

CMEARTICLE

Basic Cardiac Life Support: 2016 Singapore Guidelines

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ABSTRACT Basic Cardiac Life Support (BCLS) or cardiopulmonary resuscitation (CPR) refers to the skills required (without use of equipment) in the resuscitation of cardiac arrest individuals. On recognising cardiac arrest, chest compressions should be initiated. Good quality compressions are with arms extended, elbows locked, shoulders directly over the casualty's chest and heel of the palm on the lower half of the sternum. The rescuer pushes hard and fast, compressing 4–6 cm deep for adults at 100–120 compressions per minute with complete chest recoil. Two quick mouth-to-mouth ventilations (each 400–600 mL tidal volume) should be delivered after every 30 chest compressions. Chest compression-only CPR is recommended for lay rescuers, dispatcher-assisted CPR and those unable or unwilling to give ventilations. CPR should be stopped when the casualty wakes up, an emergency team takes over casualty care or if an automated external defibrillator prompts for analysis of heart rhythm or delivery of shock.

Keywords: breathing, cardiac arrest, cardiopulmonary resuscitation, mouth-to-mouth ventilations, pulse check

INTRODUCTION

Basic Cardiac Life Support (BCLS) refers to the recognition of sudden cardiac arrest, calling for help, supporting the circulation, maintaining the airway and supporting breathing without the use of equipment other than personal protective devices. This is also commonly referred to as cardiopulmonary resuscitation (CPR). This skill could be used by a layperson or a healthcare provider in both out-of-hospital and in-hospital settings.

The majority of sudden cardiac arrests occur in the community (i.e. out-of-hospital). The success of the chain of survival depends on the first-responder layperson. The goal of CPR training is to ensure that participants 'can do' and 'will do' CPR when the need arises. CPR guidelines must be not only scientific, but also simple to follow. Simplification will improve skills retention, decrease the fear of imperfect CPR performance and increase willingness to perform CPR.

In 2015, the International Liaison Committee on Resuscitation (ILCOR) reviewed and updated the consensus document on the science based on the latest developments in research. The International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations (CoSTR) was published in the journals *Circulation*^(1,2) and *Resuscitation*,^(3,4) in October 2015. The various resuscitation councils then formulated their own guidelines based on the 2015 international CoSTR. The American Heart Association (AHA) and European Resuscitation Council (ERC) have published their own guidelines^(5,6) on the same issue as the CoSTR document. The following document spells out the Singapore guidelines, as drawn up by the National Resuscitation Council (NRC) Singapore.

HIGHLIGHTS OF CHANGES IN BCLS GUIDELINES SINCE 2010

Recognition of cardiac arrest

Studies have shown that gasping is common (up to 40% of cases) in the immediate phase when casualties sustain sudden cardiac arrest. During the first few minutes of sudden cardiac arrest, the presence of gasping is associated with increased survival. Laypersons or healthcare providers should be taught to recognise gasping as cardiac arrest and not normal breathing, and to begin CPR immediately. Dispatchers should be trained to interrogate callers to elicit the presence of non-responsiveness and absence of normal breathing (including recognition of gasping).^(1,2,7)

Pulse check is a difficult technique for both laypersons and healthcare providers to master,⁽⁸⁾ and should not be taught to laypersons (recommended in the 2006 and 2011 NRC guidelines).^(9,10) Training centres that wish to teach healthcare workers the pulse check as an additional tool for determination of cardiac arrest, to decide whether to start CPR, should use manikins that are able to simulate the presence or absence of a pulse. The healthcare provider should take no more than ten seconds to check for the presence or absence of normal breathing and pulse. If there is no normal breathing or definite absence of a pulse within this time period, the healthcare provider should presume cardiac arrest and start chest compressions.

Technique of chest compression

The landmark for chest compression remains as the centre of the chest (which is at the lower half of the sternum). Studies have shown that use of the inter-nipple line as a landmark to signify the lower half of the sternum for the hand position is not reliable.^(11,12) One study showed that there were shorter pauses

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between ventilations and compressions if the rescuer was taught to 'place the heel of the hand' on the lower half of the casualty's breastbone (and was shown the location), as compared to the conventional method of locating the landmark for chest compression one finger breadth above the xiphoid process by tracing the lower margin of the casualty's rib cage.⁽¹³⁾ In 2011, the NRC BCLS committee decided to retain the conventional method (i.e. locating the xiphoid process by tracing the lower margin of the casualty's rib cage; Fig. 1),^(10,14) as it was felt that the majority of the rescuers might feel uncomfortable undressing the casualty (especially a female) and exposing the casualty's chest in public.

A local study reported a high incidence of compression over the epigastrium among participants during a six-month post-training test.⁽¹⁵⁾ Participants who compressed at the incorrect position on the sternum compressed at a significantly lower average depth than those who compressed at the correct position. Participants who were taught the use of the two-finger method for locating the landmark for chest compression had a significantly higher rate of compressions at the epigastrium.

In the 2016 NRC BCLS guidelines, it is recommended that the rescuer should be taught and shown the location of the landmark for chest compression – lower half of the sternum and centre of the chest on the manikin.⁽¹³⁾

Studies done in both out-of-hospital cardiac arrest (OHCA) and in-hospital cardiac arrest situations showed that rescuers do not compress the chest hard and fast enough, and have frequent interruptions of chest compressions.^(15,16) In the 2010 CoSTR, the recommended rate of chest compression was changed for both adults and children, from 100 per minute to at least 100 per minute. The depth of chest compressions was changed from 4–5 cm to at least 5 cm (AHA) or 5–6 cm (ERC) for adults, 5 cm for children and 4 cm for infants.^(17,18)

A large study of OHCA adult casualties (n = 9,136) treated by emergency medical service providers found that the maximum survival occurs with a depth interval of 40.3–55.3 mm (peak 45.6 mm).⁽¹⁹⁾ In an observational study of 170 casualties, injuries were reported in 28%, 27% and 49% of casualties who had compression depths of < 5 cm, 5–6 cm and > 6 cm, respectively.⁽²⁰⁾

Considering that the body size of Asians is generally smaller than that of people in the West, compression of the chest deeper than 5 cm might not be necessary in Singapore. A study from Japan that investigated the association between the body weight of rescuers and the quality of chest compressions revealed that adequate compression rate and depth among the light body weight group decreased significantly over time as compared to the heavy body weight group. In Asia, a considerable proportion of female doctors or nurses may not be able to compress more than 5 cm in depth due to their small body weight.⁽²¹⁾

Data from a large study (n = 10,371) on adults with OHCA treated by emergency medical service providers found that, after adjustments for chest compression depth, compression rates of 100–120 per minute were associated with greater survival to hospital discharge.⁽²²⁾ The NRC recommends a chest compression



Fig. 1 Landmark for chest compression.

depth of about 5 cm (i.e. 4–6 cm) during manual CPR and a chest compression rate of 100–120 per minute.

Chest compression-only CPR

The 2010 AHA and ERC guidelines recommend that all trained rescuers (both healthcare providers and laypersons) should perform conventional CPR (CVC), i.e. chest compression with mouth-to-mouth ventilation.^(17,18) This was because a large observational study of OHCA showed that survival was better when CVC, as opposed to chest compression-only CPR (CCC), was provided for paediatric arrests (other than sudden, witnessed collapse of adolescents), asphyxial cardiac arrests in both adults and children (e.g. drowning, drug overdose) and prolonged cardiac arrests (> 15-minute downtime).⁽²³⁾ However, most sudden OHCA occur in adults and are of cardiac origin.^(24,25) 70%–80% of OHCA casualties initially have ventricular fibrillation (VF).^(26,27) At the initial phase of sudden cardiac arrest with VF, rescue breaths are not as important as chest compressions, because the oxygen level in the blood remains adequate for the first few minutes after cardiac arrest.⁽²⁸⁾ In a prospective observational study of bystander-witnessed OHCA casualties with shockable rhythms, those who received CCC had a higher one-month survival rate with favourable neurological outcome than those who received CVC (19.4% vs. 11.2%, p = 0.041).⁽²⁹⁾ However, the above observational clinical studies were unable to conclude whether lay rescuers should be taught CVC or CCC. Furthermore, we could not ascertain whether bystanders in these OHCA studies received any CPR training, and if so, which CPR training method (CVC or CCC) was received.

Two before-and-after implementation observation studies showed that there was an improved rate of survival in adult OHCA after the implementation of CCC in the community (Arizona, USA and Japan).⁽²⁶⁾ In Arizona, the survival rate of adult OHCA of cardiac aetiology was 7.8% for those who received CVC, 13.3% for those who received CCC and 5.2% for those who received neither. There was a significant increase in bystander CPR rate, from 28% in 2005 to 40% in 2009, and an increase in the likelihood of bystanders performing CCC vs. CVC (20%–76%).⁽⁷⁾

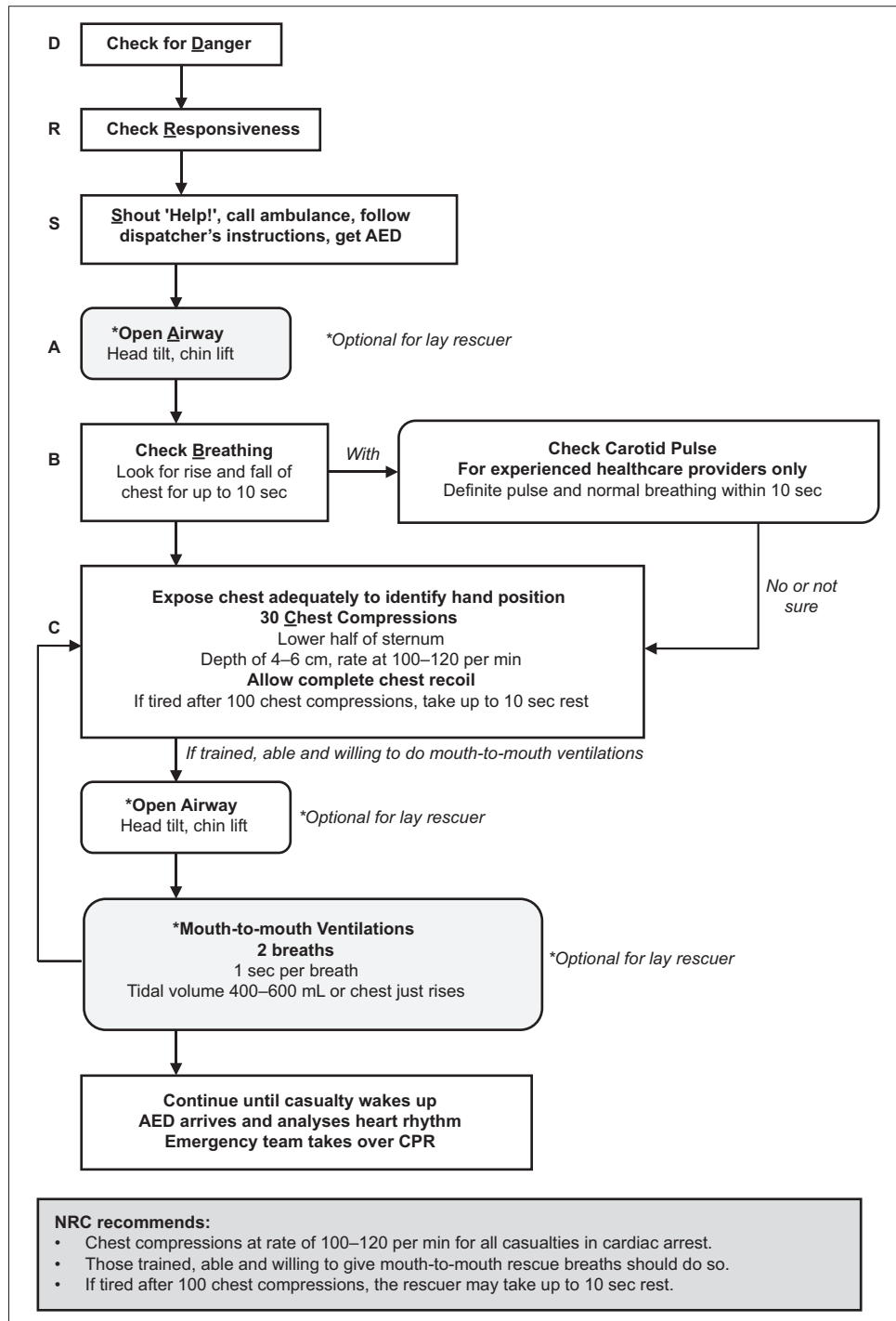


Fig. 2 NRC 2016 Adult Basic Cardiac Life Support one-man cardiopulmonary resuscitation algorithm.

The 2015 ILCOR recommendations state that chest compressions should be performed for all cardiac arrest casualties and that those who are trained, able and willing to give mouth-to-mouth rescue breaths should do so.^(1,2) Bystanders may be trained in CCC for adult OHCA as an alternative to CVC training.⁽¹⁻⁴⁾ This recommendation has been reflected in the new AHA and Resuscitation Council of Asia guidelines.^(5,30)

A local study showed that during a six-month post-training test, 14.9% of participants who were trained in CCC pretended to do mouth-to-mouth ventilation, only 14.9% were able to perform ≥ 5 effective ventilations (≥ 400 mL), and only 3.7% were able to

perform ≥ 10 effective ventilations in five minutes. Most participants who were trained in mouth-to-mouth ventilation were unwilling or unable to perform effective mouth-to-mouth ventilations six months after training. Interrupting chest compression to perform ineffective mouth-to-mouth ventilations is definitely detrimental.⁽¹⁵⁾

Therefore, the NRC recommends that CPR training for lay rescuers should focus on recognition of cardiac arrest, calling for an ambulance and good-quality manual chest compression, with optional mouth-to-mouth ventilation. Fig. 2 shows the NRC's adult BCLS CPR algorithm, while Fig. 3 shows the algorithm for lay rescuers.

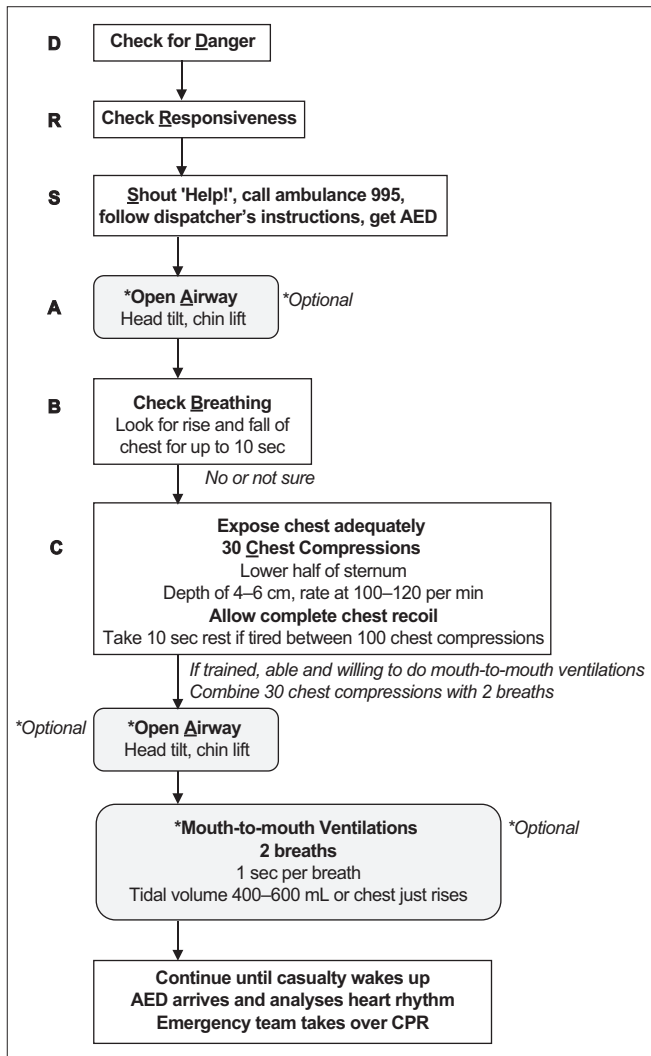


Fig. 3 NRC 2016 Adult Basic Cardiac Life Support one-man cardiopulmonary resuscitation algorithm for the lay rescuer.

Sequence of adult one-man CPR

The recommended sequence of adult one-man CPR for the healthcare provider is as follows:

1. Check for danger: this ensures that the rescuer operates in a safe environment.
2. Check for responsiveness: the rescuer should tap the casualty firmly and ask loudly: 'Hello! Hello! Are you okay?'
3. If unresponsive: shout for help, call '995' for an ambulance or activate the emergency response system (for in-hospital cardiac arrest), and get an automated external defibrillator (AED) if there is one within a 60-second walking distance. An emergency medical dispatcher can help a lay rescuer recognise a cardiac arrest, and once this is established, the dispatcher should lead the rescuer to begin CPR by providing instructions on how to perform CCC via telephone. Dispatcher-assisted telephone CPR increases the bystander CPR rate and improves the survival rate of cardiac arrest. The emergency medical dispatcher may also be able to locate the nearest AED and summon CPR-trained rescuers in the vicinity.
4. Open airway: head tilt, chin lift.

5. Look, listen and feel for up to ten seconds to check for normal breathing. Gaspings is NOT considered normal breathing
 - (a) Checking of pulse, if done, should be left to trained healthcare workers.
 - (b) Checking of normal breathing and pulse should not take more than ten seconds.
 - (c) If unsure of the presence of normal breathing or pulse (for trained healthcare providers only) within ten seconds, start chest compressions.
6. Technique of chest compressions
 - (a) Site of compression should be at the centre of the chest and the lower half of the sternum (breastbone).
 - Ensure adequate exposure of the chest.
 - Kneel by the side of the casualty.
 - Place the heel of the palm of the other hand on the lower half of the sternum (breastbone) next to the index finger.
 - Place the heel of the first hand on top of the second.
 - Interlace the fingers of both hands and lift the fingers off the chest wall.
 - Straighten both the elbows and lock them into position.
 - Position the shoulders directly over the casualty's chest. Use the body weight to compress the casualty's breastbone.
 - (b) Depth of chest compression for adults must be at least 4 cm but not more than 6 cm.^(15,30,31)
 - (c) The compression rate is 100–120 per minute.
 - (d) Allow complete recoil of the chest wall after each compression. If tired after 100 compressions, take up to 10 seconds of rest.⁽³²⁾
 - (e) Loud counting of the compressions should be encouraged: 1&2&3&4&5&, 1&2&3&4&10&, 1&2&3&4&15, 1&2&3&4&20, 1&2&3&4&25, 1&2&3&4&30.
 - (f) Perform two ventilations (one second per breath, tidal volume 400–600 mL) after every 30 chest compressions,⁽¹⁸⁾ so that the chest just rises.
 - (g) Check for return of spontaneous circulation.
 - The public should continue performing CPR until emergency medical help arrives and takes over, or an available AED prompts the rescuer not to touch the casualty, or the casualty starts moving.
 - Healthcare workers who are trained and confident in pulse check should check the pulse after at least five cycles of 30 compressions to two ventilations. Checking of pulse should not take more than ten seconds. If unsure of the presence of a pulse by the end of ten seconds, the rescuer should resume 30 chest compressions to two ventilations (see Table I for comparison of CPR sequences across various age groups).

Table I. CPR sequences across age groups.

CPR Sequence	Adult and older child	Child (1–8 yr)	Infant (< 1 yr)
Establish unresponsiveness, call 995, get AED	Immediately		
Open airway	Head tilt-chin lift		
Recognition of cardiac arrest	Check for normal breathing (gaspings is not normal breathing)		
Pulse check*	Carotid		Brachial
Start chest compressions	If no normal breathing, or ensure pulse check* within 10 s		
Compression landmarks	Lower half of sternum		Lower half of sternum (just below intermammary line)
Compression method	Heel of 1 hand, other on top		2 fingers
Compression depth (cm)	4–6	4–5	3.5–4.5
Compression rate	100–120/min		
Compression-ventilation ratio	30:2 (1 or 2 rescuers)		
Mouth-to-mouth ventilation	2 breaths at 1 s/breath. Should not interrupt chest compression for more than 10 s to perform the 2 breaths.		

*For trained healthcare providers only. AED: automated external defibrillator; CPR: cardiopulmonary resuscitation

Two-person CPR

1. If there is more than one trained rescuer, two-person CPR may be more efficient, with one person doing the ventilations and the other the chest compressions.
2. If more than one rescuer is present, they should take turns to perform 30 chest compressions after every two minutes, as fatigue would otherwise set in. One rescuer should focus on chest compressions and the other on ventilations. The changeover should involve minimal interruption of chest compressions (see Table I for comparison of CPR sequences across various age groups).

Duration of retraining cycle

There is evidence of skills decay within 3–6 months after CPR training, especially mouth-to-mouth-ventilations.⁽³¹⁾ There is also evidence that frequent training improves CPR skills, responder confidence and willingness to perform CPR. Although the NRC retains the two yearly recertification guidelines for BCLS courses, individuals who are likely to encounter cardiac arrests should consider more frequent retraining.

Relief of foreign body airway obstruction

The recommended sequence of actions for relief of foreign body airway obstruction (FBAO) with a responsive casualty is detailed below (Fig. 4).

Recognition of FBAO in a person who chokes while eating and clutches his throat.

1. If the casualty is coughing effectively, this means that the airway is mildly obstructed. Do not interfere. Allow the casualty to cough to expel the object himself.
2. In severe airway obstruction, the casualty is unable to speak, breathe or cough effectively, which requires immediate action. The Heimlich manoeuvre, also known as the abdominal thrust, is recommended for the relief of FBAO in responsive adults (more than eight years old) and children (1–8 years old).
3. If the casualty becomes unconscious:

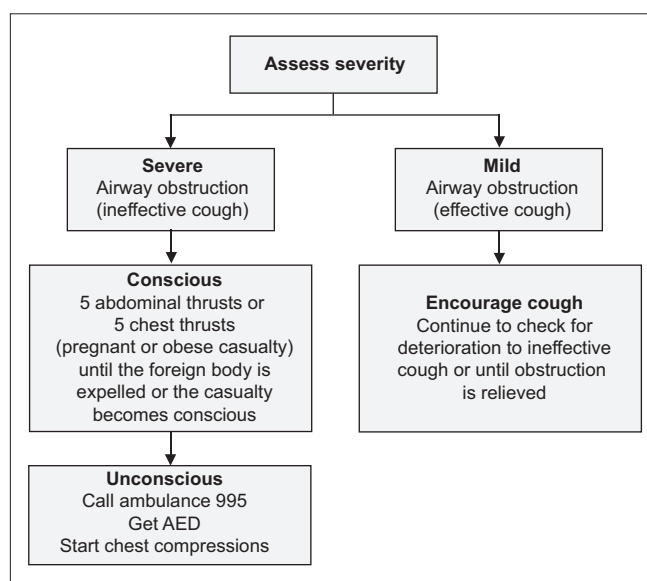


Fig. 4 Adult choking treatment algorithm.

- (a) Support and position the casualty on his back on a firm flat surface, wherever possible.
- (b) The rescuer should shout for help and activate the emergency ambulance by calling '995'.
- (c) Begin 30 chest compressions immediately.
- (d) Open the airway with the head tilt-chin lift procedure. The rescuer should look for an object in the mouth and remove it, if found.
- (e) Check for normal breathing.
- (f) If breathing is absent, attempt one ventilation.
- (g) If the chest does not rise, reposition the airway with the head tilt-chin lift procedure.
- (h) Attempt a second ventilation.
- (i) Perform 30 chest compressions, repeat the head tilt-chin lift procedure and check for foreign body.
- (j) Repeat (3d–3h) till help arrives and a healthcare worker takes over, or the casualty starts breathing, coughing, talking or moving.



Fig. 5 Photograph shows the recovery position.

Recovery position

The recovery position is used in the management of casualties who are unresponsive but breathing and have signs of circulation. Several versions of the recovery position exist, each with its own variations. The position adopted should allow free drainage of fluid from the mouth and the upper airway, give stability and enable the casualty to be turned to his side and returned easily and safely onto his back, with due care taken for possible cervical spine injury (Fig. 5). Any pressure on the chest that impairs breathing should be avoided.

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SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

(Code SMJ 201707A)

Question 1. When performing cardiopulmonary resuscitation (CPR) on an adult, the heel of the hand should be placed:

- (a) On the centre of the sternum.
- (b) On the lower half of the sternum.
- (c) Just above the xiphoid process.
- (d) Over the left anterior chest wall.

True False

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Question 2. The optimal rate of chest compressions for adult CPR is:

- (a) 80–100 per minute.
- (b) 60 per minute.
- (c) 100–120 per minute.
- (d) 30 per minute for two minutes.

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Question 3. The recommended depth of chest compressions for adult CPR in Singapore is:

- (a) 3.0–4.0 cm.
- (b) 4.0–6.0 cm.
- (c) > 6.0 cm.
- (d) Dependent on the size of the adult.

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Question 4. Chest compressions during CPR should be done with the rescuer counting loudly as follows:

- (a) 1&2&3&4&5&, 1&2&3&4&10&, 1&2&3&4&15, 1&2&3&4&20, 1&2&3&4&25, 1&2&3&4&30.
- (b) One one-thousand, two one-thousand, three one-thousand, and so on until thirty one-thousand.
- (c) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, and so on until 30.
- (d) 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16, and so on until 30.

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Question 5. The following statement(s) regarding two-rescuer adult CPR is/are true:

- (a) If two trained rescuers are available, one rescuer should perform 30:2 chest compressions for two minutes, while the other rescuer should call 995 for dispatcher-assisted instructions.
- (b) If two trained rescuers are performing CPR on a casualty, one rescuer should perform 30 chest compressions and then hand over to the other rescuer for the other 30 compressions.
- (c) If two trained rescuers are performing CPR on a casualty, one rescuer should perform 30:2 CPR and hand over to the other rescuer when he feels tired.
- (d) If two trained rescuers are performing CPR on a casualty, one rescuer can focus on chest compressions and the other can focus on mouth-to-mouth breathing or bag-valve-mask ventilation, and they can switch roles, if needed.

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Doctor's particulars:

Name in full: _____ MCR no.: _____
 Specialty: _____ Email: _____

SUBMISSION INSTRUCTIONS:

Visit the SMJ website: <http://www.smj.org.sg/current-issue> and select the appropriate quiz. You will be redirected to the SMA login page.

For SMA member: (1) Log in with your username and password (if you have not activated your membership account, please email membership@sma.org.sg). (2) Select your answers for each quiz and click 'Submit'.

For non-SMA member: (1) Create an SMJ CME account, or log in with your SMJ CME username and password (for returning users). (2) Make payment of SGD 21.40 (inclusive of 7% GST) via PayPal to access this month's quizzes. (3) Select your answers for each quiz and click 'Submit'.

RESULTS:

(1) Answers will be published online in the SMJ September 2017 issue. (2) The MCR numbers of successful candidates will be posted online at the SMJ website by 14 September 2017. (3) Passing mark is 60%. No mark will be deducted for incorrect answers. (4) The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council. (5) One CME point is awarded for successful candidates.

Deadline for submission: (July 2017 SMJ 3B CME programme): 12 noon, 7 September 2017.