

## SOUNDING BOARD

# Is the juice worth the squeeze? Transdisciplinary team science in bladder health

Kathryn H. Schmitz PhD, MPH<sup>1</sup>  | Tamara Bavendam MD<sup>2</sup>  |  
 Sonya S. Brady PhD<sup>3</sup>  | Linda Brubaker MD<sup>4</sup>  | Kathryn Burgio PhD<sup>5</sup>  |  
 Bernard L. Harlow PhD<sup>6</sup>  | Aimee James PhD<sup>7</sup>  | Emily S. Lukacz MD<sup>4</sup>  |  
 Janis M. Miller PhD<sup>8</sup>  | Diane K. Newman DNP<sup>9</sup>  | Mary H. Palmer PhD<sup>10</sup>  |  
 Kyle Rudser PhD<sup>11</sup>  | Siobhan Sutcliffe PhD<sup>7</sup>  | Prevention of Lower Urinary  
 Tract Symptoms (PLUS) Research Consortium

<sup>1</sup>Department of Public Health Sciences, Penn State College of Medicine, Hershey, Pennsylvania

<sup>2</sup>Women's Urologic Health, National Institutes of Diabetes and Digestive and Kidney Diseases, Bethesda, Maryland

<sup>3</sup>Department of Epidemiology and Community Health, University of Minnesota School of Public Health, Minneapolis, Minnesota

<sup>4</sup>Division of Obstetrics, Gynecology, and Reproductive Sciences, UC San Diego, San Diego, California

<sup>5</sup>Department of Medicine, University of Alabama at Birmingham School of Medicine, Birmingham, Alabama, Geriatric Research, Education, and Clinical Center, Department of Veterans Affairs, Birmingham, Alabama

<sup>6</sup>Department of Epidemiology, Boston University School of Public Health, Boston, Massachusetts

<sup>7</sup>Department of Surgery, Washington University, St. Louis, Missouri

<sup>8</sup>Department of Health Behavior and Biological Sciences, University of Michigan School of Nursing, Ann Arbor, Michigan

<sup>9</sup>Department of Surgery, Division of Urology, University of Pennsylvania's Perelman School of Medicine, Philadelphia, Pennsylvania

<sup>10</sup>UNC School of Nursing, Chapel Hill, North Carolina

<sup>11</sup>Division of Biostatistics, University of Minnesota School of Public Health, Minneapolis, Minnesota

## Correspondence

Kathryn H. Schmitz, PhD, MPH, FACSM,  
 FTOS, Penn State College of Medicine,  
 500 University Drive, Hershey, PA 17033.  
 Email: [kschmitz@psh.psu.edu](mailto:kschmitz@psh.psu.edu)

## Abstract

**Aims:** Prior research on lower urinary tract symptoms (LUTS) has focused on the treatment and management of these conditions with scant attention to prevention. The Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium was formed to address the complexities of preventing LUTS and promoting bladder health.

**Methods:** Herein, we describe challenges faced and strategies used to develop the PLUS Research Consortium into an engaged and productive transdisciplinary scientific team. We apply four previously defined team science phases (development, conceptualization, implementation, and translation) to frame our progress.

**Results:** Strategies to progress through the development phase included the generation of a shared mission, and valuing of other disciplinary perspectives. The conceptualization phase included generating a shared language and

developing a team transdisciplinary orientation. During the implementation phase, the group developed roles and procedures and focused on conflict management. The translation phase includes continued refinement of the mission and goals, implementation of research protocols, and robust dissemination of the scientific work products related to bladder health.

**Conclusion:** A diverse group has matured into a productive transdisciplinary team science consortium. Achieving this outcome required dedicated effort for each member to engage in activities that often required more time than single discipline research activities. Provision of the necessary time and tools has fostered a transdisciplinary team science culture and rich research agenda that reflects the complexity of the health issue to be addressed. Our experience may be useful for others embarking on team science projects.

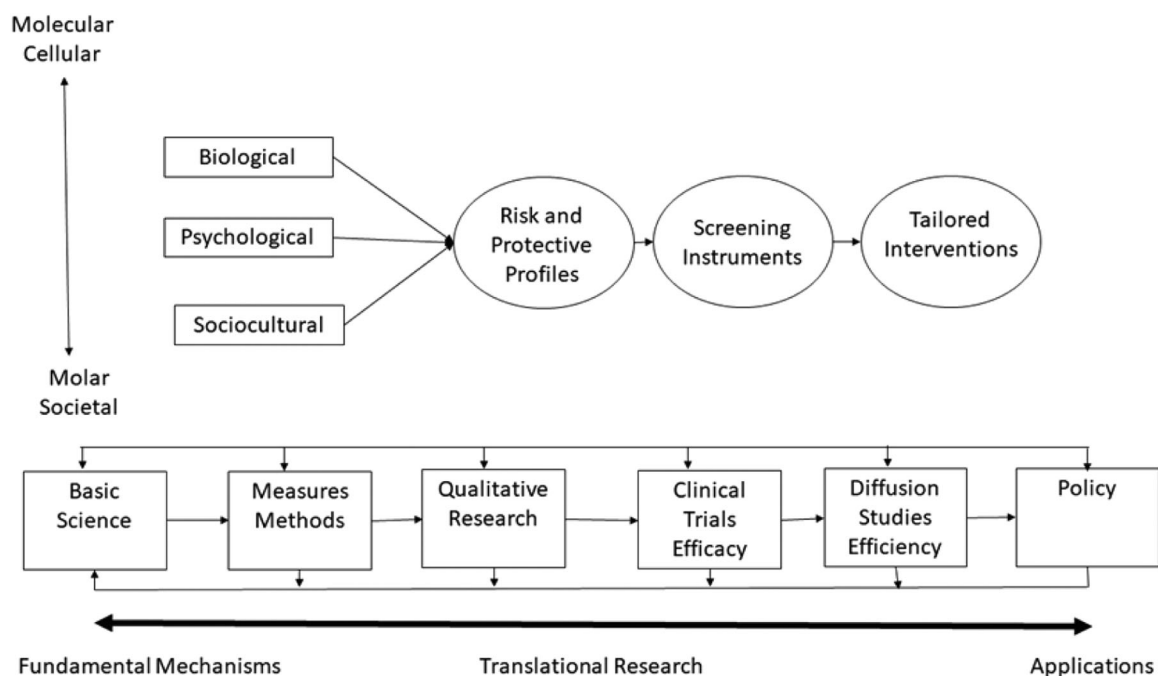
#### KEYWORDS

cooperative behavior, interdisciplinary communication, lower urinary tract symptoms, organizational objectives, problem-solving, research activities, transdisciplinary

## 1 | INTRODUCTION

The Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium was formed by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) in 2015, in recognition of the need to prevent a particularly complex set of health conditions that are highly prevalent and create significant burden on individuals, societies, and healthcare systems.<sup>1</sup> The

NIDDK recognized the need to bring together a diverse group of investigators to address these particularly complex health issues. Prior research on Lower Urinary Tract Symptoms (LUTS) has focused on the treatment and management of bladder-related conditions, with scant attention to prevention. The PLUS Research Consortium differs from prior research groups in both aims and methods, by focusing on characterizing bladder health and LUTS *prevention* in women and girls.



**FIGURE 1** Transdisciplinary Research Conceptual Model (Adapted from Abrams DB Transdisciplinary paradigms for tobacco prevention research. *Nicotine and Tobacco Research* 1:S15-S23, 1999)

The social, clinical, and public health issues of LUTS highlight the need for transdisciplinary team science and integration across clinical, epidemiologic, and behavioral sciences to address complex health research problems that cannot be effectively addressed by one or even a few disciplines.<sup>2</sup> Transdisciplinary team science has been distinguished by Holly Falk-Krzenski as the combination of “specialized expertise, theoretical approaches, and research methods across disciplinary boundaries, toward the goal of solving complex problems and producing high-impact science.” A conceptual model of this approach to science was originally developed by Abrams.<sup>3</sup> An adapted version of the model can be found in Figure 1.

The NIDDK request for applications (RFA) (RFA-DK-14-004 and RFA-DK-14-018) to form PLUS set the stage for transdisciplinary science by calling for a wide range of expertise, resulting in the desired outcome of consortium membership with diverse disciplines (see Table 1).

This article describes the development of our transdisciplinary team science approach to addressing LUTS prevention in women and girls during the consortium's first 4 years of funding (between 2015-2019). We frame our discussion using a four-phase model of developing transdisciplinary teams as outlined by Dr. Kara Hall,<sup>2</sup> including development, conceptualization, implementation, and translation. We describe how the PLUS Consortium began, has progressed, and continues to evolve through these phases. Investigators value this unique opportunity and have provided insights and observations throughout this paper to describe progress along the path toward achieving and maintaining a transdisciplinary science framework. This may guide others on their journeys to transdisciplinary team science. While the PLUS Consortium experience described herein was particularly complex due to the breadth of the NIH charge with broad research goals, we hypothesize that these challenges will be present in the formation and work of all transdisciplinary team science research groups.

## 2 | METHODS

### 2.1 | Development: The inception of PLUS

Grant application responses to the PLUS Consortium RFA were required to include an investigative team with a diversity of expertise, a gap analysis of the current state of the evidence on LUTS prevention and bladder health promotion in women and girls, a conceptual framework, and at least one plan to fill gaps in the evidence base. The RFA also specified that the consortium would start from the

**TABLE 1** Areas of expertise represented within the PLUS Research Consortium

|                                                                              |                                      |
|------------------------------------------------------------------------------|--------------------------------------|
| Adolescent Medicine                                                          | Medical Sociology                    |
| Behavioral Medicine                                                          | Midwifery                            |
| Behavioral Sciences                                                          | Mixed-Methods Research               |
| Bioethics                                                                    | Multilevel Intervention Research     |
| Biomarkers                                                                   | Neuroendocrinology                   |
| Biostatistics                                                                | Neuroscience                         |
| Cancer Screening and Early Detection                                         | Nursing                              |
| Cell Biology                                                                 | Obstetrics & Gynecology              |
| Clinical Trials                                                              | Pediatrics                           |
| Community-Based Participatory Research                                       | Physical Medicine and Rehabilitation |
| Community-Engaged Research                                                   | Policy                               |
| Community Health Promotion                                                   | Prevention Science                   |
| Developmental-Behavioral Pediatrics                                          | Preventive Medicine                  |
| Disparities in Healthcare                                                    | Psychiatry                           |
| Dissemination and Implementation Science                                     | Psychology                           |
| Epidemiology                                                                 | Psychometrics                        |
| Exercise Physiology                                                          | Public Health                        |
| Female Pelvic Medicine and Reconstructive Surgery/Urogynecology              | Qualitative Methods                  |
| Geriatrics                                                                   | Quantitative Methods                 |
| Gerontology                                                                  | Reproductive Medicine                |
| Gerontological Nursing                                                       | Research Methods                     |
| Global Health                                                                | Scale and Measurement Development    |
| Health Disparities Research                                                  | Sexual and Gender Minority Health    |
| • Informed Clinical Decisions (patients and providers)                       | Social Determinants of Health        |
| • Language and Cultural Concordant Methods in Research and Clinical Practice | Social Epidemiology                  |
| Health Literacy                                                              | Social Network Analysis              |
| Health Promotion                                                             | Survey Methods                       |
| Health Services Research                                                     | Social Welfare                       |
| Health Technology                                                            | Social Work                          |
| Infectious Disease Research                                                  | Urology                              |
|                                                                              | Women's Health/Gynecology            |
|                                                                              | Women's Studies                      |

Abbreviation: PLUS, Prevention of Lower Urinary Tract Symptoms.

**TABLE 2** PLUS Consortium vision, mission, and goals

Vision: Bladder health for all

Mission: Prevent lower urinary tract symptoms and promote bladder health through research

Goals:

The PLUS Research Consortium will:

- Create and refine a research definition for bladder health
- Create and refine a conceptual framework for promoting bladder health and preventing LUTS in women (and girls) throughout the life course
- Employ principles of community engagement
- Empower communities to advocate for bladder health
- Use a multi-level dissemination strategy (academic, policy, and community)
- Create and use new conceptual models and paradigms for LUTS prevention research at individual and population level
- Share experience with transdisciplinary team science with broader community
- Through our research, support global efforts for bladder health promotion and LUTS prevention

Abbreviations: LUTS, lower urinary tract symptoms; PLUS, Prevention of Lower Urinary Tract Symptoms.

beginning in building the evidence base for LUTS prevention, thus creating a new field of investigation. Minimum time requirements for all investigators acknowledged the significant time needed for learning, reflecting, discussing, planning, and revising the PLUS vision, mission, and goals (see Table 2). Further, this approach facilitated the initial steps for developing a transdisciplinary scientific team, described below.<sup>2</sup>

## 2.2 | Development of a group environment of psychological safety

In order for all team members to perceive a group environment of psychological safety, efforts were made to promote active listening and debate and to ensure that conversations were characterized by mutual respect and openness to new ideas.<sup>2</sup> Toward this goal, initially, every member was encouraged by the NIDDK leadership to disengage from traditional views of multicenter research networks that focused on treatment (eg, Urinary Incontinence Treatment Network or Interstitial Cystitis Collaborative Research Network, Pelvic Floor Disorders Network)<sup>4,5</sup> and consider all available research designs and methods to build sufficient foundational knowledge across disciplines. Rather than prioritizing large multi-site randomized controlled trials coordinated across research centers, PLUS Consortium uses parallel studies and multiple methods with a strong intention to consider social, environmental, behavioral, and

cultural contributors to bladder health as equivalent in priority to understanding the biological underpinnings of LUTS. This approach emphasizes that no individual investigator or discipline contains all of the knowledge needed to solve the complex problems to be addressed.

Anticipatory guidance from the scientific program officer helped PLUS Consortium members to expect stages of ambiguity and uncertainty, as well as the potential to test and expand one's psychological comfort zone. Time was provided to consider disciplinary differences along with individual perspectives and avoid the temptation to set a specific research agenda without consideration of the alternatives at the beginning. This has ultimately enabled the PLUS Research Consortium to benefit from prevention strategies in other disciplines and address the complexities of LUTS prevention more comprehensively than would have been possible with the involvement of fewer disciplines.

Various strategies were used to create equitable conditions and reduce the traditionally entrenched hierarchy of sciences<sup>6</sup> and the perceived ordering of disciplines.<sup>7</sup> As an example, all members, regardless of seniority, received investigator biographies before the first meeting, allowing them to identify shared professional and other interests and complementary skill sets. Investigators completed the Meyers Briggs Type Indicator<sup>8</sup> (MBTI) before a facilitated workshop at the first in-person consortium meeting. The MBTI facilitated awareness of the different communication and interaction styles within the consortium, and to find common ground for improved interactions.

A PLUS committee was formed to organize and develop web-based educational seminars, with mandated attendance. These seminars facilitated a rapid understanding of the variety of expertise within and outside of the consortium. Topics included those relevant to bladder health, prevention science, technology, specific populations (eg, LGBTQ, pregnant women, athletes, women in the military), and transdisciplinary team science methodology.

## 2.3 | Generation of a shared mission and goals

The creation of a shared mission and goals provides transdisciplinary team members with the opportunity to define a shared problem space that includes relevant information from a variety of perspectives.<sup>2</sup> A unique PLUS perspective is that LUTS prevention requires an explicit new understanding and evidence base about bladder health. Members agreed that although the promotion of bladder health and LUTS prevention were distinct related issues, the line between them was blurred and bladder health and LUTS were best viewed as existing on a continuum. While there was some understanding of risk

factors for LUTS based on existing research literature, there was no generally accepted definition for “bladder health.” The group determined that the defining features of bladder health<sup>9</sup> are more than the absence of LUTS and agreed that a woman’s or girl’s bladder health is affected by many factors beyond just individual biology.

A professional facilitator was engaged early in the team development process to help members build an initial goal statement and proactively identify and discuss potential challenges. The facilitator helped members to develop informed decisions by demonstrating and exploring a variety of communication strategies (Table 3), including active listening to many voices, advocating for the breadth of discussion, allocating time for different

perspectives to be expressed, and coming to consensus or agreement to revisit issues later when there were a variety of opinions that could not be fully heard.

## 2.4 | Externalization of group cognition

In order for a team of scientists from diverse disciplines to address complex problems effectively, they must process information outside their area of expertise. Externalization of group cognition occurs when a group engages in creative problem solving to bring ideas from multiple perspectives.<sup>2</sup> A pivotal moment in the PLUS Consortium’s externalization of group cognition was the

**TABLE 3** Communication norms developed within the PLUS Research Consortium

| Communication mode or product                                          | communication norms (generally accepted and adopted practices)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| All Communications                                                     | <ul style="list-style-type: none"> <li>Flexibility in developing and adjusting norms within subcommittees and work groups</li> <li>Trust in colleagues to set norms that will result in the most rigorous scientific processes and products</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| WebEx Meetings                                                         | <ul style="list-style-type: none"> <li>Regularly scheduled meetings for the whole consortium, subcommittees, and work groups</li> <li>Option for group members to join by computer and/or telephone</li> <li>Option for group members to access documents via WebEx display and/or email</li> <li>Sharing of progress and solicitation of feedback across all subcommittees and work groups to facilitate transparent, transdisciplinary approach to team science</li> <li>Solicitation of feedback from individuals representing different disciplines and areas of expertise</li> <li>Solicitation of feedback from all attendees (for smaller meetings)</li> <li>Editing of documents in real time to reflect group discussion and decisions (for smaller meetings)</li> <li>“7-second rule” – waiting at least 7 seconds after posing a question before moving on</li> </ul> |
| Emails                                                                 | <ul style="list-style-type: none"> <li>Identification of “PLUS” and applicable subcommittee or work group in the subject line</li> <li>Content of email or attachment clearly identifies goals and objectives, division of tasks between group members, and requested delivery dates</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Agendas/Minutes                                                        | <ul style="list-style-type: none"> <li>Always includes the first paragraph of our consortium goal statement</li> <li>Co-chairs of subcommittees/workgroups or other responsible individuals develop and send agendas before meetings and minutes after meetings</li> <li>Agenda template displays meeting information, including date, time, and login url and call-in number for WebEx meetings</li> <li>Minutes template includes clearly identified action items, assigned tasks, and requested delivery dates</li> </ul>                                                                                                                                                                                                                                                                                                                                                     |
| Dissemination Products (eg, papers, posters, PowerPoint presentations) | <ul style="list-style-type: none"> <li>Chair of dissemination work group is responsible for leading the development of dissemination goals and objectives, facilitating the development of sub-work groups, assigning tasks and delivery dates, monitoring progress, resolving challenges, collating sub-work group progress, synthesizing materials, and sharing revised products with group members</li> <li>Most work groups have elected to share progress via email</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                              |

Abbreviations: PLUS, Prevention of Lower Urinary Tract Symptoms.



process of evaluating conceptual frameworks that had been included in each site's initial research grant applications. Lively discussions led to the development of an adapted conceptual framework designed to guide the PLUS research agenda. The agreed-upon framework<sup>10</sup> (see Figure 2) drew from traditional social-ecological models, biopsychosocial models, Glass and McAtee's Society-Behavior-Biology Nexus, and the World Health Organization's conceptual framework for action on the social determinants of health.<sup>11-14</sup> Through the generation of this conceptual framework over a period of several months, the value and relevance of all disciplines was crystallized. The PLUS conceptual framework and prioritized research themes were inclusive of all represented disciplinary perspectives and spanned all levels of social ecology.

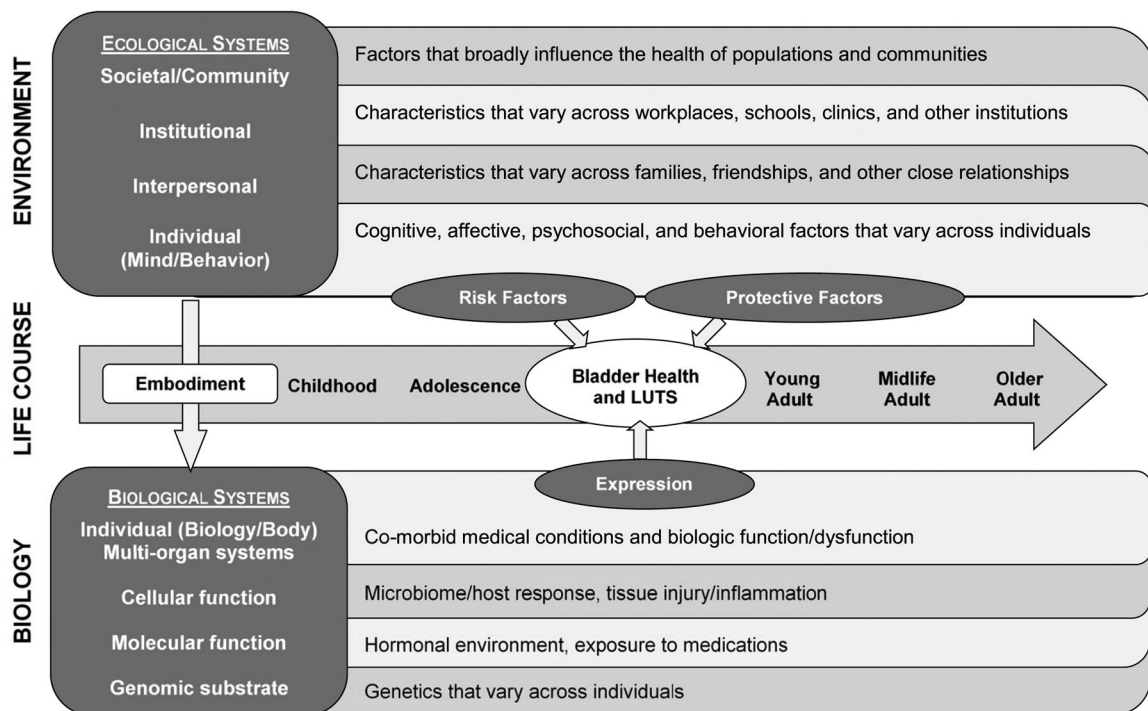
## 2.5 | Development of critical awareness

In the development of effective transdisciplinary scientific teams, members mature over time in awareness of the strengths and limitations of their own and other participating disciplines.<sup>2</sup> At the start of scientific initiatives involving multiple disciplines, predictable resistance to task design hierarchies exist. This resistance has been described in separate work using case studies series as “vehemently rejecting the serving role”<sup>6</sup> and

“defensive posturing”<sup>7</sup> against a perceived dominant discipline. Naturally occurring, resistance can be a marker of important underlying disciplinary symbolic divides.<sup>7</sup> Knowledge production and organization of science by disciplinary “differences in work content and work style, patterns of explanations, the frame of reference, and institutional contexts can be large and have to be bridged.”<sup>6</sup>

Most PLUS investigators were new to transdisciplinary research and had not yet experienced the known challenges and struggle to bridge these divides and the rewards of doing so. Many investigators were accustomed to knowing what is disciplinarily “right” and having their perspectives accepted without further discussion. But awareness grew that at a bare minimum, acknowledging and “naming” symbolic divides is a necessary part of transdisciplinary work, as is recognizing that emphatic resistance or defensive posturing on an issue might represent differing disciplinary philosophies, not just stubborn individual opinion.

PLUS members are gaining confidence in naming the symbolic divides and welcoming differing values, perspectives, and disciplinary expertise in particular methods or content. The emerging critical awareness about the value of diverse opinions is beginning to advantage the scientific work of the PLUS Consortium by enabling collaboration and communication among heterogeneous group members on equal terms<sup>6</sup> and promoting



**FIGURE 2** Prevention of Lower Urinary Tract Symptoms (PLUS) among girls and women: A conceptual framework adapted from Glass and McAtee.<sup>10,13</sup> LUTS, Lower Urinary Tract Symptoms

sustainable, authentic relationships over time. An example of this is a “communication norms” document PLUS members developed, with one item that declared members agreed to acknowledge an inability to accept a certain position means either (a) a failure to understand said position or a (b) fundamental disagreement (see Table 3 of other selected norms). Clarification of norms led to more robust discussion and coming to terms/compromise.

### 3 | CONCEPTUALIZATION

Several strategies were used to advance the second phase of transdisciplinary team science, including the generation of a shared language and development of a team transdisciplinary orientation. Each is described in detail below.

#### 3.1 | Generation of a shared language

During the second phase of development of a transdisciplinary scientific team, members begin to learn each other's disciplinary language and develop a shared vocabulary.<sup>2</sup> PLUS made use of naming symbolic divides to navigate from the development to the conceptualization stage, as evidenced by the creation of a shared language. To help promote shared language, a sub-group was tasked with developing a document of common terminology, as PLUS investigators frequently observed that colleagues spoke a different scientific “language.” The terminology document included definitions for different components of bladder health and LUTS<sup>9</sup>; biological sex, gender identity, and sexual orientation; life course concepts; medical terms; feminist terms; terms to promote inclusiveness and cultural sensitivity; and preferred terms for the dissemination of PLUS Consortium's work. Understanding differences in the language required considerable patience, tolerance, and ongoing dialog and discussion. Although many investigators found this developmental stage to be slow and less efficient than interacting with others who “think and act alike,” it was foundational for effective working relationships among the members. Communication norms were developed to assist with navigating this period (Table 3).

Besides terminology, shared language included establishing a working knowledge of methodological approaches that were new to many. Early in the first year of PLUS, the concept of community engagement was introduced as a potential method to gather or create essential foundational data to inform future LUTS prevention and bladder health promotion. Most PLUS

members had limited exposure to community engagement in research. Ongoing dialog and educational sessions prepared PLUS members to seek community input on our investigator-proposed measure of bladder health. Input from community stakeholders ensured that our definition of bladder health was grounded in lived experience and was instrumental in shaping our initial project, a qualitative research study to explore experiences of women and girls with regard to bladder health and LUTS.<sup>15-18</sup> PLUS members with and without prior community engagement experience developed a Community Engagement Practices and Procedures manual to develop a shared language for PLUS members to use in all future research endeavors.

#### 3.2 | Implementation: Getting the work done

Once transdisciplinary teams achieve a shared language, goals, and orientation, the research work can be implemented. There are discipline-specific approaches to carrying out the work of research. Differing assumptions regarding who knows what, who does what, how things get done, and how interactions occur can cause conflict. Common strategies used during this phase include the development of philosophical statements, policies, and procedures, as well as setting cultural and procedural norms for managing conflict and team learning.

PLUS investigators remained united in the desire to have an inclusive consortium infrastructure that cultivated mutual respect across different disciplines. To promote this goal, all PLUS committees and working groups were designed to have all-research center representation and multi-disciplinary representation to the fullest extent possible. Further, an explicit set of norms was developed and endorsed by PLUS members that included statements about diversity and opportunity (eg, solicit and listen to all voices, perspectives, and opinions), responsibility (eg, members will hold one another accountable for accepted responsibilities, while allowing for flexibility in assignment/reassignments), learning (eg, adopt a philosophy of plain language writing to promote transdisciplinary communication), sustainability (eg, cultivate the culture of a “peer learning community” and develop “buy-in” to maintain engagement by all consortium members), and conflict transformation (eg, when communicating disagreement or criticism, be constructive and courteous).

An additional facilitator to transdisciplinary teamwork was recognizing the perspectives of PLUS members whose time was primarily devoted to active clinical practice versus nonclinical academic responsibilities.

Thus, in addition to members of the coordinating center and NIDDK, the Executive Committee always includes representation from one primarily clinically oriented and one primarily academically oriented Principal Investigator (PI). This committee has met weekly to advance and monitor the progress of PLUS activities, to act as a clearinghouse for issues brought forward by members, and generate action items and agendas for upcoming work. PI representatives serve on a 6-month rotation cycle, with new pairings of clinically oriented and academically oriented PIs. This strategy for diversity in views by PI representation on the Executive Committee is an example of balancing power, building trust, keeping the perspective of the consortium fresh, and fostering a culture that views change as positive.

### 3.3 | Conflict management and team learning

Conceptual confusion due to misinterpretation resulting from differences in terminology across disciplines can create conflict in the development of transdisciplinary scientific teams.<sup>2</sup> To maintain a fresh perspective, address conflicts, and meet the needs of the consortium, positive disruption can be useful. Positive disruption can occur with changes in group leadership, membership, structure, and sometimes even mission. This continues to be encouraged by PLUS Consortium policies. For example, as the work of the terminology group progressed, members became clear that more focused effort on measuring bladder health was necessary. The conflict was possible, given that the work to be done was distinct from what the original terminology group was formed to do. As questions arose about whether to add members to the terminology group, another solution arose. Rather than reassigning the existing terminology group to this new task, a different organizational structure was developed to capitalize on PLUS member expertise in measurement and survey design. Members of the consortium with relevant expertise were enlisted to bring fresh and diverse perspectives into the discussion. The leads of the newly formed measurement group, selected by the PLUS Executive Committee, included a small group of three members with specific expertise in epidemiologic research, survey development, and LUTS.

Despite expressions from some investigators of discomfort with structural change, benefits of positive disruption to structures were also acknowledged by consortium members. These benefits included (a) personally getting to know far more individuals within the larger group, (b) having the opportunity to articulate/teach our differing disciplinary assumptions, and

(c) learning the disciplinary language/jargon of others. These strategies allowed the formation of new PLUS-specific (not discipline-specific) language, perspectives, and methods to emerge and for shared priorities to become solidified, along with new comfort with embracing shared values. Overlap in membership of project-based work groups and flexibility gained with these strategies has made for surprisingly high efficiencies in completion of very complicated work, as evidenced by publications, presentations, completed and ongoing multi-site projects, and the successful development of a cohort study that is planned for another 5 years of funding of PLUS. This cohort study will aim to address multiple specific research questions, including the distribution of bladder health in the general female population, and risk and protective factors for bladder health and LUTS that can be targeted through future LUTS prevention and bladder health promotion efforts.

## 4 | RESULTS

### 4.1 | Translation: looking to the future

As our transdisciplinary research progresses, PLUS will use the adaptive skills it has developed to address new opportunities and challenges. Challenges may develop because of the addition of new tasks over time and the absence of a “blueprint” for how transdisciplinary research teams should approach a new task. The need to revise or develop shared goals for new translational scientific endeavors is recognized. Anticipating this challenge, PLUS held a mid-course meeting to review, revise, and clarify PLUS’ mission, vision, and core values (the revised version is in Table 2). Future periodic meetings including all consortium members are planned to update and evaluate any needed course corrections.

PLUS investigators recognized the need for upfront time to develop a positive transdisciplinary culture, and that this would likely delay short-term productivity when judged by traditional metrics (eg, publications, presentations, and abstracts at national meetings). These short-term delays have already been offset by progress with conceptual work and research that promises a significant health impact, including 11 peer-reviewed papers,<sup>1,9,10,15-22</sup> 26 peer-reviewed abstracts,<sup>23-47</sup> and 15 invited presentations to date. PLUS has formalized key strategic initiatives informed by the shared language, critical awareness, and transdisciplinary orientation developed over the past 4 years. Plans are in place to iteratively update goals for tasks and deliverables and review our progress. PLUS investigators also plan to evaluate the success of our transdisciplinary development



and collaboration through bibliometrics and reviewing evidence of transdisciplinarity (eg, diversity of expertise on committees and in dissemination products). PLUS members recognize the importance of rigorously evaluating productivity and the transdisciplinary nature of the research, given the large investment in the formation and development of our Consortium.

There is evidence that the PLUS Consortium is maturing as a transdisciplinary team. Products include a strong conceptual framework,<sup>10</sup> a clear working definition of bladder health,<sup>9</sup> insights from the PLUS consortium qualitative study,<sup>15-17,26</sup> completed literature reviews,<sup>21</sup> development of items to measure bladder health and protocols to validate the instrument (not yet published), submitted and planned manuscripts, completed academic presentations, ongoing foundational studies, and a solidified commitment to community engagement.

Our next steps will include completing the current ongoing activities of refinement and validation of a bladder health instrument; engaging adolescent and adult women in stakeholder councils and studies on bladder health and strengthening our community engagement infrastructure. As mentioned above, PLUS anticipates launching a landmark observational study of bladder health in women and girls across the US in the next few years. Confidence in accomplishing these diverse goals arises from the foundational work done to build a well-functioning transdisciplinary team.

## 5 | CONCLUSION

The original PLUS RFA described a limited interdisciplinary perspective. The term “transdisciplinary team science” was unknown to most PLUS members at the outset. However, the success of the team in developing a transdisciplinary approach has facilitated an expanded health-focused vision for research to address LUTS prevention and bladder health promotion in women and girls. This expanded vision, which views women and girls within a broad social ecology, is unlikely to have occurred without the variety of disciplines represented in PLUS. The dedicated effort for each member to engage in the transdisciplinary process is reaping rewards. The leadership of the NIDDK in providing the resources necessary for creating a solid transdisciplinary culture to address a novel research agenda was absolutely essential. We are encouraged by the significant progress to date. Yet there is still much work to do before we will know whether the transdisciplinary juice is worth the squeeze. We hope that the PLUS Consortium and PLUS productivity may inform other areas of health sciences research and shift traditional paradigms, which often focus

on the identification and treatment of symptoms, to a paradigm of health promotion and disease prevention.

## ACKNOWLEDGMENT

This work was supported by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) at the National Institutes of Health (NIH) by cooperative agreements [grants U01 DK106786, U01 DK106853, U01 DK106858, U01 DK106898, U01 DK106893, U01 DK106827, U01 DK106908, U01 DK106892].

## ORCID

Kathryn H. Schmitz  <http://orcid.org/0000-0003-2400-2935>

Tamara Bavendam  <http://orcid.org/0000-0001-8032-8361>

Sonya S. Brady  <http://orcid.org/0000-0001-8660-9308>

Linda Brubaker  <http://orcid.org/0000-0002-8598-2589>

Kathryn Burgio  <http://orcid.org/0000-0003-3357-2593>

Bernard L. Harlow  <http://orcid.org/0000-0002-6735-8862>

Aimee James  <http://orcid.org/0000-0002-1411-9307>

Emily S. Lukacz  <http://orcid.org/0000-0002-2189-8927>

Janis M. Miller  <http://orcid.org/0000-0003-4604-196X>

Diane K. Newman  <http://orcid.org/0000-0002-5083-6397>

Mary H. Palmer  <http://orcid.org/0000-0002-3849-5577>

Kyle Rudser  <http://orcid.org/0000-0001-9968-0090>

Siobhan Sutcliffe  <http://orcid.org/0000-0002-4613-8107>

## REFERENCES

1. Harlow BL, Bavendam TG, Palmer MH, et al. The prevention of lower urinary tract symptoms (PLUS) research consortium: a transdisciplinary approach toward promoting bladder health and preventing Lower urinary tract symptoms in women across the life course. *J Womens Health (Larchmt)*. 2018;27(3):283-289.
2. Hall KL, Vogel AL, Stipelman B, Stokols D, Morgan G, Gehlert S. A four-phase model of transdisciplinary team-based research: goals, team processes, and strategies. *Transl Behav Med*. 2012;2(4):415-430.
3. Abrams DB. Transdisciplinary paradigms for tobacco prevention research. *Nicotine Tob Res*. 1999;1(Suppl 1):S15-23.
4. Steers W, Richter H, Nyberg L, et al. Challenges of conducting multi-center, multi-disciplinary urinary incontinence clinical trials: experience of the urinary incontinence treatment network. *Neurourol Urodyn*. 2009;28(3):170-176.
5. Foster HE Jr., Hanno PM, Nickel JC, et al. Effect of amitriptyline on symptoms in treatment naive patients with interstitial cystitis/painful bladder syndrome. *J Urol*. 2010;183(5):1853-1858.
6. Duncker E. Symbolic communication in multidisciplinary co-operations. *Sci Technol Hum Values*. 2001;26:349-386.
7. Osbakken SL. *Gendered Intersections: Negotiating Power, Status, and Identity in Interdisciplinary Science* [dissertation]. Ann Arbor, MI: University of Michigan; 2014.

8. Myers IB, Myers PB. *Gifts Differing: Understanding Personality Type*. Mountain View, CA: Davies-Black Publishing; 1995.
9. Lukacz ES, Bavendam TG, Berry A, et al. A novel research definition of bladder health in women and girls: implications for research and public health promotion. *J Womens Health (Larchmt)*. 2018;27(8):974-981.
10. Brady SS, Bavendam TG, Berry A, et al. The prevention of lower urinary tract symptoms (PLUS) in girls and women: developing a conceptual framework for a prevention research agenda. *Neurourol Urodyn*. 2018;37(8):2951-2964.
11. Richard L, Gauvin L, Raine K. Ecological models revisited: their uses and evolution in health promotion over two decades. *Annu Rev Public Health*. 2011;32:307-326.
12. Engel GL. The need for a new medical model: a challenge for biomedicine. *Science*. 1977;196(4286):129-136.
13. Glass TA, McAtee MJ. Behavioral science at the crossroads in public health: extending horizons, envisioning the future. *Soc Sci Med*. 2006;62(7):1650-1671.
14. Solar O, Irwin A. *A Conceptual Framework for Action on the Social Determinants of Health: Social Determinates of Health Discussion Paper 2, (Policy and Practice)*. Geneva, Switzerland: World Health Organization; 2010.
15. Low LK, Williams BR, Camenga DR, et al. Prevention of lower urinary tract symptoms research consortium focus group study of habits, attitudes, realities, and experiences of bladder health. *J Adv Nurs*. 2019;75:3111-3125.
16. Camenga DR, Brady SS, Hardacker CT, et al. U.S. adolescent and adult women's experiences accessing and using toilets in schools, workplaces, and public spaces: a multi-site focus group study to inform future research in bladder health. *Int J Environ Res Public Health*. 2019;16:18.
17. Williams BR, Nodora J, Newman DK, et al. I never knew anyone who peed on themselves on purpose: Exploring adolescent and adult women's lay language and discourse about bladder health and function. *Neurourol Urodyn*. 2019;39:225-236.
18. Hebert-Beirne J, Kane Low L, Burgio KL, et al. Novel (multi-level) focus group training for a transdisciplinary research consortium. *Health Promot Pract*. 2019;1524839919875725. <https://doi.org/10.1177/1524839919875725>
19. Lowder JL, Bavendam TG, Berry A, et al. Terminology for bladder health research in women and girls: prevention of lower urinary tract symptoms transdisciplinary consortium definitions. *Neurourol Urodyn*. 2019;38(5):1339-1352.
20. Sutcliffe S, Bavendam T, Cain C, et al. The spectrum of bladder health: the relationship between lower urinary tract symptoms and interference with activities. *J Womens Health (Larchmt)*. 2019;28(6):827-841.
21. Markland AD, Chu H, Epperson CN, et al. Prevention of lower urinary tract symptoms (PLUS) research consortium. Occupation and lower urinary tract symptoms in women: a rapid review and meta-analysis from the PLUS research consortium. *Neurourol Urodyn*. 2018;37(8):288-2892.
22. Brady SS, Brubaker L, Fok CS, et al. Prevention of lower urinary tract symptoms (PLUS) research consortium. Development of conceptual models to guide public health research, practice, and policy: synthesizing traditional and contemporary paradigms. *Health Promot Pract* In Press.
23. Bavendam T, Newman D, Lowder JL, Brady SS, Camenga D, Markland AD. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Continence Begins with Prevention: A New Paradigm Using a Transdisciplinary Science Approach. Paper presented at: American Urogynecologic Society 38th Annual Scientific Meeting - Pelvic Floor Disorders Week; October 3, 2017; Providence, RI.
24. Camenga DR, Hardacker C, Low L, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. A multi-site focus group study of U.S. adolescent and adult females' experiences accessing toilets in public spaces, workplaces and schools. AUGS/IUGA 44th Annual Scientific Meeting; 2019; Nashville, TN.
25. Hebert-Beirne J, Camenga D, James A, et al. on behalf of the Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium The social processes of monitoring bladder behavior among adolescent and adult women across social ecologies and throughout the life course: Being monitored by others, monitoring oneself and monitoring others Paper presented at: American Public Health Association Annual Meeting; November 4, 2019; Philadelphia, PA.
26. Hebert-Beirne JM, Nodora J, Hardacker CT, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium Implementation of best practices for training in focus group methodology and bladder health: A novel curriculum from the PLUS Consortium Study of Habits, Attitudes, Realities and Experiences (SHARE) Study Paper presented at: American Public Health Association Annual Meeting; November 12, 2018; San Diego, CA.
27. Low L, Williams B, Camenga D, et al. on behalf of the Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Bladder health focus group study: The Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium Study of Habits, Attitudes, Realities and Experiences (SHARE) Paper presented at: American Public Health Association Annual Meeting; November 4, 2019; Philadelphia, PA.
28. Low LK, Baccellieri A, Brady SS, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Distress protocol for focus group methodology: Bringing a trauma-informed practice to the research process for the PLUS Consortium Study of Habits, Attitudes, Realities and Experiences (SHARE) Study. Paper presented at: American Public Health Association Annual Meeting; November 12, 2018; San Diego, CA.
29. Newman DK, Camenga DR, Hardacker CT, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. A multi-site focus group study of U.S. adolescent and adult women's experiences accessing toilets in public spaces, workplaces and schools. Paper presented at: 2019 Urologic Conference, Society of Urologic Nurses and Associates; September 20-23, 2019; Lake Buena Vista, FL.
30. Williams B, Low L, Brady S, et al. on behalf of the Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. It's something that we adapt to and move on: Exploring the social process of normalizing Lower Urinary Tract Symptoms (LUTS). Paper presented at: American Public Health Association; November 4, 2019; Philadelphia, PA.
31. Williams BR, Nodora J, Newman D, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. I don't know anyone who pees on themselves on purpose:" Exploring women's and adolescents' lay discourse about bladder health

- and function. Paper presented at: Society of Urodynamics, Female Pelvic Medicine & Urogenital Reconstruction Meeting; February 28, 2019; Miami, FL.
32. Bavendam T, Hardacker CT. Social processes impacting bladder health: contributions to a national prevention science research effort. Paper presented at: American Public Health Association Annual Meeting; November 4, 2019; Philadelphia, PA.
  33. Berry A, Newman DK, Wyman JF, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Prevention of Lower Urinary Tract Symptoms in Girls and Women: Developing a conceptual framework for a prevention research agenda. Paper presented at: Society of Urologic Nurses and Associates Annual Conference; October 28, 2018; San Diego, CA.
  34. Brady SS, Bavendam TG, Berry A, et al. MH; Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. The Prevention of Lower Urinary Tract Symptoms (PLUS) in Girls and Women: Developing a prevention research agenda and conceptual framework. Paper presented at: 25th Annual Meeting of the Society for Prevention Research; May 31, 2017.
  35. Lowder JL, Bavendam T, Berry A, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Bladder health terminology - Proposed definitions for women and girls. Paper presented at: American Urogynecologic Society PFD Week; October 11, 2018; Chicago, IL.
  36. Williams BR, Vargo K, Connett J, et al. For the Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. It's about time: The temporal burden of lower urinary tract symptoms among women. Paper presented at: 2019 Urologic Conference, Society of Urologic Nurses and Associates; September 20-23, 2019; Lake Buena Vista, FL.
  37. Hardacker C, Baccellieri A, Brubaker L, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Bladder health experiences and perceptions of sexual gender minorities: voiding in cis-heteronormative systems and spaces. Paper presented at: American Public Health Association Annual Meeting; November 4, 2019; Philadelphia, PA.
  38. Cunningham S, Lewis C, Douglass F, Rickey L. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Community engagement is a PLUS for bladder health. Paper presented at: Annual meeting and conference of the Connecticut Public Health Association; October 21, 2019; Plantsville, CT.
  39. Sutcliffe S, Cain C, Bavendam T, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Changes in bladder health over time: a longitudinal analysis of adult women in the Boston area community health survey. International Continence Society; September 3-6, 2019; Gothenberg, Sweden.
  40. Shoham DA, Brady SS, Chai TC, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Evolution of the PLUS Consortium Scientific Team over 3 years. Paper presented at: XXXIX Sunbelt Social Networks Conference of the International Network for Social Network Analysis (INSNA); June 21, 2019; Montreal, Quebec.
  41. Wyman JF, Chu H, LaCoursiere Y, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Normative non-invasive bladder function measurements in healthy women: A systematic review and meta-analysis. Paper presented at: American Urological Association's 2019 Annual Meeting; May 3, 2019; Chicago, IL.
  42. Markland A, Bavendam T, Cain C, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Occupational groups and lower urinary tract symptoms in women. *Neurourol Urodynamics*. 2018;37:S158-S159.
  43. Sutcliffe S, Bavendam T, Cain C, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Insight into Bladder Health: The Relation Between Lower Urinary Tract Symptoms and Interference in Women. Paper presented at: Society for Epidemiologic Research 51st Annual Meeting; June 19, 2018; Baltimore, MD.
  44. Sutcliffe S, Bavendam T, Cain C, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Insight into bladder health: the relation between prevalent lower urinary tract symptoms and interference in women in the Boston Area Community Health Survey. *Neurourol Urodynamics*. 2018;37(Suppl 5):S366-S367.
  45. Markland A, Bavendam T, Cain C, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Occupational Groups and Lower Urinary Tract Symptoms in Women. *J Urol*. 2018;199(Suppl 4S):e645. <https://doi.org/10.1016/j.juro.2018021545>
  46. Smith A, Bavendam T, Berry A, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Defining bladder health in women and girls: implications for research, clinical practice and public health promotion. *Neurourol Urodynamics*. 2018;37(Suppl 1):S603-S604.
  47. Lowder J, Berry A, Brady S, et al. Prevention of Lower Urinary Tract Symptoms (PLUS) Research Consortium. Defining bladder health in women and girls: implications for research, clinical practice, and public health. *Neurourol Urodynamics*. 2017;36(Suppl 3):S432-S433.

**How to cite this article:** Schmitz KH, Bavendam T, Brady SS, et al. Is the juice worth the squeeze? Transdisciplinary team science in bladder health. *Neurourology and Urodynamics*. 2020;39: 1601–1611. <https://doi.org/10.1002/nau.24357>