254
medical study designs, 265–266
meta-analysis, 271–273
primary cost-effectiveness studies, 273–274
prospective studies, 268–270
randomized controlled trials, 270–271
retrospective studies, 266–268
statistical inference, 261–263
weighted means calculation, 263–265
EQ-5D-5L Crosswalk Index Value Calculator, 162
EQ-5D-5L Health Questionnaire, 158–161, 383–385
cost for, 171
in scoring acute conditions, 165–167
in scoring diabetes, 161–165
EQ-5D Health Questionnaire, 158, 167
EQ-5D preference scores:
  by age, 167
  and disease stage, 168
  and interventions, 169–170
Error(s), 254–260
  in data sources, 245
  in electronic data, 284, 290
  identifying, 276. See also Limitations of studies
  managing, in CEA, 257–263
  nonrandom (bias), 254–257
  random (sampling), 254–257
  sensitivity analysis in testing for, 202
  type I and type II, 262
Ethical information, 19
Ethics:
  in decision making, 21
  fairness, 191
Europe, 20, 87, 289
EuroQol, 49, 162, 171
Events. See also Chart of events
  dependent, 111–112
  independent, 111
  mutually exclusive, 67, 68, 110, 111
  recursive, 143, 145
Event pathways, 67–68, 80
  in decision analysis models, 112–114
  and decision trees, 119
  defined, 112
  journal article description of, 234
Evidence, levels of, 283
Evidence-based decision making, 272
Evidence-based medicine, 110
Example of cost-effectiveness analysis, see TreeAge Pro Software
Exclusion criteria (for studies), 275
Expected cost, 123–127
Expected payoff, 106–107
Expected probability, 121
Expected utility theory, 155–157
  and rating scales, 156
  standard gamble technique, 155–156
  time trade-off method, 156
Expected value, 128–129
  in decision analysis, 105–108
  of QALYs, 135
Expenditures:
  adjusting, 89–90
  defined, 89
  education as, 12
  finding data on, 75–76
  per capita, by governments, 13
Experienced utility, 157
Expert opinion, 296
  on conceptual models, 62
  Delphi panels, 218
  in levels of evidence, 283
  in research project development, 59
External validity, 100, 274
Extra-welfarism, 33
Face validity, 62
Fairness, 191
False-positive test results, 2, 108
Farmer, Paul, 3–4
FDA (Food and Drug Administration), 47
Federal Electronic Research and Review Extraction Tool (DataFerret), 292
Federal supply schedule (FSS), 77
Fees, for HRQL instruments, 171
Figures (in articles), 237, 241–242
First DataBank, 76
First-order (stochastic) Monte Carlo simulation, 202, 211–212
Fixed costs, 99
Food and Drug Administration (FDA), 47
Frequency distributions, 257–261
Friction costs, 101
FSS (federal supply schedule), 77
Future costs:
  discounting, 91–95
  and premature death, 101–102
Future values, discounting, 149
Gambling casinos, 128–129
Gamma distribution, 216, 217
Gaussian distribution, 259
Generalizability, 274–275
Germany, 289
Gold Standard, 76
Good Research Practices in Modeling Task Force, 114
Google Scholar, 231, 281, 282
Governmental perspective, 31, 87
Grading published data, 283–284
Graphs, for articles, 240
Gross costs, 80–82
Gross costing, 80–82

Half-cycle correction, 141
HALYs (health-adjusted life-years), 44
Happiness, purchase of, 33
Harvard International Health Systems Program, 288
Harvard University, 48
HCUP, see Healthcare Cost and Utilization Project
Health-adjusted life-years (HALYs), 44
Health benefits, discounting of, 189–190
Healthcare Cost and Utilization Project (HCUP), 84–86, 286, 290
Healthcare delivery system (U.S.), xxi
Health datasets, see Electronic datasets
Health insurance (U.S.):
calculating cost-effectiveness of (example), 335–346
charges for private insurance, 87
sensitivity analysis on insurance model (example), 347–360
Health interventions, 16, 17, 47. See also specific interventions
and change in QALE, 184
competing alternatives, 4–5
defined, 4
effectiveness of, 7
and health states, 5–6
and HRQL scores, 169–170
medical interventions vs., 46, 47
outcomes of, 4
prioritizing, 17–22
social implications of, 21
Health outcomes, see Outcomes
Health Questionnaire, 383–385
Health-related quality-of-life (HRQL), 35–38, 153–172
for acute conditions, 165–167
and age, 168
in burden-of-disease analysis, 48–49
converting DALY to, 195
defined, 35
deriving, 158–168
disability-adjusted life-years, 171–172
disease effect on, 184
disease-specific instruments, 170
and disease stage, 169
in diverse populations, 170
fees associated with instruments, 171
generation of scores, 154–155
intangible costs in, 95
and interventions, 169–170
from other health surveys, 167–168
persons valuating, 157–158
preference scores, 154–158
preference-weighted generic instruments, 158–165. See also individual instruments
in QALE calculation, 184
Health states, 5–6
defined, 5
HRQL scores and, 161
perceived quality of life in, see Health-related quality-of-life (HRQL)
and preference scores, 154–157
Health status, 6–7, 191
Health surveys, HRQL scores from, 167–168
Health Utility Index (HUI), 49, 160
cost for, 171
Healthy People 2020, 292
Healthy volunteer effect, 269
Healthy-years equivalent (HYE), 44, 46
Herd immunity, 139
Hidden dangers of tests/treatments, 14
Hirth, R. A., 47
Hospital charges:
  adjusting, 87–89
  cost-to-charge ratios, 87–89
  by DRG code and cost-to-charge ratio, 387–422
  micro-costing of, 83–84
  using diagnosis codes, 84–86
HRQL, see Health-related quality-of-life
HUI, see Health Utility Index
HYE (healthy-years equivalent), 44, 46

ICD, see International Classification for Disease
ICD-9 codes, 85
ICD-10, 85
ICER, see Incremental cost-effectiveness ratio
Identifying costs, 77–80
IHME (Institute for Health Metrics and Evaluation), 172
Illness, differing definitions of, 275
Illustrations (fin articles), 241–242
Impact statement, 231–232
Inaction, saving lives through, 139–140
Incidence, 246–254
  adjusted incidence rate, 249–250
  category-specific incidence rate, 248–250
  crude incidence rate, 248
  cumulative, 246–248
  incidence rate, 247–248
  prevalence vs., 252
  risk and rate relationship in, 249, 252–254
Incidence rate(s), 247–248
  adjusted, 249–250
  category-specific, 248–250
  crude, 248
  and risk, 252–254
  risk ratio as, 268
Inclusion criteria (for studies), 275
Incremental changes in cost and effectiveness, interpreting, 43
Incremental cost-effectiveness ratio (ICER), 9–10
  interpreting, 43
  and Keeler-Cretin paradox, 190
  Markov model calculation of, 192–195
  and relevant costs, 62
  in tornado diagrams, 209–210
  and von Neumann–Morgenstern utility maximization theory, 33
Independent events, 111–112
India, 87
Indirect costs, 34
  in HRQL score, 38
  and perspective of study, 61
Inflation, adjusting costs for, 90–91
Inflation standards, 93
Influence analysis, 208
Inputs, value of, 202–203
Institute for Health Metrics and Evaluation (IHME), 172
Insurance, see Health insurance (U.S.)
Insurance company perspective, 30, 32
  and research project development, 61
  and saving lives through inaction, 139–140
Intangible costs, 34
  in cost-benefit analysis, 46
  defined, 95
International Classification for Disease (ICD), 84, 85, 88–89
International health data:
  data extraction tools for, 293
  sources of, 288
International Health Data Reference Guide (Centers for Disease Control and Prevention), 288
International Society for Pharmacoeconomics and Outcomes Research (ISPOR), 58
CHEERS checklist from, 226–230
good research practices guidelines, 114–116
Interventions. See also Health interventions
defining, in research question, 56–57
dominant, 43
dominated, 43
effectiveness vs. efficacy of, 13–14
health vs. medical, 16, 46, 47
intervals for, 60
medical, 17, 46, 47
place for, 59
reimbursed costs of, 75
standardized CEAs for comparing, 15–16
Introduction (of articles), 231–233
ISPOR, see International Society for Pharmacoeconomics and Outcomes Research

Jadad, A. R., 284
Jadad score, 284
Journals:
authors’ guidelines for, 231, 232.
See also Publication format
open source, 282

Keeler-Cretin paradox, 190
Kessler Index, 167
Kids’ Inpatient Database (KID), 286

LA Health Data Now!, 290
League tables, 18–21
and DALY, 172
defined, 18
Lee, C. P., 47
Leisure time loss, in HRQL score, 38

Levels of evidence, 283
Licensing fees, for HRQL instruments, 171
Life, assigning dollar value to, 46–47, 92–93
Life expectancy. See also Quantity of life (mortality)
by age, 180–182
building Markov model to calculate, 302–322
in cost-effectiveness analysis, 7
disease effect on, 184
and HRQL, 36
maximizing, 3
quality-adjusted, see Quality-adjusted life expectancy (QALE)
at specific ages, 137–138
in the United States, xxi, 379–380
U.S. worldwide ranking in, 13
Life expectancy calculation, 135–150
annual probability of death, 325
life-years lost, using Markov models, 140–150
years gained, hand-calculation of, 135–139
Life tables:
abridged, 180, 182–184, 318
converting intervals on, 318
in hand-calculating years gained, 136–137
from other countries, 136
quality-adjusted, 185
quality-adjusted, for U.S. population, 380–381
standard, 180
for total U.S. population, 136–137, 379–380
Life table method (QALY calculation), 177, 180–184
Life-years (LYs), 8
Life-years lost:
calculated with Markov models, 140–150
INDEX 445

to disability, see Disability-adjusted life-years (DALY)
Limitations of electronic data, 295
Limitations of studies, 265–266
authors’ discussions of, 276
and generalizability of results, 274–276
meta-analysis, 272
primary cost-effectiveness analysis, 273–274
prospective studies, 269–270
randomized controlled trials, 270–271
retrospective studies, 267–268
List price, 77
Location of interventions:
factors in choosing, 59
and generalizability of results, 274–275
journal article description of, 233
Log-normal distribution, 217
Longitudinal studies, 270, 273–274
Los Angeles County, 290
Lost productivity, 38, 96
LYs (life-years), 8

McKesson Corporation, 76
Major Diagnosis Category (MDC), 85
Malawi, 18–19
Manufacturing costs (drugs), 75
Market prices, 75
Markov models:
in decision analysis, 130
in first-order Monte Carlo simulation, 211
and HRQL scores, 164
for ICER calculation, 192–195
for life expectancy calculation (example), 302–322
for life expectancy comparing interventions (example), 322–334
for life-years lost calculation, 140–150
in practice, 147–150
principles underlying, 143, 145–147
for QALE calculation, 177, 186–189
MDC (Major Diagnosis Category), 85
Mean age of death, calculating, 137–138
Mean values, 254
and sample size, 260
in second-order Monte Carlo simulations, 214–215
and statistical inference, 262
Medicaid, 21
Medical Expenditure Panel Survey (MEPS), 75, 286
cost data from, 89–90
in HRQL estimation, 167–168
online tool for, 90
Medical interventions, 17, 46, 47
Medical literature:
finding data in, 281–282
organizing data from, 297
quality of data from electronic datasets vs., 291–292
Medical study designs, 265–266.
See also Designing cost-effectiveness analysis
cross-sectional studies, 266
meta-analysis, 271–273
primary cost-effectiveness studies, 273–274
prospective studies, 268–270
randomized controlled trials, 270–271
retrospective studies, 266–268
Medicare:
cost-to-charge ratios from, 87
MEDPAR data from, 88–89
payment policies of, 20
reimbursement by DRG code, 387–422
Medicare Provider Analysis and Review (MEDPAR), 87–89
MEDSTAT MarketScan Databases, 296
MEPS, see Medical Expenditure Panel Survey
Meta-analysis, 215, 271–273, 283
Methodological standards, xxiii
Methods section (of articles), 233–235
Micro-costs, 80–82
Micro-costing:
  defined, 81
  of hospitalization visit, 83–84
  of medical office visit/vaccination, 80–82
  of time costs, 96
  when to use, 99–101
Microsimulation, 212
Misclassification bias, 295
Mistakes in research, 265
Monetary value. See also Valuation of human life, 46–47, 92–93
  of quality-adjusted life-year, 47
  of resources used, 81
  of time resources, 83
Monte Carlo simulation, 211–222
  first-order, 202, 211–212
  normal distribution in, 261
  picking distributions, 214–217
  plausible ranges of variables in, 217–218
  presenting results of, 218–222
  second-order (probabilistic sensitivity analysis), 202, 212–222
Morbidity, see Quality of life
Morbidity costs, 34
Mortality costs, 34
Mortality rate, 142, 144, 248
  actual vs. crude, 253
  age-adjusted, 250
Mortality Statistics (dataset), 288
Muennig, Peter, 302
Multiattribute health status
  classification systems, 161. See also Preference-weighted generic HRQL instruments
Multicenter randomized controlled trials, 283
Multiplicative rule of independent events, 111–112
Multiway sensitivity analysis, 210–211.
  See also Monte Carlo simulation
Mutually exclusive events, 67, 68, 110, 111
NADAC (national average drug acquisition price), 76–77
National Ambulatory Medical Care Survey (NAMCS), 96, 97, 287
National average drug acquisition price (NADAC), 76–77
National Cancer Institute, 109
National Center for Health Statistics (NCHS), 136, 141, 289, 292–294
National Health and Nutrition Examination Survey (NHANES), 256–257, 287, 294
National Health Interview Survey (NHIS), 256, 287, 294
National health surveys, 167
National health systems, 87
  in Chile, 20
  data specific to, 89
National Home and Hospice Care Survey (NHHCS), 287
National Hospital Ambulatory Medical Care Survey (NHAMCS), 287, 290
National Hospital Ambulatory Medicare Care Survey (NHAMCS), 286
National Hospital Care Survey (NHCS), 286, 290
National Hospital Discharge Survey (NHDS), 286, 290
National Inpatient Sample (NIS), 286
National Institute for Health and Care Excellence (NICE, UK), 22
National Institute of Health and Clinical Excellence (NICE, UK), 59
National Library of Medicine, 282
National Nursing Home Survey (NNHS), 287
Nationwide Emergency Department Sample (NEDS), 286
NCHS, see National Center for Health Statistics
NEDS (Nationwide Emergency Department Sample), 286
Net present value, 86, 92
NHAMCS (National Hospital Ambulatory Medical Care Survey), 287, 290
NHAMCS (National Hospital Ambulatory Medicare Care Survey), 286
NHANES, see National Health and Nutrition Examination Survey
NHCS (National Hospital Care Survey), 286, 290
NHDS (National Hospital Discharge Survey), 286, 290
NHHCS (National Home and Hospice Care Survey), 287
NHIS, see National Health Interview Survey
NICE (National Institute for Health and Care Excellence, UK), 22
NICE (National Institute of Health and Clinical Excellence, UK), 59
NIS (National Inpatient Sample), 286
NLM (U.S. National Library of Medicine), 282
NNHS (National Nursing Home Survey), 287
No-intervention comparator, 42
Nonrandom error, 254–257. See also Bias
in electronic data, 295
and study design, 199
Nonreference-case cost-effectiveness analysis, 44–45
Normal distribution, 217, 259–260
in Monte Carlo simulations, 261
and statistical inference, 261–263
Obamacare (Patient Protection and Affordable Care Act), 22
Odds ratios, 269
OECD Health Data 2014: Statistics and Indicators, 288
One-way (univariate) sensitivity analysis, 202–207
answering secondary questions with, 206–207
limitation with, 210
validating models with, 205–206
Online technical appendices, 240–241
Open source journals, 282
Opportunity costs, 12, 74–76
defined, 74
of patient or caregiver time, 97
Oregon, prioritization of interventions in, 21
Organization for Economic Cooperation and Development, 136
Organizing data, 297
Outcomes:
defined, 4
most common, 4
and quality/quantity of life, 7–8
Overbilling, 87, 89
Oxford Center for Evidence-Based Medicine, 284
Pain and suffering:
in cost-effectiveness ratio, 36–38
costs associated with, 95–98
in HRQL score, 95
Panel on Cost-Effectiveness in Health and Medicine (U.S. Public Health Service), xxiii
CEA recommendations of, 38
discount rate recommended by, 93, 190
on HRQL scores determination, 157
on mammography screening, 16
defined, 4
most common, 4
and quality/quantity of life, 7–8
Overbilling, 87, 89
Oxford Center for Evidence-Based Medicine, 284
Panel on Cost-Effectiveness in Health and Medicine (U.S. Public Health Service) (continued)
reference case scenario of, 32
and savings associated with premature death, 101–102
Parameters of models, 201–202
Parameter uncertainty, 202, 212. See also Second-order Monte Carlo simulation
Patient-Centered Outcomes Research Institute (PCORI), 22, 47
Patient Health Questionnaire, 167
Patient perspective, 61
Patient Protection and Affordable Care Act (PPACA, Obamacare), 22
Patient time cost, 83
Payer perspective, 61. See also Insurance company perspective
Payoff(s):
cost as, 124
efficacy as, 124, 125
expected, 106–107
rollback method for, 125–130
PCORI (Patient-Centered Outcomes Research Institute), 22, 47
Per capita government health-related expenditures, 13
Personalized medicine, xxi
Person-years, 146
calculating, 141–147
defined, 141
in life table method, 180–184
in QALE calculation, 184
in QALY calculation, 177, 180–184
Perspectives of CEs, 29–33, 61
Pharmaceutical benchmark prices, 76–77
Pharmaceutical Benefits Advisory Committee (Australia), 22–23
Pharmaceutical treatment, xxi
emergency medications within hospitals, 99–101
example of ICER for, 9–10
HRQL scores for, 36
real cost of, 40–41
side effects from, 14
valuing, 75–76
Physician contact time, see Duration of physician contact
Piggybacked studies, 225, 296
Placebo-controlled studies, 266
Placebo effect, 266, 270, 271
Policy:
abstracted decision making for, 4
complex decision making for, 20
and cost-effectiveness analysis, 17–22
for resource allocation, 3
social, 23–24
Population (research), 55–56
diversity of, 170
and generalizability of results, 274–276
matching research/datasets with, 55–56
PPACA (Patient Protection and Affordable Care Act), 22
Preference scores, 154–158. See also Health-related quality-of-life (HRQL)
ex ante vs. post ante capture of, 191
from experts, 171–172
Preference-weighted generic HRQL instruments, 158–165. See also individual instruments
community weights in, 171
and cultural differences, 161
EQ-5D-5L Health Questionnaire, 158–166
Health Utility Index, 160
Quality of Life and Health Questionnaire, 160
Quality of Well-Being scale, 160, 165
SF-6D, 160
using, 160–165
Premature death, cost savings associated with, 101–102
Prevalence, 252
Prevalence ratio, 252
Prevalent cases, 252
Prices:
  consumer price index, 90–91
  finding data on, 75–76
  market, 75
  pharmaceutical benchmark, 76–77
  when to use, 75
Primary cost-effectiveness analysis, 273–274, 296
Printed tabulations of electronic data, 285, 293–294
Prioritizing health interventions, 17–22
Private insurance, 87
Probabilistic sensitivity analysis, 212.
  See also Second-order Monte Carlo simulation
Probability(-ies), 108–113
  applying rules of, 112–113
  basic rules of, 110–112
  defined, 109
  in event pathways, 67–68
  expected, 121
  in first-order Monte Carlo simulation, 211–212
  as framework for decision making, 105
  of incurring a cost, 98
  of strategies, calculating, 120–122
Probability distributions, 213
  beta, 216, 217
  defined, 258
  frequency distributions, 258–261
  gamma, 216, 217
  log-normal, 217
  normal, 217, 259–260
  triangular, 215–216, 263, 264
Productivity loss, 38, 96
Program in Cost-Effectiveness and Outcomes, 146
Prospective studies, 268–270
Publication format, 55, 225–241
  abstract, 231
  content and structure of articles, 225–230
  disclosure statements and conflicts of interests, 238–239
  discussion section, 238
  figures and illustrations, 241–242
  introduction, 231–233
  methods section, 233–235
  results section, 235–237
  technical appendix, 240–241
  title, 230–231
Published data, see Journals; Medical literature
Publishing CEAs, reference case analysis when, 32
PubMed, 231, 281, 282
Purchasing power, 92
QALE, see Quality-adjusted life expectancy
QALY, see Quality-adjusted life-year
QALY calculation, see Quality-adjusted life-year calculation
Quality:
  capturing, 35–40
  of studies, grading, 283–284
Quality-adjusted life expectancy (QALE), 8, 184–186
  defined, 8
  in ICER calculation, 10
  Markov models in calculating, 186–189
  in summation method, 179
  table for total U.S. population, 380–381
Quality-adjusted life-year (QALY), 7–8, 35
  in comparing interventions, 16
  defined, 7, 153
  and disutility, 169
  and HRQL scores, 36–38
  issues with, 191
  monetary value of, 47
  in reference case analysis, 16
Quality-adjusted life-year (QALY) calculation, 177–196
disability-adjusted life-year, 195–196
and discounting of health benefits, 189–190
incremental cost-effectiveness, 192–195
and issues with QALYs, 189–190
life table method, 177, 180–184
with Markov models, 177, 186–189
quality-adjusted life expectancy, 184–186
summation method, 177–179
Quality of life (morbidity):
health events affecting, 15
in health status, 6–7
maximizing, 3
perceived, see Health-related quality-of-life (HRQL)
Quality of Life and Health Questionnaire, 160
Quality of Well-Being (QWB) scale,
160, 165
Quantifying resources, 81–82
Quantity of life (mortality). See also Life expectancy
health events affecting, 15
in health status, 6–7
maximizing, 3
QWB (Quality of Well-Being) scale, 160
R (statistical package), 294
RAND Corporation, 218
Random error, 199
and frequency distributions, 257–261
understanding, 254–257
Randomized controlled trials, 270–271, 283
Rate ratio, 269
Rating scales, 156
Ratios, 9. See also specific ratios
Recall bias, 256
Recursive events, 143, 145
RED BOOK, 76
Reference case analysis, 15–17
and audience for studies, 60
defined, 16
journal article description of, 234
in published CEAs, 32
Reimbursed cost of interventions, 75, 80
cost-to-charge ratios, 88
by DRG code, 387–422
and pharmaceutical benchmark prices, 76
Relative risk (RR), 268, 269
Relevant costs, 62, 98
Relevant resources, identifying, 81
Reliable values, 254
Repositories, 282
Reproducible values, 254
Research Gate, 282
Research project development, 53–70.
See also Medical study designs
analytical (time) horizon in, 62
checklist for, 58–64
competing alternatives in, 58–59
deciding on type of analysis, 60
designing the analysis, 64–69
factors included/ignored in, 62
identifying audience in, 61
levels of treatment/screening intervals in, 60
location of intervention in, 59
project map for, 65
research question in, 54–64
steps in, 53–55
threshold analysis in, 63–64
Research question, 54–64
anatomy of, 55–58
evaluation checklist for, 58–64
Resources:
changes in delivery of, 100
identifying costs of, 81
placing monetary value on, 81
quantifying, 81
value of, 74, 75
Resource allocation, 3, 139–140
Results section (of articles), 235–237
Retrospective cohort studies, 267
Retrospective studies, 266–268
Risk:
  and incidence rates, 249, 252–254
  and life expectancy by age, 137
Risk of bias tool, 284
Risk ratios (RR), 268–269
Robust models, 202
Rollback method, 125–130
Rolling back (Markov model), 149–150
Rounding, 128, 139
RR (relative risk), 268
RR (risk ratios), 268–269

Sampling error, 254. See also Random error
Sarris, Patti B., 76
SASD (State Ambulatory Surgery and Services Databases), 286
SAS Transport, 294
Scientific meeting abstracts, 295
Scoping process, 59
Screening tests, 1–4, 7–9, 15–17
  false-positive results from, 2
  hidden dangers of, 14
  intervals for, 60
  valuing time spent receiving, 97
Search engines, 231, 281–282
Secondary questions, one-way sensitivity analysis for, 206–207
Second-order Monte Carlo simulation, 212–222
  picking distributions, 214–217
  plausible ranges of variables in, 217–218
  presenting results of, 218–222
SEDD (State Emergency Department Databases), 286
SEER (Surveillance, Epidemiology, and End Results System), 287
Self, W. H., 200
Sensitivity analysis, 55, 199–222
  defined, 55
  and discount rate, 93
  as good research practice, 115
  on insurance model (example), 347–360
  journal article description of, 235, 237
  multiway (Monte Carlo simulation), 210–222
  one-way, 203–207
  performing, 199–201
  as “stress test” of decision model, 201–203
  Tornado diagram in, 208–210
  two-way, 207–208
SF-6D, 160, 167
SF-12, 167
SF-36, 160, 167
Sheldon, Andy, 302
SHIELD (U.S. Study to Help Improve Early Evaluation and Management of Risk Factors Leading to Diabetes), 169
Side effects:
  of social policies, 23–24
  of treatments, 14
SIDS (State Inpatient Databases), 286
Simple decision analysis tree, 130
Skewness, 260
SMDM (Society for Medical Decision Making), 58, 114–116
Social contracts, transfer payments as part of, 101
Social implications of interventions, 21
Social policies, applying CEA to, 23–24
Societal perspective, 31, 32, 45, 61
Society, 32
Society for Medical Decision Making (SMDM), 58, 114–116
Socioeconomic status, 170
Software versions, 147
SPSS, 294
Standard deviation, 260, 261
Standard error, 199
Standard gamble technique, 155–156
Standardizing cost-effectiveness analysis, 15–16, 32
Standard life table, 180
Standard of care:
  as comparator, 58
  defined, 42
STATA, 294
State Ambulatory Surgery and Services Databases (SASD), 286
State Emergency Department Databases (SEDD), 286
State Inpatient Databases (SIDS), 286
State-level data, 286, 290
Statement of need, 231–232
State transition model, 130, 142, 144, 145. See also Markov models
Statistical inference, 261–263
Statistical life-year, 47
Statistical power, 262
Statistical software packages, 293–295
Statistics Canada, 289
Stat/Transfer, 294
Status quo, 42
Stochastic (first-order) Monte Carlo simulation, 202, 211–212
Structural uncertainty, 200
Structure of models, 201
Sub-Saharan Africa, 59
Summation method, 177–179
Surveillance, Epidemiology, and End Results System (SEER), 287
Switzerland, 59
Systematic bias, 255

Tables (in articles), 241
Tabulations of electronic data, 285, 293–294
Technical appendix (of articles), 115–116, 226, 240–241
Terminal nodes, 113
  calculating expected cost for, 123–125
  calculating probabilities for, 120–122
  calculating total cost for, 122
  in decision analysis models, 111
  on decision trees, 120
Testing decision analysis models, 54, 192–193
Threshold analysis, 63–64
Time, calculating QALYs across, 191
Time costs, 96–98
  average length of stay, 97
  defined, 96
  duration of physician contact, 97
  and intangible costs, 95
  opportunity costs of patient or caregiver time, 97
  time in transit, 96
Time horizon, 62, 92
  for decision analysis models, 115
  defined, 62
  journal article description of, 234
Time in transit, 96
Time preference, 92
Time resources, monetary value of, 83
Time trade-off method, 156
Title (of articles), 230–231
Tornado diagram, 202, 208–210
Total cost, 122
Transfer payments, 101
Transit time, 96
TreeAge Pro Software, 147–150, 301
  building Markov model to calculate life expectancy, 320–322
  calculating cost-effectiveness of U.S health insurance, 335–346
  expanding model to compare interventions, 322–334
  sensitivity analysis on insurance model, 347–360
TreeAge Software Inc., 302
Triangular distribution, 215–216, 263, 264
Two-way (bivariate) sensitivity analysis, 202, 207–208, 210
Type I error, 262
Type II error, 262

Uncertainty, 5
change in results due to, see
   Sensitivity analysis
in health care, 110
parameter, 202, 212. See also
   Second-order Monte Carlo
   simulation
probability in describing, 109–110
structural, 200
Uniform discounting rate, 190
Unit Costs for Health Services by
   Country, 288
United Kingdom, 59
United Nations Statistics Division, 288
U.S. Bureau of Labor Statistics, 90, 288
U.S. Bureau of the Census, 292
U.S. Department of Health and Human
   Services: Global Health, 288
U.S. life tables, 136–137, 379–380
U.S. National Library of Medicine
   (NLM), 282
U.S. Preventive Services Task Force
   (USPSTF), 60, 109, 282
U.S. quality-adjusted life expectancy
   table, 380–381
U.S. Study to Help Improve Early
   Evaluation and Management of
   Risk Factors Leading to Diabetes
   (SHIELD), 169
Univariate (one-way) sensitivity analysis,
   see One-way sensitivity analysis
Universal Access with Explicit
   Guarantees (AUGE) program, 20
Unpublished data, 295
USPSTF, see U.S. Preventive Services
   Task Force
“Usual care,” see Current medical
   practice
Utility, 158. See also Preference scores
   additive utility independence, 191
   cost-utility analysis, 44, 169
decision, 157
   and disutility, 169
   expected utility theory, 155–157
   experienced, 157
Vaccine efficacy, 67, 69, 207–208
Validating models, 205–206
Validity, external, 100, 274
Valuation:
   of health-related quality-of-life
      measures, 157–158
   of life, 46–47, 92–93
   of a person’s time, 97
   of pharmaceutical treatment, 75–76
   of QALYs, 191
   of quality-adjusted life-year, 47
   of resources, 74, 75, 81–82
   of time resources, 83
Value(s). See also Monetary value
   baseline, 203, 263
   expected, 105–108, 128–129, 135
   expert opinion on, 296
   future, 149
   of inputs to models, 202–203
   mean, see Mean values
   measured, 254
   net present, 86, 92
   plausible, 199
   “Value-based insurance design,” 22
   Value in Health, 231, 241
Value of statistical life year (VSLY), 47
Variables:
   in electronic datasets, 290, 291
   in one-way sensitivity analysis,
      203–204
   in second-order Monte Carlo
      simulation, 217–218
   in sensitivity analysis, 202–203
   in tornado diagrams, 209–210
Variable costs, 99
Von Neumann–Morgenstern utility
   maximization theory, 33, 156
VSLY (value of statistical
   life year), 47
<table>
<thead>
<tr>
<th>Term</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAC (wholesale acquisition cost)</td>
<td>75–77</td>
</tr>
<tr>
<td>Wages:</td>
<td></td>
</tr>
<tr>
<td>in cost estimates</td>
<td>32, 76</td>
</tr>
<tr>
<td>in time costs calculation</td>
<td>81, 83, 96, 97</td>
</tr>
<tr>
<td>Weighted means calculation</td>
<td>263–265</td>
</tr>
<tr>
<td>Weights, in rate construction</td>
<td>250</td>
</tr>
<tr>
<td>Welfarism</td>
<td>33</td>
</tr>
<tr>
<td>WHO, see World Health Organization</td>
<td></td>
</tr>
<tr>
<td>Wholesale acquisition cost (WAC)</td>
<td>75–77</td>
</tr>
<tr>
<td>WHO Statistical Information System</td>
<td>288</td>
</tr>
<tr>
<td>Willingness-to-pay</td>
<td>43, 220–221</td>
</tr>
<tr>
<td>Wizards</td>
<td>292</td>
</tr>
<tr>
<td>WONDER system (Centers for Disease Control and Prevention)</td>
<td>292, 293</td>
</tr>
<tr>
<td>World Bank</td>
<td>48</td>
</tr>
<tr>
<td>World Health Organization (WHO)</td>
<td>48, 57–58</td>
</tr>
<tr>
<td>WHOStatistical Information System</td>
<td>288</td>
</tr>
<tr>
<td>Years gained, hand-calculation of</td>
<td>135–139</td>
</tr>
</tbody>
</table>