Canada Foundation for Innovation

Description of Infrastructure Project and Assessment Against CFI Criteria

Date: 30/08/2001 Project number 4805

Descriptive title of infrastructure project (no more than 200 characters):

Centre for Global eHealth Innovation

Funding program applied to:

Innovation Fund

Language of application:

☒ English ☐ French

Institution/lead institution (See next page for multi-institution applications)

University Health Network

Total cost of infrastructure project and amount requested from the CFI

Note that for each year the CFI request should not exceed 40% of the cumulative cost to that year.

Costs	Year 1	Year 2	Year 3	Year 4	4-year TOTAL
Total project	1 242 907	3 891 099	466 667		5 600 673
Partner contributions	745 744	2 334 659	280 000		3 360 403
CFI request	497 163	1 556 440	186 667		2 240 270

Designated Project Leader

Name: Jadad, Alejandro Title: Professor

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Key words: Provide a maximum of ten (10) words that describe the infrastructure project. Use commas to separate each key word.

eHealth, Internet, Technology, Knowledge-management, Usability, Simulation, Experiments, Society, Globalization, Evidence-based Decision-making

Research discipline/field code:

Primary: 42300

Secondary: 11800

Area of application code:

Primary: 4.9

Secondary: 8.7

Signature: It is agreed that the general conditions governing the matching provisions and the use of CFI funds as outlined in the Institutional Agreement and the CFI Policy and Program Guide apply to the infrastructure project outlined in this application and are hereby accepted by the institution.

Name _____ Signature _____ Date _____

CEO or President of the Institution (or authorized representative)

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Description of the infrastructure: Briefly describe the **infrastructure** that will be acquired or developed and indicate where the infrastructure will be located. Use language appropriate for a multidisciplinary committee.
Use this page and up to one additional page.

Our intention is to create the 'Centre for Global eHealth Innovation' (the Centre). By 'eHealth Innovation', we mean the conceptualization, design, development, application and evaluation of new ways of using existing or emerging Information and Communication Technologies (ICTs) in the health sector. This concept goes beyond pure technological considerations, including an analysis of the effects of ICTs on access to information, services, the culture of health and healthcare, society in general, and technologies themselves.

The development of the Centre represents a major research priority for the University Health Network (UHN), as reflected by its strategic plan and the commitment to completing and making available 15,024 sq. ft. of contiguous space in a prime location, on the fourth floor of the new Toronto General Hospital's 'R. Fraser Elliott Building'. By centralizing and equipping the key facilities to support eHealth Innovation research activities, the Centre will create an integrated set of resources that will optimize research potential and efficiency, promoting collaborative links amongst the researchers associated with the UHN and the University of Toronto (U of T), as well as amongst innovators across provincial, national and international boundaries.

The Centre will include three main components, easily upgradable over time.
(a) The 'eHealth Innovation Collaboratory' ('collaboration - laboratory'): This will be an area of 8,252 sq. ft. designed as dry laboratory space and including three sub-components:
(a.1) A network of 60 fully equipped workstations serving a team of 10 senior scientists, 5 senior research associates, and 45 research and technical staff, post-doctoral fellows and graduate students. The research team will work on three major thematic areas: society, health knowledge management, and technology.
(a.2) Collaborative research spaces include multimedia resource / archive rooms and interaction / meeting spaces (e.g., for group-to-group interaction tools)
(a.3) 16 dual processor Graphic Workstations with server capabilities.

(b) The 'Health Usability Laboratory': The first facility of its kind in Canada. This lab will include a total area of 952 sq. ft. dedicated to supporting pre-testing and refinement of computer interfaces and applications, implementing research projects on human-machine interaction, and developing new methods to study eHealth innovations. This laboratory will comprise the following research structures:
(b.1) A Testing Room of 464 sq. ft. within which research subjects will interact with eHealth innovations on an individual basis. The room will contain high-resolution video cameras and microphones to capture data on task analysis, user-technology interaction (e.g., eyeball tracking), relevance and preference (e.g., speak-aloud navigation).
(b.2) An Observation Room of 281 sq. ft. will include 3 workstations to support researchers' activities. This room will be connected to the testing room physically and electronically. A removable one-way mirror will allow researchers to observe human-technology interactions. Using the workstations and cameras, researchers will be able to monitor and analyze data captured in the testing room and to modify in 'real time' the

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eHealth innovations being tested.
(b.3) A Research Collaborators' Observation Room of 207 sq. ft. This structure will allow simultaneous observation of both research subjects in the Testing Room and researchers in the Observation Room. It will enable research on usability testing - a field on which there is limited knowledge in health - and allow for training of researchers in the use of this type of facilities.

(C) A 'Health Multi-tasking Simulation Environment': Two important barriers exist that hinder the development of research on eHealth innovation. First, innovators have limited access to the environments where health-related decisions and information exchange happen. Second, innovations cannot usually be tested in the real world without serious disruptions of daily activities. This multi-tasking environment will be the first simulation laboratory in the world exclusively dedicated to health. It will be used to assess group use of eHealth innovations, in controlled conditions, in an area that simulates real-world health settings. By manipulating the context where eHealth innovations can be used and allowing for group interactions to be observed, innovators will have the ability to develop and evaluate such innovations thoroughly and efficiently. Following testing and refinement of eHealth innovations in this environment, innovators can take newly developed technologies to the real world with maximum likelihood of uptake and minimum disruption. The simulation environment will cover a total area of 5,820 sq. ft. and will include the following structures:
(c.1) A Testing Room of 4,240 sq. ft. with a central area that can be transformed, through the use of movie set techniques, into health related environments such as, among others: a hospital waiting room, a consulting room, a nursing station, an intensive care unit, an emergency room, an operating room, a classroom or a home environment. Equipped with data capture and transmission equipment, the central area will have the capacity to simulate more than one setting at a time, either to conduct simultaneous, independent experiments or to analyze complex interactions between two related environments. The maximum number of research subjects involved in the simulations would be 40. Around the central area there will be a corridor to let technical staff and researchers move and work without disrupting the ongoing experiment and 220 sq. ft. of user-interaction space.
(c.2) Two Research Observation Rooms with a total of 509 sq. ft. to accommodate up to 12 researchers. The room configuration will be flexible to adapt to the needs of the specific simulation under way. For example, experiments on the use of eHealth innovations across settings will host groups of participants, such as physicians at a hospital and patients at home, contributing to a telehealth project, with observation from separate rooms to minimize the potential for contamination and bias. The equipment for the Observation Rooms will be similar to that described for those in the Usability Lab.
(c.3) A Research Collaborators' Observation Room of 292 sq. ft. with functions similar to those described for the Usability Laboratory.
(c.4) A Modular Environments Repository of 559 sq. ft. will be used to store the used to recreate the simulation environments in the testing room.

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Self-assessment

A1 - The Research
Choose the statement that best represents the research

The proposed infrastructure will be used for research that has the potential to:

☐ (a) produce a modest but useful advance;
☐ (b) meet national standards, or be the best in an underdeveloped field, AND contains some innovative aspects;
☐ (c) meet international standards AND be innovative;
☒ (d) be exceptional by international standards, have a major impact, AND be highly innovative.

Provide information to explain and justify the choice of statement, using the space below and up to 5 additional pages.
Outline the major research programs to be enabled by the infrastructure.
Situate the research in the larger international context and highlight the innovative aspects of the research.
Describe the anticipated impact on the research programs of the major users (those with CVs attached).

Imagine a world in which people, regardless of who they are or where they live, use state-of-the-art information and communications technologies (ICTs) with enthusiasm, proficiency and confidence, to achieve the highest possible levels of health and to help health systems make the most efficient use of available resources. This has been an elusive goal for Canada and the rest of the world, for a number of reasons.

Ironically, many of the barriers preventing us from achieving this goal stem from the accelerating pace with which technology and knowledge are developing. This has generated what Thomas Barlow has described as "technological angst, an ambivalence to change, and an escalating feeling that advances in science have begun to outpace human ability for making judgments about their application" (Financial Times Weekend, page II, London, May 12 - 13, 2001). In addition, innovations are usually developed in a business environment, driven by the need to rapidly enter the marketplace and not by health sector priorities. As a result, such innovations are often introduced into the health system with incomplete evaluation, in conditions that do not meet the needs of their intended users. For testing, innovations are brought to busy clinical settings - often through disjointed, slow and awkward efforts, disrupting routine activities, producing scant evidence of their usefulness and potential risks, and creating frustration among patients, providers and administrators. This, in turn, leads to further delays in the introduction of technology into the health system. Finally, the current health system was designed for the pre-Internet era, without the flexibility or incentives to adapt to rapidly changing conditions.

Solutions for the creation of an accessible, effective, efficient, and equitable health system in the 'Information Age' will only emerge through the close and dynamic collaboration of innovators from a variety of disciplines, including information technology, the social sciences, and health knowledge management; through creative partnership among the government, academic institutions and the industry, with meaningful public participation; and through political will. One of the most important factors for this endeavour to succeed is the creation of a strong research infrastructure.

Canada is uniquely positioned to accept and meet the challenges. The infrastructure proposed will be a perfect example of a strategic investment for shared benefits based on

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the principles of economies of scale. The paramount goal of the Centre for Global eHealth Innovation (referred to as the Centre hereafter) is to provide scientists with access to unique physical and virtual research facilities and testing environments with the flexibility for accelerating the conceptualization, design, development and evaluation of new ways to use existing and emerging ICTs related to health. The Centre will build on the diversity of Canada (the country is home to people from over 150 countries) and complement its strong service infrastructure, to help create a 'mini-model of the world' to study eHealth innovations in ways that are not possible anywhere else in the world.

Although the infrastructure will be generic and will support a wide-ranging scope of innovation, many of the projects in the first 3 years will focus on cancer, to ensure a coherent program of research that can lead to substantial results within a reasonable timeframe. Cancer provides ideal conditions to develop and test eHealth Innovations. It is one of the leading causes of death for Canadians of all ages; is a disease associated with high morbidity, stress and costs; there is a strong clinical infrastructure in Canada devoted to its management; it has a spectrum of concerns that span from prevention through treatment to palliative care and bereavement; it concerns a large segment of the population; and is experiencing a disorderly explosion of information on the Internet. Work on cancer will not only maximize the impact of the research on society from the outset, but it will help speed up the integration and cooperative capacity of groups working in different regions of the country. The Centre will also be available to researchers from other areas with great societal impact such as arthritis/musculo-skeletal conditions and rehabilitation, cardiovascular disorders and neurosciences. The projects in these areas will be increased in number and complexity gradually. The possibilities of the Centre for research and innovation are so numerous, and the pace of development of technology and knowledge is so fast, that we anticipate that there will be many uses for the infrastructure that we cannot now imagine.

Three key research themes have been identified to provide the framework for organizing projects and setting priorities for investigation. The themes have been structured in a way that will promote transdisciplinary research across groups. These themes, and their leaders, are as follows:

== Theme 1: Society (Leaders: Coyte, De Kerckhove, Streiner). This will examine the human, organizational and social elements related to the introduction of eHealth innovations for the improvement of the health system and the health of the population.

== Theme 2: Health Knowledge Management (Leaders: Goel, Jadad, Reznick, Straus). This will contribute to the exploration of innovative ways to synthesize, 'package', integrate and deliver different types of information (e.g., clinical, anecdotal, heuristic), to different groups of decision-makers operating in different settings.

== Theme 3: Technology (Leaders: Gallie, Mann, Vicente). This will contribute to the evaluation of the impact of existing and emerging ICTs to help decision-makers access information and communicate efficiently, and to enhance the interconnectivity of different components of the health system in different settings.

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The Centre will support programs of research that will benefit from its infrastructure and that will incorporate elements of the 3 themes. The first generation of programs will be as follows.

++ Virtual knowledge management centres. This program will lead to the creation of virtual tools, spaces and resources to help decision-makers access, understand and use high quality information to guide health-related decisions.

One of the first projects within this program will be the design and evaluation of a 'Virtual Pain Control Centre' (Jadad, Reznick, Vicente). Pain relief will be used as the initial model, because it is the most prevalent and distressing symptom in patients with most types of cancer and other pathologies, it involves physical and emotional components, it remains inadequately managed despite the availability of effective treatments, and because its adequate treatment is hindered by significant communication problems and myths.

The Virtual Pain Control Centre will be the first of its kind in the world. It will include virtual agents and virtual knowledge resources. These components will be conceptualized, designed, tested and refined making use of the Collaboratory, the Usability Laboratory and the Multi-tasking Simulation Environment. In the Collaboratory, a multidisciplinary group of researchers, with input from pain specialists, patients and significant others, will develop the computer-generated agents that will 'manage' a set of high-quality Internet-based resources on the management of cancer pain. These agents and resources will be pre-tested through multiple iterations in the Usability Laboratory, where researchers will obtain input from potential users of different demographic, socio-economic, ethnic, linguistic and educational backgrounds. Special emphasis will be placed on meeting the needs of people with low literacy or socio-economic levels, recent immigrants with non-dominant cultural backgrounds, and members of indigenous communities. Research participants will help evaluate different formats, media, interfaces and devices for each of the components of the virtual centre. These components will be subsequently tested in the Multi-tasking Simulation Environment. For example, in a simulated living room, patients and their family members will use the virtual centre to prepare for the encounter with physicians and nurses, will learn about different treatment modalities and will prepare a set of questions to discuss during the clinical consultation. In a simulated consulting room, physicians and nurses will receive information from patients and respond to them, evaluating the impact of the interactions on the clinical encounter. After this, the refined virtual centre will be further evaluated in real-world clinical settings at Princess Margaret Hospital.

++ Wearable computing (Mann, Jadad, Straus): The wearable computer was invented in Canada, 20 years ago, by one of the lead investigators in this proposal (Mann). This field is undergoing major transformation thanks to the progressive miniaturization of computers. This program will support projects in which members of the public (healthy and ill) and health professionals will use wearable computers to create a 'community of online cyborgs'. The Usability Laboratory will be used to refine existing tools and interfaces, adapt them for use in the health system, and to help the project participants to become familiar with the equipment for their use as part of research efforts. Subsequently, research will be conducted in the Simulation Environment by allowing the group of participants to wear the computers and interact with others in different settings. The ultimate goals of this program are to create 'ecologically' valid experiments in real,

actual settings with participation of people from any background, and to study the implications for the patient-provider relationship of the availability of uninterrupted communication between the public and the health system.

++ Hand-held computing (Straus, Reznick, Mann): This program will look at the role of hand-held computers to provide easy, consistent and inexpensive access to health resources (people, information and services), in real-time, irrespective of the physical location of the user. The program will support projects that share a common goal: studying the role of hand-held devices to create an effective, real-time, bi-directional connection between 'knowledge' and 'practice'. In one of the projects, the Usability Laboratory and the Simulation Environment will be used to test and refine the interfaces, databases and network infrastructures required to make clinically relevant and valid research evidence available, immediately, at the point of care. In another project, the infrastructure will be used to explore the opposite direction, looking at ways of capturing clinical information at the point of care, and integrating it into the existing pool of knowledge, to support future decisions.

++ Telehealth (Coyte, Goel, Jadad): This program will facilitate the transition from the current institutional- physician-centric approach to telehealth, into a new model that involves home-based applications, relies more on the Internet and gives members of the public more control over the decisions related to their health. One project will use the simulation environment and the living laboratories at UHN hospitals and homes, to study different configurations of clinical settings and home-based knowledge centres and the impact of e-mail and Web-based communication between health professionals and patients, using supportive cancer care and palliative medicine as the model. Another project will utilize the simulation environment to develop and evaluate measures for assessing the impact of telehealth. Presently, there are very few rigourously validated tools for this purpose, resulting in limited research in this field. Within the simulation environment it will be possible to study health interactions with and without the use of communications technology. For example, telehealth is increasingly used in dermatology for diagnosis of difficult cases. In the simulation environment, two rooms will be set up for an experiment. In one space, a typical dermatology consultation room will be set up and the clinician will be presented with potential melanoma cases. In the other space, the consultation will be done over a simulated telemedicine connection. In this controlled scenario, we will develop and refine outcomes to assess the quality of the clinical encounter, physical and through virtual means, and the impact of ICTs on the patient-provider relationship. Another example of the many uses of the simulation environment to study other innovative applications of telehealth technology will be through a project with Cancer Care Ontario, in which the Centre's infrastructure will be used to support a virtual surgical oncology tumour board to study how ICTs could bring the expertise of academic specialists in tertiary centres to community based practitioners. Projects like this will make considerable contributions to our understanding of how group-to-group collaboration can be implemented successfully in the health system.

++ Integration of clinical information systems (Gallie, Goel, Mann, Streiner): This program will focus on the integration in the electronic health record of new biomedical devices, decision-support tools, evidence-based resources and systems, data generated by

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new bio-optics tools and wireless devices, and data collected in bio-informatics databases. The first projects will lead to the design of new interfaces and Semantic Web-based applications to facilitate the use of electronic health records by different groups of decision-makers at tertiary level institutions. A key simulation will be that of a population based health information system. A major challenge to developing new tools for health information management is that they must be tested in real world environments. In particular, it is currently impossible to examine issues of interoperability between systems within the health system. Within the Collaboratory, a population of 1 million people will be simulated. A complete medical record for each individual will be developed and stored in the formats of the leading medical records software vendors. This data set, the first of its kind in the world, will enable research on the exchange of data between different standards and across institutional boundaries. More importantly, it will be possible to examine the interaction between new tools, such as evidence-based guideline reminders that are triggered by laboratory results, and these different systems. In the Usability lab, interfaces for accessing these systems will be evaluated with different types of health providers. In the Simulation Environment, typical settings for accessing such systems will be set up, such as offices, nursing stations and homes, and the interaction between groups of providers and these systems will be studied.

++ Innovation in eLearning (Reznick, Goel, Jadad, Straus, Vicente): The rapid development of knowledge and ICTs are putting increasing pressure on educators, academic institutions and professional organizations to develop and implement effective and efficient educational strategies. For more than a decade, it has been clear that most traditional programs and tools do not meet basic educational principles [http://jama.ama-assn.org/issues/v282n9/abs/jrv90027.html]. With the advent of the Internet and the increase in power of ICTs, there is increasing optimism about the ability of technology to lead to effective learning with efficient use of the limited resources available to education and training activities [http://www.aahe.org/technology/ehrmann.htm]. To date, however, most efforts to use technology to promote learning (eLearning) have failed to meet this promise
[http://tamino.catchword.com/vl=55822587/cl=8/nw=1/rpsv/catchword/tandf/0142159x/v23n2/s1/p117].
This program will support research projects on eLearning strategies to help learners achieve high levels of competence, optimal performance and decisions that lead to improvement in health outcomes. For instance, the Usability Laboratory will be used to help developers of clinical practice guidelines on the prevention and treatment of cancer to assess whether their eLearning tools are flexible enough to meet the range of preferences and learning styles of family physicians, residents and undergraduate medical students. In the Simulation Environment, researchers will simulate different settings (consulting room, classroom) to evaluate the ability of the applications to promote contact between learners and tutors, reciprocity and cooperation among learners, active learning techniques, sufficient time on task, effective delivery of feedback, and meeting high expectations. In particular, the Simulation Environment will be used to assess the effectiveness of learning in on-line forums versus small group sessions.
The program will also support research on computer-intense virtual reality applications, to help learners (e.g., surgeons) acquire the complex skills needed for surgical care of patients with cancer.

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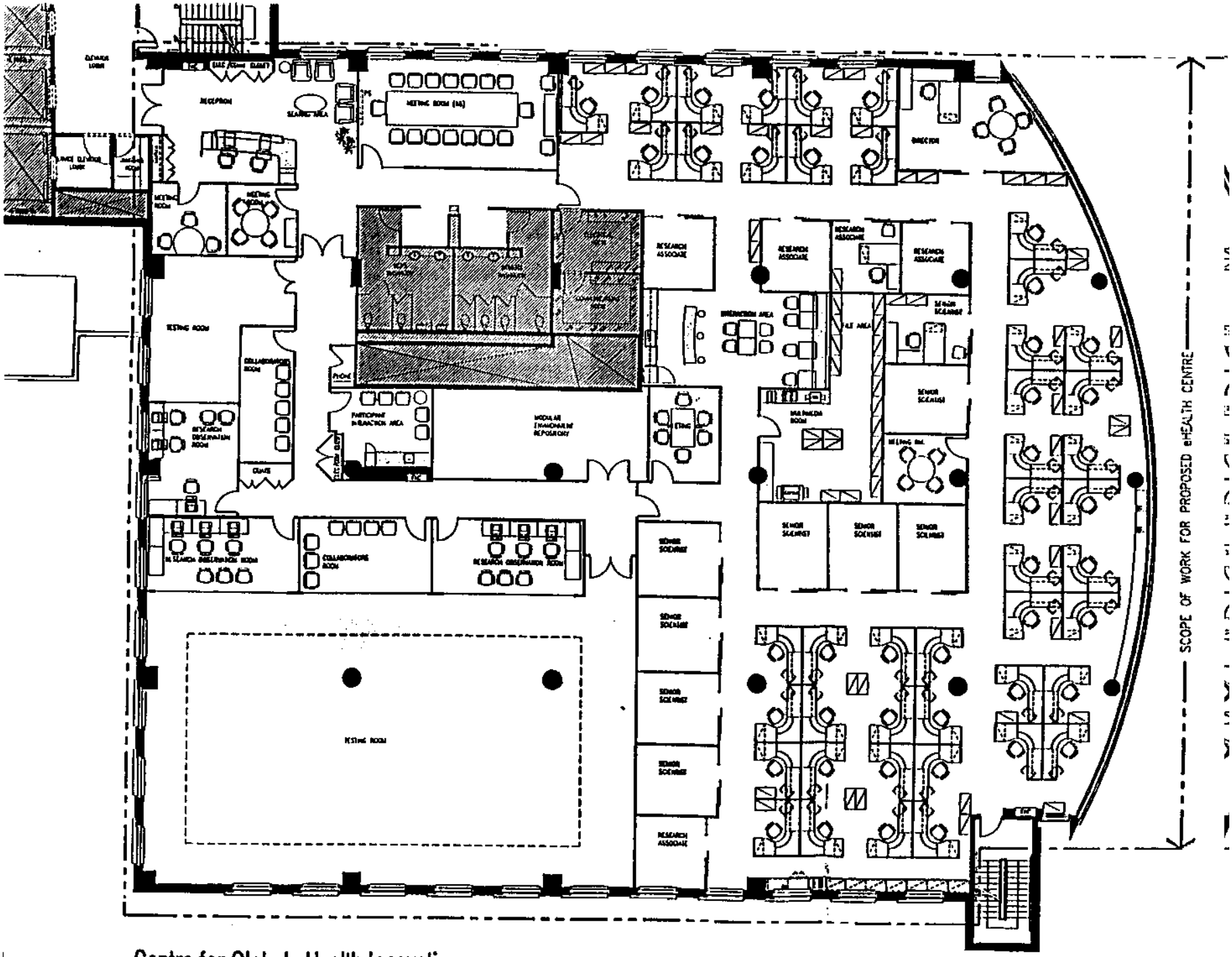
++ International and cross-cultural aspects of eHealth innovation (De Kerckhove, Gallie, Jadad): This program will seek to expand the Network beyond Canada, through the development of international collaborative efforts between innovators in Canada and colleagues in other countries who are facing a similar constellation of challenges. One of the main thrusts of this program will be the evaluation of the extent to which research done in Canada could be extrapolated to other countries, and the development of innovative tools to promote international collaborative research projects. By using the diverse multi-cultural population of Toronto as a 'mini-model' of the world, innovators supported by the Centre will explore the extent to which the results of research on eHealth innovations involving immigrant communities in Canada compare across other communities (e.g., comparison of the results of an experiment on the Virtual Pain Control Centre involving Chinese and Western European participants) or can be extrapolated to their countries of origin.

++ Meta-research on methods for the evaluation of eHealth innovations (Gallie, Jadad, Streiner, Vicente): This program will lead to improvement of existing methods or the creation of new methods to handle and understand the complex and dynamic nature of the interactions among humans, communications technology, multimedia and knowledge. Emphasis will be placed on methods to evaluate the impact of information technology on health-related outcomes in 'real enough time'.

Once the infrastructure is developed, the Centre will catalyze the formation of a Global eHealth Innovation Network. The Network will be composed of scientists from Canada and around the world, who will be using the infrastructure of the Centre and the products of the research fuelled by the Centre to invent new hardware, software, processes of care, and methodologies that will be rapidly introduced into the health system through currently networked areas, which will act as living laboratories. The research supported by the Centre and the Network will accelerate the transformation of the health system to be more effective, accessible and efficient. The unique contribution of the rigorous, systematic and trans-disciplinary approach proposed will ensure that we avoid self-deception and a recurrence of the 'irrational exuberance' witnessed in the last decade.



Centre for Global eHealth Innovation May 22, 2001

RESEARCH FACILITIES