Mixed Methods Research to Advance Nephrology

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There are problems in medicine that are incompletely understood because they are difficult to define, observe and consequently, rigorously study. Quantitative methodologies collect and analyze numerical data to forecast probabilities, test hypotheses and create generalizable knowledge about a phenomenon. However, some phenomena do not fit neatly into numerical measures, information gained on the basis of verifying or rejecting pre-specified hypotheses can be limited, and generalizations applicable to a broad population may be relatively superficial. Qualitative methodologies collect and analyze artifacts from individuals who experience a phenomenon to construct rich descriptions, hypotheses and theoretical explanatory frameworks about the phenomenon. At the same time, qualitative data is not objective, can vary in content and breadth across cases limiting comparability and categorization, and may lead to conclusions that are not representative of the experiences of the broader population. Mixed methods research combines elements of quantitative and qualitative methodologies in an effort to leverage their unique strengths and counterbalance their respective limitations. This article provides a concise overview of mixed methods research, highlighting the general forms and functions of mixing quantitative and qualitative methodologies, and concludes with an example from the nephrology literature to illustrate its application.

A new binary of classical methodologies

Quantitative and qualitative methodologies are generally recognized by their distinctive properties with respect to underlying paradigms, scope of scientific inquiry, sampling strategy, data collection and analytical approach (Table). Nonetheless, quantitative and qualitative methodologies are inherently complementary. Each methodology can be used to triangulate
and optimize the meaningfulness of information derived from the other approach and facilitate a more nuanced understanding of phenomena in ways that a single standalone approach may be limited.

Mixed methods research innovatively combines features of quantitative and qualitative methodologies into the *same* study. It emerged as a pragmatic solution to answering scientific questions that cannot be sufficiently addressed using only one methodology or the other.¹ Despite the increasing popularity of mixed methods research in medicine, there is still little consensus around terminology, techniques and standards for mixing methodologies to guide its conduct, reporting and appraisal.² Rather than resolve the ongoing academic debate, this article offers simplified and practical descriptions of mixed methods research practices in an effort to make them more accessible to readers.

**Demystifying mixed methods**

The combination of quantitative and qualitative methodologies in mixed methods research occurs at the levels of study design, sampling, data collection and/or data analysis. Study designs may take several different structures.³ A mixed methods study may use quantitative and qualitative methods *simultaneously* in which both methods are used at the same time, *sequentially* in which one method is used after the other, or *cyclically* in which one method is repeated after the other is completed (e.g. phenomenological interviews on quality of life to inform development of a questionnaire that is then interrogated using cognitive interviews). A study design may also use both methods *equally* in which both methods are given equal weight or *hierarchically* in which one method serves as the primary method and
the other as the secondary (e.g. randomized controlled trial with nested qualitative study of participants who received the intervention).

At the sampling stage, techniques related to probabilistic sampling with quantitative methods are typically applied to purposeful sampling with qualitative methods rather than vice versa. The intent of this combination is not to increase the generalizability of the findings of qualitative work but to aid in the identification of information-rich cases for qualitative inquiry. For instance, criterion or intensity sampling incorporates quantitative data to identify unique clusters of cases for qualitative inquiry (e.g. cases selected based on extreme scores on an instrument). Random purposeful sampling is the random selection of cases when there is a large pool of potential cases who fulfill the criteria for purposeful selection but no obvious reason to choose one case over another. Stratified purposeful sampling is the selection of cases that vary on a preselected parameter for qualitative inquiry (e.g. selecting cases from each of the different racial groups).

The focal point of most mixed methods research is the combination of quantitative and qualitative methodologies at the data collection stage. Combinations at this level may be classified into three general orientations. Features of quantitative and qualitative methodologies may be used in parallel to collect data on distinct but related aspects of the same phenomenon (e.g. standardized surveys on patient care satisfaction and ethnographic field notes of medical encounters to assess patient-provider interactions). Features of each methodology may also be used interactively to enrich, expand upon, explain or triangulate data collected (e.g. open-ended interview responses that give meaning to numerical questionnaire responses). Features can also be integrated to create new data. Namely, qualitative data may be transformed or quantitized into measurable units to support statistical
analyses (e.g. degree and severity of fibrosis on a kidney biopsy sample is enumerated into a score). Conversely, quantitative data may be \textit{qualitized} or transformed into complex narratives (e.g. combination of scores on different psychological and behavioral scales are developed into a rubric of personality profiles).

In parallel and interactive approaches, because quantitative and qualitative data are collected using different tools, each data type is also treated and analyzed separately. That is, quantitative numerical data are analyzed using quantitative techniques; and qualitative data, using qualitative techniques. The results of quantitative and qualitative analyses are then converged at the interpretive stage. However, in mixed method studies using integrated approaches of mixing quantitative and qualitative methodologies, data collection and analysis occur simultaneously to enable transformation of one data type into the other.

\textbf{An illustrative example}

While it is relatively straightforward to track receipt of dialysis using administrative records, circumstances under which dialysis might have been indicated but was not pursued are not as easily observed or as well understood. In a retrospective cohort study of a national sample of 28,568 patients with advanced kidney disease receiving care in the Veterans Affairs (VA) health system between 2000-2011, a mixed methods analysis was innovatively used to ascertain the treatment decisions made for patients who did not receive dialysis. First, linked data from the United States Renal Data System (USRDS)--a national registry on dialysis and kidney transplant—and dialysis procedure code search of VA and Medicare treatment files were used to identify cohort members who had received renal replacement therapy (n=19,165). For remaining cohort members (n=9403), a random 25\% sample stratified by calendar year
and service region was selected for qualitative analysis of their national VA electronic medical record to ascertain their treatment status with respect to dialysis at most recent follow-up. On the basis of documentation in clinical progress notes, cohort members selected for chart review were classified into three mutually exclusive groups: those who had in fact received dialysis but that this was not captured in administrative records, those who were preparing for and/or discussing dialysis but had not started dialysis at most recent follow-up, and those in whom there had been a decision not to pursue dialysis. Further multivariable regression analyses were performed to determine patient characteristics and patterns of end-of-life care associated with each treatment group.⁹

This example demonstrates a sequential use of qualitative then quantitative methodologies, randomized and stratified purposeful sampling and transformation of unstructured qualitative data reflecting treatment decisions for advanced kidney disease documented in progress notes into quantitative data (Figure). Using mixed methods, this study was able to shed light on a poorly recognized group of patients with advanced kidney disease and describe national trends on care practices for patients not treated with dialysis.

At the same time, in rendering qualitative data into quantitative data, valuable information is lost. Decision-making for dialysis is a dynamic and multi-dimensional process that unfolds over time. Flattening and partitioning this process into a manageable number of categories do not do justice to the diversity of experiences that occur with decision-making around dialysis. A dedicated post-hoc qualitative analysis of the subgroup of patients in whom there was a decision to forgo dialysis provided a far more granular and nuanced account of how decisions unfolded for this group.¹⁰ Qualitative analysis of the medical record of patients revealed that preferences for dialysis could change over time. When patients
expressed a preference to forgo dialysis, it was often met with great resistance by clinicians. It was also sometimes unclear whether decisions were driven by patients or their clinicians, especially when clinicians viewed certain patients not to be candidates for dialysis. While the mixed methods study provided a more complete picture of treatment practices for advanced kidney disease than a quantitative study of administrative records would have, it is still relatively coarse as compared with what the qualitative study produced.

In summary, mixed methods research combines elements of quantitative and qualitative methodologies to enable the study of phenomena through multiple perspectives and data sources. It is used to address scientific questions that cannot be sufficiently answered with quantitative or qualitative methodologies alone, but it cannot take the place of either and is best regarded as a useful addition to the toolbox of resources available to nephrology researchers.

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References

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1 Empiricist and positivist paradigms pertain to knowledge that is based on objective reality and independent of personal values; interpretivist and constructivist paradigms pertain to knowledge and meaning gained through personal interaction and subjective interpretation and reasoning.

2 Probabilistic sampling is the random selection of cases that lead to a sample that is representative of the population from which the sample is drawn; purposeful sampling is the non-random selection of cases on the basis of whether cases can provide diverse and rich information.
Figure. An illustrative example of a mixed methods study. This retrospective cohort study demonstrates a sequential use of qualitative then quantitative methodologies, randomized and stratified purposeful sampling and transformation of unstructured qualitative data reflecting treatment decisions for advanced kidney disease documented in progress notes into quantitative data.
Retrospective cohort study of patients with advanced kidney disease

Treated with renal replacement therapy

Not treated with renal replacement therapy

• Random and stratified purposeful sampling
• "Quantification" of documented treatment decision in progress notes

Received dialysis
Preparing for/discussing dialysis
Decision against dialysis

Differences in care practices

Multivariable regression models