

CME Article

Basic Cardiac Life Support: 2011 Singapore guidelines

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ABSTRACT

The core skills required in resuscitation of cardiac arrest individuals is referred to as Basic Cardiac Life Support or cardiopulmonary resuscitation (CPR). Once cardiac arrest (an unresponsive patient with no breathing or only gasping motions) is recognised, chest compressions should be initiated. Healthcare workers may choose to also check for a pulse to verify cardiac arrest if they are trained. The time taken for breathing check (and pulse check) should not exceed ten seconds. Good quality chest compressions are recommended with each being delivered with arms extended, elbows locked, shoulders vertically above the patient's chest and the heel of the palm on the lower half of the sternum. The rescuer should push hard and fast, with a compression of at least 5.0 cm, 100 compressions per minute for adults and allow complete chest recoil after each compression. Every 30 chest compressions should be followed promptly by two quick and short ventilations (each 400–600 ml tidal volume) delivered within six seconds. Chest compression-only CPR is recommended for dispatcher-instructed CPR or if the rescuer, for any reason, is unable or unwilling to do mouth-to-mouth ventilations. CPR should only be stopped when the patient wakes up or an emergency team arrives and takes over patient care, or if an automated external defibrillator were to prompt interruption of chest compressions for analysis of heart rhythm or delivery of shock.

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

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INTRODUCTION

Basic Cardiac Life Support (BCLS) refers to recognition of sudden cardiac arrest, call for help, maintaining airway patency, and supporting breathing and the circulation 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 the layperson and healthcare provider in both out-of-hospital and in-hospital settings.

The majority of sudden cardiac arrests occur in the community (out-of-hospital); thus, 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. The CPR guidelines must not only be scientific but also simple. Simplification will improve skills retention, increase the willingness to perform CPR and decrease the fear of imperfect CPR performance.

In 2010, the International Liaison Committee on Resuscitation reviewed and updated the consensus document on science based on the latest developments in research. This international consensus on CPR and treatment recommendations (CoSTR) was published in the *Circulation*⁽¹⁾ and *Resuscitation*⁽²⁾ journals in October 2010. The various resuscitation councils then formulated their own guidelines based on the 2010 international CoSTR. The American Heart Association and European Resuscitation Council have also published their own guidelines.^(3,4) The following document spells out the Singapore guidelines as drawn up by the National Resuscitation Council and is an update of previous local guidelines from 2001⁽⁵⁾ and 2006.⁽⁶⁾

HIGHLIGHTS OF CHANGES IN BCLS GUIDELINES SINCE 2005

Recognition of cardiac arrest

Studies have shown that gasping is common (up to 40%) in the immediate phase when patients sustain sudden cardiac arrest. During the first few minutes of sudden cardiac arrest, the presence of gasping is associated with increased survival. Layperson or healthcare providers should be taught to recognise gasping as not normal breathing but the start of cardiac arrest, and 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).⁽⁷⁾

The pulse check is a difficult technique⁽⁸⁾ for both laypersons and healthcare providers to master. The pulse check should not be taught to laypersons (recommended

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Fig. 1 Landmark for chest compressions.

in the 2006 NRC guidelines).⁽⁶⁾ Training centres that wish to teach healthcare workers the pulse check as an additional tool for determination of cardiac arrest should use manikins that are able to test for the presence or absence of a pulse. The healthcare provider should take no more than ten seconds to check for breathing and pulse. If no pulse is detected within this time period, the healthcare provider should presume cardiac arrest and start chest compressions.

Sequence of CPR

Observational studies conducted prior to 2005 have shown that adult patients with a cardiac cause of sudden arrest or an initial rhythm of ventricular fibrillation and receiving chest compression-only CPR (without ventilation) have equivalent survival rates as those receiving the then conventional bystander CPR (chest compressions and ventilations at a ratio of 15:2) and significantly better survival than those not receiving any CPR at all.⁽⁹⁾ Ventilations are required for the resuscitation of paediatric arrest and asphyxial cardiac arrest (noncardiac cause) in both adults and children (e.g. trauma, drug overdose, drowning, etc) as well as victims with prolonged cardiac arrest (more than six minutes). Conventional CPR (compression:ventilation ratio of 30:2) is recommended for all trained rescuers (healthcare providers or laypersons).^(10,11) Conventional CPR will start with 30 chest compressions instead of two ventilations. Rescuers are reminded that if they are unwilling or unable to do mouth-to-mouth ventilations, they must, at the least, do continuous chest compressions. Rescuers will be taught not to take more than six seconds to perform the two ventilations.

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 the use of the inter-nipple line

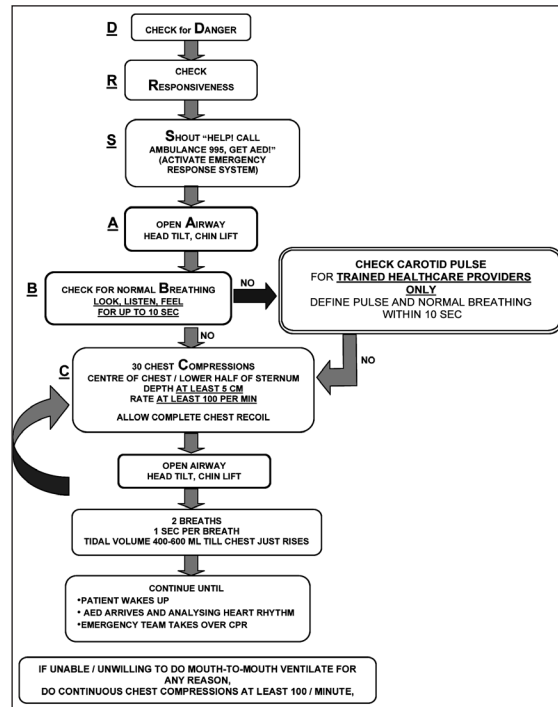


Fig. 2 Adult basic cardiac life support one-man CPR algorithm.

as a landmark to signify the lower half of the sternum for the hand positions is not reliable.^(12,13) One study showed that there were shorter pauses between ventilations and compressions if the rescuer were taught to “place the heel of hand” on the lower half of the victim’s breast bone (and were shown the location) vs. the conventional method of locating the landmark for chest compression with one finger breadth above the xiphoid process by tracing the lower margin of the victim’s rib cage.⁽¹⁴⁾ The committee has decided to retain the conventional method (Fig. 1).⁽¹⁵⁾

Studies conducted in both out-of-hospital and in-hospital cardiac arrest situations showed that rescuers do not compress the chest hard and fast enough, as well as cause many and frequent interruptions of chest compressions.^(16,17) The recommended rate of chest compression has been changed for both adults and children from 100 per minute to *at least* 100 per minute. The depth of compressions has been changed from 4–5 cm to *at least* 5 cm for adults, 5 cm for children and 4 cm for infants.

SEQUENCE OF ADULT ONE-MAN CPR

The recommended sequence for adult one-man CPR is shown in Fig. 2.

- (1) Check for danger: this ensures that the rescuer operates in a safe environment.
- (2) Check for responsiveness: the rescuer should tap the victim firmly and ask loudly, “Hello! Hello! Are you okay?”

Table I. CPR sequences across age groups.

CPR sequence	Adult and older child	Child (1–8 years of age)	Infant (< 1 year of age)
Establish unresponsiveness; call 995, get AED	Immediately	After 2 minutes CPR	After 2 minutes CPR
Open airway	Head tilt – chin lift	Head tilt – chin lift	Head tilt – chin lift
Recognition of cardiac arrest	Check for normal breathing*	Check for normal breathing*	Check for normal breathing*
Pulse check [†]	Carotid	Carotid	Brachial
Start chest compressions	If no normal breathing or pulse [‡]	If no normal breathing or pulse [‡]	If no normal breathing or pulse [‡]
Compression landmarks	Lower half of sternum	Lower half of sternum	Lower half of sternum (just below intermammary line)
Compression method	Heel of one hand, other on top	Heel of one hand, other on top	Two fingers
Compression depth	At least 5 cm	5 cm	4 cm
Compression rate	At least 100/min	At least 100/min	At least 100/min
Compression:ventilation ratio	30:2 (1 or 2 rescuers)	30:2 (1 or 2 rescuers)	30:2 (1 or 2 rescuers)
Breathing	Two breaths at one second per breath. Should not interrupt chest compressions for more than six seconds to perform the two breaths.	Two breaths at one second per breath. Should not interrupt chest compressions for more than six seconds to perform the two breaths.	Two breaths at one second per breath. Should not interrupt chest compressions for more than six seconds to perform the two breaths.

* Gasping is not normal breathing; [†]For trained healthcare providers only; [‡]For trained healthcare providers only within ten seconds. CPR: cardiopulmonary resuscitation; AED: automated external defibrillator

- (3) If unresponsive: shout for help, call ‘995’ for an ambulance or activate the emergency response system, and get an automated external defibrillator (AED) if there is one within a 90 seconds walking distance.
- (4) Open airway: head tilt, chin lift
- (5) Look, listen and feel for up to ten seconds to check for normal breathing. Gasping is *not* considered normal breathing.
 - Checking of pulse, if to be done at all, should be left to trained healthcare workers.
 - Checking of normal breathing and pulse should not take more than ten seconds.
 - 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
 - The sternum (breastbone) may be exposed; however, especially in cases of a female victim, chest compressions may be done through the clothes.
 - The site of compression should be at the centre of the chest/lower half of the sternum.
 - (a) Kneel by the side of the victim
 - (b) Run the middle finger along the lower margin of the victim’s ribcage on the near side till you reach the notch at the centre (Fig. 1). Place your index finger next to it.
 - (c) Place the heel of the palm of the other hand on the lower half of the sternum (breastbone) next to the index finger.
 - (d) Place the heel of the first hand on top of the second.
 - (e) Interlace the fingers of both hands and lift the fingers off the chest wall.
 - (f) Straighten both elbows and lock them into position.
 - (g) Position shoulders directly over the victim’s chest. Use your body weight to compress the victim’s breastbone.
 - Depth of chest compression for adults must be at least 5 cm.
 - Compression rate is at least 100 per minute. Allow complete recoil of the chest wall after each compression.
 - Counting aloud of the compressions below is 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.
 - Every 30 chest compressions should be followed promptly by two quick and short ventilations (each 400–600 ml tidal volume so that the chest just rises) delivered within six seconds.
 - Checking for return of spontaneous circulation:
 - (a) The rescuer should continue performing CPR until emergency medical help arrives and takes over, or an AED arrives and prompts not to touch the patient, or if the victim starts moving.

- (b) For healthcare workers who are trained and confident to perform a pulse check, check the pulse after at least five cycles of 30 compressions: two ventilations. The checking of pulse should not take more than ten seconds. If the rescuer is unsure of the presence of a pulse by the end of ten seconds, resume 30 chest compressions: two ventilations. See Table I for comparison of CPR sequences across various age groups.

CHEST COMPRESSION-ONLY CPR

Compression-only CPR is usually only instructed during dispatcher-assisted CPR. In addition, lay rescuers who are unable, or for some reason, unwilling to provide mouth-to-mouth ventilations should be encouraged to at least perform good chest compressions.

TWO-PERSON CPR

- A layperson should call the ambulance at '995' to activate the emergency response system and get an AED once the victim is found to be unresponsive.
- If there is more than one rescuer, one person should call for the ambulance (995) to activate the emergency response system and get the AED once the victim is found to be unresponsive. The other continues to check for breathing (and pulse for trained healthcare providers only) and starts chest compressions, if needed.
- Rescuers should take turns to perform CPR every two minutes (or around five cycles of 30 chest compressions: two ventilations) as fatigue may set in. This change-over should involve minimal interruption of chest compressions.
- Two-person CPR may be more efficient with one person doing the ventilations and the other doing the chest compressions.

RELIEF OF FOREIGN BODY AIRWAY OBSTRUCTION (FBAO)

Below is the recommended sequence of actions for relief of FBAO with a responsive victim (Fig. 3):

Recognition of FBAO: choking occurs while eating and the victim may clutch his throat.

- If the victim is coughing effectively, this means that the airway is mildly obstructed. Do not interfere. Allow the victim to expel the object himself by coughing.
- In severe airway obstruction, the victim is unable to speak, breathe or cough effectively, and that requires immediate action. The Heimlich manoeuvre, also known as the abdominal thrust, is recommended for

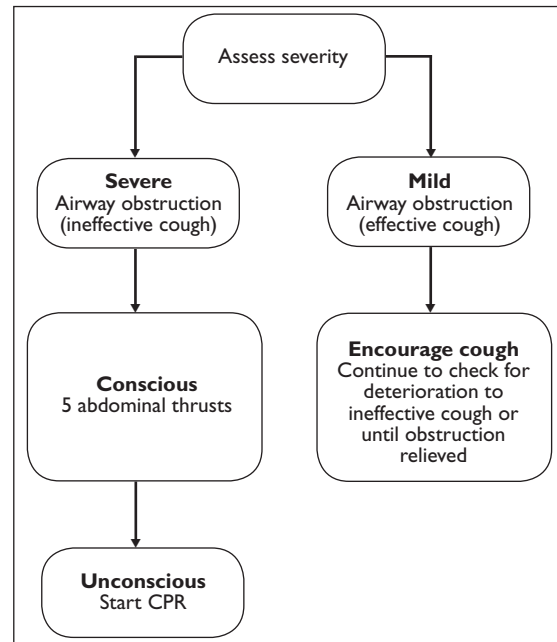


Fig. 3 Adult choking treatment algorithm.

the relief of FBAO in responsive adults (> eight years of age) and children (1–8 years of age).

- If the victim becomes unconscious,
 - (a) Support and position the victim on his/her 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) Then, open the airway by tilting the head and lifting the chin. The rescuer should look for the foreign object in the mouth, and if found, remove it.
 - (e) Check for normal breathing.
 - (f) If breathing is absent, attempt one ventilation.
 - (g) If the chest does not rise, re-position the airway with the head tilt, chin lift procedure.
 - (h) Attempt a second ventilation.
 - (i) Perform 30 chest compressions and then proceed back to head tilt, chin lift and check for foreign body.
 - (j) Repeat steps d–h above until help arrives and takes over, or when the patient starts breathing, coughing, talking or moving.

RECOVERY POSITION

The recovery position is used in the management of victims who are unresponsive but are 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 victim



Fig. 4 Recovery position.

to be turned to his side and returned onto his back easily and safely, with due care taken for possible cervical spine injury. Any pressure on the chest that impairs breathing should be avoided (Fig. 4).

In summary, the major changes to the 2011 guidelines are:

- The rescuer will be taught to recognise gasping as abnormal breathing and as an indication to start CPR. Determination of absence of carotid pulse, however, should be left to trained healthcare providers.
- CPR will start with 30 chest compressions instead of two ventilations. The new guidelines also place greater emphasis on better quality of chest compressions. Compression depth should be > 5 cm for adults, 4–5 cm for children and 4 cm for infants. The rate of chest compression should be more than 100 per minute for all age groups.
- The new guidelines re-emphasise that if the rescuer is not willing or unable to perform mouth-to-mouth ventilations, they could still perform good quality chest compressions (rate at least 100 per minute).

CONCLUSION

Simplification of the basic life support guidelines, together with focus on quality performance of the basic steps in these skills, has been core to the modifications made for 2011. Over time, the need to minimise the differences in practice in the conduct of these skills for in-hospital and out-of-hospital rescuers and for different age groups has been another major factor in the development and simplification of these guidelines. This should enable easier teaching, retention and confident performance of these skills, with the expectation of greater use of effective life support for cardiac arrest patients in the community.

REFERENCES

1. Sayre MR, Koster RW, Botha M, et al. Part 5: Adult basic life support: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency cardiovascular Care Science with Treatment Recommendations. *Circulation* 2010; 122 (16 Suppl 2): S298-324.
2. Koster RW, Sayre MR, Botha M, et al. Part 5: Adult basic life support. 2010 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Resuscitation* 2010; 81 Suppl 1: e48-e70.
3. Berg RA, Hemphill R, Abella BS, et al. Part 5: adult basic life support. 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2010; 122 Suppl 3: S685-705.
4. Koster RW, Baubin MA, Bossaert LL, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 2. Adult basic life support and use of automated external defibrillators. *Resuscitation* 2010; 81:1277-92.
5. Lim SH. Basic cardiac life support (BCLS). *Singapore Med J* 2001; Suppl 1:2-3.
6. Teo WS, Anantharaman V, Lim SH. Update on resuscitation 2006. *Singapore Med J* 2007; 46:100-5.
7. Bobrow BJ, Zuercher M, Ewy GA, et al. Gasping during cardiac arrest in humans is frequent and associated with improved survival. *Circulation* 2008; 118:2250-4.
8. Eberle B, Dick WF, Schneider T, et al. Checking the carotid pulse: diagnostic accuracy of first responders in patients with and without a pulse. *Resuscitation* 1996; 33:107-16.
9. Hupfl M, Selig HF, Naggle P. Chest-compression-only versus standard cardiopulmonary resuscitation: a meta-analysis. *Lancet* 2010; 376:1552-7.
10. Kitamura T, Iwami T, Kawamura T, et al. Conventional and chest-compression only cardiopulmonary resuscitation bystanders for children who have out-of-hospital cardiac arrests: a prospective, nationwide, population-based cohort study. *Lancet* 2010; 375:1347-54.
11. Kitamura T, Iwami T, Kawamura T, et al. Time dependent effectiveness of chest compression-only and conventional cardiopulmonary resuscitation for out-of-hospital cardiac arrests of cardiac origin. *Resuscitation* 2011; 82:3-9.
12. Shin J, Rhee JE, Kim K. Is the inter-nipple line the correct hand position for effective chest compression in adult cardiopulmonary resuscitation? *Resuscitation* 2007; 75:305-10.
13. Kusunoki S, Tanigawa K, Kondo T, Kawamoto M, Yuge O. Safety of the inter-nipple line hand position landmark for chest compression. *Resuscitation* 2009; 80:1175-80.
14. Handley AJ. Teaching hand placement for chest compression – a simpler technique. *Resuscitation* 2002; 53:29-36.
15. Kouwenhoven WB, Jude JR, Knickerbocker GG. Closed-chest cardiac massage. *JAMA* 1960;173:1064-7.
16. Abella BS, Alvarado JP, Myklebust H, et al. Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest. *JAMA* 2005; 293:305-10.
17. Wik L, Kramer-Johansen J, Myklebust H, et al. Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest. *JAMA* 2005; 293:299-304.
18. Aufderheide TP, Sigurdsson G, Pirralo RG, et al. Hyperventilation-induced hypotension during cardiopulmonary resuscitation. *Circulation* 2004; 109:1960-5.

SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME
Multiple Choice Questions (Code SMJ 201108A)

- | | True | False |
|---|--------------------------|--------------------------|
| Question 1. The criteria for diagnosis of cardiac arrest in an adult, based on the 2011 guidelines, include the following: | | |
| (a) Reduced movement of upper and lower limbs to pain stimuli. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Decreased breath sounds in both lungs. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Occasional gasping motions in a non-responsive patient. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) Occasional gasping motions and absence of carotid pulse. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 2. The pulse check: | | |
| (a) Is mandatory for a diagnosis of cardiac arrest. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Picks up the presence of a heartbeat after palpation of the radial artery for a 20-second period. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Is conducted over the brachial region in infants. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) Is not taught to laypersons and is optional for health workers. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 3. The correct landmark for chest compression in an adult is: | | |
| (a) The inter-nipple line in both male and female patients. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Over the lower half of the sternum. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Over the middle of the sternum. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) 5 cm below the upper sternal notch. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 4. The following are characteristics of high-quality chest compressions during performance of CPR in an adult: | | |
| (a) Elbows locked, 90 degrees above the sternum and 100 compressions per minute. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Elbows locked, 90 degrees above the sternum and at least 5 cm depth for each compression. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Elbows locked in extension, 4–5 cm depth for each compression and 30 compressions after every breath. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) Light contact with the sternum at the end of the relaxation phase after each compression. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 5. During two-rescuer CPR: | | |
| (a) The first rescuer checks for responsiveness and starts chest compressions, while the second rescuer calls for an ambulance and gets an AED. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) The first rescuer does chest compressions, while the second rescuer gives two quick, short breaths after every 30 chest compressions. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) For foreign body airway obstruction, one rescuer does abdominal thrusts and the other does chest compressions. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) The first rescuer does 30:2 CPR for 2–5 minutes and then hands over to the second rescuer if he feels tired. | <input type="checkbox"/> | <input type="checkbox"/> |

Doctor's particulars:

Name in full: _____

MCR number: _____ Specialty: _____

Email address: _____

SUBMISSION INSTRUCTIONS:

(1) Log on at the SMJ website: <http://www.sma.org.sg/cme/smj> and select the appropriate set of questions. (2) Select your answers and provide your name, email address and MCR number. Click on "Submit answers" to submit.

RESULTS:

(1) Answers will be published in the SMJ October 2011 issue. (2) The MCR numbers of successful candidates will be posted online at www.sma.org.sg/cme/smj by 26 September 2011. (3) All online submissions will receive an automatic email acknowledgment. (4) Passing mark is 60%. No mark will be deducted for incorrect answers. (5) The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council.

Deadline for submission: (August 2011 SMJ 3B CME programme): 12 noon, 19 September 2011.