TRAINEE SECTION

Aiman Alak MD^{1*}
Katarzyna J. Jerzak MD^{1*}
Jaclyn A. Quirt MD^{1*}
Shannon J. Lane MPH¹
Patricia A. Miller PhD²
Shariq Haider MD¹
Donald M. Arnold MD MSc^{1,3}

**AA, KJ and JQ contributed equally to the work.*

¹Department of Medicine, McMaster University, Hamilton, Ontario, Canada

²School of Rehabilitation Science, McMaster University, Hamilton, Ontario, Canada

³Canadian Blood Services, Hamilton, Ontario, Canada

How to Succeed in Research During Medical Training: A Qualitative Study

Abstract

Purpose: The objective of this study was to examine the characteristics of the medical trainee (resident), the supervisor and the project that contribute to successful completion of resident-led research and publication in a peer-reviewed scientific journal.

Methods: Qualitative, interview-based study of Internal Medicine trainees and their supervisors. All interviewed trainees published at least one first-author research paper based on a project they completed during residency. Thematic analysis was used to explore key themes from interview transcripts. An iterative, team-based approach was used to develop a coding framework, which was then applied to the data and summarized. Six investigators independently reviewed and coded transcripts, discussed the data collectively and developed key themes by consensus.

Results: Thirty participants (15 residents and 15 supervisors) were interviewed. Three major themes for successful resident research projects emerged: 1) the resident is the project champion; 2) supervisors ensure feasibility and timeliness of the project; and, 3) limited time is a challenge that can be overcome. Residents were motivated by fellowship aspirations, prioritized the project and were genuinely interested in the content area. Supervisors were responsible for setting deadlines, limiting the scope of the project and ensuring feasibility of the study design. Existing research funds and infrastructure from other projects were frequently used by supervisors to support research done by trainees.

Conclusions: Successful resident-led research projects require leadership and motivation by the resident and engagement, reality-checking and deadline-setting by the supervisor. Responsibilities and expectations in the resident-supervisor relationship should be set early and adequate program resources and funding are required.

Manuscript submitted 11th March, 2014

Manuscript accepted 23rd May, 2014

Clin Invest Med 2014; 37 (3): E117-E123.

Correspondence to:

Donald M. Arnold MD, MSc, FRCP(C)
HSC 3V-50
1280 Main Street West
Hamilton, Ontario, Canada
Email: arnolddm@mcmaster.ca

Completion of a research project during residency training can be a formative experience [1,2]. The merits of such a project include enhancement of self-directed learning skills, critical appraisal, application of evidence-based medicine and experience in project management. Early exposure to research may stimulate interest in an academic career.

Surveys of trainees and program directors have identified barriers that lead to failure of research projects during residency, including lack of motivation, inadequate funding and lack of dedicated research time [3-7]; however, little information is available on the enablers of successful resident research. A deeper understanding of the factors that contribute to the success of resident-led research projects and a description of productive resident-supervisor relationships are needed to foster positive early experiences and encourage pursuit of a research career. This information would benefit physician training programs including those with a strong research focus, such as the Clinician Investigator Program in Canada [8]. The objective of this study was to describe the elements of a successful resident research project from the perspective of both the resident and the supervisor. Qualitative methods were used to explore contributing factors and to probe the resident-supervisor relationship in depth. The ultimate goal of this project was to provide residents, supervisors and training programs with guidance on how to improve trainees' ability to complete and publish a research project.

Methods

A descriptive, interview-based study was conducted to explore characteristics of the resident, the supervisor, the program and the project that contributed to the successful completion and publication of a resident-led research project.

Sampling and context

Purposive sampling was used to identify trainees from the Internal Medicine residency training program at McMaster University who published an original, first-author research paper (our definition of "success") between 2005 and 2013 and their supervisors. Purposive sampling ensures that the participants have personal experience with the phenomenon of interest so they can speak knowledgeably about the issue [9]. Authors of narrative reviews and case reports were not considered in order to ensure a high level of scientific inquiry and study quality. If the supervisor of the project was unavailable, any other eligible faculty member with supervisory experience was invited to participate. Eligible residents and supervisors were identified from a database of trainees' publications. Each participant was

invited by email and interviews were conducted consecutively. Although sample size cannot be predetermined in a qualitative study it was estimated from the study outset that 10-15 interviews with both supervisors and residents would be sufficient to reach data 'saturation'; the point in data collection where the interviewer begins to be able to predict responses and new ideas are not forthcoming [9-10]. Our research team included three residents, the residency program director, the residency research director and two qualitative researchers.

Data collection and analysis

An open-ended, semi-structured interview guide was developed by the investigators to explore and identify characteristics of the resident, supervisor, program and project (supplementary appendix) [11]. The interview was designed to allow participants the freedom to reveal and clarify concepts during the discussion. One of three resident-investigators (AA, KJ and JQ) conducted one-to-one interviews that lasted 45 – 60 minutes. Interviews were conducted in person, except for one telephone interview, digitally recorded and transcribed verbatim anonymously. Written informed consent was obtained from all participants. The study was approved by the Hamilton Integrated Research Ethics Board at McMaster University. Funding for this study was provided by a Resident Research Grant from the Regional Medical Associates of Hamilton, McMaster University.

Anonymized transcripts were imported into a coding software program for data management and analysis (NVivo 9, QSR International Pty Ltd. Version 9, 2010). Six of the authors initially reviewed six resident and supervisor transcripts independently to identify recurrent concepts, then all team members met in person to organize recurrent concepts into a coding framework using discussion and consensus. NVivo 9 was used to organize the data and to apply the framework to the transcripts. Six major categories were used to group the sub themes/recurrent concepts: 1) the resident; 2) the supervisor; 3) the project; 4) the research team; 5) the program; and, 6) suggestions for success. Trustworthiness of the coding framework was established through duplicate analysis (by JQ and SL) of a sample of three transcripts. Both investigators independently applied the draft coding framework to the same interview and then performed a coding comparison to assess the level of agreement between investigators. The level of agreement was high (90% or higher for all codes); nonetheless, codes with less than 95% agreement were reviewed and refined by consensus. This process was repeated three times until agreement for almost all codes was 95% or higher. Minor revisions to the coding framework and/or definitions of codes were

TABLE 1. Major themes and representative quotes on the features of successful resident research projects.

Theme	Description	Residents' perspective	Supervisors' perspective
The resident is the project champion	Primary responsibility for the project rests with the resident	"I essentially did most things. ... The initial research ethics board [application] ... the proposal for protocol. I designed the surveys, administered all the surveys. Then someone else did data collection. I did the manuscript writing. Put together all the results of the data, all the statistical analysis." (resident 06)	"When people have initiative and take the project as their own and they are truly intellectually engaged, things go better." (supervisor 10)
		"When I really want to finish something I will do everything to finish it ... cardiology was my dream and I knew that finishing the project, getting published, would help me in my goals so that always made me more eager to finish it." (resident 05)	"I think most of the motivation and most of the work was done by the resident and I think that at the end of the day it'll lose momentum if the resident isn't hugely motivated." (supervisor 06)
The supervisor ensures feasibility of the study design and sets timelines	Role of the supervisor is to limit the scope of the project, help choose a study design that is feasible and set realistic deadlines	"When [my supervisor] sets a goal he will do everything and he will try to keep everyone in the team on board just to reach that goal rather than just reach the middle of the project and then stopping. He is the one who if he does not hear back from me...he would email me and say 'what is happening with this and that?'" (resident 05)	"[The project] has to be limited. It has to have a clear boundary around it. Otherwise, you will never finish it. If you bite off too much, you will never be able to finish it and you will get frustrated." (supervisor 11)
	Balance supervisor involvement and resident independence	"You also need a supervisor who will not be on top of you, in other words harassing you to get things done, but you need to make sure that there is some gentle nudging along the way ..." (resident 07)	"If you just say 'go away and do it', you are antiquating your role as a mentor and they are not going to do well." (supervisor 11)
	Choosing the right supervisor	"It's very easy to find a mentor...what's more challenging is finding the right mentor" (resident 01)	"One of the factors that I think contributes to resident's success is a very involved mentor/supervisor. And when I say involved, I don't mean that they have to have their hands in everything but they need to be readily accessible and give the resident enough leeway to do what they need to do so that they can learn but at the same time, guide them through the whole process." (supervisor 15)
Limited time is a challenge that can be overcome	Residents prioritized the projects; supervisors were available and communicative	"I think maybe shopping around a little bit and seeing what people have to offer is a good thing to do... finding a mentor/supervisor and not just somebody who has a lot of snazzy qualifications but someone who you actually work well with personality-wise." (resident 14)	"I think the first thing is that you want a supervisor who publishes and actually regularly writes, reads and reviews manuscripts because if you do that on a regular basis I think it is much easier to help a resident do that as well." (supervisor 13)
	Collaborative research teams	"Lots of my own free time was sacrificed so maybe that is what is different about me than other people is that I was willing to make those sacrifices." (resident 14)	"You really do need to stay on top of them as well. It is our responsibility to make sure it gets finished. I think we can't feel shy to keep bothering the resident. You need to keep reminding them. But if you lay that out right away then the emails are not intimidating." (supervisor 09)
		"Another reason why resident research fails is because we are not their [supervisor's] number one priority. Their clinics are their priority...they have other commitments." (resident 13)	"I try and put in a team in place early and to have some structure just like I would for my Master's or PhD students... if there's a little team to support the resident then it's not always on the supervisor, it's a group. And it's a greater, richer learning experience." (supervisor 04)

made accordingly. Two investigators (JQ and SL) independently applied the coding framework to half of the transcripts using the NVivo 9 qualitative analysis software.

Through ongoing team meetings and discussions, an inductive approach was used to identify major themes that emerged from the data through consideration of the various codes. Data collection and thematic analysis were done iteratively and tracked with an audit trail [12-14]. This audit trail was composed of detailed notes of team meetings, which enabled us to track the discussions and decisions that led to the identification of the codes and subsequently the themes. Participants' quotes were then selected to represent the major themes. During the course of the interviews, participants provided accounts of prior experience with unsuccessful research (e.g., never published or negative experiences), which helped reinforce major themes.

Results

Thirty participants (15 residents and 15 supervisors), including 10 resident-supervisor pairs, were interviewed. At the time of the interview, residents had completed a median of four years of post-graduate training and had published a median of six papers each. Two of the residents had completed graduate degrees before residency and 14 of 15 residents pursued subspecialty training. Supervisors had been on faculty for a median of 15 years and had published a median of 87 papers each. Eight of the supervisors had at least 50% of their time protected for research, and 11 supervisors had either a Master's or Doctorate degree.

Three major themes about successful resident projects emerged: 1) the resident is the project champion; 2) the supervisor ensures feasibility and timeliness of the project; and, 3) limited time is a surmountable challenge for both resident and supervisor. Each theme with representative quotes is presented in Table 1.

The resident is the project champion

The research project was viewed primarily as the resident's responsibility. Successful residents were proactive in implementing and leading the study and demonstrated a strong ability to persevere. When residents stopped taking the lead, the project often failed.

Residents' motivation was a major determinant of the success of the project. They were able to see the project through to completion including maneuvering the "long and arduous" and even "massively tedious" process of publication (supervisor 05). Project topics that were of genuine interest to the resident and

aligned with their future career goals provided a strong incentive to finish. Residents also commented on the importance of choosing a supervisor carefully.

Supervisors ensure feasibility and timeliness of the project

Supervisors were responsible for ensuring that the scope of the project was limited such that the project could realistically be completed in the available time. Supervisors provided guidance on the selection of topics to ensure their novelty, and on the selection of designs to ensure their feasibility. Successful study designs often included case series, systematic reviews and retrospective cohort studies.

Supervisors recognized that "even exceptional residents need support" (supervisor 03) but emphasized the importance of self-directed critical thinking. Supervisors had to balance their involvement against the need for resident independence. They also recognized different learning styles; for example, some residents required more frequent oversight, while others preferred "big picture" leadership (resident 07). Successful supervisors provided sufficient but not excessive prompting.

Supervisors' roles included teaching research methods and providing access to statistical support and manuscript editing. Supervisors often used existing research infrastructure to advance resident projects including research databases, registries, or ongoing prospective studies. Supervisors identified funding as a serious barrier for resident research and described having to be "creative ... to try to find funds and also mix and match funds" to support resident projects (supervisor 08). Rapid communication between supervisor and resident maintained momentum, whereas lags in response times hindered progress. As one resident summarized: "if [residents] have a hard enough time trying to track [their supervisor] down, then the project is going to have little chance of succeeding due to lack of feedback and regular check points" (resident 01).

Projects tended to fail when supervisors lacked experience in research and publishing, when they did not adequately vet the topic or study design, or were not perceived as an ongoing source of support.

Limited time is a universal challenge that can be overcome

A theme among both residents and supervisors was the limited amount of time available for resident research projects. Successful residents prioritized the project and started early and successful supervisors were available and approachable. Protected research time instituted by the training program was highly valued by residents. Deadline setting was an essential time-management tactic used by supervisors and external deadlines,

such as research ethics board applications, grant or abstract submission deadlines, were particularly effective. The creation of research teams that included multiple residents and staff with complementary expertise maximized efficiency.

Based on our findings, recommendations for residents, supervisors and training programs have been developed regarding the successful completion of a resident research project (Table 2).

TABLE 2. Recommendations for the successful completion of a resident research project

Recommendations for the Resident

Take ultimate responsibility and 'champion' the project
Choose a project topic that is of genuine interest to you
Expect time delays, start early, plan for protected research time (if available)
Prioritize the project
Actively choose a suitable supervisor based on expertise and compatibility

Recommendations for the Supervisor

Limit the scope of the project and choose a feasible study design
Provide resources and advice based on the needs of the resident
Choose a project topic that is of genuine interest to you
Set deadlines
Be accessible and prompt the resident as appropriate

Recommendations for the Program

Provide adequate protected time for residents to do research
Provide funding for supervisors to support resident research
Facilitate linking residents with suitable supervisors

Discussion

We identified three themes of successful resident research projects: 1) The resident is the project champion; 2) supervisors ensure feasibility and timeliness of the project; and, 3) successful projects require planning and efficiency. Trainees were motivated by fellowship applications and other career goals, were dedicated to finish and to prioritize the project despite busy clinical schedules. Supervisors were responsible for negotiating deadlines, ensuring that the scope of the project was limited and that the study design was feasible. Supervisors were also responsible for ensuring the appropriateness and novelty of the research question. Early planning by the residents and the creation of a team of residents and staff with complementary expertise were common among successful projects. Our study also identified a key challenge of linking residents with suitable su-

pervisors and highlighted the fact that no single recipe for success could be applied to all projects.

Previous studies of residents [4,6,7,15-17], program directors [3,5,6,16], and research directors have identified other barriers to the successful completion of resident research projects [17]. Levine et al. surveyed Internal Medicine program directors and residents who were presenting abstracts at the American College of Physicians' annual meeting [5,7]. Residents identified lack of time, lack of funding, lack of faculty mentors and lack of research training and skills as barriers. Program directors also identified lack of time, lack of funding and lack of resident interest. DeHaven interviewed residents and programs directors to characterize qualities of a successful research environment among Family Medicine training programs [16]. They found that program support, protected research time, faculty role models and a research curriculum were essential [16]. Levitt interviewed residents and research directors from an Emergency Medicine training program and found that a dedicated research director, financial support, research awards and protected time for residents were linked to abstract presentations, but did not influence the number of published manuscripts [17]. Other investigators have promoted an evidence-based curriculum, incentives for supervisors and broad recognition of resident publications and presentations within the training program [19].

Our study is the first to examine factors that contributed to the successful publication of a resident-led research project from the perspective of both the resident and the supervisor using qualitative methods. These convergent perspectives added to the richness of the data. Individual interviews allowed us to gather novel insights with a degree of depth that was not achievable from surveys. In addition to confirming several barriers identified in previous reports, our results highlight strategies used to successfully overcome them including the role of an active supervisor and the importance of collaborative research teams. Our findings are particularly relevant as the number of clinician scientists continues to diminish [20], which may be partly due to research inexperience during medical training. Furthermore, practical guidance on the implementation of resident research will help maintain this skill in competency-based curricula. Such guidance may be particularly valuable given that the amount of time and resources dedicated to research are variable across training programs in Canada.

Strengths of our study were the academic setting, our experienced research team and the application of qualitative methodology to this area of medical education. Our study was conducted in a research-intensive university with prolific staff who were well-positioned to address the needs of trainees in re-

search. Having residents on our research team made for candid discussions with participants, rich discussions in our team meetings and an informed perspective on resident-led research projects [21,22]. Our team also consisted of experienced qualitative researchers who lead a rigorous analysis of this study. Our methods allowed us to describe the unique resident-supervisor relationship in depth, to uncover key themes and to develop recommendations which can be applied to academic training programs.

Our definition of “success” in resident research was limited to original, hypothesis-testing or hypothesis-generating studies that ultimately led to a first-author publication in a peer-reviewed journal. While conservative, this definition reflects a high standard and inevitably excluded some well-conducted research projects. Nevertheless, the achievement of a publication is commonly used to evaluate candidates for fellowships and academic posts. In this study, residents and supervisors had significant research experience and the core Internal Medicine residency training program included one month of protected research time, a 10-week lecture series on research methods, basic statistical support and a dedicated research director. Thus, the views of participants in this study may not apply to all residents and supervisors from the broad range of Canadian training programs. Another limitation inherent to this study design was the difficulty separating experiences from beliefs; however, both perspectives added to the richness of the data.

In summary, for resident research to be successful, the resident must ‘champion’ the project and the supervisor must limit its scope. Success in residency research depends to a large extent on the resident-supervisor relationship, effective planning and collaborations. The impact of our findings on residency research productivity and pursuit of a clinician-investigator career will require prospective evaluation. Future studies are needed to investigate research success among different trainees and different types of research.

Acknowledgments

Dr. Donald M. Arnold had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. AA, KJ, and JQ contributed to the design of the study, acquisition of data, and analysis and interpretation of the data. PM contributed to the design of the study and analysis and interpretation of the data. SL contributed to analysis and interpretation of the data. SH contributed to the conception of the study and analysis and interpretation of the data. DA contributed to the conception and design of the study, and analysis and interpretation of the data. All

authors were involved in drafting the manuscript, revising it critically, and giving final approval of the version submitted.

Financial Support

This study was funded by a Resident Research Grant awarded to KJ, JD, PM and DMA by the Regional Medical Associates of Hamilton, McMaster University. The sponsor was not involved in any aspect of the study. The authors report no conflict of interest.

References

1. Accreditation Council for Graduate Medical Education. ACGME program requirements for graduate medical education in Internal Medicine. http://www.acgme.org/acgmeweb/Portals/0/PFAssets/2013-P-R-FAQ-PIF/140_internal_medicine_07012013.pdf. Accessed May 14, 2013.
2. Royal College of Physicians and Surgeons of Canada. Objectives of training in the specialty of general Internal Medicine. <http://rcpsc.medical.org/information/?specialty=136&submit=Select>. Accessed May 14, 2013.
3. Alguire PC, Anderson WA, Albrecht RR, Poland GA. Resident research in internal medicine training programs. *Ann Intern Med*. 1996;124(3):321-328.
4. Gill S, Levin A, Djurdjev O, Yoshida EM. Obstacles to residents' conducting research and predictors of publication. *Acad Med*. 2001;76(5):477.
5. Levine RB, Hebert RS, Wright SM. Resident research and scholarly activity in internal medicine residency training programs. *J Gen Intern Med*. 2005;20(2):155-159.
6. Silcox LC, Ashbury TL, VanDenKerkhof EG, Milne B. Residents' and program directors' attitudes toward research during anesthesiology training: a Canadian perspective. *Anesth Analg*. 2006;102(3):859-864.
7. Rivera JA, Levine RB, Wright SM. Completing a scholarly project during residency training. Perspectives of residents who have been successful. *J Gen Intern Med*. 2005;20(4):366-369.
8. Hayward CP, Danoff D, Kennedy M, Lee AC, Brzezina S, Bond U. Clinician Investigator Training in Canada: A Review. *Clin Invest Med*. 2011;34(4):E192-E201.
9. Guest G, Namey EE, Mitchell M. Collecting qualitative data: a field manual for applied research. Thousand Oaks, California: Sage; 2013.
10. Guest G, Bunce A, Johnson L. How many interviews are enough? An experiment with data saturation and variability. *Field Methods*. 2006;18(1):59-82.
11. Sofaer S. Qualitative methods: what are they and why use them? *Health Serv Res*. 1999;34(5 Pt 2):1101-1118.

12. Strauss A CJ. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Newbury Park, California: Sage; 1998.
13. Burnard P. A method of analysing interview transcripts in qualitative research. *Nurse Educ Today*. 1991;11(6):461-466.
14. Mason J. *Qualitative Research*. Thousand Oaks, California: Sage; 2006.
15. Vinci RJ, Bauchner H, Finkelstein J, Newby PK, Muret-Wagstaff S, Lovejoy FH, Jr. Research during pediatric residency training: outcome of a senior resident block rotation. *Pediatrics*. 2009;124(4):1126-1134.
16. DeHaven MJ, Wilson GR, O'Connor-Kettlestrings P. Creating a research culture: what we can learn from residencies that are successful in research. *Fam Med*. 1998;30(7):501-507.
17. Levitt MA, Terregino CA, Lopez BL, Celi C. Factors affecting research directors' and residents' research experience and productivity in emergency medicine training programs. *Acad Emerg Med*. 1999;6(4):356-359.
18. Palacio A, Campbell DT, Moore M, Symes S, Tamariz L. Predictors of Scholarly Success among Internal Medicine Residents. *Am J Med*. 2016;126(2):181-185.
19. Rothberg MB. Overcoming the obstacles to research during residency: what does it take? *JAMA*. 2012;308(21):2191-2192.
20. Schafer A. The vanishing physician-scientist? *Transl Res*. 2010;155(1):1-3.
21. Britten N. Qualitative interviews in medical research. *BMJ*. 1995;311(6999):251-253.
22. Dickey-Bloom B, Crabtree BF. The qualitative research interview. *Med Educ*. 2006;40(4):314-321.