A manikin-based simulation study of a dispatch operator directed CPR-algorithm within the Western Cape setting and the self- reported comfort around its execution

by

Leonel Paulo De Caires

MBBCH (Wits), DipPEC (SA)

DCRLEO001

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Supervisor(s): Dr Willem Stassen and Dr Katya Evans

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Declaration

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Table of Contents

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Dedication

To my parents, Miguel and Fatima, for showing me that its ok to start from humble beginnings. Much love to you both.

Abbreviations

AED	Automated Electronic Defibrillator
AHA	American Heart Association
EMS	Emergency Medical Service
CDC	Centres for Disease Control and Prevention
CPR	Cardio-Pulmonary Resuscitation
ILCOR	International Liaison Committee on Resuscitation
HIC	High Income Country
LMIC	Low to Middle Income Country
OHCA	Out-of-Hospital Cardiac Arrest
PAD	Public Access Defibrillation
ROSC	Return of Spontaneous Circulation
tCPR	Telephone Guided CPR
VF	Ventricular Fibrillation
WHO	World Health Organization

PART A: LITERATURE REVIEW

This literature review will be presented in two parts. Firstly, a general introduction aims to familiarise the reader with the definition of out-of-hospital cardiac arrest, its epidemiology in South Africa and abroad, and its survival rate. The introduction will also provide some information on the main interventions to minimise morbidity and mortality following OHCA.

Secondly, the results of a directed literature search will be presented that focuses on just one of these interventions: early bystander cardiopulmonary resuscitation (CPR). More importantly, telephone-guided cardiopulmonary resuscitation (tCPR).

Introduction

Out-of-Hospital Cardiac Arrest

The American Heart Association defines cardiac arrest as "the sudden cessation of cardiac activity so that the victim becomes unresponsive, with no normal breathing and no signs of circulation." If corrective measures are not taken rapidly to reverse this, this condition progresses to death (1). Approximately 31% of all deaths globally, according to the World Health Organization (WHO), are as a result of sudden cardiac arrest (2). Ischaemic heart disease is also listed as the number one cause of death on the Global Health Observatory data for the WHO (3). In South Africa however, Statistics South Africa has listed heart disease, hypertensive disease and ischaemic heart disease as the underlying cause of death for a combined total of almost 54 000 people in 2015 (4). Approximately 53% of all deaths in South Africa occur outside of a medical/hospital (4).

While the literature of cardiac arrest originating from the low to middle-income country (LMIC) setting is scarce or non-existent, what is available does however show worse survival rates where cardiac arrest chains of care are in the very early stages of development or are completely absent (5, 6).

Out-of-hospital cardiac arrest (OHCA) is used to distinguish between cardiac arrest that occurs out of a hospital setting to those that occur in a hospital setting around medical professionals (7). OHCA has a very poor outcome and mortality rates are as high as 91-100% in some settings (8, 9).

Despite the high mortality rate of OHCA, numerous factors have been identified that are associated with survival. These include, and are not limited to: whether the prehospital arrest was witnessed or not, the time taken for Emergency Medical Services (EMS) to arrive on scene, if a shockable rhythm was present and identified, if there is availability of a defibrillator and whether pre-hospital cardiopulmonary resuscitation (CPR) was initiated or not. Survival rates are greatly improved the earlier treatment is provided and this is especially true for the early commencement of bystander CPR (10).

The chain of survival is a 5-step concept created by the AHA which comprises of a series of actions to be performed as quickly as possible to increase the chances of survival for patients who have OHCA (11). The five steps include early recognition of OHCA and EMS activation, early CPR, rapid defibrillation, effective advanced life support and integrated post cardiac arrest care.

Early Recognition

In order to both access EMS services and initiate early CPR one would be required to recognize OHCA. The earlier this is recognized, the earlier the steps of the chain of survival can be activated to increase the likelihood of survival from the OHCA. Due to the large educational gaps, cultural beliefs around death/dying and the multitude of languages spoken in South Africa, it may not always be a simple entity to recognise early, but as approximately 53% of all deaths occur outside the hospital domain in South Africa one can understand how important this task should be (4). With the increase in noncommunicable diseases in SA, the rates of OHCA may increase and thus early recognition should be emphasized.

Early CPR

The next most important step, following early recognition of OHCA, is early CPR. Early CPR can be attained by improving the likelihood of bystander CPR being initiated. This could be achieved by global awareness campaigns, formal community training or simply by encouraging and leading bystander CPR by the EMS Dispatch Operator. ILCOR Telephone CPR Time Standards (Appendix A) recommends time from call to the dispatch operator recognition of cardiac arrest, to initiating CPR should be within the first 180 seconds of the call (12). This is to improve survival rates from those that suffer OHCA.

Early Defibrillation

An Automated External Defibrillator (AED) is a device created specifically for laypersons. It consists of two self-adhesive pads that are attached to the bare chest of a collapsed patient, presumed to be in cardiac arrest, where the AED will then analyse the patient's cardiac rhythm. Once analysed the AED will then independently decide whether a shock should be automatically delivered or not. An AED typically comes with pictures or diagrams to show users how to use the device as well as voice prompts that instructs the user, in a simple step by step manner, on how to make use of the device.

A systematic review (13) published in 2017 looked at 41 studies that included Public Access Defibrillation (PAD) programs and it was shown that there was a median overall survival rate of 40% when an AED was used in an OHCA (13). Of the 41 studies included, only 18 reported on lay-person responders, 20 reported on trained responders (EMS and firefighters) and 3 studies reported on both. It was noted that individuals of OHCA had a two-fold higher survival rate if a PAD was utilized by a non-dispatched lay-person responder when compared to a dispatched healthcare responder. One needs to consider that the increase of survival in this group may not be just from the defibrillation alone as a lay responder who effectively uses a PAD may have some sort of basic life support training, and are therefore more likely to recognise signs of cardiac arrest earlier, call EMS for support, start early effective CPR and utilise an AED at a much earlier and more effective time (14). PAD programs have been introduced in many countries due to their simplicity and effectiveness.

In South Africa, the availability of an AED to the general public is likely to be very poor, although no literature has been found to support this. An AED is typically found in shopping malls, sports stadiums, airports, gyms and any particular place where crowds may be expected to be. International studies have shown that the willingness of general laypersons to utilize an AED ranged between 12 and 87% where concerns were raised with regards on how to use the device, concerns of causing more harm and the fear of legal litigation being cited as reasons for poor AED utilization (15). There is also no literature that looks at the use of, or the outcome of the use of, an AED with laypersons in South Africa specifically. A literature search for effectiveness in other LMIC countries does reveal how the implementation of an AED program in the Metro Subway of São Paulo saves lives (14). Of patients who had an initial heart rhythm consistent of ventricular fibrillation, survival to discharge improved from 0% pre-AED implementation to 43% post-AED implementation in this subgroup of individuals (14). An AED or a manual defibrillator would possibly be on hand with EMS crew and the first time one would be used on a patient will more likely than not depend on the time taken for the first trained EMS provider to arrive on scene.

Early ACLS

Time taken for EMS to arrive at a medical scene varies in duration and is restricted to the available resources at the time of the incident. A study in Amsterdam highlighted how survival of OHCA was greatly improved by shorter time intervals for EMS to arrive at the scene (10). In South Africa, due to poor financial and human resources, times for EMS arrival may be prolonged when compared to HICs and therefore bystander CPR may assist in bridging this time gap.

Early Post-Resuscitative Care

Of all the Sub-Saharan African (SSA) countries six do not have access to even one qualified registered cardiologist. Only one-third of all SSA countries have a working cardiac catherisation laboratory leaving over 110 million people in SSA without the option of percutaneous coronary intervention (16). South Africa is fortunate enough to have some cardiology services and in some urban centres there is access to Intensive Care Units for post-resuscitative care. That said, the provision of these services are highly dependent on the area in which you reside and is not evenly distributed throughout the country. All the steps of the chain of survival are integral for patient survival of OHCA and if the final step cannot be provided one may argue about the futility of the steps preceding it.

While all of the links in the chain of survival are essential to improving mortality following OHCA, the remainder of this review will focus on tCPR only.

Aims and Objectives

To evaluate and appraise global literature pertaining to tCPR.

Search Strategy

A search was performed using the Pubmed Database on 28 December 2019. The search was conducted, specifically and then more broadly. Each of the search strings (1-9) is shown below.

1. "Out-of-Hospital Cardiac Arrest"[Mesh] AND "Cardiopulmonary Resuscitation"[Mesh] AND "Emergency Medical Dispatch"[Mesh] AND "South Africa"[Mesh]
2. "Out-of-Hospital Cardiac Arrest"[Mesh] AND "Cardiopulmonary Resuscitation"[Mesh] AND "Emergency Medical Dispatch"[Mesh] AND "Africa"[Mesh]
3. "Out-of-Hospital Cardiac Arrest"[Mesh] AND "Cardiopulmonary Resuscitation"[Mesh] AND "Emergency Medical Dispatch"[Mesh]
4. "Out-of-Hospital Cardiac Arrest"[Mesh] AND "Emergency Medical Dispatch"[Mesh]
5. "Out-of-Hospital Cardiac Arrest"[Mesh] AND "South Africa"[Mesh]
6. "Out-of-Hospital Cardiac Arrest"[Mesh] AND "Africa"[Mesh]
7. telephonic[All Fields] AND ("cardiopulmonary resuscitation"[MeSH Terms] OR ("cardiopulmonary"[All Fields] AND "resuscitation"[All Fields]) OR "cardiopulmonary resuscitation"[All Fields] OR "cpr"[All Fields])
8. dispatch[All Fields] AND assisted[All Fields] AND ("cardiopulmonary resuscitation"[MeSH Terms] OR ("cardiopulmonary"[All Fields] AND "resuscitation"[All Fields]) OR "cardiopulmonary resuscitation"[All Fields] OR "cpr"[All Fields])
9. ("call centers"[MeSH Terms] OR ("call"[All Fields] AND "centers"[All Fields]) OR "call centers"[All Fields] OR ("call"[All Fields] AND "centre"[All Fields]) OR "call centre"[All Fields]) AND ("cardiopulmonary resuscitation"[MeSH Terms] OR ("cardiopulmonary"[All Fields] AND "resuscitation"[All Fields]) OR "cardiopulmonary resuscitation"[All Fields] OR "cpr"[All Fields])

Search results were first scanned for relevance and excluded based on title and abstract prior to interrogation of the full-text article. Any duplicates were removed. Articles were limited to English and those that were published in the last 10 years. The reference list of each of the included articles was then inspected to include any other relevant studies. While there was a paucity of literature from the African continent, some international studies were included. The following major themes were evident from the literature:

- CPR and the role of bystander CPR
- Telephonic CPR
- Overall effects of implementing tCPR programs
- Executed tCPR quality
- Linguistics of tCPR
- Barriers and challenges of tCPR
- Audio vs Visual tCPR

These themes will form the basis of the discussion in the sections that follow.

CPR and the role of bystander CPR

The first recommendations for CPR were issued in 1974 (17) and since then international CPR guidelines have been reviewed and altered regularly. The International Liaison Committee on Resuscitation (ILCOR) have undertaken continuous scientific reviews of CPR. A huge emphasis has been placed on improving CPR quality provided by all forms of rescuers, with an aim to improve survival of patients who have suffered cardiac arrest. Multiple studies highlight the importance of chest compressions and the clinical importance of delaying the gaps between chest compression cycles(18, 19) but conclusive evidence is still lacking with regards to ventilation.

During an acute cardiac arrest, a proportion of patients may have a shockable cardiac rhythm, such as ventricular fibrillation (VF), which requires a defibrillator device, either AED or manual, to treat the dysrhythmia. It has been shown that early CPR may prolong the duration of VF and may likely increase the susceptibility of the heart to successfully convert from a VF to a normal rhythm after defibrillation (20). Due to poor AED availability and delays in EMS care CPR may play a large role in prolonging the VF duration giving the patient a better chance for ROSC when an EMS provider does arrive on scene.

The latest ILCOR summary on cardiopulmonary resuscitation and emergency cardiovascular care science focuses on all forms of CPR strategies including EMS, Dispatch Assisted and

Bystander CPR interventions and the recommendations attached to each. A strong emphasis has been placed on Dispatch Assisted and Bystander CPR and it has been recommended that bystander CPR is performed for all patients in cardiac arrest (21).

Bystander CPR has been shown to improve neurologically intact survival from patients who have suffered from OHCA (22, 23) and bystander CPR is being recommended for all patients in cardiac arrest (24). This is a class 1 recommendation by the American Heart Association with level of evidence C-LD (21) (This means that evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective and its use is recommended/suggested). The benefits of performing early CPR have been shown repeatedly (25). Patients who received bystander CPR had 1.3 times the chance to survive to assessment in hospital and were 2.5-fold more likely to survive to hospital discharge when compared to people who did not receive bystander CPR (10). Despite the push for bystander CPR it has been shown that bystanders are apprehensive to perform CPR (26). In Seattle, a city in the United States of America, citizens were extensively trained to perform CPR and yet almost half witnessed cardiac arrests did not have CPR performed on them (26).

There is paucity in the literature of bystander CPR within LMIC countries but in 2017 a cohort study was done in Cameroon looking at the epidemiology of sudden cardiac arrest (6). Of the 88.9% cases of witnessed cardiac arrest in two health areas of Doula, family members were present in 63% of cases and CPR was only attempted in 3.7% of all cases (6). OHCA analysis in Taipei revealed that the initial shockable rhythm and early bystander CPR was strongly associated with better survival rates following arrest (27).

A South African study on OHCA and return of spontaneous circulation was conducted in Johannesburg (9). In this particular study, OHCA data were extracted out of a database and analysed with regards to what favoured return of spontaneous circulation (ROSC). A total of 510 confirmed cardiac arrest patients were considered for resuscitation due to OHCA, of these 205 of them were offered resuscitation. All 205 received chest compressions. ROSC was not obtained in those with no form of resuscitation compared to 36 patients where ROSC was obtained when resuscitation was performed.

There appears however to be no literature on this topic within the Western Cape. CPR is a basic skill that could be easily initiated by the community with the potential of making an impact on survival and thus there should be an emphasis made towards the study and teaching of this important skill in our population.

Telephonic CPR

To increase the likelihood of performing bystander CPR, ILCOR has advised the use of and the promotion of tCPR (12, 21). Multiple studies have looked at the effectiveness of the use of tCPR throughout the world but most of the data are coming from high-income countries. Research done in both Holland and Denmark displayed the ease and success of the use of tCPR (28, 29). In Arizona, tCPR was shown to be an independent predictor for OHCA survival and improved functional outcome (30). There is a lack of data in LMICs but tCPR was addressed recently in Iran and published in July 2019 (31). Data on OHCA was looked at 6 months before and after the integration of a tCPR program. Successful CPR increased from 28.1% to 32% (31).

Overall effects of implementing tCPR programs

Ideally, the implementation of a tCPR program needs to be carefully planned, in order to have a positive effect on bystander CPR and OHCA survival rates and should be a simple process to introduce. Before looking at the intricacies of such a program one should evaluate the overall effects of implementing tCPR programs.

Hasan, et al. piloted a prospective interventional study where the before and after effects of implementing a dispatcher-assisted cardiopulmonary resuscitation (DACPR) program for OHCA in Kuwait was assessed (32). In this particular study two focus groups, pre and post-intervention, were compared by analysing the effects of the DACPR program on OHCA recognition rate, CPR instruction rate and bystander CPR rate. EMS call-takers were trained with a standardised protocol over one day. A total of 332 OHCA cases were extracted from the EMS data of which 176 qualified for interpretation. OHCA recognition rate and CPR instruction rate increased post pilot implementation but interestingly, unlike most other studies, bystander CPR rates did not increase and neither did ROSC and survival to discharge rates (32). Despite the poor uptake of bystander CPR, OHCA recognition increased from 2% to 12,9% and CPR instruction rate increased from 0% to 10.4% (32).

Participants in this study were living the middle east with little detail given on the nationality of those callers who were not from Kuwait, and no information regarding the genders, religion or nationality of the individuals who had suffered the OHCA. The study does not explain why there was such a poor uptake by bystanders to perform CPR or why, despite training, CPR instruction rates only increased to 10.4%. There are large cultural differences between the Middle East and South Africa and it is not clear if these cultural differences play a role in bystander CPR uptake. If this is so then it is likely that one cannot extrapolate these results to our population.

A similar prospective, before-after, tCPR program study was conducted in Arizona in the USA by Bobrow, et al. over a 3 year period (33). A tCPR 'bundle' program was introduced to 2 regional dispatch EMS staff which included protocols, multiple telecommunicator training modules, data collection and feedback. A total of 2334 OHCA cases were analysed during this time. Provision of tCPR significantly increased by 9.3%, time to first compression decreased by 46 seconds and overall survival was positively affected from 5.6% to 8.3% (33). Unlike the study by Hasan, et al. this study appears to have a much more comprehensive and extensive training program for dispatch operators. Arizona is situated in a HIC whereas South Africa is an LMIC which may not have the same available resources, both monetary and human, to conduct a program as extensive and comprehensive as this.

In Rouen France, a tCPR program too was introduced, also with a before-after observational study being performed (34). After training dispatchers were able to increase their identification of OHCA by 12.5% and CPR recommendations to arrest witnessed increased fivefold. Besnier, et al. did comment how there was a small but insignificant trend to increased survival of victims of OHCA and how up to only 51% of those who were given recommendation were found to still be performing CPR when EMS arrived on the scene. Despite this, this study highlighted how easy and efficacious a tCPR program was to implement and that it came at no cost at all. The cost-effectiveness is important in a low resource environment. Almost identical findings were published by Stipulante, et al. in Belgium after introducing their tCPR algorithm with ROSC increasing by around 1% (35). The biggest confounder for starting tCPR was the difficulty recognising OHCA due to agonal gasps being interpreted as normal breathing. It is anticipated that this could be of bigger concern in South Africa due to different levels of education and the multitude of languages spoken by our population.

Song, et al. performed a before-after observational study which explored the effects of the implementation of tCPR in the Republic of Korea. Bystander CPR rates increased as so did survival to discharge out of hospital rates (36). Patients with unknown outcomes were however excluded from findings which may have biased results. Almost identical results were found by Plodr, et al. in the Czech Republic (37). Dami, et all. highlighted how a brief campaign sensitizing dispatch operators to tCPR, and not actually providing them with formal training, increased bystander CPR rates similar to other study results (38). This was done in a non-advanced dispatch system in Switzerland that had no prior experience with tCPR. This provides hope in LMICs where resources for extensive programs may not be available.

The effects of a centralised system providing tCPR instructions was described by two studies, one from America by Lerner EB and another from Korea by Ro YS (39, 40). Lerner found that a centralized system allowed them to train smaller groups of dispatch operators, provided them with more experience and was cost-effective (39). Lerner also highlighted how bystander CPR rate was 53% compared to the countrywide rate of 20% and that survival rates were higher than countrywide rates. Almost identical findings were reported by Ro and it was noted that OHCA diagnosis was also improved by centralizing tCPR dispatch programs (40).

With very little published research on the implementation of tCPR programs in the LMIC setting, one paper was released in 2019 from Iran (31). A sample of 10 dispatch operators were trained in tCPR and how to recognize OHCA and deliver instructions to callers. Successful CPR increased from 28.1% to 32% and neurological complications decreased. The largest flaw in this study was that individuals who refused to take part in CPR were completely excluded, this may lead to selection bias and erroneously increase the validity of the positive results. As Iran is a LMIC, one may consider that similar positive results may be possible in South Africa due to similarities in our infrastructure and finances in certain areas.

Based on these studies, which analysed the overall effects of implementing a tCPR program, a common theme is apparent: Bystander CPR rates are increased globally when tCPR is offered with effects on survival, either trending upwards or statistically significantly improving. It is common too that despite having the option to institute elaborate training programs, introducing a tCPR program can be done very cost-effectively and with minimal effort if one chooses.

Executed tCPR quality

Other literature which exists on the topic of telephonic guided CPR focusses on the actual quality of executed CPR when guided by a dispatch operator. Yet again existing studies are heavily weighted from HICs. However, it is often an untrained layperson who is assessed, and this may, therefore, allow for some translation to the South African setting.

Asai, et al. performed an observational simulation study in Japan where 23 laypersons were recruited at a shopping mall (41). Dispatchers provided CPR instructions and CPR quality was assessed in terms of chest compression depth, rate and hand placement. Time intervals to recognise cardiac arrest and to start compressions were recorded. It was found that the quality of CPR performed was suboptimal with regards to compression depth but had a good median compression rate. This study was limited not only by the number of participants but by the large number of female participants included. It has been shown that gender may perhaps play a role in the execution of CPR quality and may have an effect on these results (42). In this study the rate was verbally 'counted out' over the phone at which compressions should be performed and rate appears to be performed uniformly well thereof. The audio cue provided may be beneficial.

Eisenberg, et al. did a similar study in the USA but also asked the question of 'Should dispatchers instruct lay bystanders to undress patients before performing CPR?'. In this study, both groups, those who exposed the chest and the group that did not, had similar suboptimal compression depths and adequate compression rates (43). This poor depth and adequate rate was in keeping with Asai, et al. The study design consisted of placing a total of three layers of clothing on the manikin so it was not surprising that the group that did not expose the chest started chest compressions 30 seconds earlier. While this layering of clothing seems relevant in the context of the Northern Hemisphere, this may not be relevant in South Africa which does not experience winter temperatures as low as the USA.

Based on these studies, which analysed the quality of CPR executed from tCPR instructions, it is shown that tCPR may be difficult to perform to standards which are recommended by AHA guidelines. Despite not adhering to international guidelines, it is still shown that tCPR positively effects bystander rates and OHCA survival rates. These studies were however all manikin based studies. Manikin study results may vastly differ from real life scenarios. A manikin scenario is very different from the realities and stressors of a real life resuscitation and it is unclear if the findings will be relatable or transferable in real life. There is currently no literature on tCPR quality in Africa or South Africa and this creates an opportunity to reveal our own unique findings on this topic.

Language and tCPR

Another aspect of tCPR that has been studied has looked at the language factors around tCPR and its effect on its execution. There is an excess of 6000 recorded languages in the world, with approximately 23 of them making up half of the world's population. The 3 most spoken languages globally are: Mandarin, Spanish, and English. The South African constitution recognises 11 official languages, with most South Africans being able to speak two or more of them, but it is known that there are far more languages spoken within our borders. With the ease of international travel and immigration in the modern world, the list of spoken languages within South Africa would likely increase.

An American based study by Nuño decided to assess the effects of Spanish-only speakers on tCPR access (44). An observational cohort study was designed and tCPR audio data was analysed between October 2010 to December 2013. All time important tasks were negatively affected by Spanish-only speakers. The average time for dispatch crew to recognize the need for CPR doubled, time to deliver CPR instructions increased by 90 seconds and time to deliver the first compression was also greatly increased. A limitation of this study is that a language barrier was coded by the telecommunicator taking the call so some individuals may have not been marked correctly. 3398 calls were made and only 39 of them were found to have a Spanish language barrier (44). In South Africa, there is likely to be a much higher number of people who do not understand English than was recorded in this study and language may play a much more important role in our setting.

Riou, et al. conducted a retrospective cohort study in Perth where the words used to initiate tCPR were analysed (45). These were either terms of willingness ('do you want to do CPR?'), futurity ('we are going to do CPR') or terms of obligation ('we need to do CPR'). Callers agreed more frequently to perform CPR when terms of futurity or obligations were used (97% and 84%) compared to willingness (43%). One could question the ethics around these terms as callers are already in an extremely stressful situation and feeling pressurized to perform CPR may have adverse psychological effects on them. There is however potential to increase bystander CPR agreement, and this is something that could potentially be studied further and utilized in a South African setting.

Notwithstanding the initiation of bystander CPR, language has also been shown to influence the quality of CPR provided. Van Tulder was aware that compression depth is generally poorly performed and questioned the effects of repetitive or intensified instructions would have on CPR quality (46). A total of 32 volunteers were randomized to either standard wording ('push down firmly 5cm'), intensified instructions ('it is very important to push down 5cm every time') or repeated instructions of either instruction (46). The best compression depths were performed by the standard wording group who managed to compress to a median depth of around 35mm. The repeated instructions may have distracted the caller performing CPR and led to shallower depths. This was also a very small study sample in each relative group and may have biased the results. No study has come out of Africa or South Africa regarding this topic but one may predict a similar finding.

Another study by van Tulder described the findings of an investigator-blinded, randomized, simulation study to assess which CPR instructions would lead to better compression depths being performed (47). Participants were allocated to a 'push down firmly 5cm' and a 'push down as hard as you can' group. No difference in exhaustion, compression depth or quality of CPR was observed. This study only included 13 participants and it is not clear whether any conclusions can be drawn from a sample of this size. How one should deliver instructions in a South African setting is a very valid concern, given the vast differences in languages spoken and education levels. A similar study in our setting may offer very different results.

Language does not only affect CPR quality but also OHCA recognition. Riou did research regarding the language factors that determine OHCA recognition by dispatch operators. It was found that agonal gasps were the most difficult description to interpret and caused 32 of the 176 confirmed OHCA cases in the study to not be recognised as OHCA cases by dispatch (48). Dami, et al. reiterated this point on a study performed in Switzerland on the time to identify cardiac arrest and initiate CPR (49). The biggest delay in starting CPR or not recognising OHCA was due to incorrectly diagnosing agonal gasps by dispatch operators. Travers,et al. had the same findings in Paris, Clegg, et al. in the United Kingdom and Lewis in the United States (50-52).

In Sweden 313 EMS calls of OHCA were analysed and according to this paper 76% of the recorded cases fulfilled criteria for OHCA (53). Only 47% of those calls that fulfilled all the criteria were offered tCPR instructions. Of those who were offered tCPR instructions only 6% of callers refused to perform bystander CPR. This paper highlights that even though bystanders were willing to perform bystander CPR, only about half of cases were offered tCPR instructions. It was highlighted that it was often difficult to distinguish between agonal breathing and normal breathing and this may have affected who was offered tCPR. The difficulty and differentiating agonal gasps has been shown numerous times in multiple countries (54-56).

It appears globally that 'breathing' is either not assessed, not understood or incorrectly identified by dispatchers. If HICs, who have utilized tCPR for some time, have difficulty detecting agonal gasps and diagnosing OHCA this would likely prove to be difficult in the African and South African setting, too. The studies on the language factors of tCPR highlight how important these topics relate to tCPR, its execution and the quality of CPR provided. However, other barriers may also exist to the initiation of bystander CPR through tCPR.

Barriers and challenges of tCPR

Most topics around tCPR focus on the benefits, simplicity and the execution of instructions. To fully review tCPR one needs to highlight the barriers and challenges faced by a tCPR program. Understanding barriers would allow one to be more prepared and mitigate these barriers effectively. Once again, a paucity of literature to identify the barriers to tCPR in the South African context exists.

Huang, et al. performed a prospective cohort study in Taiwan to compare the effects of landline, mobile, and transferred calls on the effectiveness of CPR (57). The use of a mobile device was associated with a higher bystander CPR rate when compared to other telecommunication modalities. Bystanders may find it difficult to receive instructions and attend to a patient when using a landline as the patient may need to be close to the device in order to do this. With a large proportion of the South African population living in rural areas or informal settlements, one may find the factor of a landline much less of an obstacle.

Recognising OHCA needs to be made as simple and as quick as possible as survival is linked to the early initiation of CPR and early defibrillation. Ireland's National Ambulance Service used a 21-question protocol to identify cardiac arrest and would then offer tCPR instructions. This is different from the general minimal question approached generally used and recommended by ILCOR (21). These minimal questions relate to the individual not being conscious, not breathing and then lead to performing CPR. In 2017 an article published from Oman, et al. aimed to identify the time taken to start chest compressions when using this 21-question approach (58). The median time to achieve this was 05:28 minutes with the biggest delay being due to the questioning process. This highlights how important it is to come up with a simple tCPR program as an extensive protocol could prove to be a barrier. This study does not include the characteristics of the callers, such as language, strength of the call and background noise which may have affected the results. The algorithm used in the Western Cape EMS does not have the same layout as one described in this study, but this study should help EMS to be cognizant of potential drawbacks of different algorithms.

Meischke, et al. sought to determine the effect of simulation training to improve dispatchers' skill in recognising OHCA and decreasing the time for tCPR in 4 western states of the United States (59). Actors were used to make fake calls for 4 simulation training sessions over a year. Of the 13 Call centres that underwent this training only 6 Call centres provided recordings of real OHCA cases of dispatch operators participating in the study. It was concluded that simulation training improved tCPR recognition of OHCA rates. As data was only collected from 6 of the 13 dispatch centres trained, these findings may have not been the same throughout the sample. Selection bias may have occurred.

A few factors have been shown to affect the compliance of tCPR instructions from being carried out, such as poor phone connection, refusal to perform CPR, cultural barriers and the emotional state of the caller (60). A familial relationship to the patient increased the odds of CPR being continued when the bystander was guided by the a dispatch operator in France. The same study in France highlighted that when an obstacle was encountered CPR was only performed in 57% of the cases (60).

Martinage, et al. conducted a single-centre prospective study at a dispatch centre in France where tCPR was offered for OHCA (61). A total of 38 patients were included in the study where predictive factors of successful tCPR were analysed (61). As a secondary finding, obstacles to tCPR were reported. Obstacles were classified as bystander obstacles (exhaustion, panic, feelings of inadequacy etc) and victim obstacles (the position of the body and the morphotype of the victim). Interestingly CPR was likely to be continued when there were no familial ties between the victim and the bystander but dropped to only 37% when a familial tie was present (61). It is unclear why this was found but maybe the emotional connection with a family member may hinder the ability to adequately perform CPR. With such a small sample size one should be wary about drawing too many conclusions from this study. Obstacles in France may be very different from obstacles found locally and for this reason, South Africa could give a very interesting perspective on this topic.

Amen, et al. evaluated whether there were any disparities of tCPR instruction offered on racial or socioeconomic lines in the U.S.A (62). The retrospective review was done on 3807 cases and it was reassuring to find that there were no differences receiving CPR instructions based on race or an increased income (62). This was a convenience sample, however, and may not be a true reflection of the US population as a whole. It is unclear whether this may be something of concern in the South African setting.

All these studies conclude that there are multiple barriers inhibiting one to either deliver tCPR instructions or affecting bystanders willingness to perform CPR. An African context would surely hold very different barriers and a study on this would prove fruitful and could add extensively to international literature.

Audio vs Visual tCPR

Over recent years there has been some discussion over which modality would be the best to deliver tCPR instructions. Should traditional audio telephonic instructions be used? Should auditory cues such as the sound of a metronome be utilized? With new technological advances should completely new forms be offered such as video instructions over a smartphone and would this have an impact on the effectiveness of CPR?

Bolle, et al. simulated cardiac arrest and randomly assigned Norwegian high school students to two groups, one with audio instructions and one with instructions being delivered via a video call (63). Students answered a questionnaire assessing their confidence, understanding and the usefulness around the technology. Irrespective of the group a student was allocated to, both groups felt that video calls were or would be superior to audio calls ($P = 0.0002$) and improved or would improve their confidence. Bolle published the quality of the CPR executed by these study participants two years prior, in 2009, and even though there was a trend towards shorter hands-off time in the video-caller group and the median time to first ventilation was significantly shorter, it was however found that video communication would not improve CPR quality without prior training (64). The study sample was all high school students who are more likely to use modern technology which is not true for older individuals and would have biased these results. The data collected for this study was also done so in 2007 where video technology was not nearly as advanced as today so findings may be very different today.

A more recent comparison of audio and video instructed CPR on resuscitation outcomes was done by Lee, et al. in the Republic of Korea. A retrospective cohort study evaluated 1489 OHCA cases that were given audio instructions and to 231 OHCA cases that were offered video instructions (65). Survival to discharge rates increased from 8.9% to 14.3% in the video group (65). This study did not measure CPR quality, but rather outcomes, and with such a large difference in the number of people in opposing groups selection bias cannot be excluded.

A systematic review and meta-analysis published in 2018 from Taiwan took tCPR a step further and compared the quality of CPR provided when guided by either audio-assisted or by video-assisted dispatch operator guided bystander CPR. It was shown that video-assisted dispatch instructed bystander CPR resulted in better hand placement and better chest compression rates (27). It was however shown in 2009 in Taiwan that the addition of video-assisted CPR caused a delay in the commencement of CPR but did however improve both compression rate and depth performed by bystanders (66).

Video has the potential to improve CPR quality and with evolving technology, this may become more evident. In the LMIC setting access to these technologies may not be as widely disseminated. It would make sense to first initiate tCPR programs before one starts to incorporate more advanced modalities.

Summary

Existing literature on tCPR is heavily weighted from HICs and very scarce or non-existent from LMICs. Worldwide literature highlights several important points regarding tCPR: Telephonic CPR programs are simple to implement and are cost-effective or come at very little cost, executed CPR quality from tCPR instructions varies greatly, linguistics and language play an important role in both delivering and understanding tCPR instructions, there are multiple barriers to performing tCPR and there are novel ideas regarding how to deliver tCPR instructions. Currently in South Africa there is no research on this topic. Therefore, there appears to be a knowledge gap in Africa and South Africa concerning tCPR, its execution and its effects. Thus, our observational simulation study aims to gather the quality of executed CPR, compared to the AHA guidelines, when directed by a trained individual utilizing the Western Cape EMS Guidecards algorithm of tCPR.

Identification of Gaps

There is a large gap in terms of ANY literature around CPR, tCPR, CPR quality and its execution within the African and South African setting. As there is a marked difference in terms of education, financial and cultural backgrounds when comparing Africa to the overwhelming literature available from HICs. Africa, and South Africa in particular, could help bridge this gap and prove to provide a wealth of information in all future fields of CPR and tCPR research.

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PART B: ARTICLE MANUSCRIPT

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A manikin-based simulation study of a telephone directed CPR-algorithm within the Western Cape setting and the self- reported comfort around its execution.

Leonel P De Caires, Katya Evans, Willem Stassen

Division of Emergency Medicine, University of Cape Town, Cape Town, South Africa

Correspondence to:

Leonel P De Caires

leoneldecaires@gmail.com

Mobile: + 27216501829

ABSTRACT

Background: There is little data in Africa regarding dispatch guided telephonic CPR. This study looks at the quality of CPR performed when compared to AHA guidelines, by untrained laypersons when given telephonic CPR instructions using the Western Cape EMS Guidecards algorithm for telephone assisted CPR.

Methods: In this prospective observational, simulation study, participants were given telephonic hands-only CPR instructions using the Western Cape EMS Guidecards. CPR quality (hand placement, rate, depth and chest recoil) was analysed and then followed by a questionnaire looking at the self-reported comfort regarding the execution of said instructions.

Results: Overall quality of CPR by participants (n=50) was suboptimal with no participant complying with current CPR guidelines. Demographic factors influenced quality where males pushed on average deeper (40.8mm vs 28.5mm, p=0.004) when compared to females. Correct hand placement and chest exposure were directly related to the caregivers' home language with English making it more likely to correctly perform these instructions (p=0.01 and p=0.002, respectively). Self-reported comfort had no effect on executed CPR quality.

Conclusion: The quality of CPR performed by laypersons, when directed by a call-taker using the Western Cape Provincial EMS Guidecards Algorithm, can be suboptimal in terms of compression rate, depth, full chest recoil and baring of the chest. There is an urgent need to find more effective ways, in the Western Cape EMS, to improve executed CPR quality when guided by a trained telephone operator.

Keywords: CPR, Bystander CPR, Telephonic CPR, Cardiac Arrest

African relevance:

- There is a shift of the burden of disease with cardiovascular disease on the rise
- With the increase of cardiovascular disease we will be seeing a rise in the number of out-of-hospital cardiac arrests
- CPR is our first treatment modality for cardiac arrest
- Bystander CPR has been to shown to increase the success rates of out-of-hospital cardiac arrest and can be encouraged through telephonic CPR instructions from an emergency medical services call taker
- Emergency Medical Services in Africa are young and evolving

INTRODUCTION

In the past, low- to middle-income countries (LMICs), concentrated their resources on tackling communicable diseases which formed their biggest causes of death (1). With the increase in non-communicable diseases such as cardiovascular disease within South Africa, the incidence of out-of-hospital cardiac arrest (OHCA) is also likely to increase (2, 3). Cardiopulmonary resuscitation (CPR) is an early potentially life-saving intervention following a cardiac arrest (4-7). OHCA has a very poor outcome with a mortality rate as high as 91%-100% in certain settings (6, 8, 9). Early implementation of CPR, including bystander CPR, has been found to improve survival in OHCA (4, 8, 10-13). Emergency Medical Services (EMS) on-scene arrival time to reach a patient for further treatment may be excessively prolonged due to resource limitations in a LMIC so steps taken to increase the chance of survival for patients who have an OHCA should be considered for potential implementation(14).

After an OHCA, call-takers from a dispatch centre are the true 'first responders' at any emergency as they will be the initial people contacted by the community when seeking medical assistance. These call-takers could be utilised to identify OHCA (10), encourage bystander CPR to be commenced and guide people on how to perform CPR over the phone, forming the second link on the chain of survival described by the International Liaison Committee on Resuscitation (ILCOR) (15-19). However, to ensure and increase CPR initiation in both dispatchers and bystanders, CPR instructions that are easy to utilise, easy to comprehend, easy to remember and quick to implement are essential (20). ILCOR promotes telephonic CPR (tCPR) but does not highlight which algorithm to utilise, with multiple independently created tCPR algorithms being used globally (21, 22).

International CPR guidelines have been reviewed and altered regularly. ILCOR had initially undertaken 5-year cycles on CPR science review and have issued their latest recommendations summary in 2017 (23). ILCOR has adapted their review cycle intending to perform continuous evidence evaluation. A huge emphasis has been placed on improving CPR quality provided by all providers to improve survival of patients who have suffered OHCA. ILCOR currently recommends a compression rate of 100–120 compressions/min, a compression depth of 5-6cm and total recoil after every compression (23).

At present, there is limited literature available on OHCA and CPR performed by trained EMS providers in South Africa. There is no literature on bystander CPR, no research available on tCPR and its utilisation. Bystander CPR has been shown to increase survival of OHCA and tCPR is one of the modalities that can be used to increase the likelihood of bystander CPR. Despite this lack of literature in South Africa, the Western Cape Provincial EMS has a tCPR algorithm for use according to their EMS 2009 EMD Guidecards (24). This algorithm provides for the identification of OHCA by call-takers and provision of tCPR instructions to the caller. For this reason, we aim to determine the quality of CPR performed on a manikin when guided by tCPR, using the Western Cape Provincial EMS tCPR algorithm, and the self-reported comfort and understanding of the executed CPR.

METHODS

Study Design

We performed a prospective observational study, using a simulated high-fidelity manikin-based design. Ethical approval was obtained from the Human Research and Ethics Committee of the University of Cape Town (Ref: 066/2019)

Study Setting

This study was performed at a series of Sisaphila events in the greater Cape Town metropole. Sisaphila is an unaccredited hands-only CPR training organisation run by Emergency Medicine Registrars from the University of Cape Town (25). Their focus is to train the Western Cape community members hands-only, bystander CPR monthly. At a Sisaphila event, members of the public arrive at their convenience and receive one-on-one CPR training from healthcare providers. In 2017 alone, Sisaphila trained approximately 1200 laypersons in hands-only CPR across seven events.

The last South African Census, done in 2011, revealed that the Western Cape was the 4th most populous province in South Africa with a population of 5.83million people and 3.74million people in Cape Town making it the 2nd largest city in South Africa. The Western Cape Department of Social Development released in 2019 that the Western Cape had an increased estimated population size of 6.76million people. The majority of people living within the City of Cape Town district municipality speak Afrikaans (35.7%) as their first language, followed by Xhosa (29.8%) and English (28.4%).

Data Collection Procedure

Potential participants were approached individually at Sisaphila CPR training events for recruitment. Involvement in the study was completely voluntary and would only be considered if participants were older than 18, had no prior CPR training and had no physical or psychological factors that would affect them personally while performing CPR.

After obtaining informed consent, participants were taken into a private room, where a high-fidelity resuscitation manikin was set up (Resus Anne QCPR; Laerdal, Norway). A standardised mobile telephone device (Apple iPhone XR, Apple Inc, California, United States of America) was placed on loudspeaker, as per the algorithm, and handed to participants to call an allocated EMS call-taker. They were told that the manikin was a *"person"* who had collapsed and they would be required to phone an emergency phone number and start with the line of *"Please help, someone has collapsed*".

A healthcare provider was trained on the Western Cape Provincial EMS hands-only tCPR guidecards and assigned the role of the EMS call-taker throughout the study to ensure consistency. The call-taker did not deviate from the allocated script used on the algorithm and was not present in the room at any point. No language other than English was used to explain CPR, regardless of participants' home language, as the EMS Guidecards are only available in English. In reality a call-taker might provide instructions in a different language if they felt comfortable to do so, but for this study language and dialogue were standardised for reliability.

Once the call-taker was phoned, tCPR instructions were provided to participants and hands-only CPR was performed on the manikin. CPR quality was independently analysed using the manikin. The manikin was linked to the Laerdal Skills Reporter software that recorded hand placement [%], mean compression rate [compressions per min], mean compression depth [mm] and chest recoil in real-time, which was then stored under a unique identifier to ensure the anonymity of the participants. Acceptable rates and depth limits can be manually programmed into the manikin and were set according to the latest American Heart Association (AHA) guidelines. The principal investigator remained in the room to observe whether the chest of the manikin was exposed or not and to set up the manikin pre and post CPR but did not assist the participant in any aspect of the simulation.

The second part of the study was to elicit the self-reported comfort and understanding of performing CPR after being guided via the telephone. A series of paper-based questions, based on literature and created by the primary investigator, were answered using a Likert scale and recorded anonymously on a paper-based questionnaire applied by the primary investigator. Whilst the questionnaire was not piloted, it was validated for content prior to data collection. The questionnaire aimed to collected very basic demographic data (gender and home language) and consisted of a set of questions regarding the participants understanding and clarity of the CPR instructions given to them. The self-reported comfort regarding the likelihood to perform bystander CPR was questioned.

Data Analysis

For the primary outcome, data were analysed descriptively to denote CPR that complies with each of the key elements of hands-only tCPR recommendations. Associations were sought between the performed CPR and AHA guidelines (Total recoil, Depth [50-60mm], Rate [100-120 compressions/min], correct hand placement [%]), demographics and tCPR performance. For all categorical variables, we ran chi-square tests. For mean depth and rate between genders, we ran independent sample t-tests. For mean depth and rate between language, we performed one-way ANOVAs. Significance was set at p=0.05.

For the secondary outcomes, demographic and survey results were analysed descriptively. Associations were sought between survey answers, CPR performance and AHA Guidelines on hands-only CPR. All analyses were performed using SPSSS (v. 25, IBM Corporation, New York, United States of America).

RESULTS

Fifty participants (n=50, female: n=32, 64%) were recruited over a series of five hands-only CPR training events in the greater Cape Town metropole (Muizenburg, Cape Town City Bowl and Woodstock) between July and December 2019. There was a female predominance (n=32, 64%) while twenty participants (40%) had English as a first language.

Table 1 below describes the overall demographic relationship between self-identified gender, language and the pass/failure rate of individual variables in CPR quality when compared to AHA guidelines (Total recoil, Depth [50-60mm], Rate [100-120 compressions/min], correct hand placement [%]) and whether the chest was exposed or not. Home language had a statistically significant effect on whether the chest was exposed (p=0.002) and on correct hand placement (p=0.014). Gender had an effect on the mean depth with males having a greater mean depth compared to females (p=0.004). Thirty-seven participants (37/50 [74%]) placed their hands correctly on the centre of the manikin's chest. The chest was exposed 40% of the time with twelve of the successful participants (12/20) having English as their first language.

__Table 1: Demographics and CPR Quality__

	Gender			**Language**			
	Male	**Female**	**p**	**English**	**Afrikaans**	**Other**	**p**
n, (%)	n = 18	n = 32		n = 20	n = 12	n = 18	
Hand Placement Co[a]	11 (61.1%)	26 (81.3%)	0.12	18 (90%)	10 (83.3%)	9 (50%)	0.01*
Expose Chest Co	5 (27.8%)	15 (46.9%)	0.19	14 (70%)	2 (16.7%)	4 (22.2%)	0.002*
Mean Rate (Compressions per/min)	95	90	0.69	87	104	88	0.49
Mean Depth (mm)	41	29	0.004*	32	31	36	0.63
Chest Recoil Co	2 (11.1%)	10 (31.3%)	0.11	7 (35%)	2 (16.7%)	3 (16.7%)	0.33
* Statistically significant, Co: Compliant,							

Thirty-eight participants (76%) were unable to obtain full chest recoil during their CPR simulation. Table 2 compares and relates total recoil within three different depth categories. Average mean depth across all participants was 32.96mm but when looking at all 3117 individual compressions performed, and not the mean compression depth per participant, 17.7% of all individual compressions (551.7) were within 50–60mm.

Table 2: Chest Recoil and Compression Depth Crosstabulation

Recoil with Compression Depth Crosstabulation						
			Compression Depth			
			<50mm	50-60mm	>60mm	Total
Recoil	Co	Count	29	6	3	38
		% of Total	58%	12%	6%	76%
Total		Count	40	7	3	50
		% of Total	80%	14%	6%	100%

Figure 1 Questionnaire Answers

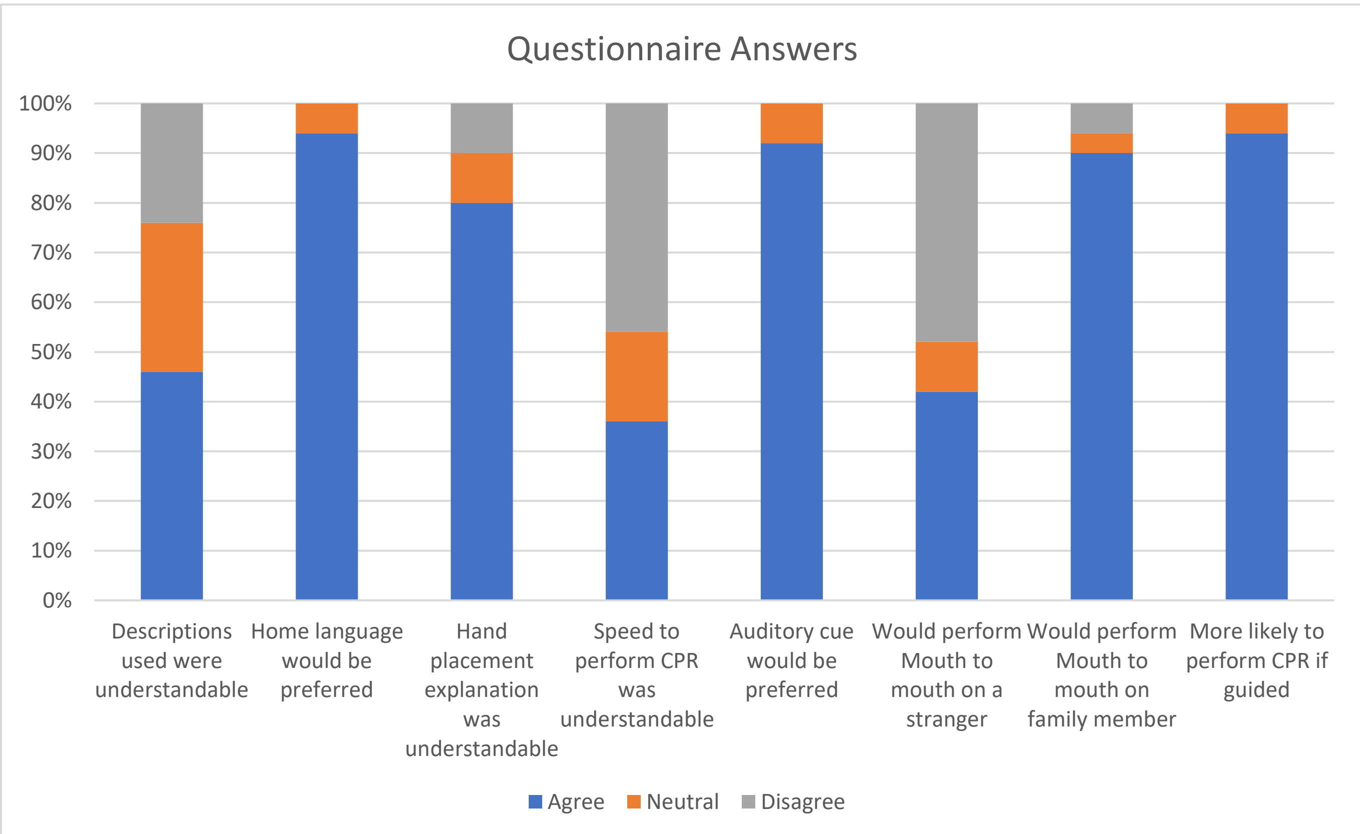

Figure 1 shows the results of the questionnaire. Neither the reported understandability of the tCPR instructions nor self-reported comfort with performing CPR was associated with CPR quality ($p>0.05$).

DISCUSSION

tCPR instruction, given by a qualified and trained call-taker, using a well-defined and standardised algorithm, has the potential to increase both the quality and the likelihood of bystanders performing CPR (16, 17, 21, 26). To the authors' knowledge, this is the first study to describe this in an African population. We sought to determine the quality of CPR performed on a manikin when guided telephonically by a call-taker, using the Western Cape Provincial EMS telephonic CPR algorithm, and the self-reported comfort and understanding of the executed CPR. We found that the quality of CPR performed was poor.

Studies have repeatedly shown that the early commencement of good quality CPR and early defibrillation are linked with maximizing survival rates (23). There are a multitude of factors that sway the overall quality of CPR. An emphasis has been placed on the quality of chest compressions performed, with the quality overall being assigned to compression rate, depth, recoil and hand placement (5, 27). Interestingly not one participant managed to successfully execute all these variables collectively when comparing them strictly to AHA guidelines.

For the overall sample, the mean depth and rate were both found to be subpar compared to AHA guidelines. It has been shown before that even trained healthcare providers performed CPR below standard guidelines with both depth and rate being below recommendations (28, 29). If a trained provider cannot meet these guidelines it may be expected that an untrained layperson may also find difficulty. An interesting finding was that males, on average, had a significantly ($p=0.004$) deeper compression depth when compared to females. It is unclear if this was due to age, the smaller male sample size ($n=18$ vs $n=32$) or due to body habitus. This finding has been noted before in a 2009 American based study (30) but was not reproducible in Kuwait where there was no difference between the two gender groups (31). Studies in both the USA and Japan, that used a similar simulated manikin approach to assess tCPR quality, both reproduced findings of subpar compression depths showing similar trends globally regarding tCPR quality (32, 33).

Hand placement assessment by the manikin is limited to an area in the centre of the chest between the nipples. This restricted area is in keeping with AHA guidelines. Correct hand placement has been debated multiple times with limited data on the topic. Over time multiple studies have looked at alternative positioning of the rescuer, such as by the patient's head, and suggestions have been made to potentially incorporate abdominal compressions rather than chest compressions (34). In our study, participants performed well in the hand placement category.

South Africa has eleven official languages and the algorithm utilised in this study is limited to English. Language barriers have been shown to affect CPR quality. In those whose native language matches the CPR instructions given to them, better quality CPR is performed (22, 35). Language played a definite role with our participants. Exposing the chest is described as *"Bare the chest"* on the algorithm and hand placement concentrates on the term *"Heel of the hand on the centre of the chest".* English speakers were much more likely to pass both these variables (p=002 and p=0.014 respectively) than non-English speakers. Compression depth is explained using *"inches*" whereas South Africa utilises the metric system and this may have created some confusion. The post CPR questionnaire reflected participants' concerns with 46% of participants feeling that the instructions were overall understandable and 94% of people believed the instructions should be offered in more languages other than English.

Several observations made during the CPR scenario merit a comment even though they were not part of the data collection elements we were observing. The scenario proved confusing for some individuals as media and television often depict CPR with ventilations. This occasionally caused some participants to stop CPR and make comment on the lack of instructions thereof. There has been a shift away from ventilations being performed by bystanders, with AHA recommending a hands-only CPR approach for tCPR (23). Despite participants concerns regarding the lack of ventilations, 90% of participants said they would be comfortable performing 'mouth-to-mouth' on a family member compared to 42% on a stranger. This has been reproduced in multiple studies (36, 37) including Bangladesh, which is an LMIC (38). Another observation that may hold some clinical impact was that a large proportion of participants would cease chest compressions every time the call-taker spoke or said *"Keep going, you're doing great"* as they tended to think another instruction was being delivered to them.

The potential futility of CPR in an LMIC is something that cannot be ignored. Most literature is focused on HICs and despite their huge resource investments and well-established EMS systems survival rates remain fairly low (39). In South Africa, EMS services are not of equal quality throughout and availability within rural areas is particularly lacking. In rural Eastern Cape, EMS services occasionally fail to arrive at more than 12 hours. (14). Survival of OHCA in these settings is likely to be dismal if any at all, and of those who do survive, one needs to be cognisant of the potential neurological deficits that may occur due to this delay and the subsequent overall burden this has on South African resources, which are finite. Should CPR be offered in these settings? Should CPR be offered to a select few in metropoles only who have better EMS access? Future studies should focus on these questions.

STUDY LIMITATIONS

One of the largest limitations to this study was that it was, unavoidably, manikin based and therefore took away from the harsh realities of a true resuscitation. The data collection was also done in a near-perfect setting, devoid of physical and auditory distractions. One could think that the CPR performed may be slightly better than in a real scenario where there is a heightened stress response and noise impairing the audio quality of the phone call. Our call-taker was a trained specialist anaesthetist and it is unclear if this would affect the instructions given over the phone. We attempted to limit the effects of the call-taker by ensuring no deviation from the script and no additional explanations or clarifications were permitted to be delivered to participants. Further, not offering instructions in a language other than English might not necessarily mimic reality however, this was done as the Guidecards are only available in English and to ensure reliability.

Another limitation would be the sample size, study location and the exclusion of individuals who may have had difficulty performing CPR. Further, a healthcare provider gave the tCPR instructions. This was due to a lack of access to trained EMS call-takers or dispatchers. Due to these factors, our study may not apply to other populations in other regions or demographic profiles who may be performing tCPR.

CONCLUSION

The current simulated observational study highlighted that the executed CPR quality performed by laypersons, when directed by a call-taker using the Western Cape Provincial EMS Guidecards Algorithm, can be suboptimal in terms of compression rate, depth, full chest recoil and baring of the chest. Hand placement was generally well performed. The study also showed that regardless of participants reported comfort and understanding of instructions given, CPR quality was uniformly less than optimal in all groups. Further studies are required to find more effective ways to provide tCPR instructions that will aid bystanders to perform CPR more effectively.

DISSEMENATION OF RESULTS

The results of this study were shared with the Western Cape Emergency Medical Services.

AUTHOR CONTRIBUTION

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: LD contributed 65%, WS contributed 25%, KE contributed 10%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

DECLERATION OF COMPETING INTEREST

The authors declared no conflicts of interest.

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PART C: ADDENDA

a. Research Protocol

A manikin-based simulation study looking at a dispatch operator directed CPR algorithm within the Western Cape setting and the self-reported comfort around its execution.

Research proposal in fulfilment of the degree of MMed in Emergency Medicine, presented by:

Student: Leonel De Caires

DCRLEO001

Supervisors: Willem Stassen

Dr Katya Evans

Division of Emergency Medicine

Department of Health Sciences

University of Cape Town

Declaration

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1. INTRODUCTION

1.1 Background

The American Heart Association defines cardiac arrest as *"the sudden cessation of cardiac activity so that the victim becomes unresponsive, with no normal breathing and no signs of circulation."* If corrective measures are not taken rapidly, this condition progresses to sudden death (1). Approximately 31% of all death globally, according to the World Health Organization (WHO), are as a result of cardiac arrest(2).

Out-of-hospital cardiac arrest (OHCA) is used to distinguish between cardiac arrest that occurs out of a hospital setting to those that occur in a hospital setting around medical professionals (3). OHCA has a very poor outcome and mortality rates are as high as 91-100% in some settings (4, 5). Numerous factors have been identified that are associated with survival. These include, and are not limited to: whether the prehospital arrest was witnessed or not, the time taken for Emergency Medical Services (EMS) to arrive on scene, if a shockable rhythm was present and identified, if there is availability of a defibrillator and whether pre-hospital cardiopulmonary resuscitation (CPR) was initiated or not. This is especially true for bystander CPR (6). In South Africa the availability of an Automated External Defibrillator (AED) to the public is likely to be poor, although no literature has been found to support this.

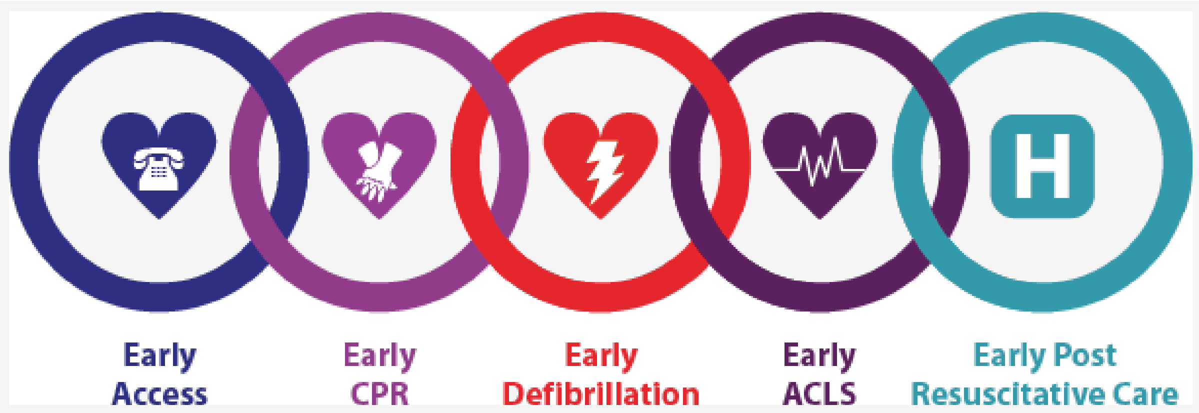
Time taken for EMS to arrive to a medical scene varies in duration and is restricted to the available resources at the time of the incident. If people were empowered with the skill of CPR this may buy some extra time for ambulance services to arrive to assist with the provision of more definitive treatment options. Bystander CPR has been shown to improve neurologically intact survival from patients who have suffered from OHCA (7) and bystander CPR is still being recommended for all patients in cardiac arrest (8). This is a class 1 recommendation by the American Heart Association with level of evidence C-LD (9) (This means that evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective and its use is recommended/suggested).

The first recommendations for CPR were issued in 1974 (10) and since then international CPR guidelines have been reviewed and altered on a regular basis. The International Liason Committee on Resuscitation (ILCOR) have undertaken 5 year cycles on science review of CPR and have issued their latest recommendations summary in 2017. Their latest summary focuses on all forms of CPR strategies including EMS, Dispatch Assisted and Bystander CPR interventions and recommendations (8). A strong emphasis has been placed particularly on Dispatch Assisted and Bystander CPR and Bystander CPR and it has been recommended that bystander CPR is performed for all patients in cardiac arrest. The benefits of performing early CPR have been shown repeatedly (11). Patients who received bystander CPR had 1.3 times the chance to survive to assessment in hospital and were 2.5-

fold more likely to survive to hospital discharge when compared to people who did not receive bystander CPR (6). In South Africa, due to the immense burden of disease and resource restrictions, EMS waiting times for retrieval of a patient may be prolonged and the use of telephone guided CPR (tCPR) may be able to bridge part of this waiting time so as to benefit those who have sustained OHCA.

The chain of survival (Figure 1) is a 5-step concept created by the AHA which comprises of a series of actions to be performed as quickly as possible to increase the chances of survival for patients who have OHCA (12). As one can see from the chain, the second point is early CPR, and this can be attained by improving the likelihood of bystander CPR being initiated. This could possibly be achieved by global awareness campaigns, formal community training or simply by encouraging and leading bystander CPR by the EMS Dispatch Operator. ILCOR Telephone CPR Time Standards (Appendix A) recommends time from call to the dispatch operator, recognition of cardiac arrest, to initiating CPR should be within the first 180 seconds of the call (12). This is to improve survival rates from those that suffer OHCA.

Figure 1



Currently there is very little research in OHCA and bystander CPR in South Africa. A paper looking at OHCA and return of spontaneous circulation was conducted in Johannesburg (5). In this particular study, OHCA data were extracted out of a database and analysed with regards to what favoured return of spontaneous circulation (ROSC). A total of 510 patients were considered for resuscitation due to OHCA, of these 305 were not resuscitated at all. Resuscitation was attempted in the remaining 205 patients. All 205 received chest compressions. ROSC was not obtained in those with no form of resuscitation compared to 36 patients where ROSC was obtained. There appears to be no literature on this topic within the Western Cape province. CPR is a basic skill that could be easily initiated with the potential of making a great impact on our society and thus there should be an emphasis made towards the study of this important skill in our population.

ILCOR currently advises bystander CPR for all those who experience OHCA and suggests the use of tCPR to ensure this (9, 13). A 12 year study in Seattle found that 29.9% of OHCA who received advanced care from a paramedic could have benefited from tCPR (14). A few factors have been shown to affect compliance of tCPR instructions from being carried out (15) such as poor phone connection, refusal to perform CPR, cultural barriers and the emotional state of the caller. Regardless of these compliance factors one cannot disregard the benefits of bystander CPR and its importance as the second link on the chain of survival (figure 1).

1.2 Motivation

With the increase in non-communicable diseases such as cardiovascular disease and myocardial infarction, the incidence of OHCA is also likely to increase. Early and bystander CPR has been found to improve survival in OHCA (7, 11). EMS ambulance waiting times to get to a patient for further treatment may be excessively prolonged due to resource restrictions so whatever means possible to increase the chances of survival for patients who have a OHCA should be put in place. Survival clearly has great implications for the general community as these patients may be productive members of society and may be bread winners for their respective families. Neurological intact survival also eases the burden on the currently overwhelmed health system. After an arrest, tele-communicators from an emergency centre are our true first responders on any out-of-hospital medical scene as they will be the initial people contacted by the community when seeking medical assistance. These tele-communicators could be utilized to identify OHCA, encourage bystander CPR to be commenced and guide people on how to perform CPR over the phone as suggested by the second link on the chain of survival (figure 1). However, in order to ensure compliance in both dispatchers and bystanders, CPR instructions that are easy to utilise, easy to remember and quick to implement are essential.

1.3 Research Question

What is the quality of CPR performed on a mannikin when guided by telephonic dispatch CPR, using the Western Cape EMS telephonic CPR algorithm, and what is the self reported comfort of lay people around this algorithm?

1.4 Aims & Objectives

To determine the quality of CPR performed on a mannikin when guided by telephonic dispatch CPR, using the Western Cape EMS telephonic CPR algorithm and self-reported comfort of the Western Cape EMS 2009 EMD algorithm (Appendix B).

2. METHODOLOGY

2.1. Study design

A simulated experimental prospective study design will be used.

2.2. Study setting

This study will be set at a series of Sisaphila events in the Western Cape province. Sisaphila is a unaccredited hands only CPR training organisation run by the Emergency Medicine Registrars of Cape Town (16). Their focus is to train the Western Cape community basic hands only CPR at an event on a monthly basis. Sisaphila events are approximately eight hours long. During this period, members of the public arrive at their convenience and receive one-on-one CPR training from healthcare providers. In 2017, Sisaphila trained approximately 1200 laypersons in hands-only CPR across seven events.

2.3. Study sample

The study will include medically inexperienced laypersons. A layperson is defined as 'A person without professional or specialized knowledge in a particular subject' (17). A convenience sample will be recruited at three consecutive Sisaphila events. We have selected more than one event in order to account for the regional variations in patient demographics that would otherwise be unavoidable should only one event be selected. Sisaphila events vary on a monthly basis and include care centres in and around Khayelitsha, schools within Cape Town Metropolitan and even an event at the Sea Point promenade (Which trains nearly 1000 people over one weekend). Approval from Sisaphila to use these events for our study has been attached (Appendix C). A convenience sample will be selected as the current project is of limited scope, with limited resources. We further hope to utilise the data from this study to generate foundational data that can be utilised to develop further robust tCPR algorithms. However, should a minimum of 50 participants not be obtained, additional Sisphila events will be earmarked for enrolment. This is to ensure that an adequate sample size is obtained to draw meaningful conclusions. The sample will be screened according to the following inclusion and exclusion criteria:

Inclusion Criteria

- Adults of 18 years or older.

Exclusion Criteria

- Children
- Individuals who have previously received formal training or experience in CPR

- Individuals with a self-reported medical condition that may be affected by the physical performance of CPR. This includes and is not limited to angina, severe arthritis, neck injuries etc.
- Individuals who self-report having suffered previous psychological trauma related to an actual resuscitation event.

2.4. tCPR Algorithms

Currently within the Western Cape EMS services the 2009 EMD Guidecards are being utilized. These guidecards are provided to dispatch operators and allow for the telephonic recognition of OHCA and gives guidance to the caller on how to perform bystander CPR. The algorithms are extended over a multitude of pages, give different options for CPR and provide directions on how to perform CPR which includes hands only CPR or CPR with ventilations. The guidecards are provided in Appendix B.

2.5 Data collection and management

Participants will be enrolled at a Sisaphila CPR event as described above in point 2.3. On the day of the event, potential participants of the planned Sisaphila event will be approached in person as they arrive, before receiving their CPR training. The nature of the study will be explained to participants and informed consent (Appendix D) will be obtained for those who agree to partake in the study. After consent has been obtained, participants will be taken to a private enclosed area where the Laerdal resuscitation manikin with the Laerdal Skills Reporting System (SkillReporter software) will be set up.

An EMS call operator will call the participant on a standard mobile phone with a speaker function. Telephonic CPR will then be administered by an EMS call centre operator. The EMS operator used will be trained in the WC EMS guidecards. Regardless of the first language of the participant, the tCPR will be performed in English, uniformly, as the guidecards are only available in english. To ensure consistency in the instruction, the same pool of instructors (two per event) will be utilised for the event. During statistical testing, sensitivity analysis (after consultation with a statistician) will be performed to determine statistical difference in the CPR quality and comfort between call-takers.

Two different sets of data will be collected and will be done by a single data collector, the primary researcher. Firstly, quality of CPR will be recorded by a Laerdal resuscitation manikin with their Laerdal Skills Reporting System (SkillReporter software) (Appendix E). CPR will be performed on an adult manikin which is connected to a computer with the SkillReporter software preinstalled. Overall CPR metrics (compression rate, mean compression depth and mean volume of ventilations) are digitally recorded and analysed on a real-time basis. This ensures data collection is standardised and free from human bias and error. The Laerdal manikin as well as the analysis software has been provided by the Laerdal head office branch in Johannesburg South Africa.

The definitions of the data points collected include:

- Compression rate: The AHA recommends a compression rate of at least 100-120 per minute (9).
- Mean Compression depth: The AHA recommends a compression depth of approximately 5cm (9).
- Hand Placement: In the centre of the chest overlying the lower third of the sternum. This is automatically determined by the manikin (9).
- Overall Score: The SkillsReporter Software provides a composite score taking all of the above factors into consideration, and provide a score of between 0% and 100%. It also provides feedback on which aspects should be improved upon.

Once CPR has been completed, an online survey tool, SurveyMonkey, will be used to administer an unvalidated questionnaire using an Apple iPad (Apple Inc. California, United States). The questionnaire has been designed to elicit five-point Likert scale responses regarding language use, CPR instructions and the self-reported confidence of participants (Appendix F).

The investigators will collate all collected data into an electronic spreadsheet (Microsoft Excel, Microsoft Corporation, Redmond, WA). Collected data will be stored on a password protected personal computer, in a password protected file. Data will be stored for a period of five years whereafter it will be destroyed.

2.6. Statistical analysis

CPR quality (overall score) will be assessed using the Laerdal Skills Reporting System and compared between groups. Furthermore, results will be presented descriptively with means, medians, standard deviations and ranges. Depending on sample sizes and distribution, the appropriate test to compare the means of the two groups will be selected. Significance will be set at a p-value of <0.05.

Survey results will be analysed and presented descriptively. Furthermore, associations between CPR quality and survey results will be sought using appropriate tests for categorical variables, depending on distribution of data and sample sizes.

2.7. Timeline

Below is a table that highlights the projected time schedule once DRC approval has been acquired.

	2017 through2018									
Task	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
EMDRC submission	X									
Ethic approval		X								
Data collection			X	X	X					
Data management						X				
Statistical analysis / reporting of results						X	X			
Writing								X	X	
Preparing and submit for publication										X

3. ETHICAL CONSIDERATIONS

This study involves human participants. An informed consent form (Appendix D) will be signed by all participants after the nature of the study has been explained to them. Time will be allocated to allow for any questions to be answered and contact will be allowed at any point after receiving consent if any other questions may arise. The participants will be allowed to leave the study at any point if they feel the need to. Consent forms will be provided in English and explained in person. Participants will be allocated a number and no personal information will be stored, published or shared.

Data collected will be restricted to members of the research team. All data collected will be entered into an electronic spreadsheet as mentioned above. This electronic spreadsheet will only be accessible on a password protected work computer.

An email from Laerdal for use of their Laerdal Adult Manikin and SkillsReporter system is attached (Appendix G). Laerdal has sponsored the manikinand the transport of the manikin down to Cape Town. An email from Dr De Vries from the Western Cape EMS giving permission to use the 2009 EMD Guidecards is attached (Appendix H.

4. LIMITATIONS

This study will only look at Western Cape EMS 2009 EMD guidecards and does not include other South African provinces or other South African private sector companies. One cannot determine the exact extent the Hawthorne Effect may have on the subjects. Confounders may include language proficiency, age and gender. Randomisation will assist us with these confounders. Finally, the simulated design of this study means that it might not reflect the real-life situation however, we feel that utilising a simulated environment is the only way to control the situation in order to reach the study aims.

Follow up studies need to look at whether dispatchers are currently utilizing the guidecards that they presently have, the limitations of the implementation to the general public and look at ways to increase awareness.

5. DISSEMINATION OF FINDINGS

Results of the study will be reported in an MMed thesis that will be published on the UCT OpenArchive repository. As far as possible, publication in a peer reviewed, open access journal will also be sought. Finally, results of the study will be provided to stakeholders at the Western Cape EMS. Furthermore, suggestions to improve the guidecards will be provided based on the feedback from participants.

6. RESOURCES

6.1 **Available Resources**

The use of the Laerdal Adult Manikin and the SkillsReporter software has been donated by Laerdal South Africa. Statistical support is funded by the Division of Emergency Medicine. The rest of the study will be self-funded.

6.2 Budget

The budget for this study is R3058. A detailed budget is attached. (Addendum)

Personal Compensation	R0
Statistical Services @ R590 per hour	R1180
Equipment courier	R1000
Stationary	R100
Telephone / Internet	R500
Total Direct Cost	R2780
Redundancy provision (10%)	R278
Total Costs	**R3058**

7. REFERENCES

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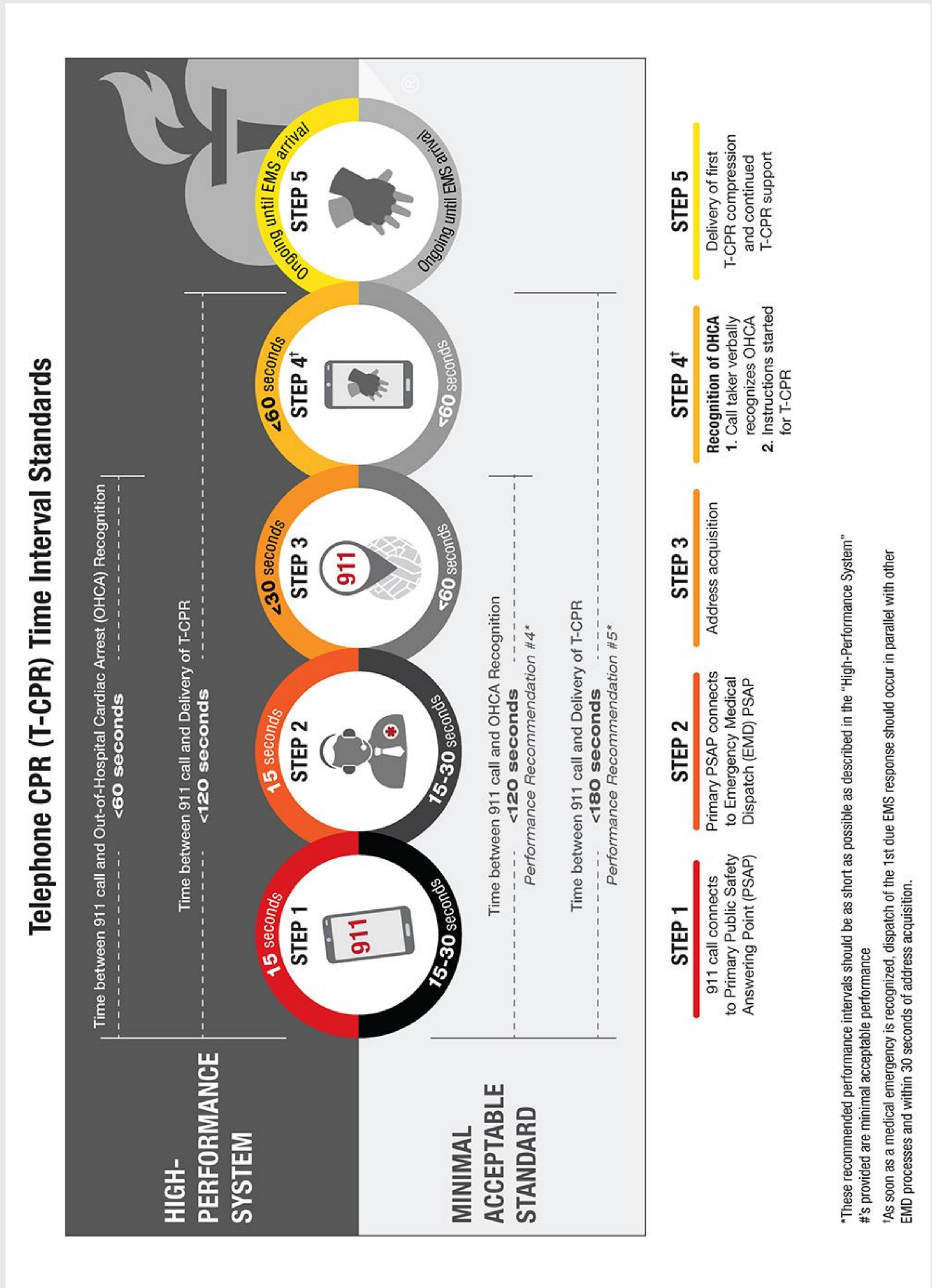
APPENDIX A:ILCOR tCPR Time Schedule



APPENDIX B: Western Cape EMD CPR Algorithm

CARDIAC ARREST / DOA

KEY QUESTIONS		
KEY QUESTIONS	Is patient alert? Is patient breathing normally? (Consider breathing card) If unsure about consciousness, interrogate further: a. Does the patient respond to you? Talk to you? Answer questions? Hear you? b. Does the patient move? Flinch? Move arms or legs? c. Are the pupils fixed and dilated?	If unsure about breathing, interrogate further: a. Have the caller go and see if the chest rises, then come back to the phone. b. Listen for the sound, frequency and description of breaths. Agonal respirations are often reported as: gasping, snoring, or gurgling barely breathing moaning weak or heavy occasional
	SIMULTANEOUS ALS/BLS	**BLS DISPATCH**
DISPATCH	Unconscious/not breathing adequately or at all. Possible DOA's, of unknown origin	**FOLLOW LOCAL PROTOCOL** CONFIRMED HOSPICE EXPECTED DEATH

CARDIAC ARREST / DOA Pre-Arrival Instructions

Go to CPR card for the appropriate age group.

Prompts	Short Report
Agonal respirations are ineffective breaths which occur after cardiac arrest	Age Sex Specific location Chief complaint Pertinent related symptoms Medical/Surgical history, if any Other agencies responding Any dangers to responding units

ADULT CPR INSTRUCTIONS

Does anyone there know how to do CPR?

NO | YES

Do you need help in remembering the

YES | NO

Begin CPR on the patient now.
I'll stay on the line if you need me until help arrives.

Get the phone NEXT to the patient if you can.

OK | CAN'T

Do you have a cordless phone?
Is there a phone that may be closer to the patient?
Can someone there relay my instructions to you?
[If not] I'll give you the instructions, then return to the phone.
If I'm not here, stay on the line.

OK

Listen carefully. I'll tell you what to do.
Get the patient FLAT on their back, on the floor.

OK | CAN'T

Is there anyone there that can help you gently roll or slide the patient to the floor?
[If not] Can you get help and return to the phone?

OK | NO HELP / CAN'T

Begin attempts as best as possible.

ARE YOU WILLING TO DO MOUTH TO MOUTH?

YES | NO

COMPRESSION ONLY ENTRY POINT PAGE 3

(CONT.)

BARE the chest. **KNEEL** at the patient's side.
PINCH the nose **SHUT** with **ONE HAND.** With your **OTHER** hand, **LIFT** the **CHIN**
COMPLETELY COVER their mouth with your mouth.
GIVE TWO BREATHS OF AIR into the patients **LUNGS**--just like you're blowing up a balloon.
Make sure the **CHEST GENTLY RISES**.

REMEMBER, FLAT on their **BACK. BARE** the **CHEST**. **PINCH** the **NOSE SHUT**.
With your **OTHER** hand, **LIFT** the **CHIN** so the head **BENDS BACK**.
GIVE TWO BREATHS. THEN COME BACK TO THE PHONE!
If I'm not here stay on the line.

OK | Reported Patient Vomited | HYSTERICAL | STOMA

Turn his/her head to the side. Sweep it all out with your fingers before you start mouth-to-mouth.

Keep the patient's head STRAIGHT>
COMPLETELY COVER the **STOMA** with your mouth.
COVER the patient's **MOUTH and NOSE** with your hand
GIVE TWO BREATHS OF AIR into the patients **LUNGS**.
Make sure the **CHEST GENTLY RISES**.

You're going to have to calm down to be able to help!

Did the CHEST RISE?

YES | NO

GO TO CHOKING ADULT INSTRUCTIONS

COMPRESSION ONLY ENTRY POINT

CHOKING ADULT ENTRY POINT

Is there an automatic defibrillator in the area?

NO | YES

Open the machine and turn it on. Follow the voice prompts and instructions from the machine.
Use large size pads on adults.
Come back to the phone when the machine tells you to do CPR and I will help you.

DO NOT OPERATE AED IN/OR AROUND:

- **Water, snow or ice.**
- **Bathtubs, pools or Jacuzzis.**
- **Metal, street ventilation gates.**
- **Hazardous materials.**
- **Any type of conductive medium.**

Put the **HEEL** of your **HAND** on the **CENTER** of their **CHEST**, right **BETWEEN** the **NIPPLES**.
Put your **OTHER HAND ON TOP** of **THAT** hand.
PUSH DOWN on the **HEELS** of your hands, **1-½ to 2** inches.
Do it **30 times**, **PUSH HARD AND FAST.**
MAKE SURE the **HEEL** of your hand is on the **CENTER** of their chest, **RIGHT BETWEEN THE NIPPLES.**

IF NOT PERFORMING **MOUTH TO MOUTH** BREATHING, **ADVISE to PUMP the CHEST 200 times and then come back to the phone.**

IF WILLING TO PERFORM MOUTH-TO-MOUTH BREATHING.
Then, **PINCH** the **NOSE SHUT** and **LIFT** the **CHIN** so the head **BENDS BACK**.
TWO MORE BREATHS and **PUMP** the **CHEST 30 times**.
KEEP DOING IT; PUMP the **CHEST 30 times**. Then **TWO BREATHS**.
KEEP DOING IT UNTIL HELP CAN TAKE OVER.
I'll stay on the line.

OK | HYSTERICAL

CONTINUE TO ASSIST UNTIL HELP ARRIVES!

You're going to have to calm down to be able to help!

APPENDIX C: Sisaphila Approval

facebook.com/sisaphilacpr

@sisaphilacpr

Sisaphila: We Are Alive

Re: Data collection by Dr De Caires

2018/06/20

To whomever it may concern.

This letter serves to provide permission for Dr LP De Caires to host Sisaphila events and collect data in the form of an online survey at these events for his MMed dissertation. We acknowledge Dr De Caires as an Emergency Medicine Registrar and his involvement in the Sisaphila outreach programme in the past.

For any queries, please contact Dr Heinri Zaayman (Sisaphila coordinator) or Dr Willem Jooste (registrar coordinator).

Regards

Dr H Zaayman
073 303 3524
heinri.zaayman@gmail.com

Dr W Jooste
083 264 4649
willem.jooste@uct.ac.za

APPENDIX D: Informed Consent Form

a.

A manikin-based simulation study looking at a dispatch operator directed CPR algorithm within the Western Cape setting and the self reported comfort around its execution.

Informed Consent form for CPR study

This Informed Consent Form is for men and women, above the age of 18, who we are inviting to participate in research on Dispatch initiated bystander telephonic CPR.
Name of Principle Investigator: Dr Leonel De Caires
Name of University: University of Cape Town

This Informed Consent Form has two parts:

- **Information Sheet (to share information about the research with you)**
- **Certificate of Consent (for signatures if you agree to take part)**

You will be given a copy of the full Informed Consent Form

PART I: Information Sheet

Introduction

I am Dr Leonel De Caires, an emergency medicine registrar (Specialist in training) enrolled at the University of Cape Town. We are doing research on dispatch initiated bystander CPR which will hopefully one day become the norm in this country. I am going to give you information and invite you to be part of this research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be words you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you questions later feel free to ask them of me.

Purpose of the research

Out of hospital cardiac arrest (when your heart stops beating out of a hospital setting) is a harsh reality the general public face. Bystander CPR may increase the chances of survival. The reason we are doing this research is to compare CPR quality with international guidelines when using two different dispatch operator cpr guidecards and compare the comfort of performing both. Simply put, we want to see how CPR performed from instructions over a phone compare to guidelines set internationally.

Type of Research Intervention

This research will involve you following some basic instructions provided to you on a manikin (a lifelike human doll). This is a physical activity and will take approximately 15 minutes of your time. Once completed a survey questionnaire will be provided after the exercise.

Participant selection

We are inviting all adults with no previous experience in CPR to participate in the research on dispatch operator guided CPR.

PART II: Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant__________________

Signature of Participant ___________________

Date ____________________________
Day/month/year

If illiterate

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness_____________________ AND Thumb print of participant

Signature of witness ______________________

Date _________________________
Day/month/year

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands all the study entails.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_________________________

Signature of Researcher /person taking the consent___________________________

Date ____________________________
Day/month/year

Voluntary Participation
Your participation in this research is entirely voluntary. It is your choice whether you would like to participate or not. You may change your mind later and stop participating even if you agreed earlier without consequence.
Procedures and Protocol
You will be taken into a room where you will find a manikin. The study will then be divided in to two sections.
1. You will be given a telephone which someone would then provide you with some instructions to complete (the instructions will be randomly allocated). This shouldn't take more than approximately 5 minutes.
2.Once completed you will be asked to take part in a short survey questionnaire about your feeling regarding the CPR you performed..

Duration
The total time should not exceed more than 15 minutes in total.

Risks
By participating in this study it is possible that you may experience some minor physical effects from the activities taken part in. These include, and are not limited to, feeling out of breath and you may experience some muscle ache.

Reimbursements
You will not be paid for this exercise.

Confidentiality
We will not be sharing the identity of those participating in the research. The information we collect from this research will be kept confidential. Any personal information about you that will be collected during the research will be locked away and no-one but the researchers will be able to see it. Any information about you will have a number instead of a name. On the researchers will know what your number is and this will be kept confidential.

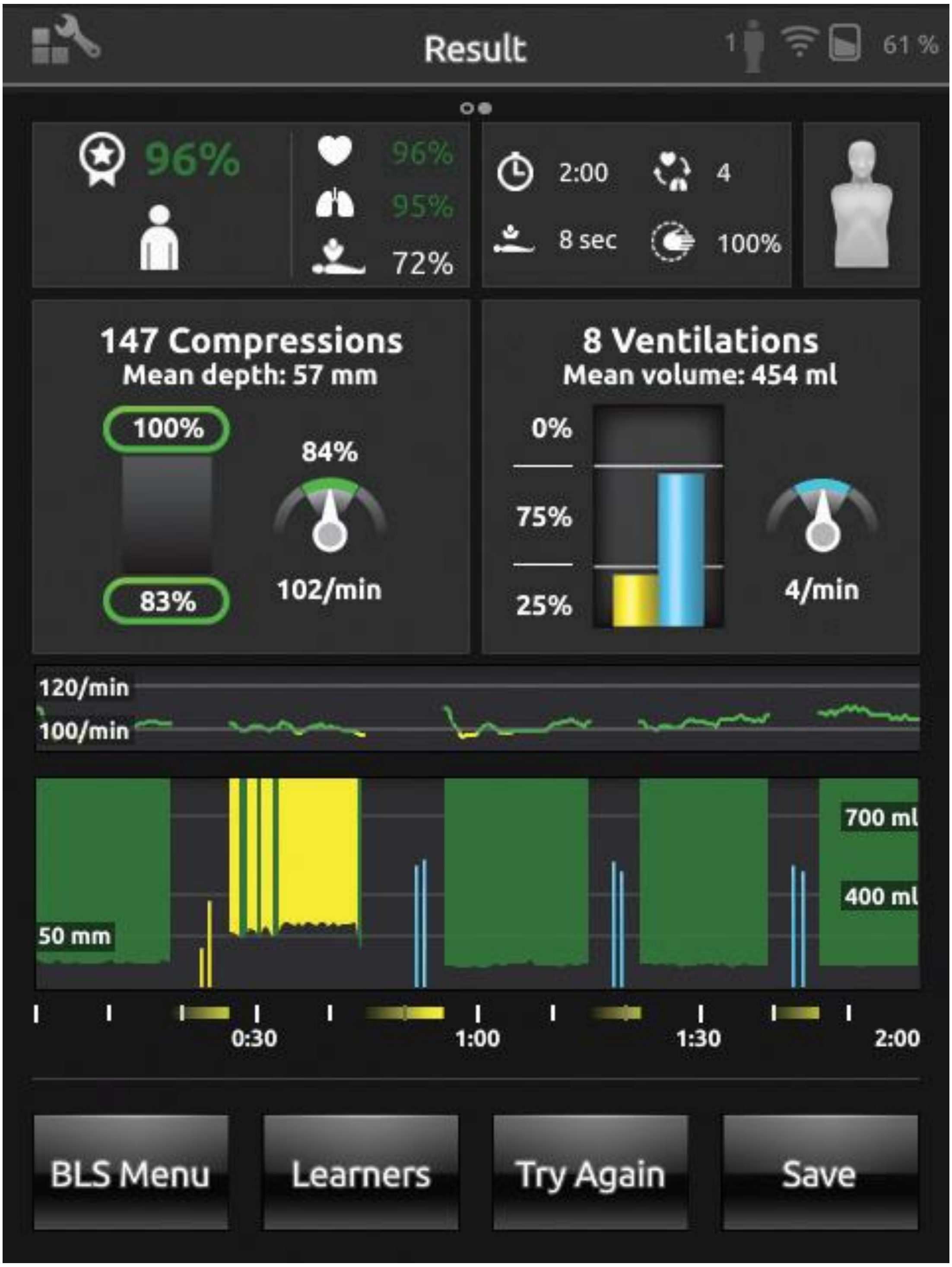
Right to Refuse or Withdraw
This is to reconfirmation that participation is voluntary. You may stop participating in the research at any time that you wish without judgment.

Who to Contact
If you have any questions you may ask them now or later, even after the study has started. If you wish to ask a question later you may contact me on leoneldecaires@gmail.com.

This proposal has been reviewed and approved by the Human Research Ethics Committee of the University of Cape Town. Should you wish to report any concerns to this Committee you may contact them on… This study is also in compliance with the Declaration of Helsinki.

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?

APPENDIX E: SkillsReporter



APPENDIX F: Post-CPR Survey

1. I Am

- [ ] Male
- [ ] Female
- [ ] Other

2. My home language is:

[ ]

3. Before today i have had some form of training or experience in CPR.

( ) Yes

( ) No

4. I feel that the descriptions used to explain CPR were understandable

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree

5. I feel that my home language should have been made available to me.

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree

6. I feel that the explanation on where to place my hands during CPR was understandable.

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree

7. I feel that the explanation on how quickly to perform chest compressions was understandable.

( ) Strongly agree
( ) Agree
( ) Neither agree nor disagree
( ) Disagree
( ) Strongly disagree

8. I feel that an auditory queue such as a beep or counter would have aided me to perform better compressions.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neither agree nor disagree
- ◯ Disagree
- ◯ Strongly disagree

9. I would feel comfortable performing mouth-to-mouth on a stranger.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neither agree nor disagree
- ◯ Disagree
- ◯ Strongly disagree

10. I would feel comfortable performing mouth-to-mouth on a family member

- ◯ Strongly agree
- ◯ Agree
- ◯ Neither agree nor disagree
- ◯ Disagree
- ◯ Strongly disagree

11. I feel that i would more likely perform CPR as a bystander if encouraged/guided over the phone.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neither agree nor disagree
- ◯ Disagree
- ◯ Strongly disagree

APPENDIX G: Laerdal Approval

Allan Pollard 02 November 2017 at 10:11

RE: CPR training manikins

To: Leonel De Caires

Dear Dr De Caires

Please have a look at this link - http://www.laerdal.com/products/simulation-training/resuscitation-training/SkillReporter-PC/

We could make a single manikin available together with the computer and software. You would need to add a printer to print out the results .

Regards

Allan Pollard
Director

See More from Leonel De Caires

APPENDIX H: Western Cape EMS Approval – via Dr S De Vries

From: Shaheem De Vries <Shaheem.DeVries@westerncape.gov.za>
Date: Tuesday, 07 November 2017 at 11:43 AM
To: Stanford Nomdo <Stanford.Nomdo@rapiddeploy.com>
Cc: Leonel De Caires <leoneldecaires@gmail.com>
Subject: Re: Good Day

Thanks Stan

It's great to hear from you.

Trust you are well.

Regards

Shaheem

From: Stanford Nomdo <Stanford.Nomdo@rapiddeploy.com>
Sent: 07 November 2017 11:25
To: Shaheem De Vries
Subject: Good Day

Good Day Dr De Vries

I received the request and will make contact with the researcher.

Regards
Stan

Stanford Nomdo
CAD & MDT Trainer | RapidDeploy
www.rapiddeploy.com
tel: +27 21 204 6019 cell: +27 60 526 9484
The Water Club, 13 Beach Road
Mouille Point, 8005, Cape Town
/// waxed.unspoiled.monsoon

RapidDeploy
MISSION CRITICAL DISPATCH

☆ **Stanford Nomdo** 13 November 2017 at 12:36 SN

Re: CPR Summary

To: Leonel De Caires

Hi Leonel

I'm glad I could be of assistance and good luck with your research.

Regards
Stan

Stanford Nomdo
CAD & MDT Trainer I RapidDeploy
www.rapiddeploy.com
tel: +27 21 204 6019 cell: +27 60 526 9484
The Water Club, 13 Beach Road
Mouille Point, 8005, Cape Town
/// waxed.unspoiled.monsoon

RapidDeploy
MISSION CRITICAL DISPATCH

Should you prefer to work with a RapidDeploy engineer please contact our Technical Support team at support@rapiddeploy.com or contact them on

South Africa +27 87 238 2700
United States +1 415 417 2743
United Kingdom +44 116 326 4129

From: Leonel De Caires <leoneldecaires@gmail.com>
Date: Monday, 13 November 2017 at 12:29 PM
To: Stanford Nomdo <Stanford.Nomdo@rapiddeploy.com>
Subject: Re: CPR Summary

Thank you Stan!

This is exactly what i was looking for!

> On 09 Nov 2017, at 6:27 AM, Stanford Nomdo <Stanford.Nomdo@rapiddeploy.com> wrote:
>
> Good Day Leonel
>
> Please find attached document. Pages 28-41 is what you probably are looking for?
>
> Kind Regards
> Stan

b. HREC Approval Letter

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Buildi
Groote Schuur Hospit
Observatory 79
Telephone [021] 406 64
Email: sumayah.ariefdien@uct.ac.
Website: www.health.uct.ac.za/fhs/research/humanethics/form

07 February 2019

HREC REF: 066/2019

Dr W Stassen
Division of Emergency Medicine
c/o Ms Vathiswa Mzamo
F51
OMB

Dear Dr Stassen

PROJECT TITLE: A MANIKIN-BASED SIMULATION STUDY OF A DISPATCH OPERATOR DIRECTED CPR-ALGORITHM WITHIN THE WESTERN CAPE SETTING AND THE SELF-REPORTED COMFORT AROUND ITS EXECUTION (MMED CANDIDATE - DR L P DE CAIRES)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 28 February 2020.

Please add the PI's contact telephone number and the correct HREC contact number to the informed consent document.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Dr Leonel de Caires will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary before the research may occur.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

c. AFJEM Guide for Authors

Full document can be found at: http://cdn.elsevier.com/promis_misc/AfJEM-GFA.pdf

AfJEM
African Journal of Emergency Medicine
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Supporting Emergency Care Across Africa

Guide for Authors

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