Pearls and Pitfalls of Team Science

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Abstract
Formidable health problems are often best addressed by teams of scientists with varied expertise. This diversity among team members and complexities in managing teams can lead to challenges in designing, funding, conducting, and reporting research. Team science difficulties can be addressed by sophisticated planning, frequent reassessment and realignment of team strategies with goals, and consistent transparent communication. This article addresses specific strategies to build and sustain research teams, manage team meetings, strategically develop publications and grants, thrive in the

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<th>Aim</th>
<th>Strategies</th>
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<tr>
<td>Form research teams</td>
<td>* Select members by identifying what kind and when new expertise is required</td>
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<td>• Large comprehensive schools may have varied expertise but it may be difficult to locate the expertise</td>
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<td>• Smaller schools may necessitate seeking expertise outside the organization</td>
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<td>• May need to add members as projects are completed or the field of science moves forward</td>
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<td>* Carefully consider whether to invite a potential team member who has difficulty working with others. If they possess a rare commodity (e.g., unusual expertise, access to a scarce pool of subjects), some interpersonal difficulties may be a reasonable trade-off.</td>
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<td>* Recruit desirable team members:</td>
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<td>• With a clear abstract of a proposed direction</td>
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<td>• With some ideas about individual scientific contribution</td>
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<td>• With some idea about other team members' roles and responsibilities</td>
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<td>* Articulate members individual scientific contributions</td>
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<td>* Articulate nursing's unique contribution if team members need the information</td>
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<td>* Start a team with a small project will allow time to develop common language and learn work styles while building relationships</td>
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<td>* Start development of shared goals</td>
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<td>* Welcome membership turnover as a means to increase new ideas</td>
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<td>* Consider when to terminate a team member (e.g., number of noncontributions to papers, inability/unwilling to work cooperatively, incompatible goals)</td>
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<td>Develop and sustain research teams</td>
<td>* Create mutual expectations regarding scope of work and build mutual goals</td>
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<td>• Develop and regularly assess operational activity links with goals</td>
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<td>• Discuss scientific products (presentations, publications, grants) early in team formation</td>
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<td>• Avoid nonproductive individual agendas</td>
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<td>* Establish new shared language—some misunderstandings are from language divergence</td>
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<td>• Encourage team members to read other team members' articles to understand their perspectives and intellectual contribution</td>
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| Strategically build presentations, publications, and future grants | • Plan products early in team process  
• Openly discuss members’ willingness to commit resources to specific products  
• Negotiate authorship early with reassessments as products are developed  
• Accept not all members will participate in all manuscript and grants  
• Recognize disciplinary differences related to authorship order  
• Recognize disciplinary differences in value of the products of team science including manuscripts, revenue generation, community collaboration, industry links, etc.  
• Use transparency around expected performance outcomes of team members  
• Assess whether outputs justify investment of time and resources from the perspective of all stakeholders  
• Secure shared site for access to project materials  
• Celebrates successes |
| Thrive in the midst of differences | • Clarify individual team members’ needs (e.g., publications to support grant submissions, promotion and tenure evidence)  
• Attend to advancing junior scientists  
• Recognize members may not share same work ethic  
• Manage conflicts  
• Expect disagreements and criticism of the science—this is how science progresses—keep them focused on the science not the scientists  
• Preserve individual creativity  
• Accept that team science requires shared control and sometime compromise  
• Recognize and plan for differences in work styles (such as preparation of grants far vs. immediately before deadlines)  
• Maintain transparent communication about disciplinary perspectives that may affect planning, implementing, or reporting projects |
| Build for future team science | • Include students and trainees  
• Recognize disciplinary differences in student engagement in projects  
• Address disciplinary variations in student authorship participation  
• Teach team science in PhD programs  
• Include team science experiences in PhD programs |
often from different disciplines. One of the key values of team science is that each member of the team brings a unique perspective. It is essential to consider your role and what you "bring to the table." It is likely that you bring expertise as a nurse and perhaps proficiency in a particular method and topic. Understanding your unique skills helps clarify your role in the team. Having the confidence to share your perspective when it is different is important. Skill is needed to know when and how to share your ideas, and listening is always valuable.

The diverse perspectives that team members bring can be a key challenge. It is likely that members will be from different disciplines, and disciplines have unique languages. It is useful to speak many languages, or at least to be bilingual! When preparing to be a good team member, reading what other team members have written on the topic may be useful. Clarifying what is said is always important, even when it seems on the surface to be clear. When different disciplinary terms are used, the meaning to one outside the discipline may not be clear. One of the values (and challenges) of language is that words have nuanced meanings that can be difficult to translate easily or with one word.

In addition, members of different disciplines likely have different expectations, and it is always important to explicitly clarify expectations. The expectation of whether one will be an author, the order of authorship, and journals in which it is appropriate to publish are all important to discuss very early in the team building process. It is always important to clarify your needs in relation to grants and publications. Team members at different career stages have different needs to be principal investigator, first author, and to present at conferences. Talking about these roles and expectations at the beginning is vital to ensure that expectations are met.

Authorship is an important and good example of an issue in team science. Katz (2015) questioned how a large number of authors could contribute sufficiently to warrant authorship. In contrast, Hammer and Miaskowski (2017) argued that each member of a large group could make unique intellectual contributions to advance the science, and to warrant authorship on a paper. Deliberation about the aspects of working with a large team is important.

Cindy Anderson

The Ohio State University

Active engagement with the right team is essential to catalyze scientific advances and solve the complex problems required to advance the field. The combined and sometimes disparate expertise needed to address pressing problems often requires different perspectives derived from inter- and
development and maintenance of effective and efficient teams include mutual respect, clear communication, and commitment to the team mutual objectives. Efficient and effective teams working together all “float the boat,” providing opportunities for advancing science and professional goals.

Cheryl Killion

Case Western Reserve University

With the heightened complexity of health conditions and related health care delivery challenges, team science has become pivotal in addressing some of these issues. Increasingly, nurse scientists are collaborating on research teams comprised of investigators from other disciplines. Also, nurse researchers are beginning to lead, develop, and participate in centers, consortia, and institutes, though nursing’s contributions in these areas have been relatively limited. Until recently, nurses’ research efforts have been dominated primarily by individual, single-investigator approaches (Meneses, 2007). Nursing’s involvement in resolving health related issues, with sustainable outcomes, by whatever means, is critical for advancing optimal quality of life, promoting the profession, and elevating the nurse scientist. Partnering with researchers from multiple disciplines has great potential for all members of the team.

Because, in team science, models of scientific collaboration differ by the level of theoretical and methodological integration, it matters how nurse scientists are positioned and participate on the teams. Although each research team is different, the ease and efficacy by which nurse scholars can incorporate a nurse science perspective, making its uniqueness visible and understandable, is critical. Establishing legitimacy of the nursing perspective by revealing facets of nursing knowledge is key. Furthermore, the ability to articulate and translate the essence of nursing, for a focal issue, is essential. This is not to suggest that nurse scientists should maintain unilateral or irreconcilable positions. Rather, the goal is that known theoretical, philosophical, and methodological approaches can be presented with confidence while maintaining openness to alternative approaches and opportunities for transformation. The hope is that other involved disciplines do the same and have similar standards. This fusion of established and new ideas, for all team members, represents a paradigm shift in research. Although there is evidence that the nursing perspective is welcomed and valued, some nurse scholars have expressed concerns about the loss of distinct nursing knowledge that could result from nurse scientists focusing on transdisciplinary research (Kneipp et al., 2014). The notion of perceived bias against the nursing profession by other team members has been identified as an issue, as well (Bartuneck,
advancing nursing science. Human health problems are complex and are best addressed through interdisciplinary collaborations (Börner et al., 2010). A valuable philosophy is to embrace teamwork as a high value concept. There are many benefits including professional validation, increased innovation, and improved patient care (Disis & Slattery, 2010).

I would not consider working in isolation as an option. While you have knowledge in a specific area, it is not sufficient. You need the expertise of others whether it is conceptual, biological, behavioral, content, methodological, policy, or political. Teamwork that capitalizes on the expertise of each member is more likely to lead to success. Always be open to requests for collaboration and consider the many benefits of being part of a collaborative team who shares leadership and responsibilities. You may be the principal investigator or first author on one project and be a co-investigator or co-author on another project. According to Rose and Anderson (2016), a well-functioning research team has shared goals, clarifies the roles of team members, meets in person as much as possible, negotiates authorship early in the process, includes students and trainees, and celebrates successes.

Working in teams is not without challenges. Rose and Anderson (2016) also noted barriers to the success of team science including misunderstandings, making faulty assumptions, and personality conflicts. I would add “values conflicts” meaning all members of the team may not share the same work ethic or vision for the research. There is always a risk that someone may appropriate your ideas when you collaborate. This may be intentional or unintentional. In my experience, the biggest challenge in team science is getting everyone to contribute. It is a useful skill to be able to recognize the person who says yes to making a contribution to the work when they mean no. Unlike baseball’s “three strikes and you are out” rule, I try to abide by a “two strikes and you are out” rule for team science. If a team member fails to deliver on an agreed-upon task or they miss deadlines twice, it is best to consider terminating the relationship.

Conflicts will arise and must be resolved expeditiously to meet goals. Steven Covey, the noted author, best known for his book *The 7 Habits of Highly Effective People*, said “we judge ourselves by our intentions and others by their behavior” (Covey & Merrill, 2008, p. 13). Building on that thought, we might acknowledge that we often judge ourselves by our *best* intentions and others by their *worst* behavior. A wise colleague once pondered over why we seem to assume the worst rather than the best in a person or situation. There is probably a biological and/or social explanation for these thoughts but whatever the reason; when it comes to collaboration, we might work harder to assume the best in others but clarify and verify.
self-interest" (Taras, 2012, p. 5), but asking someone why they are willing to venture out of their scientific discipline to work as part of an interdisciplinary team can be enlightening. Being transparent in disclosing what you and other members of the team expect to achieve because of their investment on the team minimizes hidden agendas and helps align the individual's goals with the team's objectives.

The final consideration when deciding to invite someone to join the team is, “Do they clearly understand their role on the team and are they committed to fulfilling that role?” Early on in developing an interdisciplinary team, each member needs to disclose to everyone else on the team what benefit(s) they expect from their participation and what they envision as their contribution to the team. Of course, the more clearly communicated and quantitative the anticipated benefits and contributions are, the less chance for misinterpretation by members of the team.

Team science leverages the strengths and expertise of professionals trained in different fields. This advantage of team science is accompanied by discipline-specific values, terminology, methods, theoretical perspectives, and work styles. These differences between disciplines in conducting scientific inquiry present a challenge, can germinate conflict within the team, but also have the potential to improve the quality of the science. An interdisciplinary team is more productive when all members of team recognize, appreciate, and have the opportunity to learn from the differences among disciplines. Learning new values, terminology, methods, theoretical perspectives and work styles and the rationale commonly results in the individual reexamining the efficacy of their own discipline-specific approaches. Comparing and integrating different discipline-specific approaches may lead to improved scientific methods and wider application of the findings. One of the best examples of this is when I was teaching a measurement class that included students from a variety of health care disciplines. An in-class assignment required the students, as an interdisciplinary group, to develop a novel approach to pain measurement to facilitate patient recovery. The nurses in the group wanted to measure a patient-centered level of acceptable pain, while the physical therapy students wanted to measure pain as a metric of physical functioning. An open respectful discussion of the discipline-specific definitions of pain, along with an explanation of the rationale for the definition allowed an exchange of values, terminology, methods, and theoretical perspectives among the students. This exchange resulted in a unique definition of pain to assess patient recovery. An important characteristic of successful interdisciplinary teams is the ability of the members to recognize and appreciate each other's discipline-specific values, terminology, methods, and theoretical perspectives and work styles to achieve an individual and team goals.
designated communications leader is valuable. The team should consider who constructs the messages about the team and their work. How are the messages disseminated and to whom? A plan for communication prevents the unfortunate breach of trust that can occur when messages are unexpected and sometimes made with a myopic view of the team.

It is important to maintain the momentum of the team and to advance junior scientists. Mentorship by senior team members is a vital component of team science. A plan for mentorship is helpful, specifying the length of time for the mentorship, expected outcomes, roles of the mentee and mentor, as well as evaluation of the experience. A team is an open system that must be flexible and responsive to input from the environment, such as scientific developments, funding opportunities, institutional priorities, composition of the team, and other factors. The ability to nimbly respond to environmental changes while protecting the valued and productive work of the team is critical. Output from the team must be worth the investment of time and resources from the perspective of all stakeholders.

Linda Herrick

University of Nebraska Medical Center

Research teams made up of multiple disciplines can be extremely rewarding and productive but also pose some challenges. Teams that have been formed through clinical relationships with common clinical and research interests often have established relationships, a degree of trust, and a common patient-oriented language. These teams have included different mixes of nurses, physicians, dieticians, social workers, biostatisticians, and economists. Effective clinical practice translated to effective research teams though challenges existed such as who to include in which study, keeping all team members involved despite competing demands, authorship, and recognizing contributions. Good team communication in which individuals are open to new ideas, respectful of all contributions, and able to negotiate not only the project but roles within the project has been key. A consistent time for team meetings has provided time for needed communication and discussion of projects, participation, and consensus building related to everything from study aims to data interpretation and decisions regarding presentation and publication opportunities.

Other study teams resulted from collaborations among various institutions for the purpose of research. In this case, relationships and knowledge of the discipline and contributions need to be established quickly. Working with basic scientists in medical adhesives proved to be problematic until we
all. In addition, I presumed each invitee would bring purposeful intention to use their expertise in some aspect of the research process. Unfortunately, nonproductive individual agendas prevailed and valuable time was lost with misdirected team building goals. After the initiative was completed with limited success, my cursory assessment was that members devalued each other’s disciplinary sophistication and were unwilling to fully participate due to a lack of skill in working together. I had attributed the problem only to an unwillingness to engage, when the deeper issues included a lack of knowledge of how, when, and why to engage. Even with dedicated funding for the collaborative project, individuals used overt and covert methods to protect and sustain their silos of disciplinary funding. Of course, these actions compromised forward movement.

Since that time, the national imperative has progressed and scientists working together reflect the national emphasis on building interdisciplinary research teams to address the complex problems of health and well-being. Team science is considered a specialty with strategies to address effective and efficient team science evolving at an accelerated pace (National Research Council, 2015; U.S. Department of Health and Human Services, NIH, National Cancer Institute, 2018).

Strategies for efficient and effective team science must systematically incorporate the institution, college or discipline, community, and individual research faculty. Selected strategies for early-career researchers include the following:

- Build your own capacity in understanding team science and the associated resources (National Research Council, 2015; SciTS and Team Science Resources, n.d.; U.S. Department of Health and Human Services, NIH, National Cancer Institute, 2018). Consider conferences and other intensive learning formats to quickly become fluent.
- As you lead or assist others in bringing a team together, maintain clarity on the scientific problem to be solved. Seek ways to establish team members’ expertise and their view of the problem. Listen and lead or secure a facilitator skilled in the “science of team science” who can manage this team building aspect.
- Move away from traditionally viewed research silos and embrace the newer incentives for team science that may include the language of published requests for proposals that connect team science with high potential for funding, institutional team science priorities endorsed by Vice Presidents of Research and tenure and promotion criteria, and the distribution of research incentive funds or grant F and A to colleges/researchers when research leaders cross colleges and departments.
expected reports of progress from team members. It is important to also discuss members informing their administrators about their time commitment to the project, each member’s role and expected responsibilities with deadlines, your own role as PI and future authorship, and continuing research opportunities.

Challenges do occur between disciplines and even among those in the same profession. These can be differing: (a) desired patient outcomes, (b) views of patient/family problems, and (c) language used related to research. Some may want questionnaire outcomes while others believe only biomedical data are valid measures. Conflicts also occur regarding “how to define patient compliance” or “why is it necessary” to enroll family members or friends in the research. Moreover, issues about what is meant by research terms such as “arms vs. groups,” “random vs. cohort design,” and “procedures vs. protocols” often cause confusion. Being aware of these differences, identifying and discussing each as these occur, does lead to consensus. Such discussions enrich the research and the collegueship. The open respectful team meetings and recognition of the value of each point of view also results in long-term teamwork and research opportunities.

Conclusion

Team science is a powerful strategy to build the complex knowledge essential to address difficult health care problems. The very diversity of expertise that makes team science valuable also leads to challenges. Difficulties in managing team science can be addressed by intricate planning, frequent reassessment and realignment of team strategies with goals, and copious transparent communication. The opportunities inherent in team science justify the effort required to build and maintain successful functioning research teams.

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