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Using Qualitative Methods to Improve Physician Research Training: Understanding the Student Perspective

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Abstract
For several decades now, physician-scientists have been referred to as an "endangered species." Many factors have contributed to the dearth of clinical investigators, and training programs in clinical research are just one tool in a multi-pronged strategy to increase the number of successful physician-scientists working in health research. A qualitative approach that analyzes students' educational goals and experiences can help fill the gaps in our knowledge about how best to train aspiring physician-scientists. This study was an interpretive phenomenology that evaluated the Master of Science program in Clinical and Translational Research (MSCTR) at the University of Cincinnati. The purpose of the study was to allow students to articulate their expectations, needs, and experiences in the MSCTR. The study included a group level assessment (GLA) and document review. Findings suggest several reasons students enrolled in the MSCTR, as well as some areas for improvement in the program: more physician-centered classes, a more directed curriculum, and a more cohesive course plan overall. Conclusions from these recommendations are that student perspectives can inform decisions around curricula and instructional methods in powerful ways, particularly when combined with a qualitative methodological approach. This study revealed several insights into how faculty and administrators can more effectively train physicians in research methodology. Training should be as applied and relevant as possible to make it directly applicable to clinical practice. This goal could be enhanced if classes – particularly statistics classes – were more physician-oriented. The curriculum of a clinical research training program for clinicians should be clear and directed, but with some flexibility and space within the curriculum for classes within areas of specialization. Collaboration should be integrated throughout, and courses should follow a logical, interconnected sequence.

Keywords
clinical and translational research, research education, research training, program evaluation, qualitative methods, physician-scientist training

Graduate training programs in clinical research were rapidly formalized in the late 1990s, when the National Institutes of Health (NIH) created the Institutional Clinical Research Curriculum Award, or K30. The purpose of the K30 award was to provide funding to teaching institutions to develop and improve curricula in clinical research theory, methodology, application, and ethics ("K30 Clinical Research Curriculum Award (CRCA)," 2006; Mullikin, Bakken, & Betz, 2007). Then, in 2006, the NIH introduced the Clinical and Translational Science Award (CTSA) program, which included the key component of fostering graduate and post-graduate programs in clinical and translational science in order to provide a knowledge base for clinical and translational researchers.

The University of Cincinnati (UC) received a K30 award in 2005, prompting the development of a new Master of Science (MS) research training program as well as the creation of multiple new courses geared specifically towards young clinician-investigators. UC also received a CTSA in 2009 and 2015, providing funding to continue the mission of training clinical professionals (physicians, nurses and other terminal degree clinical professionals) to become independent investigators. The MS instructs students in research methodology, advanced statistics, study design, grant writing, and research ethics, all skills that are necessary to prepare successful career development and independent investigator awards. The ultimate goal of the program is to develop practitioners with personal clinical observations into scientific investigators whose research can provide objective evidence.

According to Core Competency for Clinical and Translational Research work groups (2011), all early development of graduate clinical research training programs need to focus on creation of core learning competencies and new courses. In the last five years, efforts have turned more towards evaluating these programs for efficacy. The UC Master of Science Clinical Translational Research (MSCTR) has utilized traditional methods of program evaluation in the past, including course evaluations and exit surveys, which have indicated a high level of satisfaction from students. Few studies have quantitatively evaluated the success of training provided through a K30 or CTSA. Although using an alumni survey, Goldhamer et al. (2009) did correlate reception of NIH grant funding with starting the training program at a younger age, being a generalist, and successfully publishing projects from coursework. A number of other tools and frameworks for assessing clinical researchers' success after completion of a training program have been developed more recently as well. The Clinical Research Appraisal Inventory (CRAI), aims to measure trainees' perceived self-efficacy in a variety of related conceptual areas such as conceiving and designing a study, funding and managing a study, collaborating with peers, conducting research responsibly, collecting and interpreting data, and reporting study results (Lipira et al., 2010; Mullikin et al., 2007). In addition, the CTSA program's Key Function Committee (KFC) on Evaluation published a comprehensive model that can be used to "theoretically explore determinants of career success among physician-scientists" (Rubio et al., 2011, p. 1574). While assessment tools such as the CRAI and the comprehensive career-success model are important and helpful approaches for program directors to consider, neither offers pragmatic methods for evaluating the contributions of investigators who are trained through CTSA-funded programs.

In 2013 and 2015, UC researchers completed empirical studies that compared publication track records and grant awards of MS fellows and non-MS fellows to evaluate program effectiveness

(Knapke, Haynes, Kuhnell, & Tsevat, 2015; Knapke et al., 2013; Leshner, Terry, Schultz, & Liverman, 2013). Researchers found that MS fellows published more first-authored articles, and more articles overall, than non-MS fellows. Additionally, men in the non-MS group outpaced their women colleagues, but the gender gap was eliminated in the MS group (Knapke et al., 2013). Controlling for age and gender, MS fellows were three times more likely to have had at least one grant than non-MS fellows. MS fellows were also significantly more likely to have obtained at least one major NIH grant award (e.g., K, R, or M grant) award than non-MS fellows (Knapke et al., 2015). Older fellows were more likely to have a least one grant of any kind, and gender was only significant when looking at R grants, with men more likely than women to have at least one R grant (Knapke et al., 2015). However, if one purpose of program evaluation is to enhance and tailor an educational program to fit the needs of its students, quantitative methods that evaluate student outcomes are limited. Successful evaluation requires a more in-depth, personal approach to identify the subtle nuances that impact a trainee's performance while pursuing a career in academic medicine. A qualitative approach that analyzes students' educational goals and experiences can help fill the gaps in our knowledge about how best to train aspiring physician-scientists. This study attempts to address that gap. The research questions for this study are straight-forward: why do trainees choose to pursue MSCTR training, what have students' educational experiences been like thus far, and what changes would students make? The purpose of this study was to allow students to articulate their expectations, needs, and experiences in the MSCTR and to develop novel training methods and/or curriculum modifications to improve physician-scholar training.

Methods

We used an interpretive, qualitative research design to better enable the program user, i.e., the trainee, to inform the development of next-generation approaches to educating clinical scholars. Data analysis was conducted using a hermeneutic method, and data collection included two methods: document review and a group level assessment (GLA). This study was reviewed and approved by the University of Cincinnati Institutional Review Board, IRB protocol # 2013-7614.

Recruitment and Sampling

This study utilized a stratified sampling approach, aiming for representative proportions of the student population by gender, institutional affiliation, and professional position. A range of academic progress within the program were sought to better represent experiences within the degree across a spectrum of time. A total of 62 current students and recent graduates were eligible to participate in the study. After seven participants responded to an open email invitation, we then followed up with individuals to achieve appropriate representation across each stratum. A total of 12 (19% of total eligible participants) students enrolled; their breakdown by identified strata is provided in Table 1. All 12 participants were affiliated with different departments and divisions, giving the broadest range of backgrounds possible, both in terms of organizational culture and medical/research specialization. All participants were invited to participate in all aspects of the study. Participants were offered a total of $50 for participation.

Table 1: Distribution of Study Participants by Identified Strata

Gender	**n**
Male	6
Female	6
Institutional Affiliation	
CCHMC	8
UC	4
Professional Position	
Fellow	10
Junior faculty	2
Academic Progress	
Early (first semester)	2
Advanced	8
Recently Graduated	2

CCHMC – Cincinnati Children's Hospital Medical Center
UC – University of Cincinnati

Data Collection Methods

Document review is a valuable method within qualitative research because it can provide unique knowledge of the history and context of a phenomenon, without actually disturbing the setting (Marshall & Rossman, 2006). As Creswell (2012) notes, documents "provide the advantage of being in the language and words of the participants, who have usually given thoughtful attention to them. They are also ready for analysis without . . . transcription" (p. 223). Applicants to the MSCTR program are required to include a personal statement and a statement of career goals, both intended to ascertain what educational experiences and professional objectives the applicant hopes to accomplish through his or her MS training. These statements tend to be one paragraph to two pages long, and they provide an initial picture of each applicant before beginning the program. In terms of this study, these documents were a rich source of data written in the students' own words. Although the topics they addressed were highly relevant to this study, students had written them without any prior knowledge of the study or its goals, lending their statements purity from bias or intention to deliver a message they think is expected of them. Researchers pulled each participant's graduate application to the MSCTR program from his or her file and reviewed it for potential information on educational goals, motivations, and expectations.

Group level assessment (GLA) is a participatory method that interactively engages participants and uses their expertise to inform the research process (Vaughn, Jacquez, Zhao, & Lang, 2011; Vaughn & Lohmueller, 2014). Vaughn and Lohmueller (2014) state, "GLA rapidly results in concrete, meaningful ideas including perceived barriers to outcomes, inadvertent oversights, and participant preferences . . . " (p. 346). The purpose of the GLA in this study was to gather group-level data about student expectations and experiences in the MS program using 10 questions that covered a broad variety of aspects related to their training. Using prompts posted around the room, participants were guided through the process of first responding as individuals to each

prompt, reflecting on the variety of responses, and then coming together in small groups to analyze responses for themes. The final step converged all participants into one larger group that identified overarching themes. The GLA process gave group members ownership and responsibility of the data, with the researchers simply facilitating the process (Vaughn & Lohmueller, 1998).

Data Analysis

Using the seven stage process described in Diekelmann, Allen, and Tanner (1989) as a foundation for the document review analysis, we used first- and second-level coding to develop categories into themes, which were then grouped into patterns. We modified the process slightly in that the first author (JMK) coded and suggested themes and patterns. The research team met regularly to discuss results throughout the analysis process. The GLA data analysis process is participant-led, meaning participants first work in small groups to determine themes for individual prompts. Then, as a larger group, participants analyze the small group results for larger themes.

Results

Document Review

All 12 participants' application documents were analyzed using the modified version of the hermeneutic analysis described above (Diekelmann et al., 1989). From this analysis, five consistent patterns were found that related to the reasons participants sought to improve and expand their research skills through the MSCTR program:

1) *Personal experiences had intensified their interest in research.*

Many students described powerful personal experiences with their patients that made them want to pursue research training. As one pediatric oncologist described,

> "Even though the battle of cancer is unique and personal to each patient, cancer is not one child. This disease is pernicious; it invades every possible organ system, it invades families, communities, and nations . . . Unless I, as a physician, have the tools to interpret data, discover new connections, take risks and ultimately see the much bigger picture, I am not really doing my job".

2) *They wanted to improve their care for patients in the clinic.*

Students in the MSCTR program maintained deep connections to the patients they care for in their roles as clinicians: "Thus, I am applying to obtain a Master of Science in Clinical and Translational Research . . . to ultimately impact the lives of the critically ill children I treat on a daily basis."

3) *They wanted to better mentor and/or teach others in their divisions and/or fellowships.*

This was perhaps one of the more surprising themes, given that the MSCTR does not currently attempt to develop students' own mentorship and teaching skills. As one participant said in his application materials, after completing the MSCTR, he aimed to "educate younger generations to follow in the gratifying footsteps of innovation and progress."

4) *They wanted to collaborate more effectively with their colleagues.*

Clinical research is inherently team-oriented, and these participants often described a desire to improve their abilities to collaborate with colleagues on research projects: "I also hope that I can

be a benefit to my colleagues in clinic with this new skill set . . . I would like to be able to help [my colleagues] pursue research and improvement projects within our clinic, patient population and community."

5) They wanted to further their own professional goals.

Students brought their own professional goals to their MS training as well, stating, " . . . I believe the [MSCTR] can begin to provide the foundation for my pursuit of a career as an independent investigator in translational research," and, "After using the literature to make clinical decisions, I now want to have some of my own publications."

Group Level Assessment

The purpose of the GLA was to gather broad, group-level data about student expectations and experiences in the MSCTR program. It was a unique opportunity for students to both generate their own data, and then analyze it themselves, all in one session. A summary of the questions and themes the group identified is found in Table 2.

Table 2: Themes from the Group Level Assessment

Question	Themes
1. Why did you enroll in the program?	• Fellowship requirements • Research skills
2. What specific skills did you hope to gain from the MS?	• Study design/analysis/ implementation • Collaboration
3. What has been the one most positive experience of your training?	• Publication & proposal completed • Basic research skills
4. What has been the one most negative experience?	• Required classes aren't that helpful
5. What hurdles did you face at the beginning of the program (applying, getting started)?	• No hurdles
6. What hurdles have you faced in getting to graduation?	• Balancing clinical responsibilities
7. What method of instruction do you feel is most effective (lecture, applied, journal club, team/group work, online, etc.)?	• Interactive and participatory
8. Name one way the MSCTR program could be improved.	• More physician-oriented classes (especially statistics) • Offer more classes more often
9. If the CTR program were a person, how would you describe its personality?	• Laid back/friendly • Accepting (but sometimes to a fault)
10. Why would you *not* recommend this program to others?	• Must have a research interest

After smaller groups reported themes from each of the 10 questions, the larger group discussed all of the issues as a whole and established three major themes:

1) *Students wanted more physician-specific courses, especially in statistics.*

Participants felt that most of the statistics professors taught too much from a statistician's perspective, i.e., instructors focused too heavily on the theory and formulae behind statistical concepts rather than the application of these concepts. If the MSCTR could offer more classes specifically geared towards the physician-scientist audience, the content and instructional methods would be more appropriate for students training to be principal investigators.

2) *Students wanted a more directed curriculum.*

While participants appreciated the flexibility of the current core curriculum, they also would appreciate more direction when choosing their "selective" classes. A selective class is one class students choose to take from a list of options. For example, to fulfill their "advanced biostatistics" requirement, students can select one class from a list of many classes. GLA participants noted that although they were aware of some of the gaps in their own knowledge base, they were still early in their research careers and they "did not know what we did not know." Most students come from medical school backgrounds where their coursework is dictated to them, and at this stage of their education, they wanted the core curriculum to be clearly and simply laid out for them.

3) *Unity and cohesion throughout the MSCTR training was a problem – the classes often felt disconnected from each other.*

Participants expressed a desire for a series of courses that are better connected to each other, or that flow together more seamlessly. At the time of the study, the core curriculum worked as a series of nine classes that operated independently of each other, although there was somewhat of a built-in sequence enforced by prerequisites. Students would have liked to take courses in a sequence that better reinforced and built upon prior learning.

Discussion

A primary lesson from this study is that program administrators and faculty can learn a tremendous amount from students. Course evaluations are a common method of inviting student feedback, and while these can be useful at the class-level, they do not provide adequate data on programmatic outcomes. Course evaluations themselves have come under recent scrutiny, with some studies finding that they can be biased and can even have a negative correlation with other metrics of teaching effectiveness (Braga, Paccagnella, & Pellizzari, 2014; Schiekirka & Raupach, 2015; Stark & Freishtat, 2014). At the programmatic level, if feedback is collected in an intentional and systematic way, students are eager to share their experiences and suggest improvements. The results from a qualitative study, such as this one, can also be surprising, since they rely on the students themselves to set the direction of recommendations. Many of this study's results were unexpected, and we learned that a qualitative approach lends itself particularly well to educational program evaluation when researchers want students' voices to be heard (Creswell, 2013; Maxwell, 2013). Qualitative methods that emphasize the student perspective can yield rich results that naturally provide directions for improvement, often more so than outcome-oriented evaluation methods that attempt to evaluate training effectiveness using empirical measures of trainee performance (Maxwell, 2013). We feel that while it is important for a graduate degree in clinical research to address areas of competency as they have been defined by leaders in the field, it is equally important to provide training that meets

students' needs in both a useful and meaningful way, and to meet this second goal, students must be a part of the process.

Document Review

Many of the patterns from the document review pertained to this study's first research question: why do trainees choose to pursue research training? A few of these patterns have already been identified in the literature as reasons physicians choose the academic medicine career path: personal experiences, the desire to further their own professional goals, and the desire to teach (Borges, Navarro, Grover, & Hoban, 2010). Although known in the literature, all of these could be better incorporated into UC's MSCTR program. In core classes, students could share their personal experiences, if comfortable, and explain what led them to pursue research training. Another pattern from the document review, furthering professional goals, is discussed frequently in classes and is an objective underlying much of the MS program's requirements. However, it would be useful for students to regularly consider and reassess what their professional goals are, and what steps they should be taking to achieve those goals (Berling, 2013; Bland, 2003). Finally, the desire to teach other residents and fellows was a pattern in participants' application documents. This is surprising, as it is not obviously related to a research career, and students have not expressed this desire in past program evaluations. Currently, training on how to instruct others is not included within the core curriculum or any electives, although students do receive some training on mentoring relationships. The desire to teach and mentor has been documented in other areas of the literature that look at why physicians choose the academic medicine career path (Borges et al., 2010; Donnelly et al., 1996; Sanders, Fulginiti, & Witzke, 1992; Straus, Straus, & Tzanetos, 2006).

The two final patterns from the document review appear to be unique to the research-specific career path: the wish to improve clinical care and the desire to collaborate with colleagues. Neither of these are core goals under the MSCTR's stated training mission, but students enter the program hoping to gain these skills from their graduate education. The desire to improve their clinical care demonstrates students' commitment to their patients and their patients' families (Berling, 2013; Newman & Peile, 2002). In order to honor and make good use of this intrinsic motivation in students, instructional methods should be as applied and relevant to clinical practice as possible (Knowles, 1973; Supino & Borer, 2007). If students can see how their educational program can be useful in their roles as physician-scientists, their learning becomes much more meaningful. Finally, trainees enrolled in the MSCTR program in part to improve their ability to collaborate with others, including more experienced researchers, mentors, and biostatisticians. At the time of publication of this article, the MS does not currently address collaboration in-depth in its curriculum, although many classes require students to work on interdisciplinary teams for projects. Trainees' desire to learn how to work more effectively with their peers on research projects is consistent across both methods of data collection, suggesting it is a topic that could be more prominently featured in the MSCTR. The next generation of CTSA programs places heavy emphasis on team science (Begg et al., 2014; "Institutional Clinical and Translational Science Award (U54)," 2014), and program leadership is working to both create a "Collaboration and Team Science" course and also embed collaboration skills and practice throughout the training program.

Group Level Assessment

Results from the GLA primarily related to this study's second and third research questions: what have trainee experiences been like thus far, and what changes would trainees make to the program? Similar to the document review, the GLA presented equally robust and somewhat surprising results. Overall, the group suggested three major conclusions: trainees wanted more physician-centered coursework, they wanted a more directed curriculum, and the current curriculum felt too disjointed, with classes not relating well to one another. The discussion at the GLA was very positive, overall, but the three problematic themes above surfaced in a variety of ways as participants discussed the 10 questions (Table 2). Throughout the GLA, there were many moments when the group would be discussing some positive aspect of the MS, but then someone would clarify that the statistics courses were the exception, e.g., "I feel like the professors would try really hard to use clinical examples in class to make it relevant to my research . . . except in the intro to Biostats course, where all he would talk about was rolling a die."

Participants' first recommendation that more classes be geared specifically towards physicians was not overly surprising. Clinical researchers are a very unique type of physician – one that operates within a clinical setting dedicated to patient care, but that also views the clinic as a means of conducting research to improve clinical care (Miles, Price, Swift, Shepstone, & Leinster, 2010; Paes, 2010). Particularly in their statistics classes, participants often felt as if professors were teaching to statisticians instead of physicians with limited math backgrounds. Participants also often felt that the physician viewpoint in research is so unique, only other physicians can understand it and approach the content and instructional methods of a course appropriately, a suggestion that is supported in the literature (Miles et al., 2010; Paes, 2010). The MSCTR program incorporates many traditional biostatistics and epidemiology courses that include a large number of non-physicians on the class rosters, and professors also must teach to those students. Many of the program's statistics classes include graduate students in Biostatistics, Epidemiology, and Public Health, whose needs and interests are very different from physician-scientists (Shine, 1998). Participants in this study noticed the incongruity, and so the instructional methods and content of some courses did not meet their needs. Since this study, we have worked with faculty to refine existing courses (in particular, Introduction to Biostatistics) and to create new courses to better meet physician students' needs. The student feedback from these changes has been very positive. In particular, the new programming course, Statistical Computation and Software, has been a welcome improvement to programming instruction, in that it gives a broad overview of several commonly-used programming software available.

The second theme from the GLA related to the sequence of courses prescribed by the MS core curriculum and the flexibility allowed in elective/selective courses. Although participants made it clear they wanted and needed a high level of flexibility in the curriculum, they also consistently expressed a desire for a stronger sequence of courses. Participants are accustomed to the typical medical school model, where their curriculum is so directed, they rarely even register for the courses themselves; the courses are assigned to them. Participants in this study maintained exceedingly busy schedules, and so they did not often have time to look carefully through course listings (Berling, 2013). Participants usually had a general idea about the types of concepts they needed to learn in order to start their research careers, but they did not understand the specifics yet (Ross-Gordon, 2011). Participants suggested it would be much easier and more effective for

them if the program would tell them what is most important for them to learn, while still allowing some flexibility and choice for those who do have specific goals in mind (Berling, 2013; Ross-Gordon, 2011). Since this study, the MS program has helped students arrange their course schedules in a more sequential way, one that enforces advanced topics soon after mastery of introductory topics. This was achieved fairly easily using courses already in the curriculum.

Finally, the GLA concluded that the curriculum in its state at the time of the study was not sufficiently connected throughout. One student summarized that it often felt like she would take this class, then this class, then this other class, all sort of tangentially related to each other, but not nicely connected or truly cohesive across classes and instructors. This issue frequently occurred within students' statistics classes because students have a wide range of class options and different professors using different analysis software. Students also suggested this issue could be remedied by having another class or two that required them to pull together their previous learning about study design and statistical analyses. Too often, classes were focused on one specific topic, without attempting to make connections back to material covered in a prerequisite class or to reach across the curriculum to, for example, discuss the ethics of a given situation. We see this issue as connected to the directed, sequential curriculum students suggested in the second GLA theme. The problem of cohesion is remediable by enforcing a stronger sequence of core courses that are more directly tied to each other, an approach in both undergraduate medical education and other graduate programs in the sciences (Gutlerner & Van Vactor, 2013; Hirsh, Ogur, Thibault, & Cox, 2007). Similarly, the program could create a core faculty that works together to tailor courses to rely upon and relate to each other in more meaningful and cohesive ways (Hirsh et al., 2007). Students would still have flexible options for at least two of their elective courses, so they could select specialized topics relevant to their research interests, but the core classes would provide a solid foundation of consistent instruction in the essentials of study design and statistical methods. Since completion of this study, the MSCTR curriculum has changed in several key ways. The core curriculum dropped a previously required seminar that was wide-ranging and geared more towards students in the Epidemiology, Biostatistics, and Public Health programs. MSCTR students now take a tighter core of four key classes, then select one class each from four topic areas: research ethics, statistical programming, regression analysis, and advanced research methods.

There are two primary limitations in the current study. First, strictly speaking, results are not transferable to other clinical research programs around the country because we relied upon qualitative feedback from a small sample of students at one CTR training program. However, by providing thick descriptions of study results, it is our hope that faculty and administrators at other research graduate programs for physicians will be able to use our results to inform their own curriculum and course development. In addition, the sample we established included students from across representative strata according to gender, affiliation, position, and time in the degree so that results could at least be transferable to the entire UC MSCTR population. Second, we did not employ member checking, which could enhance the credibility to our conclusions. However, results from the GLA were endorsed by the participants themselves, and themes from the document review were very clear in the data.

Conclusions and Recommendations

Physicians choose the research career path within academic medicine for a variety of reasons. In order to better educate clinicians in the methods of conducting research, we should thoroughly understand their perspectives on what they hope to obtain from their training, and how their training experiences are or are not helping them achieve their goals. This study solicited and analyzed qualitative feedback directly from its key stakeholders, the students, to uncover several areas for improvement within UC's MSCTR that would not have been found using traditional quantitative methods of evaluation. The results of this study will help the MSCTR as it works to incorporate students' original training goals directly into its curriculum and instructional methods, as well as address student-identified areas of weakness within the program.
Based on this study's results, we suggest several recommendations to improve the training of physicians in clinical and translational research. First, training should be as applied and relevant as possible to make it directly applicable to clinical practice. This goal could be enhanced if more classes – particularly statistics classes – were physician-oriented. The curriculum of a clinical research training program for clinicians should be clear and directed, but with some flexibility and space within the curriculum for classes within areas of specialization. Collaboration should be integrated throughout the curriculum, and courses should follow a logical, interconnected sequence.

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