Case Report ■

Infrastructure for Reaching Disadvantaged Consumers:

Telecommunications in Rural and Remote Nursing in Australia

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Abstract Both consumers and health service providers need access to up-to-date information, including patient and practice guidelines, that allows them to make decisions in partnership about individual and public health in line with the primary health care model of health service delivery. Only then is it possible for patient preferences to be considered while the health of the general population is improved. The Commonwealth Government of Australia has allocated $250 million over five years, starting July 1, 1997, to support activities and projects designed to meet a range of telecommunication needs in regional, rural, and remote Australia. This paper defines rural and remote communities, then reviews rural and remote health services, information, and telecommunication technology infrastructures and their use in Australia to establish the current state of access to information tools by rural and remote communities and rural health workers in Australia today. It is argued that a suitable telecommunication infrastructure is needed to reach disadvantaged persons in extremely remote areas and that intersectoral support is essential to build this infrastructure. In addition, education will make its utilization possible.

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Australia's rural and remote areas cover most of its continent. According to the Australian Bureau of Transport and Communications Economics,[1] approximately 71 percent of all households are located in inner and outer urban and provincial areas, mostly near cities on the coast. Studies have shown that remote communities can be classed largely as geographically distant from commercial resource centers.[2–4] Recent figures extrapolated from Australian Bureau of Statistics sources by Humphreys et al.[5] show that there are 910 remote localities (population 200–999) and a further 348 urban centers (population 1,000–2,499) in Australia. The total number of people in these communities is 920,050, which constitutes 5.5 percent of Australia's population. These people are among the most disadvantaged in terms of health care and other services; according to Clinton and Nelson[6] their demographic profile closely resembles "the population and epidemiological nature of a developing nation." The locations of these remote communities vary from the tropical areas of the north of Western Australia, Northern Territory, and Queensland, to the cold Snowy Mountain regions and offshore islands like King Island or Cocos Island. Consequently, the cost-to-revenue ratio of telecommunication varies significantly between these and larger regional or provincial areas. This is a major impediment to getting the desired telecommunication infrastructure in rural and remote communities in the absence of government intervention.

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health service delivery. Only then is it possible for patient preferences to be considered while the health of the general population is improved. This paper argues that only an intersectoral approach will ensure that the disadvantaged people in rural and remote areas are provided with adequate access to a sound but costly national telecommunication infrastructure. Indeed, such an infrastructure should be used not only for health but also for education; other government, social and cultural services; general information; and strategic business and specialized industry activities, including all forms of electronic commerce by a wide range of individuals, groups, and businesses. Sound use of such an infrastructure requires the provision of technical support plus education and training opportunities for all potential users to attain the necessary computing and information literacy.

Health Services in Rural and Remote Areas

The existing telecommunication infrastructure is inadequate and is characterized in particular by a lack of access to integrated services digital networks by rural and remote practitioners.[7] Many of these practitioners work alone, are always on call, and lack ready access to their peers and to up-to-date clinical information. Rural and remote communities, because of their isolation, have long been disadvantaged in terms of access to specialist health services and community care. This is compounded by the time required for travel to regional and city centers, its high cost, and the family dislocation caused by the absence of one family member. Women, the elderly and infirm, the poor, and indigenous peoples are the most disadvantaged in these communities. A 1997 government report on health information management and telemedicine noted that "telehealth is valuable in solving many challenges created by underserviced rural communities."[7]

The Royal Flying Doctor Service of Australia (RFDS) has since 1936 provided a vital aeromedical emergency service.[8] However, the 1993 report of the National Health Strategy Working Group to the RFDS recommended that the service should greatly extend its preventive health care and clinical services into proactive programs, following their findings that rural health is often poorer than urban health and that the problems with service delivery in rural and remote Australia are long-term and getting worse. It also recognized the urgent need to develop a more culturally sensitive and appropriate approach to help improve the very poor standards of health among the aboriginal and Torres Strait Islander populations. The RFDS works closely with other health care providers such as rural doctors and remote area nurses (RANs).

Remote area nursing is unique in that RANs provide all emergency health services as well as manage ongoing health services for clearly defined isolated communities. Primary health care is the model that best suits the type of health service delivery required in remote communities. This is because it encourages community participation from people who are already largely self-reliant as a result of their lifestyles, in the development of the mix of health services their community might require from health service providers. This self-reliance is primarily due to geographic and social isolation. A description of this work environment is perhaps best illustrated in the following summary by a RAN[9] located two hours' drive from a major regional center, who cares for a community of 400 people:

> To provide medical services, I consult with the GPs in the center by telephone, although the line often drops out. I participate in ongoing education by teleconference and fax—sometimes that gives me access to more than half of the session. When I visit my patients, the HF radio gives me access to the RFDS, should I need emergency care or evacuate the patient. Most specialist services can give me opinions or test results within a week—or I can refer patients for appointments 1,000 km away. . . .

The literature reveals that people in remote communities currently expect more medical than preventive work from a RAN.[10,11] Humphreys et al.[5] attribute this to the continuation of the medical and curative care ethos. This ethos is one of the difficulties of implementing primary health care practice in remote communities. In some communities and within some professional groups a great deal of education is required before people are comfortable taking up the challenge of organizing and providing for their own health care. Smith[12] noted that "more and more emphasis [is] being placed on outcomes—difficult criteria to meet in a primary health care setting."

This difficulty may be overcome to some extent by providing health care consumers with access to public health information and patient guidelines. Such access is expected to provide health professionals with the information and support they need to meet the health needs of the community and to be a resource for the community. In some regions, a formally accepted standard treatment manual at least provides a tool for RANs to make urgent medical decisions.[13] Few RANs other than those who have gained comprehensive experience in this field of practice have known how to match their current knowledge, skills, and attitudes to the often hidden requirements of the position. In part, this situation has contributed to high turnover among RANs who become disillusioned with the realities of living and working in remote communities.

The costs of not identifying the skills, knowledge, and attributes of RANs through nationally recognized competency standards and of not providing adequate support services are unacceptable. There are personal costs for the RANs who leave remote communities disillusioned and defeated, and there are costs for the remote communities who face endless successions of RANs who are often ill-prepared and at times appear uncaring, unknowledgeable, and culturally ignorant. There are also the costs to the community when health outcomes are not achieved because the services offered are not appropriate. In addition, there are financial costs for the employers of RANs who, accordingly, are faced with continual recruitment and retention issues. In a time of national fiscal restraint more than ever, the costs of providing a less-than-optimal or an inefficient service must be of concern to all Australians.

Information and Telecommunications Technology Infrastructure

The information and telecommunication technology infrastructure needs to accommodate the many and varied applications required for the support of rural and remote communities. The infrastructure consists of both the telecommunication media used to actually transmit information—such as phone lines, fiber-optic cables, satellites, and microwave systems—and the media used as input/output devices—such as telephones, video cameras, monitors, fax machines, and computers—that are needed to send and receive data. One set of media cannot be used without the other, but various combinations of use are possible.

When deciding what is required and what is possible for use of the media to support health care, distance education, and general consumer-information needs, important considerations include: the possible and required ranges of transmissions, the media available, the nature and volume of the information to be transmitted, whether interaction is required, financial limitations, the availability of technical support, the projected audience or users and their locations, and the expected life of required usage. This requires information providers to be conversant with what each technology has to offer, its availability, and the target group characteristics. In many instances providers need to be flexible and may need to use a variety of delivery methods to accommodate these constraints. Only an intersectoral approach will make such projects financially viable.

Communication systems in use in Australia include small citizens band (CB), high-frequency (HF), very-high-frequency (VHF), and ultra-high-frequency (UHF) radio systems; a public switched telephone network; data and private networks; public broadcasting networks; and satellites—including low and medium earth-orbiting satellites—with variable capabilities and geographic coverage. The core network links telecommunication service providers and international gateway exchanges and provides all the trunk transmission, switching, and other network capabilities. Other communication capabilities such as mobile telecommunication systems, intelligent network products, and integration of overlay networks (such as an integrated services digital network and data networks) are being added. The growth of data networks is phenomenal.

The core telephone network in Australia was analog, but by 1999 this network is expected to be fully digital, have a greatly simplified exchange hierarchy, and have fully integrated trunk transmission capacity, based primarily on the advanced, high-volume synchronous digital hierarchy. This network can be used for telephone calls, paging, voice mail, interactive audio information services, facsimile, audio-conferencing, computer-mediated communication, and audiographic conferencing. Although coverage by fiber-optic cable is extensive, in some remote areas the trunk bearers for the plain old (voice) telephone service (POTS) are provided by radio communication links such as microwave transmission.[1] Thus, access to the available telecommunication infrastructure and its potential use are dependent on both location and use of technology—as, for example, compression techniques.

The infrastructure consists of a combination of both land-based and air-based communication networks and systems, each offering various bandwidths—from a single telephone line using copper wire, which is adequate for voice, facsimile, and text-based data transmission, to broadcast television cable and satellite networks. Convergence of some of these technologies make it possible to combine audio, data, and video communication, both synchronous and asynchronous, by means of personal computers.

Consumer access to telecommunication networks is dependent on access to these devices, including access to high-speed computers with CD-ROM drives and local-call access to an Internet service provider in order to take good advantage of what the Internet, the World Wide Web, and educational CDs have to offer. People in rural and remote areas also encounter special problems such as erratic power supplies, dust storms, and severe electrical storms that affect the reliability of the telecommunication network. Our use of this network for educational purposes revealed, for example, that a student in Western Australia was hav-

ing difficulty getting a reliable phone connection. Another student in New Guinea had to start a generator to receive and send faxes—the connections often are successful for only 15 minutes at a time. Many outback communities share a single phone line that uses microwave connections to a ''radio concentrator'' into the phone system; while any one of the telephones (including one in a public solar-powered phone booth) is in use, the others are not available at all.

University and Government Initiatives

A number of universities, other educational establishments, hospitals, and other organizations are using various established networks. For example, Central Queensland University has its own microwave-linked broadband infrastructure connecting its five regional campuses. Hesketh et al.[14] noted a number of specific initiatives for the educational sector, such as the establishment of the Open Learning Technology Corporation in 1993, the Educational Network Australia in 1995, and Open Learning Australia, which involves the collaboration of 29 Australian universities and technical and further education colleges assisted by the Australian Broadcasting Corporation with radio and television broadcasts. Fifteen percent of current units of study offered are supported by computer-aided learning. Then there was Open Net in 1995, the formation of the cooperative multimedia center program, and the establishment of the Professional and Postgraduate Education program assisted by television broadcasts via the SBS network and internationally by Australian Television. The Project for Rural Health Communications and Information Technologies (PRHCIT)[9] reported that there are about 500 compressed videoconferencing sites in Australia, of which more than half are in educational establishments. This number is expected to increase. The Queensland government strategic plan includes networking all schools and public hospitals. Currently, an experimental broadband network is limited mainly to hospital networks in capital cities, although the Queensland link established in August 1995 involves non–capital city hospitals, linking the Royal Brisbane, Maryborough, and Nambour hospitals. Med-E-Serv is a commercial national provider of electronic networks, satellite broadcasting, and videoconferencing to the health sector.

A 1991 report of the Australian House of Representatives Standing Committee for Long Term Strategies on Australia as an Information Society, is ''Grasping New Paradigms,'' noted that ''there is a pressing need to increase the community's use of information.'' This committee expressed its concern that ''existing education systems are not bridging the gap between the skills provided in secondary education and the expectations of society in the world of work'' and noted that ''special provision should be made for those groups in society which are disadvantaged in their access to information.'' Within this group the rural isolated, aboriginal people, and women were identified. These groups are of particular relevance to rural nursing in Australia. The report also noted that ''information retrieval, including database searching, should be regarded as a fundamental skill at all levels of education'' and that ''priority must be given to the use and users of information, rather than to putting elaborate structures in place to supply information in the first instance.'' It also set out the elements of a national information policy for further debate.

By 1997, the Information Industries Taskforce[16] reported to the Commonwealth Department of Industry, Science and Tourism that ''to prosper in the 21st century, Australia must be a leading user and producer of information and communication technologies.'' The needs to enable and empower users, enhance information and communication technology education in schools and in the tertiary education sector, and to reskill the work force were among its recommendations to the government. As a result, a five-year, $250-million funding program—called Networking the Nation: The Regional Telecommunications Infrastructure Fund[17]—was established specifically to support activities and projects designed to meet a range of telecommunication needs in regional, rural, and remote Australia. The program was established in recognition of significant opportunities to improve the delivery of education, training, and health services in these areas through the provision of an improved information and telecommunication technology infrastructure. In addition, the Queensland government aims to progressively increase the standard of living and quality of life for Queenslanders by transforming employment, living, and business conditions, particularly in rural and regional areas, through innovation and investment in information technology and communication through the implementation of its information technology strategy plan.[18]

Hesketh et al.[14] noted the implementation of a number of government policies in relation to information technology, such as the development of telecenters to assist rural communities; the establishment of community-based information technology centers as a network of nonprofit organizations that provide training and information technology services to their local communities; the piloting of the Community Information Network (CIN) in 1995 as part of the Commonwealth government's Working Nation's initia-

tives to provide information and communications networks for access by individuals, groups, and organizations; and the establishment of the National Information Services Council in 1995.

Telemedicine and Telehealth

Telehealth is a generic term in use in Australia to denote "healthcare at a distance."[7,9] It describes the provision of a range of health services that use information technology and training to deliver and enhance services to rural and remote communities, including education and training, telemedicine, and the use of these technologies to improve the organization and administration of health services. Many rural and remote communities in Australia are already receiving a number of telemedicine services, although the appropriate role of these services has not yet been determined.[19] For example, a telepsychiatry project conducted by Yellowlees and Kennedy[20] was conducted using compressed videoconferencing. Patient assessment by telephone, with a nurse at one end and the patient at the other, has often been done. This was quite common and quite effective. As a further example, a community nurse caring for an asthmatic child could video the child, convey the images immediately, and confer with a specialist expert on the advisability of transporting the child to an urban center by air ambulance. While audio-conferencing offered the opportunity for peer consultation, it effectively excluded the client from participating in the development of an accurate assessment and an appropriate plan for intervention.

The Health Communication Network (HCN)[21] began in 1991 as an initiative of the Australian Health Ministers to improve the flow of information throughout the health system in a safe, secure, and effective way. It became an independent company in 1995. The HCN and various Commonwealth and state government departments provide e-mail and Internet access plus a range of health information services, including access to biomedical literature databases, via the Internet or intranets using Web technologies. The HCN has also commissioned a range of pilot projects concerned with asthma management, teleradiology, anesthetic incident monitoring, the public health network, telepsychiatry, and hospital and community communications to demonstrate the benefits and uses of the network and to evaluate privacy and security guidelines. Local experience, which is thus steadily increasing, needs to be monitored carefully and evaluated for its ability to affect health outcomes.

Evaluations of programs need to probe beyond the superficial. The bulk of evaluations carried out on professional development programs and the use of technologies has tended to look only at "satisfaction" and short-term "achievement" in terms of what was learned by the end of the program. Yellowlees and Kennedy[20] have called for greater academic and multidisciplinary involvement for the further development and evaluation of telemedicine services. There are several frameworks for in-depth evaluation in the literature. For example, Kirkpatrick[22] provides a model of evaluation for nursing that has four levels: reaction, learning, behavior, and results. Others have recommended a framework that extends Kirkpatrick's levels to six, namely, reaction, feedback, knowledge gained by participants, capability developed by participants, behavior change, and organizational outcomes and results.[9] Copies of the evaluation instruments and summaries of the outcomes of projects or programs provide an audit trail of progress on the achievement of outcomes. These can be used to assess the evaluations and can be shared with others. Evaluation is not cost-neutral. It should be noted that as these levels are pursued, the cost of evaluation increases exponentially.

Other Uses of Information and Telecommunications Technologies

The Telehealth in Rural and Remote Australia Project identified key issues pertaining to the implementation of information technology and training in rural and remote areas.[9] For example, it was revealed that nurses were the least likely (77 percent) to have participated in work-related training, mainly because of a lack of locums and the high cost in terms of time and travel. Nurses were most likely to use video players (75 percent) and HF, VHF, and UHF radios (59 percent) and least likely (55 percent) to use computers in their work, compared with other rural and remotely located health professionals. At a recent conference for RANs, some nurses reported having been issued with computers that were still in the box, since they didn't know what they were supposed to do with them. . . . Neither training nor technical support was offered.

One study[9] suggested that the use of teleconferencing is a cost-effective means of providing continuing education and professional networking. One example of the use of these technologies for distance learning was seen at the School of Nursing at Edith Cowan University, Churchlands Campus. The media network provides support to outlying regions in a number of ways: a fortnightly videoconference service to Derby Hospital (voice interaction via a 1-800 number) for staff development; a newly scheduled rural and re-

mote pharmacy support program; and video-mediated lectures to all other campuses in Joondalup, Mount Lawley, Kununurra, and Bunbury for 490 external students. Interactive diabetes telephone education for rural and remote area professionals is provided by the Faculty of Nursing, University of South Australia. An audio-conference program for new graduates and more experienced nurses was conducted from Charles Sturt University, Bathurst (personal communication, 1995–6). A renal nurses satellite link was established in 1992 for nurses in geographically isolated renal units; it operates nationwide to about 48 sites. The Derby Hospital is involved in the Nursing Satellite Broadcast Program to keep nurses' clinical knowledge updated statewide in areas such as orthopedics, palliative care, and pain management; the network includes 50 hospitals, 100 other centers, and 3,000 private satellite dishes. Presentations at a nursing research forum held in one rural center were put on the Web as a "virtual conference" to widen the audience and to demonstrate that rural nurses can participate in "high tech" approaches to research publication.[23] As a result, one accident-and-emergency nurse now corresponds by e-mail with a rural Canadian accident-and-emergency nurse who read her presentation.

Conclusion

The infrastructure required for high-quality information and health service delivery is far from universally available or reliable. It is extremely costly in sparsely populated or distant areas, although ultimately its absence may be more costly. We need to prepare communities now to exercise their rights, be informed, and have their preferences considered when they need health care. Also, the administrators of health services must factor in the human (intangible) cost with the financial cost of health care in rural and remote areas, and they must encourage professional excellence by providing continuing education to nurses and other health workers so that they can adequately work with informed consumers and deliver care in accordance with the best available practice guidelines.

While there are many existing and emerging technologies that may provide effective or alternative options for consumer access to information, distance education, and continuing staff development and support, we need to be able to offer various modes of delivery of information and educational services to suit individual learning styles, time, finances, access to technology, and other specific needs. Traditional education does provide social interaction, networking, and emotional support, which is impossible to replicate in distance modes, although these needs may be met in other ways. A shift is occurring as the use of the Internet spreads: We have all heard of people falling in love "over the Internet," and other close supporting relationships being established and fostered through this medium. Our experiences with distance education have convinced us that potential users of telecommunication technologies must receive suitable education and have ready access to technical support if they are to have access to guidelines and other health information when required using the proposed infrastructure.

Governments must have the will and the fiscal objectives to resource the necessary telecommunication infrastructure for their citizens irrespective of location. The disadvantaged in rural and remote areas can benefit significantly from these technologies. This is feasible only when the technologies can be fully utilized for a variety of purposes. This requires intersectoral support and cooperation. Furthermore, our education system needs to develop people who have the necessary computer and information literacy skills to benefit from using these technologies. Professional and regulatory bodies also need to devise and implement competencies and standards to ensure adequate preparation of rural and remote health workers, including nurses, before they embark on "adventurous" practice in distant communities—at both their perils.

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