

Between the local and the global: organized research units and international collaborations in the health sciences

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Published online: 11 November 2010
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Abstract Organized research units—also known as centers, institutes, and laboratories—are increasingly prominent in the university. This paper examines how ORUs emerge to promote global agendas and international collaborations in an academic health center in North America. The roles these units play in helping researchers work across institutional and national boundaries are identified and analyzed. The concept of boundary organizations is employed to explain the features of ORUs and the challenges they face. Findings provide insight into how such units operate between local and global mandates, interest groups, and sources of influence, helping to extend university research into the global space.

Keywords Organized research units · Centers and institutes · Medical school · Academic medicine · Academic health science centers · International research collaborations · Organizational change · Globalization · University research · Interdisciplinary research · Interdisciplinary fields

Research collaborations across national boundaries have steadily grown over the past decades (Wagner and Leydesdorff 2005). Historically driven by many factors that are both internal and external to science, international research linkages have been actively promoted recently by academics, university administrators, and policy makers in Canada. Universities have embraced the goal of forging international research connections, and those are framed as a means to achieve and retain excellence (Knight 1995; Munroe Blum et al. 1999; Skinner et al. 2005; Stein et al. 2001). Funding agencies have pushed such collaborations to plug Canadian science to international hubs of scientific activity, and project national research globally (AUCC 2008a). Given the size of the country's academic research enterprise, international linkages are viewed as necessary to facilitate Canadian

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contributions to the global scientific mainstream and to enhance the competitiveness of national science (Government of Canada 2007; AUCC 2008b). In spite of these policy thrusts and a few studies on the topic (Knight 1999, 2004; Bond and Lemasson 1999; AUCC 2007), little is known about how Canadian universities are adapting organizationally to support international research collaborations.

Studies on the ‘internationalization’ of universities suggest that associations and networks have been primary vehicles that universities employ for international research agendas and cross-border collaborations (Knight 1999, 2004; Stein et al. 2001; Beerkens 2002). The literature also reports on joint research projects, international research agreements, and research exchange programs that academics use for cross-border activities. These however do not necessarily involve organizational change in universities. With the growing pressure on universities to diversify revenues and compete for research funding, ‘entrepreneurial’ organizational structures that facilitate research have become more prominent (Clark 1998; Geiger 2004). In particular, organized research units (ORUs)—also called centers, institutes, and laboratories, among other terms—have become major components of universities. This paper examines the intersection of this major organizational development in universities and the trend towards international collaborations in academic research, focusing on the health sciences.

ORUs are important components of North American health science centers, as the biomedical and health sciences have become increasingly interdisciplinary, team-based, and large-scale (Ibrahim et al. 2003; Mallon and Bunton 2005; Mallon 2006). ORUs not only perform much sponsored research, but also increasingly participate in important academic decisions. Such decisions include faculty hiring and evaluation, definition of research priorities, support for graduate students, and investments on research facilities (Ibrahim et al. 2003; Mallon and Bunton 2005). Moreover, there is a growing interest in fostering global research ties in academic health science centers through multiple kinds of ORUs (Haq et al. 2008; Kolars 2000; Macfarlane et al. 2008; Quinn 2008; Vermund et al. 2008; Whitcomb 2007). The ORU as a vehicle in the internationalization of university research remains, however, largely unexplored.

This study investigated the development of ORUs and how they bring an international dimension to university research in a Canadian academic health sciences center. This paper argues that viewing such units as boundary organizations is useful in understanding the changes they bring to universities and the challenges they face. This view is consistent with the literature on ORUs, which highlights how they operate as intermediaries between the university and multiple stakeholders, extending academic research roles to meet external demands (Geiger 1990).

Conceptual background: ORUs as boundary organizations

Research on boundary organizations provides a useful conceptual lens to analyze ORUs in the university. Growing from the observation of organizations created to be intermediaries between the scientific community and policy makers, the concept of boundary organization has been applied to a series of organizations, including university-based research units (Guston 1999, 2000; Agrawala et al. 2001; Cash 2001; Keating 2001; Klerkx and Leeuwis 2008). Boundary organizations operate at the interface of different professional communities, mediating their interactions and providing each with useful resources (Guston 2000). To fulfill this role, such organizations develop expertise to communicate with and remain accountable to disparate sets of actors. Recent studies have examined how boundary

organizations arise from interactions among actors from multiple sectors to help them cooperate around the production of novel products (O'Mahoney and Bechky 2008), and how such organizations can create spaces for several research demands to be articulated to scientists (Klerkx and Leeuwis 2008). Several aspects of ORUs related to the features of boundary organizations are reviewed below.

First, ORUs help internalize external agendas and priorities in the university. Centers have been established since at least the nineteenth century to conduct research of interest to sponsors (Geiger 1990). University research settings are increasingly diverse, with the multiplication of demands on academic scientists to advance knowledge, contribute to technological innovation, support regional development agendas, and inform policy debates, among other tasks (Geiger 2004; Slaughter and Rhoades 2004; Gibbons et al. 1994). ORUs have been described as intermediaries between these external demands and universities, allowing researchers to respond to new knowledge needs by extending the roles of academic departments (Geiger 1990). Governmental research agencies have emphasized modes of research support that involve ORUs, whether to perform 'big science', to facilitate university-industry collaborations, or to forge inter-institutional cooperation. Some of these units were created by large grants from government funding agencies, and as such are highly influenced by their requirements and procedures (Sá 2008). In his study of entrepreneurial universities, Clark (1998) noted that boundary-crossing ORUs may be a source of creativity and intellectual renewal in academic departments by bringing in new ideas and approaches. Conversely, such external influences channeled through ORUs may create concerns around the nature of research conducted on campus and how it is governed (Gumport 1993).

Second, ORUs facilitate interactions among disparate sets of actors. Such units deal with multiple stakeholders within and outside the university: administrators that may approve and/or support their operation, academic departments from where faculty are recruited, sponsors that fund their activities, donors that provide gifts, potential users of their research, among others (Ikenberry and Friedman 1972; Friedman and Friedman 1982; Teich 1982; Geiger 1990; Gumport 1993). ORUs thus need to manage multiple sources of influence, resources, support, and legitimacy. Managing these interactions involves decisions about the mission, activities, and organizational structure of ORUs. Some have attempted to develop typologies to describe this variation (Ikenberry and Friedman 1972; Mallon and Bunton 2005), a task made challenging by evolving forms of sponsorship and research organization.

Third, ORUs need to be accountable to disparate sets of actors. Such units often focus on problem-oriented, applied, and interdisciplinary research of interest to sponsors (Geiger 1990; Klein 1990). However, they are embedded in universities whose incentive and reward structures are discipline-based. As a result, ORUs' work may be considered less rigorous or marginal (Klein 1990; Lattuca 2001). This may affect ORUs, as their fit and perceived value within the academic structure may condition their possibilities (Ikenberry and Friedman 1972). Researchers participating in ORUs may experience "role strain"; they may be pulled in different directions by ORUs and departments that value and reward different kinds of scholarly work (Boardman and Bozeman 2007; Bunton and Mallon 2006). Previous studies investigating the impacts of ORUs on faculty work highlight these issues (Bunton and Mallon 2006; Boardman and Bozeman 2007). Faculty get caught between the orientations and priorities of each unit they are accountable to, often receiving mixed signals about incentives and rewards. Indeed, there may be limits in the ability of boundary organizations to conciliate competing demands (Klerkx and Leeuwis 2008).

Lastly, ORUs provide multiple actors with access to resources. Observations that ORUs result from the opportunistic pursuit of funding date back to the early twentieth century (Flexner 1930). University administrators and faculty create these units to seek external funding opportunities, to hire and retain researchers, to coordinate shared research facilities and instruments, and to coordinate multiple units and programs in a given field, among other objectives (Ikenberry and Friedman 1972; Friedman and Friedman 1982; Geiger 1990; Mallon and Bunton 2005). For faculty, ORUs may be a source of important resources to help them advance their research agendas. External sponsors and potential research users obtain relevant knowledge from ORUs in exchange for their support. Thus, such units establish themselves in universities by serving the needs of different actors.

The study

ORUs oriented towards international missions are becoming increasingly common across North American medical schools (Haq et al. 2008, Kolars 2000, Macfarlane et al. 2008, Quinn 2008, Vermund et al. 2008, Whitcomb 2007). However, little is known about how such units succeed or fail to bring about changes in universities. To start to address this gap, this study investigated the experience of ORUs at the University of Toronto Academic Health Sciences Center, comprising the Faculty of Medicine and affiliated teaching hospitals. Applying the conceptual lens of boundary organizations, this study focused on understanding how and why ORUs assimilate international research agendas in the health center, how they facilitate interactions across institutional boundaries, and what tensions they need to manage.

With over half a billion dollars in annual research revenues, the faculty is the largest performer of biomedical and health research in Canada and one of the largest in North America. The Faculty is comprised of 28 departments and 11 affiliated hospitals, with over 5,000 faculty members and staff. Located in a large and diverse metropolitan area, Toronto's health sciences center is typical of those found in research-intensive universities. The organizational context of Toronto's health science center can be described as highly decentralized. It has a complex governance system, which involves a stream of conflicting demands and pressures from local stakeholders for instruction, research, and health care (Ferris et al. 2004).

As a first step, this study focused on identifying the organizational units advancing international research collaborations. This entailed an examination of publicly available documents, including mission statements, reports, and strategic plans produced between 2000 and 2009 by the faculty and its ORUs. Over the decade, the Faculty of Medicine has embraced a vision of becoming an international leader in health research and education. Pursuing international research initiatives and partnerships is part of this bold vision, as articulated in the Faculty's academic plans (Faculty of Medicine 2000, 2004). Eight units with clearly defined objectives for international research were identified (see Table 1), although there are numerous other ORUs across the Faculty of Medicine and affiliated hospitals fulfilling multiple roles. Interestingly, most of these units have been created since 2000, although two have been in operation since the 1980s. The second stage of the study involved 32 semi-structured personal and telephone interviews with knowledgeable informants (advisory committee members, dean's office representatives, center directors, associate directors, researchers). This stage included between 3 and 5 interviews per each research unit. Following standard qualitative data analysis techniques (Miles and

Table 1 Organized research units with an international focus at the University of Toronto Academic Health Sciences Center

Name	Year of creation	Description	Institutional affiliations
McLaughlin –Rotman Centre for Global Health (MRC Global)	2006	Performs scientific and policy research on global health, focusing on diseases and treatments in developing countries	University Health Network, MaRS Centre
International Centre for Disabilities and Rehabilitation (ICDR)	2004	Conducts research on rehabilitation in various cultural and ethnic settings; teaching and service activities in Canada and developing countries	Rehabilitation Science Sector, Faculty of Medicine (including Departments of Occupational Science and Occupational Therapy, Physical Therapy, Rehabilitation Science and Speech-Language Pathology)
The Peter A. Silverman Centre for International Health (PASCIH)	c. 2003	Harnesses collaborations among hospital scientists and international partners on international health issues; facilitates professional development and knowledge exchanges focusing on “healthcare in a globalized environment”	Mount Sinai Hospital
Centre for Global Health Research (CGHR)	2002	Conducts research on global health, focusing on HIV-1 and tobacco	Based in St. Michael’s Hospital, with offices in New Delhi, Bangalore and Chandigarh. Affiliated with the Centre for International Health, the McLaughlin Centre for Molecular Medicine
Centre for International Health (CIH)	2001	Promotes collaborations in research, education, and outreach in global health, focusing on developing countries	2001–2007—linked to the Dean’s office; since 2008—under the new Dalla Lana School of Public Health (formerly the Department of Public Health Sciences)
Joint Centre for Bioethics (JCB)	1995	Performs bioethical research with an international focus, as well as instructional and clinical activities	Located at the Faculty of Medicine, with links to the Faculty of Arts and Science, Faculty of Law, Faculty of Nursing and the Graduate School of Studies; Pan American Health Organization/ World Health Organization Collaborating Centre for Bioethics
Centre for Health Promotion (CHP)	1989	Facilitates multidisciplinary research, education and service to develop and evaluate health promotion approaches in Canada and internationally	Department of Public Health Sciences; World Health Organization Collaborating Centre for Health Promotion
Canada International Scientific Exchange Program (CISEPO)	1984	Non-governmental organization facilitating cross-border partnerships in education, training, scientific exchange and research, with a focus on the Middle East	Mount Sinai Hospital, Peter A. Silverman Centre for International Health, Department of Public Health Sciences

Huberman 1994), the interviews were recorded and the data were coded and tabulated; these data were triangulated with the documentary data.

Findings

Investigating organizational developments over the 2000s, it was evident that multiple global thrusts permeate the Faculty of Medicine and affiliated hospitals. The ORUs identified in this study enabled international research agendas and helped embed such activities in the academic structure. Below, we present the findings under two main themes. First, the factors shaping the emergence and operation of the internationally-oriented ORUs are examined. Second, we discuss the organizational models employed and the boundary roles played by ORUs.

How and why do ORUs assimilate international research agendas and what tensions do they need to manage?

The analysis of the data indicated multiple factors shaping the emergence and evolution of ORUs with international agendas. Some of those factors relate more proximately to the organizational context of the health center, whereas others are part of the broader research environment. This distinction can sometimes be artificial, as university researchers are part of disciplinary and professional networks that operate across organizations. However, such differentiation is useful in examining ORUs through the conceptual lens of boundary organizations. Table 2 summarizes the findings related to three key features of boundary organizations employed in the analysis of the data: the mandates they fulfill, the resources they provide to disparate actors, and the multiple lines of accountability they manage. These are explained below.

Globally minded scientists play a key role in establishing and operating international agendas into the ORUs investigated. All units examined in this study revolve around personal stories of scientific curiosity that compels international partnerships and commitments to carrying out work in other countries. These scientists created or participated in ORUs to further their international interests, often having to go beyond the usual national research funding schemes to enable and sustain major initiatives. In one case, the Dean recruited a leading scientist to the faculty by giving him a chance to establish his own research center, tailored around extensive collaborations overseas and strong relations with a donor. The “charismatic leadership” of those researchers played a distinctive role in the creation and evolution of centers.

The oldest of these units illustrates well these themes. CISEPO came into being as a result of a researcher’s personal interest in promoting cross-cultural cooperation in the Middle East through academic initiatives in otolaryngology. This scientist was able to tap the local community in Toronto, among other sponsors interested in promoting peace in the region, for private donations to develop this center. The longstanding personal relationships around this multi-disciplinary center have sustained it over the years, and led to the creation of several other units since 2001. Private donations allowed for the establishment of the Silverman Center, which now coordinates CISEPO and other programs. In another illustrative example, MRC Global grew out of close collaborations among researchers with disparate research foci, but a common interest on global health issues. Scientists linked to this unit conduct both scientific and policy-oriented research on global health problems, involving research approaches from multiple disciplines. The merger between “discovery

Table 2 Enablers and constraints to internationally-oriented ORUs

	Mandates		Resources		Accountability	
	Internally	Externally	Internally	Externally	Internally	Externally
Enablers	Globally-minded scientists	International health movements, internationalization agendas	Seed funds, institutional policies	Donors, foundations, international agencies	Academic performance reviews	Grant renewal requirements, partner expectations
Constraints	International missions not recognized as priority	Fragmented funding landscape, competing federal S&T priorities	Competition for limited overhead on external grants	Dispersed and incremental governmental subsidies	Some outcomes not rewarded by traditional reward systems	Sponsor requirements for “solutions” beyond research

and delivery” occurred as two researchers identified their complementary strengths and pulled together their research teams. As the collaboration evolved and external funding increased, the unit established a physical location in a technology park located at the University of Toronto (MaRS Centre).

The interplay between researchers’ aspirations and their ability to adapt to the priorities of external funders shaped the ORUs. The interests and research agendas of the scientists participating in such units were connected to, or were reinforced by, movements in the scientific and policy communities promoting fields such as “global health”. The internationalization agendas of Canadian funding agencies were another source of external endorsement and support for cross-border research partnerships. Still, ORUs had to deal with a fragmented and uncertain funding landscape. University seed funds and overhead negotiated on external grants provided modest support. To operate internationally, those units engaged a number of patrons, such as international organizations, aid agencies, and foreign foundations. To deal with this context, ORU directors argue they need to be “focused”, “goal-driven”, and “managerially savvy”. One director describes how his unit adapted to the rising popularity of a research field:

the strategy changed over time... there were so few opportunities in [academic field] that [scientists] would jump at any opportunity, prepare a proposal and respond to a call... but as funding opportunities somewhat increased ... [the researchers] were able to become a little bit more strategic and more focused on where they want to go.

Another ORU director explains how the mission of his unit was refocused in response to the perceived preferences of international sponsors:

The initial focus was on translational science research, and the broader focus [was] on [research field]. Now the [unit] has focused on both, which is appropriate because that’s what you need to go from discovery to delivery; it’s a more integrated approach.

Gathering resources from and remaining accountable to both the university and external sponsors are critical to the survival of these ORUs. Each of these issues, resources and accountability, bring in certain tensions to the operation of these units. Pressed by the expectation of being at least to some degree self-sustainable, ORUs may become engaged in revenue-generating activities that are viewed as competing with their research mission. Many important sponsors of international health projects emphasize projects that facilitate knowledge transfer and focus on applied solutions to real world problems. Directors of those units reported having to maintain a balancing act between securing external funding for worthy health causes involving technical assistance and outreach and maintaining a strong focus on scientific research agendas that would be valued by disciplinary colleagues in academic departments. Interviewees were unanimous in agreeing that ORUs are more likely to be successful if they added resources and helped scientists produce what the research university values the most—peer-reviewed research in distinguished journals, prestigious awards, and other academic accolades. Such activities are viewed as important when they follow from, or reinforce, research. One interviewee points to the problem from the perspective of participating faculty members, who end up divided between their commitments to their primary academic units and the ORUs:

That takes a lot of energy and that’s why you need the institutional support [to the center] as well. If you don’t have the institutional support then it’s going to be argued that the energy is spent on the [center] is the energy you are taking away from your real job...[in the academic department].

Moreover, the missions of the ORUs often create risks for tenure-seeking faculty. Departmental colleagues seek evidence of research achievement and productivity, which may be affected by the longer time frames required to initiate international research projects. Senior scientists may have more latitude to take risks, although they are by no means unconstrained by departmental and institutional merit and promotion evaluations. As two researchers explain, ORUs need to accommodate the needs of faculty whose tenure-lines and main responsibilities lie elsewhere:

If you apply for tenure, or apply for promotion, each department or faculty wants to see your particular contribution to that field. This is a problem not only for [the center], but for any center doing interdisciplinary research... it becomes kind of vague or ambiguous—it becomes really difficult to find people who can evaluate your contribution.

[Ideally you have] a model where people would have a level of trust [indicating] that they are able to work with each other without feeling that they were investing a lot of effort into something that was not giving them a lot of recognition or grants. They should not have felt exploited of course, and that's always been a danger.

These tensions between academic work that is rewarded and the diverse missions of ORUs can affect their development. For example, one of the units experienced difficulties as projects focusing on knowledge transfer and technical assistance became more numerous, requiring greater administrative support and attention from researchers. Scientists were wary of dedicating time to those activities, which were seen as taking time and effort away from research. The revenue-generating activities thus constrained institutional resources and increased faculty “role strain” (Boardman and Bozeman 2007). As a result, the unit was ultimately reorganized to undertake a more modest mission within the health sciences center, as its scientific value came into question.

On the other hand, remaining accountable to external sponsors involve demonstrating the relevance and impact of funded projects. This goes beyond reporting requirements on completed projects, and includes on-going interactions. ORUs provided a formal structure for scientists to engage with external actors. CISEPO was even incorporated as a non-governmental organization, which gave more latitude to researchers in engaging external stakeholders in the unit's governance structure. One of the leading scientists explains, “this makes us unique: although we struggle a lot for money, I don't think we have ever struggled for capturing government attention and demonstrating value.” Communicating research ideas persuasively and meeting the interests of disparate sponsors were viewed as key to building and sustaining the units.

Another important constraint in the broader research environment concerns the funding policies of the Canadian federal research councils. One of the factors contributing to the proliferation of ORUs in American universities over the past several decades is the funding of direct and indirect costs of research by a number of funding agencies (Geiger 1990; Gumpert 1993; Dill and Vught 2010). In Canada, on the other hand, federal councils neither allowed for the reimbursement of salaries of faculty involved in research grants, nor for the inclusion of indirect costs at a rate considered adequate by research universities.¹ As a result, multiple units had to “compete” for the limited overhead on grants, including the academic departments to which the researchers belong. Moreover, as mentioned above, there are a number of ORUs at the health sciences center, with faculty holding overlapping

¹ Only in this decade have indirect costs become reimbursed regularly by the federal government. See Fisher and Rubenson (2010).

affiliations. Directors interviewed indicated that even researchers active in their centers sometimes prefer to administer projects through their departments. As one of the directors explains:

We could never really get people to do their research through the [unit] easily because nobody really wanted to pay an administration fee; nobody wanted to give a cut to the center because they already had to give a big cut to the university, or maybe even to the hospital... nobody is keen on paying extra taxes... and then there was a scientist who wanted to do his research project through our center, but [the researcher] was not allowed to do that.

How do ORUs facilitate interactions across institutional boundaries?

The internal features (e.g. organizational structure, mission, activities) of boundary organizations are important in understanding how they manage interactions among multiple actors (O'Mahoney and Bechky 2008). The ORUs span conventional administrative and organizational structures at the university's academic health sciences center. Several functions of ORUs were noted by the interviewees (Table 3). In general, the units investigated were "adhocracies"—dynamic and fluid organizational forms, with little formalization and standardization. Led by small groups of committed researchers, they can innovate relatively quickly as resources become available. Such units provided them with greater autonomy in decisions about funding and resource allocation to build research programs and promote knowledge transfer activities. Moreover, ORUs also provided status and visibility to researchers, facilitating interactions with a range of stakeholders in the global arena. Within the university, the ORUs allowed researchers to create a visible home for their undertakings, get access to seed funding, solicit administrative support, build networks of collaborators, and stay tuned into the trends emerging in the research and sponsoring communities. These internal roles enabled research and knowledge transfer efforts in international settings, and the engagement of ORU researchers in cross-national collaborative projects.

As for how they carried out their international mandates, the ORUs varied in the relative emphasis they placed on supporting international research collaborations and integrating a global agenda within local activities. They engage teams across departments, as well as institutions, to link with funding agencies and other external stakeholders (i.e. governments, industry, foreign academic and non-academic organizations etc.). Two

Table 3 Functions of internationally-oriented ORUs

	Internally	Externally
Legitimizing international research	Providing an institutional home for globally minded scholars, internal visibility	Signaling organized efforts to meet external priorities; creating institutional ties to foreign agencies, governments, communities
Building research programs	Networking across departments, seed funding, administrative support, promoting international projects and publications	Research performed in foreign sites; collaborative research with international partners; clinical trials conducted internationally
Promoting knowledge transfer	Disseminating information about external opportunities, networking, events	Technical assistance to foreign governments; consulting to international organizations; research-based training

Table 4 ORUs' models and boundary roles

	Umbrella	Interdisciplinary niches
Assimilating external influences	Building multiple thematic, disciplinary and regional foci; process-oriented	Selective and focused in themes and regions; problem-oriented
Facilitating collaboration	Open networks; interdepartmental and multidisciplinary teams	Closely knit teams, selective in disciplines and expert areas, project-specific, and outcome-oriented
Managing boundaries	Supporting emerging academic fields and creating homes for globally minded scholars, building new institutional identities, coordinating communication and fundraising efforts	Extending researchers' expertise to new locales; combining expertise from different departments; streamlining communication and fundraising efforts
Providing resources to different stakeholders	Facilitating large-scale collaborations, providing seed funds, tailoring projects to a variety of sponsors with multiple priorities	Providing scientists with connections to specific sponsors; intellectual community for scientists, specialized interdisciplinary expertise to sponsors

organizational models for harnessing international collaborations were evident: the umbrella model and the interdisciplinary niches model. Table 4 summarizes these models, describing how each fulfills the roles of boundary organizations.

CIH followed the umbrella model, to set up networks for collaboration across departments in the medical school and the affiliated hospitals. CIH received seed funds and administrative support from the university to enable research programs in international health issues. Over time, the unit established and coordinated multidisciplinary groups of researchers involved in broad thematic or regional health problems. The challenges of HIV/AIDS in Africa, for example, was a core theme for CIH to engender cross-departmental collaborations to reach out to universities in Botswana, Kenya, Nigeria and other countries. Other themes involved nursing in Asia and Latin America, and women's health across national settings. Addressing such research problems required inputs from biomedical scientists, anthropologists, public health professionals, educators, and management specialists. Another umbrella unit is The Peter Silverman Centre for International Health, which came to life at the Mount Sinai Hospital to coordinate initiatives among teaching hospitals. This unit was primarily engaged in practical field-based projects, outreach, and training activities. These umbrella units brokered interactions among researchers, disseminated information, and provided research and administrative support to a range of distinctive projects. To carry out their activities across internal academic divisions, the umbrella units depended on upper-administrative support and endorsement for their mandates.

The interdisciplinary niches model was followed by JCB, CHP, and ICDR, for example. Such units specialize on research niches with an international dimension, including health problems, diseases or health policy issues in foreign countries. They brought together researchers from a number of departments and teaching hospitals, creating a home for specialized interdisciplinary research. CGHR for example, emerged in one of the teaching hospitals and created three outposts for HIV-1 and tobacco-focused epidemiological research in India. ICDR brought together faculty from a number of departments engaged in rehabilitation-related research (i.e. Occupational Science and Occupational Therapy, Physical Therapy, Rehabilitation Science, and Speech-Language Pathology) carrying out

work related to parts of Africa, Asia and the Caribbean. Selective in their membership and driven by small groups of research collaborators, such units were less dependent on institutional endorsement than umbrella centers. These units were basically networks of scientists with intellectual affinities, who engage in research studies internationally in various parts of the globe.

Both kinds of units operate across organizational and disciplinary boundaries and depend on faculty based in academic departments. Enlisting the participation of productive scientists, convincing them to run their sponsored research projects through the centers, is key. ORUs thrived when a core group of faculty viewed them as an intellectual home for the research activities that are central to their careers, although those might not necessarily be central to their academic departments. As researchers note:

They let me do the international research. The Faculty wanted me to do the local, Toronto-based studies...so the presence of the [unit] helped me. They funded a part of my salary.

[The center] gave me opportunities to meet other colleagues working in the field through the seminars and conferences [they] organized.

Thus, ORUs contributed to cross-border linkages by providing faculty with access to information, funding, collaborators, and administrative support. They brokered collaborations across academic divisions, as umbrella organizations did, and supporting research on specialized interdisciplinary areas. Internally, they facilitated information flows, interactions, and networking. Externally, they provided valuable contacts and supports to researchers working in foreign settings with international partners.

Discussion and conclusions

This study examined how and why ORUs assimilate international research agendas and activities in Toronto's health center, how they facilitate interactions across institutional boundaries, and what tensions they need to manage. Several findings emerged from this analysis. They help specify the contribution of such units to the health research enterprise in the Canadian context, supporting global research agendas and enabling cross-border collaborations. More broadly, the findings provide insight into how university-based boundary organizations work.

The literature on international academic collaborations in universities has by and large glossed over the specific features of different fields (de Wit 2002). Prescriptive studies on how universities (should) internalize an international mission often catalogue a variety of means to achieve that objective, with little attention to disciplinary differences (e.g. Knight 1995, 2004). This paper has unveiled multiple aspects of the experience of research units with an international orientation in a health center. Examining ORUs is important in this context, as such units have sprawled across academic health centers in North America, becoming increasingly influential in setting research agendas and supporting faculty work (Ibrahim et al. 2003; Geiger 2004; Mallon and Buntun 2005). The units examined above bring together researchers interested to forge international partnerships, conduct research overseas, and incorporate global problems and issues into their projects.

The conceptual lens of boundary organizations proved useful in analyzing the roles ORUs play in the health center. The units investigated operate at the interface of academia and other professional communities, fulfilling roles ascribed to boundary organizations in

the literature (Agrawala et al. 2001; Cash 2001; Guston 1999, 2000; Keating 2001; O'Mahoney and Bechky 2008; Klerkx and Leeuwis 2008). They internalized the demands of multiple interest groups, provided them with access to valuable resources, and remained accountable to them. The umbrella and niche ORUs provided faculty with a visible institutional home for research agendas and collaborations reaching across national boundaries. Research and knowledge transfer programs were built in multiple sub-fields, involving global themes and partners. The organizational models differed in the specific strategies used to encourage and support such programs, highlighting the impact of the internal features of boundary organizations on how they fulfill their roles. This is an aspect of research on boundary organizations that the literature has not yet explored in great detail (O'Mahoney and Bechky 2008; Klerkx and Leeuwis 2008).

Unlike boundary organizations that derive legitimacy from governmental mandates (Guston 1999, 2000), the status of ORUs as mediators is not taken-for-granted and can be contested and contingent. Many advocate cross-national research collaborations as a means to better create and disseminate knowledge on challenging health problems (e.g. Riley et al. 2003; Rosser et al. 1997; Kaput et al. 2005). However, the research problems and sponsors driving international collaborations are not universally regarded as priorities, in spite of the rhetoric around internationalization among policy makers (Government of Canada 2007) and higher education leaders (AUCC 2008b) in Canada. Units focused on global agendas are sometimes viewed as competing with academic departments for faculty time and institutional infrastructure. The organizational and administrative structures of universities are historically built around academic departments (Clark 1995), creating uncertainties for research units with distinctive purposes and needs. Some of the work carried out overseas in the health sciences involves research problems and approaches not regarded as priorities for Canadian funding agencies and biomedical disciplines. This may inhibit faculty participation in the ORUs and affect how such units are perceived on campus. Hence, establishing academic credibility within the university is as important as being able to meet the needs of sponsors.

Bringing multiple sources of influence into the university, globally minded scientists were critical boundary mediators. They provided ORUs with the intellectual authority, expertise, and leadership needed for them to emerge and flourish. Such scientists work across organizational, disciplinary, and national boundaries to advance research and service missions. They forged local and global connections that supported global research agendas and international collaborations. Differently from previous studies focusing on ORUs operating within a single national context and even relying on one major sponsor (Mallon 2006; Mallon and Bunton 2005; Quinn 2008), the units created by globally minded scientists were invariably exposed to variegated sources of influence. They worked with a diverse range of sponsors from different settings and with disparate orientations from basic research to knowledge transfer activities.

In closing, the ORUs investigated in this study operate between local and global settings, research problems, and actors. They supported cross-border linkages by providing academic scientists with access to information, research resources, and administrative support. Organizationally, they worked across the health center's academic structure, brokering research collaborations and forming interdisciplinary networks of scientists specializing on global agendas. As boundary organizations, they facilitated interactions between globally minded scientists, international partners, and sponsors, helping to project the research role of the health center in the global space.

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