



CLINICAL ENGINEERING PLAN APPLIED TO HOME CARE FOR THE COVID-19 PÓS-PANDEMIC SCENARIO IN BRAZIL

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Abstract. Home care, or home assistance, is a treatment modality that aims at the comfort and dehospitalization of patients dependent on aid for daily care and/or chronic diseases. It has had its requests and needs considerably increased due to the COVID-19 pandemic, as well as the development of the Post-COVID Syndrome. The present project brings information obtained through bibliographic reviews about the concepts of home care and clinical engineering, as well as its evolution and regulation in Brazil, in order to develop a clinical engineering plan applicable to this modality, aiming the improvement of your performance, management and control. Then, it's highlighted the discussion about the points that need attention, such as the precariousness of the equipment in the public hospital network and its adaptability to the home care infrastructure,

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Introduction

The diffusion of home assistance, or Home Care, is relatively new throughout the world, where each country has different reports and events that marked such emergence and evolution. In Brazil, its growth dates from the last decade of the 20th century. [1]



Where it is present in the agendas of discussions on health policies, both in the private and public sectors, since both seek solutions for better applicability of financial resources, given the high costs of hospital admissions FLORIANI. [2]

In 2020, the COVID-19 pandemic caused the population to isolate themselves at home, especially the elderly population and those with diseases in the risk group, affecting their access to health. This event caused an increase in the demand for home care and assistance. [3]

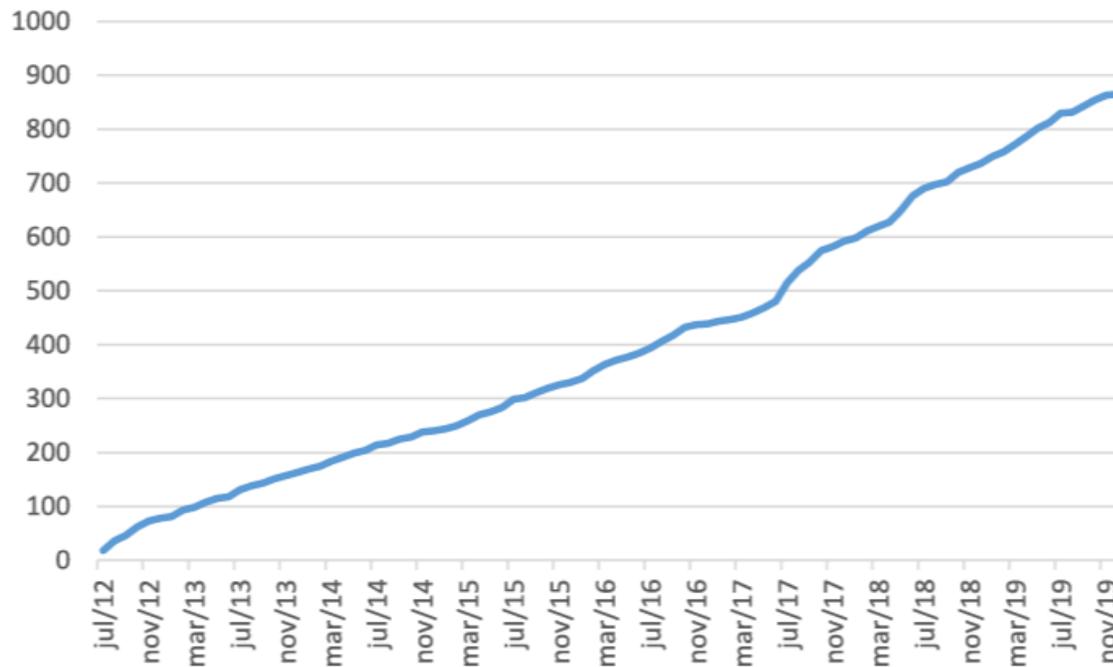
Imhotep, who was the doctor responsible for home and hospital care the Third Dynasty of Ancient Egypt (13th century BC), treated the patient both at home and in an office / hospital being responsible for the Pharaoh's care in the palace dependencies. In Ancient Greece, the doctor Asklépios performed care at home while his followers attended at the temples, where they had medicines and materials, these places were considered the primitive hospital structure. Hippocrates describes in his 'Treatise on Air, Water and Places' the efficiency of home care, which provided successful care.

At the end of the 17th century, the founder of homeopathy Samuel Hanneman started to visit the sick where he believed that the doctor had the duty to fight against the disease regardless of where this fight took place, he remained together with the beds of his patients, in the domicile for as long as necessary. [4]

In 1850, the Public Health Nurse program was created, led by Lilian Wald, aiming to offer health actions at home. [5]

In 1898, Los Angeles and other municipalities, and sometimes the US federal government, became financiers of home health care, and gradually these government funds were directed to official health departments. With the decrease in contagious diseases in 1950, there was a greater need for attention to chronic health problems, with home care models being created for the purpose. [6]

The home health services sector (Home Care) is still little studied in the country, although there has been considerable growth in recent decades. According to the National Registry of Health Establishments (Cadastro Nacional dos Estabelecimentos de Saúde - CNES, in Portuguese), the number of Home Care companies in Brazil jumped from 18 in July 2012 to 830 in July 2019, as Graph 1. [7]



Graph 1 - Number of Home Care establishments in Brazil, July/2012 to December/2019

Source: Censo Nead Fipe 2019/2020

In Brazil, we face a series of challenges when applying Home Care, one of which is the possible limitations faced in care outside a specialized health unit, mainly related to home hospitalizations. [8]

Other difficulties encountered are the lack of adequate equipment and structures, and lack of investment in professional qualification. [9]

Most of the service provision offers are from private companies, in the Public Health Program (Sistema Único de Saúde – SUS, in Portuguese) there is a great challenge to be overcome, since not all Brazilian municipalities have this program, as the adhesion is made in cities with more than



20 thousand inhabitants and with coverage of the Mobile Emergency Care Service (Serviço de Atendimento Móvel de Urgência – SAMU, in Portuguese). [10]

At the peak of COVID-19, we could observe crowded hospitals and people needing hospitalization, but not enough beds for the sick. From this need to free up hospital beds, the importance of this method was seen, allowing early de-hospitalization, which impacts on reducing hospital capacity, reduces the risk of infection and readmission of patients. With the pandemic, the adhesion to home care growth about 40%, which shows advances in terms of reliability of this type of service. [11]

In addition, home care can accelerate the restoration of the patient's health, due to the proximity of contact with doctors and multidisciplinary teams, quality of service and proximity to friends and family. [11]

In Home Care, as well as in conventional hospital care, the use of low and medium complexity medical-hospital equipment (EMHs) is essential, such as pulse oximeters, multiparameter monitors, oxygen concentrators and BIPAP type lung ventilators, being necessary that the use of these devices is performed in a safe, reliable and appropriate way to the needs of patients. [12]

According to Empresa Brasileira de Serviços Hospitalares (EBSERH), Clinical Engineering is the area responsible for “managing the technologies used in the productive activities of procedures related to patient care, establishing the strategies for managing the useful life of these technologies incorporated through routines of preventive and corrective maintenance”. [12]

Clinical Engineering is the essential sector in the implementation of technologies in health services, including those carried out in Home Care. It is also noteworthy that Resolution RDC nº 11/2006 defines that the Home Care Service (Serviço de Atendimento Domiciliar – SAD, in Portuguese) must guarantee the calibration and preventive maintenance of medical and hospital equipment, which reinforces the need to have a specialized Clinical Engineering Service. [12]

It is also the role of Clinical Engineering to intelligently acquire medical and hospital equipment, which can minimize the costs associated with the management of a Home Care service, since more assertive purchases are made, aiming at the incorporation of resistant and suitable equipment for this purpose. Clinical Engineering also contributes to a more functional Home Care service as it is



responsible for promoting training and qualifications for the clinical staff and eventually for the patient companions, making home care more assertive and safer, being imperative to provide an online tool for these trainings, since the equipment is distributed in several locations. [12]

One of the great challenges of Clinical Engineering in the context of home care is the management of EMHs, since they are in a decentralized way, demanding online management tools for effective control of location and maintenance of the scheduled maintenance plan. Thus, Clinical Engineering is essential to ensure that the technology park is cost-controlled and functioning correctly, keeping calibrations, preventive maintenance, and electrical safety tests up to date, despite all the turnover involved in Home Care. [12]

Neovero Engenharia Clínica e Hospitalar was developed specifically to manage the medical-hospital equipment and infrastructure assets and their entire life cycle: from acquisition planning to disposal, through maintenance and other processes. It is based on the concepts of mobility, through its “Neovero Mobile” mobile application, and of integrability, through the integration of Neovero with other corporate systems of the institution, aiming at eliminating paper in daily work and guaranteeing the exchange of information and processes between systems.

With Neovero, the Clinical Engineering sector manages the 3 focuses of hospital maintenance management:

- Control and administration of resources, manage all elements involved in hospital maintenance and monitor the status of biomedical actions and assets.
- Strategic information, providing the manager with accurate tools and reliable data, necessary for decision making.
- Safety and Quality, ensure patient safety and adapt the hospital-to-hospital accreditation and certification regulations. [13]

Home health care devices cover a wide range, so each device is intended for a different Home Care modality.

According to ORDINANCE No. 963, OF MAY 27, 2013, there are the following modalities:

Art. 18. Home Care will be organized in three modalities:

I - Type 1 Home Care (AD1).



II - Type 2 Home Care (AD2).

III - Type 3 Home Care (AD3).

Single paragraph. The modalities provided for in the "caput" will observe the complexity and characteristics of the user's health condition, as well as the frequency of necessary care.

AD1 mode is intended for users who:

I- Have controlled/compensated health problems and with physical difficulty or impossibility of locomotion to a health unit.

II- Requires less complex care, including nutritional recovery, less frequently, with less need for health resources and within the service capacity of the Basic Health Units (Unidade Básica de Saúde – UBS, in Portuguese); [14]

AD2 mode is intended for users who:

I- Have health problems and physical difficulty or impossibility of locomotion to a health unit and who need more frequent care, health resources and continuous monitoring, which may come from different services of the care network.

II- demand for more complex procedures, which can be performed at home, such as: complex dressings and abscess drainage, among others.

III- dependence on frequent monitoring of vital signs.

IV- frequent need for less complex laboratory tests.

V- adaptation of the user and/or caregiver to the use of the tracheostomy device.

VI - adaptation of the user to the use of orthoses/prostheses.

VII - adaptation of users to the use of probes and ostomies.

VIII - home follow-up in the postoperative period.

IX - rehabilitation of people with permanent or transitory disabilities, who need continuous care, until they can attend other rehabilitation services.

X - use of an airway aspirator for bronchial hygiene.

XI - monitoring of weight gain in low-birthweight newborns.

XII - need for permanent or transitory nutritional care.

XIII - need for palliative care; and



XIV - need for intravenous, muscular, or subcutaneous medication, for a pre-established time.

Art. 23. Inclusion for care in the AD2 modality will be based on the analysis of the user's health needs, based on the situations listed below:

Single paragraph. In the AD2 modality, if necessary, sanitary and back-up transport will be guaranteed to the assistance units operating 24 (twenty-four) hours/day, defined in advance as a reference for the user, in cases of interurrences. [14]

AD3 mode is intended for users who:

I- Have health problems and physical difficulty or impossibility of getting to a health unit, requiring greater frequency of care, health resources, continuous monitoring, and use of equipment, which may come from different services of the health care network; [14]

II- for the user to be included for care in the AD3 modality, it is necessary to verify the existence of at least one of the situations admitted as inclusion criteria for care in the AD2 modality (ORDINANCE No. 963, 2013); [14]

III - need to use at least one of the following equipment/procedures: [14]

a) Non-invasive ventilatory support:

i. Continuous Positive Airway Pressure (CPAP).

ii. Bi-Level Positive Air Pressure (BIPAP).

b) peritoneal dialysis; or

c) paracentesis.

Equipment that is included in Modality AD1 is separated into medication administration and basic dressing items: [14]

- Measuring cups, pipettes, syringes, needles, nasal sprays, inhalers, transdermal patch, band aid, bandages, sterile gauze and swabs and intravascular administration set.

Equipment that is included in Modality AD2 are items from AD1, monitoring, test kit, childcare equipment, palliative care, and respiratory origin: [14]

- Thermometer, stethoscope, blood glucose meter, blood clotting, apnea monitor, blood pressure monitor, ventricular bypass device, pacemaker.



- Hepatitis C, cholesterol and allergy tests, insulin pump, fetal monitor, phototherapy equipment, weight scale, walker, hospital bed, wheelchair, oximeter, respiratory supplements, masks and cannulas, pulmonary respirator, cardiac defibrillator, cardioverter implantable defibrillator, and nebulizer.

Equipment that is included in Modality AD3 are items from AD1 plus AD2, drainage of body slag and fluids for pediatric use: [14]

- CPAP, BIPAP, catheter; feeding tubes; pumps for enteral and parenteral nutrition.

The present project aims, initially, to conceptualize the Home Care and contextualize it on Brazil reality and regulations after the pandemic, as well as understanding the role of Clinical Engineering in the management of Home Care, based on a literature review.

Methodology:

The Bibliographic Review (BR) is considered by Webster and Watson, the initial step of any scientific research [15], and has an exploratory character, allowing improvements, knowledge of the problem involved and even discoveries from materials already prepared, such as articles and books. [16]

Despite the great diffusion of BR as the main and initial methodology in scientific research, Shaw reports that there are problems in the progress of theory and concepts, due to the number of published articles and numerous databases for research, making the research complex and exhaustive. [17]

Thus, there are three main forms of review that aim to overcome this difficulty presented and should be chosen based on the final objective of using BR, narrative, integrative and systematic, the last being the form chosen by the authors of the present study.

A systematic review is a rigorous process for selecting, collecting, and analyzing data, as well as describing their contributions to the research [18]. It must be carried out by more than one researcher, where everyone must read the articles obtained and then hold a study meeting, defining which articles should or should not enter the bibliographic portfolio of the project. [19]



Thus, about twenty scientific articles and thirty-six websites focused on the main theme were gathered for reading and understanding. Afterwards, 12 articles and 19 websites were selected as materials that best contribute to the project, which are present in the study bibliographic portfolio.

Results and Discussion:

In this chapter, care contexts that are already consolidated in our reality [20] will be presented with some clippings in international literature [21]. Some domains are also considered home care quality criteria. [22]

For those patients who are functional and may benefit from short-term treatment of acute complications, with a predetermined duration of care: treatment of bronchopneumonia (BCP), urinary tract infection (UTI), cellulitis, deep vein thrombosis, surgery, rehabilitation, decompensated chronic obstructive pulmonary disease (COPD), decompensated congestive heart failure (CHF), etc. In addition to patient satisfaction, the optimization of hospital beds, the risk of nosocomial infections and loss of function are also significantly reduced; however, parts of the costs of care are borne by the family - hence the need to guarantee essential medicines and supplies for care at home.

Medium-term home care (weeks to a few months) is also typical of Emad (AD2 mode), as access requirements decrease and Primary Care (AD1 Mode). For example, injectable heparin anticoagulation, oral anticoagulation, rehabilitation after femur fracture, complex wounds, osteomyelitis, critical neuropathy, postpartum home care.

- Stroke, other recovery period after prolonged hospitalization. Long-term/duration home care (several months to years).

These patients are the most disabled, with the sequelae of disabling chronic diseases, including neurodegenerative diseases. In the nursing process, the instrumentalization of the family is the most important part.

A longitudinal perspective, which will help to strengthen the connection and trust that underpin the shared care process.



In Brazil, there is already an urgent need to implement intersectionality between the Unified Social Assistance System (Sistema Único de Assistência Social – SUAS, in Portuguese) and the SUS, as has happened in other countries, to have a legacy of long-term care, either in the community or in an institution, like aging. [23]

Palliative home care (PC) can be applied in short-, medium- or long-term models, depending on patient characteristics and comorbidity it is best to refer patients in PC to stages before the last days or weeks of life, so that connections can be made in the last days or weeks of life. [24]

Some medical devices may not be safe, causing problems for all users or usage environments, but medical device manufacturers have a responsibility to recognize and mitigate the risks as much as possible: [25]

- I. Devices are used in ways they were not intended.
- II. Devices are used in ways that were anticipated but inadequately controlled.
- III. Using the device requires physical, perceptual, and cognitive skills that exceed those of the user.
- IV. Use of the device is inconsistent with the user's expectations or intuition about the device's operation.
- V. The usage environment affects the operation of the device, and this effect is not understood by the user; and
- VI. The user's physical, perceptual, and cognitive capabilities are exceeded when using the device in a specific environment.

The devices involved in the largest number of events were:

Insulin infusion pump, implantable cardioverter defibrillator, automatic implantable cardioverter defibrillator with cardiac resynchronization, ventricular bypass device, walker, implantable pacemaker pulse generator, piston syringe, intravascular administration set, and lung ventilator.

Medical devices used at home must be easy to operate for lay users and have minimal requirements for calibration and maintenance. Although hospitals have departments dedicated to performing these tasks, lay users should not be expected to have this level of interaction with equipment.

Devices should be self-calibrated whenever possible. Maintenance should generally be limited to



just the most basic routine functions such as simple cleaning and battery replacement. However, depending on the device involved, some home care providers will need to sterilize components or dispose of used supplies, and the device system must be designed so that these tasks are easy to perform. [25]

In hospital units visiting hours are limited, since when the patient is at home it is much more accessible, favoring his recovery.

“It is a care modality that provides more individualized care in chronic diseases and with comprehensive care guaranteed by the multidisciplinary team, with the participation of the family, leading to greater adherence to treatment.”, points out the doctor and manager of the Salvador Home Care unit at SOS Vida, Cristiara Allem. [26]

Having the treatment at home, the patient avoids getting into contact with bacteria and hospital infections, as they are more vulnerable there.

“We have achieved good results, such as a zero rate for some types of infections in cases of patients using central venous catheters. And so, we have kept the picture below international indicators.”, stresses Monique, an infectious disease specialist at SOS Vida's Home Care unit in Salvador. [26]

According to lawyer Claudia Nakano, from the EPD – Escola Paulista de Direito and author of the Patient Rights Booklets, explains that the income tax exemption benefits those who have serious illnesses and who receive some retirement income. Those with reduced mobility also gain exemption, even if temporary, in IPVA, ICMS, IPI, IOP. [27]

The lawyer explains that, if the financing contract has been made before the illness, the patient earns discharge of their own home due to total or permanent disability. And those with serious illnesses or even the dependent family member in these conditions, obtain release from the FGTS/PIS/PASEP. [27]

In addition to all the benefits for patients and families, Home Care plays an important role in improving health care in general in Brazil, considering the release of hospital beds for patients who need procedures and therapies that can only be performed in a hospital environment.

In this way, Home Care contributes to increasing the efficiency of the Brazilian health system, which is experiencing a critical situation of lack of beds in several specialties.



Below are some disadvantages of Home Care in Brazil.

Many occurrences can come from homes where public transport is not as accessible. Which demands more travel time for the health professional. [27]

Although the home is more comfortable and pleasant for the patient, most of the time it is not as prepared as a hospital for eventual emergencies. Therefore, depending on the patient's condition, it is recommended to visit a hospital to make sure it is safe. [27]

The "great challenge is not to anticipate the future, but to build it" (ICN, 1999) according to the guide for futuristic nurses.

Although Home Care assistance can be provided directly by health professionals with higher education, the literature has pointed out more formal caregivers, with secondary education, or trained informal caregivers, especially in countries that aim to reduce costs, provide comfort to the patient, and prevent possible complications, like hospital infections.

The current trend is still towards the creation or expansion of residential services to assist not only chronic patients, but also acute patients, from preoperative to postoperative preparation, perinatal care, palliative care, and even episodic events. One could also offer day care or night care for the elderly or chronic, relief care for the terminally ill, sick childcare, surgical day care, counseling on care of all kinds, and even occupational health and school health for companies.

Another trend that is beginning to be practiced in some countries is the specific training program for lay people, called caregivers, to take care of elderly relatives, the chronically ill or children with a prolonged illness in their own homes. [28]

Conclusion:

In view of the aspects observed in the evolution of Home Care, the importance of this sector was seen both for the clinical staff of a hospital and especially for the patient, where he can be treated in the comfort of his home, but some problems such as the lack of equipment mainly in the SUS, inadequate infrastructure and the lack of investment in professional qualification, this process of evolution becomes more difficult, in this way it is necessary to correct these problems in order to have a quality system and based on what was presented in the research, clinical engineering is



responsible for making improvements to all these problems involved, either by creating software for a management with an efficient traceability of the equipment, thus leaving the flow of equipment for corrective and preventive maintenance better, conducting training in order to qualify health professionals, as well as adapting the equipment to an infrastructure inferior to that of a hospital.

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