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ORIGINAL ARTICLE

CPR performance in lay people with telephone assisted CPR instructions – A prospective manikin-based observational study

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Background

Emergency Medical Services (EMS) in Europe, annually encounter about 275,000 out-of-hospital cardiac arrests (OHCA), whilst in the United States this number rises to 420,000. The chance of survival from an OHCA is dependent on the recognition of cardiac arrest by Emergency Medical Dispatchers' (EMDs), early bystander cardiopulmonary resuscitation (CPR), and early defibrillation. Telephone assisted CPR (TCPR) by EMDs (also known as dispatcher assisted CPR – DA-CPR) has been shown to double the frequency of bystander CPR so much so that it has now included as a key parameter in the 2015 European Resuscitation Council guidelines.

Method

A prospective, manikin-based observational study was conducted in Malta between July 2018 and July 2019. The aim of this study was to test a set of TCPR instructions in Maltese on lay people with no previous knowledge of CPR. The primary endpoint was to check for understanding and correct execution of such instructions vis-à-vis hand positioning during chest compression, compressions depth and rate. Participants were recruited from 10 localities around Malta. Data was collected using Laerdal's Resus Annie® QCPR manikin and SkillReporterTM (PC) software.

Results

One hundred fifty-five participants were included in the study. Approximately 7 out of 10 participants performed compressions with the correct hand position, 6 out of 10 participants achieved a compression rate between 100 – 120/min, and 2 out of 10 rescuers achieved the recommended 50-60mm compression depth.

Conclusion

Laypeople with no previous CPR training can understand and execute a set of chest compression-only TCPR instructions in Maltese. The introduction of a standard operating procedure and training of EMDs on policy, expectations and performance is vital if bystander CPR and survival rates are to improve locally. Training, coupled with quality improvement projects such as call collection for review, analysis and feedback is the way forward.

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Introduction

It has been reported that Emergency Medical Services (EMS) in Europe, annually encounter about 275,000 out-of-hospital cardiac arrests (OHCA), whilst in the United States (US) this number rises to 420,000.[1] Sixty-five to 70 percent of all sudden cardiac deaths (SCDs) are attributable to coronary heart disease (CHD), however, the frequency of CHD is much lower in SCDs occurring under the age of 40.[2-3] Ten percent of SCDs are due to other types of structural heart disease including congenital coronary artery anomalies, myocarditis, hypertrophic cardiomyopathy and arrhythmogenic right ventricular cardiomyopathy.[2-4] Structural heart disease is much higher in subjects under the age of 30. Five to 10 percent of SCDs are arrhythmic, occurring in the absence of structural heart disease such as long QT syndrome, Brugada syndrome, Wolff-Parkinson-White syndrome and catecholaminergic polymorphic ventricular tachycardia (VT).[3-4] In the absence of any structural abnormality or electrophysiologic abnormality on the ECG, these entities are often termed primary electrical disease.[5-7] Fifteen to 25 percent of cardiac arrests are noncardiac in origin. These include trauma, bleeding, drug intoxication, intracranial haemorrhage, pulmonary embolism, near-drowning, and central airway obstruction.[5-8] Survival rates have been reported to be poor with a survival to hospital discharge of less than 10%.[9] According to our local cardiac arrest registry, in Malta survival to hospital discharge is around 3%.[10]

The chance of survival from an OHCA is dependent on the recognition of cardiac arrest by Emergency Medical Dispatchers' (EMDs), early bystander cardiopulmonary resuscitation (CPR), and early defibrillation.[11] To-date, in order to increase bystander intervention, millions of laypeople (non-specialists within the general public) have undergone CPR training, and AEDs have been widely disseminated in the community.[12] Despite these efforts, many OHCA patients still fail to receive bystander intervention,[11,13] and it is estimated that 65% of CPR-trained bystanders will fail to provide CPR.[14] In Malta the rate of bystander CPR is around 38%.[10] Similarly, in the United Kingdom (UK) the rate of bystander CPR is around 40%.[15] Impediments to initiating CPR include panic, fear of causing harm, not performing CPR adequately (even for those who have received CPR training or have performed CPR in the past),[14,16-18] and a reluctance to perform mouth-to-mouth ventilation.[19-20] Telephone assisted CPR (TCPR) by EMDs, is proven to be an effective and reasonable method to improve the rate of bystander-performed CPR.[21] Furthermore, TCPR by EMDs (also known as dispatcher assisted CPR – DA-CPR) has been shown to double the frequency of bystander CPR,[22] so much so that it has now obtained a key position in the 2015 ERC guidelines.[23]

According to the 2015 European Resuscitation Guidelines (ERC), OHCA has occurred if a patient is unconscious and not breathing normally.[23] However, the ability to recognize OHCA over the phone can be challenging especially if agonal breathing occurs.[24-25] Despite this, recognition of OHCA by EMDs in certain European countries such as Finland, has been reported to be as high as 70–83%.[26-28] In Malta, EMDs do not yet have a standard protocol on TCPR but, nevertheless, provide TCPR in approximately 58% of OHCA victims.[29]

The aim of this study was to test a set of TCPR instructions in Maltese on lay people with no previous knowledge of CPR, and assess the effectiveness and quality of the CPR provided.

METHODS AND MATERIALS

A prospective, manikin-based observational study was conducted in Malta between July 2018 and July 2019. A set of TCPR instructions in Maltese was drawn up and tested on lay people with no previous knowledge of CPR. The primary endpoint was to check for understanding and correct execution of such instructions vis-à-vis hand positioning during chest compression, compressions depth and rate. Ethical approval was granted from the Faculty Research Ethics Committee (Ref no. FRECMDS_1718_061).

TCPR instructions in Maltese were created using commonly used language *(figure 1)*. These included instructions on the recognition of cardiac arrest and compression-only CPR. English TCPR instructions from the resuscitation academy were also used with permission as guidance *(figure 2)*.[30] Given that this study was manikin-based, instructions about the recognition of cardiac arrest were not tested, and only instructions relating to compressions-only CPR were assessed. Six experienced EMD's were recruited and underwent training on how to deliver TCPR instructions.

Figure 1 All caller interview – Cardiac arrest recognition and TCPR instructions in Maltese.

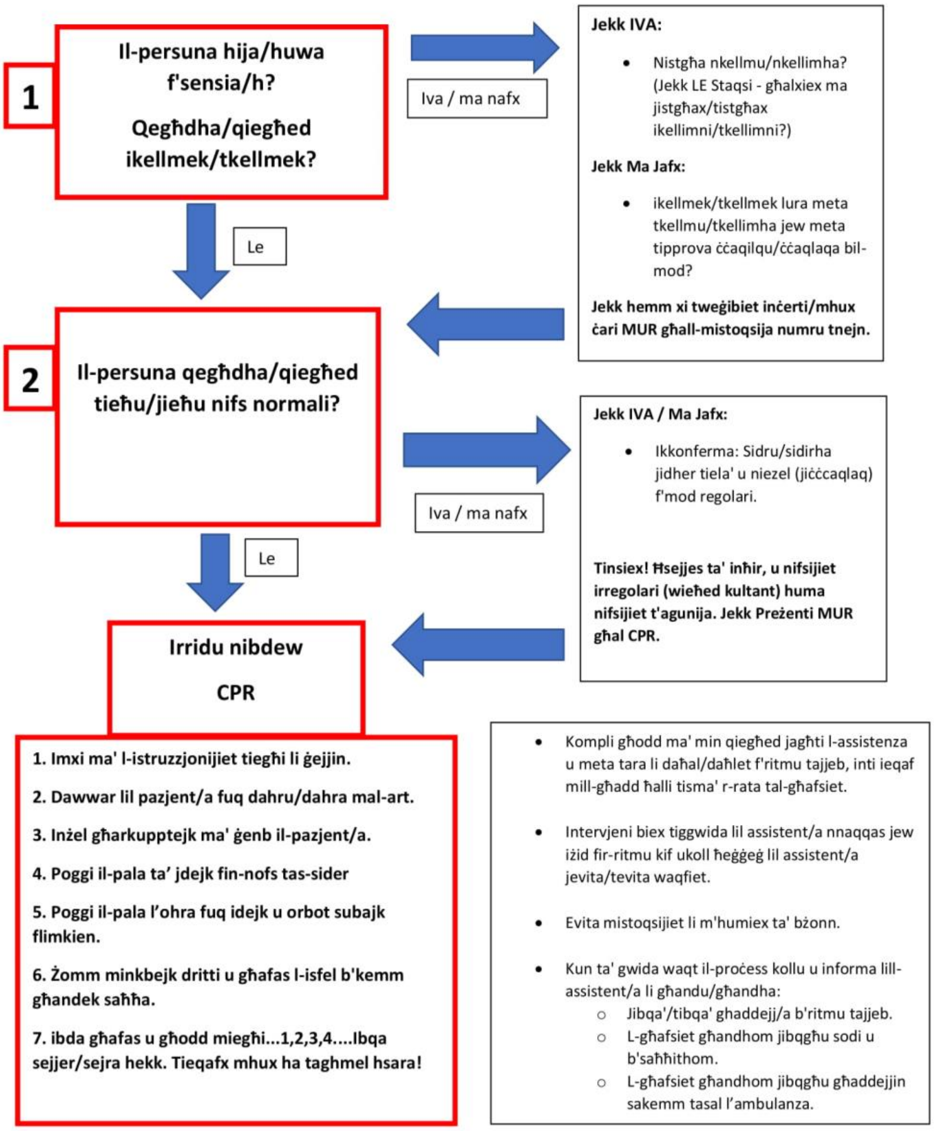
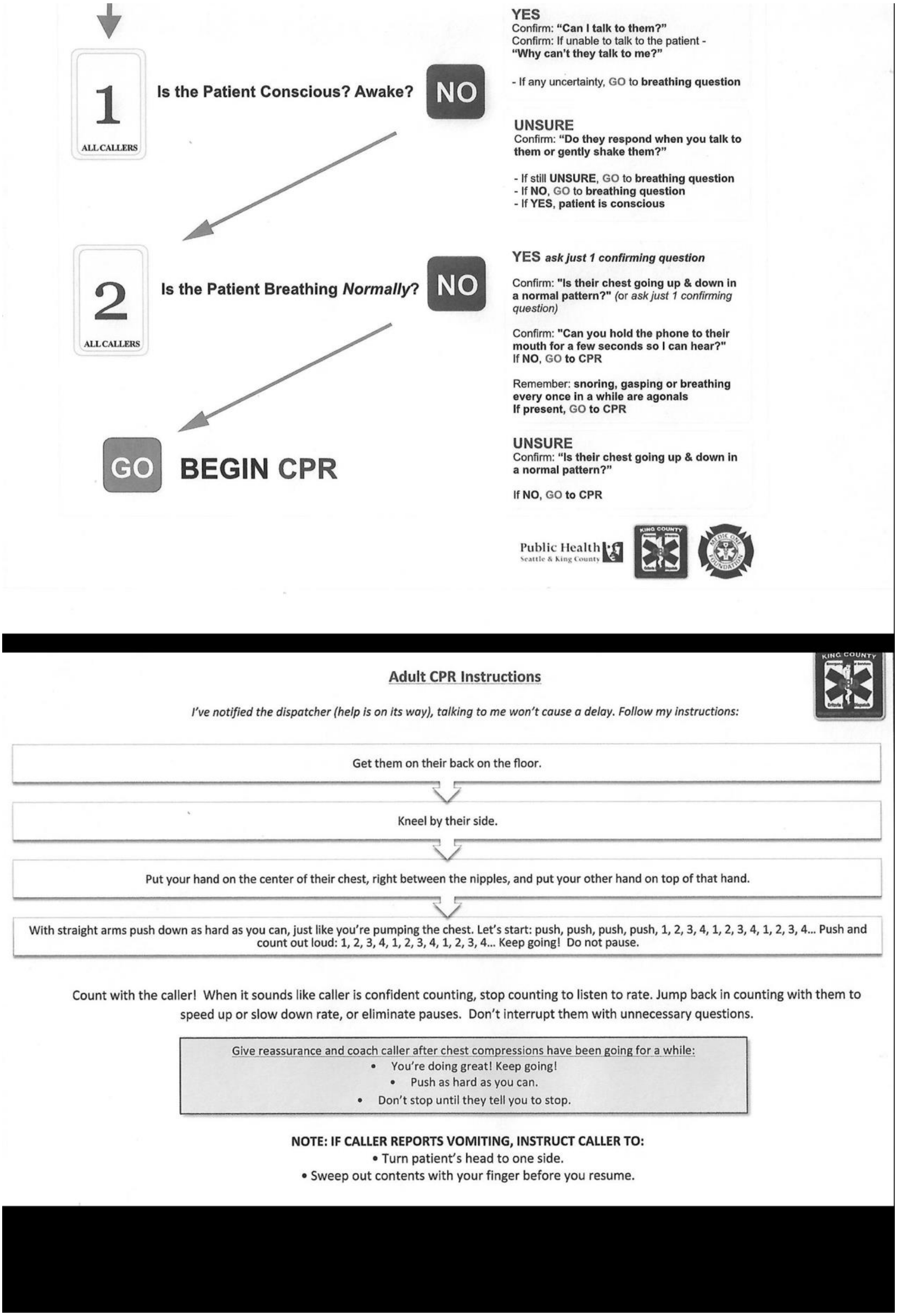


Figure 2 TCPR instructions in English used with permission from the Resuscitation Academy



1 ALL CALLERS — Is the Patient Conscious? Awake? — NO

YES
Confirm: **"Can I talk to them?"**
Confirm: If unable to talk to the patient - **"Why can't they talk to me?"**

- If any uncertainty, GO to **breathing question**

UNSURE
Confirm: **"Do they respond when you talk to them or gently shake them?"**

- If still **UNSURE**, GO to **breathing question**
- If **NO**, GO to **breathing question**
- If **YES, patient is conscious**

2 ALL CALLERS — Is the Patient Breathing *Normally*? — NO

YES *ask just 1 confirming question*

Confirm: **"Is their chest going up & down in a normal pattern?"** (or *ask just 1 confirming question*)

Confirm: **"Can you hold the phone to their mouth for a few seconds so I can hear?"**
If **NO**, GO **to CPR**

Remember: **snoring, gasping or breathing every once in a while are agonals**
If present, GO **to CPR**

UNSURE
Confirm: **"Is their chest going up & down in a normal pattern?"**

If **NO**, GO **to CPR**

GO **BEGIN CPR**

Public Health Seattle & King County

Adult CPR Instructions

I've notified the dispatcher (help is on its way), talking to me won't cause a delay. Follow my instructions:

Get them on their back on the floor.

Kneel by their side.

Put your hand on the center of their chest, right between the nipples, and put your other hand on top of that hand.

With straight arms push down as hard as you can, just like you're pumping the chest. Let's start: push, push, push, push, 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4... Push and count out loud: 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4... Keep going! Do not pause.

Count with the caller! When it sounds like caller is confident counting, stop counting to listen to rate. Jump back in counting with them to speed up or slow down rate, or eliminate pauses. Don't interrupt them with unnecessary questions.

Give reassurance and coach caller after chest compressions have been going for a while:
- You're doing great! Keep going!
- Push as hard as you can.
- Don't stop until they tell you to stop.

NOTE: IF CALLER REPORTS VOMITING, INSTRUCT CALLER TO:
- Turn patient's head to one side.
- Sweep out contents with your finger before you resume.

Participants were recruited from 10 localities around Malta. With a population of around 441,000 people,[31] Malta is subdivided into five districts *(figure 3)*, each consisting of a number of localities. These include the Northern Harbour District, the Western District, the Northern District, the South Eastern District and the Southern Harbour District.[32] Localities were invited to participate in the study via their respective local councils. Ten localities accepted to participate, two from each district *(figure 4)*. The inclusion criteria included age over 18 years of age and no previous CPR training. Each Local Council issued an open public invitation to its residents in the form of a poster, stating clearly the eligibility criteria *(Figure 5)*. Attendance was voluntary and the authors had no part in the selection process of participants. Consent was obtained from all participants before data collection.

Data was collected using Laerdal's Resus Annie® QCPR manikin and SkillReporterTM (PC) software. Participants were asked to follow a set of compression-only CPR instructions in Maltese simulating a telephone call. Data was collected over one minute of compression-only CPR. Information about the correct hand position, depth of compressions, fully released compressions and mean rate of compressions were recorded and stored. Study investigators also noted the correct hand, elbow and shoulder positioning during the simulation. A depth of 50-60mm and a rate of 100-120/min was taken as the 'correct' standard reference.[23] For correct hand positioning, an arbitrary performance target of 90% or better was set. After data collection, all participants in each locality were trained in Basic Life Support and AED use by certified instructors.

Figure 3 Districts of Malta and Gozo

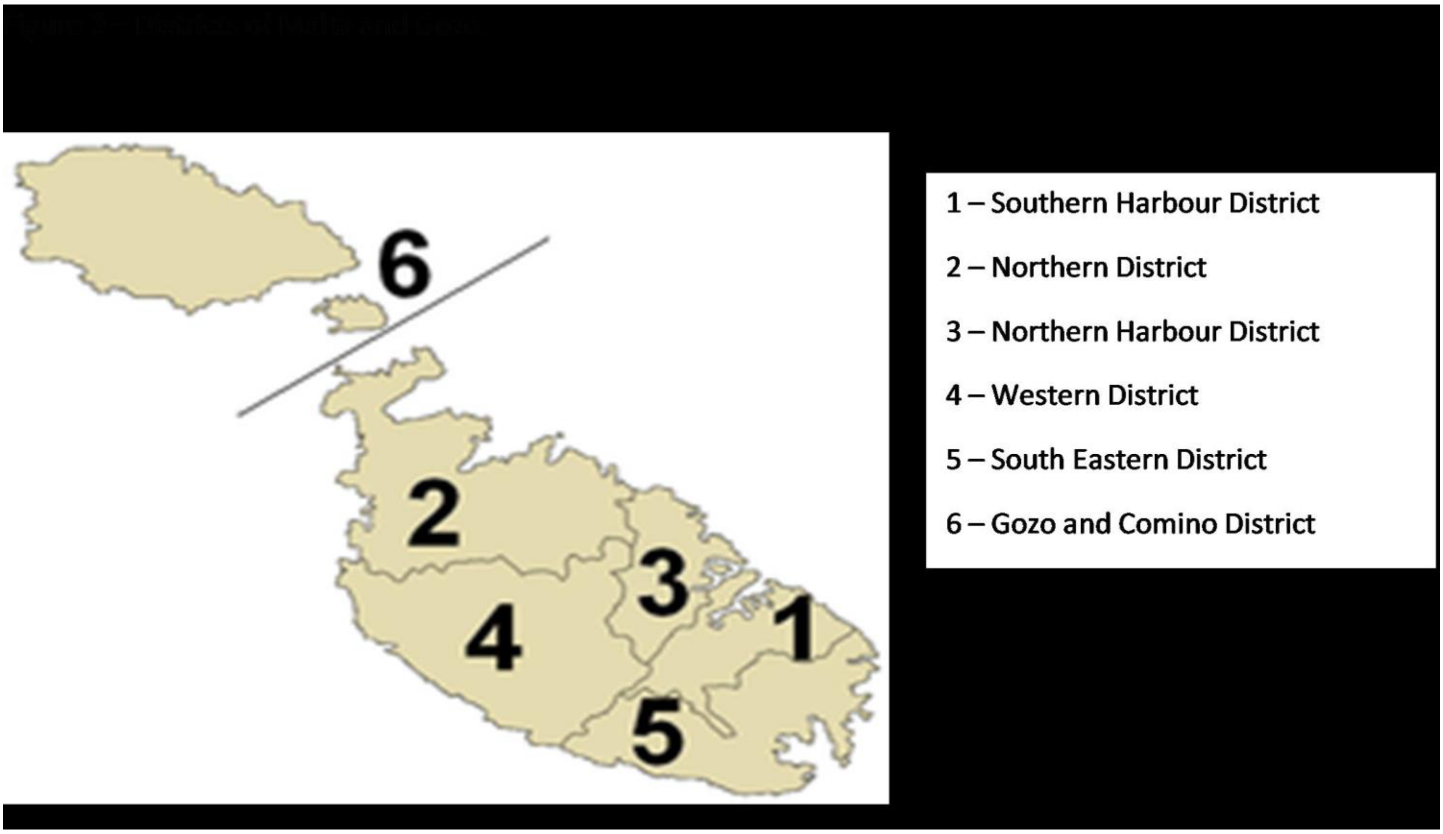


Figure 4 Localities taking part in study

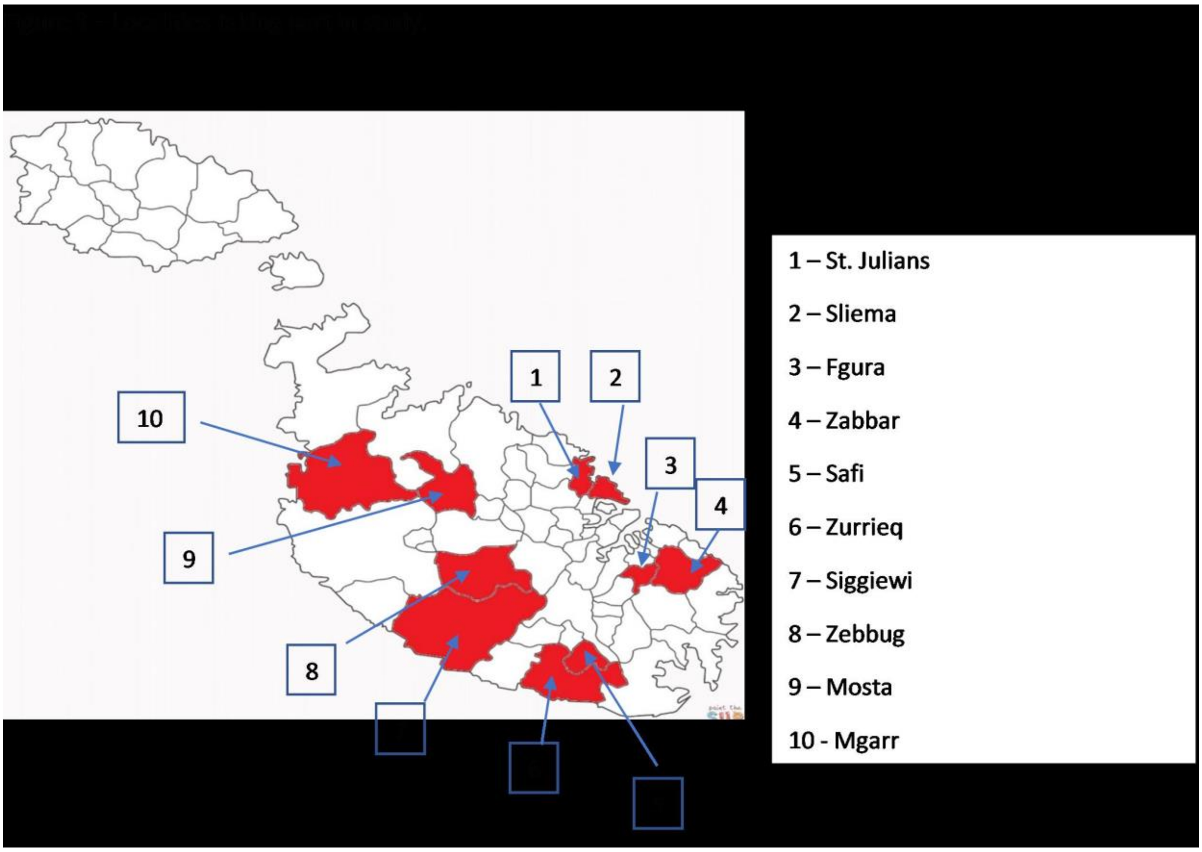
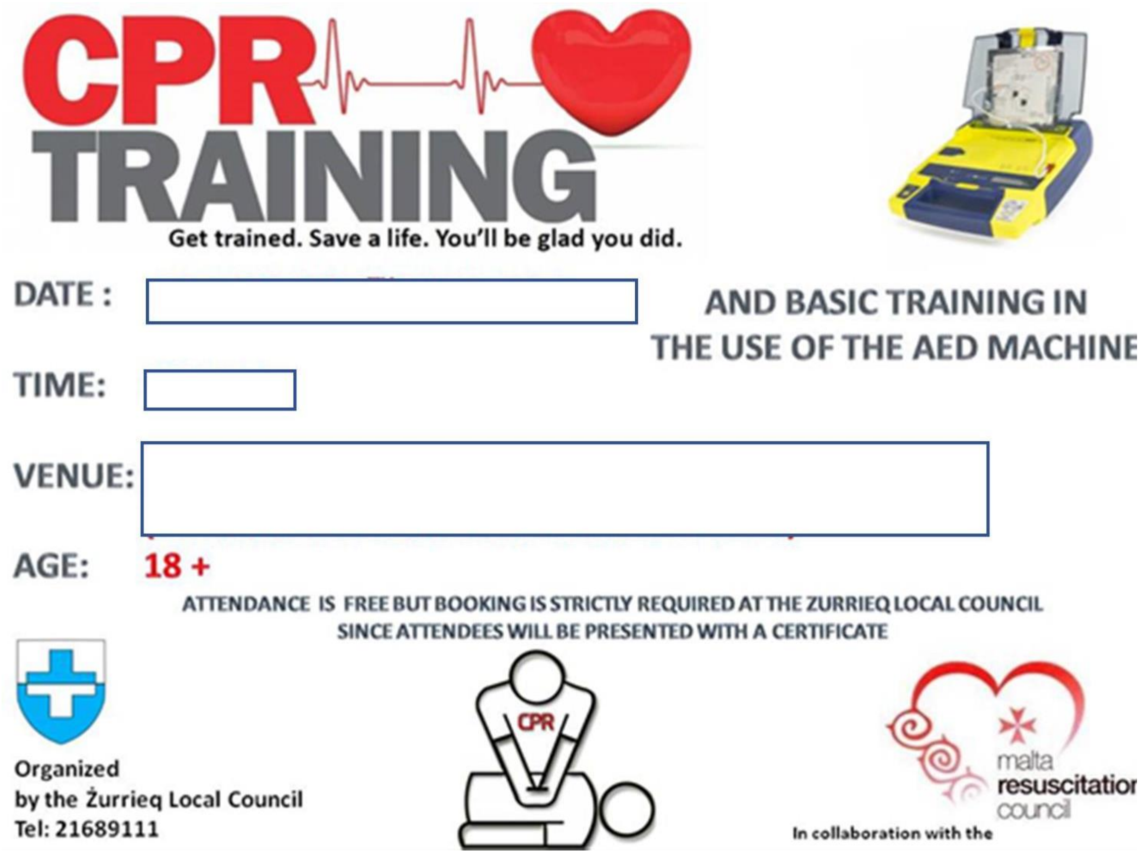


Figure 5 Invitation poster used for recruitment of participants.



Statistical Analysis

Descriptive and inferential analyses were performed through a combination of Microsoft Office Professional Plus 2010 Excel and IBM SPSS Statistics version 22. Details on how the variables were modelled are shown in *Table 1*.

Table 1 Sociodemographic and CPR variables

Sociodemographic variables		
Variable	Grouping	Variable type
Age	<25	Ordinal
	25-34	
	35-44	
	45-54	
	55-64	
	65+	
Gender	Male	Binary
	Female	
Education	Primary/Secondary	Binary
	Tertiary	
District of Residence	Northern Harbour (Sliema, St. Julians)	Nominal
	Southern Harbour (Fgura, Zabbar)	
	South Eastern (Safi, Zurrieq)	
	Western (Siggiewi, Zebbug)	
	Northern (Mgarr, Mosta)	
CPR performance variables		
Compressions with correct hand position (%)		Continuous
Compressions fully released (%)		Continuous
Deep enough compressions (%)		Continuous
Mean depth (mm)		Continuous
Mean rate (per minute)		Continuous

A Kolmogorov-Smirnov test was performed to test the normality of the distribution for dependent continuous variables. Kruskal-Wallis test was used to identify if there were any statistically significant differences between the independent variables, age groups and district of residence, and the dependent variables, proportion of compressions with correct hand position, compressions fully released, deep enough compressions and mean rate of compressions. Mann-Whitney U test was used to identify if there were any statistically significant differences between the independent variables, gender and education, and the dependent variables, proportion of compressions with correct hand position, compressions fully released, deep enough compressions and mean rate of compressions. One-way analysis of variance (ANOVA) was used to identify if there were any statistically significant differences between the independent variables, age groups and district of residence, and the dependent variable, mean depth of compressions. Independent-samples t-test was used to identify if there were any statistically significant differences between the independent variables, gender and education, and the dependent variable, mean depth of compressions.

Results

The distribution of participants by age group, gender, highest educational attainment, and district of residence (based on Local Administrative Units Level 1) are shown in Table 2. Assuming a performance target of 90% or more, 64.5% (*n*=100) of the cohort performed compressions with the correct hand position and 73.6% (*n*=114) fully released their compressions appropriately. Only 12.9% (*n*=20) of participants performed deep-enough compressions. The distribution of the overall performance of the recruited sample with regards to compressions with correct hand position, compressions fully released and deep-enough compressions are shown in Table 3. The distribution of the overall performance of the recruited sample for mean depth (mm) and mean rate (per minute) are shown in Tables 4 and 5, respectively. With regards to mean depth of compressions, only 18.1 % (*n*=28) of the cohort achieved the recommended 50-60mm depth of compressions (Table 4). Just over half of the participants (53.5%, *n*=83) performed the compressions at the recommended rate of 100 – 120/min (Table 5).

The variable distribution of mean depth followed a normal distribution (Kolmogorov-Smirnov D test, D(155) = 0.064, p=0.200). In contrast, the variable distribution of compressions with correct hand position (D(155) = 0.360, p=<0.001), compressions fully released (D(155) = 0.300, p=<0.001), deep-enough compressions (D(155) = 0.323, p=<0.001) and mean rate (D(155) = 0.100, p=0.001) did not follow a normal distribution.

The distribution and univariate analyses between the sociodemographic variables and the various dependent continuous variables are shown in Tables 6-10. There were no statistically significant differences between age groups, gender, education and district of residence in relation to compressions with the correct hand position (Table 6). Females were statistically significantly more likely to perform compressions which were fully released when compared to males (Mann-Whitney U test, U=2343.500, p=0.017). No statistically significant differences were found however, between age groups, education and district of residence in relation to compressions which were fully released (Table

7). Males were statistically significantly more likely to perform deep enough compressions when compared to females (Mann-Whitney U test, U=2446.000, *p*=0.037) (Table 8). Similarly, participants with tertiary education (Mann-Whitney U test, U=2388.500, p=0.016) and from the Western district (Kruskal-Wallis H test, x^2=15.468, p=0.004) were statistically significantly more likely to perform deep-enough compressions when compared to the rest (Table 8). No statistically significant difference was found however between age groups, and the proportion of deep-enough compressions. With regards to the mean depth of compressions, participants with tertiary education were statistically significantly more likely to have a higher average mean depth of compressions (Independent-samples t-test, t(153)=1.860, p=0.004). There were no statistically significant differences between age groups, gender and district of residence, in relation to mean depth of compressions (Table 9). Table 10 shows that participants with primary or secondary education were statistically significantly less likely to have a higher mean rate of compressions when compared to participants with tertiary education (Mann-Whitney U test, U = 2209.500, *p*=0.004). There were no statistically significant differences between age groups, gender and district of residence, in relation to mean rate of compressions (Table 10).

Table 2 Sociodemographic variables of the recruited sample

Age Groups	**Frequency**	**Percent**
<25	24	15.5%
25-34	27	17.4%
35-44	29	18.7%
45-54	21	13.5%
55-64	24	15.5%
65+	30	19.4%
Gender	**Frequency**	**Percent**
Male	70	45.2%
Female	85	54.8%
Education	**Frequency**	**Percent**
Primary	1	0.6%
Secondary	76	49.0%
Tertiary	78	50.3%
District of Residence	**Frequency**	**Percent**
Northern Harbour	25	16.1%
Southern Harbour	25	16.1%
South Eastern	55	35.5%
Western	23	14.8%
Northern	27	17.4%
Total	**155**	**100.0%**

Table 3 Frequency and proportion of compressions with correct hand position, compressions fully released and deep enough compressions

	Compressions with correct hand position		Compressions fully released		Deep enough compressions	
Performance (%)	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
0-89	55	35.5%	41	26.5%	135	87.1%
90-99	15	9.7%	42	27.1%	15	9.7%
100	85	54.8%	72	46.5%	5	3.2%

Table 4 Frequency and proportion of mean depth of compressions

Mean Depth (mm)	Frequency	Percent
<50	126	81.3%
50-60*	28	18.1%
>60	1	0.6%

*Gold standard

Table 5 Frequency and proportion of mean rate of compressions

Mean Rate (per minute)	Frequency	Percent
<100	40	25.8%
100-120*	83	53.5%
>120	32	20.6%

*Gold standard

Table 6 Distribution and univariate analyses between the sociodemographic variables and the proportion of compressions with correct hand position

	Compressions with correct hand position (%)					
Age Groups	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
<25	24	79.6	100.0	74.0	100.0	0.558*
25-34	27	77.2	100.0	80.0	100.0	
35-44	29	61.8	98.0	3.0	100.0	
45-54	21	60.8	98.0	4.0	100.0	
55-64	24	77.1	100.0	69.3	100.0	
65+	30	67.1	100.0	2.3	100.0	
Gender	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Male	70	64.7	100.0	2.0	100.0	0.157†
Female	85	75.2	100.0	56.0	100.0	
Education	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Primary/Secondary	77	66.6	99.0	6.0	100.0	0.124†
Tertiary	78	74.4	100.0	47.3	100.0	
District of Residence	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Northern Harbour	25	76.1	100.0	100.0	100.0	0.147*
Southern Harbour	25	61.0	99.0	2.0	100.0	
South Eastern	55	70.3	99.0	37.5	100.0	
Western	23	81.7	100.0	87.5	100.0	
Northern	27	64.8	99.0	4.0	100.0	
Overall	**155**	**70.5**	**100.0**	**16.0**	**100.0**	

*Kruskal-Wallis Test

† Mann-Whitney U Test

Table 7 Distribution and univariate analyses between the sociodemographic variables and the proportion of compressions which were fully released

	Compressions fully released (%)					
Age Groups	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
<25	24	83.7	98.0	87.0	100.0	0.806*
25-34	27	85.9	100.0	81.0	100.0	
35-44	29	89.7	99.0	94.0	100.0	
45-54	21	87.1	99.0	97.0	100.0	
55-64	24	92.0	99.5	95.0	100.0	
65+	30	87.4	95.0	82.3	100.0	
Gender	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Male	70	83.1	97.5	81.3	100.0	0.017†
Female	85	91.4	100.0	93.0	100.0	
Education	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Primary/Secondary	77	89.8	99.0	84.0	100.0	0.469†
Tertiary	78	85.5	99.0	90.0	100.0	
District of Residence	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Northern Harbour	25	92.3	95.0	83.0	100.0	0.054*
Southern Harbour	25	87.7	100.0	93.0	100.0	
South Eastern	55	86.0	99.0	89.5	100.0	
Western	23	77.3	91.0	68.5	99.5	
Northern	27	95.5	100.0	98.0	100.0	
Overall	**155**	**87.7**	**99.0**	**86.0**	**100.0**	

*Kruskal-Wallis Test
† Mann-Whitney U Test

Table 8 Distribution and univariate analyses between the sociodemographic variables and the proportion of deep enough compressions

	Deep enough compressions (%)					
Age Groups	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
<25	24	26.3	0.0	0.0	48.3	0.219*
25-34	27	22.9	0.0	0.0	24.5	
35-44	29	31.7	4.0	0.0	66.0	
45-54	21	26.1	1.0	0.0	44.0	
55-64	24	12.3	0.0	0.0	5.8	
65+	30	8.7	0.0	0.0	3.0	
Gender	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Male	70	30.6	0.5	0.0	68.8	0.037†
Female	85	13.3	0.0	0.0	8.0	
Education	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Primary/Secondary	77	14.1	0.0	0.0	6.0	0.016†
Tertiary	78	28.1	1.5	0.0	56.8	
District of Residence	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Northern Harbour	25	1.3	0.0	0.0	0.0	0.004*
Southern Harbour	25	8.8	0.0	0.0	1.0	
South Eastern	55	27.8	0.0	0.0	62.5	
Western	23	31.3	13.0	0.0	56.0	
Northern	27	28.6	2.0	0.0	47.5	
Overall	**155**	**21.1**	**0.0**	**0.0**	**24.5**	

*Kruskal-Wallis Test
† Mann-Whitney U Test

Table 9 Distribution and univariate analyses between the sociodemographic variables and the mean depth of compressions (mm)

	Mean depth (mm)					
Age Groups	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
<25	24	40.3	40.5	33.3	49.3	0.514*
25-34	27	42.0	40.0	36.0	46.0	
35-44	29	43.4	42.0	37.0	51.0	
45-54	21	42.6	43.0	35.0	49.0	
55-64	24	38.2	34.0	32.0	45.3	
65+	30	34.0	33.0	29.0	41.3	
Gender	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Male	70	41.6	42.0	32.0	50.8	0.920†
Female	85	38.6	39.0	32.0	45.0	
Education	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Primary/Secondary	77	38.1	37.0	32.0	45.0	0.004†
Tertiary	78	41.8	42.0	34.3	49.8	
District of Residence	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Northern Harbour	25	33.0	32.0	29.0	37.0	0.269*
Southern Harbour	25	34.0	32.0	28.0	42.0	
South Eastern	55	42.4	41.0	35.0	50.0	
Western	23	44.4	46.0	37.0	50.0	
Northern	27	43.1	44.0	36.5	49.5	
Overall	**155**	**40.0**	**39.0**	**32.0**	**46.5**	

* Analysis of Variance
† Independent-samples t-test

Table 10 Distribution and univariate analyses between the sociodemographic variables and the mean rate of compressions (per minute)

	Mean rate (per minute)					
Age Groups	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
<25	24	115.9	113.5	102.0	121.8	0.514*
25-34	27	106.3	110.0	101.5	115.0	
35-44	29	115.4	107.0	98.0	123.0	
45-54	21	103.5	105.0	93.0	115.0	
55-64	24	106.8	107.0	98.0	116.3	
65+	30	108.6	108.0	102.0	110.8	
Gender	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Male	70	110.3	109.0	99.0	119.0	0.920†
Female	85	109.1	110.0	99.0	117.0	
Education	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Primary/Secondary	77	105.2	105.0	95.0	116.0	0.004†
Tertiary	78	114.0	110.0	104.3	119.0	
District of Residence	**Frequency**	**Mean**	**Median**	**1st Quartile**	**3rd Quartile**	***p* value**
Northern Harbour	25	111.4	109.0	105.0	123.0	0.269*
Southern Harbour	25	109.7	110.0	103.0	117.0	
South Eastern	55	110.2	109.0	98.0	116.0	
Western	23	114.4	113.0	103.0	127.0	
Northern	27	102.7	105.0	91.5	115.0	
Overall	**155**	**109.6**	**109.0**	**99.0**	**119.0**	

*Kruskal-Wallis Test

† Mann-Whitney U Test

Discussion

The decision to use compression-only CPR instructions on lay people rather than the standard compressions with ventilations, was based on evidence from randomized controlled trials.[33-34] In a systematic review and meta-analysis by Cabrini *et al.*, (2010), it was shown that compression-only CPR is superior to standard CPR at least when performed by untrained bystanders.[34] Other observational studies of bystander-initiated CPR comparing standard and compressions-only CPR reported similar survival rates.[35-37] Apart from survival rates, compression-only CPR instructions are easier to teach to lay persons during BLS courses and easily communicated by dispatchers under real conditions during TCPR.[20,34] Moreover, bystanders are more likely to accept and perform compressions-only CPR rather than standard CPR, since this avoids mouth-to-mouth contact.[19-20]

The choice of words used during TCPR has been shown to be important in order to engage with the caller. Phrases like:

"Irridu nibdew CPR"

(we need to start CPR)

Has been associated with higher caller agreement. According to *Riou et al.*, (2018), talking about bystander-CPR in terms of willingness *("want", "be willing", "would like",* *"be happy to")* was associated with low caller agreement (43%).[38] On the other hand, talking about it in terms of futurity *("going to", "will")* and/or obligation *("need", "have to")* was associated with high caller agreement (97% and 84% respectively).[38]

In this study, we showed that the phrases used for hand positioning during CPR:

"Poggi il-pala ta' jdejk fin-nofs tas-sider"

(Put your hand on the centre of their chest)

Was understood and executed accurately by approximately 7 out of 10 rescuers with no previous background of CPR training. No statistical significance between age, gender, level of education and district of residence was found vis a vis correct hand positioning in our study. With regards to phrases about locking of fingers and elbow positioning:

"Poggi il-pala l'ohra fuq idejk u orbot subajk flimkien"

(Put your other hand on top of that hand and clasp your fingers together)

and

"Żomm minkbejk dritti"

(Keep your elbows straight)

This study found that all participants understood and executed these instructions accurately. Similarly, phrases about the rate of compressions:

"ibda għafas u għodd miegħi...1,2,3,4....Ibqa sejjer/sejra hekk. Tieqafx mhux ha taghmel hsara!"

(Keep pushing and count out loud…1,2,3,4…keep going, do not pause, you won't cause any harm)

Was understood and accurately executed in 6 out of 10 rescuers adhering to the recommended 100-120/min compression rate. No statistical significance between age, gender and district of residence was found on rate of compressions. We opted not to use metronomes to help rescuers with their compression rate but counting repeatedly with them from 1 to 4 throughout the whole minute of CPR. In two separate studies, Park *et al.,* (2013) and Scott *et al.,* (2018), showed that rescuers receiving instructions with metronome assistance although performing better with correct compression rate had consistently shallower compression depth than those receiving instructions without metronome assistance.[39-40]

When it came to phrases about depth:

"għafas l-isfel b'kemm għandek saħħa"

(Push down as hard as you can)

Only 2 out of 10 rescuers achieved the recommended 50-60mm depth, and the vast majority of participants achieved a depth less than 50mm. Overall males performed deeper compressions when compared to females, whilst rescuers with tertiary education and those living in the western district (Siġġiewi and *Ż*ebbug) had a significantly higher compression depth when compared to the rest. No statistical significance was found between age and depth of compressions. It is well documented in the literature that even with correct knowledge and feedback, rescuers often do not achieve adequate depth.[41-43] Moreover, physical fatigue,[44-45] overall rescuer's physical fitness, height and weight [46-47] all impact on the quality of depth of chest compressions. These variables might partly explain our findings that males were better than females at deeper compressions. The amount of power required to depress a sternum by 5 cm is about 500 N,[48] and it can be difficult to judge how much force is required to achieve 5cm of compression even for trained professionals. Data from two RCTs by Mirza *et al.,* (2008), suggest that instructions to "push down as hard as you can" ("*għafas l-isfel b'kemm għandek saħħa")* are superior to instructions to "push down firmly 2 inches (50mm)" in achieving improvement in chest compression depth.[49]

Limitations

Manikin simulation cannot replicate the complexity, urgency and constraints of a real life scenario. Although participants were taken from the five main districts of Malta, the sample size was still small and Gożo, a separate district, was not included in this study. CPR efficiency by rescuers was not tested in this study since the main aim was to test understanding and execution of TCPR instructions in Maltese.

Conclusion

This study showed that, in Malta, laypeople with no previous CPR training can understand and execute a set of chest compression-only TCPR instructions in Maltese. The introduction of a standard operating procedure and training of EMDs on policy, expectations and performance is vital if bystander CPR and survival rates are to improve locally. Training coupled with quality improvement projects such as call collection for review, analysis and feedback is the way forward.

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