ADDRESSING HEALTH DISPARITIES THROUGH MULTI-INSTITUTIONAL, MULTIDISCIPLINARY COLLABORATORIES

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The national research leadership has recently become aware of the tremendous potential of translational research as an approach to address health disparities. The Research Centers in Minority Institutions (RCMI) Translational Research Network (RTRN) is a research network that supports multi-institutional, multidisciplinary collaboration with a focus on key diseases and conditions for which disproportionately adverse racial and ethnic health disparities exist. The RTRN is designed to facilitate the movement of scientific advances across the translational research spectrum by providing researchers at different institutions with the infrastructure and tools necessary to collaborate on interdisciplinary and transdisciplinary research projects relating to specific health outcomes for which major racial/ethnic disparities exist. In the past, the difficulty of overcoming the restrictions imposed by time and space have made it difficult to carry out this type of large-scale, multilevel collaboration efficiently. To address this formidable challenge, the RTRN will deploy a translational research cluster system that uses ''cyber workspaces'' to bring researchers with similar interests together by using online collaboratory technology. These virtual meeting environments will provide a number of tools, including videoconferences (seminars, works in progress, meetings); project management tools (WebCT, Microsoft Share Point); and posting areas for projects, concepts, and other research and educational activities. This technology will help enhance access to resources across institutions with a common mission, minimize many of the logistical hurdles that impede intellectual exchange, streamline the planning and implementation of innovative interdisciplinary research, and assess the use of protocols and practices to assist researchers in interacting across and within cyber workspaces. (*Ethn Dis*. 2008;18[Suppl 2]:S2-161–S2-167)

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INTRODUCTION

A collaboratory can be defined as ''an information technology (IT) infrastructure that supports cooperation among individuals, groups, or organizations in pursuit of a shared goal by facilitating interaction, communication, and knowledge-sharing.''[1] The creation of collaboratories represents an emerging approach for medical scientific collaboration, in which linkages of scientist to data, to unique resources, and to other scientists can be accomplished despite the restrictions of time or place. This capacity has traditionally been used to aid collaboration within relatively static disciplinary parameters, but more recently it has been recognized as an effective means to augment and support the translation of scientific breakthroughs from the bench, to the bedside, to the community, and back.[2] Presently, increasing this capacity is major element of the national research agenda established by the National Institutes of Health (NIH) through the development of the Clinical and Translational Science Award program.[3]

Applying the collaboratory paradigm to translational research entails using many of the same technologies employed by large physical science and health-related basic science collaboratories. However, mediating the exchange of ideas between investigators from the disparate fields of clinical, basic science, and public health research requires placing a greater emphasis on addressing the human factors involved in collaborative research. In order to overcome the barriers that have traditionally impeded interdisciplinary collaboration, a translational research collaboratory must incorporate a unique set of tools and protocols that simplify interpersonal communication and facilitate productive interaction. This paper describes the key elements of a system with such functionality developed for the Research Centers in Minority Institutions (RCMI) Translational Research Network (RTRN).

BACKGROUND

The significant potential of collaboratories for enabling scientific research efforts has been recognized by agencies such as National Science Foundation (NSF), NIH, and Department of Energy since the late 1980s.[4] The National Center for Research Resources[5] identified three powerful trends that have rapidly coalesced to create an environment that has fostered the development of a new generation of collaboratories: 1) ''big science'' (large-

scale projects of increasing size and complexity); 2) growing volume of data and the capacity to produce data (eg, human genome and proteomic data); and 3) the rapid development and expansion of cyber infrastructure (computing and network capacity). The third trend has brought about the use of high-bandwidth cyber infrastructure to create virtual laboratories that greatly facilitate or even enhance geographically distributed scientific activities.

New Internet2-mediated research collaboratories represent a powerful platform and a significant opportunity for implementing cross-disciplinary research and translational research; however, data from the NSF-funded Science of Collaboratory project indicates that the number and scope of collaboratories within the United States that are dedicated to biomedical research is limited compared with the magnitude of currently funded research activity.[6,7] This apparent disconnect is actually a reflection of the reality that acquiring new technology is not the only requisite condition for the creation of a successful collaboratory. Attention must also be paid to the research process. Systems are needed to regulate, facilitate, and evaluate researchers' involvement in collaborative activities.[8]

During the past decade, several large-scale health sciences research collaboratories have been developed. The Biomedical Informatics Research Network (BIRN) is one such example. This network is a geographically distributed virtual community of shared resources that aids biomedical scientists and clinical researchers by enhancing communication and collaboration across research disciplines. The BIRN has four test beds, each housing a different neuroscience-related project. Investigators at participating institutions can use the BIRN cyberinfrastructure to virtually pool their data and share common resources.[9] Another example is the National Cancer Institute's Cancer Biomedical Informatics Grid (CaBIG). This collaboratory is built on a cutting-edge IT infrastructure, and it has a robust inventory of applications for collecting, sharing, and analyzing data and images related to cancer research, linked through cyber workgroups.[10] These networks serve different purposes and they use somewhat different tools, but both can serve as models for future networks.

RTRN

RTRN has expanded on key elements of the aforementioned models to form a collaboratory that will help facilitate innovative multi-, inter-, and transdisciplinary research and generate evidence-based knowledge and techniques to diagnose, prevent, and treat a host of diseases that are Healthy People 2010 priorities for improving the nation's health and reducing health disparities. Unlike CaBIG and BIRN, RTRN is designed to facilitate simultaneous collaboration of multiple mixed groups of researchers from different disciplines studying different diseases and health outcomes. To organize and differentiate these similarly structured groups, a research cluster system was developed.

There are three types of clusters: 1) health/disease clusters; 2) research method clusters; and 3) supportive clusters (Figure 1). The clusters are composed of biomedical, clinical, and public health researchers at the 18 RCMI institutions located across the United States, from Hawaii to Puerto Rico (Figure 2). By linking the researchers through internet-mediated virtual meeting places or ''cyber workspaces,'' the cluster system will help researchers from a broad range of disciplines work together effectively and overcome the barriers imposed by space and time. The strategic use of these cyber workspaces can promote intellectual exchange and expedite the translation of advances in clinical, biomedical, and public health research into improvements in clinical care and secondary interventions delivered in community settings.

Developing a successful cluster system requires addressing factors at three levels:[11] technological (collaborative technology), organizational (collaboratory functions), and social (transforming the culture of research).

COLLABORATIVE TECHNOLOGY

The clusters' cyber workspaces will be accessed through the network's web portal (Figure 3). The RTRN portal, which was constructed by using Oracle Portal Middleware is a powerful collaboration tool that provides a secure, unified point of access to all information relevant to the network. The cyber workspaces will support multiple online groupware technologies, including videoconferences (seminars, works in progress, meetings), project management tools (WebCT, Microsoft SharePoint), news and discussion groups, Web 2.0 tools (wikis and blogs), and other web-based resources to optimize multi- and interdisciplinary interactions. A cluster member can post a manuscript or grant draft and get feedback from their cluster, such as new biomarkers, genome-wide association approaches, and influence of psychosocial/cultural factors, that may not have been considered. Collaborations that are developed through RTRN cluster interactions will be documented in a designated area of the RTRN portal where concept plans, protocols, and grants will be posted. Once the protocol for a project is approved, collaborators can still use the tools used by the clusters, but they will also have access to a new battery of tools for sharing data and instruments in a secure environment. Regardless of the type of project, the tools needed to support the project will be accessible to authorized individuals through the RTRN portal. The portal will also

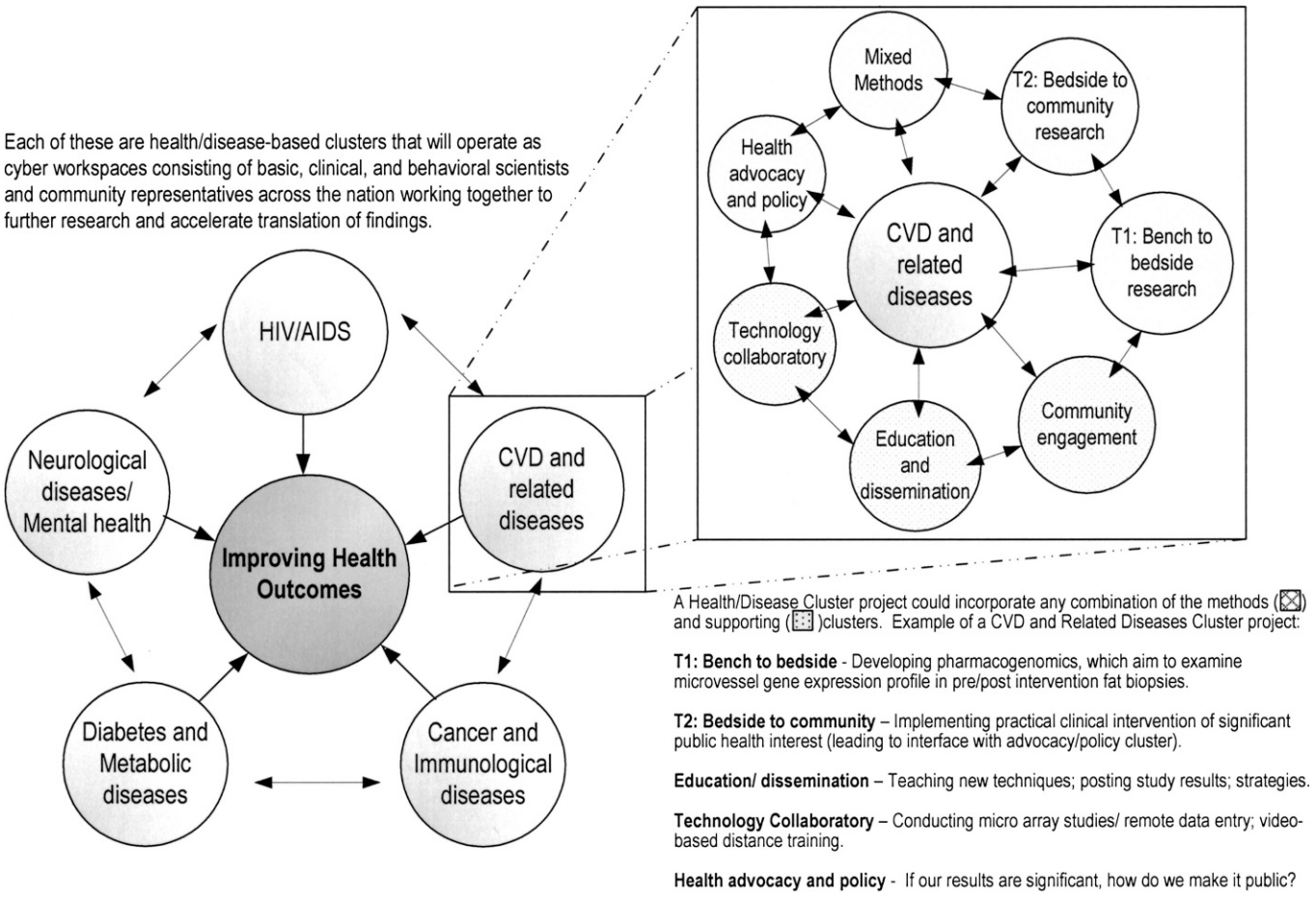

Fig 1. Translational research clusters.

provide broader access to publications, aggregate data, and other research highlights when appropriate.

As the RTRN grows, it will incorporate more clinical and biomedical tools for sharing and analyzing data and slowly add highly technical applications that exist in some of the research networks. Nonetheless, what makes the RTRN model innovative is its use of a multitude of collaborative technologies that will enable more dynamic interaction between researchers. These collaborative tools will support numerous types of communication, both synchronous and asynchronous.

Synchronous interactions such as meetings can be supported by: videoconferencing (H.323, Virtual, Conference XP, Webex, Access Grid), shared whiteboards, shared presentations, and shared desktops. Communication of this type can be valuable in the early stages of any collaborative activity, and it is particularly useful when bringing together investigators whom may not share the same knowledge base or skill sets. However, even though real-time interaction may be perceived as a more evolved form of communication, such interaction is not always most conducive to effective collaboration. Consequently, the cluster system also employs semisynchronous communication tools that support time-delayed communication (eg, instant messaging, seminar capture and broadcast, wiki workspaces, Listservs, document sharing systems). The technologies selected to support RTRN are not necessarily the most expensive or the most recently developed; rather they are the tools best suited to the needs of the network and its researchers.

One of the RTRN support clusters focuses exclusively on collaboratory technology. This cluster is a forum designed to help participating institutions stay abreast of trends in technology that could enhance interinstitutional collaboration. The cluster will provide recommendations to the network steering committee and the Data and Technology Coordinating Center (DTCC) regarding feasible upgrades in technology that would improve network communication.

COLLABORATORY FUNCTION

Unlike other collaboratories, RTRN will take an active approach towards

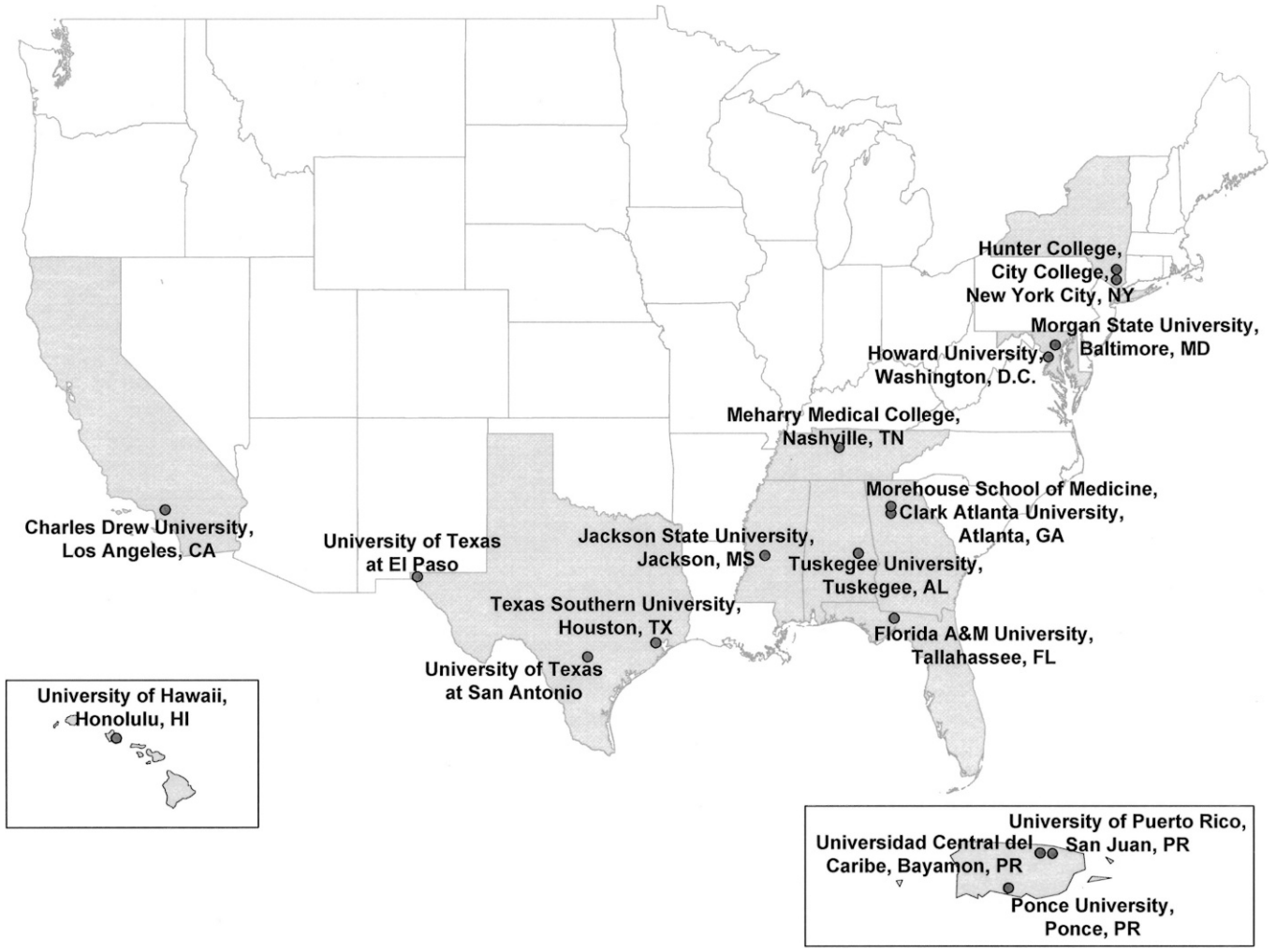

Fig 2. National Institutes of Health/National Center for Research Resources: Research Centers in Minority Institutions sites.

fostering translation. RTRN clusters will have bimonthly virtual meetings to discuss recent research findings, epidemiology, recent uses for research methods, and potential projects for reducing health disparities. Each group will develop at least one new collaborative translational research project per year. Cluster members will have access to up-to-the-minute information on all ongoing multisite research, and when authorized, access to the data. To enhance collaboration both within a disease area and across areas, each cluster member can participate in one or more disease-specific and research method-specific cluster. Participation in these ''research teams of the future'' will enable investigators to continuously build upon the most recent breakthroughs in their own areas of interest, to synthesize concepts and knowledge from other disciplines, and to contribute more profoundly to general scientific discourse by shaping investigations in other fields.

To ensure that participation is active and not passive, co-chairs will be appointed to lead each cluster. Cluster co-chairs will be responsible for convening and facilitating bimonthly cluster meetings, developing meeting agendas, facilitating the development of cluster policies and procedures, overseeing the development of the cluster research agenda, and ensuring that the clusters follow the research agenda.

The network administrators will be responsible for facilitating cluster activities, providing administrative support, developing and distributing agendas and minutes, organizing the distribution of materials, and coordinating the development of new projects. These administrators will also promote the active bridging of disciplinary domains by liaising between clusters and the other RTRN components, including the DTCC, the protocol review committee, and the steering sommittee.

The RTRN steering committee will oversee the activities of the translational research clusters. They will work in close communication with cluster administrators to verify that interdisciplinary interactions are occurring and

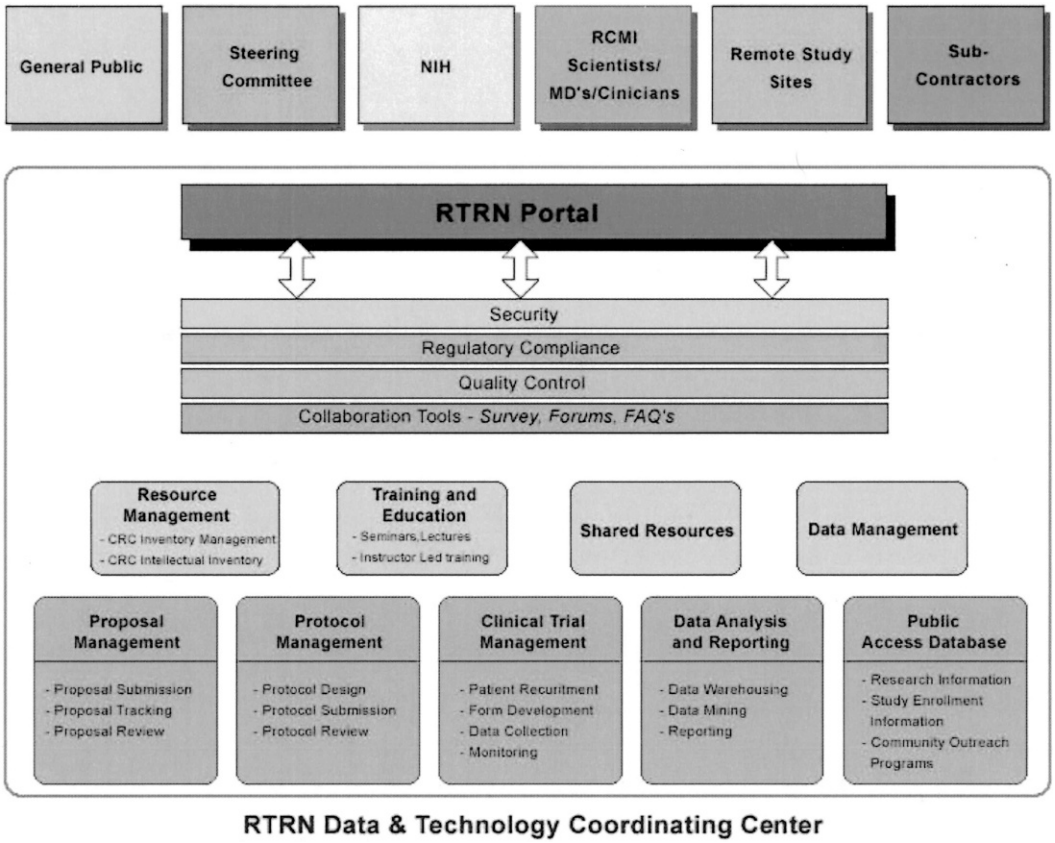

Fig 3. Schematic of the Research Centers in Minority Institutions Translational Research Network Web portal.

collaborations are developed. The steering committee will ensure direct communication between all of the network partners as well as institutional compliance with lines of authority and applicable laws, regulations, and policies, while also allocating appropriate resources and infrastructure for the smooth functioning of the network.

TRANSFORMING THE CULTURE OF RESEARCH

In the Western world, the rapid advancement of scientific knowledge has been spurred, in part, by the evolution of a culture that thrives on competition, which is largely fueled by the recognition of individual achievement. Creating a successful translational research collaboratory requires transforming the culture of research by reconstructing the vision of the research community to place value on efficiency (which can be bolstered by pooling knowledge and resources), and reasserting the research community's dedication to the goal of improving the health of human populations. This transformation of culture must occur at both the institutional and the individual level.

Institutional Level

On the institutional level, the culture of research must be transformed so that promotion and recognition of individual accomplishments are realigned to reward equally or even more so key accomplishments (eg, improving patient outcomes) achieved as a member of a team. This cultural transformation requires input at the highest level, including presidents and deans of universities and colleges. It also will require input from a faculty governance to ensure that there is a thoughtful dialogue as to how this transformation occurs. There needs to be a recognition that the future of health-related research will be rewarded not only for accomplishments at individual levels along the continuum of health research but, more specifically, will be rewarded for improving patient outcomes. At an institutional level, a high level of recognition for team efforts leading to the improvement of patient outcomes must be highly rewarded and highly recognized. As these rewards and incentives are aligned with improvements in patient outcomes and the development of strategic partnerships and alliances across both academia and community, there will be the slow transformation of the culture of research that truly embraces and supports translational and multisite research activities.

Change at this level is essential to ensure that individual researchers are compelled to participate in the collaboratory.

Individual Level

Advanced technological infrastructures and tools for collaboration are of no value if they are not used by the individuals that make up a network. Researchers must be capable of and comfortable with using these resources. Additionally, tools should be as minimally disruptive of normal workflows as possible. Fortunately, advances in IT are making it ever easier to meet these criteria. The technologies described earlier have intuitive, user-friendly interfaces, and they are presently accessible to RCMI researchers, often in the settings in which they normally work. The ease with which researchers can meet with colleagues across town or across the country attenuates the impact of the limitations imposed by space and time, which would have previously rendered such interactions excessively difficult or time-consuming.

Another important step in fostering productive remote working relationships is developing trust between researchers who, despite their common interests, may be total strangers. Forming relationships and building trust are inherently social processes, but it is possible to nurture them in a structured manner, in a set time frame through effective interactions involving both social and work communication. Some interaction will be orchestrated through face-to-face meetings (extremely important for project initiation), but most ongoing interactions between remote researchers will be facilitated through the collaborative tools available in the cyber workspaces.

Essential internal interactivities for RTRN that will be critical for ensuring continued use of the network's resources include the following:

- Building trust and mutual respect through increased interaction backed by strong support for the network's mission.
- Keeping open membership and providing broad opportunities for participation of key constituencies, particularly community members, community providers, and nontraditional health disciplines (eg, public health, behavioral and social sciences research).
- Actively recruiting members and staying abreast of members' needs and circumstances by using a variety of practices such as tiered membership and active retreats to remain sensitive to the issues of the members within the network and honoring a commitment to foundational concepts (eg, bi-directionality, equitable inclusion of new partners) and supporting those in concrete practices (eg, equitable representation in network governance, paired partner side arrangements).
- The use of a cluster facilitator to move the entire process forward and to assess and document successful and failed strategies and processes.

CONCLUSION

When appropriately developed, collaboratories can uniquely contribute to: enhancing research capacity, increasing scientific productivity, and expediting the translation of major scientific advances. Collaboratories can help researchers in different parts of the world overcome the barriers of space and time, but collaboratories do not automatically nullify other barriers that complicate collaborative research. Upgrades in IT tools and infrastructure provide the foundation for research collaboratories, but these enhancements must be accompanied by changes in research processes in order to have an effect. Developing collaboratories that incorporate the tools, infrastructure, and oversight protocol available in cyber workspaces will enable the full power of information and communication technologies to be brought to bear on a broad range of health research applications and increase the speed and efficiency of the translation of scientific discoveries into improvements in the health of human populations.

The RTRN is a pioneering network that shows how collaboratories can be used not only to improve the translation of scientific knowledge, but also to addresses racial and ethnic health disparities. The cumulative strength forged by participation in collaborative research can empower investigators at minority institutions to play a greater role in mainstream scientific discourse. Additionally, improved sharing of evidence compiled from traditionally under-served, understudied minority communities can help to better inform healthcare providers and policymakers so that they can more expediently implement changes that can improve the health of those communities.

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REFERENCES

1. Schleyer TK. Collaboratories: leveraging information technology for cooperative research. *J Dent Res*. 2001;80(6):1508–1512.
2. Zerhouni EA. Translational research: moving discovery to practice. *Clin Pharmacol Ther*. 2007;81(1):126–128.
3. Zerhouni EA, Alving B. Clinical and Translational Science Awards: a framework for a national research agenda. *Transl Res*. 2006; 148:4–5.
4. Finholt TA, Olson GM. From laboratories to collaboratories: a new organizational form for scientific collaboration. *Psychol Sci*. 1997;8(1): 28–36.
5. Arzberger P, Finholt TA. *Data and Collaboratories in the Biomedical Research Community*. Final Workshop Report from Conference September 16–18, 2002,Arlington, Virginia.

National Center for Research Resources. Available at http://nbcr.sdsc.eud/Collaboratories/CollaboratoryFinal2.doc. Last accessed 4/12/2007.

6. Science of Collaboratories. Collaboratories at a glance. Available at: http://www.scienceofcollaboratories.org/Resources/colisting.php. Accessed 12/6/2005.
7. Schleyer TK, Teasley SD, Bhatnagar R. Comparative case study of two biomedical research collaboratories. *J Med Internet Res*. 2005;7(5):e53.
8. Arzberger P, Finholt TA. *Data and Collaboratories in the Biomedical Research Community*. Final Workshop Report from Conference September 16–18, 2002, Arlington, Virginia. National Center for Research Resources. Available at http://nbcr.sdsc.eud/Collaboratories/CollaboratoryFinal2.doc. Last accessed 4/12/2007.
9. National Center for Research Resources. Biomedical Informatics Research Network. Available at: http://www.nbirn.net/index.shtm. Last accessed 4/12/2007.
10. National Cancer Institute. Cancer Biomedical Informatics Grid. Available at: http://cabig.cancer.gov/index.asp. Last retrieved 4/12/2007.
11. Olson GM, Teasley SD, Bietz M, Cogburn D. Collaboratories to support distributed science: the example of iInternational HIV/AIDS research. Paper presented at: Proceedings of the 2002 annual research conference of the South African institute of computer scientists and information technologists on enablement through technology, 2002; South Africa.