

# **Recycling to Save Lives: Making Manikins from Recyclable Materials for Cardiopulmonary Resuscitation Training**

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## **Abstract**

**Introduction:** *Cardiopulmonary Arrest (CPA) is a global public health problem and, for this reason, once it is identified, early Cardiopulmonary Resuscitation (CPR) must be initiated and effectively carried out in order to improve the victim's prognosis.* **Objective:** *The objective of the project was to train students and civil servants from a public university in order to promote their interaction with the population assisted by the DIST/Shopping Park program through workshops on making recyclable manikins; training on Cardiopulmonary Arrest (CPA) identification and Cardiopulmonary Resuscitation.* **Methodology:** *The RECYCLE TO SAVE LIVES - CPR project was an activity promoted by the Federal University of Uberlandia (UFU), in 2018, which associated environment with health promotion and education and encouraged the initial training of 28 people to serve as volunteers in the external community of the University, 44 people from different age groups then received a similar training through workshops.* **Result:** *The project approach was efficient, as it managed to associate theory with practice, through the use of the recyclable manikins. However, it was found that health education activities need to be more present in educational environments, and not just at specific moments of intervention, as proposed by the project, as we assume that over time, theoretical and practical knowledge might be forgotten.* **Conclusion:** *The project achieved*

*good results with the training offered through workshops, and while working directly with the community it played a significant role of social intervention, which is one of the responsibilities of the University.*

**Keywords:** Cardiopulmonary Arrest; Cardiopulmonary Resuscitation; Basic Life Support; Health Education; Health Promotion; Community Health Nursing.

## Introduction

Cardiovascular diseases (CVD) are the main cause of death in Brazil and worldwide <sup>(1-4)</sup>. Ischemic heart diseases <sup>(5)</sup> alone are responsible for 80% of sudden death cases, most of which happen in the pre-hospital environment <sup>(6)</sup>. For this reason, Cardiopulmonary Arrest (CPA) is a global public health problem. It is defined as a sudden, unexpected and catastrophic cessation of the systemic circulation, associated with the absence of breathing <sup>(7)</sup>.

However, despite the advances related to prevention and treatment in recent years, CPA mortality rates in Brazil remain high. Whereas the exact dimension of the problem is not clearly understood, due to lack of robust statistics, 200.000 CPA cases are estimated to occur in Brazil every year, half of which happen in an out-of-hospital environment due to rhythms such as ventricular fibrillation and sudden pulseless ventricular tachycardia, and, to a large extent, due to arrhythmias resulting from acute ischemic conditions or primary electrical dysfunctions <sup>(5)</sup>.

Considering the aforementioned reality, Cardiopulmonary Resuscitation (CPR) is of utmost importance for the minimization of myocardial and cerebral sequelae, relief of suffering and preservation of life, when it is possible, which is directly associated with when it is initiated and how effectively it is performed, once according to the Brazilian Society of Cardiology, a person who suffers from a cardiopulmonary emergency has between 6 and 10 minutes to be given the first Cardiopulmonary Resuscitation maneuvers to enable survival conditions. It corresponds to a set of measures performed with the purpose of promoting artificial circulation of oxygenated blood to the heart, brain and other vital organs, until the cardiovascular and ventilatory functions are spontaneously re-established <sup>(8)</sup>.

In this context, from 2015 on, the American Heart Association (AHA) started to recommend the use of different survival chains for in-hospital and out-of-hospital CRA, as these are two environments that require different structural elements and processes. The patients of an Out-of-Hospital Cardiac Arrests (OHCAs) depend on the assistance of lay people, who must know how to identify the arrest, ask for help, start CPR and use defibrillation, if they have an Automatic External Defibrillator (AED) on site, before the emergency service arrives <sup>(9)</sup>. It is important to state that in Brazil there is still no National Legislation that regulates and obliges public places to make the AED available although some states in this country have independently passed such law. In São Paulo State, for example, establishments with a flow greater than 1500 people are required to make the AED available (Law N°. 13.945, of JANUARY, 7<sup>th</sup>, 2005) <sup>(10)</sup>.

Access to this knowledge occurs through studies on Basic Life Support (BLS), which can be carried out by lay people, namely, people other than health professionals, as long as they are trained, with the purpose of identifying and helping in emergencies. The greatest challenges, especially in Brazil, are to expand access to CPR teaching and establish processes for continuous improvement of its quality, so as to minimize the

time spent between CPR and the application of the first shock with the defibrillator <sup>(5)</sup> once this early defibrillation with the use of AED can improve the patients' prognosis, prompting greater survival and better neurological prognosis among survivors <sup>(11)</sup>.

This indicates the importance of making AED available in places with a significant circulation of people, as it is advocated by the AHA-2015 <sup>(9)</sup>. It consists of an easy-to-handle device that applies a large current pulse to the heart to restore the normal rhythm of the heartbeat in patients with ventricular fibrillation or ventricular tachycardia <sup>(12)</sup>. And a properly trained layperson can perform the defibrillation procedure as skillfully and safely as a healthcare professional <sup>(11)</sup>, because it is a portable device that allows for diagnosing and evaluating the need to provide an electrical discharge, indicating to the operator step by step how to do it in a safe and effective manner <sup>(12)</sup>.

Because of this, the project developed intended to democratize access to health education through the use of a manikin made from recyclable material, which produces an expectation of reality to the participant, simulating the use of a commercial simulation manikin, but at a considerably lower cost. In addition to this, efforts are made for the preservation of the environment as the incorrect disposal of the material in nature is avoided and thus the cooperative of collectors of recyclable materials is assisted with the promotion of health. It is important to emphasize that the simulations that use manikins facilitate the acquisition of skills, fostering the construction of knowledge <sup>(13)</sup>.

Therefore, the objective of the project was to train students and civil servants from a public university in order to promote their interaction with the population assisted by the DIST/Shopping Park<sup>1</sup> program through workshops on making recyclable manikins; training on Cardiopulmonary Arrest (CPA) identification and Cardiopulmonary Resuscitation (CPR).

## **Methodology**

The project RECYCLING TO SAVE LIVES – CPR was an activity carried out by the Federal University of Uberlandia (UFU), in 2018, through the UFU/Community Integration and Extension Program - CIEP, which combined environmental preservation by using recyclable materials in the construction of manikins and health promotion and education by providing CRA identification training as well as workshops on Cardiopulmonary Resuscitation to participants at DIST/Shopping Park, in Shopping Park, a neighborhood in the city of Uberlandia-MG (Brazil). This training was conducted following the American Heart Association (AHA) guidelines, which were updated in 2015.

In this context, the project encouraged the initial training of 28 people, among civil servants and students from UFU, to serve as volunteers in the external community of the University. These volunteers reproduced the knowledge they acquired to an average of 25 people of different age groups in three meetings in different months. In addition, the project was extended as some of the workshops were linked to scientific events, in which 19 other people (students) were trained. During the training, the active methodology was used, as it encouraged the active participation of the students in the dynamic process of knowledge construction, evaluation and problem solving of reality, bringing them to the role of the active subject of their growth, that is, the leading role of the teaching and learning process <sup>(14)</sup>. We used the questionnaire

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<sup>1</sup> Program for Integrated and Sustainable Development of the Shopping Park Territory

with multiple-choice questions (pre-test and post-test) to estimate the participants' knowledge on the subject, CRA and CPR, only in the workshops related to the events. In addition, a folder was prepared with informative content on the subject, as well as the step-by-step guide for the preparation of the manikin.

The workshops for the population took place at DIST/Shopping Park in accordance with the objective of the project and, besides, in workshops at the VII National Meeting for Teaching Biology and I Regional Meeting for Teaching Biology - North (Belém-PA/Brazil) and at the XXVII Scientific Week of Biological Studies-UFU (Uberlandia – MG/Brazil).

The choice of the non-conventional manikin for training in CRA care was a measure of substitution to what is normally used, as it is not easily accessible to every person, as it is still sold for a high price. In order to make training more accessible to all, Cardiologist Agnaldo Piscopo, on behalf of the Cardiology Society of the State of São Paulo <sup>(15)</sup> and as the director of the training center, developed an all-exclusive manikin, known as "Guizinho", a dummy made with a covered plastic bottle full of air, whose pressure is identical to that of the human thorax, and with scientifically proven effectiveness, through tests conducted with 200 students at a school in Araras (SP/ Brazil), which showed that training with "Guizinho" is as effective as training with traditional imported manikins <sup>(16)</sup>. Therefore, the participants of the trainings carried out by our project will also be able to make their own manikins with recyclable material.

Thus, the workshops proceeded in the following way. Firstly, the participants were taught how to build the manikins; secondly, they learned how to identify a patient in Cardiopulmonary Arrest and then how to perform Cardiorespiratory Resuscitation. And, at the end of each intervention, folders were distributed as a review material, support for the performance of CPR and for the construction of the manikins, in order to promote the spread of knowledge.

#### **1- Materials used to make the manikins:**

- A basic T-shirt/blouse (It must not be sleeveless or have buttons);
- PET<sup>2</sup> bottles of 1,5 liters or 2 liters;
- A stapler;
- A String;
- A pair of Scissors;
- Styrofoam or pricked or crumpled newspapers or magazines.

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<sup>2</sup> Known as PET, polyethylene terephthalate is a type of plastic widely used in the manufacture of bottles (soft drinks, water, juices, oils, etc.).



Source: Authors' collection

Figure1: Materials used to make the manikins

## 2- Step-by-step guide to make the manikin:

1. Place the open shirt /blouse on a smooth surface and fold the sleeve and trunk ends in the size of 3 to 7 cm.
2. Staple the parts of the shirt /blouse that have been folded.
3. Fill the inside part of shirt /blouse through the neck opening with the chosen recyclable material leaving room to place the PET bottle.
4. Place the PET bottle inside the shirt /blouse, through the neck opening, taking care so that it stays in the middle as it will simulate the center of the chest.
5. Finish filling the inside part of the shirt /blouse if necessary.
6. With the string, attach the cap part of the bottle to the collar of the shirt /blouse so that it does not move out of place.
7. Tie as many knots as necessary and cut the excess string with the scissors.



Source: Authors' collection

Figure 2: Manikins made by the workshops participants

## 3- Identification of the Cardiorespiratory Arrest:

Checking the patient's condition



- 1- Touch the patient's shoulders emphatically and ask or call her in an audible tone "Can you hear me?". But remember that you are not looking for an answer, but some kind of reaction like eyelid contractions, muscle movement, reacting to sounds.
  - ✓ If there is no answer, it means that the patient is not responding.
- 2- Look for signs of circulation:
  - ✓ The patient's lips, face and extremities are pale;
  - ✓ Observe if the patient is breathing by checking the movement of the chest region.

If there is no responsiveness combined with no signs of circulation, it means the patient is in CRA.

#### 4- How to perform Cardiorespiratory Resuscitation:

The American Heart Association (2015) <sup>(9)</sup> currently brings guidelines that make Cardiopulmonary Resuscitation simple and easy to be applied in an emergency situation.

- The CPR maneuver should be performed with the patient lying on his/her back on a rigid, smooth and dry surface, in a place that does not pose a risk to those who are providing assistance.
- The person who is going to perform the cardiac massage should position himself/herself on his/her knees on the floor next to the patient, keeping his/her arms stretched with his/her hands on top of each other in the center of the chest in the final portion of the sternum bone of the person who is going to receive the massage and start rapid and uninterrupted compressions. Compressions should be made using the weight of the body of the person performing CPR without flexing the arms.
- Cardiopulmonary Resuscitation must be maintained until specialized help arrives or until there are signs of return of circulation: return of consciousness, redder skin, breathing returning to normal.

#### Stages:

1. Evaluate the patient's, the rescuer's and the site safety;
2. Call emergency service;
3. Check the patient's condition (level of consciousness and signs of presence of circulation);
4. Initiate the CPR maneuvers;
5. Place the Automatic External Defibrillator (AED) – if available.



Source: American Heart Association 2015 Highlights: CPR and ECC Guidelines Update.

Figure 3: OHCA chain of survival

### Rhythm/frequency

Perform 30 compressions at a frequency of 100 to 120 compressions/min for 2 ventilations only if you have a mask (Pocket Mask); or a manual insufflator (bag-valve-mask) and if you are a health professional according to AHA recommendations <sup>(9)</sup>.



Source: Mountainside Medical Equipment

Figure 4: Pocket Mask



Source: Medicaexpo

Figure 5: Bag-valve-mask

Otherwise, ventilation is not recommended, for the safety of the patient and the rescuer, because if s/he is a lay person, without any BLS training, he will not know the anatomy to open the airways, neglecting the time of compressions, he will not know how to do the ventilation correctly, which can lead to clinical problems such as bronchospraction, decreased blood return and if s/he is a professional or a lay person with BLS training, s/he might come into contact with secretion and might be contaminated with some infectious disease.

As a matter of fact, as the focus of the project is to train people who are not health professionals in accordance with the guidelines of the American Heart Association (AHA) <sup>(9)</sup>, it is not recommended for them to perform the ventilations. So, in these cases, what is recommended are uninterrupted compressions, for two minutes if there is someone to take turns with, and at the recommended frequency of 100 to 120 compressions/min until the emergency service arrives or until there is the reestablishment of the vital signs of the patient.

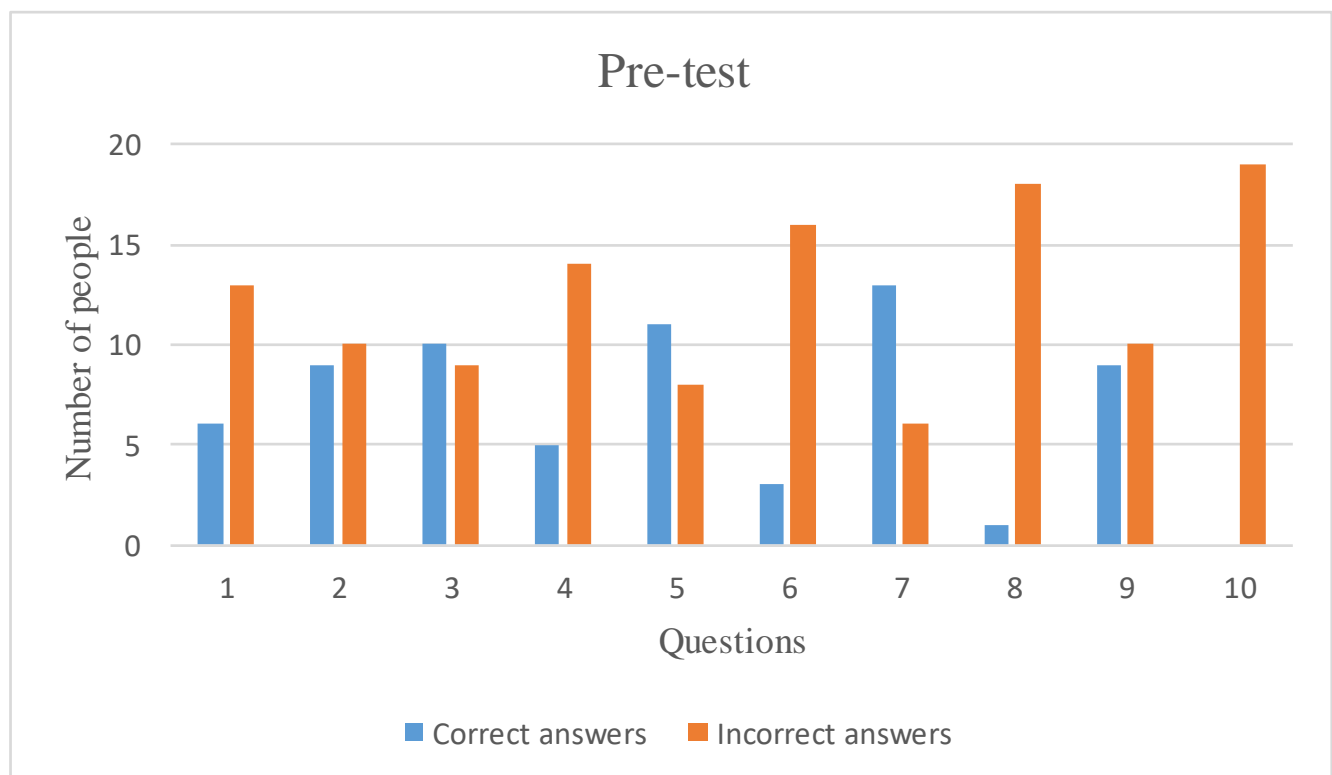
### Results and Discussion

The RECYCLING TO SAVE LIVES - CPR project, through teaching participants to identify a CPA and training them how to perform a CPR in manikins with recyclable materials made by themselves, was able to unite civil servants and students from UFU, most of whom were students of the Nursing Undergraduate Course, with the population from DIST/Shopping Park. This reinforced the role a future nurse should play: act in the community as an educator, in order to contribute significantly to the prevention of diseases or even complications that may arise. Likewise, Smeltzer; Bare (2005) <sup>(17)</sup> emphasizes that the nurse, while planning health education, needs to be available to perform this work outside the conventional environment so he needs to think about alternative strategies that raise awareness in the community, unlike traditionally recommended actions. With the scientific event workshop group, there was a similar training, but with a greater appreciation of the pro-health potential, because it is a target audience mostly linked to the

biological sciences, thus combining a discussion and encouragement to selective collection, due to the materials used in the making of the manikins.

At the first moment, which was the execution of the workshops, held for an average of 25 people of different age groups in 3 meetings in different months, there was no data collection, because this was not the focus of project, but during the process of formation of the participants in the midst of conversations and exchange of knowledge it was possible to observe that some had a vague knowledge on the subject and another large part did not know what a CRA and a CPR meant. Because of this, in order to have an estimate of the population's knowledge on the subject and also in order to expand the project, the proposal of the short course for scientific events was created, totaling the training of 19 students. The data collection was carried out according to the questionnaire used containing 10 multiple-choice questions about CRA and CPR. This was done as a pre-test, before starting the intervention, and as a post-test, only applied one month later, by means of an online questionnaire sent to the participants.

Based on these questionnaires, it was possible to have a chart on participants' knowledge of CRA and CPR, which is presented below as graph 1.



Source: Designed by the authors

Graph 1 – Participants' correct and incorrect answers before the workshop

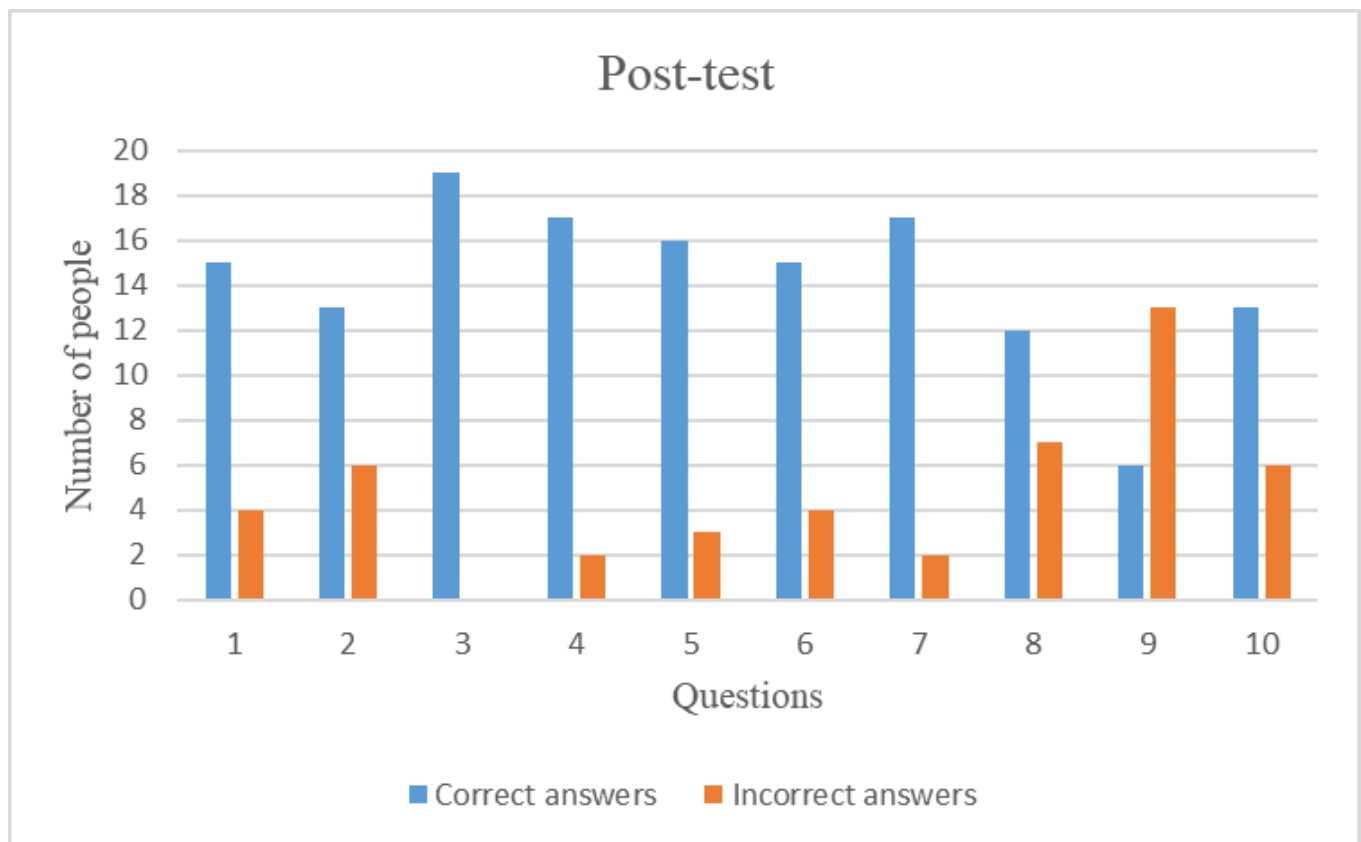
The questions with the highest rates of correct answers were 5 and 7, which referred, respectively, to the telephone number of the Mobile Emergency Assistance Service (SAMU) and to ventilation. This indicated that the students had some knowledge on the subject to be addressed. In addition, it's worth mentioning that questions 4 and 5 were elaborated in order to demonstrate the importance of knowing the telephone number of the emergency service that is offered in the city where you live or are passing through. However,



in question 4, which refers to the telephone number of the Fire Department (193), the students had more difficulty, what can be confirmed by the relatively high rate of incorrect answers, mainly because they were confused with the telephone number of SAMU (192) or even with the one of the Military Police (190), but also because it is not the main emergency number in the city, differently from the case of Belém-PA (Brazil), where a workshop took place. There, SAMU (192) is responsible for pre-hospital care.

Although some research participants didn't achieve the expected goal in these questions, this doesn't constitute a disadvantage, as the simple act of calling an institutionalized sector is already a positive aspect when this is compared to those who would not call any in search of help, because they don't know what number to dial. This importance is observed because these institutions usually have an interaction and a partnership to be able to help the patient and speed up the assistance to the population.

On the other hand, the questions with the highest rates of incorrect answers were 6, 8 and 10, whose subject referred, respectively, to the correct sequence that the rescuer must follow in an emergency care of a patient in CRA, the historical issue of CPR and the AED. The latter shows that the population doesn't know what an AED is and what its function is. Hence, from the execution of the project during the workshops, it was possible to notice with the analysis of the quantitative data collected in the pre-test that in an emergency situation lay people, not health professionals, would not be able to recognize a CRA and perform an effective CPR, thus preventing a quick and adequate response, which is essential in these cases until the emergency service arrives.



Source: Designed by the authors

Graph 2 – Participants' correct and incorrect answers 30 days after the workshop

In order for the participants to process the content and the practice offered in the workshops, in their community environments, after 30 days the post-test was conducted online, containing the same questions, but with a different structure from the pre-test, in the perspective of observing the rates of correct and incorrect answers, in addition to distancing themselves from biased results, because it's a short-term approach. Likewise, it was chosen not to carry out the post-test immediately after the completion of the workshops in scientific events. Thus, through the quantitative analysis of this data, it was possible to observe that although the rates of correctness increased in most of the questions, the rates of incorrect answers were still high. Question number 3, which approached how to perform a CPR with quality, reached 100% of correctness, demonstrating that the approach of project was efficient, for not having been restricted only to theory, but having associated it with practice, through the use of recyclable manikin, which prompted to correct and solve the doubts of performance of CPR and enable a better assimilation of the content by the participants. However, Question number 9, which addressed the purpose of CPR, reached low rates of correctness, which prompted the understanding that the participants understood how a CPR is performed and that it needs to follow a sequence (question 6) as well as be carried out with quality (question 3), however, they didn't assimilate its purpose, and this may have occurred because it's a short-term course. Therefore, we consider that health education activities need to be more present in educational environments and not only at certain moments of intervention, as proposed by our project, because we suppose that over time theoretical and practical knowledge might be forgotten.

Based on this study, it is clear that the teaching of BLS should be included in the school curriculum from infant to primary education, but also in universities, where this teaching ends up being restricted to health courses. As it was identified in the conversations with the participants of the scientific event workshop (most of whom were undergraduate students in Biological Science), one of the motivations for having chosen the workshop was the need of having access to more specific health issues in their curriculum. Another motivation was that the topic would help to deal with this situation in the school environment in case of first aid, but also to be able to teach students how to make the manikin, as well as to inform them how to proceed in cases of CRA and how to perform CPR with quality.

In this context, the insertion of this content in the curriculum would be a way for students to have constant contact with this knowledge and systematic training, because studies show the importance of the number of trainings on a short-term basis to obtain a rapid response and early onset of CPR, thus improving the prognosis of a victim in OHCA <sup>(18)</sup>. Furthermore, according to Fernandes et al. (2014) <sup>(19)</sup>, schools are ideal environments for the population to learn about Basic Life Support techniques, thus improving the chances of a more favorable prognosis for pre-hospital CRA patients.

However, in Brazil, Law N° 13,722 of October 4<sup>th</sup>, 2018 <sup>(20)</sup> only guarantees mandatory trainings in basic notions of first aid for teachers and employees of public and private educational establishments of basic education and of children's recreation establishments, therefore there's no legislation that requires their teaching in educational environments. Hence, it's clear that programs to raise awareness of the population must also be part of the public policy agenda in order to reduce mortality from sudden cardiac death in the country <sup>(18)</sup>.

Through the quantitative data analyzed and the workshops held, it was possible to observe the participants had insufficient knowledge on the subject. Moreover, there is not much data available to make a

comparison, because in the national literature, there are few studies with specific statistics about the knowledge of the lay population on BLS, so the indicators of this study become favorable for the development of new health interventions, including more effective public policies. The fact that this training involves life-threatening situations that should be managed in order to reduce morbidity and mortality caused by accidents and emergencies meets the need to enhance the knowledge of these subjects in the country <sup>(21)</sup> and to propagate in a similar way to what happens in Sweden, according to a study. There approximately 30% of the population is trained in CPR and out of 30,381 cases of pre-hospital CRA analyzed, 51.1% of the occurrences resuscitation maneuvers were performed before the arrival of the emergency medical service, which was associated with better results in 30-day survival when compared to patients who didn't receive CPR before the arrival of the emergency service <sup>(22)</sup>.

## **Conclusion**

The project achieved its goal, as it reached good results with the training in the workshops, for two different public. In addition, the participation of the students added expanded knowledge on the subject, because they learned, performed and taught the technique of Cardiopulmonary Resuscitation, and also could emphasize the importance of the preservation of the environment, avoiding the incorrect disposal in nature, as well as, helped the cooperatives of recyclable materials collectors, with the promotion of health and health education, with the community, then playing an important role of fundamental responsibility of the University in terms of social contribution.

Thus, through the analysis of the quantitative data of the workshops it was possible to observe that actions on a short-term basis, such as those carried out by our project have effects and are of great help to the population, but over time this knowledge might be forgotten, because they are actions that need to permeate time and be present in people's daily lives. This conclusion meets the fact that these attitudes must be taken in an emergency situation, which could happen at any given time, especially in Brazil, where the CRA rate is high. Thus, the population needs to be trained with BLS to act quickly and effectively for a better prognosis of the patient, if s/he survives. Therefore, it is undeniable that this issue should be inscribed in public policies agendas and in people's daily lives in different ways, such as through the school curriculum.

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