# NATIONAL RESEARCH AND EDUCATION NETWORKS TO SUPPORT TELEMEDICINE AND TELEHEALTH: THE BRAZILIAN EXPERIENCE

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## Abstract

National Research and Education Networks (NRENs) worldwide are expanding capacities, including collaboration amongst teams of health scientists to create academic telehealth communities that bridge science, technology, innovation, education, assistance, and federal health authorities to discuss, seek funding and work together. The World Health Organisation promotes Universal Health Coverage (UHC) as a goal for equitable access to health services without pushing people to poverty. UHC has been adopted by the United Nations General Assembly as one of the health targets under Goal 3 on health. Using information and communication technologies to bring healthcare to people in remote areas and to those who need health services most is one of the objectives of UHC. RUTE is the Brazilian Telemedicine University Network programme, coordinated by the NREN RNP (Rede Nacional de Ensino e Pesquisa) . In September 2015 RUTE launched its 118th Telemedicine Unit, all of them located in university and teaching hospitals all over the 27 Brazilian states. Fifty-five special interest groups (SIGs) in health specialties operate over the collaborative network model with 2 to 3 scientific videoconferenced sessions every day, amongst 150 participating institutions. Last year the programme published its second book on its impact in the Brazilian Telehealth initiative as well as in Latin America. As quoted in the foreword: "It is an example of what a country can and has done and what lessons the world can learn from them." This paper provides insight regarding the development and evaluation of the programme and may provide thoughts and even guidance to policy makers.

**Keywords:** telemedicine; telehealth; eHealth; Brazil.

## Brazilian National Initiatives

RUTE (Rede Universitaria de Telemedicina) is part of the Brazilian Telehealth Programme,[1] coordinated by the Secretariat of Work and Health Education Management (SGTES) of the Ministry for Health. The programme seeks to improve the quality of service and basic care provided through the Unified Health System (SUS), and to promote tele-assistance and tele-education (working together with the Open University of the Unified Health System (UNA-SUS) and facilitating access and training to healthcare professionals).[2] The telehealth and telemedicine centres are equipped with cutting-edge ICT equipment for real-time communication connected to high performance network infrastructure operated by RNP (Rede Nacional de Ensino e Pesquisa) of the National Education and Research Network. Currently, telehealth services, beyond RUTE, are provided in 14 states encompassing 30 thousand professionals from the Family Health Programme, present in more than two thousand Brazilian municipalities.

Started in 2011, the Brazilian Enterprise for Hospital Services (EBSERH), a new organisation responsible for the management of more than half of the federal university hospitals, is also supporting the programme.[3]

A partnership exists amongst 18 Latin American Ministries of Health from Brazil, Colombia, Ecuador, México, Uruguay, El Salvador, Chile, Peru, Argentina, Guatemala, Costa Rica, Venezuela, Paraguay, Dominican Republic, Haiti, Bolivia, Panamá and Guiana. Through the Telehealth Regional Project from the Inter-American Development Bank (IADB), RUTE and the Brazilian Telehealth Programme, among others, were certified for best practice of telemedicine by the IADB,[4] the Pan American Health Organisation (PAHO), and the Economic Commission

for Latin America and the Caribbean (ECLAC). The regional academic network RedClara and many academic networks (RNP, Renata, Cedia, Cudi, RAU, Reuna, C@ribNET, Internet2, Innova|RED, Conare, Ragie, Raices, RAAP, Reacciun/Cenit, ADSIB, RedCyT, Arandu, and Radei), participated in the eHealth Conversations coordinated by PAHO.[5] A current initiative is led by RedClara, RNP, Cudi, and the Mexican NREN, to stimulate and develop collaborative processes to enable a better understanding of how to promote and run Telemedicine University Networks in Latin America. They also organise collaborative sessions among Latin American (LA) countries on Telemedicine and health specialties. An example on endoscopy, conducted by the Kyushu University Hospital in Japan, has been running since 2008 which also include LA partners.[6] The next session is being organised by the Clinic Hospital from the State University of São Paulo (USP).

In 2012 the Programme for Maintenance and Development of RNP (which also includes the Ministry of Education, Ministry of Science, Technology and Innovation, and the Ministry of Culture) was officially integrated into the Health Ministry.

In 2007 nine states (Amazonas, Ceará, Pernambuco, Minas Gerais, Goias, Rio de Janeiro, São Paulo, Santa Catarina and Rio Grande do Sul), began the National Telehealth Programme. Since then all have expanded their programmes to provide tele-assistance and tele-education to at least, 100 municipalities each. Two of them, from Santa Catarina and Minas Gerais, have had their projects sustained and turned into services by their Health State Department, assisting 250 and 770 municipalities respectively.[7]

The National Research and Education Network (RNP)

RNP's mission is to promote the innovative use of advanced networks in Brazil. In addition to providing connectivity, RNP facilitates the interaction between researchers and resources located far from more developed centres, enables the deployment of new network applications and protocols, and forms integrated scientific communities with great benefits to the public, in areas such as education and healthcare.[8] Under the Social Organisation (OS) title, RNP is linked by a special contract to the Ministry of Science, Technology and Innovation (MCTI), which

coordinates the Programme for Maintenance and Development of RNP mentioned above. A pioneer in Internet access in Brazil, RNP develops and operates the Ipê Network, a nationwide high performance optical network. With Points of Presence in all 27 states, the network connects over 1,200 campuses and university units in state capitals and major cities in the country's interior. It serves approximately 3.5 million users, taking advantage of an advanced network infrastructure for communication, computing and experimentation, which contributes to the integration of the whole system of Science and Technology, Higher Education, Health and Culture.

## RUTE's Objectives

The two main goals of the RUTE programmes are to:

1. implement an IT infrastructure for the interconnection of faculty, university hospital and teaching units from different regions of the country, enabling communication and collaboration for national and international educational and research institutions

2. improve care of the population in the most underprivileged regions without specialised medical care, through the resulting benefits achieved by the exchange of specialised medical knowledge over the above infrastructure.

The following approach was devised to create an operational structure for RUTE:

• The formation of a national coordination advisory committee, several special interest groups, centres for the implementation and maintenance of telehealth communication and a certified infrastructure for national and local network were required to achieve the first objective – implementation of organisational and technological infrastructure

• Each health institution was invited to submit a project to formally establish its Telehealth Unit, including a physical location and a dedicated team

• The institutions could propose, create and coordinate Special Interest Groups that promote the development of collaborative activities in health specialties.

## Collaborative scientific network using Special Interest Groups

Currently, there are 55 SIGs collaborating in areas such as audiology, nursing, cardiology, psychiatry, ophthalmology, child and adolescent healthcare,

paediatric radiology, neurology, and dentistry among others. They promote approximately two to three scientific sessions every day, yielding around 600 video and web conference sessions per year, which are recorded and made available for those who are not able to participate on the live sessions. (Figure 1)

Global demand in the field of healthcare, recent research, new ICT creation and expansion of each of the 118 RUTE units in Brazilian universities, university hospitals, research institutes, and certified teaching hospitals, guarantee the search for innovation, sustainability and the development of tools, services and processes for education, remote assistance, collaborative research, management, monitoring and telehealth evaluation, using advanced networks.

Since 2013, real-time surgeries and procedures among RUTE Centres are transmitted in Ultra High Definition within the country, and also in some sessions to the USA. The 4K technology generates images with resolution four times higher than Full HD. (Figure 2) Other research projects such as mobile and 3D applications are being developed.

From April to July 2014, coordinators of the first



**Figure 2**. The 4K technology allows the generation of images with resolution four times higher than that of Full HD.

100 RUTE units and 55 SIGs were invited to answer an online survey about their current status. These data were used in a process of graphical data visualisation to represent the social network analysis of RUTE, focusing on the role of coordinating SIG units. Three main highlights are noted from the graphs, and are discussed as relevant results. The RUTE units



**Figure 1**. Sample of SIG's agenda Oct 2015.

considered most collaborative are located in the centre of the graph and interconnected according to the number of coordination SIGs. They are: UNIFESP, UERJ, UFBA, ISCMPA, UFSC, UFES, UFRN and HSL.[9]

Between September and December 2015, the SIG on Residency in Health promoted weekly videoconference session (VC) updates for preceptors in Residency management, coordinated by the Ministry of Education. This initiative alone is yielded an average of 50 VC rooms and 600 participating preceptors in each session. Participant presence is registered in a web and mobile system specially designed for this purpose.[10]

## Evaluation an important component in the improvement of RUTE

The diffusion and reach of applications of telemedicine depend on its maturity and performance levels. The level of maturity is related to the quantity and quality of research, development of standards and protocols, and acceptance by health professionals. The level of performance depends on the quantity and quality of published results on viability, diagnostic precision, sensitivity and specificity of application, clinical indicators and effectiveness.[11]. However, the literature has emphasised the lack of scientifically recognised evidence of the effectiveness of telemedicine and telehealth. This is a barrier to its consolidation as a consistent alternative for improving service provision, broadening access to healthcare services and reducing costs. Thus, assessing telemedicine projects and programmes is essential to allow reproduction of positive experiences and mitigation of negative experiences that may still exist. Assessment in healthcare consists of systematic analysis of safety, pertinence, sufficiency, efficiency, effectiveness, and the positive and negative effects of healthcare programmes or activities.[12]

Assessments can indicate whether a programme or activity is: pertinent (satisfying stated needs, policies and social and healthcare priorities); sufficient (proportional to needs); efficient (the efforts expended are the most satisfactory possible in terms of the resources employed); and effective (the results obtained are close to the objectives and goals established for reducing the size of a problem or improving an unsatisfactory situation). In the recent context of Brazilian telemedicine and telehealth programmes, assessment and academic assessment

processes with distinct objectives and methods have been incorporated.

In 2013, Lopes studied the contribution of RUTE to the development of new healthcare practices, based on the idea that eHealth practices are the techniques, practices, attitudes, modes of thinking, and new values that develop as a result of the growth of digital space.[13] The RUTE programme provides supportive action that aims to transform the practice of eHealth. Lopes set out to investigate the contribution of the project along five axes to describe the condition of the units and establish performance measures for the practice of digital health within the project: The five axes were: healthcare education – ENS; remote collaborative care practices – ASS; multicenter research, development, innovation, and research on telemedicine itself – PDI; university hospital management – GES; and 5 social impact – SOC. The method used for this mixed methods exploratory study was an electronic survey using a questionnaire with 55 semi-structured questions. Coordinators from 72 operational RUTE telemedicine units were asked to complete the survey. The response rate was 75% of RUTE units. In addition, 203 qualitative interviews collected perceptions regarding the network's impact on the units, classified into 14 categories upon thematic analysis. Quantitative performance was measured comparatively along the five axes for analysis. The study showed that the operational units were mainly focused on using RUTE for the education axis, followed by healthcare provision, and then research. (Figure 3)
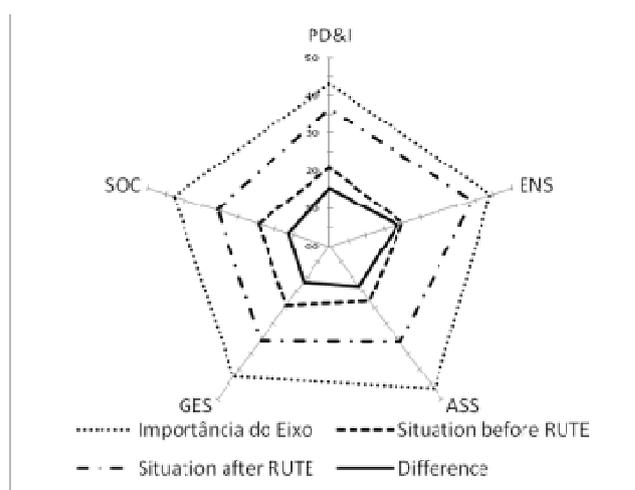


**Figure 3.** Evolution of Digital Health Practices with the implementation of RUTE.

Note the mean level of importance of axis according to Rute unit coordinators, mean level of local digital health practices before the Rute project and after the operation of the Rute project, and, finally, the gradient indicating the Rute axes with the highest impact on this new healthcare practice.

In view of the assumptions made about the RUTE programme, as proposed by RNP, the results obtained in this study of the operational units indicated that the network has instigated and stimulated the development of new eHealth practices in university hospitals, especially in education and research.

## Conclusion

RNP's offering as an advanced communication infrastructure arose as a technological response to healthcare and research and education demands that developed into a Telemedicine University Network initiative – RUTE. The success and sustainability of RUTE lies in the participation, coordination, integration and funding coming from the three sponsor Ministries: Education; Health; and Science, Technology and Innovation.

The model shows how an academic network manages to bring together several health institutions to work in cooperation, forming a scientific community within a virtual network. The network makes use of ICT to bring healthcare and education to people in remote areas, and to those who need health services most. It also uses ICT to remotely manage its activities, promote collaboration, education, and monitor and evaluate its own performance and results.

Healthcare has been delivered by the Telemedicine network using a multidisciplinary specialty approach. This leverages the power of multiple institutions in a network allowing each to offer their best, bringing not only expertise but also resources to make the network a successful social innovation, and presenting many lessons to be learnt.

This and similar NREN examples around the world are transforming the way healthcare is applied, managed, monitored and evaluated. Such virtual collaborative approaches and efforts are being undertaken by researchers, health authorities, and other enterprises to promote integration of other South American NRENs, and to support remote scientific communities at the Brazilian borders. Similar approaches have also been undertaken within BRICS countries, exhibiting geographical similarities and challenges.

RNP/RUTE clearly demonstrates that ICT and Health, that is eHealth, forms a strong alliance for remote health-related assistance, education, and collaborative research.

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**Conflict of Interest.** The authors declare no conflicts of interest.

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