Termination of Cardiopulmonary Resuscitation in Mountain Rescue

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Introduction

Mountain rescuers are regularly confronted with dead persons. In Scotland 57 fatal incidents in 622 emergency missions (fatalities 9%) (Hearns, 2003)

CPR may be potentially dangerous because of exposed terrain and extreme climatic conditions (Paal et al., 2006)

Also, limited medical resources may be directed to those who have a chance of survival (Morrison et al., 2009)

Introduction

In some emergency medical services (EMS) non-physicians may withhold or terminate CPR

(Lockey, 2002; Morrison et al., 2009; Grudzen et al., 2010)

Aim to create decision guidelines for termination of CPR in mountain rescue missions

Materials and Methods

In 2009 ICAR MEDCOM established a working group

Literature search in PubMed

Articles were searched with keywords

"termination cardiopulmonary resuscitation", "primary cardiac arrest survival", "trauma cardiac arrest survival", "hypothermia cardiac arrest survival", "drowning cardiac arrest survival", "avalanche survival", "lightning survival", "electrocution survival", " burns cardiac arrest survival", "poisoning survival", "autoresuscitation", and "resuscitation ethics survival"

In total 3618 hits

Materials and Methods

Relevant articles were hand searched for additional articles and 70 articles were included in this review

Drafts were discussed at the MEDCOM fall meeting 2009 in Zermatt (CH) the spring meeting 2010 in Laterns (A), at the fall meeting 2010 in Stary Smocovec, Slovakia

General aspects

Termination of CPR depends on

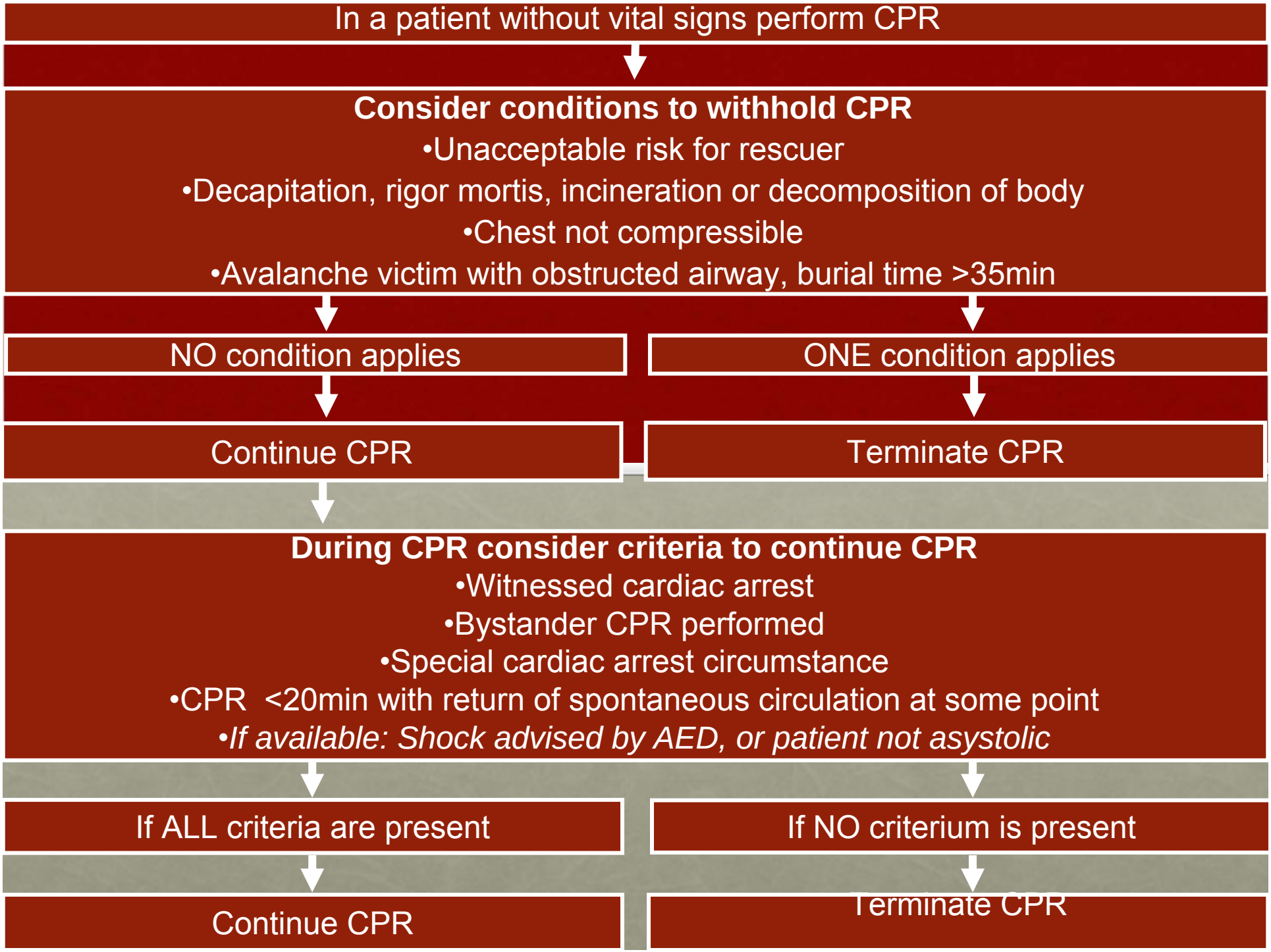
- Regional and national laws and policies
- Do-not-resuscitate orders
- Patient's past medical history and living will
- Cultural and religious context
- Site and mechanism of accident
- Likelihood that CPR will be futile
  (Lockey, 2002; Farber et al., 2006; Rydvall et al., 2007; Rydvall et al., 2008; Grudzen et al., 2010)

General aspects

Death may be defined as the irreversible cessation of vital functions including absence of

- heartbeat
- spontaneous breathing, and
- brain activity

In the field diagnosing death is not that simple
(Morrison et al., 2008; Morrison et al., 2009)


In a patient without vital signs perform CPR
Consider conditions to withhold CPR
•Unacceptable risk for rescuer
•Decapitation, rigor mortis, incineration or decomposition of body
•Chest not compressible
•Avalanche victim with obstructed airway, burial time >35min
NO condition applies
ONE condition applies
Continue CPR
Terminate CPR
During CPR consider criteria to continue CPR
•Witnessed cardiac arrest
•Bystander CPR performed
•Special cardiac arrest circumstance
•CPR <20min with return of spontaneous circulation at some point
•If available: Shock advised by AED, or patient not asystolic
If ALL criteria are present
If NO criterium is present
Continue CPR
Terminate CPR

Special circumstances

- Cardiac arrest in mountains when compared to an urban setting more often is a “cardiac arrest in special circumstances”, requiring modified criteria for termination of CPR

  (Soar et al., 2005)

- In mountain rescue, outcome of CPR may be worse than in an urban area due to limited personnel, equipment, a longer extrication and transportation time

  (Sanders et al., 2008)

Special circumstances

Primary cardiac arrest

About 50% of all fatalities in mountains suffer a sudden cardiac arrest

To improve outcome mountain rescue teams should be equipped with an automated external defibrillator (AED)
(Elsensohn et al., 2006)

Special circumstances

Trauma

In Scottish mountains trauma accounts for ~10% of all fatalities
(Hearns, 2003)

Higher mortality rate when compared to an urban area due to traumatic shock
(Hopson et al., 2003; Sumann et al., 2009)

In traumatic shock, CPR in most cases is unsuccessful; however, a few patients survived CPR when trauma was associated either with hypoxia, hypothermia or electrical injury
(Pickens et al., 2005; Willis et al., 2006)

Special circumstances

Hypothermia

In Scotland isolated hypothermia accounts for 4% of mountain deaths
(Hearns, 2003)

A patient can be considered frozen and CPR can be terminated if the chest is not compressible
(Lloyd, 1996)

Even with several hours of CPR, survival without neurological deficit is possible if patient is sufficiently cold before onset of cardiac arrest
(Lexow, 1991; Walpoth et al., 1997; Gilbert et al., 2000; Ruttmann et al., 2007; Oberhammer et al., 2008)

In the absence of alternate causes of death, all non-frozen, hypothermic patients without vital signs require CPR. CPR should be continued until rewarming >35°C
(Larach, 1995; Soar et al., 2005)

Special circumstances

Drowning

Hypothermia, following cold water immersion is brain-protective, thus survival even after prolonged submersion and CPR is possible
(Harries, 2003)

In many cases drowning may be the result of a primary event, for example malignant arrhythmia, intoxication, seizure, trauma, or stroke
(Modell, 1993; Layon et al., 2009)

Drowned patients that have not started to decompose should receive CPR

Special circumstances

Avalanche

Trauma is the cause of death in up to 25% of avalanche fatalities
(Boyd et al., 2009; Brugger et al., 2009)

With fast cooling hypothermia is brain-protective and survival with good outcome after prolonged cardiac arrest is possible
(Oberhammer et al., 2008; Putzer et al., 2010)

With burial <35min and absence of trauma incompatible with life, victims should be resuscitated

With burial time >35min and absent vital signs only victims with a patent airway require CPR
(Brugger et al., 2001)

Special circumstances

Lightning

In the USA ~100 persons per year die from lightning
(Koumbourlis, 2002)

A victim may have cardiac activity but not breath, thus requiring prolonged rescue breathing
(Zafren et al., 2005)

Burns and trauma may lead to death
(Cooper, 1980; Koumbourlis, 2002; Ritenour et al., 2008)

If asystole persists >20min CPR should be terminated

Special circumstances

Burns

Worldwide, burns related to open flame cooking that is common in many remote mountain communities, are responsible for over three hundred thousand deaths annually
(WHO, 2002)

Inhalational injuries dramatically increase mortality
(Belgian-Outcome-in-Burn-Injury-Study-Group, 2009)

If the patient is not incinerated CPR for 20min should be attempted
(Jeschke et al., 2000)

Special circumstances

Poisoning

Poisoning in the mountains may result from carbon monoxide, plant ingestion or envenomation
(Boyd et al. 2007)

Self-protection of the rescuer

Be prepared to perform CPR for a prolonged period, especially in young patients a toxin may be metabolized during CPR. Consider consulting with a poison control centre before discontinuing CPR
(Durward et al., 2003)

Special circumstances

Pediatric emergencies

When exposed to hypothermia, children cool faster than adults, thus brain-protective hypothermia develops earlier than in adults

Children may metabolize up to five times more oxygen per kilogram bodyweight, this may lead to a worse outcome after CPR when compared to adults

Relevant conditions for continuing CPR in children include causes of cardiac arrest such as ice water drowning and hypothermia
(Soar et al., 2005)

Special circumstances

Delayed assessmet and transport scenarios

Assessing a victim on site may be too dangerous, thus evacuation first and assessment of a victim in a second step may be prudent
(Samuel, 2008)

Declaring a victim dead on site too early may be lead to a false death declaration
(Herff et al., 2010)

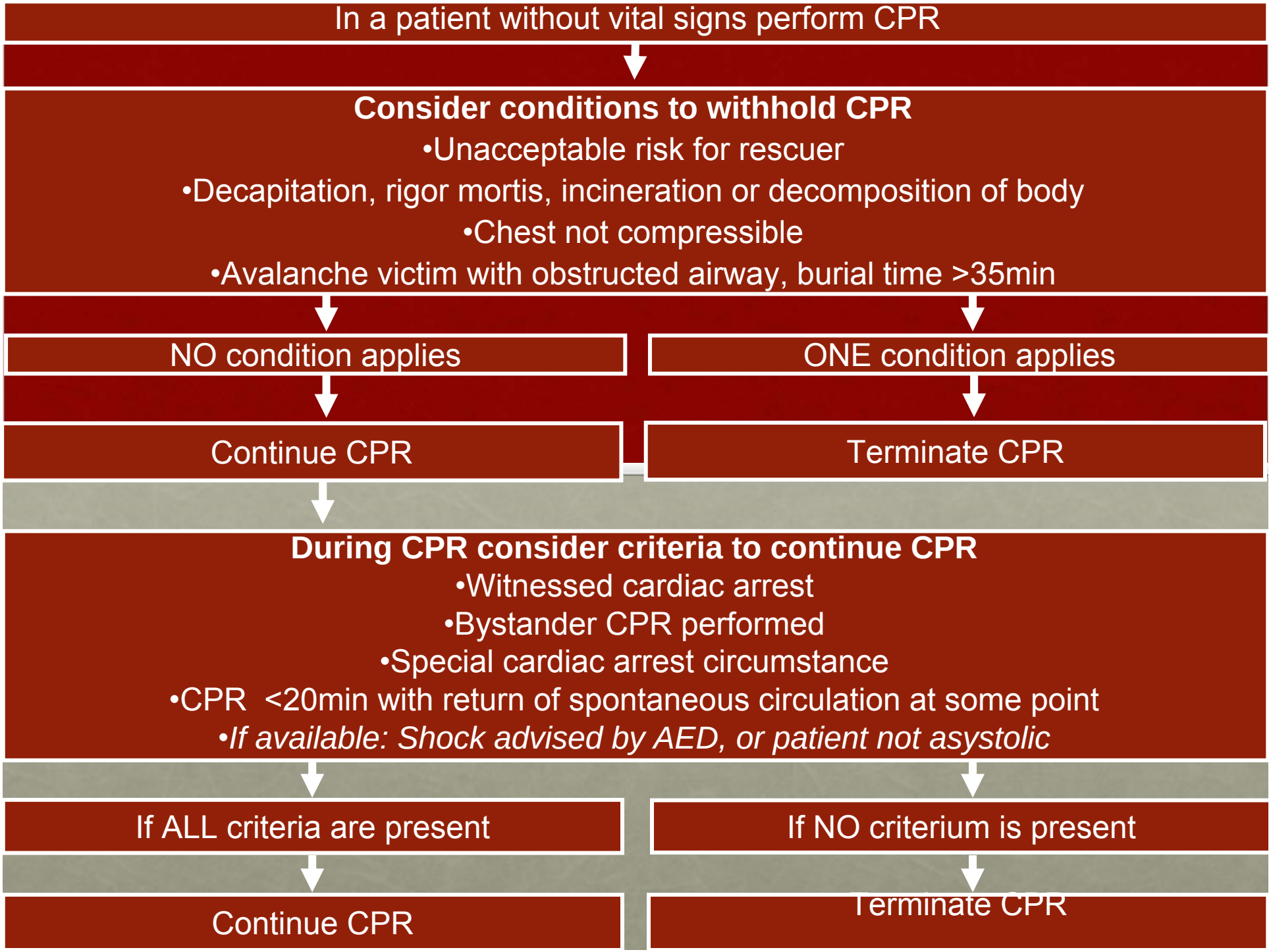
If the risk of performing CPR is acceptable and a rescuer is in doubt about the outcome, CPR should be performed continuously until arrival to an appropriate hospital

Mechanical chest compression devices may improve CPR outcome in long and difficult evacuations
(Larsen et al., 2010)

Special circumstances

Legal issues

Medical directors of mountain rescue teams should interpret these guidelines on termination of CPR in the context of local conditions and national laws and create team specific training and guidelines
(Bailey et al., 2000; Richman et al., 2008; Stratton et al., 2008; Morrison et al., 2009; Ruygrok et al., 2009)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Thank you for your attention