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In-hospital resuscitation

Introduction

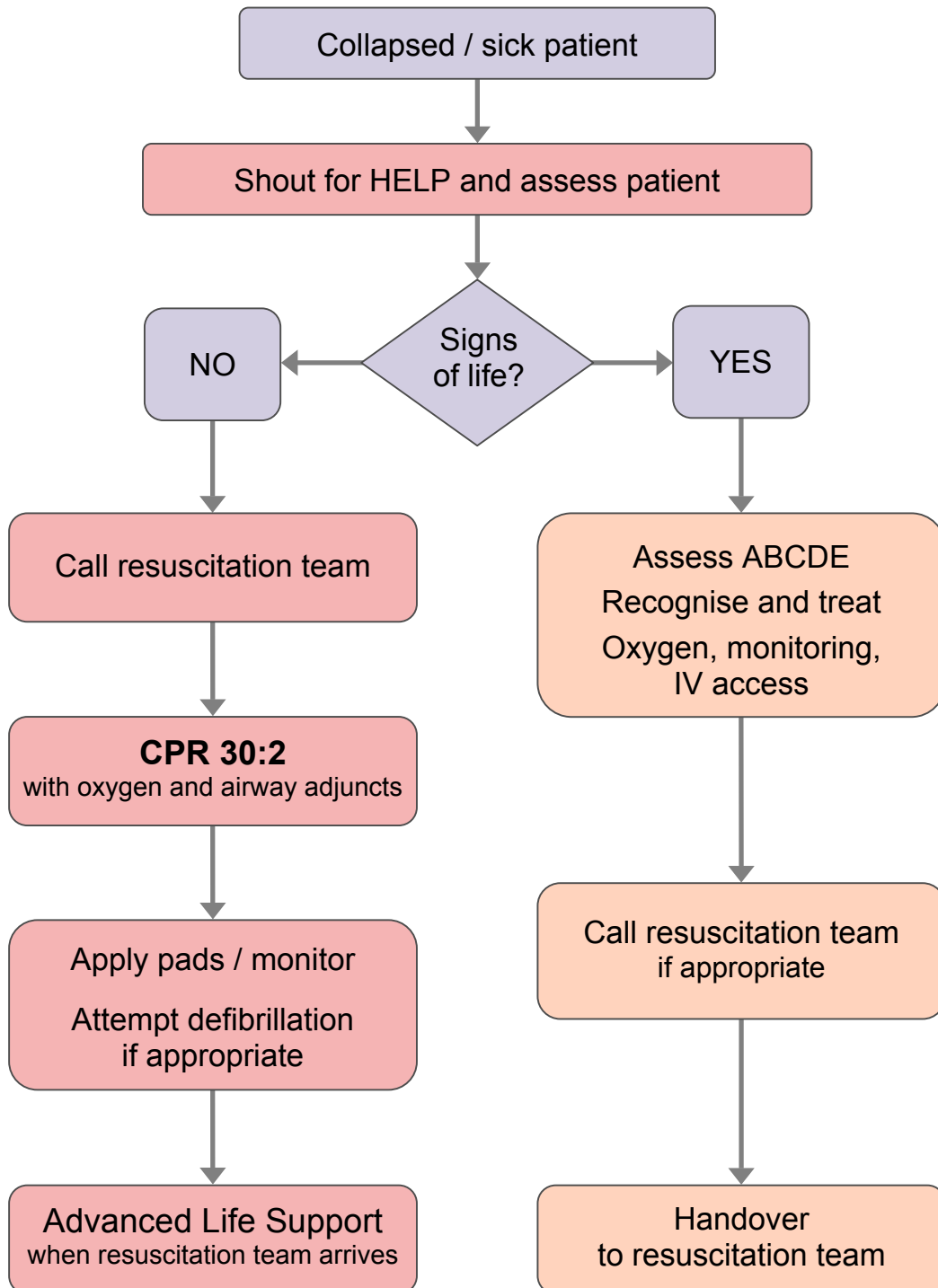
These guidelines are aimed primarily at healthcare professionals who are first to respond to an in-hospital cardiac arrest and may also be applicable to healthcare professionals in other clinical settings.

After in-hospital cardiac arrest the division between basic life support (BLS) and advanced life support (ALS) is arbitrary; in practice, the resuscitation process is a continuum. For all in-hospital cardiac arrests, ensure that:

- cardiorespiratory arrest is recognised immediately;
- help is summoned using a standard telephone number (e.g., 2222),⁸⁸
- cardiopulmonary resuscitation (CPR) is started immediately using adjuncts, for example a pocket mask, and, if indicated, defibrillation attempted as rapidly as possible and certainly within 3 min.

All in-hospital cardiac arrests should be reviewed as part of an audit and quality improvement process. Details should be recorded after each event. The [National Cardiac Arrest Audit](#) enables hospitals to collect standardised data, and monitor changes in cardiac arrest activity.

In-hospital resuscitation algorithm



Sequence for 'collapsed' patient in-hospital

1, Ensure personal safety

2. Check the patient for a response

- When a healthcare professional sees a patient collapse, or finds a patient apparently unconscious in a clinical area, he should first shout for help, then assess if the patient is responsive by gently shaking his shoulders and asking loudly, 'Are you all right?'
- It will be possible to undertake several actions simultaneously if other members of staff are nearby.

3A. If the patient responds:

- Urgent medical assessment is required. Call for help according to local protocols. This may be a resuscitation team (e.g. medical emergency team (MET)).
- While waiting for the team, assess the patient using the ABCDE (Airway Breathing Circulation Disability Exposure) approach.
- Give the patient oxygen – use pulse oximetry to guide oxygen therapy.⁸⁹
- Attach monitoring (minimum of: pulse oximetry, ECG and blood pressure) and record vital signs.⁶⁷
- Obtain venous access.
- Prepare for handover to team using SBAR (Situation, Background, Assessment, Recommendation)⁹⁰ or RSVP (Reason, Story, Vital signs, Plan)⁹¹ communication framework.

3B. If the patient does not respond:

- Shout for help (if this has not already been done).
- Turn the patient onto his back.
- Open the airway using head tilt and chin lift.
- If you suspect that there is a cervical spine injury, try to open the airway using a jaw thrust. Maintaining an airway and adequate ventilation is the overriding priority in managing a patient with a suspected spinal injury. If this is unsuccessful, use just enough head tilt to clear the airway. Use manual in-line stabilisation to minimise head movement if sufficient rescuers are available. Efforts to protect the cervical spine must not jeopardise oxygenation and ventilation.
- Keeping the airway open, look, listen, and feel to determine if the victim is breathing normally. This should be a rapid check and should take **less than 10 s**:
 - Listen at the victim's mouth for breath sounds.
 - Look for chest movement.
 - Feel for air on your cheek.

- Agonal breathing (occasional gasps, slow, laboured, or noisy breathing) is common immediately after cardiac arrest and is not normal breathing – it is a sign of cardiac arrest and should not be mistaken for a sign of life.
- Those experienced in clinical assessment may wish to assess the carotid pulse for less than 10 s. This may be performed simultaneously with checking for breathing or after the breathing check.
- The exact sequence will depend on the training of staff and their experience in assessment of breathing and circulation.

4A. If the patient has a pulse or other signs of life:

- Urgent medical assessment is required. Depending on the local protocols this may take the form of a resuscitation team.
- While awaiting this team, assess the patient using the ABCDE approach.
- Follow the steps in 3A above whilst waiting for the team.
- The patient is at high risk of further deterioration and cardiac arrest and needs continued observation until the team arrives.

4B. If there is no pulse or other sign of life:

- One person starts CPR as others call the resuscitation team and collect the resuscitation equipment and a defibrillator. If only one member of staff is present, this will mean leaving the patient.
- Give 30 chest compressions followed by 2 ventilations.
- Minimise interruptions and ensure high-quality compressions.
- The correct hand position for chest compression is the middle of the lower half of the sternum.
- The recommended depth of compression is at least 5 cm (not more than 6 cm) and the rate is at least 100 compressions min^{-1} (not more than 120 min^{-1}). Allow the chest to completely recoil in between each compression.
- If available, use a prompt and/or feedback device to help ensure high quality chest compressions.
- The person providing chest compressions should change about every 2 min, or earlier if unable to continue high quality chest compressions. This change should be done with minimal interruption to compressions.
- Maintain the airway and ventilate the lungs with the most appropriate equipment immediately at hand. A pocket mask, which may be supplemented with an oral airway, is usually readily available. Alternatively, use a supraglottic airway device (e.g. laryngeal mask airway (LMA)) and self-inflating bag, or bag-mask, according to local policy.
- Tracheal intubation should be attempted only by those who are trained, competent and experienced in this skill. Waveform capnography should be available routinely for confirming tracheal tube placement (in the presence of a cardiac output) and subsequent monitoring of an intubated patient.

Waveform capnography can also be used to monitor the quality of CPR (see ALS guidelines).

- Use an inspiratory time of 1 s and give enough volume to produce a normal chest rise. Add supplemental oxygen as soon as possible.
- Once the patient's trachea has been intubated or a supraglottic airway device has been inserted, continue chest compressions uninterrupted (except for defibrillation or pulse checks when indicated), at a rate of at least 100 min⁻¹, and ventilate the lungs at approximately 10 breaths min⁻¹. Avoid hyperventilation (both excessive rate and tidal volume), which may worsen outcome.
- If there is no airway and ventilation equipment available, consider giving mouth-to-mouth ventilation. If there are clinical reasons to avoid mouth-to-mouth contact, or you are unwilling or unable to do this, do chest compressions until help or airway equipment arrives. A pocket mask or bag mask device should be available rapidly in all clinical areas.
- When the defibrillator arrives, apply self-adhesive defibrillation pads to the patient and analyse the rhythm. These should be applied whilst chest compressions are ongoing. The use of adhesive pads will enable more rapid assessment of heart rhythm than attaching ECG electrodes.⁹²
- If using an automated external defibrillator (AED) switch on the machine and follow the AED's audio-visual prompts.
- For manual defibrillation, minimise the interruption to CPR to deliver a shock. Using a manual defibrillator it is possible to reduce the pause between stopping and restarting of chest compressions to less than 5 s.
- Plan what to do if the rhythm is shockable before CPR is stopped. Safety issues should also be addressed and planned for while chest compressions are ongoing.
- Pause briefly to assess the heart rhythm. With a manual defibrillator, if the rhythm is ventricular fibrillation/pulseless ventricular tachycardia (VF/VT), charge the defibrillator and restart chest compressions. Once the defibrillator is charged and everyone apart from the person doing compressions is clear, pause the chest compressions, rapidly ensure that all rescuers are clear of the patient and then deliver the shock. Restart chest compressions immediately after shock delivery. This sequence should be planned before stopping compressions.
- Continue resuscitation until the resuscitation team arrives or the patient shows signs of life. Follow the universal algorithm for ALS (see ALS guidelines).
- Once resuscitation is underway, and if there are sufficient staff present, prepare intravenous cannulae and drugs likely to be used by the resuscitation team (e.g., adrenaline).

- Identify one person to be responsible for handover to the resuscitation team leader. Use a structured communication tool for handover (e.g., SBAR, RSVP).^{90, 91} Locate the patient's records and ensure that they are available immediately the resuscitation team arrives.

4C. If the patient is not breathing but has a pulse (respiratory arrest):

- Ventilate the patient's lungs (as described above) and check for a pulse every 10 breaths (about every minute).

Only those competent in assessing breathing and a pulse will be able to make the diagnosis of respiratory arrest. If there are any doubts about the presence of a pulse, start chest compression and continue until more experienced help arrives.

5. If the patient has a monitored and witnessed cardiac arrest:

If a patient has a monitored and witnessed cardiac arrest in the cardiac catheter laboratory or early after cardiac surgery:

- Confirm cardiac arrest and shout for help.
- If the initial rhythm is VF/VT, give up to three quick successive (stacked) shocks if necessary. Start chest compressions immediately after the third shock and continue CPR for 2 min.
- This three-shock strategy may also be considered when a conscious patient has a witnessed VF/VT cardiac arrest and is already monitored using adhesive defibrillator electrodes with a manual defibrillator.
- A precordial thump in these settings works rarely⁹³⁻⁹⁵ and may succeed only if given within seconds of the onset of a shockable rhythm.⁹⁶ Delivery of a precordial thump must not delay calling for help or accessing a defibrillator. It is therefore appropriate therapy only when several clinicians are present at a witnessed, monitored arrest, and when a defibrillator is not immediately to hand. In practice, this is only likely to be in a critical care environment such as the emergency department or ICU, or in the cardiac catheter laboratory or pacing room.

Background notes

Hospital and staff factors

The exact sequence of actions after in-hospital cardiac arrest depends on several factors including:

- location (clinical or non-clinical area; monitored or unmonitored patients);
- skills of staff who respond;
- number of responders;
- equipment available;
- hospital system for response to cardiac arrest and medical emergencies (e.g. MET, cardiac arrest team).

Location

Monitored arrests are usually diagnosed rapidly. Ward patients may have had a period of deterioration and an unwitnessed arrest.^{62, 63} Ideally, all patients who are at high risk of cardiac arrest should be cared for in a monitored area where facilities for immediate resuscitation are available. Patients, visitors, or staff may also have a cardiac arrest in non-clinical areas (e.g. car parks, corridors). The Resuscitation Council (UK) has published [guidance for safer handling during resuscitation in healthcare settings](#).

Delay in attempting defibrillation may occur when patients sustain cardiac arrest in unmonitored hospital beds and in outpatient departments.⁹⁷ In these areas several minutes may elapse before resuscitation teams arrive with a defibrillator and deliver shocks. Despite limited evidence, AEDs should be considered for the hospital setting as a way to facilitate early defibrillation (a goal of less than 3 min from collapse), especially in areas where healthcare providers have no rhythm recognition skills or where they use defibrillators infrequently.

Skills of staff who respond

All healthcare professionals should be able to recognise cardiac arrest, call for help, and start resuscitation. Staff should do what they have been trained to do. For example, staff in critical care and emergency medicine may have more advanced resuscitation skills than staff who are not involved regularly in resuscitation in their normal clinical role. Hospital staff who attend a cardiac arrest may have different competencies in managing the airway, breathing, and circulation. Rescuers should use those resuscitation skills they have been trained to do.

The RC(UK) Immediate Life Support (ILS) course is aimed at the majority of healthcare professionals who attend cardiac arrests rarely but have the potential to be first responders or resuscitation team members.⁹⁸ A recent study found that the number of cardiac arrest calls decreased while pre-arrest calls increased after implementing a programme that included ILS teaching in two hospitals. This was associated with an increase in initial survival after cardiac arrest and survival to discharge.⁷⁹ The course teaches healthcare professionals the skills that, if used whilst awaiting the arrival of the resuscitation team, are most likely to result in successful resuscitation.

The RC(UK) Advanced Life Support (ALS) course is aimed at doctors and senior nurses working in acute areas of the hospital and those who may be resuscitation team leaders and members.^{99, 100} The course is also suitable for senior paramedics and some hospital technicians.

During training and clinical practice there should be a greater emphasis on non-technical skills (NTS).¹⁰¹ These consist of situational awareness, decision making, team working, including team leadership and task management. Tools such as SBAR or RSVP should be used to ensure rapid effective communication and handovers.

Number of responders

The single responder must ensure that help is on its way. If other staff are nearby, several actions can be undertaken simultaneously. Hospital staffing tends to be at its lowest during the night and at weekends. This may influence patient monitoring,

treatment and outcomes. Data from the US National Registry of CPR Investigators shows that survival rates from in-hospital cardiac arrest are lower during nights and weekends.¹⁰² Several studies show that higher nurse staffing is associated with lower rates of failure-to-rescue, and reductions in incidence of cardiac arrest, pneumonia, shock and death.¹⁰³⁻¹⁰⁵

Equipment available

Ideally, the equipment used for CPR (including defibrillators) and the layout of equipment and drugs should be standardised throughout the hospital.^{106, 107} A review by the RC(UK) of serious patient safety incidents associated with CPR and patient deterioration reported to the National Patient Safety Agency showed that equipment problems are a common contributing cause. All resuscitation equipment must be checked on a regular basis to ensure it is ready for use. AEDs should be considered for clinical and non-clinical areas where staff do not have rhythm recognition skills or rarely need to use a defibrillator.

Hospitals and teams that regularly treat cardiac arrests should have monitoring and equipment for transferring patients after they have been resuscitated. This includes portable monitors with a minimum of pulse oximetry, ECG, non-invasive blood pressure and waveform capnography for ventilated patients. For further information, refer to the Intensive Care Society's [Guidelines for the Transport of the Critically ill Adult](#).

Resuscitation team

The resuscitation team may take the form of a traditional cardiac arrest team, which is called only when cardiac arrest is recognised. Alternatively, hospitals may have strategies to recognise patients at risk of cardiac arrest and summon a team (e.g., MET) before cardiac arrest occurs. The term 'resuscitation team' reflects the range of response teams. In-hospital cardiac arrests are rarely sudden or unexpected. A strategy of recognising patients at risk of cardiac arrest may enable some of these arrests to be prevented, or may prevent futile resuscitation attempts in those patients who are unlikely to benefit from CPR (See prevention of in-hospital cardiac arrest and decisions about CPR chapter).

Surveys show that resuscitation teams rarely have formal pre- and post-event briefings (briefings and debriefings).¹⁰⁸⁻¹¹⁰ Resuscitation team members should meet for introductions and plan before they attend actual events. Team members should also debrief after each event based on what they actually did during the resuscitation. Ideally this should be based on data collected during the event.¹¹¹

National Cardiac Arrest Audit

All in-hospital cardiac arrests should be reviewed and audited. The National Cardiac Arrest Audit (NCAA) is a UK-wide database of in-hospital cardiac arrests and is supported by the RC(UK) and the Intensive Care National Audit & Research Centre (ICNARC). NCAA monitors and reports on the incidence of and outcome from, in-hospital cardiac arrests in order to inform practice and policy. It aims to identify and foster improvements in the prevention, care delivery and outcomes from cardiac arrest.

Participating in NCAA means that your hospital is collecting and contributing to national, standardised data on cardiac arrest, enabling improvements in patient care.^{57, 112, 113}

Diagnosis of cardiac arrest

Trained healthcare staff cannot assess the breathing and pulse sufficiently reliably to confirm cardiac arrest.¹¹⁴⁻¹²³ Agonal breathing (occasional gasps, slow, laboured or noisy breathing) is common in the early stages of cardiac arrest and is a sign of cardiac arrest and should not be confused as a sign of life/circulation.^{10, 124-126} Agonal breathing can also occur during chest compressions as cerebral perfusion improves, but is not indicative of a return of spontaneous circulation (ROSC). Delivering chest compressions to a patient with a beating heart is unlikely to cause harm.¹²⁷ However, delays in diagnosis of cardiac arrest and starting CPR will adversely effect survival and must be avoided.

High-quality CPR

The quality of chest compressions during in-hospital CPR is frequently sub-optimal.^{12, 15} The importance of uninterrupted chest compressions cannot be over-emphasised. Even short interruptions to chest compressions are disastrous for outcome and every effort must be made to ensure that continuous, effective chest compression is maintained throughout the resuscitation attempt. The person providing chest compressions should be changed every 2 min, but without causing long pauses in chest compressions.

Defibrillation strategy

The length of the pre-shock pause (the interval between stopping chest compressions and delivering a shock) is inversely related to the chance of successful defibrillation. Every 5-second increase in the duration of the pre-shock pause almost halves the chance of successful defibrillation, therefore it is critical to minimise the pause.¹³ The lengthy 'top-to-toe' safety check (e.g., "head, middle, bottom, self, oxygen away") performed after the defibrillator has charged and before shock delivery, taught and used in clinical practice commonly, will therefore significantly diminish the chances of successful defibrillation. Previous RC(UK) guidance and teaching materials state that the pre-shock pause should be less than 10 s; we believe that it is possible to reduce this to less than 5 s without endangering rescuers.

Rescuers should not compromise on safety. Actions should be planned before stopping chest compressions. If there are delays caused by difficulties in rhythm analysis or if individuals are still in contact with the patient, chest compressions should be restarted whilst plans are made to decide what to do when compressions are next stopped. Rescuers should wear gloves during CPR attempts. If they are not immediately available this should not delay starting CPR. Wearing gloves may decrease the risk of accidental shocks to rescuers although this requires further study.¹²⁸

Although there are no data supporting a three-shock strategy, it is unlikely that chest compressions will improve the already very high chance of ROSC when defibrillation occurs early in the electrical phase, immediately after onset of VF/VT. In circumstances where rapid early defibrillation is feasible (cardiac catheter laboratory, in monitored cardiac surgery patients, patients who have a witnessed and monitored VF/VT and are already connected to a defibrillator) three rapid defibrillation attempts may achieve ROSC without the need for chest compressions.