Arriving at the Emergency Site and Resuscitation

See online here

In an emergency, a smooth flow of the chain of rescue is essential for a positive prognosis for the injured or sick person. After the fastest possible report of the incident and first-aid from civilians, the medical emergency team provides professional care. Stabilization of the vital functions and initial medical care (e.g., resuscitation, stabilization of respiration, administration of medication and fluid loading) serve to transport the injured patient to a hospital as smoothly as possible, where the clinical primary care is performed.

General Information about Emergencies

Oxygen supply to the organs is crucial to preserve life, and respiration and the circulatory system are vital parameters—if any of these fail, the patient's life can be put in danger very quickly. With an insufficient oxygen supply, after three to five minutes, a **brain** becomes irrevocably damaged, longer time period damage other organ systems that results in biological death.

Respiratory arrest results in cardiac arrest after five to ten minutes, due to the

subsequent **hypoxia** (lack of oxygen). In case of cardiac arrest as heart doesn't pump enough blood to the circulation brain is not supplied by enough amount of oxygen as well. The patient falls unconscious within a brief period of time.

The lack of oxygen supply to the respiratory center located in the **brain stem** results in a loss of **spontaneous respiration** after only a minute.

As a medical student you should learn the basics of first-aid and resuscitation not just theoretically, but also practically to be used without hesitation in emergency situation.

Polytrauma as a serious emergency

In addition to sudden cardiac arrest and accidents in the home environment, doctors may come in contact with more severe cases. So-called **polytraumas** (e.g., from a traffic accident) are particularly challenging for the emergency care providers.

Note: A polytrauma is defined by injuries in various parts of the body that occurred at the same time, of which one injury or combination of them is life-threatening.

The **principle** of the clinical treatment of polytraumas is thus, **"Treat first what kills first."** This means that the injuries that are most fatal to the patient must be treated first. Additional injuries are treated provisionally and then definitively once the patient has been successfully stabilized.

Basic Life Support (BLS)

Only very rarely are the first responders to an accident or other medical emergencies medically trained individuals. More often, they are passersby or witnesses, i.e., medical laypersons.

Basic Life Support (BLS) describes all measures of cardiopulmonary resuscitation that can be performed without aids by first responders. In broader terms, BLS includes calling for assistance, freeing the airways, a cardiac massage and respiration, and now the usage of an **AED** (automated external defibrillator).

Reporting the incident

The incident should **immediately** be reported if there is an apparent need for assistance: In the best-case scenario, multiple helpers are present at the emergency site, one of whom can begin performing first-aid measures while another alerts the emergency rescue services by **phone (911)**.

If an individual falls unconscious or is apparently found unconscious, the emergency rescue team is alerted immediately after the **breath test** was conducted and before a **cardiac massage** begins.

These **5 questions** should be remembered to properly and quickly relay information:

- **Where** (emergency site)?
- **What** (happened)?
- **How many** injured?
- **Which** injuries?
- **Wait** for questions from the emergency dispatcher (do not hang up immediately once all information has been provided).

Self-protection and protection of others

One of the most important principles of first-aid: **self-protection.** A rescue worker should never put their own life at risk by putting themselves in dangerous situations. If their own safety is ensured (or if they are not in danger), the injured person must be removed from the dangerous area (**protection of others**).

The **Rautek maneuver** is designed for this, and it can be used to pull a patient backward from the dangerous area (fire, accident site, etc.).

With the **Rautek maneuver**, the patient is grabbed from behind under the arms, one of the patient's arms is held against their chest and the forearm is held by the left and right hand of the rescue worker. This allows the responder to pull the injured person with relative stability.

Exam tip: The Rautek maneuver does not only help in emergencies but is also a common topic for examination questions.

Unconscious patient: Breath test

If a presumably unconscious patient is found, speak to them. If you do not receive a response, carefully shake their shoulders. **If they remain unresponsive, their breathing must be checked**. The airways can be freed up by overflexing the head or lifting the chin. When performing the breath test, all of the senses (sight, hearing, feeling) are used.

It is best to keep your head tilted just over the patient's face, your gaze directed toward their ribcage, ears, and cheeks, near the mouth and nose.

You must work with your available senses:

- **Sight:** Is their chest moving up and down?
- **Hearing:** Can respiration be heard from the nose or mouth?
- **Feeling:** Heave of the chest, air from breathing

The assessment of the patient's respiration can last for a maximum of **ten seconds**. Professional assistants can also check the **carotid pulse**, but this should also not last more than ten seconds not to lose any valuable time in case of a necessary resuscitation. In case of doubt, an unnecessary cardiac massage does much less damage than one that was begun too late.

If the patient is breathing regularly, they must be placed into the **recovery position** and then alert the emergency. If the patient is breathing only sporadically, irregularly or not breathing at all, **cardiopulmonary resuscitation** and possibly **defibrillation** with an AED (automated external defibrillator) is required. Nowadays these devices are installed in many public areas and institutions.

Recovery position

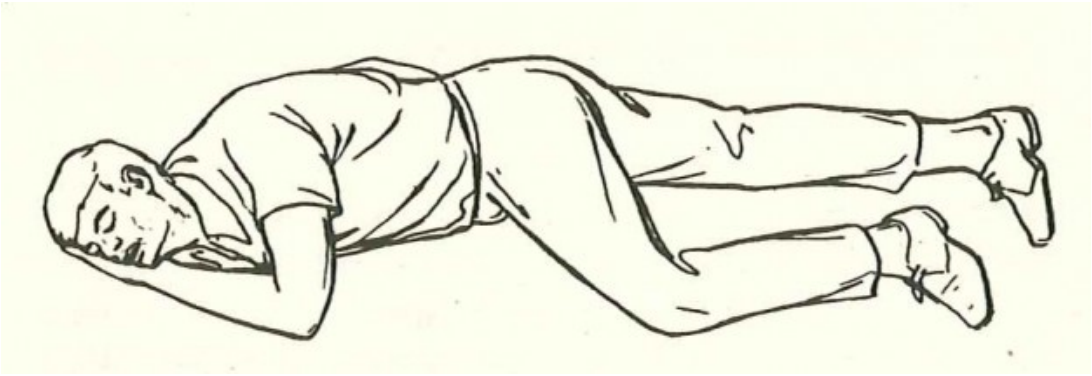

Image: “Stabile Seitenlage” by Hauptabteilung der Schutzpolizei der DDR. License: CC BY-SA 3.0

If the patient is breathing but is not responding when spoken to, they must be placed in the **recovery position**. This way the patient should be able to **breathe.**

Overflexion of the head prevents the tongue from sliding into the throat and blocking the airways. The recovery position prevents any potential aspiration of vomit, as the mouth is lying lower than the rest of the body and vomit or blood can flow out.

If the patient is in the recovery position, **respiration and circulation must still be regularly monitored** until the emergency rescue services arrive as the patient’s health can always deteriorate, and a cardiac arrest is not to be ruled out.

Cardiopulmonary resuscitation (CPR)

If a person found is not responding and if the breath test reveals **apnoea or gasping** a cardiac massage and ventilation must commence immediately. Lack of a pulse is not sufficient criteria for making a decision.

Essentially, measures of resuscitation must be performed for as long as it takes for the patient to show **signs of life**, qualified **medical professionals** to arrive, or until the first responder is **exhausted**.

Note: Gasping is also a sign of circulatory arrest! In 40 % of cases, it precedes apnoea and circulatory arrest.

Image: “CPR training” by Rama. License: CC BY-SA 2.0 FR

Cardiac massage

To perform **cardiac massage**, the person must be lying on their back **on a solid surface** (on the floor if necessary). The balls of the hand are placed over one another on the middle of the **sternum**, fingers laced. The pressure must come down vertically from arms as outstretched as possible.

Ideally, the first-aid provider is kneeling at the patient's side. According to the guidelines of the **ERC (European Resuscitation Council)**, the goal is to achieve a **compression depth of at least five centimeters** and a **pressure frequency of at least 100 per minute**.

Tip: You can think of the song "Stayin' Alive" by the Bee Gees to find the proper rhythm – at 103 beats per minute, this is a good aid.
After each compression, the thorax must be completely relieved, but the balls of your hands must remain at the pressure point. In principle, the cardiac massage begins immediately, before respiration.

Rescue breathing

A **respiration ratio of 30:2** is ideal (30 compressions followed by two breaths). The respiration can either occur via mouth-to-mouth or mouth-to-nose.

Image: "Mund-zu-Nase-Beatmung" by Hauptabteilung der Schutzpolizei der DDR. License: CC BY-SA 3.0

Both types require an **overflexion of the head**, to keep the airways free (one hand is kept on the patient's hairline, the fingers of the other hand hold up the chin). With mouth-to-mouth resuscitation, the patient's nose must also be held shut so that the air provided does not immediately exit once again.

Image: “Mund-zu-Mund-Beatmung” by Hauptabteilung der Schutzpolizei der DDR. License: CC BY-SA 3.0

The person providing the respiration generally inhales completely normally and then blows the exhaled air continuously into the patient. A heave of the thorax shows whether the respiration was successful **(thoracic excursion)**. After inhaling, the helper then turns their head and observes the patient’s thorax – this should lower again during the next passive exhalation.

Both **forms of respiration** should **not take longer than five seconds**, as the cardiac massage must then be continued.

Laypersons may also perform “**chest-compression-only CPR**“, in which only a cardiac massage is performed with no respiration. This also applies in the event that respiration is not possible for other reasons, such as due to facial injuries of hygienic or personal reasons.

Studies have shown that the inhibition threshold of beginning CPR is lower among laypersons if they only have to perform cardiac massage. The **cardiac massage should be interrupted as less as possible, or not at all**.

Automated External Defibrillator (AED)

In accordance with the resuscitation guidelines of ERC, basic life support also entails the use of an **AED**. If such a device is available in an emergency, it should be used. AEDs can be found in many public spaces, such as train stations and airports. However, an immediate cardiac massage is still the most important measure; ideally, a third person will be asked to bring and prepare the AED.

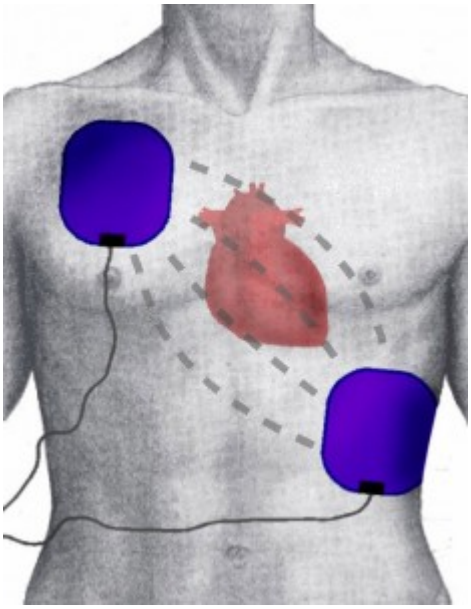

Image: “Position der Elektroden” by PhilippN.
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An AED has **two large adhesive electrodes** (pads) that are placed upon the patient following the instructions provided with the AED. The device conducts an **automatic ECG diagnosis** and declares whether defibrillation is required via voice command.

The **cardiac massage** is briefly interrupted and everybody present must keep a safe distance away from the patient so as not to be put in danger by the electrical shock, as this can trigger **ventricular fibrillation** in healthy individuals. Also, they must not be standing in a puddle near the patient! Afterward, the cardiac massage must be continued immediately.

Generally, the device automatically will give directions after **two minutes** for a new diagnosis and possibly a defibrillation.

Advanced Life Support (ALS)

Those measures taken by professional medical assistants are called **Advanced Life Support**.

While the diagnosis and CPR (**cardiopulmonary resuscitation**) is conducted just as in BLS, **ALS** also includes electrical defibrillation, ECG diagnostics, securing the airways (e.g., via intubation) and administration of medication.

One of the first measures taken by the rescue team at the emergency site—after securing the area—is assessing the patient’s state of consciousness.

Glasgow coma scale

The **Glasgow coma scale** (Teasdale and Jenett, 1974) is used for an objective assessment of the level of **consciousness** and of **brain functions** after a traumatic brain injury. The parameters of the scale should be used by an emergency medic in every emergency and be compiled when the emergency medic arrives at the emergency site to better document and assess the procedure.

The patient is scored in the areas of “best eye response”, “best verbal response” and

“best motor response”. A minimum of three points and a maximum of 15 can be achieved. A severe traumatic brain injury is assumed for a score less than eight points: This entails an indication of **endotracheal intubation** to secure the airways.

Best eye response	4 = spontaneous; 3 = to voice command; 2 = to pain; 1 = none
Best verbal response	5 = orientated; 4 = confused but coherent; 3 = incoherent words; 2 = incomprehensible sounds; 1 = none
Best motor response	6 = obeys commands; 5 = localizes pain; 4 = withdrawal from pain; 3 = abnormal flexion (decorticate posture); 2 = extensor response (decerebrate posture); 1 = none

Primary survey: The ABCDE approach

Each emergency requires an individual approach from the attending team and physician, but in order to ensure nothing important is overlooked in an emergency or when the time is of the essence, a procedure following the **ABCDE approach** has proven effective. It ensures that the three most important vital parameters of consciousness, respiration, and circulation can be systematically evaluated and treated.

A:	**Airway**	Check the airways
B:	**Breathing**	Check respiration
C:	**Circulation**	Check circulation
D:	**Disability**	Check consciousness, orientating neurological examination
E:	**Exposure**	Examine undressed patient for injuries, bleeding, etc.

Trauma assessment

Trauma assessment is part of the systematic evaluation of the awake emergency patient (following the ABCDE approach, it corresponds to the E of Exposure) with the goal of systematically documenting injuries and not overlooking any injuries that require treatment. If the patient is unconscious, then a rough assessment of dislocations, bleeding, and injuries is performed.

Trauma assessment consists of the following steps:

- Brief anamnesis
- Head assessment
- Assessment of the spine
- Assessment of the thorax and abdomen (**palpation**, **percussion**, **auscultation**)
- Assessment of pelvic stability
- Assessment of pain in the spine and neurological deficits
- Assessment of the extremities for dislocations, injuries, motor function and sensitivity
- Monitoring circulation (measuring blood sugar, blood pressure, heart rate, ECG lead, **pulse oximetry**, monitoring respiration)

Causes of circulatory arrest

Signs of circulatory arrest are **lack of pulse and apnoea**.

The reasons for circulatory arrest may vary: **cardiac** (e.g., myocardial infarction, CHD, myocarditis, cardiac arrhythmias), **respiratory** (pulmonary edema, apnoea,

pneumothorax), **cerebral** (traumatic brain injury, stroke).

Hypoxia, **hyperthermia,** or **metabolic lapses** can, in an extreme case, trigger circulatory arrest—this can only be treated by resuscitation within a brief window of time of about three to five minutes.

Should cardiac arrhythmias lead to a lack of blood circulation in the body, the heart still exhibits electrical activity and may have to be defibrillated.

Defibrillation

The voltage applied during **defibrillation** charges all of the heart muscles at once. After such a synchronization, the likelihood that the conduction and excitation in the heart will continue to function in a normal rhythm increases.

The emergency defibrillation process conducted by medically trained personnel is similar to that of the AED. The cardiac massage is briefly interrupted to fasten the ECG electrodes, and an **emergency ECG diagnosis** is performed. While the device charges, the cardiac massage is continued. Once the device is charged, it's "**hands off**": Everybody must move a safe distance away from the patient.

The electrodes are placed in a **sternal-apical** position, i.e., one right-parasternal below the **clavicle** and the other left-lateral of the **cardiac apex**. The patient is shocked and the cardiac massage continues immediately thereafter.

After a **resuscitation cycle** (by definition: 2 minutes = 5 x 30 cardiac massages + 2 respirations), another ECG diagnosis should be performed and another defibrillation should be done if necessary.

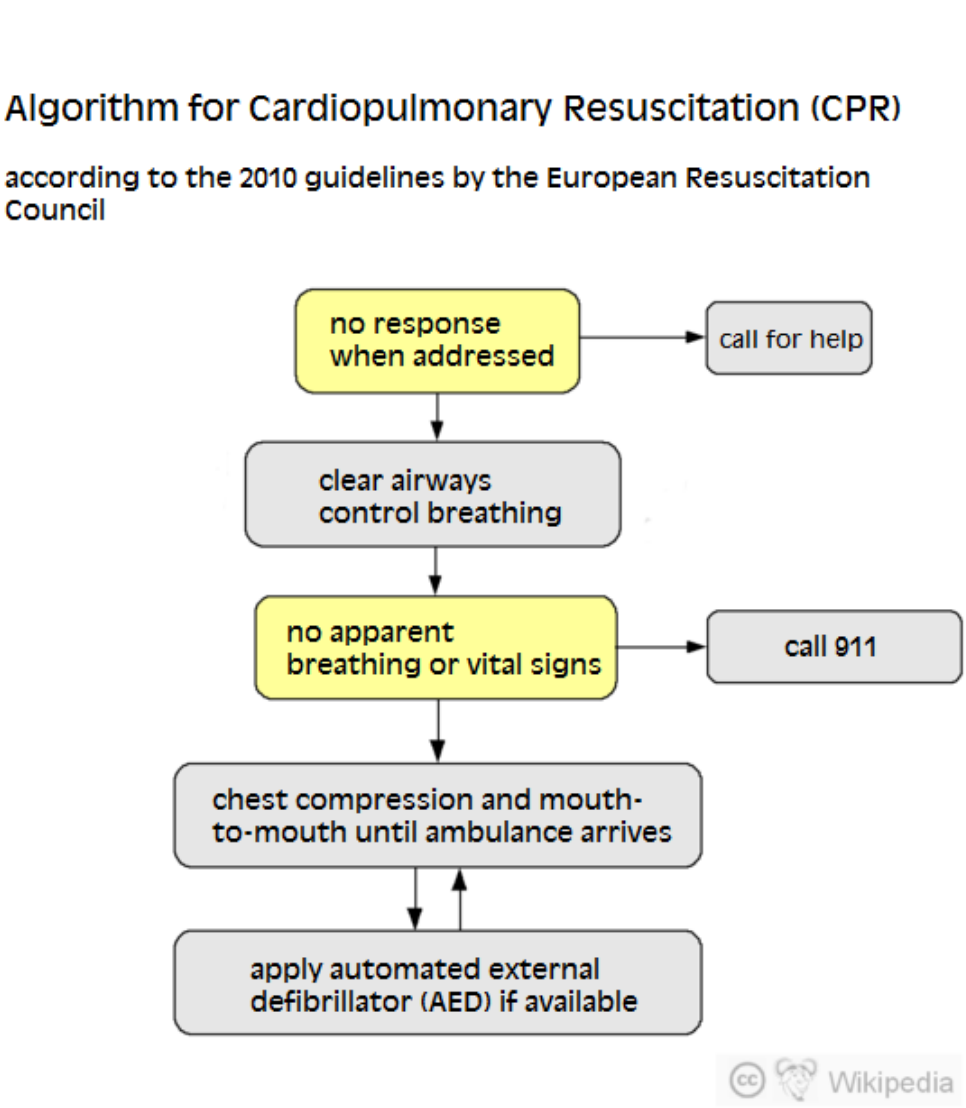

Image: “Algorithm for Cardiopulmonary resuscitation (CPR)” by Andante [edited]. License: CC BY-SA 3.0

There are generally two forms of electrical defibrillation: **monophasic** and **biphasic defibrillation**. Today, biphasic defibrillation (alternating current) is recommended since a lower number of joules reduces the risk of long-term damage to the heart muscle cells while still achieving the same effect.
Exam tip: For the exam, you should know that monophasic defibrillation works with 360 joules. Biphasic defibrillation uses 150 – 200 joules (150 – 360 for additional shocks).
Defibrillate rhythms

The prerequisite for defibrillation is the presence of a defibrillate heart rhythm: **pulseless ventricular tachycardia** or **ventricular fibrillation**. Ventricular fibrillation is the most common cause of cardiac arrest. On ECG, this is seen as arrhythmic flutter waves—the cardiac excitation is so uncoordinated that the heart muscles can no longer contract, and no ejection fraction is present.

Pulseless ventricular tachycardia represents a rapid and regular ventricular contraction. At the same time, this keeps the heart’s ejection fraction too low—there is often no pulse to be felt, or if there is, only the carotid pulse.

In case of asystolia (no electrical activity on the ECG) and **PEA** (pulseless electrical activity) defibrillation is not performed. The treatment of choice for both is the immediate intravenous administration of 1 mg of **adrenaline** (for adults), which is injected after every second resuscitation cycle. If in this manner the heart’s activity is increased to the

extent that Vfib waves are seen, defibrillation can be performed.

Digression: Resuscitating Children

There are special ERC guidelines for resuscitating newborns and children. One crucial difference between adults is that the child's respiration, not their heart, must often be supported.

Newborns are initially respirated five times, five more times if this is unsuccessful, and only then is **thoracic compression** performed.

One first-aid provider uses the **two-finger technique** for newborns, and multiple first-aid providers use the **two-thumb technique** with a circumferential thoracic squeeze. Respiration is performed in a ratio of 3 : 1.

For children older than one year, the difference between adults is that they are initially respirated five times before the thoracic compressions are performed (100 – 120 per min). Unlike with adults, professional assistants should respirate in a ratio of 15 : 2, and untrained assistants in a "normal" ratio of 30 : 2.

Popular Exam Questions on Resuscitation and Arriving at the Emergency Site

The solutions can be found below the references.

1. What should the ratio be for respiration during a cardiac massage in adults?

A. 15 : 2
B. 20 : 2
C. 30 : 2
D. 3 : 1
E. 40 : 3

2. What are the criteria of the Glasgow coma scale?

1. **Skin complexion**
2. **Best eye response**
3. **Best motor response**
4. **Best verbal response**
5. **Breathing**

A. All answers are correct.
B. 2, 3, and 4 are correct.
C. 2, 3, 4, and 5 are correct.
D. 3, 4, and 5 are correct.

E. No answer is correct.

3. What are defibrillate rhythms?

A. Cardiac arrest
B. Pulseless ventricular tachycardia, ventricular fibrillation
C. Ventricular fibrillation, cardiac arrest
D. Pulseless ventricular tachycardia, cardiac arrest
E. All rhythms are fundamentally defibrillatable.

References

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Rettungsablauf am Unfallort via miamed.de

Correct answers: 1C, 2B, 3B

Notes