

✦ SIX ✦

ASSESSING QUALITY IN MIXED METHODS STUDIES

Information you will find in this chapter: *This chapter discusses issues of quality (or scientific rigor) in mixed methods research. In the first section, we summarize common standards of quality and appraisal criteria that apply in both qualitative and quantitative studies. The next section presents a critical appraisal framework for quality that is uniquely relevant to designing and conducting mixed methods research. Finally, we describe potential methodological threats to quality that arise from decisions related to sampling, data collection, analysis, interpretation, and presentation in mixed methods studies.*

Key features in this chapter:

- Brief quotations and reflections from mixed methods researchers
- Figure of key stakeholders with an interest in quality in mixed methods
- Brief list of resources on assessing quality of qualitative research
- Table summarizing standards of quality and appraisal criteria for qualitative and quantitative studies
- Critical appraisal framework for quality in mixed methods studies in the health sciences
- Examples of justifications for using mixed methods
- Examples of design decisions and threats to quality

THE IMPORTANCE OF RESEARCH QUALITY FOR DIFFERENT AUDIENCES

In this chapter we address scientific rigor, which we also refer to as quality, in mixed methods research. Many texts present this topic as a concluding chapter; however, we have deliberately placed it in Part II: Getting Mixed Methods Research Funded because we believe it is important for researchers to be familiar with the standards of quality and to apply them actively in the development of their research. We would also note that the quality of evidence generated through mixed methods is of interest to a wide range of potential audiences (see Figure 6.1). These audiences include research affiliates (e.g.,

- ▶ Researchers can find more specific and practical guidance on addressing domains of quality when developing grant applications and manuscripts for publication in Chapter 4: Writing a Scientifically Sound and Compelling Grant Proposal for a Mixed Methods Study and in Chapter 11: Publishing Mixed Methods Studies in the Health Sciences.

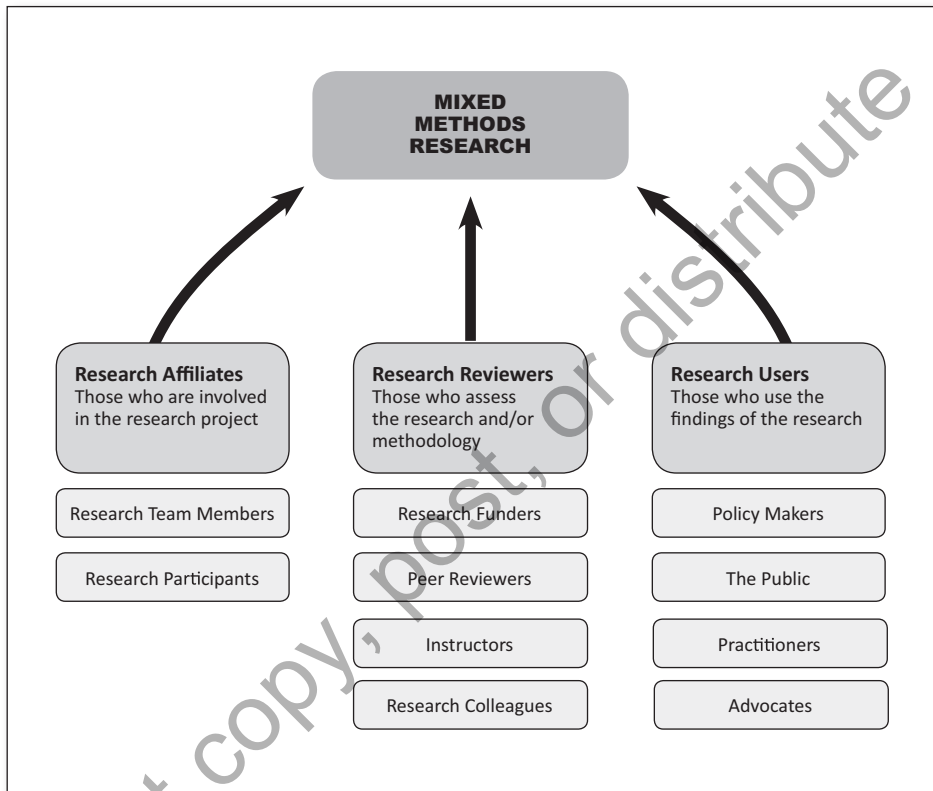
members of the research team, research participants), research reviewers (e.g., funders, peer reviewers, instructors, research colleagues), and research users (e.g., policymakers, the public, practitioners, advocates).

While the issue of research quality is relevant for each of these audiences, in this chapter we generally tailor the discussion for reviewers of grant applications or manuscripts. We seek to provide those in a position of evaluating mixed methods studies with an informed understanding of essential principles and concepts relevant to scientific rigor. Of course, researchers who are planning or conducting a mixed methods study must also be familiar with and apply these principles and concepts in their work. In addition, when designing a study and writing a proposal, it is important to keep these audiences in mind, especially in terms of how they will assess the quality of your research.

COMMON STANDARDS OF QUALITY IN QUALITATIVE AND QUANTITATIVE RESEARCH

There is a large universe of robust and dynamic literature addressing issues of scientific rigor for both quantitative and qualitative research. Mastery of this literature is surely a daunting task for methodologists whose careers are devoted to improving processes of scientific discovery, let alone busy health

Figure 6.1 Audiences With an Interest in the Quality of Mixed Methods Research



SOURCE: Adapted from O’Cathain (2010b).

sciences researchers embarking on a path to use mixed methods in their work. Using mixed methods requires turning an eye toward three sets of standards: those for qualitative methods, those for quantitative methods, and those for mixed methods. Reading across these voluminous sets of standards is no small task, especially given the varied orientations, terminology, and practices that characterize each. While there is a very well-developed science around conducting systematic reviews of quantitative studies, systematic reviews have increasingly begun to include qualitative and mixed methods studies. The literature around appraising the quality of several methods in a single review is emerging accordingly (Pluye, Grad, Levine, & Nicolau, 2009).

We presume that many readers of this text will be familiar with established criteria for quality in quantitative studies. Exponential growth in big data and increasing access to large data sets of all types has given rise to exciting innovations in advanced analytic techniques that are evolving rapidly. Nevertheless, quantitative research sits firmly upon a foundational set of principles for scientific rigor for which there is clear consensus in the field (e.g., Aschengrau & Seage, 2008; Cook & Campbell, 1979; Gordis, 2009; Hulley, Cummings, Browner, Grady, & Newman, 2013). On the other hand, qualitative research has highly diverse roots, with origins in anthropology, sociology, philosophy, and other disciplines and has been introduced into the health sciences comparatively recently (Crabtree & Miller, 1999; Glaser & Strauss, 1967; Miles & Huberman, 1994; Patton, 2002; Strauss & Corbin, 1998). This disciplinary diversity brings richness to the methods yet presents challenges to achieving consensus on how to most appropriately describe and assess the quality of qualitative research as used in health sciences. The central question is whether to ground the standards in concepts and terminology from quantitative research or to apply unique standards created exclusively for qualitative methods. Multiple sets of standards for qualitative research exist that reflect these varied scientific traditions and orientations. While essential, they are sometimes inconsistent and often overwhelming for researchers new to the method. Researchers interested in learning more about standards of quality in qualitative research *per se* are encouraged to turn to resources such as those in Box 6.1. This is just a small sampling; there are many excellent resources available in textbook form, journal articles, and on the Internet.

Box 6.1 Resources on Assessing Quality in Qualitative Research

We expect that many of the readers of this text may be somewhat new to qualitative research. For more information on this topic, we suggest these selected resources:

- Denzin, N. K., & Lincoln, Y. (Eds.). (2000). *Handbook of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

- Horsburgh, D. (2003). Evaluation of qualitative research. *Journal of Clinical Nursing*, 12(2), 307–312.
- Mays, N., & Pope, C. (2000). Qualitative research in health care. Assessing quality in qualitative research. *BMJ*, 320(7226), 50–52.
- Morse, J. M., & Richards, L. (2002). *README first for a user's guide to qualitative methods*. Thousand Oaks, CA: Sage.
- Onwuegbuzie, A. J., & Leech, N. L. (2007). Validity and qualitative research: An oxymoron. *Quality and Quantity*, 41(2), 233–249.
- Padgett, D. (2012). Strategies for rigor. In *Qualitative and mixed methods research in public health* (pp. 203–220). Thousand Oaks, CA: Sage.
- Patton, M. (2002). *Qualitative evaluation and research methods* (3rd ed.). Thousand Oaks, CA: Sage.

The question of quality becomes even more complicated when considering a mixed methods study. One position is that the philosophical underpinnings of qualitative and quantitative methods are wholly distinct and that independent criteria are needed to assess the respective qualitative and quantitative components of a mixed methods study. Others suggest that there are aspects of scientific investigation that are essentially analogous for qualitative and quantitative research, although they may be manifest differently in the research process (Bryman, 1988; Mays & Pope, 2000; Morse, 1999; Murphy, Dingwall, Greatbatch, Parker, & Watson, 1998). We agree with this view.

Accordingly, we endorse alignment of quantitative and qualitative methods across common standards in order to focus on the essential elements of quality in scientific investigations. To create the list of common standards of quality and appraisal criteria for qualitative and quantitative studies in Figure 6.2, we draw upon multiple sources (Bradley, 1997; Lincoln & Guba, 1985; Miles & Huberman, 1994; Polit & Beck, 2010; Sale & Brazil, 2004) to define core attributes, or common standards, of quality and to describe how these attributes are appraised in both qualitative and quantitative studies. In addition to distilling the standards to their essence and hence making them digestible, we believe this approach has the benefit of bringing us closer to a shared view of core standards that can unite (rather than divide) quantitative and qualitative researchers.

Figure 6.2 Common Standards of Quality and Appraisal Criteria for Qualitative and Quantitative Studies

STANDARD	QUALITATIVE Appraisal Criteria	QUANTITATIVE Appraisal Criteria
Veracity	Credibility —The degree to which the findings plausibly explain the phenomenon of interest or cohere with what is known; attention paid to alternative explanations; correspondence between the researcher’s and respondent’s portrayal of respondent experience	Internal validity —The degree to which the findings represent a “true” reflection of a causal relationship between the variables of interest in the population under study
Consistency	Dependability —The degree to which the researchers account for and describe the changing contexts and circumstances during the study	Reliability —The degree to which observations, measures or results can be replicated (for the same participant or in different studies)
Applicability	Transferability —The degree to which findings or research protocols can be transferred to other settings, contexts, or populations as determined by the reader	Generalizability (or external validity)—The degree to which the study results hold true for a population beyond the participants in the study or in other settings
Neutrality	Confirmability —The degree to which the findings of a study are shaped by respondents and not researcher bias, motivation, or interest	Objectivity —The degree to which researchers can remain distanced from what they study so findings reflect the nature of what was studied rather than researcher bias, motivation, or interest

SOURCES: Adapted from Bradley (1997); Lincoln and Guba (1985); Miles and Huberman (1994); Polit and Beck (2010); Sale and Brazil (2004).

Next we describe each of the common standards in detail and suggest techniques that can be used to address the appraisal criteria in study design, implementation, and data analysis. Reviewers of a mixed methods research proposal should look for whether and how these techniques will be employed

to ensure quality in the study under consideration. Readers of peer-reviewed studies may find it difficult to assess adherence to these standards when the methods section of the article does not provide sufficient information, whether because of space constraints or the authors' lack of attention to the standards, or both. Experts have called for improved transparency and completeness of reporting in manuscripts for mixed methods studies (O'Cathain, Murphy, & Nicholl, 2008; Wisdom, Cavaleri, Onwuegbuzie, & Green, 2012).

► For more information on the transparency in reporting mixed methods studies, see Chapter 11: Publishing Mixed Methods Studies in the Health Sciences.

The first common standard is veracity, which refers to credibility in qualitative research and internal validity in quantitative research. Veracity is concerned with the "truth value" of the findings (Lincoln & Guba, 1985), or the degree to which the results accurately and precisely represent the phenomenon under study. In qualitative research, several questions can be asked to assess the credibility of findings: Are the findings plausible? Do they cohere with what is known? Do the researchers deliberately consider alternative explanations? Do they represent the respondents' experience accurately?

A key technique for enhancing credibility is triangulation (use of multiple methods, data sources, and researchers) (Campbell & Fiske, 1959; Cook, 1985; Denzin, 1978), which seeks convergence and corroboration across data sets. Several other techniques exist. A primary technique is sampling to the point of theoretical saturation (the point at which no new data emerge from subsequent data collection). Participant confirmation (or member checking) is a process of presenting findings to participants to assess whether the findings are consistent with their experience or the experiences of like others). Tactics to encourage participants to be candid and truthful can also enhance credibility, such as assigning interviewers who are concordant on a potentially salient characteristic such as gender (although the evidence on concordance is mixed) or reassuring participants of confidentiality protections. Finally, negative case analysis can increase credibility. This analysis involves deliberate examination of cases that present disconfirming or deviant evidence and developing modified analytic propositions to accommodate the data. Some also suggest that the iterative process of data collection and analysis in a qualitative study is a form of progressive validation of emergent constructs.

In quantitative methods, internal validity is concerned with the degree to which the findings represent a true reflection of a causal relationship between

the variables of interest in the population under study. In evaluating internal validity, we want to know the following: Did the study measure what it was intended to measure? Were sources of bias and confounding addressed and minimized within the study conditions? Common techniques to enhance internal validity include randomizing study conditions, identifying and controlling for extraneous or confounding variables, comparing control versus intervention groups, and developing instruments through systematic processes such as cognitive interviews and factor analysis.

The second common standard is consistency and refers to dependability in qualitative research and reliability in quantitative research. In a qualitative study, dependability reflects the degree to which the researchers adequately document the research process in toto, from study conceptualization through to interpretation. Because qualitative research is carried out in naturalistic settings, with the researcher as a human instrument, unexpected and potentially relevant variables may emerge over the course of the study. Reviewers or readers might ask the following questions: Do the researchers provide enough detail about the context and process so that another researcher can repeat the study (if not find the same results)? Is variation in the phenomenon tracked or explained consistently, with possible sources of variability noted? The key technique for ensuring dependability in a study is an external audit. External audits involve having an independent researcher examine both the process and results of the study to evaluate whether the findings are supported by the data. There are differing views as to the value and feasibility of external audits. While they can help to assess the quality of a given study, there are many challenges to an outside researcher's ability to master the extensive amount of data and generate similar interpretations. Challenges include human research protection program (HRPP) policies and procedures that may preclude external parties accessing data, ensuring participant confidentiality, and encountering logistical impediments to data access.

- For more information on HRPPs as they relate to mixed methods, see Chapter 10: Implementation Issues in Mixed Methods Research.

In a quantitative study, reliability refers to the consistency, stability, and repeatability of observations or measures. In assessing reliability, one might ask the following: Can we repeat the measure with the same participant or in different participants and get the same results? Techniques to increase reliability of measures are using multiple measures of the same

construct, cognitive testing and piloting of survey instruments, training of data collectors to ensure high inter-rater reliability, data cleaning, and using statistical procedures to adjust for measurement error.

The third common standard is applicability; it addresses what is known as transferability in qualitative research and generalizability (or external validity) in quantitative research. Applicability of a given study is the degree to which we can take what is learned in one study and use the findings in another setting or population. This concept is of critical importance in moving a body of knowledge forward. In qualitative studies, we assess transferability by asking the following: Can findings be applied in other similar contexts or settings? Transferability can be enhanced in several ways. Reports of findings should include a clear and explicit statement of research aims, including a compelling rationale for qualitative methods and appropriate citations. A thorough description of study context including aspects of the study setting that are most salient to the research question can also be useful. The intention is to provide readers of the research with information needed to evaluate the degree to which their own setting is similar to the study context. Finally, reports should include procedures for sampling, participants, data collection, and analysis including transcription and coding.

In quantitative studies, generalizability can be evaluated by asking the following questions: What is the degree to which similar results could be expected for others in the same population or in other populations? Techniques to enhance the generalizability of findings include random selection, clear definition of and rationale for inclusion and exclusion criteria, use of validated instruments, assessment of nonrespondent bias, and descriptions of statistical procedures including treatment of missing data and confidence intervals.

The final common standard, neutrality, refers to confirmability in qualitative research and objectivity in quantitative research. The concept of neutrality addresses whether the researchers have a priori assumptions that may bias implementation of the study or interpretation of results. A reviewer or reader might ask the following: Do the reported research findings accurately reflect the experiences and attitudes of participants, without bias from researchers? Those who have limited familiarity with qualitative methods may express concerns about bias. These concerns may be raised by several intrinsic features of qualitative methods, including the dynamic interpersonal nature of gathering data, the iterative process of collecting data and interpreting it, as well as the seemingly opaque methods of data analysis. For many researchers,

however, theoretical sensitivity and deep prior experience with or knowledge of the research topic is considered an asset. Qualitative researchers seek to produce study findings that authentically capture the respondents' views or experience, without undue influence of researcher bias, motivation, or interest. Established techniques to facilitate confirmability include external audits (described previously). Bracketing is a process whereby the researcher holds in abeyance any biases, presuppositions, or previous experiences, which can be documented through memos or debriefs with an external party (Tufford & Newman, 2012). Finally, reflexivity involves acknowledging the effect of the researcher on every step of the research process, fostered by multiple investigators; journaling research reflections throughout the study; and reporting this information in manuscripts (Lincoln & Guba, 1985).

Neutrality may be less often perceived as a potential risk in quantitative research, which is typically regarded as protected from bias because studies use random selection, apply explicit protocols, and perform statistical computations. Yet our view is that quantitative studies are also vulnerable to biases. Biases may manifest themselves in the definition of the research question, the setting of inclusion and exclusion criteria, and decisions about measurement (what variables are included and how are they operationalized) and analytics (how models are built). Hence, neutrality is equally relevant for both qualitative and quantitative studies (Malterud, 2001) (see Box 6.2). As noted previously, transparency, or complete and detailed description of methods, is most often used as a standard for reporting qualitative studies. This should apply to quantitative studies as well. Sufficient detailed information should be provided to allow the reader to understand all key design and analysis decisions. Maximum transparency in reporting key decisions and processes for study implementation and analysis can go a fair way toward addressing concerns about neutrality.

Box 6.2 Neutrality as a Goal in Both Qualitative and Quantitative Research

A researcher's background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, and the framing and communication of conclusions. (Malterud, 2001, pp. 483–484)

ADDITIONAL STANDARDS FOR QUALITY IN DESIGNING AND CONDUCTING MIXED METHODS STUDIES

Simply appraising the rigor of the respective qualitative and quantitative components is not sufficient to ensure a high-quality mixed methods study. By definition, a mixed methods study is more than the sum of its parts, where data integration and generation of overarching (or meta) insights or inferences are essential characteristics. Experts have devoted substantial effort to the development of quality standards for mixed methods studies; there are over a dozen sets of standards currently available. Yet while there is an encouraging amount of consistency across these standards, there is also a fair amount of variability (Bryman, Becker, & Sempik, 2008; Caracelli & Riggin, 1994; Creswell & Plano Clark, 2011; Heyvaert, Hannes, Maes, & Onghena, 2013; Morse, Wolfe, & Niehaus, 2006; O’Cathain, 2010a; O’Cathain et al., 2008; Onwuegbuzie & Johnson, 2006; Pluye, Gagnon, Griffiths, & Johnson-Lafleur, 2009; Sale & Brazil, 2004; Teddlie & Tashakkori, 2009; Wisdom et al., 2012). Research funders have also become increasingly aware of criteria for rigor in qualitative and mixed methods studies. A senior official at the Commonwealth Fund describes the evolution of these approaches and the growing capacity of their reviewers in assessing quality in Box 6.3.

Box 6.3 Assessing Rigor in Mixed Methods Grant Applications

For a long time, study sections at NIH or other large funders did not recognize mixed and qualitative methods because there were just no criteria to evaluate them, but I think that’s changed a lot now. There has been a lot of work to increase the awareness of some criteria that can be usedAt the Commonwealth Fund, because we’re very small and may not have the expertise in house, we will reach out to experts that can help us evaluate the quality, validity, and soundness of a proposal. Over time we’ve really become aware that even if people put a lot of fancy words on the page, that doesn’t mean that they really understand what these terms mean, and that’s really what we want to know—whether there is a sound team behind those methods that can really deliver.

—Anne Marie Audet, MD, MSC, Vice President for
the Delivery System & Reform Breakthrough
Opportunities, The Commonwealth Fund

In an effort to make this extensive and somewhat disparate information more accessible for researchers new to mixed methods, we have attempted to distill current frameworks to a set of minimum essential elements. We fully appreciate that this is not an exhaustive list and recognize that experts will differ in the degree of depth of criteria within these broad domains. We also regard the existing more detailed standards as critical to advancing the broad field of mixed methods with regard to methods and quality. Nevertheless, in the pragmatic spirit of this book we sought to make the essential elements more accessible and therefore more likely to be understood and taken up by researchers in the health sciences. In addition to the common standards for qualitative and quantitative methods defined previously, we recommend the mixed methods appraisal framework outlined in Table 6.1. Note that while some of these standards must be applied retrospectively, reviewers of grant proposals can assess the degree to which the researchers describe their plans for adhering to them throughout the proposed study.

Table 6.1 Critical Appraisal Framework for Quality in Mixed Methods Studies in Health Sciences

Domain of Quality	Appraisal Criteria	References
Conceptualization and justification of the study as mixed methods	To what degree is there an explicit and sound rationale for using mixed methods? Are the strengths of each method used to minimize limitations of the other? Was there an a priori plan for ensuring yield (whole is more than sum of parts)?	1–7
Design quality	Is the design appropriate for addressing the overall question, and does it align with the reason for combining methods? Is a description of design from a known typology provided?	2–3, 5, 8, 9
Adherence to respective standards for qualitative and quantitative methods throughout the study	To what degree were established standards adhered to for each of the individual components with regard to sampling, data collection, and analysis?	2–3, 9–10
Adherence to standards for mixed methods data analysis		2–3, 5, 7–8

Domain of Quality	Appraisal Criteria	References
<ul style="list-style-type: none"> Resolution of divergent findings 	Have divergent findings from different components been adequately identified and plausibly explained?	
<ul style="list-style-type: none"> Treatment of concordant findings 	Has the possibility of shared bias between the methods been considered and addressed?	
<ul style="list-style-type: none"> Rigor of data transformation 	Is there a clear rationale for the data transformation? Have established procedures been described and followed?	
Quality of analytic integration		1–3, 4–8
<ul style="list-style-type: none"> Statement of type of integration 	Is there a clear a priori plan and technique for integration across data sets?	
<ul style="list-style-type: none"> Type of integration is appropriate for the particular design 	Is the integration plan appropriate given the particular study design? Is the plan designed with attention to sequencing, weighting of components?	
<ul style="list-style-type: none"> Degree of yield 	Do results from integration generate more comprehensive findings than either component would alone? Does the study produce publications that include findings from both components?	
Quality of interpretation		1–2, 5–9
<ul style="list-style-type: none"> Interpretive transparency 	Is it clear which findings have emerged from each method?	
<ul style="list-style-type: none"> Interpretive efficacy 	Do the overarching (meta) inferences adequately synthesize inferences from the qualitative and quantitative findings?	
<p>References:</p> <ol style="list-style-type: none"> Bryman, Becker, and Sempik (2008). Caracelli and Riggin (1994). Creswell and Plano Clark (2011). O’Cathain, Murphy, and Nicholl (2007). Onwuegbuzie and Johnson (2006). Pluye, Gagnon, Griffiths, and Johnson-Lafleur (2009). Wisdom, Cavaleri, Onwuegbuzie, and Green (2012). O’Cathain, Murphy, and Nicholl (2008). Teddlie and Tashakkori (2009). Morse (2010). 		

SOURCE: Adapted from O’Cathain (2010a).

Conceptualization and Justification of the Study as Mixed Methods

The conceptualization and justification of the study as requiring a mixed methods approach is fundamental to assessing the quality of the research. While it may seem obvious, in our experience this initial stage is where many researchers who are new to mixed methods stumble. The researchers should make a convincing case that the phenomenon of interest is sufficiently complex and

◀ For more information on justifications that many other researchers have used for employing mixed methods in health sciences, see Chapter 2: Applications and Illustrations of Mixed Methods Health Sciences Research.

multifaceted as to require mixed methods (as opposed to simply being strategic by including a qualitative component because the funder has expressed interest, which we have seen in our grant reviewer and mentor roles). One review of published mixed methods health services studies found that only one third of reports provided justification for a mixed methods design (Wisdom et al., 2012). Not only is it necessary to make a compelling case that a mixed methods approach is

warranted but the rationale for the specific design selected (e.g., explanatory sequential) must also be provided. Some common circumstances in which a mixed methods design might be appropriate are included in Box 6.4. As a reviewer, be sure to look for one of these or another justification early in the grant application or manuscript. Also pay attention to whether the stated justification carries throughout the conceptualization and presentation of methods and findings.

Box 6.4 Examples of Justifications for Using Mixed Methods

- Pursuing a topic about which little is known and hence conducting both hypothesis generation and subsequent testing in one study
- Producing a comprehensive account of both the nature and magnitude of a phenomenon
- Seeking both in-depth detailed understanding and generalizable findings
- Aiming to describe context, process, and outcomes of a particular phenomenon
- Minimizing limitations inherent in each method through capitalizing on their respective complementary strengths

In addition to these circumstances that suggest a need for a mixed methods approach, there is also a broad range of potential focal topics that are well suited for mixed methods. In the health sciences, potential topics might include complex clinical or quality issues, health care organizational performance, behavioral interventions, processes of implementation of innovations, health care decision making, and measurement and development for complex constructs.

◀ Further discussion of topical areas that are well suited for mixed methods research is provided in Chapter 3: Determining the Appropriateness and Feasibility of Using Mixed Methods.

Design Quality

The second domain of quality relates to the study design. Criteria for appraising the quality of a study design include how the study is conceived with regard to the aim and how it is described. As we have noted throughout the text, the overall research question drives the design decisions. It is essential that the chosen study design is well suited to generate quantitative, qualitative, and integrated data that are directly relevant to answering the study question. In addition, the design should align with the stated rationale for using a mixed methods approach. The rationale may either tie to the focal topic or to the needed methodology. For instance, if the rationale is to study a topic about which little is known and therefore to generate and test hypotheses, the design should be exploratory sequential.

In terms of describing the design, experts recommend using concepts, language, and formats from a known typology (Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009). Typologies are intended to organize and simplify complex constructs through classification systems. The benefits of typologies in research are substantial, particularly in the earliest phases of development of a field. They can improve communication both within a professional community and externally through shared language and understanding. Typologies can facilitate comparisons across studies in order to allow for synthesis of evidence and the development of a body of knowledge. In a pragmatic sense, typologies can also serve as practical tools for researchers to guide the organization and implementation of a study. Importantly, they can also support efforts to legitimize a field of study. There are more than a dozen typologies of mixed methods studies available (Creswell, 1999; Creswell, Fetters, & Ivankova, 2004; Creswell, Plano Clark, Gutmann, & Hanson, 2003; Greene,

2007; Hannemann-Weber, Kessel, Budych, & Schultz, 2011; Morgan, 1998; Morse, 1991; Morse & Niehaus, 2009; Patton, 1990; Sandelowski, 2000; Steckler, McLeroy, Goodman, Bird, & McCormick, 1992; Tashakkori & Teddlie, 1998; Teddlie & Tashakkori, 2009); some are commonly used in the health sciences. However, existing typologies cannot fully accommodate the extraordinarily diverse forms of mixed methods studies—particularly large, complex projects that are iterative and dynamic. Guest (2013) has recently proposed an alternative approach that reduces the descriptive dimensions of a study to focus on points of interface. As there is no single correct or uniformly endorsed typology for mixed methods studies, researchers should identify one that captures and conveys the essential aspects of their study most effectively (Guest, 2013). Reviewers should assess the degree to which the design is a fit for the research question and also expect to see some form of study typology or recognized descriptors provided in a grant or manuscript.

Adherence to Respective Standards of Quality for Qualitative and Quantitative Research

As discussed at the beginning of this chapter, each component in a mixed methods study should comply with respective standards for qualitative and quantitative research. It is critical to follow the established methodological principles and practices of sampling, data collection, and analysis for each component to the greatest degree feasible.

Yet for multiple reasons (e.g., efficiency concerns, dominance of one orientation within the team, lack of awareness) it is not uncommon for threats to quality to appear in either the qualitative or quantitative components (or both).

There are many existing resources that describe the standards of quality for qualitative and quantitative work, and as a result, this book will not describe these standards in detail. However, for a brief summary of guidelines to be used in assessing the rigor of each component of a mixed methods study, refer to Appendix C: Assessing Rigor in Quantitative Health Sciences Research and Appendix D: Assessing Rigor in Qualitative Health Sciences Research: Consolidated Criteria for Reporting Qualitative Research (COREQ).

For more information on mixed methods sampling, data collection, and analysis, refer to Chapter 7: Sampling and Data Collection in Mixed Methods Studies and Chapter 8: Data Analysis and Integration in Mixed Methods Studies.

In terms of sampling, a qualitative sample ought to be purposeful in nature (i.e., nonrandom), is typically smaller than sample sizes in quantitative studies and the size is not defined a priori. As such, a qualitative sampling frame is generally not suited to serve a quantitative purpose. A quantitative sample should be randomly drawn with attention to nonresponse bias and is typically larger than those in a qualitative design. Importantly, failure to adhere to principles of sampling for each method presents risks to the quality of findings generated in the respective components.

► See the Glossary of Key Terms and Definitions for more information on theoretical saturation.

Data collection in a qualitative study requires flexibility. The data collector must be nimble and able to pursue unanticipated directions during the observation or interview. In addition, the data collection instrument is dynamic and may be revised through the course of the study. The data collection period is not predefined; it continues until theoretical saturation is achieved through an iterative process of data collection and analysis. In a quantitative study, data collection is necessarily fixed, predetermined, and explicitly defined. The instruments are static and are not altered once the data collection begins. Standardization in administration is imperative, with careful training of interviewers including inter-rater reliability checks. Finally, deviations from the administration protocol are considered problematic.

Processes of data analysis differ in qualitative and quantitative methods. Qualitative data are typically analyzed with focus on narrative descriptions, using various techniques such as the constant comparative method (Glaser & Strauss, 1967; Lincoln & Guba, 1985) to generate themes, taxonomies, or conceptual frameworks (Bradley, Curry, & Devers, 2007). In some cases, researchers generate quantitative output from the qualitative data. We share the view of experts who note that quantifying qualitative data can present a threat to validity and should be thoroughly justified, approached with caution, and follow established procedures (Morse et al., 2006). In quantitative studies, hypotheses are precisely defined in advance, and data analysis is not performed until the data collection phase has closed. Output takes the form of numeric results from various forms of statistical modeling and testing. Analyses should be defined as exploratory or confirmatory in nature, as appropriate, at the outset.

In sum, qualitative and quantitative components in a mixed methods study must be implemented with deliberate attention to the key methodological

assumptions, principles, and practices underpinning each. As researcher and mixed methods expert Jan Morse wisely cautioned, “*Mixed methods are not data soup!*” (Morse, 2010, p. 348). Several strategies for ensuring that the scientific integrity of each component remains intact exist. They include explicit valuing and supporting all methods by the principal investigator throughout the project; having sufficiently deep expertise on the team for both qualitative and quantitative methods; and developing an overall project budget that appropriately allocates adequate time and resources for each study component. As a reviewer, you will want to have sufficient information to be able to determine the degree to which respective standards for quality were adhered to in all aspects of the quantitative and qualitative study components (sampling, data collection, and analysis).

Adherence to Standards for Mixed Methods Data Analysis

A number of aspects of data analysis are unique to mixed methods studies: treatment of divergent data, treatment of convergent data, and procedures for data transformation.

First, it is possible that the qualitative and quantitative findings from a mixed methods study may be divergent or inconsistent. Simply putting aside or ignoring inconsistent findings is not an option. Points of divergence or inconsistency may highlight important areas of discovery. These points ought to be systematically examined and addressed through analysis. Insights and unanswered issues should be reflected in the final report of findings; readers should not be left to try to interpret or understand discrepancies on their own. Several strategies can help with divergence (Pluye, et al., 2009), including confirming the rigor of each study component, conducting additional data collection or analysis, and developing hypotheses about potential explanations.

Second, it is also possible that the two (or more) sources of convergent data may have a shared bias, which could mean that the results are converging toward a set of findings that does not reflect reality. One of the strengths of mixed methods research is that it can minimize the biases and weakness of individual methods; however, if the methods are subject to the same biases, then the use of multiple methods does not add to the strength of the

- For more information on mixed methods data analysis, refer to Chapter 8: Data Analysis and Integration in Mixed Methods Studies.

study. For instance, if the data for both components were collected from similarly biased samples or if the researchers failed to control for confounders in the quantitative arm and the qualitative sample was derived from this group, then both methods could be pointing to the same results only because they suffer from the same weaknesses. These circumstances can be addressed in several ways, including having discussions throughout the planning process, keeping records of potential biases in different components, using caution when selecting a qualitative sample out of a quantitative sample, and collecting all of the data needed to adequately control for confounders in quantitative analyses.

The third form of analysis unique to mixed methods is data transformation (turning qualitative results into quantitative data or turning quantitative results into qualitative data). The most difficult challenges to rigor may arise in processes of data transformation, particularly when the implicit or explicit intention is to bring more validity to the qualitative data (Collingridge, 2013; Onwuegbuzie & Teddlie, 2003; Sandelowski, Voils, & Knafl, 2009).

In our view, researchers should use great care in carrying out data transformation; we recommend following established standards for transformation wherever possible (Onwuegbuzie & Teddlie, 2003; Sandelowski et al., 2009). We also note that this is an area of rapid development in the mixed methods field, with a steady emergence of novel approaches. This innovation is exciting in that it holds promise for advancing the field.

At the same time, caution is advised since existing quality standards may not fully accommodate these techniques. The primary strategies for adhering to existing standards in mixed methods data analysis are to review the available resources and create a detailed written analytic plan, ensure relevant expertise is represented on the team, and build in sufficient time to allow for the analysis phase. Grant reviewers should look for evidence of these strategies in multiple parts of the application including the analysis section within methods, the biographical sketches of the team members, and the proposed timeline. Evaluating the quality of data analysis is more challenging for manuscript reviewers, as there is often limited information provided. At a minimum, the manuscript should describe treatment of divergent and convergent data in the analysis and perhaps findings and processes of data transformation, if applicable.

► Data transformation is discussed in Chapter 8: Data Analysis and Integration in Mixed Methods Studies.

Quality of Analytic Integration

The quality of analytic integration in a mixed methods study can be assessed with attention to several factors. First, as described in Chapter 1, there is general consensus in the field regarding the primary forms of data integration (e.g., connect, merge, build). The particular type of integration used in the analysis should be readily identified in the research proposal or manuscript, using established terminology and brief definitions if needed. Second, certain types of integration are suited for particular mixed methods study designs. The approach should be appropriate for the given design (for instance, a convergent design may not employ connected integration; an explanatory sequential design cannot use merged integration in data collection). Finally, reviewers should evaluate the yield of a mixed methods study (such that the whole is more than the sum of its parts). Key indicators of yield include the extent of integration in design, sampling, analysis, and interpretation and the types and content of publications from the study (O’Cathain, Murphy, & Nicholl, 2007). Ideally, the foundational publication from a mixed methods study will report findings from both qualitative and quantitative components. In our own work, we have sometimes experienced having the integration step glossed over or given superficial attention in an effort to publish findings in a timely way or in a particular disciplinary journal. A factor that cannot be underestimated in terms of its impact on publishing integrated results in mixed methods studies is word limits in journal articles. Space constraints may lead researchers to publish results separately, forgoing the opportunity for integration in reporting results. For instance, a manuscript may be published using data from only the initial component in a sequential design, without integrating the subsequent findings.

Reviewers should attempt to assess whether adequate resources (financial, technical, and intellectual) have been invested in the integration activities. Grant reviewers should look for evidence of plans for integration in the dissemination section of an application, where the applicants should explain the intended publications as well as how data will be integrated and reported in the publications. Reviewers of manuscripts can assess the quality of integration as described within the methods, findings, and discussion sections. In studies that have produced multiple publications, it can be useful for reviewers to assess whether linkages have been made across publications with respect to integration.

- ▶ For more discussion about challenges and strategies for publishing mixed methods studies, see Chapter 11: Publishing Mixed Methods Studies in the Health Sciences.

Quality of Interpretation

Finally, the quality of interpretation and inference is central to the rigor of a mixed methods study. Two considerations are particularly important elements of quality. First, as with the need for transparency in research methods generally, transparency of the interpretations derived from the respective qualitative and quantitative data sets is essential. Researchers should be deliberate in their interpretations from each data set and clearly identify which findings emerged from which data set.

Second, interpretive efficacy refers to the degree to which the researchers have leveraged the full potential of each data set in order to generate overarching inferences (referred to as “meta-inferences”) (Teddle & Tashakkori, 2006). In the process of generating meta-inferences, attention should be paid toward placing emphasis on particular components as appropriate given sampling and data collection strengths and limitations for each. The development of unique findings that adequately synthesize inferences from the qualitative and quantitative data is a signal of this important dimension of quality in mixed methods studies.

We have proposed a consolidated critical appraisal framework to assess the quality of mixed methods studies. The framework is recommended as an addition to existing standards of rigor for qualitative and quantitative research, which should apply to each respective component. This combination of traditional and alternative criteria has been recommended by several mixed methods experts (Bryman et al., 2008; O’Cathain, 2010a; Wisdom et al., 2012). These suggestions may be useful for reviewers of grants and manuscripts as well as readers of empirical papers reporting mixed methods studies.

EXAMPLES OF THREATS TO QUALITY IN THE DESIGN AND CONDUCT OF MIXED METHODS STUDIES

The risk of undermining quality standards is heightened in mixed methods studies, where team members with quantitative and qualitative orientations may disagree about specific design issues, such as approaches to sampling or data collection. They may also have very different views about data analysis and integration across data sets. These differences pose challenges for each aspect of the study—the qualitative component, the quantitative component, and the mixed methods elements. For example, qualitative researchers may regard a standardized closed-ended questionnaire as inadequate to capture the full range of respondent experience or views and may advocate for alternative or supplemental forms of data collection. An iterative process of data collection and analysis is contrary

to quantitative methodological norms that data analysis cannot begin until data collection is complete. Quantitatively oriented members of the research team may question the validity of data collected with highly dynamic instruments and press for greater standardization. As one senior administrator for research reflects in Box 6.5, this heightened risk means that mixed methods researchers should set themselves a high bar for meeting quality standards.

Here we present several potential threats to quality that can occur in mixed methods studies. While this is far from an exhaustive inventory, these flaws are among the more common in our experience in the health sciences. We discuss threats to quality that arise from decisions related to sampling, data collection, analysis, interpretation, and presentation. For each topic, we present a potentially problematic design decision and then discuss the threats to quality that the decision may introduce into a mixed methods study.

Box 6.5 Setting a High Bar for Quality in Mixed Methods Research

Hold yourself and your team to the absolute highest standards possible. Don't do sloppy qualitative or quantitative research, and definitely don't just slap stuff together and call it mixed methods research because then that hurts the rest of the field.

—Dr. Jennifer Wisdom, MPH, PhD,
Associate Vice President for Research,
George Washington University

Design decision about sampling: *To conduct in-depth interviews with all members of a randomly selected, predefined sample of study participants enrolled in a large intervention trial*

Threats to quality: This sampling approach poses at least three threats to quality. First, the proposed design violates the guiding principle of sample selection in qualitative studies, which is that the sample must be purposeful rather than random in nature. Second, the sample size was defined a priori according to power calculations. This approach violates the principle guiding sample size determinations in qualitative studies: theoretical saturation achieved during data analysis. Defining the sample size in advance is not appropriate for a qualitative study, where data

collection and analysis should be carried out iteratively and the decision to stop enrolling respondents is made when the analysis indicates that saturation is met. Finally, unless carefully designed, this extensive qualitative data collection activity may be expensive, disruptive, and intrusive and also interfere with the trial in unanticipated ways.

Design decision about data collection: *To gather qualitative data via an open-ended item at the end of a quantitative survey in order to maximize efficiency in data collection*

Threat to quality: This approach is inconsistent with established practices of data collection in qualitative research. Primary forms of qualitative data collection include interviews, focus groups, various forms of visual observations, and document analysis.

Underpinning these practices are the principles that qualitative data collection, particularly for interviews, is a dynamic interchange between respondent and interviewer (a “guided conversation”; Lofland & Lofland, 1984). The interviewer uses a discussion guide to elicit narrative, with probes for clarification or additional depth, letting the respondent shape the pace and direction of the interview. Intonation, gestures, and body language are also important sources of data (and may be less accessible if interviews are conducted by phone). In addition to these fundamental concerns, there is the pragmatic reality that open-ended items in questionnaires or surveys are more likely to have higher skip rates (resulting in a greater possibility for response bias) since they take more time and effort on the part of the respondent. For example, consider that those with negative attitudes may find it more cumbersome to describe their opinions, and are therefore more likely to leave the question blank than those with neutral or positive attitudes. In addition, this format tends to yield very thin or limited data (often a few sentences as compared to pages of free flowing narrative from an interview or focus group), which may leave many unanswered questions that could have been addressed in a dynamic interaction. There is also a risk that qualitative results generated in this fashion might be interpreted to be generalizable when reported with

► For more information on types of qualitative data collection, refer to Table 7.3 in Chapter 7: Sampling and Data Collection in Mixed Methods Studies.

findings from the forced choice items, which is not an appropriate interpretation. Finally, participants' qualitative responses might be biased by the quantitative items, limiting the range of discussable topics and thereby making the two sources less independent from one another.

Design decision about analysis: *Premature merging of quantitative and qualitative data sets in convergent studies*

Threats to quality: The question of when and how to combine qualitative and quantitative data sets is relevant across all mixed methods designs. However, the temptation to immediately merge data may be greatest in studies with a convergent design. In these studies, researchers collect both qualitative and quantitative data simultaneously with either overlapping or distinct participant groups. In contrast to working within a sequential design framework, investigators using a convergent design are not forced to wait and conduct preliminary analysis on the first study component before proceeding to the next phase of data collection. Therefore, the risk of merging data sets too soon is of particular concern. As noted previously, investigators sometimes will *transform* qualitative data into quantitative data (e.g., development of counts or scales or overall scores) in order to facilitate merging with data from the quantitative component. Likewise, quantitative data may sometimes be transformed into qualitative data (e.g., profiling participants to create a verbal description of them). However, data transformation should follow independent analysis of qualitative and quantitative data sets using the standards of rigor discussed earlier in this chapter. Because this is an essential step in mixed methods work, skipping this first part of the analytic process dilutes the mixed methods potential of the project. Whether data collection occurs in a convergent or sequential manner, research teams should independently analyze qualitative and quantitative data initially prior to merging or connecting data sets for integrated analyses.

Design decision about interpretation: *Independent analysis of qualitative and quantitative data from different respondent groups yields divergent findings that are not addressed*

Threats to quality: Divergent results may emerge in multiple points—such as within and across respondent groups (patients and physicians),

or methods (interviews and surveys)—and should be addressed in data interpretation. In mixed methods in particular, we focus on divergence across the qualitative and quantitative findings. For instance, survey results from physicians might identify language barriers as the primary contributor to poor communication between physicians and patients. Yet interviews with patients might describe insufficient time and poor interpersonal interactions as the primary barriers. Possible reasons for and implications of this difference in perspectives must be explored and reported. Approaches to explaining divergent findings include gathering additional data from the full sample or a subsample, reanalyzing current data and reviewing the study procedures to determine possible threats to data quality.

► For more information on addressing divergence, refer to Chapter 8: Data Analysis and Integration in Mixed Methods Studies.

Design decision about presentation: *In a sequential design, quantitative and qualitative data are interpreted and presented as merged data instead of as exploratory or explanatory*

Threats to quality: Space limitations in journals and a desire for health sciences researchers to succinctly communicate findings in a timely way are two reasons why researchers sometimes make this mistake. In a sequential design, one study component (qualitative or quantitative) builds upon the study component preceding it. Therefore, the link or relationship between the two components is predetermined; the second component is intended to extend the knowledge acquired in the first component. However, researchers sometimes compare these data sets as they interpret and present their findings. Comparison of data sets is appropriate in a convergent design when merging data is a key integration step. When interpreting and presenting merged data, researchers are answering this question: To what degree do the quantitative and qualitative findings converge? In contrast, data sets in a sequential design require interpretation and presentation that reflects the “follow-up” nature of the second component. Researchers are answering this question: How do the quantitative results generalize (or support transferability) the qualitative findings (explanatory designs)? or How do the qualitative results explain the quantitative findings (exploratory designs)?

Summary and Key Points

- Defining quality in mixed methods research is essential to maximizing the contribution of these methods to research in the health sciences.
- Common standards of quality of both the qualitative and quantitative components of mixed methods studies include veracity, consistency, applicability, and neutrality. Criteria for appraising the degree to which these standards are met differ for qualitative and quantitative research.
- In addition to the standards for quality that apply to qualitative and quantitative research, multiple frameworks exist for appraising quality in mixed methods studies.
- A comprehensive appraisal of the quality of mixed methods studies includes six core domains of quality: (1) justification for mixed methods, (2) design quality, (3) adherence to respective standards for qualitative and quantitative research, (4) adherence to standards for data analysis in mixed methods, (5) quality of analytic integration, and (6) quality of interpretation and inference.
- Several types of potentially problematic design decisions are common in the health sciences (related to sampling, data collection, analysis, interpretation, and presentation) and may introduce threats to quality in a mixed methods study.

Review Questions and Exercises

1. Select two mixed methods articles from journals in your discipline and review them with a focus on common standards of quality and appraisal criteria for qualitative and quantitative studies (Figure 6.2). What was done well? What could have been done better? How do the articles differ in terms of quality?
2. Using the two articles, refer to the appraisal framework for quality in mixed methods studies outlined in Table 6.1. To what degree does each study meet the domains of quality in the framework?
3. Researchers must be aware of potential threats to quality when they are designing a mixed methods study. Working in a group, discuss the threats to quality that may affect a study you would like to conduct. What are some ways you can avoid these threats?

4. Review the following case vignettes, and discuss threats to quality and strategies to address these threats for each.

Case #1

Dr. A sought to evaluate an innovative clinical decision support tool for physicians and residents treating diabetic ketoacidosis being implemented system-wide across three hospitals. She was interested in the impact of the tool on adherence to core clinical guidelines as measured by error rates in the electronic medical record (EMR) system. She was also interested in experiences of doctors and residents using the tool including overall attitudes as well as sources of user resistance, frustration, and implications for their workflow. She considered a convergent mixed methods design to assess effectiveness (quantitative data on error rates for guideline deviation), acceptability (quantitative survey and qualitative data), and user experiences (qualitative data). In addition to reviewing guideline error rates in the EMR system, she planned to administer a web-based survey to a random sample of doctors and residents on 10 shifts in the emergency department in each of the three hospitals to gather quantitative and qualitative data (five doctors and residents from each shift, 50 doctors and residents per hospital; 150 total). In addition to usability and attitudinal quantitative scales validated in previous evaluations of clinical decision support tools, he proposed to collect qualitative data by inserting an open-ended question at the end of the survey to be completed by all respondents. This design poses several threats to quality, primarily in terms of the qualitative component.

Discuss how to address these threats to quality. Are there others?

- Improper selection of qualitative sample
- Unsuitable determination of qualitative sample size
- Inadequate qualitative data collection strategy

Case #2

Dr. B was interested in understanding the impact of a novel peer-based intervention for breast cancer survivors in remission on mental health and health behaviors. The intervention was designed to support patients in remission

transition out of intensive oncology care into follow-up care and to encourage patients to adhere to recommendations about diet and exercise. He proposed an intervention study with an embedded qualitative component to characterize attitudes about the usefulness of the support groups (qualitative focus groups) and to examine associations between support group participation and differences in mental health and health behaviors (standardized quantitative surveys, programmatic and clinical data). He planned to enroll 40 women total (20 in the intervention and 20 in the control group), based on feasibility issues given the number of patients available for recruitment at the hospitals in his network. The quantitative measures, to be gathered at three points during the six-month intervention, included standardized validated instruments to assess mental health and health behaviors in nutrition and exercise. In addition, he proposed focus groups (three groups with six participants in each for a total sample of 18), at the intervention midpoint (three months). For efficiency, he planned to administer the quantitative measures for the midpoint data collection at the conclusion of the focus groups since all participants would be onsite and available. This design poses several threats to quality in terms of both the quantitative and qualitative components.

Discuss how to address these threats to quality. Are there others?

- Inadequate and potentially biased quantitative sample
- Inappropriate qualitative data collection strategy

Case #3

Dr. C was interested in patient–provider communication in the context of primary care services for newly arrived refugees receiving care in refugee clinics. He wanted to understand the quality of communication from the perspectives of patients and providers, and because there was very little existing literature on this topic, he decided to conduct a mixed methods study that included a qualitative component that informed the development of a structured survey. He conducted in-depth interviews with patients and providers in several clinics in order to gain an understanding of range of experiences and attitudes regarding the quality of communication. He then used this information to develop questions and response options for a survey that aimed to measure patient and provider satisfaction with communication in the clinic setting. He

was careful to adhere to the respective standards for sampling, data collection, and analysis for the qualitative and quantitative components of the study. However, this study did not achieve integration during analysis and interpretation. Dr. C set out with a plan for qualitative data collection that included a specific number of interviews in a specific time, and then the team did the qualitative analysis and survey development after the interviews ended. Although integration was possible given the sequential design, two separate teams analyzed the data from the qualitative and quantitative components and published the results separately in two articles.

Discuss how to address these threats to quality. Are there others?

- Lack of iterative qualitative data collection process
- Inadequate handling of divergent results

References

- Aschengrau, A., & Seage, G. R. (2008). *Essentials of epidemiology in public health*. Sudbury, MA: Jones and Bartlett.
- Bradley, C. (1997). Qualitative vs. quantitative research methods. In Y. Carter & C. Thomas (Eds.), *Research methods in primary care* (pp. 31–39). Abingdon, Oxon, UK: Radcliffe Medical Press Ltd.
- Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative data analysis for health services research: Developing taxonomy, themes, and theory. *Health Services Research, 42*(4), 1758–1772.
- Bryman, A. (1988). *Quantity and quality in social research*. London, UK: Unwin Hyman.
- Bryman, A., Becker, S., & Sempik, J. (2008). Quality criteria for quantitative, qualitative and mixed methods research: a view from social policy. *International Journal of Social Research Methodology, 11*(4), 261–276.
- Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*(2), 81–105.
- Caracelli, V. J., & Riggin, L. J. C. (1994). Mixed method evaluation: Developing quality criteria through concept mapping. *Evaluation Practice, 15*(2), 139–152.
- Collingridge, D. S. (2013). A primer on quantitized data analysis and permutation testing. *Journal of Mixed Methods Research, 7*(1), 81–97.
- Cook, T. D. (1985). Postpositivist critical multiplism. In R. L. Shotland & M. M. Mark (Eds.), *Social science and social policy* (pp. 21–62). Beverly Hills, CA: Sage.
- Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues for field settings*. Boston, MA: Houghton Mifflin.

- Crabtree, B. F., & Miller, W. L. (1999). *Doing qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.
- Creswell, J. W. (1999). Mixed-method research: Introduction and application. In G. J. Cizek (Ed.), *Handbook of educational policy* (pp. 455–472). San Diego, CA: Academic Press.
- Creswell, J. W., Fetters, M. D., & Ivankova, N. V. (2004). Designing a mixed methods study in primary care. *Annals of Family Medicine*, 2(1), 7–12.
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage.
- Creswell, J. W., Plano Clark, V. L., Gutmann, M., & Hanson, W. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral health* (pp. 209–240). Thousand Oaks, CA: Sage.
- Denzin, N. K. (1978). *The research act: A theoretical introduction to sociological methods* (2nd ed.). New York, NY: McGraw-Hill.
- Denzin, N. K., & Lincoln, Y. (Eds.). (2000). *Handbook of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine.
- Gordis, L. (2009). *Epidemiology* (4th ed.). Philadelphia, PA: Elsevier/Saunders.
- Greene, J. C. (2007). *Mixed methods in social inquiry* (1st ed.). San Francisco, CA: Jossey-Bass.
- Guest, G. (2013). Describing mixed methods research: An alternative to typologies. *Journal of Mixed Methods Research*, 7(2), 141–151.
- Hannemann-Weber, H., Kessel, M., Budysh, K., & Schultz, C. (2011). Shared communication processes within healthcare teams for rare diseases and their influence on healthcare professionals' innovative behavior and patient satisfaction. *Implementation Science*, 6, 40. doi: 10.1186/1748-5908-6-40
- Heyvaert, M., Hannes, K., Maes, B., & Onghena, P. (2013). Critical appraisal of mixed methods studies. *Journal of Mixed Methods Research*, 7(4), 302–327.
- Horsburgh, D. (2003). Evaluation of qualitative research. *Journal of Clinical Nursing*, 12(2), 307–312.
- Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2013). *Designing clinical research* (4th ed.). Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Lofland, J., & Lofland, L. H. (1984). *Analyzing social settings: A guide to qualitative observation and analysis*. Belmont, CA: Wadsworth Publishing Co.
- Malterud, K. (2001). Qualitative research: Standards, challenges, and guidelines. *Lancet*, 358(9280), 483–488. doi: 10.1016/S0140-6736(01)05627-6
- Mays, N., & Pope, C. (2000). Qualitative research in health care. Assessing quality in qualitative research. *BMJ*, 320(7226), 50–52.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage.

- Morgan, D. L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research, 8*(3), 362–376.
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research, 40*(2), 120–123.
- Morse, J. M. (1999). Myth # 93: Reliability and validity are not relevant to qualitative inquiry. *Qualitative Health Research, 9*(6), 717–718.
- Morse, J. M. (2010). Procedures and practice of mixed method design: maintaining control, rigor, and complexity. In A. Tashakkori & C. Teddlie (Eds.), *SAGE handbook of mixed methods in social and behavioral research* (pp. 348). Thousand Oaks, CA: Sage.
- Morse, J. M., & Niehaus, L. (2009). *Mixed method design: Principles and procedures*. Walnut Creek, CA: Left Coast Press.
- Morse, J. M., & Richards, L. (2002). *README first for a user's guide to qualitative methods*. Thousand Oaks, CA: Sage.
- Morse, J. M., Wolfe, R. R., & Niehaus, L. (2006). Principles and procedures of maintaining validity for mixed-method design. In L. Curry, R. Shield, & T. T. Wetle (Eds.), *Improving aging and public health research: Qualitative and mixed methods* (pp. 65–78). Washington, DC: American Public Health Association.
- Murphy, E., Dingwall, R., Greatbatch, D., Parker, S., & Watson, P. (1998). Qualitative research methods in health technology assessment: A review of the literature. *Health Technology Assessment, 2*(16), iii–ix, 1–274.
- O’Cathain, A. (2010a). Assessing the quality of mixed methods research: Toward a comprehensive framework. In A. Tashakkori & C. Teddlie (Eds.), *SAGE handbook of mixed methods in social and behavioral research* (2nd ed., pp. 531–555). Thousand Oaks, CA: Sage.
- O’Cathain, A. (2010b). Stakeholders relevant to the assessment of the quality of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *SAGE handbook of mixed methods in social and behavioral research* (pp. 533). Thousand Oaks, CA: Sage.
- O’Cathain, A., Murphy, E., & Nicholl, J. (2007). Integration and publications as indicators of “yield” from mixed methods studies. *Journal of Mixed Methods Research, 1*(2), 147–163.
- O’Cathain, A., Murphy, E., & Nicholl, J. (2008). The quality of mixed methods studies in health services research. *Journal of Health Services Research and Policy, 13*(2), 92–98. doi: 10.1258/jhsrp.2007.007074
- Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the schools, 13*(1), 48–63.
- Onwuegbuzie, A. J., & Leech, N. L. (2007). Validity and qualitative research: An oxymoron. *Quality and Quantity, 41*(2), 233–249.
- Onwuegbuzie, A. J., & Teddlie, C. (2003). A framework for analyzing data in mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 351–384). Thousand Oaks, CA: Sage.
- Padgett, D. (2012). Strategies for rigor. In *Qualitative and mixed methods research in public health* (pp. 203–220). Thousand Oaks, CA: Sage.

- Patton, M. Q. (1990). *Quality evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage.
- Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.
- Pluye, P., Gagnon, M. P., Griffiths, F., & Johnson-Lafleur, J. (2009). A scoring system for appraising mixed methods research, and concomitantly appraising qualitative, quantitative and mixed methods primary studies in mixed studies reviews. *International Journal of Nursing Studies*, 46(4), 529–546. doi: 10.1016/j.ijnurstu.2009.01.009
- Pluye, P., Grad, R. M., Levine, A., & Nicolau, B. (2009). Understanding divergence of quantitative and qualitative data (or results) in mixed methods studies. *International Journal of Multiple Research Approaches*, 3(1), 58–72.
- Polit, D. F., & Beck, C. T. (2010). Generalization in quantitative and qualitative research: Myths and strategies. *International Journal of Nursing Studies*, 47(11), 1451–1458. doi: 10.1016/j.ijnurstu.2010.06.004
- Sale, J. E. M., & Brazil, K. (2004). A strategy to identify critical appraisal for criteria for primary mixed-methods studies. *Quality and Quantity*, 38(4), 351–365.
- Sandelowski, M. (2000). Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Research in Nursing and Health*, 23(3), 246–255.
- Sandelowski, M., Voils, C. I., & Knafl, G. (2009). On quantizing. *Journal of Mixed Methods Research*, 3(3), 208–222. doi: 10.1177/1558689809334210
- Steckler, A., McLeroy, K. R., Goodman, R. M., Bird, S. T., & McCormick, L. (1992). Toward integrating qualitative and quantitative methods: An introduction. *Health Education Quarterly*, 19(1), 1–8.
- Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks, CA: Sage.
- Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.
- Teddlie, C., & Tashakkori, A. (2006). A general typology of research designs featuring mixed methods. *Research in the Schools*, 13, 12–28.
- Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. Thousand Oaks, CA: Sage.
- Tufford, L., & Newman, P. (2012). Bracketing in qualitative research. *Qualitative Social Work*, 11(1), 80–96.
- Wisdom, J. P., Cavaleri, M. A., Onwuegbuzie, A. J., & Green, C. A. (2012). Methodological reporting in qualitative, quantitative, and mixed methods health services research articles. *Health Services Research*, 47(2), 721–745. doi: 10.1111/j.1475-6773.2011.01344.x