

Creating a Sustainable Health Research Industry in Northern Ontario

Appendix 3: Benchmark Profiles Report

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**Northern Ontario
School of Medicine**

Table of Contents

1. Summary of Key Findings and Recommendations	3
2. Prince George, BC: University of Northern British Columbia	5
A. Regional Overview.....	5
B. Institutional Overview.....	5
C. Biomedical Cluster Support and Infrastructures.....	7
D. Perspectives on Facilitating Growth of the Regional Health Sector.....	7
E. Key Findings and Recommendations.....	9
3. Hamilton, ON: McMaster University	11
A. Regional Overview.....	11
B. Institutional Overview.....	11
C. Biomedical Cluster Support and Infrastructures.....	12
D. Perspectives on Facilitating Growth of the Regional Health Sector.....	14
E. Key Findings and Recommendations.....	16
4. Winnipeg, MB: University of Manitoba	18
A. Regional Overview.....	18
B. Institutional Overview.....	18
C. Biomedical Cluster Support and Infrastructures.....	20
D. Perspectives on Facilitating Growth of the Regional Health Sector.....	21
E. Key Findings and Recommendations.....	22
5. Syracuse, NY: SUNY Upstate Medical College	24
A. Regional Overview.....	24
B. Institutional Overview.....	24
C. Biomedical Cluster Support and Infrastructures.....	25
D. Perspectives on Facilitating Growth of the Regional Health Sector.....	26
E. Key Findings and Recommendations.....	29
6. Honolulu, HI: University of Hawaii	30
A. Regional Overview.....	30
B. Institutional Overview.....	30
C. Biomedical Cluster Support and Infrastructures.....	32
D. Perspectives on Facilitating Growth of the Regional Health Sector.....	33
E. Key Findings and Recommendations.....	35

1. Summary of Key Findings and Recommendations

There are several issues, including geographic, demographic, capital sourcing, infrastructure, staffing, and leadership, that are common to Northern Ontario and each of the selected benchmarked regions. All of the benchmarked communities faced similar challenges on each one of these fronts with varying degrees of success. Those regions that experienced the most success in overcoming these challenges did so through the use of dynamic leadership, strategic planning and implementation on a number of fronts simultaneously. The following factors were identified by the leaders interviewed as important determinants of success in each of the benchmarked regions and are therefore recommended to key decision-makers of NOSM in developing its strategy and business plan:

1. Recruiting. The ability to succeed in the life sciences generally and in commercialization of basic and clinical research findings is directly proportional to the quality of people involved. This includes both researchers and management. It is particularly critical to recruit the best quality researchers that a region can afford. This includes provision of excellent compensation packages, substantial participation in revenues generated through commercialization of researcher intellectual property, and excellent laboratory infrastructure.

2. Culture of Commercialization. This is seen by many leaders to be crucial to success. Commercialization must be seen to be an important value and promoted as such by senior administrators within the university, research community, and local industry and government officials. Once success begins to materialize, it must be actively harnessed in order to facilitate the development of further interest in commercialization by other researchers. Being realistic about commercialization timelines was also seen as an important element of success, as biotechnology incubation and commercialization is a much longer process than in other industries e.g., information technology.

3. Motivation: Many of the leaders of the benchmark communities assessed viewed success as a function of strong leadership. In particular, the formation of commercialization committees that include leaders/champions from all relevant disciplines was seen to be critical. Such committees optimally include researchers, academic administrators, technology transfer officers, industry leaders, capital sourcing, developers, and politicians at all levels (municipal, regional and provincial/state, federal).

4. Momentum: Once momentum has been gained, for example through institution of new university infrastructure or facilities, biotechnology clusters, research incubators, and new hospitals etc., it is critical to maintain this momentum. This is best done through active participation of all leaders on the commercialization committee. The goal is to celebrate the organization's successes, and to use this success for recruiting purposes, to attract higher levels of government funding, to attract interest in industry partnering and funding opportunities, and to encourage both further and new research collaborations.

5. Collaboration. Collaboration is a key determinant of success, particularly for the more remote benchmarked communities. Bringing partners together from other remote but

geographically-related areas was very important for the benchmarked regions in developing critical mass, both in terms of developing a regional niche speciality, but also for attracting funding from external capital sources such as venture capital and attracting funding and industry partnering opportunities for clinical trials. Once collaboration has been established, communication between participants is key to facilitating growth and maintaining relationships. Collaboration can be facilitated using new technology, such as video-conferencing.

6. Grass-root Support. Several leaders of the benchmark communities assessed indicated grass-root support has been very important to their success, again particularly in the more remote regions. Communication to the local population of the advantages of supporting biotechnology (increased health care quality, access to specialists, job creation, injection of revenues into local economy), both financially and politically, was integral to obtaining their support.

7. Development of Niche Specialties. Most of the benchmarked communities saw developing niche specialties as critical to their success. Identification and growth of niche specialties is dependent on the quality, critical mass and specialties of the current and prospective researchers associated with the organization and on the geographic and demographic nature of the benchmarked region.

8. Research Parks/Incubators. All of the benchmarked communities had significant success with incubators and research parks. These were seen as integral to the success of the regions, as they facilitated commercialization culture, attracted venture capital and industry partnering opportunities, facilitated opportunities for collaboration with other regions and within a given region, and allowed researchers and management to efficiently commercialize technologies.

9. World-class Infrastructure. The development of world-class research facilities was seen to be critical in order to attract accomplished researchers and technical staff, particularly to the more remote locations.

10. New Technologies. Use of new technologies was also an integral component of success for the more remote benchmarked regions. Leaders from those communities all recommended heavy use of such technologies, including tele-health, tele-surgery and video-conferencing in setting up and facilitating the growth of their biotechnology industries. This was seen to be particularly valuable in facilitating communication with industry partners and potential capital sourcing partners, and between collaborators.

2. Prince George, BC: University of Northern British Columbia

A. Regional Overview

Population:

Prince George is a rural city of over 77,000 inhabitants. The majority of the population is employed mainly in the hospitality and retail sectors.

Geographic Region:

Known as BC's northern capital, Prince George is situated at the confluence of the Fraser and Nechako Rivers.

Overview of Health Cluster:

There is a growing research infrastructure around the University of Northern British Columbia (UNBC) with several research institutes dedicated to northern community development, adolescents and children with special needs, social indicators, and rural health. However, the major teaching hospital clusters in BC are still located in Vancouver.

Relevance to Northern Ontario:

The remoteness of Prince George relative to Vancouver, as well as the presence of a medical school specializing in rural medicine, makes this a highly appropriate and relevant site for benchmarking.

B. Institutional Overview

Background

The citizens of remote rural communities are significantly underserved when it comes to health care provision. As in Northern Ontario, the population of Northern British Columbia has worrisome health indicators. For example, mortality and morbidity rates are higher than in the rest of Canada, as are those for suicide and accidental deaths¹.

In 1990, the *University of Northern British Columbia Act* RSBC 1996 (repealed July 15, 2002) was passed for the creation of a university in Northern British Columbia. In September of 1994, the UNBC opened with around 1,500 students enrolled. UNBC was the first new university to be built in Canada in over 25 years with a total of 55 programs, 15 masters programs, 2 PhD programs as well as the new Northern Medical Program. Much of UNBC's research remains focused on northern issues.

Currently there are 3,664 students enrolled with 64.5% from Northern BC and 9.5% from outside of BC. With regional campuses in Terrace, Quesnel and Fort St. John, and a number of programs and courses in communities across northern BC, students have the flexibility to complete their degrees without leaving their jobs and/or families.

¹ <http://www.unbc.ca/research/plan.html>

The UNBC has made it a priority to focus on research relating to the key determinants of health care in its immediate environment. Through research, it seeks to remedy local problems by developing health care practices that will improve the quality of regional health care generally, including educational programs aimed at preventive health care.

Health Related Facilities and Programs

The UNBC offers several programs and training opportunities at the undergraduate and graduate level in medical science. The programs offered at UNBC are mainly focused on themes pertaining to rural health, such as:

- Specialized undergrad programs in Northern Studies, as well as undergrad and grad programs in First Nation Studies
- Programs in Development include the Northern Medical Program and the Bachelor of Health Sciences program
- Degree programs for health research such as Nursing, Community Health, Disability Management, Psychology and Social Work.
- Certificates and Diplomas for a variety of First Nation specific programs including Aboriginal Health Sciences and Rural & Northern Nursing

Importantly, Prince George Regional Hospital (PGRH) is northern BC's largest healthcare facility. It plays a key role in providing clinical instruction for the Northern Medical Program, in addition to the family practice residency program.

The UNBC faculty also conducts research relating to social and health issues that are relevant to the surrounding rural community. There are several research centres and institutes that host these research initiatives:

- The Centre of Excellence for Children and Adolescents with Special Needs, Rural Health
- The Centre of Excellence in Women's Health
- The British Columbia Rural and Remote Health Research Institute – founded in 2000 to improve rural health conditions and is involved in a rural and remote health research projects
- The Centre of Excellence for Children and Adolescents with Special Needs – dedicated to researching substance abuse in rural, remote and northern communities
- The Northern Health Sciences Centre – opened in August 2004

Showcase Programs in Health

The Northern Medical Program (NMP) is a partnership between UBC and UNBC which was created in response to the critical need for physicians and healthcare professionals in northern and rural areas by providing to students the UBC curriculum in a northern and rural context. Through the NMP, a collaborative research program was developed which focussed on issues relating to the local community, including aboriginal and environmental health issues, and rural, remote and northern health issues. This program will allow students to learn through placements with community-based physicians as well as utilize the various regional health care facilities in rural and remote northern communities.

C. Biomedical Cluster Support and Infrastructures

In order to leverage research discovery at UNBC, the University Industry Liaison Office provides support and guidance to researchers and prospective inventors in the following manner²:

- It liaises with the industry and the community to facilitate collaboration
- It assists in research capacity building
- It educates UNBC community about intellectual property
- It supports intellectual property filing of discoveries
- It helps in commercializing discoveries

The UNBC also hosts an Industrial Technology Advisor from the Industrial Research Assistance Program (IRAP), who adds to the resources of the University Industry Liaison Office. The development of a research park and technology incubator program has been promoted to help innovators pursuing commercial ventures.

Additionally, the Innovation Resource Centre in Prince George provides support to the innovators of Northern BC through several programs, resources, and initiatives. In 2003, a study entitled *North-Central BC; High Technology Study*³ was conducted. This study highlighted the successes and challenges faced by the high-tech industry in the region. Most high “tech firms” in the Northern BC region were in the field of information technology rather than life sciences. Indeed, only 2% of them (3/172) were in the medical industry. The main challenges identified for the high tech sector in Northern BC were:

- Attracting and retaining skilled employee (work shortage, geographic location, compensation, and limited HR pool)
- Poor economic conditions
- Poor communication infrastructure
- Insufficiently sophisticated customers for these product and services
- The lack of proper financing channels forces entrepreneurs to resort to personal financing

D. Perspectives on Facilitating Growth of the Regional Health Sector

Name: Lorne MacGregor

Affiliation: Director of Intellectual Property Management, UNBC

There has been research in health-related field for sometime in the region. However, the medical school and associated clinical research are new developments. In the community, life science research does not have a direct economic impact. However, it helps to make the area more liveable for families. For example, a professional family will not relocate if they cannot have access to a good family doctor and specialists. Also the school of medicine makes it easier to attract physicians because it provides more interesting opportunities for them to do more things (e.g., teaching and research).

² <http://www.unbc.ca/research/uilo/index.html>

³ <http://www.innovate.bc.ca/media/downloads/hightechstudy2003.pdf>

The IPM office is not currently playing a huge role in developing the life science sector because there is very little research in medical science. Activities depend on the research that is being done and its outcomes and frankly it is quite unpredictable. There is a lot of variability in research outcomes and patenting success, even more so with respect to patent licensing or company spin-off capabilities. Also, there is a significant lag time; once investments are made in research, potential commercial outcomes should not be expected for at least 5 to 10 years. Moreover, a patent is not likely to generate much revenue until 4 to 5 more years.

The motivation should not be to generate direct immediate revenue but to attract researchers and clinicians, to raise additional research funding, to support local industry through service provision to the community or local firms, etc. These are important issues and generate value, but the outcome will be mostly indirect or only develop in the long term. The office helps in other ways e.g., helping to identify when an invention can be patented, educating faculty on the reality of business. For instance, it is not necessarily a good idea to have inventors to run off to start companies when the technology is too premature. The office helps by providing an effective management structure; it is often better for the scientist to continue doing research and to have business people pursue the commercial venture.

Currently, one inventor at UNBC has a biomedical technology with commercialization potential. The challenge is the early stage of the technology; it is not ready to be commercialized. There is an attempt to structure some of the research toward developing the technology further. However, the problem is that further development work is either encompassed by regular operating grants from CIHR or NSERC and/or is too early for CIHR-Proof of Principle grants or NSERC Idea to Innovation grants. There are few tactics available to bridge the gap between these funding poles other than to seek funding from other resources. The office is looking into forming an angel network or forming a network of mentors that will develop into an angel network. One pending question is whether people that developed their asset base in forestry would be comfortable investing in the life sciences.

It is also important to establish a culture which values commercialization of research outcomes. The senior administration and faculty need to promote this vision for it to be successful. There is also a need to offset peer pressure against commercialization. However, UNBC did not have much of this problem because both the university and faculty are relatively new/young. Moreover, a culture of commercialization has been promoted since the beginning of UNBC.

Once developed, a bias against commercialization is hard to change. One way to offset the problem is to make commercial-friendly attitude a hiring criteria. More importantly, management should not only play lip service to the vision, but promote it and make allowances for demands it places on faculty and staff. It is also important to avoid bureaucracy, which is a barrier for researchers to engage in commercial ventures. The technology transfer professionals should be continually talking to researchers, and act as a service provider helping people with both small and large issues as they arise. Success does not have to merely comprise direct revenues. It can also occur in helping local companies and generating research contracts.

Name: His Worship, Colin Kinsley
Affiliation: Mayor of Prince George

The health sector is very important to Prince George. The city has about 80,000 people and the closest neighbouring city is more than 400 km away. The region has a higher incidence of tuberculosis, diabetes, traumatic injury, and abuse of alcohol. There is significant wealth in rural Canada (mining, forestry, agriculture, etc.), yet the primary challenge remains one of accessibility.

The city plays an important role in health care by collaborating with UNBC, the hospital, and the rural government to lobby to provincial and federal governments for funding. In terms of economic growth, the main issue is community capacity-building. Professionals insist on having access to good health care services before they move in the region. The basic needs of families determine attraction of more professionals.

The Medical School has resulted in significant economic development for the region. It has increased the local government payroll, and these people in turn invest in the community. Once a service has been established that is specialized, it attracts research dollars, researchers, chairs, and corporate research activities. Prince George has created a partnership for a research park mostly from the computer sciences program at UNBC. It now has about 130 classified IT firms. There will hopefully be a medical component to this park, which may reach a similar level of importance.

The number one health care success in the region is the creation of the Northern Medical program. There are now 25 medical students in training. A trust fund was created to sustain students in the program when they travel to see patients. The city of Prince George alone has pledged \$2M for this. The city has been successful in lobbying for the expansion of the hospital and expenditure relating to health care.

The greatest challenge has been the recruitment and retention of medical professionals. Not just physicians, but nurses and pathologists. A program was started for nurse practitioners. Most physicians that trained in our family practice school have stayed.

It is very important to get grass-root support from local citizens. In Prince George, there was a rally where 7000 people showed up and gave \$5 each instead of signing a petition. This money went into the Medical School, and received substantial government attention. Local governments are also allied in lobbying provincial and federal government. There are certainly great synergies that could be created through partnership between NOSM and UNBC.

E. Key Findings and Recommendations

- The Prince George region faces unique health challenges (tuberculosis, diabetes, and high incidence of injuries).
- The UNBC has elected to focus on rural health medicine, particularly on local health care issues such as those enumerated above.
- Direct commercial outcomes from research are unpredictable and require significant time to materialize.
- For example, from research to a patent may take anywhere between 5-10 years, and license revenues generally don't occur until several more years.

- The most important economic outcome of basic research and technology commercialization at UNBC are the indirect returns of providing the community with research and health services, including:
 - Attract research contract and public funding
 - Researchers can perform research for local firms
 - Attracting high profile researchers
 - Impact quality of life i.e. better health care provision
 - Help attract physicians by offering research and teaching opportunities
 - Social benefits through increase government pay roll in the community.
- The city is a key collaborator and partner in lobbying with provincial and federal government. Community support is fundamental asset.
- Building a research park and incubators is deemed essential for discovery commercialization.
- Recruiting skilled workers is a challenge.
- Investors are fundamental for leveraging research discoveries, but are sparse in region. Prince George is building a network that will serve as a channel to access capital.
- It is key to establish a culture of commercialization in the academic community
- Stakeholders along with the community must come together to lobby to governments.
- Opportunities for collaboration between NO and UNBC may provide synergies to both communities.

3. Hamilton, ON: McMaster University

A. Regional Overview

Population:

The City of Hamilton has approximately 500,000 inhabitants and is considered a large rural city, with a highly educated work force.

Geographic Region:

Hamilton consists of the amalgamation of 6 small communities: Ancaster, Dundas, Flamborough, Glanbrook, Hamilton, and Stoney Creek.

Overview of Health Cluster:

The Hamilton cluster serves the healthcare needs of the Niagara and Halton regions, but faces strong competition for resources and recognition because of its proximity to Toronto. The Hamilton region is also well known as a strong hub for clinical trials and research, with a strong network of hospitals and research institutions.

The Faculty of Health Sciences at McMaster University is also in partnership with the Academic Health Care Network to provide proper healthcare practices to the Central West and North-Western Ontario region

Relevance to Northern Ontario:

Hamilton is a suitable cluster for benchmarking as it shares similarities with the rural communities of Northern Ontario based on its role as a healthcare focal point for many more remote communities in Northwestern Ontario.

B. Institutional Overview

Background

McMaster was founded in Toronto in 1887, and was later moved to Hamilton in 1930. There are 15,000 full-time students currently enrolled at the university with 100,000 alumni representing 129 countries. It has been named Canada's most innovative "medical doctoral" university 8 times in the last 11 years in *Maclean's* annual ranking of universities. Its method of teaching employs a student-centred, problem-solving based approach to learning, which now has been adopted by universities around the world.

Health Related Facilities and Programs

The Faculty of Health Sciences offers programs in nursing, medicine, midwifery, and rehabilitation science. The Faculty is housed in the 40-acre McMaster University Health Sciences Centre, which also houses part of the Hamilton Health Sciences Hospital. The university faculty, 96% of which have PhDs, is home to the notable Dr. Bertram Brockhouse, who was the co-winner of the 1994 Nobel Prize for physics.

The Institute for Molecular Biology and Biotechnology (MOBIX), a centre for life science and translational research for diagnostic and therapeutic interventions in human health, is another key institution for medical research in Hamilton. MOBIX consists of four

separate centres, each with its own research and development capabilities. These include the Antimicrobial Research Centre, the Centre for Gene Therapeutics, CEGeBio, and the Functional Genomics Centre. The central facility of MOBIX is the centralized MOBIXlab, which provides molecular biology expertise and services to those within the McMaster community as well as other research communities that collaborate with McMaster.

The University offers several specialty centres and programs including:

- Antimicrobial Research Centre
- CanChild Centre for Childhood Disability Research
- Centre for Evaluation of Medicines
- Centre for Gene Therapeutics
- Centre for Minimal Access Surgery
- Indigenous Studies
- Environment and Health program

Showcase Programs in Health

The Northwestern Ontario medical program (NOPM) is a joint program between McMaster University's affiliated teaching hospitals and the Northern Medical Program's affiliated regional clinical learning sites (i.e. Thunder Bay Regional Health Sciences Centre). This postgraduate surgical program allows the residents to be exposed to the practice of surgery in smaller regional clinical learning sites such as Dryden, Kenora, Sioux Lookout. About half of the training program is spent in Northwestern Ontario, mainly in Thunder Bay. NOMP provides a comprehensive learning experience for postgraduate students as well as the skills required for a surgical practice in both urban and rural regions.

C. Biomedical Cluster Support and Infrastructures

Incubators are key enablers of spin-off and start-up companies. The Hamilton region currently benefits from one incubator that caters to the biomedical industry. The new DeGroot building associated with McMaster is currently being completed and will provide additional incubator space. McMaster is further working towards the development of a biotech incubator that will be part of an innovation park. The current incubator, The Hamilton Incubator of Technology is a modern 40,000 square foot facility that opened in 1993 which offers experienced mentorship, networking, access to capital, training solutions, and ready-to-use facilities. It is a multi-purpose incubator which hosts tenants in robotics, biotechnology, and software.

The Hamilton region has tax rates that are significantly higher than some of the other municipalities in Ontario. However, this is changing through the introduction of the Business Tax Reduction plan leading to significant cuts in both municipal and education tax rates.

The Golden Horseshoe's prime geographic location provides accessibility to a large number of venture capital funds through Toronto as well as across the border through New York. The Golden Horseshoe Venture Forum (GHVF) and Golden Horseshoe Biosciences Network (GHBN) facilitate the development of emerging companies through

networking these businesses to venture capital sources and other biosciences companies. The objective of GHVF and GHBN is to keep successful businesses and entrepreneurs in the area by providing an entity to link them to sources of capital and mentorship. Also, a variety of different organizations with a wide array of business support and financing opportunities exist in the region.

Hamilton is highly research-intensive with 67 research institutes/programs and Centres of Excellence, which are located at McMaster University and the hospitals of Hamilton. Several hospitals in Hamilton conduct research, including Henderson Hospital and Hamilton Health Sciences. The HHS is comprised of five hospitals and a cancer centre—Chedoke Hospital, Hamilton General Hospital, Henderson Hospital, McMaster Children’s Hospital, McMaster University Medical Centre and Jurvinski Cancer Centre— and employs over 10,000 people.

McMaster University has established and is growing its Research Contracts & Intellectual Property Office to support researchers in the area of commercialization, through initiatives like the Intellectual Property Policy and Contract Research Policy, which entails a 50/50 royalty split and patenting support by the university.

330 patents have been granted by the United States Patent and Trademark Office to companies and institutions within Hamilton.⁴ Over 30 firms⁵ have been identified as McMaster spin-offs. Some of these firms are still research intensive and in their infancy, whereas others have developed and become prominent in their respective sectors. Examples of successful spin-off companies include:

- **IMI International Medical Innovations Inc.** IMI is a leader in predictive medicine. They are dedicated to developing innovative tests that detect life-threatening diseases at the earliest possible stage when they can be effectively treated, perhaps even prevented altogether. Their products are currently focused in two major disease areas: cardiovascular disease and cancer. The first product to be widely available is Cholesterol 1,2,3, a rapid, non-invasive test that measures cholesterol on the surface of the skin (on the palm of the hand). The second test to be available will be ColorectAlert, a minimally invasive test for colorectal cancer that provides results that are significantly more specific than the current standard tests. Other products in their pipeline include LungAlert, a non-invasive test for lung cancer, and a non-invasive test for prostate cancer that uses a urine sample. IMI is a public company with shares trading on the Toronto Stock Exchange (symbol IMI) and the American Exchange (symbol IME). The company's head office is in Toronto, and its product-development facility is at McMaster University.
- **Health Utilities Inc.** HU Inc. specializes in preference-based (utility) measures of health-related quality of life for use in: describing treatment processes and outcomes in clinical studies, economic evaluations of health care programs, and the measurement and monitoring of population health.
- **Affinity Biologicals Inc.** A primary manufacturer of polyclonal antibodies and immune depleted factor deficient plasmas for use in the research of thrombosis

⁴ <http://www.uspto.gov/patft/index.html>

⁵ PriceWaterHouseCoopers. McMaster University – Regional Economic Impact Analysis (in-print)

and hemostasis. The company is also a supplier of bulk antibodies and factor deficient plasmas to medical diagnostics manufacturers.

D. Perspectives on Facilitating Growth of the Regional Health Sector

Name: Nick Markettos

Affiliation: McMaster Office of Research, Senior Advisor

The health research sector is very important in Hamilton because it has a tremendous research capacity in health science. Not only does it affect local economic outcomes, it also serves an important health services function. Research activities in Hamilton are impacting the quality of health care provisions. The local health industry cluster serves to complement the strong research assets at McMaster University.

The office of research was the driver for the Biotechnology Cluster Innovation Program (BCIP) in Hamilton. The university is at the centre of the health research cluster, the reason being that there is not a huge receptor capacity in the region. McMaster is very strong in clinical research and this has been successfully leveraged into economic outcomes by attracting research investment from the pharmaceutical and biotechnology companies. Clinical research attracts partnering interest, which allows these companies to propose more research collaborations and services. The main path to generate economic outcomes from health research is through partnerships with biomedical firms or secondarily through the creation of new companies.

Importantly, research outcomes often lead to procedures or techniques that can be applied in clinical practice, which directly benefits the community. The tactics used by McMaster to build BCIP was to create opportunities via small seminars, breakfast meetings, day events, and participating in Bio-Summit. The university supports inventors/entrepreneurs by putting people in touch, having a technology transfer office, educating researchers on intellectual property and business plans. Another key factor is access to capital. Despite the fact that there very little capital sourcing in Hamilton per se, there is a network that channel money and opportunities to entrepreneurs.

Clinical trials are also important. McMaster is very well known for its clinical trials and innovative teaching methods. This model attracts many students to the university. For example, in 2004 McMaster was named the research university of the year by *McLean's*.

Once momentum is created it needs to be kept going by obtaining more funding and by recruiting star scientists. There are a lot of factors that affect the success of a health research cluster. Of these, two of the most important are the quality of the researchers and an environment that fosters and stimulates growth and innovation.

The biggest barrier has been the lack of commercialization facilities (incubator space). This has been hindering researchers to explore commercialization ventures. The university, in January 2005 has secured a site for the development of an innovation park that will include a 30,000 to 50,000 sq. ft. incubator for start up companies. Another challenge was to continue to raise funds for the research needs and to maintain the momentum. McMaster has been able to attract top researchers from around the world. Recruiting the best scientists is fundamental to keep momentum. To be competitive on a truly global level, facilities and resources need to be provided to researchers.

Northern Ontario should pick an area to focus on, a priority area. It cannot spread itself too thin, given that it does not have enough resources. One key objective should be to create opportunities for attracting doctors and incentives to locate in the region. It should seek investment into niche areas such as telemedicine and telesurgery. Whenever a new technology is introduced in a remote area that may be technology-shy, reassurance should be provided that there will be sufficient support and maintenance resources.

Name: Dorothy Redfearn

Affiliation: Business Development Consultant, City of Hamilton

Hamilton has historically been a steel-based economy. However, there has been a recent shift toward knowledge-based industries. Hamilton did invest in an IT cluster but it was difficult to get anything to move forward because this industry serves several different sectors. It was decided instead to develop the IT sector through the sectors it serves instead.

Developing a health cluster has been very important to Hamilton. The hospital is the number one employer for the city, and helps serve a population of 2.2 million people. Health research is important to the region and there are a significant number of high-profile scientists and research clinicians working in the area.

The main role of the city in building the life sciences cluster was to bring the partners together. The city has moved from a geography-based approach to industry-based economic development. The city did an inventory of research strengths, companies, and research institutes. Before the initiative, research was performed in silos in the university and hospitals. The city organized focus groups, bringing together companies and research groups to develop a profile database. The assessment showed that there were gaps in financial resources and physical infrastructures (incubators and research space were crowded). There was a tremendous amount of research, with the result that it was difficult identifying the real strengths. Relationships between health science stakeholders (researchers and clinicians) are good.

However, McMaster health researchers have not been successful at commercialization: only a few companies are active in the biomedical sector. Commercialization was poor due to the fact that there was no push from the university in that direction, there were poor technology transfer policies, no venture capital readily available, and no network for life science stakeholders to meet.

Hard work has, therefore, been invested in having stakeholders talk to each other. The city has initiated and actively managed forums and created a database of up to 500 stakeholders in the industry. The outcomes have been very positive: there is significant interest and high participation. For example, BMS has set up a facility, three biotechnology firms have been created, and the new incubator in the DeGroot building is already half committed. In addition, there is an innovation park currently being built which will include an incubator. The City of Hamilton has committed funds for the innovation park, and a by-law that limits land-use for complementary firms around the innovation park was passed. The city will actively market this land and now has a liaison committee for life sciences. The City also provides active support to the hospital for its application to the Federation of Canadian Municipality funds (FCM).

The main challenge in building the cluster was to get partners to talk to each other and to keep the momentum in the planning process. Another challenge is the short sightedness of many stakeholders. Clustering is a long term project. However, even so, there is a need for City stakeholders to see tangible outcomes early on, such as firm inauguration, construction of a research park, etc. Communication is a critical challenge, as universities and researchers speak their own language. It is difficult to have them to connect with business partners to make a compelling case. Arrogance must be avoided. There is a need to make a case that speaks to the industry partners and the City. Leadership is also very important, it is necessary for making things happen. It is critical that the initiative has a champion that keeps bringing people together, setting goals and motivating stakeholders. There also is a need to keep setting deliverables, milestones, and timeframes.

NOSM should look into FCM funding opportunities for innovative projects and finding new ways to improve its community. It is important to get people involved and foster communication between people and groups. The message needs to be simple and well communicated; it has to create a buzz. Also important is that the vision is realistic. It should revolve around a few niches where the school can become a leader (e.g. Peterborough established an international reputation in forensic DNA) or to provide services and products that speak directly to its community, catering to the local market.

E. Key Findings and Recommendations

- Hamilton is seen as a large rural community that has to compete with Toronto. It has tremendous research capacity in health science and has been successful at attracting medical students through its problem-based approach to learning. The hospital is the number one employer for the city.
- A shift in economy drivers rendered development of the knowledge economy a necessity to offset the decline in manufacturing industry.
- McMaster offers programs in indigenous studies and in rural and northern medicine. In association with Northern Ontario it trains students in surgery in rural community institutions.
- McMaster is very good at clinical research and has used clinical trials to attract research contracts and create visibility for the school of medicine.
- Outcomes of health research are:
 - Attracting research contracts
 - Firm creation
 - Improved quality of care
 - Positive impact on health care quality.
- Key factors for stimulating health cluster development include, creation of incubators, investments in research, and investment in recruiting the best scientists possible.
- Success depends on the quality of the researchers and having an environment that fosters and stimulates growth and innovation
- To overcome the absence of local Venture Capitals in the region, the Golden Horseshoe Venture Forum (GHVF) was created to connect entrepreneurs with investors
- The path to success is to select niche areas to develop, educate the scientific community on technology transfer and business issues, make a compelling case that speaks the language of the scientist, the business partner and the city



council, and ensure the presence of a project champion who will be a strong leader.

4. Winnipeg, MB: University of Manitoba

A. Regional Overview

Population: Winnipeg has a population of about 650,000 people with the majority of its inhabitants employed in the healthcare sector.

Geographic Region: Winnipeg is regarded as Manitoba's major urban centre with numerous neighbouring smaller communities. Its location at the junction of the Red and Assiniboine River has made Winnipeg a long-standing hub for transportation and commerce.

Overview of Health Cluster: Winnipeg's network of hospitals and clinics are the province's premier institutions. It is also globally recognized as a centre for ag-biotech and research on infectious diseases.

Relevance to Northern Ontario: Winnipeg has one of Canada's most diverse economies, including agribusiness and health/biotechnology, which makes it a key influencer to its surrounding rural communities in terms of healthcare delivery.

B. Institutional Overview

The University of Manitoba was founded in 1877 as the first university to be established in western Canada. As of 2004, more than 26,000 students were enrolled in university programs. Fort Garry, the main campus, has teaching facilities, special laboratories, residences, and service offices. The Bannatyne Campus houses the medical and dental schools.

The university is very successful at raising research funds; it has received close to \$20 million of public funding. Discovery translation has led to 113 patents for inventions and technologies to date.

The university has 30 Canada Research Chairs in natural sciences and engineering, health sciences, social sciences and humanities. It hosts the province's only medical school program. Similar to UNBC and NOSM the University of Manitoba is dedicated to rural health issues; it has an Office of Rural and Northern Medicine (ORNM) that was established to encourage medical students and health professionals to practice medicine in rural and northern regions of Manitoba.

The university hosts three major health science units on its Bannatyne campus:

- The Faculty of Medicine
- The School of Medical Rehabilitation
- The School of Dental Hygiene

There are also several research centres devoted to medical research, which are affiliated with the University of Manitoba such as:

- The Breast Cancer and Diagnosis Centre (with Cancer Care Manitoba)

- The Centre for Aboriginal Health Research
- The Centre for Human Models of Disease
- The Centre for Research and Treatment of Atherosclerosis
- The Manitoba Centre for Proteomics
- The Manitoba Institute for Cell Biology
- The NMR Facility, and Spinal Cord Research Centre
- The Developmental Health Research Group
- The Mood and Anxiety Disorders Research Group
- The Psychiatric Neuroimaging Research Group

Health Related Facilities and Programs

Noteworthy, the National Microbiology Laboratory (NML) in Winnipeg is home to the only Canadian Biosecurity Level 4 laboratory⁶. This facility is one of the 15 international laboratories that are equipped to handle the most deadly infectious organisms. It can handle pathogens that produce very serious or fatal diseases and that are readily transmitted through the air or casual contact.

The NML's programs include among others:

- Host Genetics and Prion Diseases
- Enteric Pathogens
- Zoonotics and Special Pathogens
- Bacteriology Viral Diagnostics

Winnipeg is also host to the International Centre for Infectious Diseases (ICID) and the National Research Council Institute for Biodiagnostics (NRC-IBD). The NRC-IBD employs 200 people and since 1992 it has spun out 5 firms that generated up to \$15 million in sales. The NRC has recently developed the Centre for the Commercialization of Biomedical Technology in the same research park as the NRC-IBD and NML. The facility, along with the ICID, is intended to be part of a national network of industrial partnership facilities, with the aim of facilitating technology commercialization.

Rural Medicine initiatives

Northern Manitoba is a rural region that is home to a high number of Aboriginal and First Nation communities. In these communities, there is a need for better healthcare services that are adapted to the environment and specific needs of these communities. For this reason, several initiatives have been launched to better address these issues. These include:

- The Centre for Aboriginal Health Research (CAHR); a joint initiative between the Assembly of Manitoba Chiefs, the Faculty of Medicine at the University of Manitoba, and the Foundations for Health.
- The CAHR coordinates and supports research activities to assist the First Nations and Aboriginal communities in improving health services in their communities. This research program will integrate scientific and traditional

⁶ <http://www.nml.ca>

- Aboriginal approaches to produce new knowledge about health care in these communities.
- Office of Rural and Northern Manitoba

There is also financial assistance available for students specifically interested in rural medical training.

C. Biomedical Cluster Support and Infrastructures

University innovation is supported by the University of Manitoba through a generous intellectual property policy, technology transfer services, and an incubator for start-ups. Inventors at the university are entitled to equal ownership on their invention, and have the right to decide whether or not to seek a patent and on what terms to commercialize the discovery⁷.

The University of Manitoba Technology Transfer Office provides a wide spectrum of intellectual property services in order to identify, protect, and commercialize intellectual assets (copyrights, patents, and trademarks). Its services support:

- Canadian and international patents
- Copyright
- Research collaborations
- Business development and corporate expertise
- Technology commercialization
- Start-up launch
- Capital formation

The Technology Transfer Office at the University of Manitoba has been successful; it has licensed important technologies in agricultural, information technology, and life science fields, and has launched several start-ups⁸.

Furthermore, the Smartpark Development Corporation (SPDC) has built a multi-tenant facility of 30,000 sq. ft. to host several high-tech and biotech companies. In the past years, over \$100-million in capital development and 13 new resident companies were added to the Smartpark community. The park is committed to developing innovative research collaborations between the university and industry in areas including information technology, wireless communication, advanced manufacturing, functional foods, nutraceuticals, and ag-biotech⁹.

Another key driver for the biomedical industry in Winnipeg is the NRC Institute for Biodiagnostics (NRC-IBD). The IBD is involved in world-class research for noninvasive medical diagnostics. The institute's mandate, along with that of the newly developed Centre for the Commercialization of Biomedical Technology, is to transfer its knowledge into commercial ventures through licensing and spin-off creation. IBD science has generated results that had worldwide impacts. Its diagnostic instruments are used

⁷ http://umanitoba.ca/admin/governance/policies/section_200/225.shtml

⁸ <http://umanitoba.ca/research/tto/>

⁹ <http://umanitoba.ca/research/smartpark/vision.php/>

around the world, and five spin-off companies were created from the IBD generating approximately \$30 million per year¹⁰.

D. Perspectives on Facilitating Growth of the Regional Health Sector

Name: Bruce Martin

Affiliation: Director of J.A. Hildes Northern Medical Unit

The specific context of the J.A. Hildes Northern Medical Unit, is to provide services to remote communities of Northern regions. The clusters of health research activities are small but vital for these communities. It is an essential component for meeting the unique health care needs of the communities involved.

The program partners with community leaders to work as logisticians to develop program to deliver the appropriate services to their communities. It offers a huge array of programs that are developed to meet needs that are identified by the communities (e.g. pediatric health and diabetes). Solutions comprise community specific programs and research. Often pilot-based studies can be used as templates for other communities. Such sharing also occurs beyond the Canadian border through networks such as the International Union for Circumpolar Health (IUCH). Health challenges and outcomes are similar in most of the Northern region because these communities share the same life style, genetic determinants, and geographic remoteness, among others.

One successful program is the Bachelor of Science in Medicine program for medical students. This program pairs undergraduate medical students with accomplished researchers during the summer months. Communities report their concerns to the program and such concerns are formulated into specific projects that are undertaken by students under supervision of an established researcher. This works in two ways: 1) it disseminates information on such programs to the community, with students acting as an emissaries; 2) students also bring community issues to the university which can then leverage its technology and expertise to bring innovative approaches to address rural problems. It helps to bridge the gap between the community and the university. One important success factor is that projects are initiated communities that request assistance.

The main challenges are infrastructure-related i.e. insufficient human resources and support for research. In a school where research is not the principal mandate, there is a need to advocate for its importance, otherwise research takes a back seat and is performed over weekends with no secretarial support. Financial support is also critical. There is a need for establishing a culture that brings research groups to come together in a collegial and not competitive fashion.

It is important for research to be made a priority that is well expressed to the hospital board and the communities, and to be seen as pillar in the community. It has to start early. A new school presents a golden opportunity to start on the right page. The Associate Dean of Research should coordinate and take a lead role in creating the awareness and making research a priority. Another important role is to ensure that there is a good research ethics board. The ethics of research has to be reviewed early on in light of current standards; there is risk of mistrust from the communities involved if there

¹⁰ http://ibd.nrc-cnrc.gc.ca/english/home_e.htm

is a misuse of information, or if the information is not first conveyed to the community. There is a need for community ownership that is well articulated.

Name: John Langstaff

Affiliation: CEO CANGENE

In Winnipeg, academic research is far larger than the private sector. With the exception of CANGENE, there are not many firms in life sciences. However, there are many academic organizations involved in health research namely: the University of Manitoba, NML, and NRC-IBD. Winnipeg has a very large federal infrastructure for research.

CANGEN played a role in helping the life science cluster development by initiating and being a member of the Health Care Product Association, and being actively involved in the program for clustering within the prairies and federal innovation strategies. CANGEN is localized to Winnipeg because the original technology has started in University of Manitoba. It has now two manufacturing facilities. CANGENE is one of the few companies in Canada that manufacture pharmaceuticals.

Setting up a research firm that has a goal of licensing its technology out after a given clinical trial phase, which comprises 90% of current firms, is different than growing a company that will manufacture its own product. There is little in Manitoba to attract research-based companies to move in. No research-based organization will move here unless big incentives are provided. What is missing is capital. There is too little capital to attract research-based firms or to support local growth. The alternative is to develop our own local companies with local VCs. However, in order to grow, firms often have to open a regional office and move key activities there. The main incentive is to gain access to capital.

There have been some positive local impacts of cluster initiatives, but not large success. One notable positive impact was that the Manitoba Government has put some money in VC funds (e.g. Western Life Science and other small VC funds).

The absolute challenge impeding growth of biotechnology clusters is the lack of public funding. Winnipeg does not have yet a critical mass of research despite its assets. CANGENE spends the equivalent of 50% of the University of Manitoba in research funding. What is needed is to have the Manitoba government to put more money in university research. For instance there is not enough local funds to match federal funds, which is a major barrier to leverage federal funding.

Northern Ontario is certainly a good place to have a medical school. However, it may be difficult to set up an industry cluster there unless substantial money is available from local investors. The region should explore niche strategies and collaboration with other communities. Winnipeg tried to align its activities with Minnesota and North Dakota, which have a very high level of funding. Northern Ontario would not gain so much by linking with Winnipeg, because Manitoba has very little available funds.

E. Key Findings and Recommendations

- Winnipeg is home to several federal labs. However, on the corporate side there have been few successes other than CANGENE.

- The University of Manitoba is home to the J.A. Hilde Northern Medical Unit. This research unit works with Northern Manitoba communities to help address their specific needs in terms of health care delivery. Undergraduate medical students that join the Bachelor of Science in Medicine program carry the field research under the supervision of a established researcher.
- When working with Northern communities, it is critical that ethics standards are met in order to keep communities collaborating with the University.
- An important development enabler for the cluster will be Smart Parks and multi-tenant facilities for incubating and hosting spin-off/growing life science firms.
- To be successful, top-notch research has to be a priority. This is accomplished by providing necessary human resource, administrative support, and financial support.
- Both public funding and private funding are a challenge in Manitoba. There is insufficient provincial funding for research, and little to no venture capital in Winnipeg. These are two major impediments to local life science cluster growth.

5. Syracuse, NY: SUNY Upstate Medical College

A. Regional Overview

Population:

Syracuse is a suburban city with a population of about 148,000.

Geographic Region:

In proximity to Toronto and Northeastern US cities which have highly developed life sciences industry.

Overview of Health Cluster:

Central New York Biotechnology Research Center located in Syracuse is a public/private partnership between Upstate Medical University, SUNY ESF, MDA and private sector companies.

Relevance to Northern Ontario:

Syracuse is similar to Northern Ontario in that the upper New York state region often finds itself competing with the clusters in larger cities such as New York City and Boston for resources.

B. Institutional Overview

The SUNY Upstate Medical University College of Medicine was established in 1837. There are currently 642 students enrolled at the school with 451 full-time faculty members on the staff. The school has two campuses, Syracuse being the main one and Binghamton as the clinical branch. Recently, four Upstate physicians were included in the guide America's Top Doctors: The Nation's Leading Medical Specialists.

The Binghamton Clinical Campus was established as a community-oriented program. The program places emphasis on patient care through clinical experiences in primary care and ambulatory settings. Clinical affiliates of the medical college in Binghamton include: United Health Services Hospitals, Our Lady of Lourdes Memorial Hospital and Robert Packer Hospital/Guthrie Clinic.

The Syracuse campus is in proximity to many affiliated health care facilities including Crouse Hospital, the Veteran's Administration Medical Center, Hutchings Psychiatric Center, Community General Hospital and St. Joseph's Hospital Health Center, as well as the medical school's own University Hospital which offers programs unique to Central New York.

The University offers a Medical Student Research Program (MSRP) for students who wish to acquire strong research backgrounds without the formal structure of a degree-granting program. Medical students in this program work with faculty in the basic sciences and clinical research departments, and are expected to write a published paper or prepare an honours thesis. A MD/PHD program is also offered. Courses are separated into Basic Science or Clinical departments where Basic Science consists of Pharmacology, Microbiology and Immunology and etc., and Clinical with sub departments such as Surgery, Neurology, Pathology etc.

Several elective research programs are offered as well, namely:

- Communicative Sciences
- Epidemiological Research
- Research in Family Medicine/ Primary Health Care
- Family Medicine Research Project
- Geriatric Research Project
- Hematology Research
- Research Elective in Infectious Disease
- Pharmacology Research
- Psychiatry Research
- Research in Preventive Medicine (Binghamton only).

Several research centres and facilities are keys to the research initiatives in Syracuse. Such centres and programs are:

- The Bioresearch Imaging Center
- The DNA Core Facility
- The Electron Microscope Core Facility
- The Flow Cytometry Core Facility
- The Genomics Core Facility
- The Proteomics Core Facility
- The SUNY Microarray Core Facility (SUNYMAC)

Health Related Facilities and Programs

Through the Rural Medical Education Program (RMED), students who are interested in primary care or in practicing a specialty in rural areas or small towns can broaden their medical training experience by living and working in a rural community under family physicians. Students learn to develop relationships with clinical preceptors and their communities, as they participate in both ambulatory and hospital settings. Each RMED student also conducts a community health project to gain better understanding of the environment they are working in. This program will enhance the quality of care in rural regions as well as encourage medical students to practice in a rural setting.

C. Biomedical Cluster Support and Infrastructures

The Central New York region has recognized that biotechnology is the most prominent vehicle for its future economic growth. Central New York currently hosts 3,000 jobs in the biotechnology sector.

The region is strong because of its two pillars in research i.e. the SUNY Upstate Medical University and the SUNY College of Environmental Science and Forestry. It also benefits from the support of the Metropolitan Development Association, with which it has endeavored to build a 240,000 sq. ft. Biotechnology Research Center. The center will host: 40 principal investigators, 80 postdoctoral fellows, 90 graduate students, 75 undergraduate students, 5 industrial partners, and 5 incubator partners¹¹.

¹¹ <http://www.upstate.edu/biocenter/facility.php>

The intellectual property policy at SUNY allows inventors to share up to 40% of the gross royalty paid on their invention. The State University of New York in Syracuse currently ranks among the top 20 patent-generating universities in the US. Success in technology transfer at SUNY is driven by the number of invention disclosures, specifically its network with industry to market SUNY technologies, and opportunity creation for investors in SUNY technologies¹².

The Technology Transfer Office at SUNY provides key support to the university inventors by¹³:

- Developing corporate guidelines concerning administration of intellectual property rights
- Managing new technology disclosures
- Responding to inventors' questions and providing advice concerning available options
- Managing compliance with sponsor requirements in grants/contracts concerning inventions and software, and involving reporting of new technologies, intellectual property protection and commercialization.
- Developing marketing programs
- Establishing direct contact between inventor and potential licensees
- Providing relevant technical, business and legal guidance to faculty involved
- Negotiating all license, option, and equity sharing agreements
- Advising faculty on the patenting/licensing implications of public disclosures
- Selecting patent attorneys
- Acting as a point of contact for companies seeking ideas for new products or processes

The Central New York region has a stronger than average biopharma industry for its population. There has been significant growth in small companies. In addition, the region is also home to Bristol-Myers Squibb, which provides jobs to more than 1,000 employees in the region. It was reported that the SUNY Health Sciences Center in Syracuse spent nearly \$8M on biological R&D yearly¹⁴.

D. Perspectives on Facilitating Growth of the Regional Health Sector

Name: Barbara Humphrey

Affiliation: Research Development Coordinator, Upstate SUNY

Upstate SUNY is important to the region as an employer and provider of health care. Also, to a lesser extent, SUNY is a research institution that produces patents and licenses. UNYCoR is a partnership of 8 biomedical research institutions funded by the CEOs of these institutions. Its mission is to establish collaborations among researchers from different institutes and with the industry, to create a research park, and to attract businesses.

Initiatives such as UNYCoR are key tools to create the needed momentum and to promote exchange among stakeholders that will allow the development of a health

¹² http://www.upstate.edu/research/core_tech.shtml

¹³ <http://www.rfsuny.org/tto/services.htm>

¹⁴ <http://www.biotech.sunysb.edu/industDev/>

cluster. Another tool is developing a web-site content-rich and informative to attract people and by the same occasion gaining visibility. UNYCoR is envisioning incorporation to allow the collection of funds for redistribution in collaborative projects, funds coming from the members and also NIH funds will be solicited. Syracuse is the central point for leveraging money from the state. The funds should also be used to foster collaboration with businesses and to promote the spin-off of companies. The region has missed out on significant clinical research opportunities due to its small population, which lacks critical mass. By linking with other institutions and committing to a common database and to one institutional review board for bioethics, it is envisioned that the critical mass of patients will be reached for winning clinical trial grants.

Upstate SUNY was successful in bringing in experts and researchers through the organization of conferences. Furthermore, UNICoR has been a key driver to empower multicenter collaborations. Collaborations are active with Rochester University, those with Canada (Toronto, Kingston, Hamilton) are being explored.

The biggest challenge has been to bring the scientists together. They require incentives, if they are to travel to Syracuse for collaboration. Another challenge was the fact that there is a lot of bad history around collaborations. Institutes used to compete with each other, which led to a lack of trust. Successful partnerships are being promoted to highlight the new vision and culture of cooperation so that people trust each other and realize that collaboration is a win-win situation.

What is critical is that NOSM enter into collaborations with other groups, perhaps in a web-based format or through videoconferencing. It is imperative that they build a network and enlarge their scope through outreach of other institutions. For instance, Upstate SUNY chose not to have a transgenic mice facility because it was not cost effective. However, SUNY does have a collaboration with Rochester that provides this service readily. The strategy should be to build a niche, and to share resources with other institutions creating win-wins.

Name: Guven Yalcintas

Affiliation: Technology Transfer Office Director, SUNY

Technology transfer is about selling: 1) Selling to the researchers – selling the potential of commercializing discovery. 2) Selling to the Administration - make a case for the value of investing in technology transfer. However, not about making the university rich, but rather about bringing recognition for the scientists and their discoveries. 3) Selling to the community. 4) Finally it is about selling the technology.

It is possible to use a model to predict the outcomes of research, which varies between sectors. For a medical faculty, \$2M of research funding amounts to one invention, 10 inventions amounts to 1 patent, 10 patents amounts to 1 license worth anywhere from \$1M to \$100M. But the value of the licence depends on the value of the researchers and technology transfer office.

At the onset, it is important to focus on two to three technologies that have great potential and do everything to make them successful. This speaks to the potential of commercialization and provides credibility and recognition from the researchers and the industry. It all starts with the scientists. If the science is not good you have nothing. Marketing should begin as early as possible, and agreement parameters thought

through early on. It is very important to reward scientists (Upstate SUNY provides 40% of net profit to inventors) and never put a cap on scientists' revenue.

In the 1980s, SUNY licensed a drug that prevents blood clotting. It has become Reopro[®], a drug that is recommended for more than 250,000 cardiac angioplasties a year. This drug generates \$70M per annum, providing \$4M a year for the inventors.

The challenge is to understand the technology and to make it understood by companies. Generally the scientists need to explain the technology, and the specialist is required to handle the regulatory and patent issues and deals.

In a small environment there is often the tendency to give the technology transfer role as a part time appointment to an in-house scientist. This jeopardizes the confidence of the scientists have in the technology transfer officer (they will fear that he/she compete or feather their own nest). It is important that the Technology Transfer Office be connected to network such as the AUTM.

Name: Lori Dietz

Affiliation: Essential NY Initiative Cluster Development

Syracuse has quite a few medical hospital units and teaching hospitals that are involved in research. A local analysis identified cluster opportunities and found a focus on biomedical devices. The biomedical devices cluster is one of the 5 star clusters identified. There is also have a robust cluster in IT but it is not growing more than the national average, so it was not a priority.

The biomedical devices cluster effort was driven by a local company network that has been very successful. Their approach was to find collaborative opportunities and the city then acted as an underwriter for the initiative in applying for grants. The Essential NY Initiative Cluster Development approach was to identify the needs of the industry and university to understand what they want to do and help them to get there. Support and resources were made available for obtaining grants, creating the legal entity, and providing funding and resources at the beginning (at least 5 years of incubation support is needed for these start-ups). The strategy has not been niche-driven per se, and this is by necessity. The assets have been driving the strategy. There is one pharmaceutical company, several medical devices firms, small services firm, and important technological firms that do not normally work in life science. The strategy was rather to identify opportunities to create collaboration and synergies between these companies.

What has been done is the formation of the CNY MedTech (a non-for-profit association that works collaboratively developing technologies). Originally there were five companies that came together to evaluate potential collaboration to develop and expand their respective activities (Bristol-Myers Squibb, ConMed, Intersurgical, Sensis, Welch Allyn). They pulled together a group of 40 companies. The association fosters collaborations among the companies themselves and with academic institutions. This association organizes frequent seminars where firms present what they do. This initiative grew out of the Metropolitan Development Association, but it is the companies that are running CNY Medtech. The 40 companies were already in the region; some are service providers other medical devices firms.

One of the challenges is talent recruitment, Syracuse cannot produce locally all the talent needed. The CNY MedTech Association has combined its recruiting effort and it reaches out and goes out to national meetings and conferences. Another issue is how more quality collaborations can be initiated with the medical institutes. The Medical Institutes have their own organization, UNYCoR, that is state-wide.

Syracuse doesn't face the challenge of distance. It is a small community but its industry is very concentrated. Nevertheless, its firms do not interact much. The challenge is to bring people together and keep them motivated to participate in these initiatives. Because its cluster was a company lead initiative, the companies kept most of the businesses at the table. This model was very successful in keeping companies involved and moving the initiative forward. It was more an industry-driven project than a university-driven project and this may have been a success factor.

E. Key Findings and Recommendations

- Although Syracuse is a small community it is distinguished from Northern Ontario by being relatively close to major centres such as Rochester and Buffalo and has a fairly concentrated population. However, it has to compete with these centres as well as New York City.
- Health care providers are one the biggest employers in Syracuse. However, it lacks the critical mass for winning clinical studies grants. To overcome this problem, it is seeking affiliations with other communities for having a single ethics board and harmonization of data management.
- Upstate SUNY offers a Rural Medical Education Program. It provides support to inventors through its UNYCoR initiative for collaborative research. It was also deemed essential for the cluster growth to build a Biotechnology Research Centre incubator.
- CNY MedTech is an industry-led organization that coordinates major companies associated with the cluster to meet on a regular basis and discuss opportunities for collaborations and synergies in research activities.
- The cluster identified and promoted by the New York Essential Initiative for Cluster Development was for a medical device speciality.
- The strategy employed was not a niche strategy per se, but an asset-driven one, by necessity.
- Significant investment is required to obtain commercial revenues. Notwithstanding this, revenues are unpredictable and take time. The major economic outcomes of this investment are indirect effects on research activities and attracting professionals who will in turn invest in the community.
- The strategy was aimed at finding opportunities for collaboration to develop new and innovative products or services.

6. Honolulu, HI: University of Hawaii

A. Regional Overview

Population:

Hawaii has a resident population of 1.3 million people. Honolulu, the state capital, has 903,000 residents.

Geographic Region:

Hawaii is a string of 137 islands encompassing a land area of 6,423 sq. mi. in the north central Pacific Ocean. The major islands are NIA, Kauai, Oahu, Molokai, Lanai, Kahoolawe, Maui, and Hawaii. Honolulu, the capital of Hawaii, is located on the island of Oahu. Its mid-pacific location makes Hawaii an ideal bridge to serve lucrative markets on both sides of the Pacific Ocean.

Overview of Health Cluster:

A new medical school campus in Kaka'ako is generating cluster growth. Renowned medical institutions such as Mayo Clinic, John Hopkins and M.D. Anderson are in partnership with healthcare providers in Hawaii. The Biomedical Research Infrastructure Network (HS-BRIN) has also been established to include resources from smaller academic institutions and biomedical research organizations to increase Hawaii's competitive research abilities in biomedical research.

Relevance to Northern Ontario:

Honolulu's healthcare assets serve the needs of the greater Hawaii community, which includes many rural, sparsely populated regions. Hawaii is also one of the first states to adopt telemedicine, which is also commonly used in Northern Ontario. A variety of remote health-care demonstrations have used NASA's Advanced Communications Technology satellite applications so that health-care institutions on the islands can link to major mainland facilities to support the delivery of medical services to locations around the state and the world.

B. Institutional Overview

Background

The university was established in 1907 as the College of Agriculture and Mechanical Arts In Honolulu and was later renamed the College of Hawaii in 1912. The University of Hawaii System consists of 10 campuses and numerous training and research centers throughout the islands. Currently, there are over 50,000 students enrolled at the University of Hawaii.

The John A. Burns School of Medicine (JABSOM) in Manoa was established in 1967, and is the most culturally diversified medical school in the United States. The medical school's basic mission is to teach and train high-quality physicians, biomedical scientists, and allied health workers for Hawaii and the Pacific region.

Health Related Facilities and Programs

The Manoa campus of the university has the strongest focus in research compared to the other 9 campuses. Numerous projects are funded by the NIH, NSF, USDA, SBIR and the Medical Research Council in the UK.

Its health related research institutes include:

- The Clinical Research Center, which is a joint program with JABSOM to include a clinical research program as well as facilities for participating clinical researchers
- The Hawaii/Pacific Basin Area Health Education Center which provides training for health professionals in rural and underserved areas
- The Hawaii State Biomedical Research Infrastructure Network, a network of small academic institutions and biomedical research organizations that seek to increase Hawaii's biomedical research abilities
- The Pacific Center for Emerging Infectious Diseases Research which provides training in infectious diseases and for the diagnosis and control of new, emerging and re-emerging microbial threats
- The Native Hawaiian Center of Excellence which focuses on improving the health of indigenous Hawaiians through research, education, service and training of Native Hawaiians in medicine

The JABSOM is in the process of building a new \$150 million campus in Kaka'ako due for completion in August 2005 with the goal of becoming a top-ranked research-intensive medical school and to attract world-class research scientists to JABSOM's faculty. The new campus will also include a biotech incubator to provide a research environment for biotechnology and bioscience companies.

Importantly, the research programs are tailored to the geography and population of Hawaii to include:

- The Department of Tropical Medicine, which focuses on infectious diseases of the Pacific Basin and Pacific Rim such as malaria vaccine development and responses to malaria infections
- Other research projects also include studies in autoimmune diseases, hepatitis problems specific to the Asian population and Pacific Islanders
- A Hyperbaric Medicine program, which provides training in emergency care for dysbaric disorders due to the popularity of scuba diving in Hawaii. Their studies have now expanded to include studies of high-altitude disorders, with implications for aerospace research

To increase the number of Native Hawaiians conducting research and to help facilitate and support research and education regarding Native Hawaiian health issues, the Native Hawaiian Center of Excellence (NHCOE) developed a year long course, which is part of JABSOM's Community Health Program. The course is intended to introduce students to basic research methodology and design, current Native Hawaiian health issues, and *lapa'au* (traditional Native Hawaiian healing practices). In addition to coursework, students work with a research mentor to gain research experience as well as complete a research project pertaining to Native Hawaiian health.

As part of NHCOE's goals to improve Native health issues, and to further support research on Native Hawaiian health, the NHCOE has developed the Native Hawaiian

Health Database (NHHD), which is a comprehensive bibliographic resource covering all aspects of Native Hawaiian health.

In addition to NHCOE, the Hawaii/Pacific Basin Area Health Education Center (AHEC) is another facility with programs focusing on improving the health care of the rural and local communities. NHCOE recruits health care professionals to rural and underserved areas in Hawaii, and at the same time provide them with continuing education to better serve the community. They also provide community-based education in areas such as telemedicine and telehealth utilization.

C. Biomedical Cluster Support and Infrastructures

The University of Hawaii is supportive of commercial ventures. It encourages its researchers to translate their discoveries by providing them with up to 50% of royalties from the commercialization of their inventions¹⁵. The University also has an Office of Technology Transfer and Economic Development¹⁶. The role of this office is to:

- Exploit University-owned intellectual properties in alignment with the needs of the university, the faculty, and industrial partners
- Foster relationships with industrial partners and broaden opportunities for faculty to engage in collaborative agreements
- Provide up-to-date counsel concerning intellectual property policies
- Effectively stimulate faculty participation in the technology transfer process.
- Market and license technologies developed at the University of Hawaii

The outstanding capabilities of laboratory facilities located throughout the islands and the unique collections of natural products allow leading-edge research to be conducted and translated into commercial applications. The University has accumulated 19 patented technologies in biology and medicine, many of which focus on tropical diseases and natural products¹⁷.

Also the region hosts several biotechnology and health-research focused private organizations. Some of the key organizations are:

The Pacific Health Research Institute (PHRI): This is an independent, non-profit research institute. PHRI promotes collaborative and multi-institutional health research designed to enhance the well being of individuals in Hawaii and around the world. Its research themes cover diabetes, cancer, Parkinson's disease, cardiovascular disease, dementia, aging, genetics, and primary care. Its research activities include epidemiological studies, clinical trials, and health services research. PHRI has a budget of about \$10M, primarily from federal funding.

Hawaii Biotech, Inc.: This private biopharmaceutical company is engaged in research and development of pharmaceuticals in anti-inflammatory drugs and vaccines. It currently has three drug-leads in its pipeline:

¹⁵ <http://www.mic.hawaii.edu/faculty/borpolicy.html>

¹⁶ <http://www.mic.hawaii.edu/who.html>

¹⁷ http://www.mic.hawaii.edu/dev_tech/bio_sci.html

- A small molecule that modulates the NF- κ B inflammatory pathway in diseases. This drug-lead down-regulates the production of inflammatory mediators and cytokines without the side effects of steroids, NSAIDS, or approved COX2 inhibitors. Applications targeted are cardioprotection and inflammatory liver damage in hepatitis C patients.
- A West Nile vaccine targeting the U.S. and Canada
- A dengue fever vaccine for travellers

Cyanotech: This firm develops and commercializes nutraceuticals and diagnostics from microalgae. Also, it produces the natural supplement Spirulina.

Science & Technology International: This engineering company has a division in medical systems, which develops advanced optical diagnostic imaging technology for cancer detection.

D. Perspectives on Facilitating Growth of the Regional Health Sector

Name: Dr. Shomaker

Affiliation: Dean of JABSOM

The life science cluster is key to Hawaii's academic and economic environment. In its first 30 years, the university focused its efforts on work force development; in the second 30 years it will be about economic development through partnership with private companies.

The university's role is several-fold: 1) It has completed the construction of a new 200,000 sq ft infrastructure facility. This infrastructure was critical to recruit world class faculty in those disciplines defined as strategic targets for the facility. JABSOM focused on a number of areas which it believed it could build a critical mass that could be internationally competitive. These include: a) tropical medicine and emerging infectious diseases, b) neuroscience, c) reproductive and developmental biology, d) health disparities (Hawaii has an extraordinary ethnic diversity such as Asians of many background, Pacific Islanders, Caucasians, African Americans, and Hispanics. 2) It has set forth administrative policies and statements that provided entrepreneurial incentives (verbal and financial incentives). 3) It has played a role in the state and local government actions towards instituting tax credits and incentives to re-locate near the school. 4) It has worked with the workforce development team in collaboration with governments to support appropriate training of the right mix of professionals.

Although it is still early on, there has been some success at hiring faculty that have experience in starting biotechnology companies. People come to Hawaii because there is the beginning of success in certain strategic areas. As a result, the push to develop successful niche areas is now starting to pay off. This in turn has generated interest from new recruits, including those who had previously left for lack of opportunity.

Providing world class facilities and very competitive salaries is critical to recruiting high profile people. The university is successfully working with private land owners to develop research spaces, and the state has passed a bill for generous tax credits for innovative firms and for venture capitals to invest in them. There has been a lot of public interest associated with the new building. One extraordinary thing has been the growth of these new research programs from \$3M in 1999 to \$25M today. Our faculty are much more

research-oriented and productive. This has been initiated by the Dean's Office to articulate the vision and put in place basic infrastructure for research activities i.e. statements that communicate the vision, grants management offices to support with grant writing and identifying granting opportunities. People pay attention when they see that these statements align with tangible funding support that catalyzes the growth of research activities.

The cluster is still nascent. At this point the challenges are to sustain growth and to have a successful start-up. Sustaining research growth in the faculty and research programs is becoming more challenging due to NIH funding leveling off; it will be hard to sustain the trajectory. This is further complicated by the fact that there are no new state funds. New sources of funding must be explored, such as other sources of federal funds (defense department), potential partnerships with private companies, major foundations, private philanthropy, etc. Having a successful start-up would be key to providing support for further development. It is important to show and convince multiple stakeholders that it is possible to have commercial success. Another challenge is to accommodate research activities and commercial ventures while the facilities are being built.

An important issue has been to be very rigorous and strategic in deciding which research area on which to focus. Such choices must be based on current faculty, and the desire and potential to become internationally competitive in the field. One has to build its program around star scientists, and hire-in activities that complement what they are doing. Also the geographic location is important, and research focuses have to make sense. Hiring high profile recruits in the selected areas is critical to actualize the cluster. Once you have a reputation then the cascade effect works to sustain growth.

Name: Lisa Gibson

Affiliation: Hawaii Commercialization Office

The health sector is very important for Hawaii. Hawaii has a lot of ag-biotech converging with pharmaceutical and oceanic research. Hawaii currently depends on tourism and the military industry. It needs to develop new sectors, especially in the knowledge-economy to improve quality of life. The cost of living is so high that people from the service industry need 2 to 3 jobs to make a living.

One of the most important issues in building a life science cluster is to bring people together. It is all about creating the right committees, bringing leadership, and motivating people. It is more a cultural exercise than an economic one. Staffing was challenging. It is important to make a case that there will be benefits for companies and the general community as well. A simple and clear agenda is key to success.

Hawaii had a lot of strengths to start with in the community and a lot of passionate people. It has been successful at getting things going because it had a critical mass of people willing to work for success. It was very important to have leaders in the private sector and the proper support from government. However, there have been only a few star spin-offs to date. The focus has been on projects that have the most potential, keeping in mind immediate, near-term, and late term returns. Infrastructure needs to be in place to seize opportunities when they arise.

It is fundamental to identify where the key strengths are, have strong leadership, and passionate participants. The region needs to build and promote collaboration and create an environment for initiatives to grow.

Name: Robert Oda

Affiliation: Hawaii, Developer

The health sector is the ultimate path to long term sustainable economic growth in Hawaii. It will have a critical impact on the state economy.

Land has been committed for health-based organizations as part of a strategic decision. Developers have provided both leadership and funding for developing the project. The health sector development was promoted because it was a good strategic business decision and because it was the right thing to do (good corporate citizenship).

One key success factor was the formation of a committee for building a strategy on the life science cluster project. Through the health community counsel the community was bought in on discussions for fostering a life-science cluster. People got interested in the prospect and the potential of the sector.

The main hurdle was to communicate to people the definition of “life science”, its potential for economic development, and to get people to believe it was possible. A second hurdle was to get people motivated to act. Providing the financial resources, taking ownership, and leading the project were also critical to get people moving.

What is fundamental is to get the community to buy-in to the vision. The only way is to showcase studies that demonstrate it is possible and achievable. The community needs to be convinced that it will have a low social impact and high return. Developing an industry that supports a segment of the working population and that provides higher incomes promotes other residual benefits to peripheral industries.

The remoteness of Hawaii is an obstacle because small communities are generally more inclined to maintain the status quo (psychological barrier). But at the same time, a small community is easier to mobilize. It is very important to present the project from the right angle to the community.

As for attracting companies, there is a challenge in terms of recruiting staff and professionals. Hawaii has distinct advantage because of its unique demography; but it has a geographical challenge of attracting people and industries. The initiative needs to answer community’s needs, particularly what it can do for them. It has to support community concerns and provide tangible outcomes. It is not enough to attract tax revenues.

E. Key Findings and Recommendations

- Hawaii is home to a large but remote heterogeneous community. It offers programs to improve indigenous health care and is also exploring the study of indigenous medicine. Hawaii has been one of the first regions to adopt telemedicine.
- The School of Medicine has a 30 year history, and is now focusing its energies on developing a health care/life sciences cluster.

- The cluster has elected to focus research on local assets (geographic and current star scientists). The objective is to invest in research activities that have the potential to become internationally competitive. Selected areas of research include: 1) Tropical Medicine, 2) Neuroscience, 3) Reproductive and Developmental Biology, and 4) Health disparities.
- The construction of incubators for start up firms has been identified as a key factor for a health industry cluster.
- Leadership of the Dean's Office has been key to driving growth of research activities and the life sciences cluster. The combination of vision statements from the Office and infrastructure and financial commitment has catalyzed the cluster growth.
- The main challenges are to bring people together and communicating effectively with the stakeholders. Another challenge was recruiting a skilled work force.
- Key success factors include strategically selecting research niches, hiring the right people, and community buy-in.