

Telepaediatrics, primary health care and developing countries

Sinclair Wynchank, MD, DPhil, FInstP, CEng

Telemedicine Platform, Medical Research Council, Cape Town, and School of Child and Adolescent Health, University of Cape Town

Jill Fortuin, MSc

Telemedicine Platform, Medical Research Council, Cape Town

Telepaediatrics, which has the potential to improve paediatric care if expert knowledge is not locally available, involves transfer of information between two or more locations, to aid diagnosis or management and/or to allow continuing professional development and education. Developed nations first introduced telemedicine. Later developing countries with different needs, levels of expertise and infrastructure often applied it in a modified manner. Teleradiology and/or tele-education/distance learning were usually the first applications of telemedicine and telepaediatrics is a more recent form of telemedicine. Developing country paediatrics typically involves primary health care (PHC) providers who deal with more serious morbidity and a greater proportion of the population than those in developed countries. Nurses provide PHC in most rural areas in South Africa and other developing countries, where telemedicine may improve PHC, as has already been seen in South African pilot schemes outlined below. In general telepaediatrics benefits from previous telemedicine experience, such as that gained by some developed nations with sparsely populated, remote areas, where means of communication are simple and socio-economic conditions poor.

Telemedicine links

Telemedicine links range from simple telephone lines with slow data transfer to very fast transmission using wireless communication. They are bidirectional, so data (e.g. responses to questions or tele-educational material) can be sent back to the 'remote' station. A common, simple technique called 'store and forward' allows a large data set (e.g. medical images) to be entered into a computer ('stored') and sent ('forwarded') slowly to an expert, e.g. as e-mail attachments. After examining the images, the recipient responds. Store and forward requires simple infrastructure, is very useful when an immediate response is not necessary (e.g. for teledermatology), and is very effective in many developing nations. Special telephone lines (ISDN lines) transmit data faster than simple phone lines and allow real-time videoconferencing. This technology is used to provide an extensive pilot paediatric service between the USA, South Africa and other developing countries.¹ Electronic medical records are also highly compatible with telemedicine. Web-based telemedicine is another method used for telepaediatrics. In north-eastern Brazil a network arose from a pilot service for paediatric cardiology, and a large hybrid Indian network includes store-and-forward and real-time telemedicine.² In contrast to these successes, a recent attempt to design a telemedicine HIV/AIDS management system in South Africa found that 'there was no all-inclusive Information and Computing Technology system' available.³

Paediatric telemedicine

With telepaediatrics local care improves and PHC providers can improve their knowledge and expertise. Telemedicine activity necessitates certain knowledge (e.g. computer literacy). An e-mail-based telepaediatrics service links seven developing countries. Another paediatric teleconsulting service, using store and forward with a mean response time of 32±8 hours, has resulted in beneficial changes in diagnosis, diagnostic planning and management and avoidance of travel for a consultation.⁴ No principles of professionalism in paediatrics are contradicted by telepaediatrics.

Application of telemedicine to paediatric specialties

A Cochrane survey⁵ on neonatology in developing countries emphasises the need for more information dissemination about therapy, interventions, etc. Here telemedicine can play a major role, as it has for neonatal echocardiology⁶ (and general paediatric echocardiology), where it often enables appropriate care to be given in PHC facilities without transfer. Currently paediatric surgery uses telemedicine sparsely. Yet in developing countries much death and disability results from inadequate surgical care,⁷ with injury a common cause of paediatric death. More community-level paediatric surgery and better surgical education are required,⁷ and telemedicine can aid dissemination of the necessary information. International outreach via telemedicine aids training in paediatric haematology-oncology care. It supports such care in Cameroon, where these conditions are managed in general paediatric wards, and an existing paediatric neuro-oncology service in Jordan.⁸ Dermatology and cardiology commonly use store-and-forward telepaediatrics. A Uruguayan proposal for specialised training in paediatric nephrology depends on telemedicine. Telepathology also serves paediatrics. In developing countries pathologists are usually responsible for several different pathology fields, so access to sub-specialists is often essential and can be provided by telemedicine (personal communication, R Kaschula). A telepathology link between Switzerland, South Africa and other developing countries achieved 18 000 consultations in 4 years.⁹ Most preschoolers worldwide never have any examination of their vision, yet tele-ophthalmology is successfully established between the UK and South Africa, Ghana, Malaysia, Tanzania and Gambia, with most consultations needing only one response from the distant specialist. This has 'reduced the burden of eye disease' in South Africa and improved 'the learning of practitioners', 'which should benefit future patients'.¹⁰ Telemedicine can aid provision of PHC paediatric dental care with tele-education and links to dental specialists, and already paediatric psychiatry has successfully used videoconferencing

to train PHC practitioners in post-trauma problems and to manage some mental illness.¹¹

South African tele-paediatrics

Various South African pilot schemes exist, but there is no national network. Teleradiology, tele-ophthalmology, telepathology and telepsychology led the way, followed by teledermatology, teleneurosurgical imaging and telepaediatrics. Two telepaediatrics pilot networks, centred on the universities of Stellenbosch and Cape Town, are linked and have remote sites at 8 and 5 hospitals, respectively. They serve PHC providers, most of whom have no other access to paediatric expertise. Initial results are encouraging, although numbers remain low (personal communication, ED Nel and R Diedericks). These networks emphasise paediatric pulmonology, cardiology, dermatology and urology. In developing countries there is usually no screening for hearing problems, but for South Africa a proposal has been made to screen for them in its immunisation clinics. A most successful local telepsychology link between the University of the Western Cape and an outreach clinic in Beaufort West ended abruptly because of equipment loss. One of its functions was a novel scheme to train high-school learners to become lay peer-counsellors for fellow high-school students, in a region where there are high levels of violence and abuse of alcohol and other substances. A simple teleradiology system using a digital camera and e-mail attachment is useful for rural clinics,¹² though much more sophisticated links have been set up by private practitioners. A teleneuroradiology link to the University of Pretoria had 900 referrals annually. As a result of this about two-thirds of the referred patients were managed at the remote station and costly transfer was avoided (personal communication, H Shapiro). A novel digital microscope with Internet connection for 'live' telepathology now operates in South Africa, with full real-time remote control, and it has revolutionised small, remote histopathology departments lacking sub-specialists.¹³

Tele-education

Tele-education is steadily increasing in the developing world. A series of computer-based interactive distance learning courses in community paediatrics for PHC nurses has been prepared by the University of Cape Town (personal communication, M A Kibel). The Wellcome Trust, with the World Health Organization, has prepared a CD-based library, treating 14 serious conditions, including tropical diseases and paediatric conditions common in developing nations (tuberculosis, HIV/AIDS, malnutrition, diarrhoeal disease, acute respiratory infections). An 'inverse performance spiral in academically isolated rural hospitals' in South Africa has been noted¹⁴ and a pilot tele-education programme has increased 'levels of job satisfaction, job competence, willingness to stay in a rural environment and quality of services provided'.¹⁴ Another ambitious tele-education project, requiring a small bandwidth, was described above for West Africa. Communication skills in clinical paediatrics are often lacking and on-line video-training has been shown



The new discipline of telepaediatrics has already improved care to infants and children, particularly in remote rural regions.

to increase practitioner confidence. So telemedicine-based training has potential benefits far beyond the transmission of information about diagnosis and management. The telepathology network technology mentioned above¹³ facilitates histopathology teaching at Walter Sisulu University, by using a library of 400 virtual (electronic format) slides, easily shared and reproducible, with an indefinite lifetime (compared with 3 or 4 years for glass-based slides). Paediatric palliative medicine is rarely discussed, yet South Africa provides the only formal training and qualifications (a diploma and MPhil) for this field in Africa. These courses contain about 20% paediatric content and are administered by the University of Cape Town, almost entirely using telemedicine. People who have successfully completed these courses are located in various African countries (personal communication, E Gwyther).

Discussion

The Alma Ata declaration of 1978 promoted 'comprehensive' PHC. This proved too ambitious and costly, so 'selective' PHC is now the current goal, concentrating on fewer diseases, 'almost all of them falling within the realm of paediatrics'.¹⁵ Telemedicine can provide much paediatric benefit in PHC in a developing country setting. It is best for telepaediatrics to fall within a planned national network, but this has rarely been done anywhere. South African telepaediatrics should learn from this to provide a more efficient service by *ab initio* planning. Local and other telemedicine experience indicates that for success, requests for teleconsultations should be sent to a co-ordinator rather than using the conventional referral system. This efficient principle has been comprehensively described for an Australian telepaediatric network and is used in the Western Cape.

Telepaediatrics is a novel form of medical practice, so previously unknown problems with medicolegal, confidentiality and security issues may arise and telemedicine-related ethical questions are under investigation in South Africa. Potential cost benefits of telemedicine are clear (less travel for patients, experts and those undergoing education, lecturers, etc.), but to measure cost-effectiveness and otherwise evaluate telemedicine is difficult. With very few costing studies reported, it has been shown that Australian telepaediatric psychiatry and videoconferencing both reduced costs significantly. Also store and forward has been shown 'to be an effective means of providing pediatric sub-specialty consultation' in a Pacific Ocean-wide project.⁴ For telemedicine success there are technological needs (e.g. sufficient infrastructure, information and computer technology resources, etc.), but non-technological requirements are equally important. These include tolerance of procedural changes in care, co-operation, and acceptance and legal recognition of second opinions. In South Africa some of these potential difficulties have been overcome with user participation in the development and setting up of telemedicine, provision of support after its inauguration, and then continuing professional development, training and participation.

In conclusion, the new discipline of telepaediatrics has already improved care to the infants and children served, particularly in remote rural regions of South Africa and other developing nations. It can be cost effective and improve continuing education for caregivers. South Africa's experience indicates that telepaediatrics is now poised to extend its benefits to more communities.

The authors are grateful to Ashley Bess for administrative assistance and to Professors L Banach, R Kaschula, M Kibel, E Nel and H Shapiro and Drs R Diedericks and E Gwyther for extensive and illuminating discussions.

References

- Ozuah PO, Reznik M. The role of telemedicine in the care of children in under-served communities. *J Telemed Telecare* 2004; 10: Suppl 1, S78-S80.
- Amble R, Comparini A, Kumar KR, Dahlgren R, Lurie YM. Delivering low-bandwidth telemedicine services over hybrid networks in developing countries. *Soc Conf Proc IEEE Eng Med Biol Soc* 2004; 7: 5375.
- Sorenson T, Ulrike R, Fortuin J. A review of ICT-systems for HIV/AIDS and anti-retroviral treatment management in South Africa. *J Telemed Telecare* 2008; 14(1): 37-41.
- Callahan CW, Malone F, Estroff D, Person DA. Effectiveness of an internet-based store-and-forward telemedicine system for pediatric subspecialty consultation. *Arch Pediatr Adolesc Med* 2005; 159: 389-393.
- Davis PG. Cochrane review neonatology: past, present and future. *Semin Fetal Neonatal Med* 2006; 11(2): 111-116.
- Randolph GR, Hagler DJ, Khandheria BK, et al. Remote telemedical interpretation of neonatal echocardiograms: impact on clinical management in a primary care setting. *J Am Coll Cardiol* 1999; 34(1): 241-245.
- Bickler SW, Rode H. Surgical services for children in developing countries. *Bull World Health Organ* 2002; 80(10): 829-835.
- Qaddoumi I, Mansour A, Mushbarbash A, et al. Impact of telemedicine on paediatric neuro-oncology in a developing country: the Jordanian-Canadian experience. *Pediatr Blood Cancer* 2007; 48(1): 39-43.
- Brauchli K, O'Mahony D, Banach L, Oberholzer M. iPath – a telemedicine platform to support health providers in low resource settings. *Stud Health Technol Inform* 2005; 114: 11-17.
- Johnston K, Kennedy C, Murdoch I, Taylor P, Cook C. The cost-effectiveness of technology transfer using telemedicine. *Health Policy Plan* 2004; 19(5): 302-309.
- Pfefferle SG, Gittel JH, Hodgkin D, Ritter G. Pediatrician coordination of care for children with mental illnesses. *Med Care* 2006; 44(12): 1085-1091.
- Corr P, Couper I, Beningfield SJ, Mars M. A simple telemedicine system using a digital camera. *J Telemed Telecare* 2000; 6(4): 233-236.
- Banach L, Stepien A, Schneider J, Wichrzycka-Lancaster E. Dynamic active telepathology over a national health laboratory service network in South Africa: Feasibility study using Nikon Coolscope. Presented at 9th European Telepathology Congress, Toledo, Spain, May 2008.
- Marais BJ, De Villiers M, Kruger J, Conradie H, Jenkins L, Reuter H. The role of educational strategies to reverse the inverse performance spiral in academically-isolated rural hospitals. *SA Fam Pract* 2007; 49(7): 15a-15e.
- Unger JP, Killingsworth JR. Selective primary health care: a critical review of methods and results. *Soc Sci Med* 1986; 22(10): 1001-1013.