# Contents

# PART 1 Foundations of Research and Evidence

# 1 Frameworks for Generating and Applying Evidence, 2

The Research Imperative, 2
The Research Process, 4
Frameworks for Clinical Research, 5
Types of Research, 11

# 2 On the Road to Translational Research, 17

The Translation Gap, 17 The Translation Continuum, 18 Effectiveness Research, 21 Outcomes Research, 23 Implementation Studies, 25

# 3 Defining the Research Question, 29

Selecting a Topic, 29
The Research Problem, 29
The Research Rationale, 32
Types of Research, 34
Framing the Research Question, 34
Independent and Dependent Variables, 34
Research Objectives and Hypotheses, 38
What Makes a Good Research Question? 39

# 4 The Role of Theory in Research and Practice, 42

Defining Theory, 42
Purposes of Theories, 42
Components of Theories, 43
Models, 44
Theory Development and Testing, 45
Characteristics of Theories, 47
Theory, Research, and Practice, 48
Scope of Theories, 49

### 5 Understanding Evidence-Based Practice, 53

Why Is Evidence-Based Practice Important? 53 How Do We Know Things? 54 What Is Evidence-Based Practice? 56 The Process of Evidence-Based Practice, 57 Levels of Evidence, 62 Implementing Evidence-Based Practice, 65

# 6 Searching the Literature, 70 with Jessica Bell

Where We Find Evidence, 70
Databases, 71
The Search Process, 74
Keyword Searching, 74
Getting Results, 76
Medical Subject Headings, 77
Refining the Search, 80
Expanding Search Strategies, 83
Choosing What to Read, 83
Accessing Full Text, 84
Staying Current and Organized, 85
When Is the Search Done? 85

### 7 Ethical Issues in Clinical Research, 88

The Protection of Human Rights, 88 The Institutional Review Board, 91 Informed Consent, 92 Research Integrity, 98

### PART 2 Concepts of Measurement

### 8 Principles of Measurement, 106

Why We Take Measurements, 106
Quantification and Measurement, 106
The Indirect Nature of Measurement, 107
Rules of Measurement, 108
Levels of Measurement, 109

## 9 Concepts of Measurement Reliability, 115

Concepts of Reliability, 115
Measuring Reliability, 117
Understanding Reliability, 118
Types of Reliability, 119
Reliability and Change, 122
Methodological Studies: Reliability, 124

# 10 Concepts of Measurement Validity, 127

with K. Douglas Gross

Defining Validity, 127
Types of Evidence for Validity, 128
Construct Validity, 132
Norm and Criterion Referencing, 135
Interpreting Change, 136
Methodological Studies: Validity, 138

# 11 Designing Surveys and Questionnaires, 141

Purposes of Surveys, 141
Survey Formats, 142
Planning the Survey, 143
Designing the Survey, 144
Types of Survey Questions, 145
Writing Good Questions, 148
Formatting the Survey, 150
Selecting a Sample, 150
Contacting Respondents, 152
Analysis of Questionnaire Data, 154
Ethics of Survey Administration, 155

# 12 Understanding Health Measurement Scales, 159

with Marianne Beninato

Understanding the Construct, 159 Summative Scales, 161 Visual Analog Scale, 164 Cumulative Scales, 167 Rasch Analysis, 168

### **PART 3 Designing Clinical Research**

### 13 Choosing a Sample, 180

Populations and Samples, 180 Sampling, 183 Probability Sampling, 185 Nonprobability Sampling, 188

### 14 Principles of Clinical Trials, 192

Types of Clinical Trials, 192
Manipulation of Variables, 193
Random Assignment, 194
Control Groups, 198
Blinding, 199
Ideal Versus Pragmatic, 200
Phases of Clinical Trials, 201
Comparing Treatments: Better or No
Worse? 204

#### 15 Design Validity, 210

Validity Questions, 210
Statistical Conclusion Validity, 210
Internal Validity, 212
Construct Validity, 215
External Validity, 217
Strategies to Control for Subject Variability, 218
Non-compliance and Missing Data, 220
Handling Missing Data, 223

#### 16 Experimental Designs, 227

Design Classifications, 227
Selecting a Design, 228
Pretest-Posttest Control Group Designs, 228
Posttest-Only Control Group Design, 230
Factorial Designs for Independent Groups, 231
Repeated Measures Designs, 233
Sequential Clinical Trials, 236

# 17 Quasi-Experimental Designs, 240

Validity Concerns, 240 Time Series Designs, 241 Nonequivalent Group Designs, 244

# 18 Single-Subject Designs, 249

Focus on the Individual, 249
Structure of Single-Subject Designs, 250
Defining the Research Question, 253
Measuring the Target Behavior, 253
Limitations of the A–B Design, 254
Withdrawal Designs, 254
Multiple Baseline Designs, 255
Designs With Multiple Treatments, 257
N-of-1 Trials, 259
Visual Data Analysis, 260
Statistical Analysis, 263
Generalization, 267

# 19 Exploratory Research: Observational Designs, 271

with K. Douglas Gross

Exploring Relationships, 272 Longitudinal Studies, 274 Cross-Sectional Studies, 276 Cohort Studies, 278 Case-Control Studies, 280

#### 20 Descriptive Research, 285

Developmental Research, 286 Normative Studies, 287 Descriptive Surveys, 288 Case Reports, 289 Historical Research, 293

#### 21 Qualitative Research, 297

with Heather Fritz and Cathy Lysack

Human Experience and Evidence, 297
The Research Question: Beyond "What"
to "Why", 299
Perspectives in Qualitative Research, 302
Methods of Qualitative Data Collection, 305
Sampling, 308
Data Analysis and Interpretation, 309
Mixed Methods, 312

# PART 4 Analyzing Data

#### 22 Descriptive Statistics, 318

Frequency Distributions, 318
Shapes of Distributions, 322
Measures of Central Tendency, 322
Measures of Variability, 324
The Normal Distribution, 328

# Foundations of Statistical Inference, 333

Probability, 333
Sampling Error, 334
Confidence Intervals, 336
Statistical Hypothesis Testing, 338
Errors in Hypothesis Testing, 340
Type I Error and Significance, 340
Type II Error and Power, 342
Concepts of Statistical Testing, 346
Parametric Versus Nonparametric
Statistics, 348

# 24 Comparing Two Means: The t-Test, 351

The Conceptual Basis for Comparing
Means, 351
The Independent Samples t-Test, 353
Paired Samples t-Test, 359
Power and Effect Size, 360
Inappropriate Use of Multiple t-Tests, 363

# 25 Comparing More Than Two Means: Analysis of Variance, 365

ANOVA Basics, 365 One-Way Analysis of Variance, 365 Two-Way Analysis of Variance, 370 Repeated Measures Analysis of Variance, 373 Mixed Designs, 378

# 26 Multiple Comparison Tests, 383

Corrections and Adjustments, 383

Post Hoc Multiple Comparisons, 384

Post Hoc Tests for Factorial Designs, 390

Post Hoc Tests for Repeated Measures, 392

Planned Comparisons, 394

# Nonparametric Tests for Group Comparisons, 400

Criteria for Choosing Nonparametric Tests, 400 Procedure for Ranking Scores, 402 Tests for Independent Samples, 403 Tests for Related Samples, 407

# 28 Measuring Association for Categorical Variables: Chi-Square, 415

Testing Proportions, 415
Goodness of Fit, 416
Tests of Independence, 419
Power and Effect Size, 423
McNemar Test for Correlated Samples, 424

#### 29 Correlation, 428

Concepts of Correlation, 428
Linear and Curvilinear Relationships, 430
Pearson Product–Moment Correlation
Coefficient, 431
Correlation of Ranked Data, 432
Correlation of Dichotomies, 435
Interpreting Correlation Coefficients, 435
Partial Correlation, 437

#### 30 Regression, 440

The Basics of Regression, 440
Simple Linear Regression, 441
Multiple Regression, 446
Power and Effect Size for Regression, 449
Stepwise Multiple Regression, 449
Dummy Variables, 453
Nonlinear Regression, 454
Logistic Regression, 456
Analysis of Covariance, 461

#### 31 Multivariate Analysis, 468

Exploratory Factor Analysis, 468 Structural Equation Modeling, 474 Cluster Analysis, 477 Multivariate Analysis of Variance, 478 Survival Analysis, 481

# 32 Measurement Revisited: Reliability and Validity Statistics, 486

with K. Douglas Gross

Intraclass Correlation Coefficient, 486 Standard Error of Measurement, 492 Agreement, 494 Internal Consistency, 497 Limits of Agreement, 499 Measuring Change, 501

#### 33 Diagnostic Accuracy, 509

Validity of Diagnostic Tests, 509
Pretest and Posttest Probabilities, 514
Receiver Operating Characteristic (ROC)
Curves, 519
Clinical Prediction Rules, 523

# 34 Epidemiology: Measuring Risk, 529

The Scope of Epidemiology, 529
Descriptive Epidemiology, 530
Analytic Epidemiology: Measures of Risk, 533
Analytic Epidemiology: Measures of Treatment
Effect, 539

#### PART 5 Putting It All Together

### 35 Writing a Research Proposal, 548

Purposes of the Research Proposal, 548
The Research Team, 548
Components of a Proposal, 549
Plan for Administrative Support, 552
Writing the Proposal, 554
Funding, 555
Submitting the Proposal, 555

# 36 Critical Appraisal: Evaluating Research Reports, 557

Levels of Evidence, 557
The Appraisal Process, 558
Core Questions, 558
Intervention Studies, 562

Studies of Diagnostic Accuracy, 564 Studies of Prognosis, 565 Qualitative Studies, 567 Critically Appraised Topics, 568

# 37 Synthesizing Literature: Systematic Reviews and Meta-Analyses, 574

with David Scalzitti

Purpose of Systematic Reviews, 575
The Research Question, 576
Methods, 578
Results, 581
Discussion and Conclusions, 586
Meta-Analysis, 587
Appraisal of Systematic Reviews and Meta-Analyses, 591
Scoping Reviews, 592

### 38 Disseminating Research, 597

with Peter S. Cahn

Choosing a Journal, 597
Authorship, 599
Standards for Reporting, 599
Structure of the Written Research Report, 602
Submitting the Manuscript, 605
Presentations, 607
Promoting Your Work, 610

#### **Appendices**

- A Statistical Tables, 613
- B Relating the Research Question to the Choice of Statistical Test, 622
- C Management of Quantitative Data, 629

Glossary, 637

Index, 659