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Mixed Methods Research in Public Health: Theoretical Underpinnings and Practical Applications

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Mixed Methods Research in Public Health: Theoretical Underpinnings and Practical Applications

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Abstract: Currently, public health researchers are investigating several complex and multi-faced health problems that require mixed-method approaches (MMA) to clearly understand problems and design proper intervention approaches and policy formulation. Besides, a comprehensive comprehension of the complex operation of society is vital. The MMA helps in having a broader understanding of the functioning and structure of the community at large. MMA deliberately integrates qualitative and quantitative approaches carefully to build on the merits of each other and confirm that the findings of research are closer to the truth. Therefore, public health scholars must have an excellent comprehension of the MMA and its philosophical foundations for discovering the complex conditions that challenge public health nowadays. However, public health researchers do not clearly understand the theoretical underpinnings and practical application of MMA, despite its popularity in developing countries. Therefore, this article aimed to provide comprehensive evidence on the theoretical underpinnings and practical application of MMA.

Keywords: mixed methods research; public health; design; integration; philosophy

History of methodological debates in public health

Public health has mainly followed a positivist paradigm based on one of its' quantitative disciplines, epidemiology (1). The positivism approach reflects that societies, like the physical globe, function based on overall laws like Newton's Law of Gravity, and the understanding that results from the confirmed data obtained via the sense organs is the experimental evidence (2). This quantitative approach, or epidemiology, has helped public health in defining health concerns (what) and calculating the size of health-related problems based on place, person, and time; features (where, who, and when); and assessing the causes of these concerns (how and why) in the past. Though, at the end of the 20th century, the development of social medicine (3) directed to a paradigm shift, and now social epidemiology has appeared (4).

The non-positivist methodology was developed to comprehend the multifaceted social occurrences associated with human behavior. The qualitative method has increased in popularity as a valid technique for understanding the 'social truth' as it happens. The qualitative method aims to advance an in-depth comprehension of social phenomena (5).

Presently, quantitative and qualitative methods are frequently mixed (5). This has raised difficulties in the perceptions of investigators (5, 6). One can be surprised at how these two methods that follow various logics, which are qualitative and quantitative and based on inductive and deductive logic, can be combined to make valid inferences. As truth is complex, no single approach can explain its nature completely. The dialectic approach, which has been fundamental to Indian philosophies since ancient times, can be utilized to resolve the inherent paradox between the qualitative and quantitative approaches. Also, in the western world, the philosophies of dialectics, as explained by Marx, Angels, and Hegel, reflect interactions and interrelations as intrinsic in all fields and shape the comprehension that the conflict acts as a driving force for the revolution, finally directing change (7, 8).

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The quantitative research approach has prevailed for a long time in public health but has recently been followed by some qualitative research studies. At the end of the 20th century, validation for utilizing the mixed design method had become the norm in most social science fields (9). Though a mixed research approach has infrequently been investigated in public health (10-14). A partial combination of qualitative and quantitative approaches has been utilized for the triangulation of findings (15). Now there is overall approval that the mixed research approach is a universal method that investigators can utilize for probing responses to complex queries. It has been comprehended that mixed research approaches are vital for the initiation, expansion, and development of new concepts in public health (16).

Also, in social research, there is substantial argument about whether quantitative and qualitative methodologies should, or even should, be mixed. Some claim that the methods' philosophical and methodological foundations are so different that they cannot be effectively combined. Others, while acknowledging the two paradigms' extremely different epistemological and ontological foundations, argue that combining the two sorts of evidence might be beneficial. The opportunity for merging quantitative and qualitative research is great. Many authors have suggested helpful frameworks for maximizing the strengths of the 2 methods (17-19).

Instead of debating whether qualitative or quantitative approaches are better for public health research, the focus of this seminar is on how to conduct research to address issues that require a combination of methods. In today's complicated world, where policy decisions affect the health of a several people, both quantitative and qualitative methodologies must be considered at times to gain a thorough comprehension of the public health concern at hand.

Methodological approaches in research

There are three methodological approaches to research. The first approach is called a mono-methodological approach, which uses a single research method and can be a quantitative or qualitative design. The second approach is a multi-methods approach that utilizes multiple methods from the same paradigm (two or more quantitative or qualitative designs). The third approach is a mixed-methods approach, which uses a combination of quantitative and qualitative designs (20-23). The main focus of this seminar is on the third research methodological approach.

Definition of mixed methods research (MMR)

There are many definitions of mixed methods research, according to Johnson's review, with over nineteen different meanings (17). Some important alternate names for the third methodological revolution, practical and intellectual synthesis, are integrative research, blended research, multiple methods, multi-method research, mixed research, and triangulated studies. The larger phrase mixed research, as opposed to integrative research, has the advantage of not implying a drawback of mixing approaches exclusively. Johnson proposes the following definition after reviewing and evaluating nineteen definitions from notable mixed-methods researchers: Mixed methods research is a kind of research in which a researcher or team of researchers links elements of quantitative and qualitative research methods (e.g., use of quantitative and qualitative perspectives, data collection methods, analysis, and conclusion methods) for the broad and deep purposes of understanding and corroboration. Mixed approaches are becoming more common in public health and are being employed in a variety of ways by researchers (24).

Differences between the MM and multiple methods research

The two terms are often mistakenly used interchangeably and overlap, but they are not synonyms. The basic difference is whether qualitative and quantitative data are collected to answer single research questions or not. The MMR is employed when qualitative and quantitative data are used together to answer a single research question. In contrast, a single study that contains qualitative and quantitative data to answer different research questions is called multiple methods research. The

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MMR is pragmatic, whereas multiple methods research is either positivist or non-positivist in terms of philosophical origin (25, 26).

Philosophical position of MMR

What philosophy of science, or set of philosophical perspectives, will complement mixed-methods research the best? Constructivism is associated with qualitative research, whereas post-positivism is associated with quantitative research. Thus, pragmatic researchers use mixed methodologies, allowing the nature of the study problem to influence the methods used for each research project. Today, pragmatism is the dominant philosophy of mixed research. Mixed methods researchers employ, and frequently make explicit, a range of philosophical orientations that bridge post-positivist and social-constructivist perspectives, pragmatic perspectives, and transformative worldviews (17-19). Mixed-methods research, for example, may be difficult for researchers who hold opposing philosophical views due to the tensions caused by their differing ideas (27). However, mixed-methods research offers the possibility of transforming these pressures into new understandings via dialectical discovery. A pragmatic viewpoint is based on doing "what works," applying many methodologies, emphasizing the significance of the research question and problem, and valuing both subjective and objective knowledge (28). A transformative viewpoint proposes a familiarizing framework for mixed-methods research based on the goal of establishing a more equitable and democratic society, which pervades the entire research process, from the problem through the findings and the use of results (29).

Key assumptions and benefits of MMR

There are several assumptions and benefits of MMR based on the arguments of different authors (17-19, 27-29).

Triangulation means looking for corroboration and convergence of findings from diverse methods examining the same phenomenon.

Complementarity means seeking illustration, elaboration, clarification, and enhancement of the findings from one method with those from the other method.

Development means using the findings from one method to support information from another method.

Initiation means discovering contradictions and paradoxes that direct to a reframing of the research question.

Expansion means seeking to expand the range and breadth of inquiry by using diverse methods for diverse inquiry components.

When do we need MMR or should be used?

The following situations may be essential in necessitating mixed-methods research (5, 30-32):

- The phenomenon under investigation's complexity;
- When the study goal necessitates both depth and breadth of comprehension; when both qualitative illuminations and quantitative generalizations are necessary;
- When the necessity for method mixing develops from experiencing conditions (seen gaps) after a research has already begun;
- When the necessary set of skills, knowledge, and funds are made accessible for the research's effective and proper execution.
- Problems appropriate for mixed methods research.
- When the reasons for employing mixed approaches are clear.

Models for MMR

The models for undertaking MMR can be classified based on different parameters. There are several mixed-technique designs available. Any of the following designs or models can be employed, depending on the sort of research topic: The mixed-method study designs listed below are not intended to be exhaustive but rather to be representative of numerous methodologies that have been employed in health science research (5, 30-33).

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Major MMR designs based on timing

The major MMR designs based on timing can be classified into five categories: concurrent, sequential, transformative, embedded and multiphase models.

1. **Concurrent or parallel or convergent design**

During the data gathering stage, there is little contact between the two data sources, but the results complement each other. The quantitative and qualitative data are collected continuously, side by side. The investigator mixes quantitative and qualitative research when the goal is to combine concurrent qualitative and quantitative data to address study objectives. This is referred to as a concurrent design. For example, to better understand participants' experiences with a health promotion plan, an investigator might collect qualitative individual or group interview data as well as quantitative correlational data and mix the two. Data analysis involves combining data and comparing the two sets of data and outcomes.

2. **Sequential design**

When the results of one method are required for designing the next procedure, sequential triangulation is used. The design requires that data for one paradigm be collected and processed first in order to aid in the direction and execution of the other technique. It can be exploratory sequential or explanatory sequential. The latter is a popular technique in the health sciences, in which qualitative data serve to explain in greater depth the means underlying quantitative outcomes. Another frequent strategy is to begin with qualitative data collection, then create a quantitative instrument based on the qualitative findings, and then administer the tool to a population sample.

3. **Transformative design**

A third model that appears in both the concurrent and sequential models. Sequential transformative models and concurrent transformative are available, and this is defined as one that is explicitly devoted to a theoretical lens (e.g., gender, race theory) to address social justice issues.

4. **Nested or embedded design:** In the health sciences, a common design is to utilize qualitative and quantitative approaches in tandem, embedding one in the other to generate fresh insights or more refined thinking. These are known as nested or embedded designs. They could be sequential or convergent design variations. To comprehend how experimental members feel about the treatment, a prototype would be to perform intervention research and include qualitative data in the intervention methods. Prior to the intervention, qualitative data may be used to inform strategies for best recruiting individuals or developing the intervention, throughout the experiment to study the procedure being experienced by members, or after the experiment to follow-up and well comprehend the quantitative results.
5. **Multiphase design:** A multiphase design comes from a series of projects that are connected by a shared goal. These are known as multiphase projects, and they are commonly employed in the health sciences. They frequently contain convergent and sequential parts. The ultimate goal, for example, could be to test, evaluate, implement, and develop a health preventive program for teenagers. Multiple projects, one quantitative, one qualitative, one mixed, and so on, must be carried out throughout the period with contacts in place; hence, one phase builds on another with the shared end goal of establishing and testing a health prevention program.

Major MMR designs based on weight

The major MMR designs based on weight can be classified into three namely qualitative dominant, quantitative dominant and equal statuses MMR.

1. **Qualitative dominant MMR**

It is qualitative + quantitative research but qualitative features dominate over quantitative methods. This paradigm would suit qualitative or mixed methods researchers who believe it is critical to incorporate quantitative data and procedures into otherwise qualitative research initiatives.

2. **Quantitative dominant MMR**

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It is quantitative + qualitative research but quantitative features dominate over quantitative methods. The paradigm is ideal for mixed methods or quantitative researchers who believe that incorporating qualitative data and procedures into otherwise quantitative research endeavors is essential.

3. Equal status MMR

It is quantitative + qualitative ore qualitative + quantitative research in which both quantitative and qualitative features equally demonstrated. What in an ideal world "Pure MMR" would like.

How should the methods be balanced?

Using many approaches to get information is usually beneficial, but it is not always practicable or acceptable. As a result, a researcher should always make decisions regarding the appropriate information balance depending on the type and significance of their research issue, the availability of funding and other resources to carry out the study, and the relative utility of the data. The data gathered should always be of "manageable interest" to the researcher. In general, there is no defined formula for determining the balance of different methods; rather, it will be influenced by the numerous criteria stated above (19, 30, 34).

Is MMR often better?

Not at all! It all relies on what you need to examine, what your primary research questions are, and how much value the additional approach will offer to data quality. More may not always imply superiority. It should be mindful work to employ a secondary approach to fill the gap left by the primary one (19, 34).

Sampling methods and sample size issues in MMR

Determining sampling strategies and sample sizes is a critical element in every scientific investigation. The choice of sample design in a mixed-methods approach is determined by the research question. There are nearly 24 sampling strategies accessible for doing MMR (35). Six of these are probabilistic schemes, whereas the remaining 18 are nonprobability schemes. It is important to recall that nonprobability sampling is commonly utilized in qualitative research, whereas probability sampling is the strength of quantitative studies. There are 35 sample systems based on MMR designs, such as sequential, concurrent, and so on. However, the literature on MMR approaches argues for following the stages emphasized to choose the sample plan. The first step is to choose the research goal, which is followed by identifying the research purpose, research objectives, research design, research question, and finally the sampling scheme.

The sample size varies according to the research topics and research design. Statistical methods are used in quantitative research to calculate sample size, or the number of units that can represent the population, by taking into account the variability in the estimate of interest as well as the chance of accepting the null hypothesis when it should not be accepted. The sample size in qualitative research is determined by the 'saturation' of information.

For example, while doing FGDs or in-depth interviews, one stops carrying out more FGDs or interviews when no new material is emerging, indicating that 'saturation' has occurred. The sample size for mixed method research is determined as the minimal sample size required for both qualitative and quantitative research (35). A recent review publication (36) gave sample criteria for MMR.

A tentative typology of mixed method sampling has been dubbed concurrent, basic, multilevel, sequential, and multiple sampling based on the four mixed method designs. Using purposive sampling, the researcher separates the groups into strata (for example, above average, below average, average, etc.) and then picks a few cases for in-depth examination within each stratum. In the sequential sampling technique, quantitative sampling can lead to qualitative sampling, or qualitative sampling can lead to quantitative sampling. The study question inspires the development of a sequential mixed technique, and one approach leads to the next. There are numerous examples of

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this sample strategy being employed in the literature on MMR in health (37). Although there are few examples of concurrent sampling techniques in which both samples (quantitative and qualitative) are chosen independently to satisfy the needs of the investigation. This sample strategy has also yielded positive results. Also, in multilevel sampling, districts can be chosen at random, but probability sampling can be used to choose health institutions such as sub-centers (38).

Data combing methods in MMR

Several authors have mentioned three approaches in the literature, which are described below as follows: (33, 39).

1. **Merging data:** This integration entails merging qualitative data in the kind of images or texts with quantitative data in the form of numerical data. This combination can be attained by reporting findings in a study's discussion section together, for example, reporting quantitative statistical data first, followed by qualitative statements or themes that support or dispute the quantitative results. This integration can also take place by using tables or figures that display both quantitative and qualitative findings.
2. **Connecting data:** This integration entails assessing one dataset, which is a quantitative survey, and then using the results to inform further data gathering (e.g., interview questions, participant identification). The integration occurs in this manner by combining the analysis of outcomes from the first phase with data gathering from the subsequent phase of the study.
3. **Embedding data:** In this type of integration, a secondary dataset is integrated within a superior, primary design. A collection of extra-qualitative data regarding how members experience an intervention during an experimental study is one example. Alternatively, qualitative data collection may go before an experimental test to inform method development or follow an experimental trial to help explain trial results.

Why mixed methods or strengths of MMR?

There are different reasons that necessitate conducting mixed-methods research (5, 30-32) and are described as follows: Any research normally employs numerous data gathering methods in order to increase the validity and reliability of the information collected. Because all data gathering approaches have strengths and limits, other ways are used to triangulate and validate the information to overcome the constraints of the specific methods. Mixed-methods research also aids in reducing bias caused by measurement errors like interviewer error, instrumental error, and interpretation error. Researchers can aim to overcome the weaknesses or inherent biases and issues associated with single technique, single observer, and single theory investigations by mixing many theories, observers, methods, and empirical materials.

Also, pictures and narratives from qualitative data add meaning to numbers, whereas numbers from quantitative data add exactitude to pictures and narratives. A wide range of research questions can be answered using MMR. There is the strongest evidence for conclusions and suggestions due to the corroboration and convergence of findings from a MMR. Understandings that can be lost in a single method are brought to light in a MMR.

Limitations of MMR

Methodological difficulties that must be foreseen arise. These methodological concerns have been explained in detail in various works and are as follows (30, 39, 40):

- **Resources:** Because different types of data are collected and evaluated, mixed methods research necessitates a significant amount of time and resources to complete the many phases involved in MMR, comprising the time needed for data collection and analysis.
- **Teamwork:** Diverse methods for a study, as well as diverse writing styles, may emerge in interdisciplinary, multidisciplinary, and transdisciplinary cooperation. The challenges and rewards of a team approach to mixed methods research must be anticipated by team leaders.
- **Word and pages limitations:** Regardless of existing NIH page limits, scientists must defend their approaches in a high-quality MMR. Space can be saved by organizing information into a table

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or showing a figure of the mixed-methods techniques. Page and word limits also have an impact on the publication of MMR in scholarly journals, since word limits necessitate inventive ways of presenting material.

- **Sampling issues:** As discussed above in this seminar.
- **Analytic and interpretive issues:** When employing specific designs, problems arise during data processing and interpretation. The findings may clash or be inconsistent when the investigator integrates the data throughout a parallel design. A method for resolving disagreements, such as acquiring more data or reviewing the databases, must be considered. The primary challenges for designs utilizing a sequential design with one phase succeeding the other revolve around the "point of interface," in which the investigator must pick what findings from the first stage will be the focus of emphasis for the follow-up data collection. Making an interpretation based on integrated results may be difficult due to the investigator's or teams unequal attention to each dataset, the validity or accuracy of each dataset, and whether philosophies are related.

Practical applications of MMR approach in public health

MAXQAD 2020 software is used to analyze quantitative, qualitative, and mixed-methods data, particularly data-based integration. I will demonstrate linking qualitative and quantitative data, analyzing variable values and code frequencies, and joint displays (crosstab, quote matrix, document map) using MAXQAD 2020 software. Some of the qualitative and quantitative data analysis methods are shown in Table 1.

Table 1. Some of quantitative and qualitative data analysis methods.

Analysis of qualitative data	Analysis of quantitative data
Data import: texts, PDFs, tables, videos, webpages, social media…	**Descriptive statistics:** Frequency tables Charts: bar charts, boxplots, histograms
Data exploration: search for words and word combinations, memos, comments, paraphrases,	Crosstabs and correlation
Data analysis: coding, memoing, writing summaries, visual tools…	**Inferential statistics**: Analysis of variance, chi-square test, correlation
Reporting: visual tools, exports	

Method of integration of quantitative and qualitative data

There are three methods of quantitative and qualitative data integration. Sequence-based integration takes place in sequential design and drives the data collection (for example, the case selection) or the development of an interview guide or questionnaire. Data-based integration requires quantitative and qualitative data in at least some cases. Results-based integration is possible in any MMR. Methods of integration of quantitative and qualitative data are shown in Figure 1.

Conclusions

An understanding of the functions and structures of society at large is necessary for public health because it deals with a variety of complex situations, from policy design to intervention delivery. A MMR approach aids in this understanding by rigorously integrating quantitative and qualitative methods to ensure that the findings are robust. Thus, MMR carefully integrates quantitative and qualitative methodologies to rely on each other's strengths to ensure that study outcomes are more realistic. As a result, public health researchers must comprehend the MMR, including its definitions, philosophical roots, methodological debates, designs, sample size calculation, sampling methods, data analysis, and interpretation, in order to investigate the complex issues that challenge public health today. Though MMR involves some limitations, as does any technique, this approach gives the researchers better evidence to use in order to solve public health problems. The results-based integration or triangulation method is most frequently used to combine the findings of the public health research.

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