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Telepharmacy: The Pharmacy of the 21st Century

Marlise Araújo dos Santos[1,4]*, Patrícia Bellicanta Lazzarotto[1,4], Helena Willhelm de Oliveira[2,4], Júlio César M de Lima[3,4] and Thais Russomano[4]

[1]Joan Vernikos Aerospace Pharmacy Laboratory, Brazil

[2]eHealth Laboratory, Brazil

[3]Aerospace Engineering Lab, Brazil

[4]MicroG- PUCRS, Brazil

***Corresponding author:** Marlise Araújo dos Santos, Joan Vernikos Aerospace Pharmacy Laboratory, MicroG- PUCRS, Brazil, Tel: +55 51 998287743 and +55 51 33536369; Email: marlise.santos@pucrs.br

Published Date: June 27, 2017

ABSTRACT

Telehealth is a new area of health assistance, research, and education, in which information and telecommunication technologies **(ICT)** are used to give support services to communities where there is a lack of healthcare or access to particular specialties of medical assistance. One area of activity of telehealth is telepharmacy, which makes pharmaceutical assistance possible to remote and disadvantaged areas.This Chapter presents the establishment of the first telepharmacy services in U.S. hospitals, its spread to local pharmacies and other countries. The Brazilian Telepharmacy experience is highlighted, which includes the laws and regulations involving the rational use of medication and medicinal plants, and how the Brazilian Health Policy and System promotes and motivates this area. According to Brazilian laws, for example, in addition to medical doctors and dentists, nutritionists, pharmacists and physiotherapists can prescribe medicinal plants and phytotherapies to their patients. This Chapter also discusses the eHealth

activities of the MicroG Centre, PUCRS. The MicroG telehealth assistance projectsbegan in its eHealth Laboratory, as a multidisciplinary initiative, involving joint projects with other labs of the MicroG, such as theAerospace Engineering and Joan Vernikos Aerospace Pharmacy laboratories. The latter has three different pharmacy assistance projects that includethe evaluation of drug interactions, drug adverse effects, drug- medicinal plant interactions, and the identification of medicinal plants and the interference of cultural aspects of different communities on their use. Therefore, the application of telecommunication and computer technologies, software and digital tools has allowed and promoted a more cost-effective spread of the technical and scientific knowledge of different areas of pharmacy. In this way, telepharmacy has successfully enabled the delivery of pharmaceutical care to patients in situations and regions where direct contact with a pharmacist is not possible, which in turn improves the quality of life of patients as a whole.

INTRODUCTION TO TELEPHARMACY

Telehealth is an emerging area of health assistance, research, and education that applies information and telecommunication technologies **(ICT)** to enable the delivery of remote health-related care, education and support services to communities where there is currently a shortage of access, such as a lack of specialist healthcare or access to particular areas of medical assistance. Telehealth has the potential to transform and improve health services, and is an important support tool for enabling the diagnosis and management of diseases.

One of the areas of activity of telehealth programs is Telepharmacy, which makes remote pharmaceutical assistance possible. According to the National Association of Boards of Pharmacy (NABP), the practice of telepharmacy is "the provision of pharmacist care by registered pharmacies and pharmacists through the use of telecommunications to patients located at a distance" [1]. It comprises of actions, such as: [2] health assistance activities aimed at optimization of medication use through prescription, dispensing and consumption habits; and [3] educational initiatives based on the promotion of continuous education and social programs providing pharmaceutical information and assistance with the intention of reducing disparities and promoting equity [1].

Pharmaceutical care **(PC)** brings together a set of actions aimed at the improvement, protection and recovery of health, through the promotion of access to medicines and their safe and rational use [4]. According to the World Health Organization **(WHO)**, it can be defined as an indispensable service in the patient-drug relationship, and the process of healing or maintenance of health can be compromised without it [5]. Telepharmacy, therefore, has the potential to improve the quality of pharmaceutical care, leading to decreases in medication errors and adverse drug-related events, while as the same time increasing the cost-effectiveness of provision and improving access to care [1]. Telepharmacy then becomes an essential tool for the advancement of pharmaceutical care, a practice that prioritizes pharmacotherapeutic guidance and monitoring to help improve patient quality of life, and is of particular benefit in remote and/or disadvantaged areas, where it is often very expensive to recruit and support the activities of pharmacists [1].

The roots of telepharmacy first grew at a hospital level, through pharmaceutical care provision via telephone, with subsequent evolution as modern technologies developed, such as multimedia access tools designed to provide remote monitoring and therapy. The advent of telephone call centers also helped contribute to the wider use of telepharmacy, as they opened up the ability to provide medication counseling, and prior and refill authorization for prescription drugs, as well as formulary compliance monitoring [2]. However, the use of telepharmacy soon spread outside the confines of the hospital environment and into the community.

Telepharmacy was first officially evaluated in the United States in 2001,when North Dakota became the first state to examine its use through a study involving 81 pharmacies (53 retail and 28 hospital-based), conducted at North Dakota State University. The findings suggested the establishment of a telepharmacy service resulted in a reduction in the rate of dispensing errors to half that of the national average, which stood at 2% [6]. A further study, also conducted in North Dakota State and performed between 2005 and 2008, assessed the differences in medication dispensing errors between remote telepharmacy sites without an on-site pharmacist and community pharmacy sites with a pharmacist in attendance. The results demonstrated a lower overall rate (1.0%) and a slight difference in medication dispensing error rates between the remote telepharmacy sites (1.3%) and the control sites (0.8%) [7]. An evaluation conducted in 2017 examined the sustainability of the business model of the North Dakota Telepharmacy Project, involving 38 community pharmacy organizations (14 central, 24 remote) and 27 organizations (11 central and 16 remote sites), with an overall response rate of 71%. The community telepharmacy business model was noted as being more established than that of the hospital telepharmacy. The majority of respondents reported their telepharmacy sites (especially the remote sites) as generating little positive financial returns for the organization. They also believed the closure of their remote sites would significantly harm the communities they served, suggesting that, although the telepharmacy model does not generate significant economic profit, it is sustainable and benefits service users [8]. Furthermore, the positive experiences of the implementation of telepharmacy in North Dakota motivated an increase in the number of telepharmacy services in other U.S. states, such as in Michigan and Ohio, following the closure of many physical pharmacies due to the global financial crises from 2007 to 2009. This period of economic calamity saw a 12.1% reduction in total pharmacy numbers, mainly in rural areas, with 490 communities losing their only local pharmacy, creating a gap in healthcare services and decreased medication adherence [9].

Telepharmacy projects and initiatives have been applied in diverse areas. For example, the use of telepharmacy has featured in the U.S. Navy since 2008 in an attempt to overcome a lack of pharmacists throughout the organization. A single pharmacist remotely oversees the dispensing of medications at multiple satellite pharmacies through the use of a bar-coded administration system, pill-counting software and other remote technologies that allow automation of the pharmacy process. All this combined has created a more accurate, efficient and cost-effective system, speeding up the time of health care delivery [1]. Going beyond simple remote medication dispensing, the application of telepharmacy technology has expanded to include point-of-care refill authorization and medication assistance referrals, as demonstrated in a study assessing telepharmacy-related services and outcomes in pharmacies located in suburban western Washington State between 2007 and 2008. A network of five community health centers with no in-house pharmacies were remotely connected to a central pharmacy, improving patient care through the provision of telepharmacy services, including automated drug dispensing system units, webcam technology, and electronic medical charts to provide remote medication order processing/dispensing, patient counseling, refill authorizations, and medication assistance referral services [10].

The scope and reach of telepharmacy continues to grow with added services and new technologies to assist in remote assistance. More recently, a study conducted by Campbell et al. (2016) presented and discussed the implementation of12 telepharmacy services and emergency medicine **(EM)** pharmacist interventions in freestanding emergency departments. They aimed to describe and categorize pharmacist interventions provided as part of telepharmacy services, to categorize drug therapy recommendations based on therapeutic class of medication, and to determine the proportion of drug therapy recommendations associated with Institute for Safe Medical Practices **(ISMP)** high-alert medications. Over 62,000 patients participated in the study conducted in 2015, during a period in which on-site EM pharmacists were not available, with remote telepharmacy coverage being provided by EM and hospital staff pharmacists based at a tertiary care center. Results revealed 761 drug therapy recommendations were made, with the main therapeutic classes involved being: antimicrobial agents (62.2%), cardiovascular agents (11.0%), analgesic agents (9.3%), endocrine agents (5.0%), and GI agents (4.5%). Furthermore, 12.7% of these pharmacist interventions were associated with Institute for Safe Medical Practices **(ISMP)** high-alert medications. The research demonstrated that EM pharmacists were able to provide significant drug therapy recommendations via telepharmacy services, optimizing the medication therapy and improving the patient safety at the freestanding emergency departments involved [11].

A study conducted by Fensterheim et al. (2015) evaluated the impact on medication adherence of specialty patients, following an initial video conferencing session between the pharmacist and patient at the beginning of treatment. The evaluated patients included those diagnosed with hepatitis C (25%), rheumatoid arthritis (22%), multiple sclerosis (18%), and other specialty conditions (35%). The average patient age was 46 years, with 56% being female. The results revealed a significantly higher chance of patient adherence if they received a video consultation with a pharmacist prior to treatment, indicating the positive impact of this form of remote consultation on specialty pharmacy patients [12].

A recent and novel approach involving the use of telepharmacy at a hospital level is the application of DrugCam®, an intelligent video system for controlling chemotherapy preparations. Automatic verification of the process at the critical stages of medication preparation is achieved through real-time remote monitoring and full video recording, with subsequent partial or total visualization of the video recording permitting identification and verification of the drug vials and volumes used. The study was performed using 120 vials with sensitivity of 100% for 84.2% of the vials and at least 97% for all the vials tested. Accuracy was at least 98.5% for all vials and the quantitative analysis was assessed by detecting 10 measures of each graduation for syringes. The identification error rate was 2.1%, i.e. almost 94% to the next graduation. Only 3% of the graduations tested for volume <0.13 ml of 1 ml syringes, presented a volume error outside the admissible limit of ± 5%. The results demonstrated the vial detection reliability of the Drug Cam® monitoring system, which can also be used to read barcodes present on vials, and offers an innovative approach for controlling chemotherapy preparations through the application of hospital telepharmacy [13].

TELEPHARMACY IN BRAZIL

Pharmaceutical care public policybegan in Brazil with the approval of Decree No. 68806, on June 25th1971, within the institution of the Central Drug Agency **(CEME)**, the organization responsible for the acquisition and distribution of medicines. One of its aims was to promote and organize pharmaceutical care activities for the low-income population. CEME was responsible for pharmaceutical care in Brazil until July 24th 1997, when it was decommissioned through Decree No. 2.283. Subsequently, in 2004, the National Pharmaceutical Assistance Policy **(PNAF)** was established through Resolution No. 338 of the Brazilian National Health Council, focused on the research, development and production of medications and supplies, and all requirements to improve the quality of life of the population [4].

The use of plants for medicinal purposes in the treatment, cure and prevention of disease is one of the oldest forms of medicinal practice known to mankind, resulting from generations of accumulation of practical knowledge by various ethnic groups regarding the therapeutic action of these plants [14]. Brazil has a large bio diversity and, consequently, a high number of medicinal plants have been used as sources of healing, based on scientific knowledge and tradition [15]. Moreover, since 2006, Brazil has two current public policies favoring the widespread use of herbal medicines, namely, the National Policy on Integrative and Complementary Practices in the Public Health System **(PNPIC)** and the National Policy on Medicinal Plants and Herbal Medicines **(PNPMF)**, through the Ordinance 971/2006 and the Decree 5813/2006, respectively [4]. At the same time, the government has also established a public policy that provides free medication to the population, which are listed in the National Drug List (RENAME). Due to the continental size of Brazil, it presents different macroclimates that result in the predominance of several diseases in different regions. In this context, the policy of the government allows each municipality to determine the list of essential medicines to be dispensed free of charge to its population. These medications are usually prescribed by medical doctors, who work in the Brazilian Unified Public Health System (SUS - Sistema Único de Saúde). Despite the existence of these three different public policies, in general, medical doctors have little knowledge or information regarding medicinal plants or how they should be prescribed. In addition and rather mistakenly, the population at large tends to believe that herbal or medicinal plants are free from side effects, by virtue of their being 'natural'. This can result in their indiscriminate use within a context of self-medication. When administered, however, these products may produce positive or negative reactions in the body [14], as well as several undesirable interactions with different medications. Moreover, different medicinal plants often share the same popular name and, therefore, a plant with no therapeutic value can be mistakenly consumed in place of a plant with value. This is an important aspect, as the incorrect consumption of plants or an unawareness of possible deleterious combinations with prescribed medications, as well as the amount consumed, could lead to undesirable side effects, ranging in severity. For the most part, medical doctors have little or no training in evaluating the effects of plant remedies or their potential interactions. This affects how these are prescribed or combined with conventional medications in order to improve their therapeutic effect, but without causing toxicity or reducing the medication effect. [3,16].

Similarly to many countries, rural or remote urban communities in Brazil can have difficulties in supporting the presence of a full-time pharmacist, as recruiting professionals to live and work in these locations is often problematic [1,14,17]. The situation becomes even more complex when taking into account the regional diversity that exists in Brazil, which creates areas with different social and economic development, with disparity in culture and educational levels, as well as a huge variety of local environment conditions that influence the prevalence of certain diseases. These circumstances contribute to greatly increasing the cost of health assistance and make the organization of a unified and integrated Brazilian Primary Health Care System a complex challenge for health authorities and the government [16,18]. In this context, telehealth emerges as a tool that is able to contribute to the improvement of health assistance management and delivery to the Brazilian population, even in poor and remote areas, with telepharmacy having been more recently added to this service provision. It is important to emphasize that Brazil is the only country where the use of medicinal plants is included in the primary health care system and, consequently, in pharmaceutical care.

THE EHEALTH PROJECTS OF THE MICROG CENTRE: TELEPHARMACY PROJECTS AND INITIATIVES

The Microgravity Centre - Historical Aspects and Evolution

Established in 1999, the Microgravity Laboratory emerged as a result of joint efforts between the Schools of Medicine, Aeronautical Sciences, and Engineering at the Pontifical Catholic University of Rio Grande do Sul **(PUCRS)** in Brazil. The Laboratory grew and expanded over the next few years with increasing work output, and earned international acknowledgement for the pioneering and highly qualified research conducted there. In 2006, the Laboratory of Microgravity was transformed into the Centre of Microgravity **(MicroG)**, and officially integrated the research of several academic departments of PUCRS.

Today, the MicroG is, par excellence, a multidisciplinary research center participating in both undergraduate and graduate courses in numerous areas of knowledge. The Centre currently comprises of eight research Laboratories, developing projects in different fields of space life sciences, aviation research and eHealth activities.

The MicroG has established several partnerships with both national and international institutions, and with researchers prominent in their field. As a consequence, two of the eight Laboratories at the MicroG Centre have been named after internationally recognized professionals who have made significant contributions to their development, and to the area of aerospace science: The John Ernsting Aerospace Physiology Laboratory, carrying out research into the behavior and adaptation of human beings to aerospace environments; and the Joan Vernikos Aerospace Pharmacy Laboratory, dedicated to studying the effects of microgravity, hypogravity, and hyper gravity conditions on pharmaceutical medications and their effects on humans.

The MicroG is placed within the School of Engineering and TecnoPuc, the technological park of PUCRS. The center exists and works in a truly interdisciplinary environment and receives the support and collaboration of various professors from different Academic Units of PUCRS. This additional human resource, however, is dynamic and constantly changing from one year to the next, as research projects begin or come to an end. In general, each study carried out at the MicroG involves at least 4 professors from differing yet complementary fields.

LABORATORIES OF THE MICROG CENTRE

Aerospace Engineering Laboratory

Coordination - Prof. Julio Cesar Marques de Lima (School of Engineering)

The main objectives of the Aerospace Engineering Laboratory are research, design and development of tools, equipment and systems for biomedical studies in the aerospace environment and ground-based simulations.

John Ernsting Aerospace Physiology Laboratory

Coordination - Prof. Thais Russomano (School of Medicine)

The Aerospace Physiology Laboratory studies the function of the human body in the aerospace environment and human adaptation to extraterrestrial environments. The Laboratory conducts research in simulations of hyper gravity, hypo gravity, microgravity, spatial disorientation and hypoxia. Experts from this laboratory have participated in two campaigns of European Space Agency **(ESA)** parabolic flights.

Aerospace Physiotherapy Laboratory

Coordination - Prof. Denizar Alberto da Silva Melo (School of Nursing, Nutrition and Physiotherapy)

The establishment of the Aerospace Physiotherapy Laboratory, in partnership with the School of Nursing, Nutrition and Physical Therapy, aims to motivate professional contributions to this area of knowledge, through research related to human adaptation to the aerospace environment and subsequent rehabilitation to Earth post-flight. The scope of the laboratory also includes studies of the ergonomics of aircraft.

Joan Vernikos Aerospace Pharmacy Laboratory

Coordination - Prof. Marlise Araujo dos Santos (School of Pharmacy)

The Aerospace Pharmacy Laboratory, created in partnership with the School of Pharmacy, has the objectives of: conducting research on pharmaceutical medications and packaging materials in conditions that simulate microgravity and radiation during aerospace flights; research of the effects of simulated hyper gravity on the germination and growth of plants, and production of secondary metabolites in medicinal plants; studies related to the effect of drugs on space motion sickness and astrobiology.

Aviation Research Laboratory (Aviation Lab)

Coordination - Prof. Eder Henriqson (School of Aeronautical Sciences)

The Aviation Lab aims to contribute to aeronautical sciences knowledge by developing research projects related to: (1) accident prevention and human factors; (2) air transport management; (3) language, aviation and complex technological systems evaluation. The Aerospace Physiology Training Laboratory is responsible for lectures, workshops and practices related to the understanding of human physiology in aeronautical and aerospace environments.

Image Laboratory

Coordination - Prof. Dario Francisco G. de Azevedo (School of Engineering)

Created with the aim of gathering together professionals, students, professors and enterprises to develop digital signal processing algorithms. The Image Laboratory builds solutions to solve challenges from different areas, such as biomedical engineering, automation and eHealth.

UsaLab - Usability Laboratory

Coordination - Prof. Eduardo Giugliani (School of Engineering)

The UsaLab was established as an area to provide students, researchers and professors with a place where usability testing can be conducted, acting as an environment that recreates health-related scenarios, in which users interact with different medical and biomedical systems, protocols, equipment and devices with the intent of evaluating their usability.

eHealth Laboratory

Coordination – Prof. Helena Willhelm de Oliveira (School of Odontology)

The TeleHealth Laboratory aims to improve health care by developing and applying telecommunication technologies in the daily practice of health professionals, enabling them to have better access to decision making information. In order to accomplish this goal, the Lab has been undergoing multidisciplinary and multicentre research projects, which are divided into four main areas: Education, Research, Assistance, and Biotechnology. As a result of its national and international collaborations on eHealth projects, the Lab has been able to establish signed partnerships with institutions in Europe, the Americas, Asia and Africa.

eHealth Lab Areas of Activity

Education

eHealth education programs are becoming a reality in universities, research institutions and scientific organizations. It provides the opportunity for a more dynamic and up-to-date teaching and learning process with a better and more efficient outcome. The objectives are (1) to stimulate the interest of students, researchers and professors in the study, development and application of telehealth/eHealth devices and systems on medical/health education; and (2) to develop virtual medical education tools (education platforms, materials and equipment, as well as apps and virtual reality/A.I. systems that can be applied to health education, research and health delivery/assistance). Projects can also include the organization, promotion and conduct of one-to-one or multipoint educational programs, including lectures, conferences, and online courses. Undergraduate and graduate students coming from IT, engineering, health-related areas can be introduced to new concepts of health/medical care, remote second opinion delivery, and to telecommunication systems used in mHealth/eHealth.

Research

Virtual meetings, secure information exchange systems and low-cost telecommunication technologies have enabled health professionals, located in different parts of a region, country or even the world, to become involved in case discussions and to give expert opinion regarding health-related matters. The use of these combined technologies for the enhancement of research activities has resulted in the ability to conduct eResearch. The eHealth Lab/MicroG-PUCRS eResearch project aims to (1) foster greater national and international multi-disciplinary collaboration, having already performed live surgery transmission for discussion at a medical congress and in classrooms; (2) live data and image transmission of a physiological experiment to international partners; (3) evaluation and data analysis of health/medical assistance projects conducted in remote/poor areas; (4) scientific assessment of protocol and acquired data related to educational projects and programs in eHealth.

Assistance

Brazil is a country with continental size, an uneven distribution of financial resources, and social inequalities and problems. A lack of access to medical specialists exists in smaller towns, and remote and poor areas, causing delays in diagnosis and inadequate management of diseases. In such cases, telehealth can provide access to information exchange and virtual case discussions, supporting health professionals in clinical decisions. Telehealth constitutes a highly innovative technology in which it is the information itself that travels and not the patient or health care professional. It uses tools that enable the sharing of health information, providing, for example, expert second opinion at distance, which can contribute to greater efficiency and effectiveness of medical care in remote areas. The development of this area at the MicroG grew from the positive results of the experience gained in implementing four telemedicine care activities in different regions of Brazil. Through these initiatives we were able to evaluate results and assimilate into future projects the benefits that are gained from problem solving by a team working together with the use of telehealth. Moreover, the importance of a full assessment of the level of knowledge of health care teams and patients regarding telehealth and its applications was highlighted. Improvements in the quality of care provided to local populations was made possible through the provision of specialized medical assistance to remote urban communities using telecommunication systems, software development, mobile technologies and biomedical engineering. The initiatives undertaken by the eHealth Lab of the MicroG have included many different areas of the health spectrum, such as teledermatology, telecardiology, teleodontology, telepharmacy, telenutrition.

Biotechnology

This area concentrates on the development of hardware and software, A.I. and virtual reality systems to be used in eHealth-related projects in the areas of education, research and assistance. The biotechnology area of the eHealth Lab-MicroG Centre has an essential role in the support of projects, as it is provides the technological basis for the establishment, running, conduct and study of eHealth initiatives.

The four areas described above work in a multi- and interdisciplinary manner, with the main goal of providing faster, better and more up-to-date solutions for the establishment of eHealth projects.

Telepharmacy Projects and Initiatives

The Microgravity Centre at PUCRS has initiated academic and research activities in the area of telehealth since 2002, with telepharmacy being introduced to its scope in 2008. This was made possible thanks due to the joint efforts of the Joan Vernikos Aerospace Pharmacy Lab, the Aerospace Engineering Lab and the TeleHealth Lab.

The Telepharmacy activities, projects and initiatives of the MicroGCentre have included:

Evaluation of the use of medications and medicinal plants in relation to drug interactions and adverse reactions

Studies related to this topic have been conducted in three remote Brazilian communities in the Alto Xingu-MT (2008), Manaus-AM (2010) and Palmares do Sul-RS (2012) regions. From all these remote regions, the patient health information was acquired, encrypted for an online transmission and then analyzed by professional experts located in a tertiary health center.

The first project occurred in an environmentally protected geographical area in Alto Xingu-MT with an indigenous population. This National Park, called the Parque Indígena do Xingu, is divided into three main regions; Baixo-Xingu, Médio-Xingu and Alto-Xingu, all located in the state of Mato Grosso in the central west region of Brazil [1]. The indigenous community that participated in this project came from the Alto-Xingu region anda total of 111 patients were interviewed. Thesecond health assistance project was conducted in the city of Manaus, located in the Amazon state in northern Brazil. Once more, a total of 111 patients were interviewed. The third and most recent project occurred in a small town called Palmares do Sul in the state of Rio Grande do Sul in southern Brazil. On this occasion a total of 49 patients were interviewed, residents of the city itself and from local indigenous communities.

Figure 1 presents the percentage of the population that used medications and those among them requiring pharmaco therapeutic interventions. It summarizes the data from the three assistance projects, showing a total of 271 patients evaluated, of which 120 (44.3%) were taking medication. In 60 (22.1%) cases, health support was given remotely in relation to the pharmaco therapeutic interventions used, which promoted a more effective use of the medication, with interventions being necessary in 50% of the patients that were taking medications.

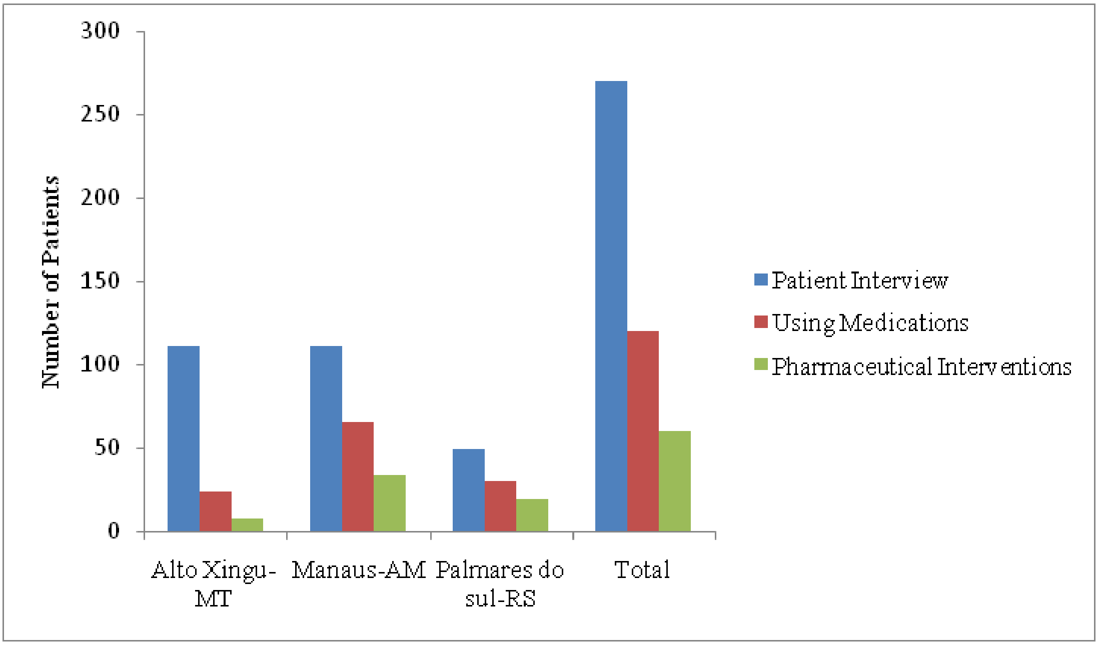

Figure 1: I presents the number of patient interviewed, the number using medication and the number of pharmaceutical interventions performed in each of the three telepharmacy assistance projects of the Joan Vernikos Aerospace Pharmacy Lab-MicroG, PUCRS, Brazil.

A limiting factor of the assistance projects of the Alto-Xingu and Manaus was the inability to identify the medicinal plants used by the populations under study, something that was needed to enable a comparison of the effects of these plants with the prescribed medications in use, in order to evaluate possible adverse effects and drug/plant interactions. It is believed this limitation occurred because these regions are well known for their vast variety of plant species, which highlighted the need for the participation of a local botanical taxonomist for the correct identification of plants.

A high percentage of medication use was observed in the last two projects, believed to be as a result of the areas being more urban and following a national trend of an increasing prevalence of chronic non-communicable diseases [8]. The application of telepharmacy allowed the identification of aspects related to the irrational use of medication, contributing to the prevention of health problems secondary to the mismanagement of pharmaco therapeutic treatments. Therefore, telepharmacy is believed to be capable of improving patient quality of life and also to increase efficacy in the use of public resources in the health sector [2,19].

Correct identification by a botanical taxonomist of the medicinal plantstaken by an urbanpopulation

through use of telecommunication tools, with a specific protocol used to capture images of the plants grown and consumed locally in private residences.

One of the strategies of the Brazilian Federal Government is the National Programme of Reorientation of Vocational Training in Health (Pró-Saúde - Programa Nacional de Reorientação da Formação Profissional em Saúde), which attempts to strengthen primary health care programs and services through the promotion of closer integration between academia and the health service. It aims to refocus professional education so the health/disease process is seen holistically, with an emphasis on primary health care [20]. The Joan Vernikos Aerospace Pharmacy Laboratory was awarded a Pró-Saúde grant to develop a project of continuous education and training of human resources aimed at improving the public health system.

The project entitled "Telepharmacy – Feasibility of Training Health Professionals in the Correct Identification of Medicinal Plants and their Interactions with Medications and Herbal Medicines" was conducted in Basic Health and Family Strategy Units in the city of Porto Alegre, Rio Grande do Sul state. In this project, a researcher went to the residences of the patients of a specific region and applied a questionnaire that included questions related to the use of medicinal plants, medications taken and medicinal plant cultivation. A photograph was taken of any medicinal plants cultivated by the participants, which was subsequently sent via telecommunication tools to be identified by a botanical taxonomist. Identification of the plant using this telecommunication tool was found to be possible for 98% of the plants examined, with only 2% of these not corresponding to the plant named. A 17% disagreement was shown between what the patient believed a plant to be and what the plant was confirmed as being by the botanical taxonomist.

Delivery of a training program for health professionals aimed at improving awareness and knowledge regarding the identification of medicinal plants

used by the general public, and their possible positive and negative interaction with medications.

The development of a professional virtual training tool in the area of pharmaceutical assistance was made possible in 2010 through a government sponsored "Pró-Saúde" health assistance project. The ideal solution would see the application of telecommunication tools for a training program, however, many remote and poor areas experience a lack of Internet availability and connection, meaning the production of a CD containing all the relevant information was required. The CD-based virtual training program was developed and subsequently made freely available to health professionals by the government.

In addition, the Joan Vernikos Aerospace Pharmacy Laboratory developed a software application **(app)** in cooperation with the School of Information Technology, PUCRS, which contained information regardingpossible interactions between medicinal plants and medications used by the population of Porto Alegre. This app was then provided free of charge by the government to heath care professionals, such as doctors, nutritionists and physiotherapists, working in the Brazilian public health system. This is in agreement with resolution nº 556 (2015) of the Federal Council on Nutrition, which regulates the prescription of oral phytotherapeuticsby nutritionists. Brazilian nutritionists are therefore allowed to prescribe medicinal plants and teas, even without a specialist degree. However, only nutritionists who hold a Phytotherapy degree are permitted to prescribe herbal medicines, traditional herbal products and special preparations of herbal medicines, which can be used as a diet ary complement [21]. In addition, two years later, resolution nº 611 (2017), also allowed physiotherapists to provide suggestions regarding the use of medicinal plants and herbal medicines without the need of a legal prescription [22].

CONCLUSION

The use of telecommunication and computer technologies, software and digital tools has allowed and promoted a more cost-effective spread of the technical and scientific knowledge of different areas of pharmacy, including drug dilutions, drug stability, pharmaceutical care related to medication adherence, drug interactions, medicinal plants, and phytotherapy, both in hospitals and health care services and units. In this way, telepharmacy has successfully enabled the delivery of pharmaceutical care to patients in situations and regions where direct contact with a pharmacist is not possible, which in turn improves the quality of life of patients as a whole.

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