

Breaking the Silo

Using Informatics to Support Clinical and Translational Science

IN 2002, Dr. Elias Zerhouni, director of the National Institutes of Health (NIH), convened meetings to chart a roadmap for this century. The goal was to identify opportunities and gaps in biomedical research to make the biggest impact on the progress of medical research.¹ Three areas comprise the roadmap—new pathways to discovery, research teams of the future and re-engineering the clinical research enterprise. Each area has initiatives to improve the clinical research enterprise.

One initiative is translational research.² Translational research is defined through its activities: “Scientists provide clinicians with new tools for use in patients and for assessment of their impact, and clinical researchers make novel observations about the nature and progression of disease that often stimulate basic investigations.”³ Its goal is to truncate the length of time between a scientific discovery through basic research at “the bench,” progressing to the clinical level or the patient’s bedside.³

THE CHALLENGE TO INFORMATICS

The following scenario is an example of the inability of today’s infrastructure to support the connectedness required for translational science.

Recently, I heard Dr. Tom Romano (name changed to preserve his anonymity) discuss his research on *Caenorhabditis elegans* (*C. elegans*), a nematode. He mentioned that such research could potentially help treat diseases like diabetes and certain heart conditions—an example of bench to bedside. A few days later, the 2006 Nobel Prize in Physiology or Medicine was awarded to Andrew Z. Fire and Craig C. Mello for discovering a mechanism to silence genes in humans, using *C. elegans*.

I wondered whether one could have inferred the possibility of Dr. Romano as a potential collaborator in a clinical and

translational science initiative, based on searching publicly available data using Google and another locally developed knowledge management system. I could not infer from his lab’s Web site a poten-

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tial link between his research and diabetes; there is no mention of diabetes in the description of the lab’s research, in the citations’ list of recent publications or in recent abstracts. He was working in his own silo.

Searching the Community of Science expertise database, I found that Dr. Romano is listed with the following keywords: biochemistry, biological sciences, developmental biology, embryology, gene expression, genetics, molecular biology, *C. elegans* and developmental biology. However, there is no mention of his expertise in diabetes or heart conditions, reinforcing the silo.

Querying the database developed at our university to support clinical and translational science, I found that *C. elegans* is not a keyword and that Dr. Romano is not listed. I discovered that *C. elegans* is a keyword in the Computer Retrieval of Infor-

mation on Scientific Projects thesaurus, a controlled vocabulary used to assign indexing terms or keywords to research projects. I learned that Dr. Romano has an ongoing NIH grant. There was no consistency in name recognition among the databases.

I searched the literature using Romano, *C. elegans* and diabetes as search terms, and found a recent paper that cites Dr. Romano’s paper, and links *C. elegans* research and diabetes. Thus, while I could not find a direct link from Dr. Romano’s publications to diabetes, I could find indirect links both in publications and through the links tab on his lab’s Web site.

Responding to my request for permission to use this case study, Dr. Romano wrote that, “None of the genes we study

are related to diabetes, so I think any links between our work and diabetes would be pretty weak. However, some of the genes we study are similar to genes controlling heart development in other species. As nematodes do not have hearts, I wouldn’t necessarily expect researchers interested in the heart and working on clinical and translational science would be aware of our work. Perhaps that link may make a more realistic case study.”

A novice in molecular biology and its applications, I had found a link, but not the best one, and certainly not without significant effort on my part.

AN INFRASTRUCTURE RESPONSE

Many researchers on campus work on *C. elegans*. Their investigations and other similar research have the potential for translation to clinical applications—if not in diabetes, then in cardiovascular dis-

eases. However, linkages appear unrecognized either by bench scientists or clinical researchers. Breaking these silos is the heart of the problem for developing clinical translational science.

It's true that a motivated researcher will find these interdisciplinary connections. However, it is more likely that people will

sage could persuade researchers to invest the time to explore the opportunity for collaboration and translation, thus breaking the silos. Systematizing the workflow across silos can reduce the time-to-application of biomedical scientific discoveries and the time-to-research of clinical and community healthcare issues.

To break the silos of research while simultaneously advancing science, the infrastructure should facilitate the back-and-forth translation of information — data, information, and knowledge — between basic researchers, animal researchers, clinical investigators and public health researchers. It must support the translation of information between the subdisciplines of each group as well (See Fig. 1).

Specifically, these infrastructures should support the following:

Social networking among scientists.

They should foster integrated and collaborative scientific studies, through multi-directional communication, required to translate research into clinical and community practice; develop a dynamic interactive online community of researchers and practitioners; catalyze communication and networking among and between researchers, clinicians and community healthcare workers; give administrators, researchers and students facilitated access to powerful integrated, informational and infrastructure resources with user-friendly interfaces; and re-engineer the process of creating collaboration networks among researchers and practitioners.

Scientific workflow management.

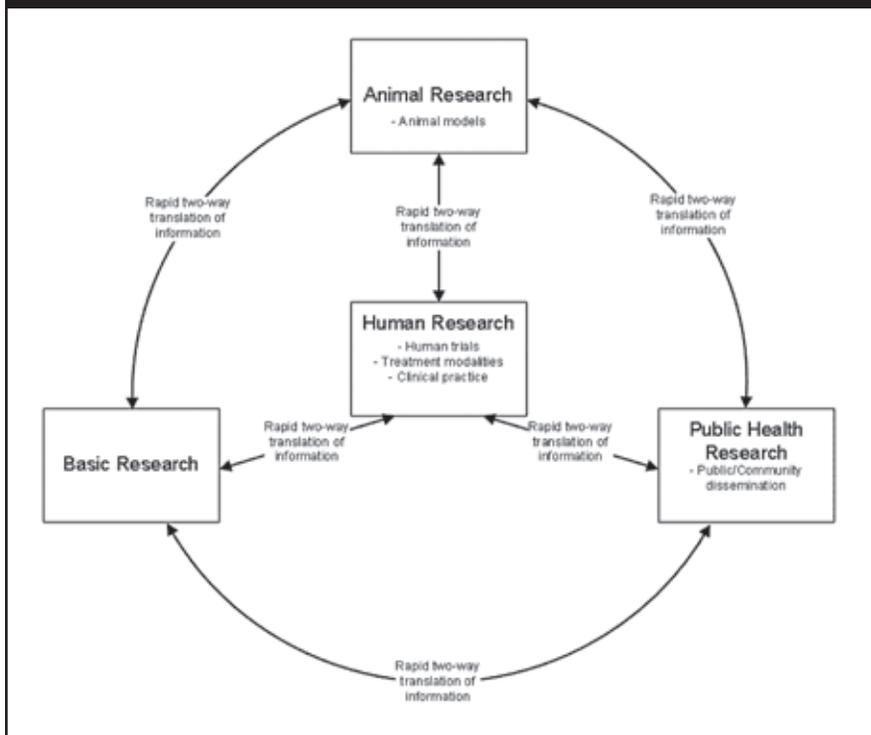
They should accelerate the pace of scientific discovery, facilitate innovation, and translate basic research to clinical and community practice by systematizing the workflow; reduce the time-to-practice of biomedical scientific discoveries and the time-to-research of clinical and community healthcare issues; and facilitate data and knowledge management through the adoption and development of standards and protocols.

Logical data warehousing.

They should create a comprehensive intra- and inter-institutional logical data warehouse. The data warehouse will link clinical inpatient and outpatient data, research and other forms of data. Researchers should be able to access these data transparently while integrating and analyzing them with tools available at their desktops. They also should manage, preserve and effectively integrate the large amounts of data collected in the various phases of translational research.

Scientist relationship management.

Figure 1: Multi-directional translation of information



participate only if they have an infrastructure that reduces the time and energy required for searching for and forming these relationships. One must discover first- and higher-order links between researchers and research topics, make the links visible, and include these in the CTS initiative. We must go beyond personal awareness and accidental meetings to form interdisciplinary teams.

One mechanism to map these hard-to-see networks is social-network analysis. Rather than broadcasting opportunities for collaboration by e-mail or other means, it's more effective to target people based on searching a knowledge base and selecting prospects for the interdisciplinary teams. A targeted message is more likely to attract a researcher's attention than a broadcast message, and a targeted mes-

Delivering this level of discovery and collaboration requires an infrastructure not normally found today. The infrastructure must permit proactive use by both researchers and research administrators, even if only a few of the *C. elegans* researchers ultimately identify with CTS.

The ideal structure would be a combination of Google, Facebook, Amazon and Orbitz. It should have the global indexing, ranking and search capabilities of Google; the social networking capabilities of Facebook; the data mining, cataloging and customer (researcher) relationship management of Amazon; and the complex scheduling (chaining) capabilities of Orbitz. These four systems, which have revolutionized consumer informatics, will serve as excellent metaphors for the design of future CTS environments.

They should foster integrated and collaborative scientific studies through the “push” and “pull” of information about, from and to researchers and practitioners, and they should facilitate data and knowledge management through the adoption and development of standards and protocols.

Bases/banks/registries inventory. They should ensure that the repositories created of databases, tissue banks, patient registries and so on are preserved and made available on-time and on-demand; provide a single point of access to repositories of data, tissue and others; and provide access to integrated support to use these repositories.

Tools inventory. They should ensure that the repositories of tools for analysis are preserved and made available on-time and on-demand; provide a single point of access to tools for research and analysis; and provide access to integrated support to use these tools.

Such a system will provide easy access to all the research across all the phases of bench-to-community, including a variety of databases and other resources spread across many labs and institutions. It will help proactively to develop networks of

researchers across these phases. It will help researchers by pushing only relevant information to them as it becomes available in other fields of research, by keeping track of their preferences and their past searches and information requests.

Such a system would have made so much easier the relational search scenario depicted earlier in this column between *C. elegans* and the researcher’s community of interest.

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