

Advancing Institutional Efforts to Support Research Mentorship: A Conceptual Framework and Self-Assessment Tool

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Abstract

The purpose of this article is to assist institutions in advancing their efforts to support research mentorship. The authors begin by describing how institutions can shape the key domains of research mentorship: (1) the criteria for selecting mentors, (2) incentives for motivating faculty to serve effectively as mentors, (3) factors that facilitate the mentor–mentee relationship, (4) factors that strengthen a mentee’s ability to conduct research responsibly, and (5) factors that contribute to the professional development of both mentees and mentors. On the basis of

a conceptual analysis of these domains as currently documented in the literature, as well as their collective experience examining mentoring programs at a range of academic medicine institutions and departments, the authors provide a framework that leaders of institutions and/or departments can adapt for use as a tool to document and monitor policies for guiding the mentorship process, the programs/activities through which these policies are implemented, and the structures that are responsible for maintaining policies and implementing programs. The authors

provide an example of how one hypothetical institution might use the self-assessment tool to track its policies, programs, and structures across the key domains of research mentorship and, on the basis of this information, identify a range of potential actions to strengthen its research mentoring efforts. The authors conclude with a brief discussion of the limitations of the self-assessment tool, the potential drawbacks and benefits of the overall approach, and proposed next steps for research in this area.

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A primary mission of academic medical institutions is to ensure that the values, standards, and practices of science are effectively transmitted from one

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generation of researchers to the next. Within the context of research, a core component of this process is mentoring. Research mentorship has been increasingly recognized as an essential catalyst for providing researchers with the skills needed to advance successfully in their careers,¹ for enhancing the institutional environments within which researchers work,² and for fostering the highest levels of research integrity and professional practice.³ Although several national reports have recommended that institutions develop multifaceted approaches for mentoring young researchers and monitoring these activities to ensure their adequacy,^{4–6} few (if any) have offered details as to how precisely institutions should do this.

In a recent (2006) review of the literature on the prevalence of mentorship and its effect on career development, Sambunjak and colleagues⁷ find that systematic empirical evidence on mentoring is limited and cannot be used “to suggest mentorship strategies that should be implemented at academic institutions.” Nevertheless, they conclude that leaders of medical schools and graduate programs “should feel compelled to stimulate interest in mentorship and to evaluate such efforts.” To this end, the

Association of American Medical Colleges (AAMC) Group on Graduate Research, Education, and Training and its postdoctoral committee has recently released the *Compact Between Postdoctoral Appointees and Their Mentors*,⁸ which is intended to initiate discussions at local and national levels about the postdoctoral mentor–mentee relationship and the institutional and individual commitments necessary for a high-quality postdoctoral training experience.

The purpose of this article is to further assist institutions in advancing their efforts to support research mentorship. We begin by describing how institutions can shape the key domains of research mentorship, which are derived from the literature and characterized as (1) the criteria for selecting mentors, (2) incentives for motivating faculty to serve effectively as mentors, (3) factors that facilitate the mentor–mentee relationship, (4) factors that strengthen a mentee’s ability to conduct research responsibly, and (5) factors that contribute to the professional development of both mentees and mentors. Next, we describe a self-assessment tool that individual institutions and/or departments can adapt to document and monitor policies (i.e., rules, guidelines, or practices) for guiding both the mentorship

programs (i.e., activities through which these policies are implemented) and the structures (i.e., units or individuals within an institution) that are responsible for maintaining policies and implementing programs. To introduce this approach, we provide an example of how one hypothetical institution might use the self-assessment tool first to track its policies, programs, and structures across the key domains of research mentorship and then, on the basis of this information, to identify a range of potential actions to strengthen its research mentoring efforts. We conclude with a brief discussion of the limitations of the self-assessment tool, the potential drawbacks and benefits of the overall approach, and proposed next steps for research in this area.

How Institutions Can Shape the Five Key Domains of Research Mentorship

Research mentorship refers to a complex and multidimensional process through which emerging scientists acquire the norms and standards, values and attitudes, and knowledge, skills, and behaviors to develop into successful independent researchers.⁹ This process can range from informal personal support to formalized mentoring relationships and can take one of several forms, depending on the setting and purpose of the mentorship.¹⁰ One-on-one mentoring occurs between a senior researcher/faculty member/student and a junior researcher/faculty member/student (i.e., anyone who is in a junior position relative to the mentor) or between individuals with the same level of experience (i.e., peers). The nature of the relationship will vary in accordance with the power differential between the mentor and the mentee, and, in the case of one-on-one peer mentoring, the relationship will reflect a two-way flow of assistance and support as opposed to a one-way flow. Group mentoring involves one mentor and several mentees who meet together on a regular basis to benefit from a larger group dynamic in which multiple mentees contribute input. Multiple or team mentoring, which entails several mentors and one mentee, may be particularly effective for promoting professional training and career development within an interdisciplinary field, where expertise in a narrow discipline must be balanced with the ability to

collaborate effectively across disciplines and where the traditional one-on-one mentoring model may be too limited. The need for team mentoring also arises because of individual differences in training experiences, career goals, and backgrounds that make matching a mentee to one single appropriate mentor along multiple dimensions difficult.

Although this analysis focuses on mentors who are actively engaged in a formal research effort with mentees, additional mentoring relationships (both formal and informal) that occur outside the research context also play an important role in developing successful, independent researchers.

The roles of mentors and mentees in the research mentorship process are described in detail in the literature. The National Academy of Sciences explains the mentor role as being of multiple dimensions, including advisor, teacher, role model, and friend.¹¹ The functions associated with these dimensions relate to strengthening academic competency, technical skills, and the responsible conduct of research (RCR); supporting personal and professional development; and providing emotional support and encouragement.

The role of the mentee is to commit to the mentoring relationship and to share responsibility with the institution and the mentor for the quality of the relationship. Fulfilling this role may include locating prospective mentors, identifying career plans, clearly communicating needs and expectations, and learning about effective mentoring.

What remains to be better defined is the role of the institution, or how institutional policies, programs, and structures can shape each of the five key domains of research mentorship, as described below.

Domain one: Criteria for selecting mentors

The appropriate qualifications for being able to serve as an effective mentor will vary according to the aspirations, interests, needs, and position of the designated mentee. In general, the mentor should have demonstrated knowledge and interest in the mentee's specific area of research, be proficient in the skills needed by the mentee, and have

enough experience with the institution, department, or program to socialize the mentee to its norms, values, and procedures.¹² The literature on mentoring has produced useful insights regarding additional personal characteristics and interpersonal traits that can enhance the mentoring relationship.¹³ These include trust, respect, understanding, flexibility, patience, integrity, support, vision, approachability, accessibility, and ability to communicate. No two mentors will behave in exactly the same way, but all good mentors will act from both a sense of responsibility and a commitment to the future of the mentee.¹⁴

Processes for identifying, recruiting, and training mentors vary across institutions and departments. Some institution or department leaders may develop a set of minimum qualifications that every mentor must meet, or a set of additional qualifications that mentors of specific types of mentees should meet, as well as a screening process for identifying faculty who meet these qualifications. Leaders may also establish formal mentorship training programs for cases of faculty members who fail to meet the minimum and/or additional qualifications. Other institution and/or department leaders may operate under an implicit expectation that all or some senior faculty members will serve as mentors. The success of many mentoring programs is often limited by the availability of senior faculty who can serve as mentors and by the failure of institutions to identify a sufficient pool of qualified mentors.

Domain two: Incentives for motivating faculty to serve effectively as mentors

Institutional recognition and support of faculty contributions to mentoring are important mechanisms for encouraging faculty members to serve as mentors and for ensuring that mentors dedicate the requisite amount of time and energy to the tasks involved. For example, willingness, experience, or success serving as a mentor may be considered as part of the annual review process for faculty members, or it may be required for promotion or tenure. In some cases, institutions or departments will give awards for excellence in mentoring or designate time and financial resources for mentoring. In others, discussions about

the importance of mentoring may be incorporated into regular faculty meetings or other faculty events (e.g., orientations, retreats). Although facing fiscal constraints, some institutions may be able to institute financial incentives for mentorship in faculty compensation plans.

Domain three: Factors that facilitate the mentor–mentee relationship

This dimension of research mentorship refers to the processes through which mentors and mentees are matched; guidelines for orienting, structuring, and guiding the mentoring relationship; and mechanisms for dealing with any problems, concerns, or conflicts that might arise during the course of the relationship.

Mentees frequently report that identifying available individuals with the appropriate experience, skills, interest, and personal qualities to serve as mentors can be difficult. This is particularly true for women and other underrepresented groups in the scientific research professions.¹⁴ Some institutions have developed innovative programs designed specifically to correct this imbalance.^{15,16} Ideally, each emerging scientist at every institution should be provided at least one mentor through all levels of training and career establishment. Increasingly, complete mentorship may require more than one mentor to address the full range of issues that may be important to a mentee's successful development.

Compatibility between the mentor and mentee is critical to a successful mentoring relationship. However, it is not clear whether mentors should be assigned or self-identified, because there are benefits and pitfalls to both approaches. In some cases, institutions will assign mentees to faculty members who have agreed to serve as mentors, without much regard for compatibility and/or other subjective factors that can adversely affect the relationship. In other cases, mentees are left on their own to seek out their mentors through a process of direct interaction or by gathering information through institutional resources (e.g., research director, department chairperson, colleagues). In cases where institutions assign mentors to mentees, the process would be strengthened by taking into account the degree to which both parties have shared research interests, as well as

complementary values, skill sets, and styles of interaction. In cases where mentors are not assigned to mentees, institutions can provide advice, assistance, and information (e.g., a list of senior faculty who have expressed an interest in mentoring and their areas of specialization, or formal and informal networking opportunities to meet potential mentors) to help mentees identify their mentors.

When asked what would most improve their mentorship experiences, most mentees respond that they would appreciate written guidelines explaining what each party can expect from the mentoring relationship, including an outline of respective duties and responsibilities.¹⁷ In some cases, leaders of institutions and departments might create individualized mentee development plans that clarify specific goals to be achieved and milestones for achieving them. Such plans may require mentors and mentees to report on the progress of the relationship and their satisfaction with specific institutional components intended to support it. They may also include procedures for determining the duration of specific types of mentoring relationships and if/when the relationships should be continued or terminated. Training programs and/or seminars and colloquia on effective mentoring techniques for both mentors and mentees may also be organized.

By definition, the mentoring relationship reflects an imbalance of power, so institutional oversight is necessary to ensure that mentors do not exploit the relationship (e.g., fail to give mentees proper credit, or require them to work exclusively on their research) and that mentees do not become so dependent on their mentors that they are unable to develop their own theories and ideas or become unwilling to explore new avenues of research separate from their mentors. These issues are all the more critical given that money (e.g., ownership of grants) and intellectual property (e.g., patents, publications) are important components of the relationship. Therefore, some institutions may find it helpful to establish explicit policies and procedures for resolving potential mentor–mentee conflicts, including structures and processes for hearing and adjudicating alleged violations of recognized mentee rights.

Domain four: Factors that strengthen a mentee's ability to conduct research responsibly

The focus of this domain of research mentorship is to ensure that mentees adhere to the rules, regulations, guidelines, and commonly accepted professional codes or norms which govern the conduct of research in their respective disciplines and across disciplines as appropriate. Core topics include protection of human subjects, welfare of laboratory animals, conflicts of interest, data management practices, interdisciplinary/collaborative research practices, authorship and publication, peer review, responsibility to the public, and interacting with the media.^{4,18}

Faculty mentors can play a critical role in increasing the level and effectiveness of mentee training related to RCR. Ideally, the mentor–mentee research process will include a combination of direct communication about RCR issues and indirect observation of the mentor's behavior or actual practice for an extended period of time. In some cases, institutions will develop not only an explicit protocol that mentors can use to instruct mentees about how to conduct research responsibly, but also a defined process both for reviewing mentees' knowledge of accepted standards and guidelines (e.g., online, paper-based, or oral examinations) and for providing useful feedback about specific practices. Institutional and departmental guidelines about how to adequately supervise the mentee's research, including review of lab books and sources of data collection, reading draft manuscripts for accuracy, etc., may also be helpful. Special attention should also be paid to the unique RCR challenges faced by individuals pursuing interdisciplinary research careers and/or working in collaboration with multiple investigators, such as how to obtain appropriate authorship credit on publications derived from multisite studies based on a teamwork approach.

Domain five: Factors that contribute to the professional development of both mentees and mentors

The professional development of mentees is a core aspect of this domain. This includes helping the mentee build a strong professional network, apply successfully for grants, publish manuscripts, participate in professional

meetings, and understand his or her range of career options. In addition, certain essential skills may require a special focus, for example, time and budget management, managing a lab or group, listening and communicating, and acting in a spirit of collegiality. Mentees engaged in interdisciplinary research may also need guidance with respect to their involvement in various professional organizations, which are typically organized to support discipline-specific career development activities.

Importantly, mentors can also obtain a number of professional benefits from the mentoring relationship, in addition to the personal satisfaction typically derived from it. In particular, mentors have reported accelerated research productivity, enhanced networking, and increased professional recognition when working with mentees who perform well.^{19,20}

Institutions can enhance the professional development of mentees and mentors by not only ensuring that both have the time to adequately explore this domain of research mentorship but also providing informational (and other) resources that support mutual career development. For example, some institutions may provide travel funds for mentees/mentors to participate either individually or together in professional meetings or conferences, or organize seminars for honing mentees' professional writing, grantsmanship, and presentation skills.

A Framework for Documenting and Monitoring Institutional Roles and Tasks in Supporting Research Mentorship

Description of the self-assessment tool

Although explicit measures of effective research mentorship have yet to be established, institutions and departments can begin to document and monitor their policies, programs, and structures for supporting the key domains of research mentorship. Appendix 1 provides a possible framework that institutions and departments can adapt for use as a tool to facilitate this tracking process.

In our assessment tool, horizontal rows delineate aspects of the five key domains of research mentorship, described above. A set of vertical columns on the matrix is intended to help institution/department leaders identify the institutional

components (i.e., policies, programs, and structures) that support each of these aspects. Policies are written or unwritten rules that guide how each domain should be implemented. Programs are activities aimed at a specific group to achieve the policy implementation. Structures are individuals or organizational units within the institution with responsibility and accountability for implementing the policies and programs. On our tool, another set of columns is used for assessing the degree (i.e., written/documented or unwritten/undocumented) of formality of these various components. We used another column for documenting ways to monitor or evaluate an institution's efforts to support research mentorship either at present or in the future (e.g., determining to what degree policies, programs, and structures actually exist; to what degree they are implemented; and to what degree they make a difference). These determinations might be made through various institutional tracking mechanisms, such as paper-based or Web surveys of mentors and mentees and/or tests of mentees' attitudes knowledge, and behaviors.

On full completion of the self-assessment tool, institutional and/or department leaders will be able to clearly identify the policies, programs, and structures that are currently in place to support the key domains of research mentorship at their institutions, as well as those domains for which no formal institutional action has been taken. On the basis of this information, they could begin to develop new or more formal and rigorous institutional policies, programs, and structures to strengthen specific research mentorship domains and to monitor or evaluate their effectiveness over time. A final column could be added to the tool for tracking any such actions that might be taken.

Benefits of the self-assessment tool

Each institution will have a range of policies, programs, and structures for supporting research mentorship that are unique to its historical, cultural, and organizational circumstances. Appendix 1 further illustrates how a hypothetical institution can benefit from using the self-assessment tool to track these components across the five key domains of research mentorship.

We begin by considering the criteria for selecting mentors at this hypothetical institution where the qualifications for serving as a mentor are generally understood, but not formally established. Structurally, department chairs are responsible for ensuring that each senior faculty member meets the institutional requirement for mentoring one or more graduate students or postdoctoral fellows. This requirement is discussed at faculty orientations, meetings, and evaluations. An annual mentorship training program is open to all senior faculty, and those who have participated in the program (fewer than 50 percent) found it useful, according to the results of hand-written evaluations completed at the end of the program. To enhance its role in formally training research mentors, the institution might consider requiring all senior faculty to participate in the program and holding department chairs responsible for ensuring their participation.

In terms of institutional incentives for motivating senior faculty to serve effectively as mentors, this institution currently has no policies, programs, or structures for evaluating the performance of mentors, and promotion and tenure decisions do not take mentoring into account. Annual department awards for excellence in mentoring based on mentee nominations are the sole means of institutional recognition. Mentors' views of the utility of these institutional incentives are currently unknown. Under these circumstances, it might be useful for institutional leaders to consider augmenting these incentives by including evaluations of mentoring performance in the faculty review process. Additional ideas for improving mentoring incentives might also be gained by obtaining feedback from faculty members about the institution's role in motivating them to serve as mentors.

This institution's role with respect to facilitating the mentor-mentee relationship is currently limited to matching mentors and mentees. The responsibility for this activity rests with department chairs. Although all graduate students and postdoctoral fellows are recommended to have at least one mentor, the administrator's records indicate that fewer than 60% have an assigned mentor. The extent to which institutional guidelines and/or oversight would strengthen the mentor-mentee

relationship is unknown, and the typical problems that may arise in the context of mentorship remain unaddressed. The apparent lack of available mentors for mentees at the institution might be addressed by requiring all senior faculty to mentor at least two individuals or by increasing the pool of mentors to include midlevel faculty as well. In the latter case, the qualifications for mentoring would need to be clearly established, and participation in the annual mentorship training program would need to be expanded to include midlevel faculty. The institution might also consider strengthening its mentoring policy to require (and not just recommend) that all graduate students and postdoctoral fellows have at least one mentor, holding both department chairs and the graduate students/postdocs themselves responsible for meeting this requirement.

With regard to advancing RCR, this hypothetical institution requires that all graduate students and postdoctoral fellows pass a Web-site assessment of their knowledge with respect to specific RCR standards and guidelines. A designated dean's office administrator is responsible for ensuring that this requirement is fulfilled. It is not clear how the institution handles cases of an individual who requires repeated attempts to pass certain sections of the assessment. In this case, it might be useful to institute a practice whereby the administrator alerts an individual's department chair when repeated attempts are needed to pass certain sections of the assessment, and the chair is required to communicate this information to the individual's mentor (assuming one has been assigned). The mentor could then pay more attention to the mentee's attitudes, knowledge, and behavior with respect to RCR issues and, perhaps, provide feedback on specific practices. On the basis of information provided in the self-assessment tool, for most individuals at this institution, the focus would be on RCR issues related to planning research. The institution might also consider including discussions about the role of mentors in increasing the level and effectiveness of RCR training in its annual mentoring training programs.

Finally, because this institution currently has no policies, programs, and structures which contribute to the professional development of mentees and/or mentors,

institutional leaders might consider including discussions about how mentoring can enhance professional development of both groups in its annual mentoring programs.

Building on Lessons Learned

The development of the institutional self-assessment tool described above is based on a conceptual analysis of the key domains of research mentorship as currently documented in the literature, as well as our collective experience examining mentoring programs at a range of academic medicine institutions and departments. We note that the usefulness of the tool for improving institutional efforts to support research mentorship has not yet been empirically tested, either in its current form or in a form modified in accordance with local institutional environments and/or circumstances. Nevertheless, institutional efforts to optimize the research mentorship experience must begin by documenting and monitoring existing policies, programs, and structures to understand better which components are most likely to produce the most value for their respective institutions. The proposed self-assessment tool can serve as a practical aid for institutions attempting to accomplish this critical first step.

Efforts to formalize research mentorship through documentation, monitoring, and the explicit assignment of institutional accountability are, of course, not without their potential downsides. For example, some may argue that the true value of mentorship lies in the organic nature of the relationships that develop between mentors and mentees, and that striving for too rigorous documentation and monitoring in an effort to improve these relationships may actually cause this organic structure to fall apart. However, rigorous attention to documenting and monitoring mentorship relationships should not preclude organic bonds from forming but, rather, help foster these bonds. Others may be concerned about holding institutional leaders accountable for achieving success in an area of scientific education for which explicit measures of effectiveness have yet to be established. However, given the high priority assigned to research mentorship by the academic medicine community and the valuable contribution that effective research mentorship can make to the future of the overall scientific

enterprise, we believe it is incumbent on all institutions invested in this enterprise to take the necessary first steps for building an evidence base to support improvements in the quality of research mentorship.

Next steps for research in this area should include a systematic examination of, first, the policies, programs, and structures that are currently in place at academic medicine institutions to support the key domains of research mentorship, and, next, the extent to which these components are perceived as valuable by mentors and mentees at the respective institutions. To advance this effort, we plan to conduct a national study of U.S. medical schools that focuses on the critical links among institutional support for research mentorship, mentorship interactions focused on RCR, and the knowledge and confidence of postdoctoral fellows with respect to RCR standards and their ability to adhere to those standards as independent investigators. This future study is intended to produce both a more sophisticated set of measures and tools that medical schools, departments, and other organizations can use to monitor, evaluate, and enhance their current mentorship efforts focused on RCR, as well as valuable knowledge that can be used by other investigators to design more extensive studies in the future.

Research mentorship is a vital part of the academic medicine enterprise and cannot be left to chance. By establishing formal policies, programs, and structures for identifying mentors, matching them with mentees, monitoring mentees' progress and mentor/mentee relationships, and providing incentives for high-quality mentorship, institutions will enhance the professional development of future researchers and take an important step toward advancing education, research, and clinical care.

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References

- 1 Palepu A, Friedman RH, Barnett RC, et al. Junior faculty members' mentoring relationships and their professional development in U.S. medical schools. *Acad Med.* 1998;73:318–323.
- 2 Wingard DL, Garman KA, Reznik V. Facilitating faculty success: Outcomes and cost benefit of the UCSD National Center of Leadership in Academic Medicine. *Acad Med.* 2004;79(10 suppl):S9–S11.
- 3 Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, Institute of Medicine. *On Being a Scientist: Responsible Conduct of Research.* 2nd ed. Washington, DC: National Academy Press; 1995. Available at: (http://www.reflexives-lpr.org/webadmin/documents/On_being_a_scientist.pdf). Accessed November 13, 2007.
- 4 Committee on Assessing Integrity in Research Environments, Board on Health Sciences Policy and Division of Earth and Life Sciences, Institute of Medicine, National Research Council Integrity in Scientific Research. *Creating an Environment That Promotes Responsible Conduct.* Washington, DC: National Academies Press; 2002.
- 5 National Academy of Sciences, National Academy of Engineering, Institute of Medicine, Committee on Science, Engineering, and Public Policy. *Enhancing the Postdoctoral Experience for Scientists and Engineers: A Guide for Postdoctoral Scholars, Advisers, Institutions, Funding Organizations, and Disciplinary Societies.* Washington, DC: National Academies Press; 2000.
- 6 Committee on Bridges to Independence: Identifying Opportunities for and Challenges to Fostering the Independence of Young Investigators in the Life Sciences, National Research Council. *Bridges to Independence: Fostering the Independence of New Investigators in Biomedical Research.* Washington, DC: National Academies Press; 2005.
- 7 Sambunjak D, Straus SE, Marusic A. Mentoring in academic medicine: A systematic review. *JAMA.* 2006;296:1103–1115.
- 8 Association of American Medical Colleges. *Compact Between Postdoctoral Appointees and Their Mentors.* Washington, DC: Association of American Medical Colleges; 2006. Available at: (<http://www.aamc.org/research/postdoccompact/postdoccompact.pdf>). Accessed November 13, 2007.
- 9 Zuckerman H. *Scientific Elite: Nobel Laureates in the United States.* New York, NY: Free Press; 1977.
- 10 Faculty Development and Instructional Design Center, Northern Illinois University. *Responsible conduct in research mentoring.* Available at: (http://ori.dhhs.gov/education/products/niu_mentorship/mentoring/relationship/relationship.htm). Accessed November 20, 2007.
- 11 National Academy of Science. *National Academy of Engineering, Institute of Medicine. Advisor, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering.* Washington, DC: National Academies Press; 1997.
- 12 Silen W. In search of the complete mentor. *Mentations* [serial online]. 1998;5. Available at: (http://www.hms.harvard.edu/dcp/mentations/fall_98/searchofmentor.html). Accessed November 20, 2007.
- 13 Johnson WB. *The intentional mentor: Strategies and guidelines for the practice of mentoring.* *Prof Psychol.* 2002;33:88–96.
- 14 Kalichman M. *Responsible Conduct of Research: An Introductory Guide.* San Diego, Calif: Office of Research Integrity, University of California, San Diego; August 2001.
- 15 Blaser B, Wheelless A, Litzler E. *Enhanced connections: Making changes to mentoring programs for science and engineering graduate students.* Available at: (http://www.x-cd.com/wepan07/WEPAN2007_0022.pdf). Accessed November 20, 2007.
- 16 Greer M. *New mentoring-intensive program fosters minority-focused research.* *GradPsych.* 2004;2(2). Available at: (<http://gradpsych.apags.org/apr04/mentoring.cfm>). Accessed November 23, 2007.
- 17 Golde CM, Dore TM. *The survey of doctoral education and career preparation: the importance of disciplinary contexts.* In: Wulff DH, Austin AE, eds. *Path to the Professoriate: Strategies for Enriching the Preparation of Future Faculty.* San Francisco, Calif: Jossey-Bass; 2004.
- 18 Steneck NH. *ORI Introduction to the Responsible Conduct of Research.* Washington, DC: U.S. Department of Health and Human Services; 2004.
- 19 Ragins BR, Scandura TA. *Gender differences in expected outcomes of mentoring relationships.* *Acad Manage J.* 1994;37:957–991.
- 20 Russell JEA, Adams DM. *The changing nature of mentoring in organizations: An introduction to the special issues on mentoring and organizations.* *J Vocat Behav.* 1997;51:1–14.

Appendix 1
Self-Assessment Tool for Documenting/Monitoring Institutional Roles in Supporting Research Mentorship, as Used by One Hypothetical Academic Research Institution

RESEARCH MENTORING DOMAINS	COMPONENT			DEGREE OF FORMALITY		EVALUATION/ MONITORING
	POLICY (GUIDELINE)	PROGRAM (ACTIVITY)	STRUCTURE (ORG. DESIGN)	INFORMAL	FORMAL	
Mentor Criteria Qualifications	No official policy or guideline; mentor qualifications are generally understood, but not formally established.	None	None	√		None
Identification	All senior faculty are required to mentor one or more graduate students or postdoctoral fellows.	Mentoring requirements are discussed at faculty orientations, meetings, and evaluations.	Department chairs are responsible for ensuring that each senior faculty member meets the mentoring requirement.		√	Department records indicate that all senior faculty are currently mentoring one or more graduate students or postdoctoral fellows.
Recruitment/Training	All senior faculty should be encouraged to participate in an annual mentorship training program.	Mentorship training program is conducted annually.	Dean's office administrator is responsible for organizing the mentorship training program; department chairs are responsible for encouraging all senior faculty to participate.		√	Administrator's records indicate that less than 50% of senior faculty participate in the annual mentorship training program; post-training evaluation forms indicate that those senior faculty who participate in the program find it useful.
Mentor Incentives Evaluation	All senior faculty are required to mentor one or more graduate students or postdoctoral fellows.	Mentoring assignments are discussed as part of the annual review process of senior faculty.	Department chairs are responsible for ensuring that each senior faculty member meets the mentoring requirement.		√	Department records indicate that all senior faculty are currently mentoring one or more graduate students or postdoctoral fellows.
Promotion/Tenure	None	None	None			None
Recognition/Rewards	All departments should recognize mentoring as a valuable service that senior faculty members can offer to graduate students and postdoctoral fellows.	All departments offer an annual award for excellence in mentorship to one senior faculty member.	Department chairs are responsible for selecting annual awardees for excellence in mentorship.		√	Awards offered annually across all departments.

(Continued)

Appendix 1
(Continued)

RESEARCH MENTORING DOMAINS	COMPONENT			DEGREE OF FORMALITY		EVALUATION/ MONITORING
	POLICY (GUIDELINE)	PROGRAM (ACTIVITY)	STRUCTURE (ORG. DESIGN)	INFORMAL	FORMAL	
Mentor-Mentee Relationship						
Matching Mentors/ Mentees	All senior faculty are required to mentor one or more graduate students or postdoctoral fellows. All graduate students and postdoctoral fellows are recommended to have at least one mentor.	Mentoring requirements and recommendations are discussed at faculty & student orientations, faculty meetings, and faculty evaluations.	Department chairs are responsible for identifying mentor-mentee pairs and providing this information to designated administrator in the dean's office.		√	Administrator's records indicate that less than 60% of graduate students and postdoctoral fellows have an assigned mentor.
Guidelines/Oversight	No official policies or guidelines; the importance of creating positive mentoring experiences for graduate students and postdoctoral fellows is generally understood, but not clearly delineated in any written documentation.	The importance of mentoring is discussed at student and faculty orientations, faculty meetings, and faculty evaluations.	None	√		None
Brokering/Managing	None	None	None			
Mentor-Mentee Research						
Planning Research	All graduate students and postdoctoral fellows must be knowledgeable about responsible conduct of research (RCR) standards and guidelines related to protection of human subjects, welfare of laboratory animals, and conflicts of interest.	A Web-site assessment of RCR knowledge is required of all graduate students and post-doctoral fellows; the assessment covers issues related to protection of human subjects, welfare of laboratory animals, and conflicts of interest.	A designated administrator in the dean's office is responsible for ensuring that all graduate students and postdoctoral fellows pass the Web-site assessment.		√	Administrator's records indicate that 50% of graduate students and postdoctoral fellows require more than two attempts to pass the Web-site assessment questions that are related to planning research.

(Continued)

Appendix 1
(Continued)

RESEARCH MENTORING DOMAINS	COMPONENT			DEGREE OF FORMALITY		EVALUATION/ MONITORING
	POLICY (GUIDELINE)	PROGRAM (ACTIVITY)	STRUCTURE (ORG. DESIGN)	INFORMAL	FORMAL	
Conducting Research	All graduate students and postdoctoral fellows must be knowledgeable about RCR standards and guidelines related to data management and interdisciplinary / collaborative research practices.	A Web-site assessment of RCR knowledge is required of all graduate students and post-doctoral fellows; the assessment covers issues related to data management and interdisc. / collab. research practices.	A designated administrator in the dean's office is responsible for ensuring that all graduate students and postdoctoral fellows pass the Web-site assessment.		√	Administrator's records indicate that 85% of graduate students and postdoctoral fellows require only one attempt to pass the Web-site assessment questions that are related to conducting research.
Reporting/Reviewing Research	All graduate students and postdoctoral fellows must be knowledgeable about RCR standards and guidelines related to authorship/publication and peer review.	A Web-site assessment of RCR knowledge is required of all graduate students and post-doctoral fellows; the assessment covers issues related to authorship/publication and peer review.	A designated administrator in the dean's office is responsible for ensuring that all graduate students and postdoctoral fellows pass the Web-site assessment.		√	Administrator's records indicate that 85% of graduate students and postdoctoral fellows require only one attempt to pass the Web-site assessment questions that are related to reporting research.
Mentee/Mentor Professional Development						
Reporting/Presenting	None	None	None			None
Publishing	None	None	None			None
Networking	None	None	None			None
Obtaining Funding	None	None	None			None