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PhD Programs and the Advancement of Nursing Science

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Abstract

Nurses are well-positioned to be groundbreaking researchers, scientists, leaders, and innovators to improve the health and well-being of individuals, families, and communities. Nurse scientists are needed to contribute to scientific discoveries that inform effective strategies to improve patient care and outcomes and to inform future policies. Thoughtful consideration is required about the preparation of nurse scientists to ensure they are equipped with the knowledge and skill sets to meet the needs of society. Evolving health needs and priority areas of inquiry along with an ever-increasing array of sophisticated methodologies and centrality of interdisciplinary teams to solve complex problems should drive how we prepare PhD students. This paper reflects a panel and subsequent dialogue with nurse leaders at the PhD summit held at the University of Pennsylvania in October, 2019. Three aspects of PhD education and the advancement of nursing science are discussed 1) examining important elements to support nurse scientist development; 2) identifying key gaps in science that the discipline needs to address in educating the next generation of nurse scientists; and 3) preparing nurse scientists for the competitive funding environment.

Keywords

PhD education; research; curriculum; nurse scientist; nursing advancement

Preparation of future nurse scientists in PhD programs is a high priority in order to meet the needs of individuals, families, communities, and society. We must carefully consider the preparation of PhD students as future nurse scientists in light of the fact that health and well-being are increasingly affected by the intricate interplay of biology, behavior, and environments; expanding technologic innovations; availability of electronic data from diverse sources; and the complexity of systems in which health care is provided (Bauer & Kirchner, 2020; Corwin, Redeker, Richmond, Docherty, & Pickler, 2019). This is one in a series of papers that represents the deliberations of nurse leaders and scientists participating in an invitational summit *Re-envisioning Research Focused PHD Programs of the Future*,

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held at the University of Pennsylvania on October 11, 2019. Representatives from the top 10 Schools of Nursing in NIH funding, leaders from professional organization and funding agencies and leaders from Latin American and the Caribbean involved in PhD education attended (Fairman, Giordano, McCauley, & Villarruel, In press).

This paper represents the reflections of three panelists who were asked to respond to the framing topic and question: “Discuss PhD programs and the advancement of nursing science. What is needed to support new graduates to be successful?”. Panelists were asked to be critical, forward-thinking, and provocative – to challenge perceived norms - in order to stimulate new ways of thinking. This paper is informed by a fourth panelist and the dialogue between the panel and the audience. The audience consisted of 77 participants from 41 educational, governmental, professional and philanthropic institutions. We reflect on three aspects in addressing future trends and needs in preparing nurse scientists 1) examining important elements to support nurse scientist development; 2) identifying key gaps in science that the discipline needs to address in educating the next generation of nurse scientists; and 3) preparing nurse scientists for the competitive funding environment.

Nurse Scientist Development: Is there a secret formula?

“Every failure is a step to success. Every detection of what is false directs us towards what is true: every trial exhaust some tempting form of error. Not only so; but scarcely any attempt is entirely a failure; scarcely any theory, the result of steady thought, is altogether false; no tempting form of Error is without some latent charm derived from Truth.”

--W. Whewell

Worldwide, nurses make up the largest proportion of health care professionals and serve as the backbone of health care systems (Kurtzman, Dawson, Johnson, & Sheingold, 2010). A research career in nursing is intellectually exciting and essential to develop new knowledge to improve health outcomes. PhD programs are designed to rigorously provide theoretical, methodological, and content expertise. However, in our opinion, nursing PhD programs often lack training or reserve time for discussing career meta-advice and normalizing failure throughout the scientific journey. It is critical that nursing PhD programs integrate resources, beyond how to obtain funding and publications, necessary to prepare nurse scientists to succeed in academia. Although obtaining funding is essential to maintain a research career (Gill, McDermott, Ibrahim, Petersen, & Doebbeling, 2004), much more is needed to develop a successful career. The road to a successful career can often be obscure for early stage investigators. It may appear as though senior nurse scientists hold the secret key to success as funding and publications may seem to have come easily. Yet, it is often the unacknowledged skillsets that lead to success. In this section, we highlight the more intangible skills required to be a successful nurse scientist and ways to hone these skills.

The path to success is a winding road that can be wide-ranging and lead to different places and the ability to thrive in science along this road can be learned. With today’s funding climate and competitive job market, nurse scientists must prepare for the inevitable career

challenges. During the PhD Summit, the panel discussed qualities and experiences important to help PhD students and emerging nurse scientists flourish in their professional journey.

Passion

Emerging nurse scientists are often told to find their passion, as if passions and interests are preformed and easily discovered. Rather, passion is fluid and evolving as we age, gain wisdom and experiences (O’Keefe, Dweck, & Walton, 2018). Passion and love for what we do is key; success is the byproduct. As one develops an academic career, aiming for individual success is not the only goal; striving to be a valuable contributor to the discipline is equally important (Stull & Ciappio, 2014). At every stage of the career trajectory it is important to take time to re-assess and evaluate one’s status. It is important to separate passion for the discipline with satisfaction for an individual position – and to help young scholars understand this and find positions that are synchronous with their values and support their growth. This opens up a wealth of possibilities for positions not only within academia but in many diverse areas such as industry and government agencies.

Supportive Institutions, Mentors, & Sponsors

“One of the greatest values of mentors is the ability to see ahead what others cannot see and to help them navigate a course to their destination.”

— John C. Maxwell

The recent National Academy of Medicine Report, *The Next Generation of Biomedical and Behavioral Sciences Researchers: Breaking Through* (2018) recommends that research institutions play an important role in providing high-quality training experiences to position trainees and emerging scientists for success (National Academies of Sciences & Medicine, 2018). Research intensive schools of nursing are well-positioned to act on this recommendation and put supportive structures and processes in place. Emerging scholars are challenged in deciding where to work as they assume their first position as PhD-prepared nurse scientists. Preparing them to make a holistic analysis including an assessment of institutional resources and the degree to which faculty and students seem genuinely happy and supported is important. Choosing a workplace that aligns with individual goals and values and where the nurse scientist will be motivated, intellectually stimulated, and supported requires careful consideration.

Selecting good mentors and sponsors is essential (Nowell, White, Mrklas, & Norris, 2015). The centrality of mentorship and sponsorship does not stop at the PhD or postdoctoral level as early-stage nurse scientists critically require ongoing and purposeful mentorship and sponsorship. Early stage nurse scientists benefit from senior scientists who see them as valuable colleagues while at the same time providing wise and thoughtful advice about their growth. Ideal mentors and sponsors take great interest in their scientific, professional, and personal development.

The difference between mentors and sponsors is important to understand. Mentors have knowledge, expertise (scientific, institutional, and/or professional) and commit to working closely with their mentees. Sponsors may or may not be mentors (and often are not) but are people who often go one step (or many steps) further, leveraging their reputation and

personal capital to advocate for success of others (Ayyala et al., 2019). A study by Patton et al., used data from a survey of NIH Mentored Career Development grant awardees to determine the degree to which sponsorship contributed to their career advancement and whether it differed by sex (Patton et al., 2017). Sponsorship was associated with success indicating early career scientists should seek connections with senior leaders to cultivate sponsors as part of their mentorship team (Patton et al., 2017).

Advances in technology and living in the digital age allow mentorship to increase its impact in a new era of changed relationships and the way in which these relationships are initiated and maintained (Whiting & de Janasz, 2004). The landscape has evolved over the past 25 years, with mentoring taking several forms such as peer mentoring, cross-gender mentoring, cross-cultural mentoring, mentoring circles, and e-mentoring (“The Handbook of Mentoring at Work: Theory, Research, and Practice,” 2008). Emerging nurse scientists can take advantage of online, e-mentoring that provides a practical means to “leverage the positive effects of multiple mentors” (Bunkowskim & Anderson, 2017). The 21st century mentor is one who adapts to new technologies to engage their mentee and leverage the relationship. It is critical that PhD students and early career nurse scientists choose mentors and sponsors wisely (McGinty, 2017), individuals who are open to learning and adapting to 21st century approaches.

Failure, Resilience, Persistence & Perseverance

“It’s not the strongest of the species that survive, not the most intelligent but the one most responsive to change”

– Darwin

Failure is important and universally experienced by all nurse scientists. Society often holds failure as something to be prevented because success must be attained. Yet failure plays an important role in the development of nurse scientists and perhaps plays an even more important role than success. Emerging nurse scientists experience countless setbacks. It is the lens through which these setbacks are viewed that makes a difference in the outcome. The capacity to be flexible and demonstrate a variety of responses to adversity considerably impacts future success. Learning from failure can turn disappointments into opportunities and build resilience. Resilience is the capacity to recover from and ease adjustment to misfortune or change and perseverance is the ability to apply effort towards something despite the challenges faced (Kanter, 2013). An elegant paper by Loscalzo celebrates failure and makes the case that failure is an integral component of the scientific method (Loscalzo, 2014). Consider that an experiment is framed in terms of the null hypothesis, which more often turns out to hold rather than its alternate. Every failed study or experiment changes the scientist’s viewpoint, helps reframe the experimental design, and informs a gradually polished approach to the problem and over time improves the prospects for a successful study. Therefore, persistence in reaching goals, resilience in confronting obstacles and perseverance in moving forward are crucial behavioral competencies to becoming a successful nurse scientist.

Work-life Harmony & Support Systems

Scientific careers reside within the broader context of life. As nurse scientists, achieving a work-life balance can be elusive. Yet finding harmony across all aspects of life is beneficial in reducing the pressure to be perfect. To live harmoniously means to be present in the moment. When at work focus on the activity at hand and give it full effort. When with family and friends, leave work aside and focus on that moment. Do we adequately cultivate achieving harmony in PhD programs as we develop nurse scientists? Science is hard work and nurse scientists make this commitment, but it is critical not confuse hard work with working all the time. PhD preparation can incorporate methods to be strategic with time throughout the program. Consciously planning a day, week or month around priorities can amplify effectiveness and increase productivity (Tarquinio, 2016). Work with PhD students in how to set the flow of their workload over a week and how to build in breaks by switching up research routines as important re-energizing strategies (Powell, 2017). Consider how we teach PhD students and early stage investigators the importance of taking time to relax, taking coffee breaks, and attending interesting lectures or seminars. These provide opportunities for informal encounters with other researchers that can be very productive.

A key strategy to thrive in academia is to develop a support system (Duke & Denicolo, 2017). Having a support system has many benefits, such as higher levels of well-being, better coping skills and a longer and healthier life. Social support is critical to reduce stress, depression and anxiety. Support can come from family, friends, colleagues, pets, neighbors, clergy or mental health professionals. Support networks do more than offer a sense of community and belonging, they are important towards the journey of success.

Self-Investment

Preparing PhD students to invest in themselves in a thoughtful and self-directed manner is critical. Strategies such as investing in learning a new skill, taking leadership courses to develop personally or professionally, learning how to master creativity, or finding an academic coach are important life-long commitments. Because students in the U.S. move into structured PhD curricula, it is important to help them build the skill set for continued investment in themselves. Knowledge turnover happens rapidly, thus PhD programs must instill in students the thirst for ongoing learning. Working with students to habitually and thoughtfully attend colloquia outside of their home PhD program on a weekly basis is one strategy of constantly pushing themselves to move outside of their comfort zone and play with new ideas. Throughout the academic journey self-investment is required before emerging nurse scientists can make investments in others.

Network

Networking is a vital component of a successful career (Streeter, 2014). Emerging nurse scientists benefit from programs aimed at developing their careers. Networking can occur at meetings, online (e.g., Twitter, LinkedIn, Facebook), and within professional organizations. Scientists are increasingly embracing social media in their professional lives. Platforms such as Twitter or Facebook allow the sharing of text, pictures, links and other content. Twitter is a popular choice of microblogging platform among academics. Sharing publications and expertise via social media has become a new way to establish a name in one's field.

The ability to build networks of social media followers is a fruitful way to foster communication and collaboration among scientists irrespective of their geographical location (“Social media for scientists,” 2018). However, it is important to be mindful and cautious of the content posted in these platforms. The people in the field and circle matters and networking occurs across the continuum from graduate students to senior leaders. Establishing social media relationships with peers can help form new ideas, obtain feedback on research, and provide social support. Social media requires attention, such that once a new contact with interesting or related work is made maintaining that contact is important. Lastly, as the network is being developed it is critical that emerging nurse scientists learn to communicate their work to a variety of audiences.

Institutional support

Academic institutions play a significant role in facilitating a nurse scientists’ success and need to provide resources and opportunities for professional development. For emerging nurse scientists, a comprehensive start-up package and/or a robust and competitive pilot funding program along with a commitment for dedicated time to establish a program of research are important. Supportive institutional environments with an established administrative infrastructure for grants management, internal peer review, statistical support and other services can help new nurse scientists navigate regulatory and institutional requirements. This supports early career nurse scientists to focus fully on science and minimizes diversions into administrative tasks. Service duties such as committee work, task forces and other projects should be carefully balanced with scholarship during the first years of the academic career.

No Secret Formula but a Systematic Approach

We conclude there is no secret formula to developing successful nurse scientists, but there are critical strategies and components that should be core to PhD programs beyond course work and dissertation work. Many of these approaches are not things that happen in the classroom. Instead they should systematically take place in scholarly environments as nurse scientists professionally develop.

Several key qualities define successful scientists such as a) passion about his or her work and career; b) resilience, self-motivation and determination; c) effective communication skills, creativity and detail-oriented; d) knowledgeable and visionary (Stull & Ciappio, 2014). Many of the approaches discussed by our panel are aimed at instilling these qualities in PhD students and emerging nurse scientists. Although critical, these approaches alone cannot position PhD students for success. Rather, they need to be coupled with critical thought about PhD curricula and how curricula address gaps in knowledge that nurse scientists must address in order to 1) improve the health and well-being of patients, families, communities and populations; 2) position nurse scientists to successfully compete for research funding; and 3) substantively add knowledge in a rapidly changing landscape of health issues, evolving and sophisticated methodologies and analytic techniques, and new disciplinary partners.

Gaps in Science We Need to Address

Nurse scientists are poised to advance discovery and improve health for populations in the U.S. and globally; but it is critical that nursing PhD programs offer the knowledge and resources necessary to prepare the nursing science workforce to make these meaningful contributions. The current nursing science research priorities of the National Institute of Nursing Research (NINR), released in 2016, are symptom science, promotion of personalized health strategies, health promotion/disease prevention, self-management, quality of life for individuals with chronic illness, and end-of-life and palliative care (or the science of compassion). Patricia Grady, then Director of the NINR, commented that these research priorities would “guide nurse scientists as they shape their research programs” (NINR, 2016). These priority topical areas do provide context and guidance to the type of focus or questions that are important to nursing science, but do not provide strategy or methods for framing research questions or designing studies.

In 2017, the Council for the Advancement of Nursing Science (CANS) also conducted a national study on nursing priorities and concluded that the major areas of importance were:

1. **Precision science:** includes physiological, psychological, and environmental factors, as well as ‘omics science, phenotypes, chronic disease symptoms, self-management, and palliative care
2. **Big data and data analytics:** include informatics, technology, and sub-topics such as data security and bioethics
3. **Health determinants:** includes health disparities, chronicity, workplace violence, military health, veterans, health promotion, and cognition
4. **Global health:** includes nursing care in under-resourced countries, emerging infectious diseases, and the threat of epidemics (Eckardt et al., 2017).

The CANS priority areas are arguably less topical than the 2016 NINR priorities; however, the consistent emphasis on precision science and big data/data analytics across papers signals that non-traditional research methods are gaining legitimacy and being prioritized by nursing scientists.

Building on this work, in the opinion of the panelists there are four areas of emerging research and methodology that can be overlooked by nursing PhD programs. We recommend that academic nursing leaders incorporate these four gap areas into their strategic planning and curricula in order to advance nursing science and position PhD students for successful engagement in the scientific community upon graduation.

Gap 1: Methods for Studying Social Determinants of Health (SDOH)

There is much dialogue surrounding the meaning of SDOH, but in general, it encompasses the five categories of social and economic stability, physical and neighborhood environment, education, community and social context, and healthcare systems ((CDC), 2018). The CANS 2017 report cited health determinants as a priority area, albeit with a broader conceptualization than SDOH. Regardless of breadth, we agree with CANS that the

relationship between health determinants and/or SDOH and health outcomes will “require innovative research approaches that will likely involve other research priorities including those focused on precision science and big data” (Eckardt et al., 2017).

Kneipp et al. (2018) examined the extent to which NINR’s funding for research has focused on health disparities, health inequities, and SDOH, relative to other NIH institutes. Examining more than 30,000 funded projects from 2000 until 2016, the investigators found that funding for health disparities projects was 14–19 times greater than that for health equity and SDOH; funding also tended to be greater for centers and training projects than for individual research projects (Kneipp et al., 2018). Strikingly, no growth in equity and SDOH funding was evident for recent years. This lack of emphasis on health equity and SDOH suggests that nursing science is focusing on research that demonstrates health disparities but has not yet moved to making meaningful contributions regarding the approaches needed to address SDOH directly. Yet, a focus on SDOH is becoming increasingly important. Indeed, the overarching goals for Healthy People 2030, which inform funding priorities, include: 1) eliminate health disparities, achieve health equity, and attain health literacy to improve the health and well-being of all; and 2) create social, physical, and economic environments that promote attaining full potential for health and well-being for all (U.S. Department of Health and Human Services, 2018).

Some schools of nursing are adopting purposeful strategies to increase the amount and quality of training in SDOH, including strategies to increase diversity, community-engaged research, and big data analytical skills. Recruitment of faculty and students from more diverse backgrounds and life experiences enhances a school’s ability to develop impactful programs of research integrating SDOH. Researchers who have programs of research based within a community-based participatory framework provide excellent opportunities for students to learn the importance of community networks and how to engage the community in developing research programs responsive to their needs. Recruitment of faculty and students with skills in data analytics increases the capacity to integrate databases on SDOH into research programs, particularly as more SDOH information is incorporated in electronic health records. To advance nursing science around SDOH, the panel believes nurses will have to employ a team science perspective in collaboration with socio-behavioral scientists, economists, informaticians, and members of the communities they serve.

Gap 2: Team Science

If faculty educate the next generation of nurse scientists in isolated intellectual environments, how will students learn the team science techniques necessary to study complex phenomena such as SDOH? Likewise, how will other disciplines understand the contribution that nursing science brings in the discovery of health and wellness solutions for society? A gauge of educational excellence should be the extent to which PhD students work with and learn from scientists of all disciplines. Interdisciplinary classes and experiential learning in laboratories of other scientists should be viewed as positive mechanisms for professional growth—and a chance to show other disciplines the unique perspectives of nurse scientists.

In our opinion, nursing and allied health professions need more training grants aimed at promoting transdisciplinary learning, such as the recent NIH initiative for administrative supplements to the NIH-funded T32 and TL1 *Training Grants to Better Integrate Behavioral and Social Science with Other Health-Related Sciences*. These funding opportunities are designed to train a research workforce that has the content expertise and skills necessary to fill scientific gaps that cannot be effectively addressed by any singular discipline. Schools of nursing in institutions with a Clinical Translational Science Award (CTSA), often have nurse scientists and trainees engaged in high levels of team science. Unfortunately, team science is viewed by some as diluting the unique characteristics of nursing science; but for scientists hoping to compete for research funding, a team science approach is essential (Barrett, 2017). Indeed, a recent study of eighteen research intensive schools of nursing showed that only eight appointment, promotion, and tenure documents included any reference to team science principles which is concerning given the increasing centrality of team science (Brody, Bryant, Perez, & Bailey, 2019). Begg et al. (2014) proposed several strategies to enhance the education of PhD students in team science, including developing core competencies for team science education and training, identifying core curricular components (and teaching best practices, such as active learning and small group teaching), and establishing metrics to determine the success of students in team engagement and productivity (Begg et al., 2014).

Gap 3: Nursing Innovation

Innovation distinguishes a leader from a follower, but nursing science is at its infancy in encouraging innovation among PhD students. Models for supporting innovation within nursing PhD programs are emerging, however, as illustrated by the Clinical Fellowship program at the University of Pennsylvania School of Nursing (Greene, FitzPatrick, Romano, Aiken, & Richmond, 2017). This program, which is designed for BSN-PhD scholars with little clinical experience, aims to cultivate scholarly reflection on the connections between research and practice and encourages nursing contributions to healthcare innovation.

In order to prepare innovative nurse scientists, strong clinical partnerships are needed; and PhD-prepared nurses are poised to offer unique value to these professional relationships. The benefit to healthcare systems of having PhD-prepared nurses generating new knowledge, and nurses with practice doctorates leading the integration of these findings into evidence-based practice, has yet to be fully realized. For decades, the focus on nursing PhD education has been on patient outcomes, but in the panelists' experiences, rarely did the student develop and test a new innovative device/technique that could improve the delivery of care and ultimately health outcomes for many patients. The panelists recommend that PhD students interested in innovation be provided opportunities to identify and solve real problems in healthcare delivery. They believe that PhD nursing programs seldom require students to collaborate with others to solve these real-world problems. Both recognizing the importance of real-world problems and collaborating broadly – beyond just other health disciplines – is viewed as critical for the future of nursing science. The earlier students are exposed to opportunities to have real-world projects integrated into their curriculum, the more likely they will be to learn and appreciate innovative approaches. Optimally, these curricular opportunities would begin before PhD education.

Gap 4: Implementation Science

Evidence resulting from nursing research is only as useful as the ability to implement the evidence into practice. Unfortunately, much of nursing research is focused on the narrow testing of interventions and measuring outcomes in select populations, sometimes, but not always in multisite settings. The gap between knowledge and practice is well documented, (Boehm, Stollendorf, & Jeffery, 2020) and both action research and implementation science seek to address this gap.

Implementation science is defined as “the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice and, hence, to improve the quality and effectiveness of health services and care” (Eccles & Mittman, 2006). Our practice partners need nurse scientists who can focus on implementation science in their healthcare systems and provide guidance to DNP-prepared nurses who are positioned to apply the evidence. Nursing must study and propose strategies to help systems with research uptake; these recommendations should address implementation development, economics, processes by which implementation effects may be measured, and factors associated with outcomes measures.

Nurse scientists should learn methods to study the effectiveness of innovative strategies directed towards patients, individual professionals, teams, and healthcare organizations, respectively. Nurse scientists are rapidly understanding that the impact of their research is best measured by the uptake of their findings in clinical settings (Demiris, Parker Oliver, Capurro, & Wittenberg-Lyles, 2014; McConnell et al., 2020; van Achterberg, 2013), but there is not yet a sufficient focus on detailed sustainability planning (Johnson et al., 2019). Boehm et. al (2020) describe the importance of preparing more nurse scientists who can engage in multidisciplinary teams to affect meaningful change in the provision of health care and provide excellent resources for faculty in PhD programs(Boehm et al., 2020). Nursing PhD students and emerging nurse scientists need this knowledge if they are truly to follow a path of generating impactful nursing knowledge.

Preparing Nurse Scientists for the Competitive Funding Climate

One of the most challenging tasks that investigators face is securing funding for their science. In today’s arid funding climate with historically low funding levels(Chung & Shauver, 2008), securing research funding is highly competitive. We have discussed the qualities of successful nurse scientists and the key gaps in science that nurse scientists must be prepared to fill. Addressing both of these will help position PhD students and emerging nurse scientists to successfully secure funding and programs must prepare nurse scientists to broadly consider funding sources. Diversifying both the individual and institutional grants portfolio is important to success.

PhD programs in research intensive universities encourage students to secure their own funding to gain experience in grant writing and to develop an individual funding record. Developing grant-writing skills early in the program provides PhD students time to hone their scientific writing abilities and to bring clarity to their scientific interests. Throughout the PhD program or even prior to starting, students should be encouraged to start identifying

potential grants to which they are eligible to apply. Doing so helps PhD students shape their research path and to consider multiple funding streams within the federal government, professional societies, and foundations. Internal school opportunities and foundations offer an excellent way to begin applying for grants and provide a springboard towards grant applications targeted to the federal government. Federal opportunities may include National Institutes of Health (NIH), The Food and Drug Administration (FDA), the Centers for Disease Control (CDC), National Science Foundation (NSF), the United States Department of Defense and other agencies.

The NIH is one of the world's largest funders of biomedical research grants and awards funding in excess of \$30 billion annually for research that falls within its mission to understand living systems, enhance health, extend healthy lives, and reduce the burdens of illness and disability. The NIH is funded by the US federal government and comprises 27 institutions and research centers. The NINR is one of the institutes but not the only institute relevant to nursing science. Thinking broadly across NIH is important for faculty and PhD students alike. The funding criteria for each individual institute vary, so deeply diving into individual institutes missions, strategic priorities, and research portfolios is crucial. Additional steps can be found at https://grants.nih.gov/grants/planning_application.htm.

The NIH encourages applicants review RePORTER to aid in identifying which institute the research best fits. In RePORTER, search by term (<https://projectreporter.nih.gov/reporter.cfm>), or input an abstract or other scientific text (https://projectreporter.nih.gov/reporter_matchmaker.cfm) to find a list of similar funded projects. Once PhD students or emerging nurse scientists have a well thought out specific aims draft, mentoring them in how to contact the appropriate NIH institute and program officer is an important skill building opportunity.

Emerging nurse scientists should carefully consider strategies to maintain funding throughout their career. Strategies to consider include 1) writing a stream of applications at different intervals; 2) developing two related but focal areas within a program of research that can be concurrent yet at different phases in the study trajectory; 3) establishing and working with interdisciplinary teams where the nurse scientist changes roles as contact PI, mPI, and Co-I; and 4) planning new applications when mid-cycle in a currently funded grant. With grant applications come rejections (often repeated) and working with emerging nurse scientists to understand this is part of the journey and to persevere is important (Ardehali, 2014).

Conclusion

As a discipline, nursing must give critical thought to the preparation of PhD students and support of emerging nurse scientists if we are to position them to conduct rigorous, socially relevant science to improve health and well-being. We have argued that it is essential to broaden our thinking in this evolving world as to the knowledge and skills that nurses bring into the PhD program and the content, approaches, and training to prepare nurse scientists to address emerging needs and evolving methodologies in science. We must thoughtfully but

rapidly refine our preparation of PhD nurse scientists in order to ensure the relevance and competitive status of nursing science.

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Highlights

- Preparation of nurse scientists requires curricular changes to keep pace with knowledge development
- Important gaps in science include social determinants of health, team science, nursing innovation, and implementation science
- Providing skills for success occurs well beyond required coursework
- Mentors and sponsors are essential for nurse scientists at the early phases of their career trajectory
- Nurse faculty must thoughtfully but rapidly refine preparation of PhD nurse scientists in order to ensure the relevance and competitive status of nursing science