Using framework analysis methods for qualitative research

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Using framework analysis methods for qualitative research: AMEE Guide No. 164

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ABSTRACT

Framework analysis methods (FAMs) are structured approaches to qualitative data analysis that originally stem from large-scale policy research. A defining feature of FAMs is the development and application of a matrix-based analytical framework. These methods can be used across research paradigms and are thus particularly useful tools in the health professions education (HPE) researcher's toolbox. Despite their utility, FAMs are not frequently used in HPE research. In this AMEE Guide, we provide an overview of FAMs and their applications, situating them within specific qualitative research approaches. We also report the specific characteristics, advantages, and disadvantages of FAMs in relation to other popular qualitative analysis methods. Using a specific type of FAM—i.e. the framework method—we illustrate the stages typically involved in doing data analysis with an FAM. Drawing on Sandelowski and Barroso's continuum of data transformation, we argue that FAMs tend to remain close to raw data and be descriptive or exploratory in nature. However, we also illustrate how FAMs can be harnessed for more interpretive analyses. We propose that FAMs are valuable resources for HPE researchers and demonstrate their utility with specific examples from the HPE literature.

KEYWORDS

Qualitative research; qualitative methods; qualitative analysis; framework method; framework analysis

Introduction

There are many different qualitative research methodologies and methods for health professions education (HPE) researchers to choose from, each tailored to unique purposes. Are you interested in developing a new theory about workplace-based learning? You might reach for constructivist grounded theory (e.g. Helmich et al. 2018). Are you interested in exploring the lived experience of shame in medical training? You might turn to hermeneutic phenomenology (e.g. Bynum et al. 2021). Most qualitative research methodologies—including constructivist grounded theory and hermeneutic phenomenology—harness the power of interpretation to deeply understand or explain a phenomenon. Such *interpretive* (see Table 1 for a glossary of key terms) qualitative research (Finlay 2021) often relies on small datasets. Smaller data sets enable analyses that involve iteratively reading and re-reading the corpus of study data, discussing evolving understandings with the research team, again and again in a cyclical fashion, to develop research insights.

However, sometimes our reasons for engaging in qualitative research are more directed. Sometimes the study is aimed towards fulfilling specific pre-determined information needs; this focus narrows the scope of data collection and analysis. In these situations, pre-existing theories, models, or evidence from the literature can direct data collection and the choice of analysis methods. For example, this is frequently the case in implementation and process evaluation studies (Klingberg et al. 2021; Draper et al. 2022). In qualitative studies that involve such directed goals, researchers often collect large datasets and engage in more focused and structured data analysis (Davidson et al. 2019). HPE researchers engaging in this kind of research might usefully rely on a *framework analysis method* (FAM). Rather than working *inductively* from the data towards abstract interpretation, FAMs often employ a *deductive* approach, and so begin with pre-set

Practice points

- Framework Analysis Methods (FAMs) are a family of data analysis approaches aimed at answering specific questions using large qualitative datasets.
- FAMs can be used across research paradigms ranging from post-positivist to interpretivist.
- FAMs can be used for both descriptive and exploratory qualitative research.
- Several different approaches to FAMs exist, but they all rely on a systematic and by-case structured data coding process, are applied to relatively homogeneous datasets, aim to capture and describe patterns in qualitative data, and typically express findings in a matrix.

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Table 1. Glossary of qualitative terminology.

Term	Explanation
Data transformation	Data transformation refers to the nature of qualitative findings or the output of qualitative data analysis in terms of what Sandelowski and Barroso (2003) call the 'interpretive distance' from raw data. The distance grows through processes like theorizing, abstraction and interpretation, whereas output that remains close to, or merely describes the content of, raw data can be considered as not having undergone data transformation, or indeed, much analysis at all.
Deductive data analysis	Deductive data analysis involves reasoning from general rules (e.g. theories, models) to infer what is happening in specific instances (e.g. in specific datasets). For example, a theory might exist that explains how medical students who live in poverty experience high levels of stress, and that high levels of stress lead to experiences of imposter syndrome. Therefore, we might use these theories to study a large number of medical students to see if imposter syndrome in medical students is related to poverty. As this example illustrates, deductive data analysis starts with and is guided by pre-existing rules that are then applied in the analysis.
Descriptive	If a study has a descriptive purpose, it is aiming to investigate, document, and describe the properties and qualities of data or a phenomenon (e.g. documenting what it is like), without necessarily extending into the wider implications of said data or phenomenon (e.g. interpreting what it means or what it can tell us). It can also be a study that '"gives voice" to a topic or a group of people' (Braun and Clarke 174). It can ask what members of a specific group have to say about a particular topic, or what a culture of interest is like (Bernard and Ryan 2010).
Exploratory	Similarly to descriptive qualitative approaches, exploratory research is primarily concerned with examining, scoping and recording different aspects of a topic or phenomenon. Instead of setting out to generate understanding, meaning, or implications, it asks questions like: 'What kinds of things are present here? How are these things related to one another? Are there natural groups of things here?' (Bernard and Ryan 2010, p8).
Framework analysis (FA)	In this AMEE guide, we use the term framework analysis or FA to refer to Ritchie and Spencer (1994) original description of this qualitative data analysis method.
Framework analysis methods (FAMs)	In this AMEE guide, we use FAM as an umbrella term to describe a family of data analysis approaches that answer specific questions through the examination of large qualitative datasets. Framework analysis approaches commonly share several characteristics—i.e. they rely on a systematic and by-case-structured data coding process; they are applied to systematically or consistently generated (and therefore homogeneous) datasets; they aim to capture and describe patterns in qualitative data; and typically express findings as a matrix of intersecting research foci (Gale et al. 2013).
Framework method (FM)	In this AMEE guide, we use the term framework method or FM to refer to a specific and popular FAM articulated in 2013 by Gale and colleagues.
Inductive data analysis	Inductive data analysis generates understanding about a phenomenon by moving from the specific (i.e. from data) to the general (i.e. more abstract statements of explanation or insight that are generated by the researcher(s), and are logically and empirically backed by the data). It 'aims to generate an analysis from the bottom (the data) up; analysis is not shaped by existing theory (but analysis is always shaped to some extent by the researcher's standpoint, disciplinary knowledge and epistemology)' (Braun and Clarke p175). For example, we might be curious to understand why some medical students experience imposter syndrome. We will collect and analyze many medical student accounts of their imposter syndrome experiences to generate insights, theories, or models about the relationship between medical student experiences of imposter syndrome and a myriad of different personal, institutional, and/or social factors.
Interpretation	Qualitative interpretation is 'a process of making sense of, and theorising the meanings in, data' (Braun and Clarke 2013, p332). Thus, interpretation of data in qualitative research 'goes beyond summarising the obvious semantic content of the data' (Braun and Clarke p332) to generate some kind of interpretive conceptual structure. It thus involves going beyond the qualities of a dataset to deeper, more abstract levels of what the data could be taken to say or mean in a particular context.
Paradigm	A paradigm 'consists of the concepts, practices, and language that define a particular approach to science' (Varpio and MacLeod 2020, p687). It is the set of beliefs and agreements that individuals working from a particular research tradition hold about how problems should be understood, addressed, and the markers of rigor associated with those approaches.

aims and objectives (Pope et al. 2000). They involve more structured forms of data collection (e.g. open ended survey questions or structured interviews), and data analysis is foundationally shaped and directed by theories, models, literature findings, and/or purposes that are established before analysis—and sometimes even before data collection—begins.

There are many analysis methods that can sit beneath the FAM umbrella—each with utility and power that differentiates it from other methods. In this guide, we aim to provide clarity around FAMs and the variety of methods that are part of this group of qualitative analysis methods. We begin by defining FAMs and the *framework analysis* approach described in 1994 by Ritchie and Spender which catalyzed the development of the many varieties of FAMs that exist today. We offer a short review of some of the most common methods under the FAM umbrella so that the HPE researcher can decide which type of FAM best suits their research needs. We then describe how FAMs sit in relation to other commonly used qualitative analysis methods to help readers know when FAMs might fit their research purposes. Next, we explain the phases that are typically part of a popular FAM, the *framework method*. To illustrate how FAMs have already been useful in HPE research, we offer some examples of published research that demonstrate how FAMs might be harnessed. We end by warning readers of potential pitfalls to avoid when using FAMs for qualitative analysis.

What are FAMs?

In the context of qualitative research, the history of FAMs trace back to *framework analysis* (FA) which was created by Jane Ritchie and Liz Spencer in the late 1980s during large-scale policy research carried out in the United Kingdom (Ritchie and Spencer 1994; Gale et al. 2013). FA was born out of applied policy researchers' need for a qualitative data analysis approach that enabled answering specific questions and creating actionable insights using large qualitative datasets

Table 2. A sample of qualitative analysis approaches that fit within the FAM umbrella.

Name of the approach	Description
Framework Method (FM)	The *framework method* is characterized by use of the framework matrix tool: 'rows (cases), columns (codes) and "cells" of summarized data' that collectively act as 'a structure into which the researcher can systematically reduce the data, in order to analyze it by case and by code' (Gale et al. 2013, p2). FM's key features are that it is: grounded (i.e. based in and driven by original data); dynamic (i.e. it can change during the analysis process); systematic (i.e. it is a methodical treatment of data); comprehensive (i.e. it involves a full review of all data); enables easy retrieval (i.e. it allows easy access to original data); within- and between-case analysis (i.e. it supports comparisons within and across data cases); accessible (i.e. the analytical process and outputs can be seen and evaluated by external scholars); and exploratory (e.g. summarizing or categorizing the responses to an open-ended question in a questionnaire).
Template Analysis	*Template analysis* follows a structured approach, utilizing a coding template that is typically, but not necessarily, developed based on codes that are identified by the researchers prior to analysis (King and Brooks 2018). Codes can also be developed inductively through the analysis of the study data. In developing and applying the coding frame—i.e. the template—the researcher typically starts with a subset or sample of data as opposed to basing the template on reading and re-reading the entire dataset. The final version of the template 'offers a way of hierarchically mapping patterned meaning, and moving from broader to more precise meanings' (Braun and Clarke 2021, p243). The template thus deeply informs the researcher's interpretations and analysis findings. Although the refinement of the template may involve many rounds of reading and iteratively working towards a developed template, this analysis method is considered suitable for working with large datasets (Burton and Galvin 2019).
Matrix Analysis	*Matrix analysis* uses different kinds of tables—matrices—to categorize and display data, thereby supporting cross case analysis (King and Brooks 2018). These matrices 'can be descriptive (depicting existing conditions or situations), outcome-orientated (concerned with consequences and results), or process-oriented (focused on the dynamics of change)' (Averill 2002, p856). It can easily accommodate large volumes of data because it builds on the case comparison aspect of framework analysis; it uses pre-established categorizations of data into cases relevant to the study in question. As Burton and Galvin (2019) argue, the structured development of a matrix or matrices is more geared towards presenting or organizing data, as opposed to analyzing and interpreting qualitative data in a greater depth.
'Best Fit' Framework Synthesis	*'Best fit' framework synthesis* provides 'a means to test, reinforce, and build on an existing published model, conceived for a potentially different but relevant population' (Carroll et al. 2013, p1). It involves identifying and using an existing conceptual framework or model for identifying a priori themes, which are then used for data extraction, coding, and synthesis of qualitative findings from relevant studies (Carroll et al. 2011; Dixon-Woods 2011). While the other FAMs support primary data analysis, 'best fit' framework analysis is a means of analyzing data in the published literature.

(Ritchie and Spencer 1994; Srivastava and Thomson 2009). Since the inception of FA, different variants and offshoots have been developed. These variants and offshoots, as well as the original FA, sit under the FAM umbrella and so share several characteristics: they rely on a systematic and by-case-structured data coding process; they are applied to relatively homogenous datasets (i.e. datasets collected to address topics or key issues somewhat consistently); they aim to capture and describe patterns in qualitative data as themes (e.g. common experiences and variation across experiences); and typically produce framework matrices consisting of codes that intersect with cases (Gale et al. 2013). The power of various FAMs have been harnessed by scholars working in a wide range of fields, including global health (Klingberg et al. 2022), health services research (Heath et al. 2012), and HPE (Kumar et al. 2011; Howman et al. 2016; Balmer et al. 2021).

In Table 2, we list some research approaches that sit beneath the FAM umbrella. As this table makes clear, only a few nuanced differences separate some of the approaches under the umbrella; nevertheless, each approach has certain characterizing, if not unique, features. Depending on the precise purpose of a particular study, HPE researchers can choose the FAM best suited for analyzing their qualitative data.

To support readers in making these selections, we next go into more detail about the defining features of FAMs. By considering FAMs in relation to other qualitative analysis methods, we can further understand the coherence that unites approaches that fall underneath the FAM umbrella.

Distinguishing FAMs from other qualitative analysis methods

One way of understanding what differentiates one qualitative analysis method from another is to consider the extent to which the data is transformed during the analysis process. Sandelowski and Barroso (2003) helpfully located different approaches to qualitative research on a continuum of data transformation. Figure 1 demonstrates how, at one end of this continuum, research studies seek to stay *close to raw data* and so the data undergo minimal transformation (e.g. summarizing the responses to an open-ended question in a questionnaire). In contrast, at the other end of the spectrum, studies engage in *interpretive explanation* and so the data undergo many transformative moves away from the original data (e.g. a phenomenological analysis of the essence of an emotional experience). There is a spectrum of research that exists between these poles, reflecting the degree to which analyses are expected to move beyond simple inventories of data content and characteristics, to generate more abstract interpretations and/or insights. This continuum can serve as a helpful conceptualization of the kind of analysis involved in different qualitative approaches.

Given that FAMs do not typically engage the researcher in deep data transformation, they generally support research working at the *close to raw data* end of Sandelowski and Barroso's continuum. As such, FAMs are methods that lend themselves to be used in specific circumstances. FAMs enable the researcher to stay close to the data to generate highly structured outputs of categorized, organized, and summarized data offering descriptions, categories, and/or typologies. Not all qualitative research needs to produce new theories or highly sophisticated explanations of social phenomena. It is therefore helpful to recognize the value of specific methods—like FAMs—for facilitating descriptive and for-practical-use oriented research. The *descriptive* or *exploratory* tendencies of FAMs are also particularly useful for analyzing qualitative datasets that include distinct participant groups and where a comparison of findings between different groups is of

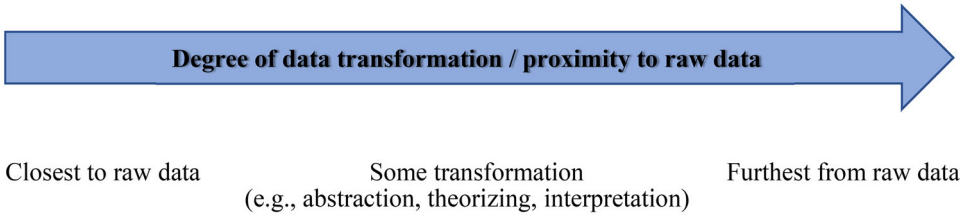

Figure 1. Continuum of data transformation (adapted from Sandelowski and Barroso 2003).

Table 3. Typical features of selected qualitative analysis methods.

Method	Purpose	Degree of data transformation
Framework Method (FM)	To generate highly structured outputs of categorized, organized, and summarized data that offer descriptions, categories, explanations and/or typologies (Gale et al. 2013).	Close to data to minimal interpretation
Qualitative content analysis	To systematically describe the meaning of the data (Schreier 2012).	Close to data to some interpretation
Hermeneutic phenomenology	To uncover the meaning and foundational structures—or the essence—of a particular lived experience of a phenomenon (Bynum et al. 2021).	Deeply interpretive explanation, far from raw data
Constructivist grounded theory	To explore and understand social or psychological processes underlying a phenomenon, and to express that understanding in a theory grounded in the data (Charmaz 2000).	Deeply interpretive explanation, far from raw data

analytical relevance. This may well be the case with larger datasets that potentially contain natural subsets of interest, such as different age groups, professions, or relationships with/experiences of a given phenomenon (e.g. health care professionals with and without chronic illness).

In contrast to FAMs, other qualitative methodologies and data analysis methods involve considerable transformation. By reflecting on how different qualitative research approaches can be located along the continuum of data transformation, we highlight how some approaches involve deep interpretation of data and explanations of phenomena, while others engage in very little interpretation. Table 3 organizes four different approaches—including *framework method,* an FAM—along this continuum and offers comparisons in terms of the kind of research purposes each approach is typically used to address.

This is not to suggest that FAMs are free of any interpretation or data transformation; instead, the transformation that takes place stays close to the raw data. Part of the power of FAMs rests in their ability to reduce large amounts of data into a purposefully constructed set of cases (i.e. the units of analysis; e.g. a participant interview) and codes (i.e. 'a descriptive or conceptual label that is assigned to excerpts of raw data' (Gale et al. 2013, p2). These cases and codes make up the coding frame which is applied to the entire dataset; this application is essentially a process of labelling data excerpts with the appropriate code. When all the data is coded into the framework, the analysis is not complete. Instead, as Ritchie and Spencer explain, this is when the researcher: returns to the study's specific objectives and ensures that the cases and codes address these objectives; maps the range and/or nature of the phenomenon of interest; develops typologies; and identifies associations and/or explanations (Ritchie and Spencer 1994). While this work clearly involves interpretations of the data, the analysis stays close to the data and offers insights that are typically limited in their level of abstraction.

How to engage in qualitative analysis using a FAM

To illustrate how to use FAMs, we select one from underneath this umbrella: the *framework method* (FM). FM uses a pattern-based and structured set of techniques to organize data into a matrix where cases intersect with codes, and eventually developing themes with the help of the framework matrix (Gale et al. 2013). The *case* (i.e. the unit of analysis) is often an individual participant, but a case could also be a participant group, an organization, or another categorization. Since this approach encourages the comparing and contrasting of cases, it is important that the dataset be relatively homogenous and consistently collected (Gale et al. 2013).

FM can be used both deductively and inductively: in the deductive approach, themes and/or codes are pre-selected based on existing theories, prior research or specific study objectives; in the inductive approach, codes and themes are generated from the data and refined as analysis progresses. FM involves seven stages: transcription; familiarization; coding; developing a working analytical framework; applying the analytical framework; charting data into the framework matrix; and interpretating the data (Gale et al. 2013). We describe each of these below. These stages can be carried out by an independent researcher or collaboratively by a research team. Qualitative data analysis software may be relevant to utilize in many or all seven stages to aid data management and analysis, especially if working with a large dataset. It is important to note that the stages we describe are specific to FM; however, the work involved in these stages parallels many of the processes used in other FAMs.

Stage 1: Transcription

As with most qualitative analysis methods, the work of data analysis using FM begins with transcription—especially if that transcription work is being done by the researcher. As such, the creation of a word-for-word (i.e. verbatim) transcript acts as a first review of the data. However, even if the transcription work is being conducted by an external contractor, the FM researcher should verify the transcript against the original recording to ensure accuracy. This process requires the researcher to immerse themselves in the data and consider them in relation to the research purposes and questions. If no transcription of recorded data is required, as in the case of using

qualitative survey responses (Palermo et al. 2019), stage 2 becomes the first analysis phase.

Stage 2: Familiarization

This phase of FM, which is still typical for many different qualitative data analysis methods, requires the researcher to become familiar with the range and diversity of the dataset. It is essentially the work of deeper immersion in the data. Familiarization can involve reading of transcripts or responses, and/or listening to recordings. During this familiarization, the researcher should write contextual and/or reflective memos of key ideas, thoughts, impressions, and recurrent themes that they notice.

Stage 3: Coding

While some form of coding is common to many qualitative analysis methods, this is the phase where FM starts to become more distinct from other methods, and where variations of FM (e.g. inductive or deductive) also differ from each other. This is because different qualitative methodologies and analysis methods approach coding in very different ways. During this FM stage, the researcher labels data segments with brief descriptive codes or paraphrased data excerpts. The goal of this line-by-line work is to identify key issues and concepts according to which the data can be examined (Ritchie and Spencer 1994). When developing codes, it may be that the researcher decides to develop codes by working with all transcripts (i.e. all cases) in the dataset or by using only a few.

When using FM to support inductive analysis, Gale et al. (2013) suggest that:

> Codes could refer to substantive things (e.g., particular behaviours, incidents or structures), values (e.g., those that inform or underpin certain statements, such as a belief in evidence-based medicine or in patient choice), emotions (e.g., sorrow, frustration, love), and more impressionistic/methodological elements (e.g., interviewee found something difficult to explain, interviewee became emotional, interviewer felt uncomfortable). (p. 4)

In contrast, in a purely deductive FM study, themes will have been pre-defined, informed by a theory, a model, or existing findings from the literature, which then informs codes (Onyura et al. 2017). In combined inductive-deductive approaches, the coding can be partly informed by pre-identified or developed frameworks, and inductive coding can be used to develop sub-themes to deductively determined themes (Redman et al. 2017).

The development of codes is a particularly important aspect of FM since codes are the foundations from which insights are developed. As Gale et al. (2013) explain: 'coding aims to classify all of the data so that it can be compared systematically with other parts of the dataset' (p. 4). Given the centrality of codes to the success of the study, it is essential that the researcher recognizes when codes are not a good 'fit' or not well aligned with the data. In these situations, Ritchie and Spencer (1994) suggest that the researcher be ready to reconsider and refine codes. This might be done by discussing them in the research team—a practice that should make the data analysis more robust.

Stage 4: Developing a working analytical framework

Once codes have been developed, the researcher progresses to the more unique and defining stages of FM by constructing a working analytical framework. This framework consists of the full set of codes—clearly defined and described—and with some codes being clustered together into categories. If working in a team, this phase will involve harmonization of different team members' coding approaches; the exact process for that will depend on the practical and philosophical approach taken for a specific study, as well as the aims of the analysis process. For instance, if working from an inductive approach, the research team will need to determine how to accommodate differences across the conceptualizations of codes (e.g. does one researcher's code 'X' overlap sufficiently with another researcher's code 'Y' so that they can be merged together?). In contrast, in a deductive approach, researchers may draw on an existing conceptual framework (see e.g. Onyura et al. 2017 and Table 4), but the researchers will then need to confirm that each coder's interpretation of the pre-existing theory, model, and/or literature-based codes are aligned.

This work of developing the framework can be laborious since—for both inductive and deductive approaches—several iterations will be required before the researcher decides that the framework is capturing all the relevant data that will enable them to answer their research question(s). As Gale et al. (2013) point out, it is worth making space for this gradual refinement by using placeholder codes such as 'other' or 'miscellaneous' until the analytical framework can be finalized. It is worth noting that the more inductively the researcher approaches the data, the more time the analysis is likely to take. This is both a practical and methodological consideration worth giving some thought to prior to selecting an analysis method or approach, and when starting the analysis process.

Stage 5: Applying the analytical framework

To apply the analytical framework developed in the previous phase, all transcripts in the dataset will be coded (i.e. all data pertaining to a code will be marked, either manually or using tags in a software) using the codes listed and described in the analytical framework. Depending on the size of the study's dataset, the work of applying the framework can be expedited using qualitative data analysis software. If the dataset has many transcripts (i.e. cases), software can help the researcher not only to code and organize all data, but also to export data excerpts into stand-alone documents, thereby facilitating cross case comparisons.

Stage 6: Charting data into the framework matrix

Based on the analytical framework used to code the data, a framework matrix is constructed by combining codes (or higher-level constructs, such as categories or themes, e.g. Klingberg et al. 2022) and cases (or groups of cases, e.g. Klingberg et al. 2022) into a spreadsheet structure (e.g. where columns represent codes and rows represent cases). For each case and code, a summary description of the aspects of the transcript that relate to that code can be included, or a representative quote can be charted into the

Table 4. Examples of FAMs in HPE research.

Authors	Research questions/aims	Methodology	Data collection method	Analysis specifics
(Palermo et al. 2019)	Research questions: 1. What are the health education research priorities over the next 3–5 years according to multiple stakeholders? 2. What is the rationale provided by multiple stakeholders for prioritizing specific health education research topics? 3. What are the similarities and differences in health education research priorities across the range of stakeholders?	Sequential mixed methods	Online questionnaire to scope priorities (open ended questions), online questionnaire to identify highest priorities (closed-ended questions), and individual interviews and focus group to affirm and understand priorities.	A hybrid approach combining inductive and deductive approaches. Started inductively with a team of six authors, then used existing priority setting frameworks to deductively develop the coding framework.
(Redman et al. 2017)	Aim: explore the experiences of Foundation Year doctors in care of the dying Research Questions: 1. What are the experiences of Foundation Year doctors? 2. How do these relate to 'the five priorities for care of the dying person'? 3. How can any findings inform under- and postgraduate medical education curricula?	Qualitative, Framework Analysis	Semi-structured individual ($N = 21$) and group interviews ($N = 8$) Topic guide informed by 'The Priorities for Care of the Dying Person'	Inductive analysis & deductive analysis based on the five priorities for care of the dying person.
(Onyura et al. 2017)	Aim: to elucidate how faculty development can work to support a range of outcomes among individuals and sub-systems in the academic health sciences.	Retrospective framework analysis informed by realist evaluation and theory-driven evaluation	Phase 1: review of program's curriculum and goals with key stakeholders Phase 2: focus groups with program participants Semi-structured interviews with program graduates	Preliminary coding frame developed based on key concepts of realist evaluation and codes derived from Phase 1. Realist evaluation—context, mechanisms, outcomes. Coding proceeded iteratively but is summarized linearly, for clarity.
(Stephens, Rees, and Lazarus 2021)	Aim: to address a gap in the tolerance of uncertainty literature by identifying the impacts (either positive or negative) of education on preclinical medical students' tolerance of uncertainty in the context of a core medical curriculum (as exemplified by anatomy education), and to compare these aspects with a model on understanding tolerance of uncertainty in the context of healthcare Research Question: How does the anatomy education learning environment impact medical students' tolerance of uncertainty?	Longitudinal qualitative study	Data collected through online discussion forum and semi-structured interviews across two cohorts of students	Steps as described by Ritchie & Spencer. Deductive coding using the model on understanding tolerance of uncertainty in the context of healthcare. Authors describe using an 'abductive' approach to analysis whereby analysis oscillated between deducted and inductive approaches.
(Jenkins et al. 2013)	Aim: to explore registrars' and supervisors' experience regarding the educational impact of the implementation of a national portfolio using the concepts of acceptability and perceived usefulness for assessment of competence.	Qualitative, Framework Analysis	Semi-structured interviews	Five steps described by Ritchie & Spencer. Respondent validation of provisional analysis.

matrix. This allows for patterns and nuances to be traced across the different cases or groups.

Stage 7: Interpreting the data

While some level of interpretation already takes place during the earlier phases of analysis when deciding on codes and writing memos, the more formal phase of data interpretation and theme generation occurs after charting data into the framework matrix. This is when the researcher reviews the study purposes and research question(s) driving the research. Ritchie and Spencer (1994) noted that the basic processes for this stage require the researcher: to review the charted data; to examine research notes/memos; compare and contrast across cases; search for patterns and connections; and to seek out descriptions that help to illuminate findings relevant to the research question(s). Gale et al. (2013) describe potential interpretive avenues as follows:

> Gradually, characteristics of and differences between the data are identified, perhaps generating typologies, interrogating theoretical concepts (either prior concepts or ones emerging

> from the data) or mapping connections between categories to explore relationships and/or causality. If the data are rich enough, the findings generated through this process can go beyond description of particular cases to explanation of, for example, reasons for the emergence of a phenomena, predicting how an organisation or other social actor is likely to instigate or respond to a situation, or identifying areas that are not functioning well within an organisation or system (p. 5).

It is also important to remember that data interpretations are often developed and refined throughout the writing process and so the process of writing the research manuscript is considered part of the analytic process. While Gale et al. (2013) describe themes as the final output of analysis, the exact process and outcome of interpretation will depend on the purpose, analysis approach (i.e. inductive or deductive), and design the study in question.

Examples of FAMs in HPE research

To illustrate how HPE scholars have successfully used FAMs in the past, Table 4 summarizes published examples from the field, each utilizing FAMs in slightly different ways (e.g. inductively, deductively or a combination of the approaches), illustrating the versatility of FAMs for different purposes in qualitative or mixed methods HPE research.

Pitfalls to avoid

Although FAMs offer significant benefits (e.g. being applicable both inductively and deductively; offering means of analyzing large qualitative datasets; and offering relatively structured approach to the data analysis process), there are also certain pitfalls that researchers will want to avoid. The first pitfall is using FAMs without situating their research within a specific *paradigm* (see Table 1). Researchers in HPE engage in their studies from different research traditions that shape how individual scholars conceptualize the questions being asked, the kind of knowledge that can be developed, the kinds of methods that are useful, and the standards of rigor that are to be expected. These traditions—or paradigms—will change the way the HPE researcher harnesses individual FAMs. Therefore, researchers should not assume that they simply follow the stages of an FAM; instead, they must tailor their FAM use to align with their paradigmatic orientation and the underlying expectations of quality and rigor for the study (Varpio and MacLeod 2020).

Another pitfall is the challenge of balancing *interpretation* with the more structured (and potentially easier to follow) elements of an FAM. For example, in Gale et al. (2013) FM, themes are described as the final output of analyzing the entire dataset, but the stages of analysis do not dictate how exactly to develop themes from the framework matrix. This will depend on the approach (i.e. inductive, deductive, or mixed) and aim (e.g. descriptive or exploratory) of the study. This is where the role of the qualitative researcher as a research instrument must be emphasized; each researcher will engage in the work of developing themes in their own preferred way. In an inductive approach to FM, it may be helpful to use the framework matrix structure to support the development of themes by, for example, gradually reading and re-reading codes, categories, and case comparisons to generate analytic memos of themes they identity that create connections between these elements. In the case of deductive approaches, themes are inputs rather than outputs of the analysis and, as such, the work of interpretation centers on carrying out coding and framework development in line with the relevant themes. Regardless of the approach and aim that underpins the study, it is important that all research processes and findings are reported transparently and consistently with aims, objectives, and undertaken practices.

Conclusion

In this AMEE guide, we have endeavored to provide clarity around FAMs and the variety of approaches that can sit beneath that umbrella term. We have highlighted the flexibility of FAMs, noting that they can be used both inductively and deductively. Using FM as an example, we have also described the stages involved in engaging in a particular FAM to provide readers with an understanding of the kind of analytical work involved in research using these methods. As with any qualitative analysis approach, FAMs involve some risks and pitfalls but we hope that the examples and recommendations we have provided can help more HPE researchers use these methods in our field.

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