

Breaking Down the Siloes: Developing Effective Multidisciplinary HIV Research Teams

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Abstract As the HIV epidemic passes its 35 years mark, the role of multidisciplinary approaches to HIV research has become increasingly important. Development of diverse, cross-cutting research teams has been found to be key to engaging and retaining participants in population-based studies; it is also a crucial component of designing studies capable of examining the sensitive and nuanced issues that surround HIV related risk and adherence behavior. Expanding our understanding of these issues is central to being able to overcome them and ultimately to the development of best practices for translation of research discovery into improvements in prevention and care. The objectives of this paper are to characterize the importance of multidisciplinary teams in HIV research where they are critical to gaining information that can have a positive impact on the epidemic and to propose specific methods for creating teams to conduct research with optimal public health impact.

Keywords HIV · Mentoring · Multidisciplinary Research · Health Education · Interdisciplinary Communication · Education-Graduate/Methods

Introduction

As the HIV epidemic passes its 35 years mark, the role of multidisciplinary approaches in HIV research has become increasingly important. Development of research teams who have complementary expertise and representative personnel has been found multiple studies to be key to engaging and retaining participants in population-based samples; it, along with support of diverse research faculty and staffs, is also a crucial component of designing studies capable of examining the sensitive and nuanced issues surrounding HIV-related risk and health utilization behavior [1–6]. Understanding barriers to multidisciplinary research is central to being able to overcome them and ultimately developing ways to translate research discovery into improvements in care. The objectives of this paper are to characterize the importance of multidisciplinary teams in HIV research where they are critical to gaining information that can have a positive impact on the epidemic, and to propose specific methods for creating multidisciplinary teams to conduct research with optimal public health impact.

The Critical Role of Multidisciplinary Teams in HIV

Although the field of HIV has had numerous successes, challenges remain: we continue to see them not only in program implementation but also in individual treatment access and adherence behavior [7–12]. Several of these result from study designs which do not adequately anticipate human behavior; discoveries in research settings continue to encounter challenges in being translated into the real world as researchers expected [10–13]. These

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Table 1 Multidisciplinary research approaches from concept to dissemination

Component of design	Steps towards multidisciplinary collaboration
Grant proposal development	<ul style="list-style-type: none"> • Much in the way community-based participatory research requires engagement of community and members of the intended population in the proposal writing and protocol development, use of multidisciplinary teams from the beginning is critical for improving HIV research • Grant writing team composition should ideally include professionals and community representatives who can provide insight into the research question as well as who will do the work; what PIs may think is feasible may not actually be feasible when front line staff are involved • Even for studies that are mono-method (e.g., qualitative or quantitative), those trained in alternative methods may be able to add layers of understanding to the research question or methods that would not otherwise be available <ul style="list-style-type: none"> • For example, a basic scientist working to recruit from an HIV clinic for a study of markers of cardiac co-morbidities might benefit from a qualitative researcher to understand the biases implicit in a clinic-based sample. That same study might benefit from inclusion of the perspective of outreach workers who can discuss expected recruitment challenges • Allowing sufficient time for conversations prior to writing so that team members do not feel that they are being included superficially and similarly seeking external reviews from peers from other disciplines and from community members beyond the typical Community Advisory Boards but into the community identified for the study • Accepting constructive criticism during the proposal phase lays the foundation for integration of multiple disciplines throughout the study • Intentional inclusion of racial, ethnic, gender, and sexual minorities on faculty and research staffs, and mentoring to support grant submissions and participation on existing studies
Study implementation	<ul style="list-style-type: none"> • The PI can set the stage for study implementation that is inherently multidisciplinary • Consistent with the idea of developing shared communication and vocabulary across siloes, listening and modeling listening behavior is of paramount importance • Setting up regular cross-cutting meetings of staff in shared spaces that accept the time constraints of all parties is useful: rather than making teams always go to the PI, having the PI go into spaces of the different collaborators can indicate dedication to meeting the needs of all team members • Community outreach early post-award and at all phases (instrumentation, intervention, dissemination) will aid in more culturally appropriate recruitment and data collection but is not automatic just through opt out communications (e.g., if you have any comments on the survey, please provide them, otherwise we assume they are all right with you versus dates for inclusion of feedback) • Hiring of research faculty and staff representative of the populations being studied • Use of community participatory approaches to gain community insight at every step of the research process • Formal engagement and time to provide iterative changes for instrumentation or design and thoughtful settings to elicit the views of community members and research team members is necessary • Regular collaborator check-ins as well as oversight and ongoing quality assurance for staff can maintain the level of cross-cutting engagement throughout the implementation phase • Encourage research staff to have a direct relationship and better rapport with the patient population than say the study PI, this can assist with patient recruitment. This is particularly paramount when it comes to HIV infection and issues of disclosure for example. People want to be contacted by people who are already familiar with their status whom they trust
Analysis and dissemination	<ul style="list-style-type: none"> • Mirroring the above, analytic approaches should continue the collaborative paradigm by setting primary goals (for papers, reports, presentations) with all areas of expertise represented • Work with staff in all positions and also with community stakeholders regarding interpretation of findings prior to completion of manuscripts • Often even studies that have qualitative components are rapidly reduced to quantitative papers due to the nature of the peer-reviewed literature and differential challenges in having qualitative papers accepted in many journals • Promoting dissemination by research team members using their methods to evaluate the hypotheses under examination continues the multidisciplinary thread and supports a richness of understanding of the data to emerge. It also allows evaluation of data in multiple ways in order to best inform the field • Sharing authorship with staff who do the work for a paper as well as allowing multiple disciplined researchers to be the lead authors on papers in their domain offers the team recognition and appropriate credit. Often in academic settings, authorship is assigned to faculty members, omitting those who do the majority of the work. Worse, when authorship is given to those on tenure tracks without consideration of the efforts put forward by each staff member, the collaborative spirit of the group may be undermined • Finally, working with community members themselves towards interpretation of findings, authorship, dissemination, and ultimately data sharing when possible is key

challenges continue even when lifesaving medications are available: barriers to medication adherence and inability to access populations most in need of interventions continue to stand in the way of adequate care in clinical trials settings as well as public health practice. Lack of generalizability of samples to the base population of interest, and failure to include minority populations that reflect those most affected by the epidemic, remain ongoing issues for HIV researchers [1–6, 10]. This barrier is furthered by inadequate support of institutions of higher learning towards mentorship of underrepresented faculty and staff in both sponsored and non-sponsored research and academic domains.

The case of pre-exposure prophylaxis (PrEP) for HIV underscores the need for multiple scientific viewpoints towards translation of research findings to real world settings [14, 15]. Lack of consistency across PrEP studies and significant challenges with adherence have made it challenging to understand whether oral PrEP is useful among women, for example and in the U.S., availability of PrEP has not translated to widespread use [11–15]. To examine efficacy of and scale-up of PrEP, one discipline alone is insufficient: healthcare providers are necessary to provide the medical, safety and prescribing perspective, nurses and research coordinators to provide the front line view, peer outreach workers to understand barriers and facilitators of PrEP from the peer viewpoint. The pharmacist may be necessary to help quantify prescription refill behaviors, the epidemiologists, data analysts, the DIS workers, or surveillance system are critical to characterize incident infections among individuals and social networks, and evaluate population-level reductions in infections following PrEP interventions in a community. The ethnographer, behaviorist, adherence coordinator, or qualitative researcher may be required to delve into individual-level behavioral or social constructs to inform our understanding of adherence. The community members, key stakeholders, and participants themselves are crucial to understand population-impacts, barriers (such as trust of the medicine or cost) to treatment and facilitators (such as location of trusted medical clinics, insurance, or transportation). Taken together, it is clear that more than just the singular, compartmentalized profession is necessary to research or develop programs for PrEP; it is too complicated for one discipline alone. Moving beyond the siloes or compartments is required in order to conduct relevant HIV research and to move research findings into practice.

PrEP is but one example among many of the need for research teams that integrate multiple disciplines. This is largely because HIV has diverse and complicated social implications. These include transmission behaviors among highly stigmatized populations, confounders of treatment including payment, poverty, and healthcare access,

potential for discrimination on the basis of race, ethnicity, gender, sexual orientation, and more. In order to study HIV, to treat, or to prevent it, we must take an approach that is necessarily as wide thinking as are the problems we are investigating. Take a narrow approach and we may be misguided and think the problems easier to tackle than they clearly are. By taking a wider approach that addresses these complex correlates comprehensively through the lens of multiple disciplines, we may be more effective [16–19]. As seen with PrEP, a solely medical approach may succeed in prescribing and monitoring those on treatment, but will not be able to engage or retain those at risk, support adherence, or wrestle with payment concerns.

There is an urgent need to train public health personnel and researchers to work together, not just to put them together in the workplace. This is highlighted by evaluating barriers to HIV research engagement, which are often the same as barriers to HIV care. In order to develop better systems to study the needs of frequently omitted patients and participants, it is critical to engage a multidisciplinary team with the ability to understand the barriers and facilitators to inclusion faced by those with or at risk for HIV. This is a skill that must be taught; while it can be learned over time in the field, teaching it to students and junior faculty not only enhances the skillset but also places value on the activity. This approach will increase the potential to slow HIV in the future with relevant and effective prevention and treatment efforts. Yet the development of this skill is not solely mentoring, per se, but rather putting teams together and integrating scientific viewpoints in practice, and then modeling how this is done to future scholars.

Models for Collaborative Research Teams

There are multiple definitions surrounding the topic of decompartmentalizing the research workforce. These build on one another and are frequently used synonymously. Choi et al. [16, 17] provide a comprehensive literature review underlying the concepts multidisciplinary, interdisciplinary, and transdisciplinary. Each of these frameworks plays an important role in HIV research and could be applied to specific situations.

Multidisciplinary research teams may be considered those teams comprised of different disciplines working together providing a “juxtaposition of disciplines that is additive, not integrative” [16]. An example of this for HIV might be basic scientists working with a peer-driven behavioral outreach strategy to engage participants into a study which collects specimens for analysis. For the purposes of this paper, we will refer to the general and most basic case of the research team as multidisciplinary.

Interdisciplinary research teams may be considered those who synthesize knowledge across two or more disciplines towards a “new level of discourse and integration of knowledge [16].” An example of this for HIV might be when behavioral epidemiologists, physicians, lab scientists, technologists, and adherence counselors, develop and study a new intervention to improve adherence to antiretroviral treatment using a novel mHealth application. The collaborative effort would require development of a behavioral intervention through all represented disciplines, retention and implementation efforts by physicians and counselors, and measurement of lab specimens for drug levels to correlate with behavioral indicators.

Transdisciplinary research teams may be considered those who fully obviate the boundaries and compartments typically seen in siloed research efforts [16]. This construct is the most challenging to achieve, but through these efforts would be able to transcend disciplines to develop jointly created frameworks and systems. These research teams also tend to integrate community members, stakeholders, and participatory approaches to research where the teams endeavor in collaboration to create new and shared methodology to study the research questions of interest. An example of a transdisciplinary research approach is seen in the use of syndemic theory in the study of HIV/AIDS among Latino populations in the United States [20]. This innovative approach provides a conceptual framework for the study of HIV that relies on multiple domains of research to create a model that explains HIV risk, offering an ideal method for the transdisciplinary team.

Developing Multidisciplinary Research Teams

How do we develop researchers that are trained to think beyond the compartment and who are able to develop effective collaborations between those with differing skillsets and professional rearing? In some fields, this is promoted through cross-cutting, multi-departmental programs. This may be seen in doctoral programs where students select faculty from several departments and work on a topic that marries content from multiple perspectives. Many graduate schools offer such programs to facilitate study where no one department can meet a student’s needs; they may not always promote multidisciplinary study as a method but rather reflect that the study is interdisciplinary. In medical, nursing, psychological or ancillary service provision such as social work, or public health settings that surround HIV research most closely, cross-cutting research training does occur but is often *ad hoc* and in the practicum portion of training, because the nature of the didactic needs are necessarily siloed or compartmental. That is, epidemiologists need to learn design and analytic skills,

physicians need to be trained in medicine, and so forth. Following the didactic phase of training, once the practical training begins, only then are students thrust into environments full of other professionals. Following challenges in merging professional cultures and learning how to collaborate effectively, especially in HIV where shared missions drive persons of different disciplines to work together; ultimately multidisciplinary teams evolve for the benefit of the research goals or simply because working together beyond the silo is more practical. It raises the potential, however, for training of such teams from the outset in order to improve the depth and quality of HIV research.

It is possible to foster innovative research that is multidisciplinary. Several examples are presented by infrastructure awards from NIH that support translational and multidisciplinary researchers, in HIV and other disciplines. The clinical translational science award [18] has successfully demonstrated the ability of these capacity building initiatives to enhance translational research efforts in multiple fields and build competencies. Similar but specific to HIV, the Centers for AIDS Research (CFAR) program has enabled both discipline specific efforts within cores as well as cross-cutting initiatives to support development of HIV researchers and HIV research infrastructure [21]. The CFAR networks do this through provision of services that support cross-disciplinary activities and proximity of investigators. For example, allowing behavioral investigators opportunities to collaborate with basic scientists to obtain specimens from high risk populations while simultaneously supporting basic scientists to collect culturally relevant questionnaires to collect behavioral data while collecting specimens. The CFAR’s social and behavioral sciences research networks is an example of the ability of such awards to foster environments that value multidisciplinary work [22] including not only providing new funding but translational findings that will have ultimate impact on the field and on the front lines of public health. Other groups have identified resources, both financial and human, to mentor the next generation of scholars, many with an emphasis on minority scholars. The HIV Prevention Trials Network (HPTN) scholars program [23] provides an example of this type of program where doctoral level scholars are integrated into HPTN work with support for time and travel, and mentored to be integrated into the work of the HPTN sites, including cross site analytic activities. These are outlined in the paper in this supplement by Fernandez and Wheeler and the work of other scholars has resulted in publications as well as support of young minority scholars entering the field of HIV research. Other examples of cross-cutting collaboration include the CFAR HIV continuum of care working group and resulting supplements [24, 25] which required researchers at CFARs

to collaborate with public health departments, allowing research to blend directly with public health. This ongoing CFAR effort highlights an awareness of the importance of this facet of education for HIV researchers and should continue to build a workforce of academicians and staff capable of embracing multidisciplinary models and structures. It also allowed researchers to benefit from a closer look at the epidemic in affected areas while allowing public health practitioners to benefit from research support. More generally, effective collaboration between researchers, health departments, and public health personnel can greatly improve translation of information into the field as well as into the peer-reviewed literature. Use of even more dynamic exchange between researchers and HIV surveillance systems can support implementation science that can help us better identify ways to improve access to treatment and prevention interventions.

Creating Multidisciplinary Studies

Given the limited number of formal programs designed to promote multidisciplinary teams in HIV, it will often fall to the PI to create a team to best address the study's goals. Using the multidisciplinary approach and setting the tone for the project is ultimately the PI's responsibility, irrespective of formal training. Despite the increasing availability of mentoring programs, both for HIV research in general as well as to support development of a diverse researcher community [26–36], few resources exist to teach team development especially on a more structural level; mentoring one-on-one is more common than a widespread approach or goal. That said, numerous funding mechanisms, including training grants (e.g., T-, F-, and K-series NIH awards), community-linked cooperative agreements, and supplemental grants (e.g., minority supplements) could be harnessed to provide didactic and field experience to junior faculty based on multidisciplinary models. The complicated workings of multidisciplinary research from grant proposal stage through community collaboration and dissemination can be imparted to any research team wishing to enhance their study's implementation. Table 1 summarizes methods for cross-discipline interaction from concept to dissemination.

Examples of Studies that Support Multidisciplinary Research

Despite these challenges, multidisciplinary HIV studies continue to flourish in recognition of the importance of this approach. Development of protocols that require multi- or transdisciplinary teams is a structural approach to

increasing multidisciplinary research. One example of this is the CDC's National HIV Behavioral Surveillance study (NHBS) [37]. NHBS has a comprehensive study protocol which integrates qualitative and quantitative metrics, with guidelines for engagement of community members and stakeholders, collaboration between field and data personnel, ethnographers, and surveillance professionals. By creating a protocol-driven multidisciplinary study, sites are obligated to work in teams; success in the field is increased through this collaborative direction and then can be evaluated. For example, if accrual is not going as planned, the ethnographer may be called upon to do ongoing quality assurance and talk with and observe participants to identify challenges. The HPTN [38] uses similar study specific anchors for multidisciplinary conduct of studies. Sites are required to engage community, have effective community communication plans, and participate in cultural competency trainings before many of the studies are cleared to begin at the site level. By structurally requiring collaboration across disciplines, these efforts increase to the benefit of the study and the community. For those investigators developing site-specific studies, such guidelines can be adapted to provide such structure independently.

Challenges of Multidisciplinary Research

As researchers become more familiar with experts in other disciplines, they better comprehend alternate worldviews which in turn allows increasing proximity beyond traditionally siloed communities of scientists and disciplines. Those communities highly affected by HIV can be better engaged and retained by such teams of researchers, and the research made more relevant [1–6]. Still, multidisciplinary research is not without challenges. Teams that work closely together learn from one another which is a key benefit; sense of shared responsibility which is critical to a harmonious working environment. Yet when a team works as closely as it must to facilitate cross-discipline collaboration, challenges may result. Leaders of research teams can be sensitive to these in order to prevent them and identify them rapidly should they occur.

Inadequately Diverse Faculty and Staff

The lack of diversity among researchers in institutions of higher learning has been well characterized along with the multiple benefits of broader inclusion in both research and care systems [26–36]. This is not new. Over a decade ago an Institute of Medicine report [39] noted the lack of diversity of underrepresented minorities in the health care workforce and the resulting detriment to population-level health, as well as institutional-level strategies and policies

to overcome this challenge. Long entrenched disadvantages for researchers and professionals from racial, ethnic, gender minorities as well as sexual minorities must be overcome particularly in the area of HIV in order to better reflect the populations that are being studied and served. Too often in research, attempts to overcome these result in homogeneous faculty and research teams having inclusion solely through one representative on, for example, a community advisory board. These efforts can be expanded through community participatory models where representative lay community members are not only a late-entry voice in the research dialogue but rather key contributors to every part of the research process. Multidisciplinary models afford this type of research more readily than do traditional models because they accommodate alternate worldviews as an intrinsic part of their design. More importantly, removal of structural barriers to faculty and staff diversity should occur through intentional and systematic institutional strategies designed to recruit and retain research teams reflective of the populations being studied. Programs such as the HPTN scholars program [23], CDC's Minority AIDS Research Initiative [40], and NIH diversity supplements, are concrete examples of programs designed to support and increase opportunities for successful funding and research careers of minority researchers working in the field of HIV. Fuchs et al. [41] describe in this issue a novel program to mentor underrepresented undergraduate students in a 12-week summer program, starting the pipeline even earlier.

Implicit and Silent Hierarchies

One important reason that HIV researchers should be trained in multidisciplinary settings is that it can prevent unhealthy hierarchy development before it begins. In team settings often doctorally prepared personnel may experience challenges listening to the insights of high school or college level staff who are interfacing daily with participants in the community; often these frontline insights are the very ones that ensure success in the study and so should not be overlooked. Perhaps more insidious is the problem of the front line workers being unable to communicate candidly with those at other levels: this is a barrier to effective research if their perceptions and connections with the community members are overlooked. Often the frontline insights are the only chance researchers may have to understand the lived experiences of those we are most trying to understand. Group exercises to facilitate talking and listening across the typical boundaries and hierarchies are useful. They are also important when healthcare providers communicate with non-providers; often those persons most engaged with a study protocol may not be the physician who works with patients directly. Ability to

communicate the need for compliance with protocol documents can be difficult and staff who are intimidated by physicians may be mired in the traditional hierarchy and may not challenge or correct mistakes before they happen. These may be prevented by from educational exercises or other exercises such as role playing to meet the team's needs. Irrespective of the approach, strategic planning surrounding overcoming hierarchies is necessary to foster transdisciplinary teams.

Shared Vocabulary

Development of a common language is necessary to building multidisciplinary teams in HIV. With researchers often trained in entrenched terminology, one central skill of working in multidisciplinary teams is learning to listen and to expand one's vocabulary. For example, qualitative and quantitative researchers must often wrestle with language that differentially describes the data of interest and the resulting information. Acknowledgement that this can be a barrier to communication is key. Each team needs to develop a process for handling of such discrepancies in order to deconstruct the barriers between the fields.

Equity

Practical fiscal considerations can undermine multidisciplinary teams. Often these considerations can be so daunting that the research leadership may not want to tackle them, preferring to remain silent about them and opt for a more compartmentalized group instead. One way this problem can manifest is with regard to compensation. With a close knit group of researchers from multiple disciplines represented and with daily ongoing efforts together, frontline staff may feel slighted by salary inequity because of the collaborative nature of the work, irrespective of duration of experience or degree. When peer outreach workers for example are close colleagues of physicians, a sense of inequity may result. Research teams often work in standalone settings beyond the walls of a typical clinic which may confuse this issue. Yet tackling these practical challenges can be done and can be learned, even if it is uncomfortable. Echoing the challenges outlined above, given that educational attainment can itself be a reflection of underlying societal disparities (e.g., racial, heteronormative, gender), several approaches may help create a more positive multidisciplinary environment: Diversity on the research teams in and between roles is important. Staff should be encouraged to pursue educational opportunities if they desire. Increased education of the staff grows a more educated team and also ensures that the persons in frontline roles do not feel that they are without opportunity for career advancement. One primary benefit of working in

many educational or research organizations is the ability to access education at reduced or no cost. Supervisors and lead investigators can encourage educational advancement and make time available so that this can be pursued by staff at all levels of the organization. In addition to supporting multidisciplinary research, this is another way to develop the future public health and research work force.

Tenure and Promotion

In addition to overcoming challenges to implementing multidisciplinary research, structural changes in academia may ultimately be required to encourage it. In addition to mentoring faculty to propose and undertake research that breaks down siloes, policies need to evolve which support this type of research. This may mean rewriting academic bylaws to recognize collaborative manuscripts as much as first and senior authored ones, provide institutional seed funding to reward cross-departmental activities, and changing policies so shared accomplishments that reach across disciplines are rewarded before those that are solely individually-based. Another area to be considered is the role of white papers and other non-peer reviewed monographs. While these products often contribute to public health practice and impact on policies, they do not always count for academic promotion, which can be a barrier to an excellent opportunity for multidisciplinary partnerships. Evolution of academic systems to support research that is not siloed will likely improve the ability of researchers to contribute to the field of HIV, and other fields as well.

Conclusions

HIV-related research, whether in the clinic or the community, is not a siloed activity; it requires multiple lenses on the field, including behavioral, medical, ethnographic, sociologic, and basic science. This approach will not only ultimately confer translational findings but also improves the conduct of research in general. Globally, correlates of HIV continue to reflect disparities: by race, socioeconomic status and poverty, geography, sexual orientation, and gender, and the interactions and intersections of those characteristics. Whether the research is intended to assess HIV treatment or prevention strategies, one key goal is to engage people research who are likely to reflect the people in the real world who can benefit from the research. When the sample introduced into the study is most reflective of those already engaged in care, our findings will be biased towards an unrealistic target; our research needs to reflect the population base. Working with multidisciplinary teams will enable innovative methods to reach those out of care and historically not engaged in research and overcome

barriers found in reaching a representative population. In order to do this, study teams, whether they are large multisite clinical trials or small pilot studies, need to have multiple lenses on the questions at hand and work together from design stages to implementation to analysis. HIV is inherently multidisciplinary and diverse because of the domains and populations touched by the disease, thus creation of researchers that are similarly so will further our ability to eventually slow HIV.

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