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## North American Consortium on Rehabilitation Engineering and Technology for the Individual (NARETI)

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## **Works in Progress: North American Consortium on Rehabilitation Engineering and Technology for the Individual (NARETI)**

**Dr. M. Barbara Silver Thorn, Marquette University**

Dr. Barbara Silver-Thorn is an associate professor at Marquette University. Her research interests are in rehabilitation engineering, prosthetic and orthotic design, functional assessment, and tissue biomechanics. Her interest and initiatives in engineering study abroad and dual degrees in engineering/STEM teaching began when she served as associate dean for Academic Affairs.

**Dr. Karla Bustamante, Itesm chihuahua**

**Works in Progress:**  
**North American Consortium on**  
**Rehabilitation Engineering and Technology for the Individual**  
**(NARETI)**

The availability and accessibility of appropriate rehabilitative health care, medical technology and treatment is an important local, regional, national, and international issue. The focus of this North American Mobility Program<sup>1</sup> project is to increase awareness among biomedical engineers of the differing individual, family and community rehabilitative health care needs in North America via student exchange with consortium institutions in the U.S., Canada and Mexico (Table 1). The aim is to increase understanding of alternative healthcare delivery systems and to enhance the development and technology transfer of new scientific tools and techniques, medical devices, and related biomedical research.

*Documentation - MOU and IRB:* Representatives from each of the consortium institutions met on two occasions to draft the memorandum of understanding (MOU). This MOU documents the tuition waiver (tuition to be paid at the respective home institution), student fees (travel, visa processing fees, room and board, books, and additional university fees), travel awards, refund policy, transfer credit evaluation and award, recruitment process, admission standards, screening and selection of exchange applicants, number of exchange students, student pre-departure preparation, housing, and host institution orientation.

Documentation related to human subject “testing” was also submitted to the various Institutional Review Boards or equivalents to support dissemination of program details and aggregate student assessment data.

*Curriculum opportunities:* Existing and potential new curriculum options at each partner institution were reviewed by NARETI faculty in concert with the NARETI program objectives. Curriculum options for junior and senior biomedical engineering students, including possible capstone design projects, technical electives, engineering service projects, research experiences, internships and clinical rotations, and cultural and language study were identified and shared with all partner institutions. Curriculum options consistent with degree requirements of the respective home institutions were then reviewed for potential transfer credit. These details, as well as contact information for two liaisons (a staff person in the respective international office and a faculty member in biomedical engineering), are posted on a common website<sup>2</sup> with links to each of the consortium institutions.

*Student recruitment:* NARETI program information is disseminated to potential engineering student participants through the aforementioned website and promotional literature distributed by international office staff and engineering faculty. Information venues include: study abroad information fairs, open house events, and emails and/or classroom visits to biomedical engineering juniors. Interested students are encouraged to contact their international office or NARETI faculty representative for more information. Students then submit a study abroad application including potential coursework and research interests to their home institution by the published application deadline.

*Student admission and travel award:* International office representatives and NARETI faculty review submitted applications in terms of applicant quality and NARETI exchange allocations. The international office at the home institution contacts the international office at the potential

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<sup>1</sup> U.S. Department of Education, International and Foreign Language Education Service,  
<http://www2.ed.gov/programs/fipsenortham/index.html>

<sup>2</sup> <http://www.nareti.com/>

host institution(s), forwarding applications for which they recommend travel awards. The host institution determines final acceptance. Accepted students then work with international office staff and NARETI faculty at the host institution regarding travel logistics, curriculum options, and specific research/internship opportunities.

*Program assessment:* An evaluation plan and specific assessment tools were identified so as to assess the program objectives (Table 2). These assessment tools include: (1) a healthcare awareness survey, (2) two case study reports, (3) a global perspectives inventory (GPI)<sup>3</sup> questionnaire evaluating cultural differences, cultural comforts and the campus environment for culture and cultural tolerance, and (4) interviews of the exchange participants and faculty research/internship mentors by the program external evaluator. As per U.S. program guidelines, U.S. students studying in Mexico are also required to complete an oral Spanish language proficiency test<sup>4</sup> pre- and post-exchange to assess foreign language skills.

Just over 40 undergraduates have expressed interest in these programs, with 20 students completing applications, and travel awards extended to 14 students (12 of whom opted to participate in study abroad experiences. These exchanges are summarized in Table 3. All students enrolled in various engineering technical electives, one participated in a capstone design project, and nearly all students conducted research in a faculty laboratory; no students participated in an engineering service project, industry internship, or formal clinical rotation as yet.

The program supports eight (two at each of the four institutions out of country) student exchanges per institution, 48 student exchanges total over the 4 year project duration. The program is in its third year; none of the partner institutions have met this target allocation as yet. This may be attributed, at least in part, to the delayed completion of the MOU, personnel changes affecting incoming student placement as well as recruitment of outgoing students, curriculum revisions affecting curriculum options for incoming students and degree requirements and potential transfer credit for outgoing students, travel warnings affecting student exchange in Mexico, and inability to identify an equivalent course for a specific graduation requirement. The higher cost of living in Chicago and Toronto may also make exchanges to these institutions less favorable for many Mexican students, particularly as Mexican travel funds are not awarded until the student returns from their exchange. Several students expressed interest in summer, rather than semester-long, exchange opportunities – an option that is not supported by the North American Mobility Program.

Assessments have been completed for the four 2011-12 exchange participants. Pre-exchange assessments for the students on exchange in 2012-13 (3 in fall, 5 in spring) have been conducted; post-exchange assessments will be completed before the end of the academic year. The preliminary results of these assessments are summarized below for each of the respective educational objectives.

Although the pre- and post-participation healthcare survey responses did not reflect increased general awareness of healthcare systems (objective 1), post-participation interviews of the exchange applicants reflected clear increases in understanding of rehabilitative technology

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<sup>3</sup> <https://gpi.central.edu>

<sup>4</sup> <http://www.actfl.org>

specific to the student's research project. The first case study reports also demonstrated knowledge, perhaps increased, of focused aspects of the healthcare systems, as well as evidence of knowledge of device-related regulatory issues. There was no evidence of increased knowledge of rehabilitation healthcare economics or privacy laws.

The pre- and post-participation healthcare survey subset of responses did not reflect increased awareness of rehabilitation economics and access, although some improvement was noted with respect to awareness of regulatory approval of medical devices (objective 2). These marginal improvements were consistent with the fact that early participants were not enrolled in rehabilitation coursework and their rehabilitation research projects involved assessments and prototype designs not yet ready for clinical adoption.

During the interviews, students cited several examples of increased awareness of training and delivery of rehabilitation products and services. These gains were based on their research experiences, discussions with their research mentors and graduate students, clinical rotation observations, and their case study reports. Students were particularly enthusiastic about what they had learned about products and services when they were able to see patient interactions. None of the assessment tools demonstrated increased knowledge of the repair or technical support of these rehabilitative healthcare products and services.

Some improvements were noted with respect to sensitivity to rehabilitation individuals (objective 3). Although only required for U.S. students, this questionnaire was completed by 9 of the 12 exchange participants (only pre-exchange scores are currently available for the spring 2013 participants); improvements were noted in intrapersonal affect, interpersonal social responsibility and interaction, and cognitive knowledge. Student replies to the healthcare survey questions addressing medical privacy issues reflected strong awareness of privacy issues pre-participation, scores that remained largely unchanged after their exchange participation. During interviews, participants were also able express an understanding of the role graduate students, research faculty and individual patients within the healthcare system and the patients' rehabilitative health; this understanding was strongly affected by the student's research experience.

Student exchange in Mexico increased the Spanish language proficiency of one of two student participants, as assessed with the American Council on the Teaching of Foreign Language (ACTFL) Oral Proficiency Interview (OPI).

More than 20 faculty participated in consortium site visits and/or hosted exchange students in their laboratories; nearly 50 faculty welcomed consortium members into their laboratories during these consortium site visits. These research laboratory visits may foster future faculty research collaboration, as well as providing research internship opportunities for exchange students.

*Conclusions:* All interviewed students were very positive about their experience and stated that they would do so again and recommend the program to a friend. Many of the primary objectives of the program were achieved in these initial student cohorts, particularly for students who participated in a research experience. Future efforts include continued program dissemination and recruitment of both student and faculty exchange participants, as well as assessment of exchange applicants and integration of assessment results. Such assessment can help to identify

future program format(s) and opportunities after the funding period, including potential expansion beyond North America.

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Table 1: Partner institutions.

Partner Institution	Country	Public/Private	Number of Students
Marquette University	U.S.	Private	11,800 (1,400 engineering, 380 biomedical)
University of Illinois at Chicago	U.S.	Public	26,200 (3,100 engineering, 340 biomedical)
University of Calgary	Canada	Public	31,320 (3,240 engineering, 125 biomedical)
University of Toronto	Canada	Public	73,785 (7,208 engineering, 254 biomedical)
University of Guadalajara	Mexico	Public	221,656 (11,917 engineering, 333 biomedical)
Technologico De Monterrey Chihuahua campus	Mexico	Private	2,550 (1,450 engineering, 129 biomedical)
Guadalajara campus			5,237 (2,400 engineering, 114 biomedical)

Table 2: Summary of NARETI program educational objectives and various assessment tools.

Assessment Tool	Objective 1: To increase awareness of healthcare systems for rehabilitation.	Objective 2: To increase awareness of rehabilitation products and services.	Objective 3: To increase sensitivity to rehabilitation individuals.
Healthcare Survey (pre/post-participation)	questions concerning rehabilitation economics, regulatory environment, issues related to privacy	questions related to rehabilitation economics, regulatory environment	questions concerning privacy issues
Case Study Report 1: (week 3 of exchange)		examination of particular rehabilitation product/ service available in student's host country	
Case Study Report 2: (week 14-16 of exchange)			interview medical personnel/biomedical engineer in host country with whom student worked
GPI questionnaire (pre/post-participation, US students only)			X
Interviews (post-participation)	questions addressed rehabilitation individual, healthcare products	questions addressed rehabilitation product awareness	questions assessing student's transformation & growth in understanding of both rehabilitation individuals & products

Table 3: Summary of student exchanges to date.

Home	U.S. (MU, UIC)	Canada (UC, UT)	Mexico (UG, ITESM-C)
Host			
U.S. (MU, UIC)	NA	0	3 (+1 declined)
Canada (UC, UT)	4 (+1 declined)	NA	3
Mexico (UG, ITESM-G)	2	0	NA