ANALYSIS

Expanding undergraduate medical education in British Columbia: a distributed campus model

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In British Columbia, as in the rest of Canada and in many other parts of the world, there is a shortage of physicians in rural areas. More than 9 million people, 30.4% of Canada's population, live in predominantly rural regions.[1] Towns and villages with populations under 10 000 account for 20.6% of Canada's population,[2] yet are served by a mere 9.3% of our country's physicians.[3] In BC this is especially true in the northern parts of the province and in remote areas of Vancouver Island.[4] For example, about half of the physicians practising in northern BC were recruited from overseas.[5] The average number of family physicians per 10 000 residents in BC is 10.6; in the mainland city of Vancouver, 16.5; and in the north, 8.1.[5] People living in northern BC have less access to health care and poorer health outcomes than those in the south.[6,7]

The Faculty of Medicine at the University of British Columbia (UBC) is BC's only medical school. It graduated its first 60 students in 1954; by 2003, the numbers of graduates had increased to 128. Until now, BC has graduated the lowest number of physicians per population of any Canadian province.

Current figures suggest that BC requires at least 300 physicians annually to serve its health needs.[8,9] Despite well-established and obligatory rural clinical rotations for its students and an active rural family-practice residency program, the number of graduating students electing to take up permanent practice in northern and remote areas has remained inadequate.

When great change is needed in a complex area, a combination of circumstances is sometimes needed to bring that change about. Such a combination happened in BC between 1999 and 2001: a national inquiry[10] addressed the problem of geographic maldistribution of physicians, bringing national and provincial attention into focus. A change of provincial government, a community health rally and a physicians' strike in the northern town of Prince George further concentrated media and government attention on the issues of equity of access to health care and sustainability of the resource-rich northern communities.

This combination of circumstances developed a political, community and academic will to quickly address the growing shortage of physicians in a way that would fit the geography and culture of BC. Provincial funding to help address the problem was promised.

Many medical schools have faced similar challenges, which are briefly summarized in Table 1. There have been 2 broad approaches: a distributed-campus model, in which undergraduate and sometimes postgraduate training takes place in remote or underserved areas but no new school is constructed; and an alternative approach, whereby a completely new medical school is located in 1 remote area.

We opted for a distributed model. BC has almost 4 times the area of Britain. The majority of its 4 million inhabitants live in the south of the province, in and around its largest city, Vancouver (home of UBC). Some 750 000 live on Vancouver Island, which has as its main population centre the city of Victoria, BC's capital and home to the well-established University of Victoria (UVic). UVic is the province's second-largest educator in the health sector (through various professional and graduate programs), with a strong science faculty and several

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Table 1: Examples of distributed medical education that are currently in operation

Medical school (start-up year)	Stated goal	Description	Outcomes
University of Washington, Washington State, USA[11] (1972)	Distributed program: educates physicians for 4 other states without medical schools	First year is taken in student's home state, then moved to main site; clinical years can be taken throughout the 5 states	61% practise within the 5 states; 20% practise in underserved areas. Students encouraged to enter medicine who otherwise may not have done so
Michigan State University, Upper Peninsula Program, USA[12] (1974)	Distributed clinical education program in underserved rural area	Program for 8 clinical students per year is part of the established medical school	Number of physicians in area has risen
James Cook University, Australia[13] (1997)	New medical school in established rural university	Delivered distributed clinical education since 1993; first intake for full program was in 2000	New schools are more flexible in curricula, but slower to get started
Northern Ontario School of Medicine, Canada[14] (2002)	New medical school across 2 established universities in underserved area	2 campuses in geographically distant universities; first intake scheduled for 2005	Significant community support

research centres and institutes. In addition, another 300 000 people live in the 500 000 km^2 of northern BC, which produces some 70% of BC's wealth and has the poorest health care outcomes in the province.[6,7]

Prince George is the "northern capital" of BC, with a population of 85 000. The city is home to one of Canada's newest universities, the University of Northern British Columbia (UNBC), which was built in 1994 with a mandate to focus on northern and aboriginal issues.

The planning process was led by a senior committee of representatives from the presidents' offices of UVic, UNBC and UBC; the UBC Faculty of Medicine; and government ministries of health and of advanced education. Working with a 6-month deadline, the committee formed various subgroups to produce reports for the Faculty of Medicine. The final plan called for distribution of 3½ years of the 4-year UBC medical program (Fig. 1) across all 3 sites, with staged implementation. Student numbers would increase to 200 for the 2004/05 academic year, with a projected total of 256 by 2010.

The recommendations were accepted by the provincial government and planning, start-up, and ongoing funds allocated in early 2002.

In our model, all of these medical students are UBC students graduating from UBC, who follow the UBC curriculum simultaneously at all 3 sites. The distributed sites have acquired new basic science, academic physician and clinical faculty who also have appointments at UBC. All sites are linked by technology that allows full audiovisual interactivity during lectures and laboratory sessions.

All students spend the first term of their education on the UBC campus, which allows faculty and students to connect in person and generates cohesiveness and belonging within the student body.

In 2002 a new leadership position of senior associate dean, MD Undergraduate Education was created. New portfolio descriptions and recruitment of associate deans of Admissions, Curriculum and Student Affairs were focused on planning and tasks related to expansion. Through a joint recruitment process with UVic and UNBC, UBC recruited associate deans to the Island Medical Program and to the Northern Medical Program who also hold senior appointments at the distributed-site universities. New faculty positions were created at all 3 universities, and all faculty teaching in the program at any site hold a UBC appointment as well as an appointment at their local university.

The expansion is governed through the governance structure of the UBC Faculty of Medicine (Fig. 2). The key unit is the Distributed Planning Program Committee, which has senior leadership from the Faculty of Medicine and senior university administrators from all 3 sites. This working group sanctions all budget expenditures, resolves disputes and acts as a forum for high-level decision-making. The collaboration is governed by interinstitutional affiliation agreements, painstakingly negotiated by key players during lengthy meetings. Affiliation agreements between UBC and each of the 6 provincial health authorities, including agreements on the development of academic space and its availability in hospitals, were in place. Advisory Councils with UVic and UNBC representatives were established in the relevant health authorities.

<table>
<tr><td>Vancouver</td><td rowspan="2">Year 1</td><td>Orientation
Principles of human biology</td><td rowspan="3">Clinical Skills (CS)

Doctor/Dentist Patient and Society (DPAS)

Family Practice Continuum (FPC)</td></tr>
<tr><td rowspan="2">Vancouver Fraser Medical Program

Island Medical Program

Northern Medical Program</td><td>Host defences and infections
Cardiovascular
Pulmonary
Fluids, electrolytes, and renal/genitourinary system</td></tr>
<tr><td>Year 2</td><td>Musculoskeletal
Blood and lymphatics
Gastrointestinal system
Endocrine and metabolism
Integument
Brain and behaviour
Reproduction
Growth and development</td></tr>
<tr><td rowspan="2">Throughout British Columbia</td><td>Year 3</td><td colspan="2">Rural practice: 4- to 8-week practicuum in rural communities
Core clerkships (internal medicine, surgery, pediatrics, obstetrics and gynecology, psychiatry, emergency medicine, dermatology, anesthesia, orthopedics, ophthalmology)</td></tr>
<tr><td>Year 4</td><td colspan="2">Advanced clerkships (electives and selectives)
Effective learning skills for medical practice (weekly themes: pharmacology and therapeutics, health care and epidemiology, health care policy, ethics, law, advanced communication skills, palliative care)</td></tr>
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Fig. 1: Curriculum for years 1 to 4 in the University of British Columbia's newly expanded medical education program.

Facilities and infrastructure

The provincial government made an investment of $135 mil-

lion for the construction of a new life-science centre at UBC and additional buildings at UVic and UNBC. Private fundraising, federal grants from Western Economic Diversification Canada and the Canada Foundation for Innovation enhanced the research facilities and technology infrastructure.

Each building combined teaching and research facilities, including teaching auditoria; computer, anatomy and multipurpose teaching laboratories; problem-based learning rooms; "wet labs" for research; administrative space; and academic offices. All sites have extensive videoconferencing systems linking the auditoria and teaching laboratories.

The universities participated in joint planning sessions and review of architectural planning to ensure equitable and effective space for the medical students. Planning was done with tight deadlines: construction of the new facilities began in the summer of 2003, with all buildings at all 3 sites ready for occupancy just over 1 year later.

Curriculum planning

UBC courses are oriented toward problem-based learning within a systems- and case-based integrated model (Fig. 1). Changes to the syllabus are made through common processes to ensure that all students experience an equivalent education and all benefit from the enrichment potential of the 3 separate sites.

Syllabus planning included mapping of faculty resources available at the partner university campuses and surrounding clinical community, to gauge the feasibility of delivering the curriculum at the 2 distant sites (Box 1). Physicians across the province responded in large numbers to a teaching-interest survey as part of the syllabus planning. In the north there is a shortage of physicians potentially available for education because of service delivery demands. The Minister of Health established a Northern Medical Program Community Action Group to develop "specific strategies with active recruitment and retention initia-

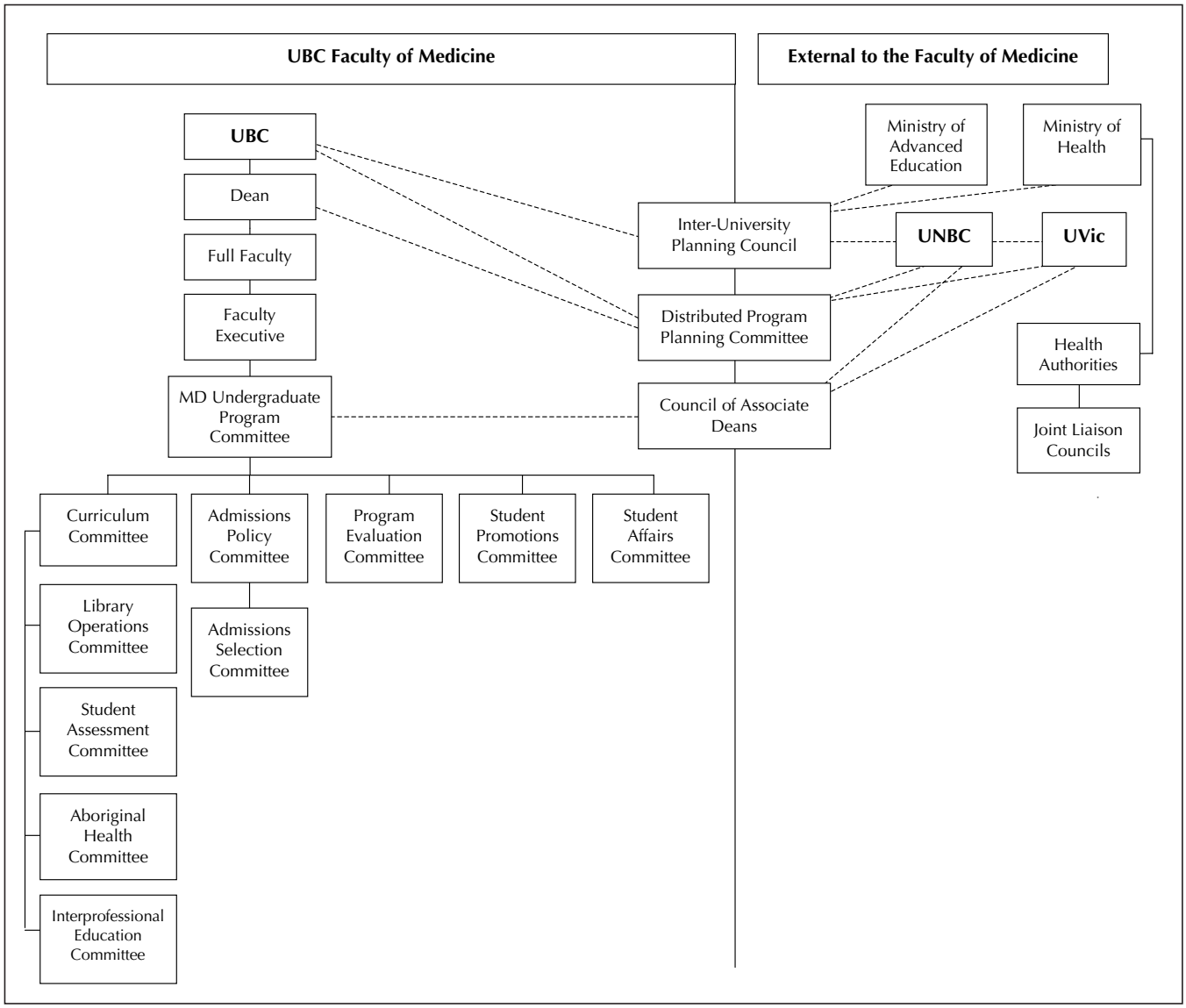

Fig. 2: Governance structure of the MD Undergraduate Program of the University of British Columbia's Faculty of Medicine.

tives for medical teachers and health professionals required by the Northern Medical Program."[15] Wherever possible, plans for clinical education built on programs of medical education already in existence, including successful family-medicine residency sites or specialty community rotations.

Curriculum implementation was preceded by detailed piloting of the main delivery methods, including demonstrations of the distributed curriculum during Prototypical Week (Jan. 26–30, 2004). Two groups of 8 volunteer, first-year medical students from UBC spent a week in Prince George and Victoria, respectively, and took all curriculum components at the geographically separate campuses while their classmates did so in Vancouver. Some components (e.g., tutorials) were delivered on-site by teachers recruited locally; others were delivered synchronously to all 3 sites via multimedia videoconferencing.

Piloting of clerkships covering all core disciplines on the distributed sites began in March 2004 with volunteers from the third year (core clerkship) class.

Technology

The use of technology was planned to enhance the student experience at all 3 sites. Piloting of curriculum delivery by technology, including videoconferenced lectures, laboratories, case discussions and tutor meetings, began in October 2003 and still continues. Attention to faculty support and training has been key to the success of the technology; students have also requested training in multimedia videoconferencing, which is now being piloted.

The technology that links the 3 campuses uses the BCNet advanced network that already links all universities in the province. Lecture theatres, histology and anatomy laboratories on all 3 sites are connected, and lectures at any site can be delivered to the collaboration. Videoconference rooms also contribute support to curriculum management, committee and student meetings.

For a distributed lecture, the students at the receiving sites see the lecturer on the centre screen of 3; any presentation (e.g., a paper document, slides, computer presentation, video or DVD), on another of the 3 screens; and split images of all the classes upon the third screen (Fig. 3). Students have access to microphones to ask questions. Image quality is high and voice or image lag-time, negligible.

Creating this technological linkage required dedicated staff on all 3 campuses, a committee across the 3 universities to approve common infrastructure, external consultant leadership and design teams, and close cooperation between 3 different installation vendors. Attention to detail, professional project management and meticulous piloting have resulted in a system that in its first 3 months of operation has had a negligible failure rate. Initial feedback from students through our formal evaluation processes indicates

Box 1: Steps in and examples of mapping the UBC curriculum to the resources required for teaching in northern British Columbia and Vancouver Island, in preparation for the January 2005 start date

For the Northern Medical Program

1. Identification of all curriculum requirements for the Rural and Underserved Community Practice Experience and the third- and fourth-year clerkships
2. Assigning of approximate time commitments for each activity
3. Addition of all year 3- and 4-physician contact hours to those estimated for years 1 and 2, to realistically simulate the teaching requirements when all 4 years of the curriculum are being offered in the North (2007/08)
4. Mapping of teaching hours to available physicians in Prince George and other northern communities
5. Incorporation of the work on physician supply planning done by the Health Authority, so that curriculum needs took projected numbers of physicians into account

Example

In Prince George in 2003 there were 5 surgeons. The plan suggested numbers should increase to 6 by 2005 to support service and educational needs; this has now been completed with the appointment of an academic surgeon.

For the Island Medical Program

1. Careful matching of the UBC Faculty of Medicine curriculum with anticipated teaching resources
2. Itemization of every component of the curriculum
3. Consideration to other needs, such as time commitments for evaluation (written exams, Objective-Structured Clinical Examination) and remediation
4. Circulation of 2 surveys to identify potential teachers, inviting expressions of interest from those contacted, the preferred nature of their involvement and particular courses in which they would like to participate:
   - To all physicians with Vancouver Island addresses
   - To University of Victoria (UVic) faculty
5. Mapping of curriculum components to the interests and expertise of interested UVic academic faculty (n = 50) and Vancouver Island clinicians (n = 526)
6. Identification of potential gaps in and issues with curriculum delivery at the UVic site
7. Development of strategies to address the gaps and issues identified

Example

We identified a need in Victoria for more expertise in anatomy and histology for lectures and labs alike. We therefore recruited the equivalent of a full-time senior anatomist by seconding a UVic faculty member teaching kinesiology to the program part-time, and using distance-learning technology to deliver histology lectures to the site from Vancouver.

Note: UBC = University of British Columbia.

that the learning experience is at least as good as that of a "live" lecture.

Admissions

As anticipated, the expansion of the medical school increased the workload in all aspects of admissions selection. More people applied for more positions, and the requirement to distribute appropriate applicants among the 3 sites meant adjusting many administrative, interview and selection processes (Fig. 4). Including community, academic and physician interviewers from diverse geographic areas ensured province-wide involvement.

Applications increased from 929 in 2003 (the year before expansion) to 1314 in 2004 and again to 1414 in 2005. A separate tool, the Rural Remote Suitability Score, was developed after full review of the medical education literature and with input from northern physicians and community members. This tool was used by the Northern Medical Program subcommittee of the Admissions Selection Committee to help define applicants who would be best suited to medical education in a rural setting, and ultimately more likely to return to smaller communities to practice medicine. Through meshing of the accepted applicants' preference of site for training with available positions at the 3 sites, the class list was determined.

Student support

Regardless of the geographic site of instruction, all MD undergraduates are students of UBC, with all rights to UBC services and support. Students at distributed campuses also have full access to the supports and services available at the host university, UVic or UNBC.

At those campuses, an Office of Student Affairs headed by an Assistant Dean of Student Affairs supports UBC students on site. These Assistant Deans report directly to UBC's Associate Dean for Student Affairs, and have authority delegated from the Associate Dean to grant students educational leave or emergency funding assistance should the need arise. They will also ensure access to appropriate personal counselling for students. Parallel mentoring and academic advisor programs have been created for students at distributed sites.

All students have full access to university and community medical services and are encouraged to secure voluntary disability insurance. They also have access to career counselling and advice with respect to housing, travel and financial aid.

Preparation

In 2004 the distributed campuses recruited core basic-science, clinical faculty and administrative staff to prepare for the arrival of students in 2005. To ensure team-building across all campuses, frequent travel between the distributed campuses was encouraged for all staff. Faculty development sessions were held at all sites to prepare physicians to teach first-year students either as lecturers, problem-based-learning tutors or preceptors. Once the buildings were complete there was comprehensive testing of the technology.

First Steps

The expanded class of 200 started in September 2004; 49 freshman students moved to the 2 distributed sites in the first week of the following January. The first 3 months' experience has been more positive than anticipated, with very little failure of technology. Students on all 3 campuses have experienced lectures from all sites. There has been remarkable commitment from physicians in the new campus regions. We rapidly moved into routines of educational delivery and are now focusing on our next challenges: building facilities and otherwise preparing for distributed clinical education.

Discussion

Chronic physician shortages in many parts of the world have led to the expansion of medical undergraduate training in various countries, including Canada,[14] Australia[13] and Britain.[16] There are particularly difficult issues surrounding the training, recruitment and retention of physicians in rural areas. Many means to increase undergraduate numbers have attempted to deal with such issues.[17–19] Most ventures are too new for us to judge their long-term success, as yet. It is heartening that part of our model, training practitioners where they are needed, is now being supported in the medical-education literature.[20]

Modern medical schools are extraordinarily complex institutions; rapid expansion, to be suc-

Fig. 3: For a distributed lecture, the students at the receiving sites see 3 screens: the lecturer on the centre screen, any presentation (e.g., slides, computer presentation, video or DVD) on another screen, and split images of all the classes on the third screen.

cessful, requires sophisticated change management. To go from any vision to reality is a considerable process. The "distributed campus" model demanded extensive planning that addressed issues of admissions, faculty appointments, resources, innovative technology applications, student support and governance. The success of the model rests on the strength of partnerships, clear principles of engagement, sharing a common vision and adequate resources. Particularly important has been an alignment of priorities and vision among university, government, health authority, physician and community stakeholders.

The pace of change has been breathtaking, and has resulted in considerable energy, time and attention being given to ensure good communications across all faculty. Senior leadership spoke a great deal with various stakeholders and departments to ensure that the purpose of the expansion was clear to all. Change has occurred at all levels, from senior leadership to faculty administrators; because few existing systems were suitable for an expanded distributed model, all systems required review and needed adaptation. The use of technology in this program has enabled a solution that could not have been implemented even 5 years ago.

In general we think we have created a unique model in that students move to distributed sites early in the program; state-

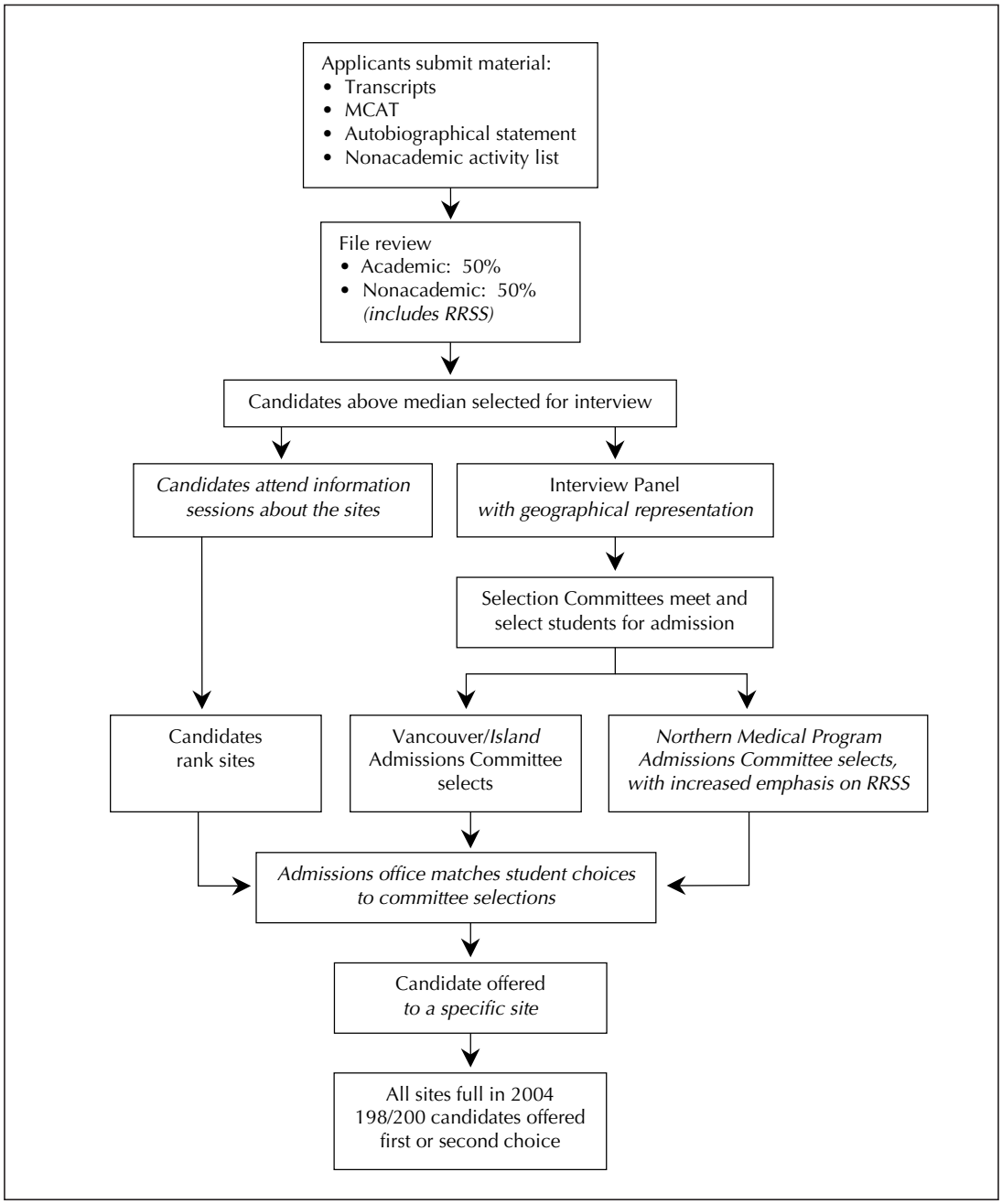

Fig. 4: Admissions process; adjustments for expansion to the University of British Columbia's MD Undergraduate Program are shown in italics. RRSS = Rural Remote Suitability Score.

of-the-art "e-learning" technology is used to link lectures, laboratories, students and faculty; and 3 universities and 6 health authorities are engaged in a partnership that shares resources and expertise over 3 different sites. We have quickly developed a collaborative, collegial spirit and strive to deliver an excellent program.

Twelve months into implementation, there are clear signs of early success, although many challenges lie ahead. We still have much to do and much to learn and have developed a comprehensive evaluation and research program to examine what is essentially a natural experiment.

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