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Strategies for Mentoring Success: A Qualitative Study of Award-Winning Research Mentors
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Editor-in-Chief, *Perspectives on Medical Education*

Dear Dr. Driessen:

On behalf of our co-authors, we are proud to submit "Strategies for mentoring success: A qualitative study of award-winning research mentors" for consideration. We respectfully share this manuscript as an *Original Research* submission. This manuscript is being submitted solely to Perspectives on Medical Education and the results have not been previously published elsewhere.

This project is personal for us. It originated after the first and senior authors met to establish a mentor-mentee research collaboration, but the senior author acknowledged that he did not know how to do so effectively. Together we searched the literature but found little practical guidance on how to mentor trainees in medical research. Out of that shared realization, we decided to attempt to fill the gap by asking expert mentors about their experiences in mentoring and the strategies that they employ for success with their mentees. Our end result is twelve very practical and actionable strategies for effective mentoring. It is our hope that other mentor-mentee partnerships will benefit from our findings as much as we have.

Please note that we recognize our qualitative manuscript is over the 3500-word limit for your journal and also that our tables are on two pages. We elected to provide the full qualitative story but are happy to revise if the journal deems this necessary.

Thank you for your consideration.

Best regards,

Alexandra Highet, MS and Brian George, MD MA

Title: *Strategies for Mentoring Success: A Qualitative Study of Award-Winning Research Mentors*

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ABSTRACT

Purpose: The value of research mentorship in academic medicine is well-recognized, yet step-by-step practical advice for how to develop and sustain effective mentoring partnerships can be hard to find. This study explored the strategies that award-winning faculty mentors utilize in collaborating with their medical student mentees in research.

Methods: For this qualitative study, the authors invited physician recipients of an institution-wide mentorship award to participate in individual, semi-structured interviews during July and August 2018. Following interview transcription, the authors independently coded the text and collaboratively identified common mentoring strategies and practices via a process of thematic analysis.

Results: Nine physician mentors, representing a mix of genders, medical specialties and types of research (basic science, clinical, translational, and health services), participated in interviews. The authors identified 12 strategies and practices from the interview transcripts that fell into 5 categories: Initiating the partnership; Determining the research focus; Providing project oversight; Developing mentee research competence; and Supporting mentee self-efficacy.

Conclusion: Award-winning mentors employ a number of shared strategies when mentoring medical trainees in research. These strategies may serve as a guide for others who wish to improve their research mentoring skills.

INTRODUCTION

Mentorship is widely recognized for its impact on research productivity, professional satisfaction, and other metrics across academic medicine.[1–10] Similarly, early research mentorship of medical students is considered the keystone to launching impactful clinician-scientist careers.[11,12] However, barriers to mentorship exist across academic medical institutions[2,13,14 15–18] and as a result, few medical students report having an established faculty mentor.[19,20]

This problem might be addressed if mentors could more easily deploy practical mentoring strategies to improve their mentoring practices. In response to the need for education in this domain, mentor workshops and didactic programs have become increasingly prevalent within medical schools and health sciences departments.[21–25] Despite these excellent training programs, there remain very few resources that explain in a step-by-step, practical fashion how to initiate, grow, and sustain a mentoring relationship. Furthermore, we also lack evidence-based best practices specific to the unique needs of faculty who mentor medical students in research.[26,11]

Investigating the experiences of faculty mentors who have been formally recognized for their mentoring expertise of medical students can support the development of these best practices. One previous study examined recommendation letters for senior faculty recipients of an institutional mentoring award written by their mentees;[27] but no prior studies have directly examined awardee mentors' approaches. We therefore conducted a qualitative study to explore the firsthand perspectives of award-winning faculty mentors and to identify the common strategies that they employ with their medical student mentees in research. We present our findings here to support

other faculty in their mentoring efforts, as well as to encourage the codification of mentoring best practices specific to our field.

METHODS

OVERVIEW

We conducted an exploratory qualitative analysis of individual, semi-structured interviews with faculty mentors at a single academic institution. We chose a qualitative approach to permit a deeper exploration of the experiences, perceptions and behaviors of the individuals within our study population. We elected to interview our subjects as this data collection technique is well-suited to exploratory research.[30] Semi-structured interviews were specifically chosen given their utility when, as in our study, interviewees can only be interviewed once.[31]

STUDY POPULATION

Utilizing purposive sampling, we identified a cohort of subjects who were physician recipients of the University of Michigan's Distinguished Clinical and Translational Research Mentor Award (MICHR Mentor Award). This award recognizes health sciences faculty who "foster the intellectual, creative, scholarly, and professional growth of their students, fellows, and trainees in the areas of clinical and translational health and research."[32] It is bestowed annually following a 7-month process involving soliciting of nominations and a NIH-style review committee.[15] Nomination packets include the nominee's curriculum vitae; a list of previous mentees; and letters of support from previous and current mentees as well as from a chair, dean or senior colleague. A scoring rubric, informed by a suggested list of competencies for effective mentoring, is used to evaluate nomination packets and select awardees.[15,33]

INTERVIEW INSTRUMENT

The interview instrument (Supplement 1) was developed by the authors (AH, HBA, CE), piloted

with the senior author (BG), and reviewed by several other senior faculty who are experienced

mentors or engage in mentorship research. Interview questions were designed to elicit the

strategies and practices employed throughout the course of a mentoring relationship. We asked

interviewees to discuss experiences with mentorship in general as well as specific recollections

of their most successful medical student mentee.

DATA COLLECTION

In July-August 2018, we invited all ten physician recipients of the 2017 and 2018 MICHR

Mentor Award to participate in semi-structured interviews. One author (CE) conducted and

audio-recorded all 30-minute interviews in person or via phone. Each interview was initiated

with an informed consent process. In order to preserve subject anonymity, the interviews were

transcribed with unique identifiers and all identifying text was removed prior to transcript

analysis. No incentives were given. Permission to conduct this study was approved via an

exemption from the University of Michigan Institutional Review Board.

DATA ANALYSIS

We utilized a process of thematic analysis that incorporated both inductive and deductive

approaches.[34] The coding team included one undergraduate student (KY), one medical student

(AH), one surgical fellow (DK), and a qualitative researcher with expertise in socio-cultural

anthropology (HBA). The study question and interview transcripts were used to develop an

initial codebook. Transcripts were then independently analyzed in order to develop more detailed

individual codebooks and ultimately, through an iterative process of consensus building and

further independent coding, a unified codebook.[35] All transcripts were then re-coded using this

final codebook in MAXQDA version 2018.2 (VERBI Software GmbH, Berlin, Germany).

The coding team met frequently to discuss progress and discordances in coding. Following

coding completion, we extracted themes from the transcripts and constructed a final list of

strategies and practices from the most prevalent themes. Working both independently and

collaboratively throughout this process enabled us to mitigate the risk of "groupthink" while

facilitating identification and exploration of differences.[36] To assess transferability and

credibility, we also facilitated a form of member checking[37,38] in which a group of medical

education researchers with experience in mentoring reviewed and provided input as to the

authors' articulation of the results.

REFLEXIVITY

Reflexivity, the process by which researchers' characteristics, perspectives and assumptions

influence data collection and interpretation, was explicitly coded and discussed throughout our

process given the impact of our differing backgrounds and levels of training, our own

experiences with mentorship, and the hierarchical nature of the medical education system on our

transcript interpretations.[38,39]

RESULTS

Nine mentors consented to give interviews (90% response rate). All mentors hold an MD degree

and five hold dual degrees. All hold full professorships, and all but one hold institutional

leadership positions in administrative, clinical or research capacities. Four mentors are basic

science researchers while five engage in clinical, translational or outcomes research. Five

mentors identify as women.

Through the coding process and analysis, twelve strategies and practices for effective mentorship

emerged (**Figure 1**). These are presented within five categories and sub-categories below. A

table of illustrative quotes is provided for each subcategory (**Tables 1-5**).

I. Initiating the partnership

1. Establish new mentor-mentee partnerships intentionally

All mentors described meeting with medical students prior to formally entering into a mentor-

mentee relationship. Many described their processes for assessing the student's commitment,

reliability and passion for research. Mentors also used this meeting to explain their scope of

research and gauge interest. One mentor described, "*I spend about five to seven minutes talking*

to them about the content of what the research is. And that is a very important five to seven

minutes because if they glaze over with boredom … it's not going to work."

Two mentors mentioned giving small assignments, such as a short literature review, to observe

the student's work ethic. One explained,

> *I'd be curious if they've done a little bit of homework. And if they haven't … I'd say,*
>
> *'here's a paper we've published. See if this interests you. And set up a meeting in a*

month or so if it does, and we can talk about where you'd want to see this research

going.'

Mentors would at times decline to work with a student following the initial meeting but acted as resources in these instances by connecting the student with other faculty.

Finally, several mentors touched on their commitment to establishing diverse mentor-mentee partnerships. One cautioned that assessing 'fit' in potential mentees beyond an alignment of mentor-mentee topical interests can impose bias and selecting "*people who look like me*" can directly counteract personal and institutional diversity goals.

2. Discuss goals and expectations

Similarly, mentors sought early on to understand the student's research goals. One asks simple, direct questions: *"'What are you looking for? What are your goals? What would you like to accomplish?'"*

Mentors also elicited the potential mentee's anticipated time commitment, including how they would balance the research with their other demands as a medical student. One mentor consistently laid out a "*mentorship contract*" that explained their general mentoring style and preferred frequency of meetings, as well as the project responsibilities that the mentee should anticipate. Mentors also noted that conveying their own expectations upfront helped to establish a clearer understanding about mentor and mentee project roles and responsibilities. Some felt

that this permitted the mentee to reconsider working with the mentor, if goals and working styles were not aligned.

II. Determining the research focus

3. Identify a research topic aligned with the mentee's interests

After committing to work with a medical student, mentors described approaches for determining the right research topic. Mentors emphasized that matching the mentee to a research topic based on the mentee's interests, rather than fitting research to the mentee, was crucial.

One mentor described, "*I try and draw out their interests to figure out what they're interested in. And then I draw a circle around that. And then I figure out which part of that circle overlaps with my circle, then find something in the middle.*" Another mentor developed "*a menu of three to four options*" for projects. The objective described in several interviews was to co-determine a research topic that would best engage the mentee.

4. Generate the research question collaboratively

Mentors described narrowing the broader research topic into a specific research question as a critical learning opportunity. As one reflected, "*I've found that if I assign a student to a project … that their heart may not be in it. But if they look at the multitude of projects, and say, 'I really like this one,' then they're much more likely to just follow through on it.*"

Engaging the mentee in the research question development was thought to build the mentee's research capability as well as their sense of ownership over their project. Common strategies to

involve the mentee were through literature reviews and background research. One mentor

described the positive end result:

> *My mentee is sitting in front of me, and they'll say, 'I just spent two days doing a*
>
> *literature review, and I can't find the answer to X.' And then I'll say to them ... 'you just*
>
> *figured it out ...You're the only one in the world right now wondering, what is the answer*
>
> *to that? So let's do a research project on that.'*

The concept of the mentor as a wellspring of research ideas also emerged. Several mentors

reflected that they have limited bandwidth to pursue their accumulated thoughts; sharing these

gave the mentee direction and facilitated the development of mature research questions that

would not otherwise be investigated.

III. Providing project oversight

5. Set short-term project goals

Once the research question was defined, mentors emphasized their responsibility to support the

mentee in moving their project forward. Teaching project management skills was thought to be

particularly important if the medical student had never initiated a research project before. One

mentor's strategy was to define incremental project milestones and overall timelines based on

both individuals' availabilities and time commitments.

Another mentor described outlining short-term goals:

We would say, 'well, if you're going to do a summer-long research project, that means

you have three months. Let's just work backwards. You have to figure out what you want

to do by this date. You want to kind of get IRB approval by this … If it's a year, we have a

little bit more flexibility.'

Some mentors used tools such as individualized development plans or 3x5 index cards to define

goals. These provided important structure for the mentee and enabled the mentor to track the

mentee's progress. As one explained, "*I ask, 'what are you going to have in the next two weeks?'*

And then I write it down."

6. Schedule regular meetings

All mentors mentioned the importance of periodic face-to-face meetings for building rapport as

well as keeping projects on track. Three explicitly described scheduling weekly one-on-one, in-

person meetings, while others checked in with mentees during weekly or bi-monthly lab

meetings. One reflected, "*I just realized that the only way to make those meetings happen is to*

make them required, and that it's on a set schedule."

Consistent meetings allowed the mentee time to ask project-related questions as well as seek

professional development. One mentor described their process:

Every Monday and Tuesday morning is basically booked between 8:00 and noon to meet

every half hour with each of my trainees. And that time is for however they want to use it,

career advice, going over specific, you know, questions that they have related to their

research at the bench, or reviewing a manuscript.

7. Address challenges directly

When asked about their experiences in navigating research-related roadblocks with their

mentees, multiple mentors stressed the importance of confronting the challenge directly and

partnering with their mentee to work through it. One mentor offered that "*If a manuscript gets*

rejected or other things like that, we just look to see, 'well, what are our next steps, what are our

options, and how do we decide the best thing to do next?'"

Empathetically exploring the basis for challenges that arise within the mentor-mentee dynamic –

such as when either party is not meeting shared expectations – is equally important. One mentor

gave examples, and suggested addressing the matter directly while remaining considerate of the

mentee's circumstances:

> *Someone is not showing up. Someone is coming in chronically late. Someone has*
>
> *deadlines, and they're not meeting them. Intervention would be, 'is there something*
>
> *going on that we need to know about? You know, we thought that we were pretty clear*
>
> *about when this had to be done, and it wasn't done. Just wondering, what's going on?'*

IV. Developing mentee research competence

8. Provide initial close supervision, then progressive autonomy

Several mentors described monitoring their mentees' initial work closely. Many reflected that new mentees needed substantial guidance and specific tasks to begin with but were given more independence as they strengthened their research skills and their understanding of the project. Several emphasized that the mentor be aware of the medical student mentee's baseline research experience and skills, with one offering, *"I think you also have to realize what stage the mentee is at ... what is it that a medical student is able to do? So I've had to kind of think back and say, 'how do I really go slowly and guide someone?'"*

Mentors stepped back as the mentee developed proficiency and confidence, as one described:

> *At the beginning, [student] needed more supervision, but then [student] really ran with the ball. [Student] did really well. But I never leave students by themselves without making sure they know what they're doing. They're safe, and they know how to do the experiments.*

9. Target and teach specific skills

Mentors discussed their responsibility to invest effort in their mentees' growth as researchers. To do so, mentors defined specific skills to focus on with their mentee at the project outset. Commonly targeted skill domains included hypothesis generation, study design, and grant writing, as well as public speaking, presenting, leadership, and other "soft skills." Mentors then coached their mentees in these specific areas.

For example, one mentor focused on quantitative skills: "*I sit down with the medical student, and I will walk through with them, 'here are the results of the statistical analysis, and here's what it means. And here are the additional questions that these results raise.'*"

10. Integrate the mentee within the research team

Mentors described several advantages to involving their mentees within their broader research groups, including hands-on instruction from other lab members; education through journal clubs and didactics; and opportunities for the mentee to obtain feedback from the group at lab meetings. One mentor reflected that "*It helps to have this team-based approach … the analyst and the student or the trainee can do a lot of work together, and then they can call me if I'm not in town.*"

Assigning one or multiple 'junior mentors' could also give the mentor feedback on the mentee's professional conduct and behavior, including trustworthiness and ability to work within a team. One mentor explained that "*My eyes and ears will be the project manager who meets with them more regularly. And they could then be the early detection device. So if there's issues, they would let me know. And then we could intervene.*"

V. Supporting mentee self-efficacy

11. Encourage and provide positive reinforcement

Mentors considered fostering an encouraging research environment as foundational to successful mentorship. Several mentors emphasized giving frequent positive feedback, with one explaining

that *"I try really hard not to make [my mentees] ask me for praise … Instead, I just give the praise upfront."*

Mentors also celebrated their mentees' small breakthroughs while emphasizing that standard metrics of research success – such as accepted papers or grants – are not the only significant milestones. Likewise, mentors consciously modelled resilience. One described emphasizing that setbacks were inevitable elements of the research process:

> *When … a paper gets rejected [or] the grant doesn't get a good score, I share it with the lab, and I tell them, 'you know, this happens, but we'll continue to work.' And they see that I overcome, so I think that helps.*

12. Highlight and promote the mentee's contributions

Mentors supported their mentees' developing researcher identities through emphasizing their contributions and promise. Some mentors reflected that their medical student mentee, as the most junior member of a diverse research team, would often doubt their ability to contribute. One mentor confronted this proactively by pointing out the mentee's valuable medical knowledge:

> *I reiterate to them again and again and again that what they bring to the table in research is content expertise.*

The importance of formally acknowledging the mentee's contributions, if mentees meet expectations for authorship, was a common theme. Several mentors emphasized the obligation of

senior researchers to elevate and advance their mentees. One simply stated, *"The only*

recognition a mentor needs is the success of their mentee."

DISCUSSION

This study utilized purposive sampling, semi-structured interviews, and thematic analysis to

explore the strategies and practices of award-winning physician research mentors. We identified

twelve discrete strategies specific to the medical student mentee context and learner level. To our

knowledge, this is the first study that has sought concrete mentoring wisdom from the firsthand

experience of a celebrated mentor cohort. These results can guide faculty in their mentoring skill

development and further support the development of research mentoring best practices for

medical students.

Choi and colleagues recently offered that "a dynamic culture of mentorship is essential to the

success of academic medical centers and should be elevated to the level of a major strategic

priority."[40] This vision will not be realized without clearer, more practical guidance on how to

mentor medical trainees. A 2010 systematic review of qualitative research in academic medicine

identified the personal characteristics and qualities of effective physician mentors and called for

further qualitative studies.[3] Other work has explored mentors' responsibilities as well as the

elements of successful mentor-mentee partnerships.[5,18,27–29,41,42] Our study therefore builds on

prior research by describing how mentors can translate their intentions into concrete behaviors

that are key to effectively mentoring medical students in research.

The recognition of the value of mentorship is not unique to medicine. The National Research Mentoring Network (NRMN) was founded to mitigate the decline of the clinical and translational research workforce and to address specific barriers to mentorship for underrepresented minorities in biomedical science.[43–46] Over the past decade, the NRMN has developed mentor competency assessment tools[47] and evidence-based curricula such as the *Entering Mentoring* seminar.[48,49] Several of our mentors' strategies echo recommendations from the NRMN and biomedical science literature. For example, many mentors described applying team science concepts to mentorship by connecting their mentees with other research or lab members[50,51] and enabling simultaneous mentoring from multiple individuals with different expertise.[52,53] The balance of autonomy and oversight that our mentor interviewees described, however, takes into account the unique medical student learner level. For example, strategies such as scheduling consistent meetings, teaching specific skills, and providing positive reinforcement address the unique context of the academic medicine learning environment. As such, the empiric strategies described here have specific relevance for the unique needs of the physician mentor community and their medical student mentees.

Several themes emerged from our findings. Mentors echoed the importance of clear and proactive communication, from their first conversations with potential mentees to challenges arising in their research or difficulties in the mentor-mentee dynamic. Positive encouragement was also recognized as vital throughout the research process. Finally, our mentor cohort repeatedly emphasized that the relationship should be mentee centric. Strategies such as clarifying the mentee's objectives, understanding the mentee's baseline skills, and guiding the mentee through research roadblocks underscore that the focus must be on the medical student's

development, instead of the research project itself or the mentor's goals. Certain other strategies, such as declining to work with potential mentees and assigning 'junior mentors,' may be interpreted as contradictory to the mentee-centric vision. These reflect an important tension between the ideal state of research mentorship and the reality of academic medical research. All mentors must navigate these challenges and our results in many ways accommodate that reality.

Our mentors' experiences add further evidence for the bidirectional benefits of mentorship, particularly the personal joy and professional satisfaction that mentoring generates for the mentor.[1,4,54] Several mentors reflected on the impact of their own mentors on their careers, professional development, and confidence, and noted their sense of responsibility to pay this forward. This 'legacy of mentorship' reinforces our obligation to embed high-quality mentorship within medical students' trajectories to sustain future generations of mentors.[27,55]

To that end, we identified a critical need for increased institutional investment in mentorship. Many within our cohort discussed struggling to balance mentoring with their clinical, research, and administrative responsibilities and needed more formal support for the significant time investment of mentoring. One stated:

> *...teaching and mentorship [are] really important. That does not translate into what we are incentivized or rewarded for doing. And because of that, anything that people do to be a good mentor or support their medical students or otherwise, is on your own time [...] it is super frustrating.*

This adds weight to calls for increased programmatic support and sustained funding for mentorship across institutions.[16,40] Infrastructure that supports faculty with the educational tools and training for effective mentoring and rewards time for mentoring is critical; otherwise, mentorship models will not flourish.

Potential limitations of this study include our single center setting and purposive selection of an award-winning mentor cohort. As such, we may have missed important strategies and practices adopted by other highly skilled mentors. We also interviewed mentors at a large, research-oriented academic medical center with a strong cultural emphasis on mentorship;[15] therefore, our findings may not apply equally well to other learning environments and institutional cultures.[3] Finally, the cohort of senior researchers we interviewed may limit the generalizability of our findings to mentors at earlier stages of their careers.

As a final note, we recognize that our findings may not serve every mentee. Despite the potential for mentorship to elevate women and minority group individuals,[56–62] studies have repeatedly illustrated that these groups have decreased access to and quality of mentoring compared with their majority counterparts.[1,2,63–68] Existing paradigms of mentorship are evidently not meeting all trainees' needs.[1,44,69,70] Unfortunately an investigation of these challenges was outside the scope of this study Further investigation into how mentees differentially access research mentorship and which strategies lead to successful outcomes is critically needed, as are increased efforts to strengthening diversity, equity and inclusion in medical student mentoring.

Mentorship is universally acknowledged for its impact on the careers of physician scientists. We hope that our findings will guide other physician research mentors and medical student mentees in finding success within this critical domain of medical education.

Initiating the Partnership	1. Establish new mentor-mentee partnerships intentionally
	2. Discuss goals and expectations
Determining the research focus	3. Identify a research topic aligned with the mentee's interests
	4. Generate the research question collaboratively
Providing project oversight	5. Set short-term project goals
	6. Schedule regular meetings
	7. Address challenges directly
Developing mentee research competence	8. Provide initial close supervision, then progressive autonomy
	9. Target and teach specific skills
	10. Integrate the mentee within the research team
Supporting mentee self-efficacy	11. Encourage and provide positive reinforcement
	12. Highlight and promote the mentee's contributions

Figure 1. Strategies and practices for effective mentoring.

Table 1. Illustrative quotes for mentoring strategies: Initiating the partnership. Based on a single-institution qualitative study of award-winning mentors, 2018.

Strategy/Practice	Illustrative quote
1. Establish new mentor-mentee partnerships intentionally	*If ... they haven't done their background work, then that shows a lack of commitment and a lack of seriousness to take it seriously. I want to know if they're committed, specifically, to the things that I can help them with.* *I try and avoid over committing, so I say no to a lot of people.* *I've helped students to meet with other faculty who I think perhaps have careers that are more aligned with where I think the medical student at that particular point in their career thinks they want to go, and I would call that a success.*
2. Discuss goals and expectations	*I will explain to them that, in a nutshell, that there are some medical students who really need that time period, be it the year-out or be it the ten weeks, to recharge and to ground themselves again after a really tough year of studying ... And that there are others who are, for lack of a better word, gunning through the whole thing. And what I tell them is that I am happy to meet them in either place, but that I need them to at least put in a certain amount of work to make it worth my time to even meet with them once a week.* *I try and walk them down the scope ... so this is the scope of the project, this is the expectation, and this is the timeline. And by the end of the summer, we should do this. By the end of the year, you should have accomplished this. I try to be pretty clear of expectations but also try and link how those expectations link to the next step. ... [The] bigger research narrative.*

Table 2. Illustrative quotes for mentoring strategies: Determining the research focus. Based on a single-institution qualitative study of award-winning mentors, 2018.

Strategy/Practice	Illustrative quote
3. Identify a research topic aligned with the mentee's interests	*We discuss what the projects are and what we work on. And then you're just talking to them, and see what would you like to do? Are you more interested in understanding how [topic], or are you more interested in testing [topic], or are you more interested in looking at [topic] and doing more translation of a project?* *One of the things that I really believe in is once the students are presented with the different projects going on in the lab, that they come up with a question that they would like to answer.*
4. Generate the research question collaboratively	*I'll often have a theme and an idea. And then I'll send them out into the world to gather information and come back to me.* *I don't hide my ideas because I don't have enough time in the day to transform all my ideas into funded research projects and manuscripts.*

Table 3. Illustrative quotes for mentoring strategies: Providing project oversight. Based on a single-institution qualitative study of award-winning mentors, 2018.

Strategy/Practice	Illustrative quote
5. Set short-term project goals	*If it's a case where a student has a summer, and they are interested in being with us for the summer, then with the project I'll carve out the new expectations for getting certain pieces done during that time. So, yes, there are expectations, but the expectations have to be realistic given the student's time.* *For example, every week they have to give me a 3" x 5" card where on one side is a list of what they did last week, and the other side is a list of the things they intend to do the following week, and I collect all of those.*
6. Schedule regular meetings	*I would have one-on-one meetings with a student, either on a weekly basis or every two weeks, so that I would have very close interactions with the student.*

		We have lab meetings, we talk about where we are, and what we need to get done. And then the next week, we go over what those things are, or they tell me where they are, why it didn't work out, or what the story is.
7.	Address challenges directly	*You have to find out what would be going on that would be, what's the ideology and the failure, what's behind it? And then you try to attack that. If they bit off more than they can chew, then you tell them, 'look, there's always another day.'*
		I have had frank conversations. But again, I only learned how to do that after doing this for ten years because they're often uncomfortable conversations that bring up negative affect ... you have to be able to sit with it, that this is going to make this mentee sad, but it's got to be said.

Table 4. Illustrative quotes for mentoring strategies: Developing mentee research competence. Based on a single-institution qualitative study of award-winning mentors, 2018.

Strategy/Practice	Illustrative quote
8. Provide initial close supervision, then progressive autonomy	*With all of my trainees, I start them with a very specific task that gives them the ability to understand what the broader questions are, what the broader approaches are.* *Once they get it... and they understand what you're doing, you can perhaps back off a little bit and give them more time or flexibility.*
9. Target and teach specific skills	*I think writing, public speaking, coming up with clearer research questions, generally are things I focus on.* *We spend a lot of time actually reviewing use of language and construction of manuscripts as well as presentation of work in PowerPoint for when you're giving talks.*
10. Integrate the mentee within the research team	*The lab manager loves teaching, and so she would teach the person how to do the experiments, and at the beginning, do it, do the experiments with them, but then give them more independence.* *We have a lab meeting every week. That's an opportunity for everybody to show what their work during that week and discuss problems and how to solve them.*

Table 5. Illustrative quotes for mentoring strategies: Supporting mentee self-efficacy. Based on a single-institution qualitative study of award-winning mentors, 2018.

Strategy/Practice	Illustrative quote
11. Encourage and provide positive reinforcement	*I've had mentors that I had no idea what I was doing, but they were just so darn positive about it that it moved me forward ... I think being positive is really important.* *I'll say to them, God, this thing you turned into me, I would give this a 97% if I was giving it a grade. This is really, really good. You amazed me, 97% ... But my job is to make you even better. And so we're going to spend the next half hour getting it to 100%.* *You don't celebrate the paper getting accepted. You go out to dinner with friends, and you celebrate that you submitted the paper, and got it done. You have to celebrate and have a little positive affect about these little milestones you achieve.*
12. Highlight and promote the mentee's contributions	*I think you learn, if you had good mentors, you want to pay it forward. And I've had great mentors [...] and mentors put you forward when they could have done it. I've had mentors that said, you know what, I don't need to, they've completely edited my paper. And they'll say, you know what would be good for you? If I'm not even on this paper. You don't even need to put me on this paper.*

Supplement 1. Interview Guide

Note: Questions in bold are open-ended; bulleted questions below these are more specific and intended to probe further. We do not anticipate obtaining an answer for every question at every interview.

Thank you for agreeing to talk to me today. There is little published guidance about how to effectively mentor medical students for research. For our project, we are interviewing awarded mentors to search for strategies or practices that foster successful mentorship relationships between medical students and research faculty. I appreciate you taking your time to contribute your perspectives because they will play an important role in our study, and hopefully future relationships. This interview is going to take about 30 min. We will be recording this interview and storing both the recording and transcription. If you don't want to or can't answer any question, I can skip to the next one. Does that sound ok to you?

What does mentorship mean to you?
- How do you define success in a mentoring relationship?

What specific experience do you have with mentoring medical students?
- How many medical students have you mentored?

I am now going to be asking questions about the process of mentorship and your actions. It would be great if you can focus your answers using examples from specific relationships in which your strategies have been successful.

What strategies do you use for finding mentees?
- Do you seek out mentees, or do they approach you?
  - Have you been paired with mentees through formal programs, established your own relationships with mentees, or a combination?
  - Why do you use this strategy?
- Do your mentees share your interests, goals and even demographics, or do you mentor across disciplines? Which strategy do you see as more productive?
- How, if at all, do you screen a mentee's baseline skill level?

How do you select the initial project on which you collaborate with a mentee?
- What tasks do you usually give to new mentees?
- How do you determine the work delegation between the two of you?

How do you develop successful mentoring relationships?
- How do you establish shared expectations and goals?
  - Do you set expectations for your mentees upfront? If so - how?
  - Did you establish a timeline with your mentees for your shared work? If so - how?

- Do you begin relationships with a specific vision in mind (such as project completion or mentee growth, etc)?

What does your project management look like?
- Have you worked with people who can't manage themselves?
- What amount of independence do you allow vs how much oversight do you provide?
    - Does this change as relationships progress?
- How do you set the cadence and frequency of communication?
    - What forms of communication do you employ - in person, emails, phone calls, texts, video?
    - How much time did you spend with your mentees per week?
    - Did you limit your availability? Why?
- What resources of yours (such as analysts, statisticians, data platforms, etc) do you share with your mentees? Why did you select these particular ones?

How much do you rely on your mentees or include your mentees in your own projects that you are particularly interested in?
- In balancing your own career needs, how do you share recognition for the work that you and a mentee have collaborated on?
- How much does a mentee's fit within your projects affect your decision to mentor them?

What other roles do you play in the career of your mentees?
- Are there any specific skills (such as grant writing, networking, etc) that you emphasized with your mentees? Why these?
- What are the boundaries, if any, that you set in your relationships? How do you handle mentees that break these boundaries?
- How do you navigate situations with a mentee involving emotions, personal or professional challenges, interpersonal conflicts, or other situations? Do you establish strict boundaries, or provide support?
    - Do you welcome these conversations, or not?

What challenges or barriers have you encountered with your mentoring relationships, and how have you overcome them?
- Have you encountered situations in which the mentee's expectations are too high? How did you dial the mentee back?
- How do you balance time management and the competing demands of your career with your responsibility to your mentee, especially when the mentee's pace of work on your shared project is outpacing your own?
- How do you recognize and prevent potentially unsuccessful mentee relationships, and, if necessary, how do you end relationships that turned out to be ineffective?
- How do you coach your mentee during failure (such as if a project isn't working, or if an abstract isn't successful)?

- What do you do when the project isn't on track? How do you motivate or cut off students?

Who was your most successful medical student mentee – and why?
- How did the relationship you created with this student compare to the steps you just described for your mentorship process?

What do you think you do that sets you apart from other mentors?

How have you learned how to mentor?
- Have you engaged in formal mentor training, seminars or faculty development sessions, or read any literature on mentorship?
- Which skills and practices from your own mentors have you applied to your own work with mentees? Which didn't you like?
- How has feedback from mentees contributed to your mentorship practices?

Is there anything that we missed or that you would like to add?

Do you have any questions about the mentorship process that you wish had an answer and that could be further explored with future studies?

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