

# National Research and Education Networks to support Healthcare: The Brazilian Telemedicine University Network RUTE

P.R.L. LOPES, N. SIMOES, W. COURY, J. L. RIBEIRO, D. CAETANO, P. MACHADO,  
M. PEREIRA, L. MEIRELES, T.D. L. V.BRITO, L.A. MESSINA<sup>1</sup>, I.T. PISA<sup>2</sup>, A.E.  
HADDAD<sup>3</sup>, N. AL-SHORBAJI<sup>4</sup>

<sup>1</sup>*Rede Nacional de Ensino e Pesquisa, Rio de Janeiro, Brazil, coord@rute.rnp.br*

<sup>2</sup>*Universidade Federal de São Paulo, São Paulo Brazil, ivanpisa@unifesp.br*

<sup>3</sup>*Universidade de São Paulo, São Paulo Brazil, anaeestelahaddad@gmail.com*

<sup>4</sup>*Knowledge World Company for Digital Content, Amman, Jordan, shorbajin@e-marefa.net*

## Abstract

**Motivation:** National Research and Education Networks NRENs world wide are expanding capacities, forming Academic Telehealth Community Collaboration of health scientists, bridging Science, Technology, Innovation, Education, Assistance and Health Federal Authorities to discuss, finance and work together. The World Health Organization - WHO promotes Universal Health Coverage as a goal for equitable access to health services without pushing people to poverty. Using information and communication technology to bring healthcare to people in remote areas and to those who need health services most is one of the objectives of UHC. **Problem statement:** RUTE, the Telemedicine University Network from Brazil, under the NREN RNP ([www.rnp.br](http://www.rnp.br)) launched July 2015 its 118th Telemedicine Unit in University and Teaching Hospitals in all 27 states. Over the network collaboration model operates 48 Special Interest Groups in health specialties with 2 to 3 scientific videoconference sessions everyday ([rute.rnp.br](http://rute.rnp.br)). RUTE is part of the Brazilian Telehealth Program ([www.telessaudebrasil.org.br](http://www.telessaudebrasil.org.br)), coordinated by the Secretariat of Work and Health Education Management (SGTES) of the Ministry of Health, that seeks to improve the quality of the service and basic care of the Unified Health System (SUS). **Approach:** RUTE's objectives are: 1. Implement infrastructure for the interconnection of faculty, university hospital and teaching units from different regions of the country, enabling the communication and collaboration between national and international educational and research institutions. 2. Improve care of populations in the most underprivileged regions without specialized medical care through the resulting benefits achieved by the exchange of specialized medical knowledge. The telehealth and telemedicine centers are equipped with cutting-edge equipment, for real-time communication, connected to high performance network infrastructure operated by the RNP. **Results:** Also newly composing the initiative – RUTE 2.0, started in 2011, today more than half of the federal university hospitals are managed by the Brazilian Enterprise for Hospital Services <http://ebserh.mec.gov.br/>. In partnership with 18 Latin American Ministries of Health through the Telehealth Regional Project from the Inter-American Development Bank (IADB), RUTE, was certified for best practice of telemedicine by IADB, the Pan American Health Organization (PAHO) and the Economic Commission for Latin America and the Caribbean (Eclac). **Conclusions:** RNP offers

advanced communication infrastructure. Healthcare, R&E has demonstrated more interest and developed into a Telemedicine University Network RUTE. Important also for its sustainability lies on the participation, coordination, integration and financing from the Ministries of Science, Technology and Innovation, Education, and Health. The model taken into consideration shows how an academic network manages to bring together a number of health institutions to work together to utilize information and communication technology to bring healthcare to people in remote areas and to those who need health services most, remotely manage, collaborate, educate, monitor and evaluate. RNP/RUTE's unquestionable statement is its ICT and Health proved qualification for remote assistance, education and collaborative research.

## **Keywords**

Telemedicine, Telehealth, e-Health, NREN

## **1. Introduction**

National Research and Education Networks (NRENs) worldwide are expanding capacities, creating academic telehealth community collaboration teams of health scientists, bridging science, technology, innovation, education, assistance and health federal authorities to discuss, seek funding and work together. The World Health Organization - WHO 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 technology 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 program, coordinated by the NREN RNP ([www.rnp.br](http://www.rnp.br)). In September 2015 RUTE launched its 118th Telemedicine Unit, all of them located in university and teaching hospitals all over the 27 Brazilian states. Over the network collaboration model operates 55 special interest groups (SIGs) in health specialties with 2 to 3 scientific videoconference sessions every day and 150 participating institutions. The program published last year its second book on its impact in the Brazilian Telehealth initiative as well as in Latin America ([rute.rnp.br](http://rute.rnp.br)) (Messina et al, 2014, European Union (2004,2006 and ICY in Health (2013, 2014)1,2,3. 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." It might provide thoughts and even guidance to policy makers.

## **2. The National Research and Education Network RNP**

RNP's mission is to promote the innovative use of advanced networks in Brazil. Additionally to providing connectivity, RNP makes the interaction between researchers and resources located far away from more developed centers, enabling the deployment of new network applications and protocols, forming integrated scientific communities with great benefits to the public, in areas such as education and health care ([www.rnp.br](http://www.rnp.br)). Under the Social Organization (OS) title, the National Research and Education Network (RNP) is linked by a special contract to the Ministry of Science, Technology and Innovation (MCTI), which coordinates the Program 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 1200 campuses and university units in state capitals and major cities in the country 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.

### **3. Telehealth Initiatives Context**

RUTE is part of the Brazilian Telehealth Program ([telessaudebrasil.org.br](http://telessaudebrasil.org.br)), coordinated by the Secretariat of Work and Health Education Management (SGTES) of the Ministry for Health, that seeks to improve the quality of the service and basic care of the Unified Health System (SUS) and to promote tele-assistance and tele-education along with the Open University of the Unified Health System (Unasus) ([unasus.gov.br](http://unasus.gov.br)), facilitating access and training to healthcare professionals. The telehealth and telemedicine centers are equipped with cutting-edge IT equipment for real-time communication connected to high performance network infrastructure operated by RNP. Currently, telehealth services, beyond RUTE, are provided in 14 states encompassing 30 thousand professionals from the Family Health Program, present in more than 2 thousand Brazilian municipalities. Since 2012 the Health Ministry officially integrates the Program for Maintenance and Development of RNP, which also includes the Ministry of Education, Ministry of Science, Technology and Innovation, and the Ministry of Culture.

It is worth to note that 9 states, including Amazonas, Ceará, Pernambuco, Minas Gerais, Goiás, Rio de Janeiro, São Paulo, Santa Catarina and Rio Grande do Sul, which were the first Brazilian states that in 2007 started the National Telehealth Program, all expanded to provide tele-assistance and tele-education to, least, 100 municipalities each. Two of them, from Santa Catarina and Minas Gerais (Alkmin, M.B.M. et al, 2010) have their projects sustained and turned into services by their Health State Department, assisting respectively 250 and 770 municipalities.

Started in 2011, the Brazilian Enterprise for Hospital Services – EBSEH ([ebserh.mec.gov.br/](http://ebserh.mec.gov.br/)), a new organization responsible for the management of more than half of the federal university hospitals, is also supporting the RUTE.

In partnership with 18 Latin American Ministries of Health (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 IADB, RUTE and the Brazilian Telehealth Program, among others, were certified for best practice of telemedicine by the Inter-American Development Bank (IADB)(Desarrollo..., 2013) the Pan American Health Organization (PAHO) and the Economic Commission for Latin America and the Caribbean (Eclac).

The regional academic network RedClara, and the academic networks, RNP, Renata, Cedia, Cudi, RAU, Reuna, C@ribNET, Internet2, InnovaRED, Conare, Ragie, Raices, RAAP, Reaccium/Cenit, ADSIB, RedCyT, Arandu, Radei, participated in the eHealth Conversations coordinated by PAHO (Conversacione...2014) There is an initiative today lead by RedClara, RNP and Cudi, 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, organizing also collaborative sessions among LA countries on Telemedicine and health specialties.

#### **4. RUTE's objectives**

The two main goals of the RUTE program can be listed below as:

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

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

- A national coordination, advisory committee, several special interest groups, centers for the implementation, maintenance, of telehealth communication, and a certified infrastructure for national and local network was responsible to achieve the first objective -- Implement organizational and technological infrastructure;
- Each health institution is invited to submit a project to formally establish its Telehealth Unit, including a physical location and a dedicated team;
- The institutions can propose, create and coordinate Special Interest Groups that promote the development of collaborative activities in health specialties.

#### **5. 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 health care, pediatric radiology, neurology, dentistry among others. They promote approximately 2 to 3 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.

Global demands in the field of health care, recent research, new ICT, creation and expansion of each one 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 Centers are transmitted in Ultra High Definition in the country, and also in some sessions to USA. The 4K technology generates images with resolution four times higher than Full HD. Other research projects such as mobile and 3D applications are being developed.

Starting in September and lasting until the end of December 2015, the SIG on Residency in Health is promoting weekly videoconference session (VC) updates for preceptors in Residency management, coordinated by the Ministry of Education. This initiative alone is yielding an average of 50 VC rooms and 600 participating preceptors in each session. Participants presence is registered in a web and mobile system specially designed for this purpose ([www.rute.rnp.br/presenca](http://www.rute.rnp.br/presenca)).

## **6. Assessment an important component in the improvement of RUTE**

The diffusion and reach of applications of telemedicine depend on its maturity and performance levels. Level of maturity is related to the quantity and quality of research, development of standards and protocols, and acceptance by health professionals. 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 (Bashur, R.L, 2002) However, the literature has emphasized the lack of scientifically recognized 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 programs is essential to allow reproduction of positive experiences and prevention of negative experiences that may still exist. Assessment in health care consists of systematic analysis of safety, pertinence, sufficiency, efficiency, effectiveness, and the positive and negative effects of healthcare programs or activities (Silva, A.B.&Hammerl, L.S.M., (2012) Assessments can indicate whether a program or activity is: pertinent (satisfying the needs, policies and social and healthcare priorities that it aims to apply); 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 programs, assessment and academic assessment processes with distinct objectives and methods have been incorporated.

In 2013, Lopes (2013) studied the contribution of RUTE to the development of new healthcare practices, based on the idea that digital health practices are the techniques, practices, attitudes, modes of thinking, and new values that develop as a result of the growth of digital space. The RUTE program provides supportive action that aims to transform the practice of digital health. 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 axes were: 1) healthcare education – ENS; 2) remote collaborative care practices – ASS; 3) multicenter research, development, innovation, and research on telemedicine itself – PDI; 4) university hospital management – GES; and 5) social impact – SOC. The method used for this quali-quantitative exploratory study was an electronic questionnaire with 55 semi-structured questions that have been used with coordinators from 72 operational RUTE telemedicine units. The response rate came from 75% of RUTE units; 203 qualitative interviews collected perceptions regarding the network's impact on the units, which in turn were classified into 14 categories. 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 1).

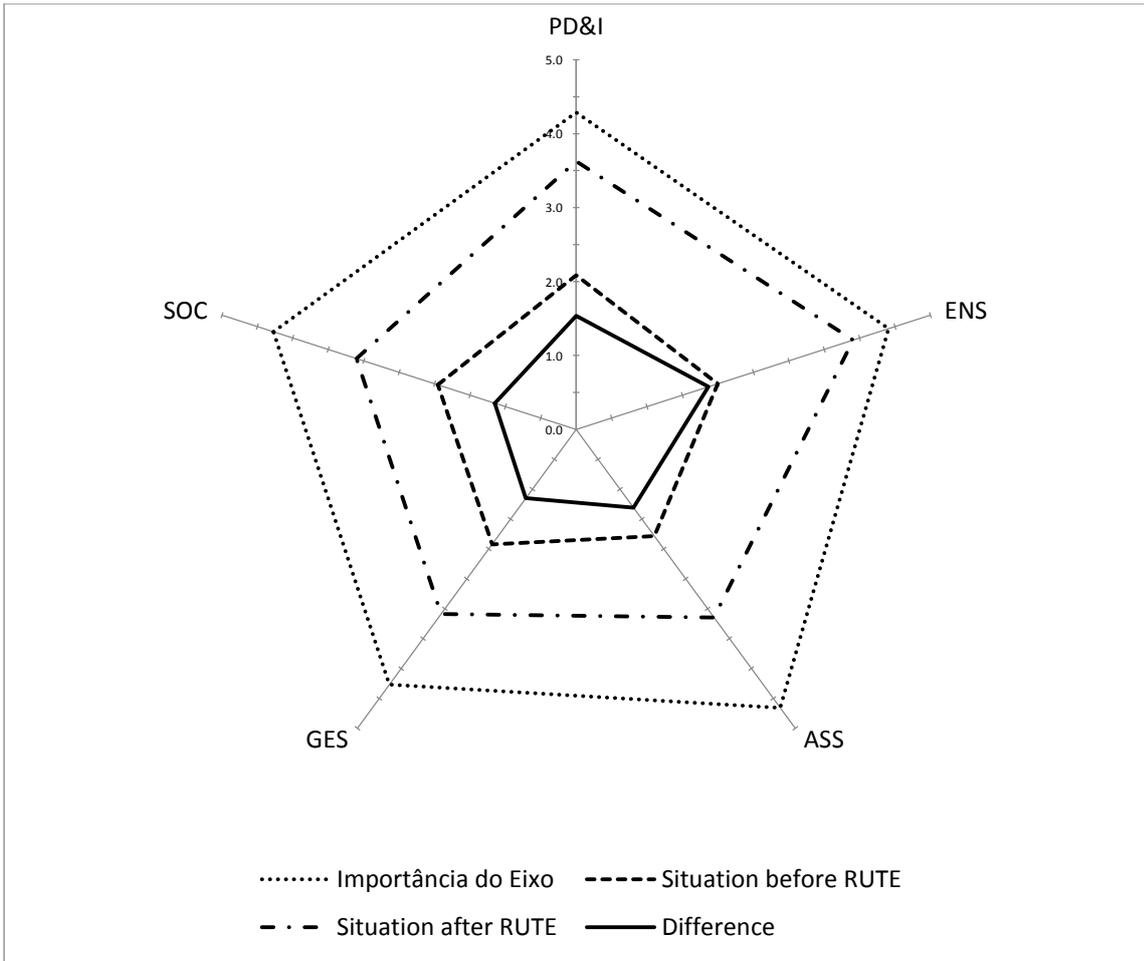


Figure 1: Evolution of Digital Health Practices with the implementation of RUTE.

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 program, 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 digital health practices in university hospitals, especially in education and research.

From April to July 2014, coordinators of the first 100 RUTE units and 55 SIGs were invited to answer an online survey about their current status. Based on these data, it was carried out a process of data visualization in the form of graph to represent the social network analysis on RUTE, focusing on the role of coordinating SIG units. Three main highlights were noted on the graphs, and discussed as relevant results. The RUTE units considered most collaborative are located in the center of the graph and interconnected according to the number of coordination SIGs. They are UNIFESP, UERJ, UFBA, ISCMPA, UFSC, UFES, UFRN and HSL (Brito, T.D.L.V., 2015)

## 7. Conclusions

RNP's offering as an advanced communication infrastructure, came as a technological answer to Healthcare and R&E demands that developed into a Telemedicine University Network initiative – RUTE. Great importance of RUTE's sustainability lies on the participation, coordination, integration and funding coming from the 3 sponsor Ministries: Education, Health, and Science, Technology and Innovation.

The model taken into consideration shows how an academic network manages to bring together several health institutions to work in cooperation, forming a scientific community in a network, which makes use of information and communication technology to bring healthcare to people in remote areas and to those who need health services most. It also remotely manages its activities, promotes collaboration, education, and monitors and evaluates its own performance and results.

Healthcare has been delivered by the Telemedicine network as a multidisciplinary specialty approach. This brings the power of multiple institutions in a networked model to get the best of each one of them, bringing not only its expertise but also resources to make the scientific network a successful social innovation, presenting many lessons to learn.

This and similar examples in worldwide association with NRENs are transforming the way health methodology can be applied, managed, monitored and evaluated. Collaborative approaches and efforts are being undertaken by researchers, health authorities and enterprises to promote also integration of other South American NRENs and the scientific communities at the Brazilian borders. Similar approach is also undertaken with BRICS countries, which also show geographical similarities and challenges.

RNP/RUTE's unquestionable statement is that ICT and Health proved its qualification as a strong alliance for remote assistance, education and collaborative research.

## References

Alkmin, M.B.M. et al, (2010) *The economic impact of using telehealth on primary care on the municipal budget in the State of Minas Gerais*, [http://www.medetel.lu/download/2010/parallel\\_sessions/presentation/day2/The\\_Economic\\_Impact.pdf](http://www.medetel.lu/download/2010/parallel_sessions/presentation/day2/The_Economic_Impact.pdf) [accessed 2 March 2016].

Bashur, R.L.; Mandil, S.H.& Shannon, G.W. (2002) 'Introduction: State-of-the-Art Telemedicine/Telehealth: An International Perspective.' *Telemedicine Journal and e-Health*, 8(1), 2002, pp. 3-4.

Brito, T.D.L.V., Baptista, R.S Lopes, P.R.L., Haddad, A.E., Messina, L.A, & Pisa, I.T.,(2015) ' The Collaborative Coordination of Special Interest Groups on the Telemedicine University Network (RUTE) in Brazil.' *15th World Congress on Health and Biomedical Informatics. São Paulo, Brazil, August 2015*.

Conversaciones sobre eSalud: (2014) *Gestión de información, diálogos e intercambio de conocimientos para acercarnos al acceso universal a la salud* OPS 2014, [Spanish]  
Download the book in .pdf format

Desarrollo de la telesalud en América Latina: aspectos conceptuales y estado actual, CEPAL octubre 2013 [http://www.cepal.org/es/search?as\\_q=telesalud](http://www.cepal.org/es/search?as_q=telesalud) [accessed 2 March 2016]

European Union – Latin America and the Caribbean Ministerial Forum on the Information Society, IV and VI (2004, 2006) – @lis, Rio de Janeiro, Nov. 2004, Lisbon, April 2006.

ICT in Health (2013 ,2014) *Survey on the use of ICT in Brazilian healthcare facilities*, [www.cgi.br](http://www.cgi.br)

Lopes, P.R.L.(2013) *Investigação sobre a contribuição da Rede Universitária de Telemedicina no desenvolvimento de uma nova prática de saúde digital*. 2013. 155 p. Tese (Doutorado em Gestão e Informática em Saúde) – Curso de Pós-Graduação em Gestão e Informática em Saúde, Universidade Federal de São Paulo, São Paulo, 2013

Messina, L.A. et al, (2014) *Rute 100 – As 100 primeiras unidades de Telemedicina no Brasil e o impacto da Rede Universitária de Telemedicina (RUTE)* <<http://rute.rnp.br/web/rute/impactos-da-rede-universitaria-de-telemedicina>> editora e-papers 2014.

Silva, A.B.& Hammerli, I.S.M. (2012) ‘ O caso da Rede Universitária de Telemedicina: análise da entrada da telessaúde na agenda política brasileira.’ *Physis Revista de Saúde Coletiva, Rio de Janeiro*, 22(3), 2012, pp 1211-1235.

## Biography

P.R.L. Lopes - PhD in health informatics and telehealth. Nowadays, he is Innovation Manager in Telemedicine University Network project collaborating with national project coordination for research, analysis, planning, development, implementation and capacity building in information and communication technology in remote assistance, education, research, management and assessment in healthcare. He also participate in various committees and working groups: Member of Standing Committee member of Telemedicine – Ministry of Health, Rapporteur of the Telemedicine on Communication Commission at the ANATEL (“National Telecommunications Agency”), Specialist on WG2 Interoperability for Devices and Systems in the Special Study Group 78 - Health Informatics at the ABNT (“Brazilian Technical Standards Association”), Specialist on ICT in Health – Survey on the use of ICT Technologies in Brazilian Healthcare Facilities at the CGI.br (“Brazilian Internet Steering Committee”), and Coordinator of Component 1 – Standards on the project for Telehealth Public Goods for Latin America and the Caribbean, sponsor by IADB - Inter-American Development Bank.