Creating a Universal Drowning Chain of Survival

Needs and Evaluation

Panel Discussion and Brainstorming Session – 120 minutes

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Session Coordinator(Chairman): Dr Steve Beerman

Drowning involves characteristics rare in other medical situations

- ✓ Drowning is primarily *environmental* in nature with few co-genetic or hereditary factors. This offers greater potential for *prevention* than other diseases/medical conditions.
- ✓ Drownings often occur in unexpectedly hostile environments that may not seem dangerous to laypersons. Removing victims often pose major risks to the rescuers.
- ✓ The impact of drowning increases exponentially during the first minutes and can end in death if a person is not removed from the water environment quickly so that basic life support can be given.
- ✓ Drowning requires some unique first aid care (e.g., ABC, not CAB)

Original drowning chain of survival – 2002

Created at World Congress on Drowning, 2002 – Netherlands

✓Prevention education/first aid for drowning is unique

✓Differences usually not taught in regular first aid/CPR classes

✓Differences are specific to aquatics and essential knowledge for all persons living, playing , or working near or around the water. (Szpilman, 2007; Deakin, 2012)

✓Need for unique water safety course was not new in 2002 although no international group of drowning experts had studied it before the 2002.

✓ This meeting resulted in first drowning chain plus Basic Water Life Support (BWLS) program (Hand Book of Drowning) (Bierens, 2006).

Original Drowning Chain of Survival – 2002

For use in first aid courses for the aquatic environment

The original (2002) chain was composed of icons that formed 6 links of a "survival chain"

Link 1 – Water safety public education and preventative measures and actions,
Link 2 - How to recognize an incident in the water, the needed actions after recognition and how to alert professional rescuers, dispatch centers and the Emergency Medical Services.
Link 3 - Rescue techniques and in-water ventilation - knowledge of how to use simple reaching or extension rescue techniques to save a life without becoming an extra victim. For some well-trained professionals with a duty to care, use of flotation equipment along with in-water ventilation and advanced rescues techniques should be included.
Link 4 - On-land basic life support for drowning - includes resuscitation for drowning using ABC sequence and some equipment used by lifeguards/lifesavers.
Link 5 - Pre-hospital advanced life support for drowning – includes specifics of drowning care and resuscitation (when to start and stop CPR, severity levels and prognosis, oxygen use, manual defibrillator, cardiac monitoring, medications)
Link 6 - Hospital advanced life support for drowning – Same as link 5 but performed within emergency medicine hospital scenario.
(Szpilman D, Morizot-Leite L, Vries W, Scarr J, Beerman S, Martinhos F, Smoris L, Lofgren B; First aid courses for the aquatic environment; Hand book of drowning - Nehterland - 2006.)

Our goal for this session is

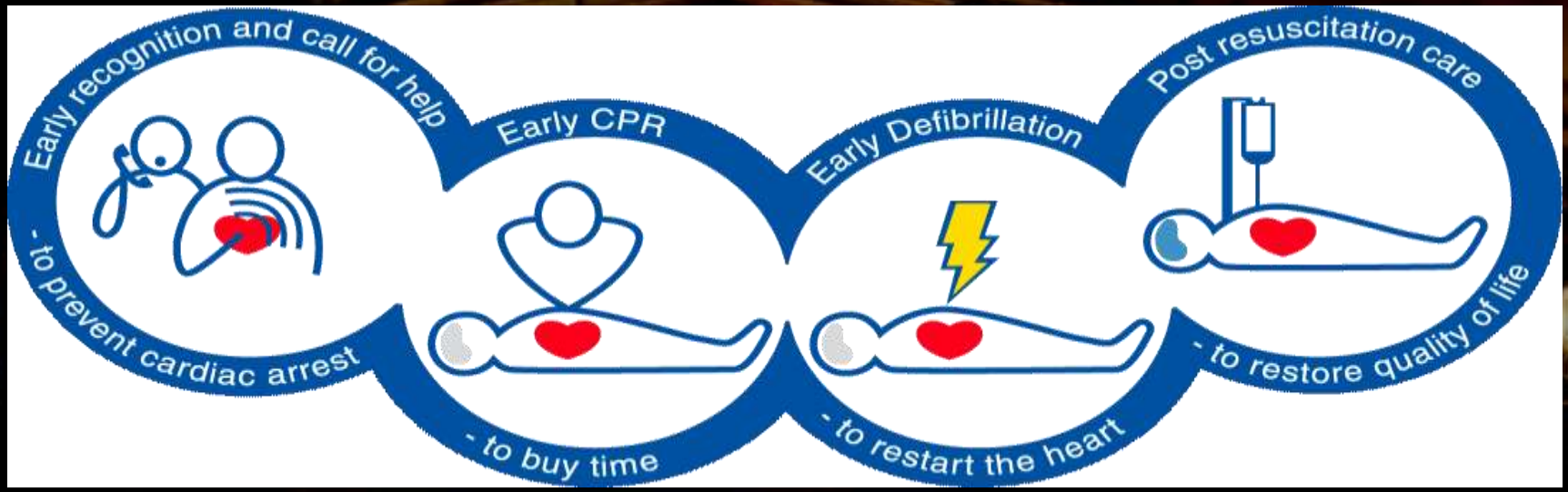
To examine the conceptual, practical, and educational value of a chain of survival for prevention and response of drowning

Proposed Method and Procedures

- ✓ Review concepts and models associated with existing chains of survival
- ✓ Present an updated proposal
- ✓ Discuss and debate pros and cons at this session

Existing Chains of Survival

European Resuscitation Council



Application "Haddon matrix" to Drowning Chain of Survival

A public health academic approach to injury prevention

	Host	Agent	Environment
Pre – event	Alcohol Use, Education, Enforcing Laws Risk –taking behavior, Medications, Cognitive function,	Technology of safety measures – Brake systems, air bags, tether systems, tire quality, Load weight, Ergonomic controls, Center of gravity, Speed capability	Visibility of hazards, Road condition, Weather, Speed limits, Intersections, Coefficient friction, Signalization Drunk driving laws
Event	Seatbelt use Age, Sex, Bone Density, Stature	Speed of impact, Direction of impact, Vehicle size, Automatic restraints, Airbag, Whiplash lessening seats and head rests,	Speed limits of traffic, Recovery areas, Guard rails, Characteristics of fixed objects, Median barriers, Roadside embankments
Post - event	Age, Sex, Medications, Preexisting medical and physical conditions, Social situation	Non collapsible vehicles, Accessibility to evacuate, Alert systems,	911 access, EMS response, Location & quality of ED, Access to definitive care, Access to rehabilitation care

Proposed Drowning Chains of Survival

My Thoughts…

We need a "Call to Action"

1. Wear a lifejacket & check conditions: *To prevent drowning*
2. Recognise drowning: *Victims may not call/wave for help*
3. Call for help: *To activate the rescue services*
4. Provide flotation: *To interrupt the drowning process*
5. Remove from water: *Attempt rescue with flotation only*
6. If not breathing, start CPR: *Continue until ambulance arrives*

RESULTS

Proposed Drowning Chain of Survival to Discuss in this Session

Link colors: Pre-event, event and post-event (Haddon Matrix)

To Whom Is the Chain Addressed?

- ✓ Aquatic Professionals (e.g., lifeguards, instructors, coaches)
- ✓ First Responders who come in contact with the water (e.g., fire fighters, police, military)
- ✓ Persons who work on or around water (e.g., fishers, boaters)
- ✓ **Especially any lay person who may encounter aquatic settings**

PREVENTION
Be safe in & around the water

RATIONALE

85% of drownings may be prevented (estimation). (Quan, 2007; Moran, 2011)

Using adequate supervision, swimming instruction, water safety education and awareness, availability of water safety equipment including life jackets, CPR training, presence of lifeguards, and appropriate water safety legislation and regulations.

ACTION (major)

1. Stay within arm's reach of children who do not know how to swim when in or near the water
2. Swim in water safe areas where there lifeguards
3. Fence pools and spas with 4-sided fencing
4. Always use a lifejacket for children, boaters and inexperienced swimmers.
5. Learn how to swim and water-safety survival skills.

When preventative measures have failed…

RECOGNIZE DISTRESS
Call for help

RATIONALE

The first challenge is to recognize anyone in the water who may be at risk of drowning and appreciate how to activate the lifeguard and emergency medical system (EMS)

ACTIONS

1. Drowning victims display recognizable signs that need to be communicated
2. Recognize that victims may not wave or call for help
3. Tell someone to call for help while staying to help
4. Ask bystanders to assist in keeping an eye on the victim.

PROVIDE FLOTATION
To prevent submersion

RATIONALE

It is critical that lay persons take precautions not to become another victim by engaging in inappropriate or dangerous rescue responses (Venema, 2010; Orlowski, 2001).

ACTIONS

While helping others…

1. Try to stay out of the water so victim cannot drown you.

2. Use a long pole or stick to reach the victim.

For your self

3. If you are drowning, don´t panic,

4. Wave for help as soon as possible and float.

REMOVE FROM WATER
Only if safe to do so

RATIONALE

- ✓ To reduced further aspiration and allow better prognostic (Szpilman, 2004),
- ✓ To allow providing care at a dry place

ACTIONS

1. Try to remove the victim without entering the water
2. Assist victim getting out by giving them directions for getting out of the water
3. If safe for your self, rescue the victim using any flotation gear

PROVIDING CARE AS NEEDED
Seek Medical attention

RATIONALE

✓ Early basic life-support improves outcomes
✓ Early advanced life-support also improves outcomes
✓ Differences from other diseases need to be informed: For example, in-water ventilation, ABC vs. CAB, improved resuscitation change, number of first ventilations, position to transport and positioning to first evaluation, likelihood of vomit and complications , less frequent cervical spine injuries than other trauma, and need for AED is less important (Baker, 2011; Kitamura, 2010; European Resuscitation Council, ✓2010; Grmec, 2009; Szpilman, 1997, 2004; Orlowski, 2001)

ACTIONS

1. If not breathing, start CPR with ventilation immediately.
2. If breathing, stay with victim until emergency services arrives.
3. Seek medical aid/hospital, if any symptoms are present.

Education version

DROWNING

Chain of Survival - A call for action

1. Stay within arm's reach of children who do not know how to swim when in or near the water
2. Swim in water safe areas where there lifeguards
3. Fence pools and spas with 4-sided fencing
4. Always use a lifejacket for children, boaters and inexperienced swimmers.
5. Learn how to swim and water-safety survival skills.

While helping others
1. Victim may not wave or call for help (is in distress if unable to move through the water or stays in a vertical position).
2. Tell someone to call for help.
3. Stop drowning - provide any flotation.
4. Try to stay out of the water so victim cannot drown you.
5. Use a long pole or stick to reach the victim.
6. If able to do safely, remove victim from water using any flotation device.

For your help
7. If you are drowning, don´t panic, wave for help as soon as possible and float.

1. If not breathing, start CPR with ventilation immediately.
2. If breathing, stay with victim until emergency services arrives.
3. Seek medical aid/hospital, if any symptoms.

Conclusion with questions

1. Do drowning links achieve these goals or need to include/exclude any?
2. Have we targeted all key audiences with proposed links?
3. Is the image/icon for each link the most representative?
4. Any comment on rationale/actions?

The major challenging question:

Is the drowning chain…

A CALL TO EDUCATE HOW TO ACT?

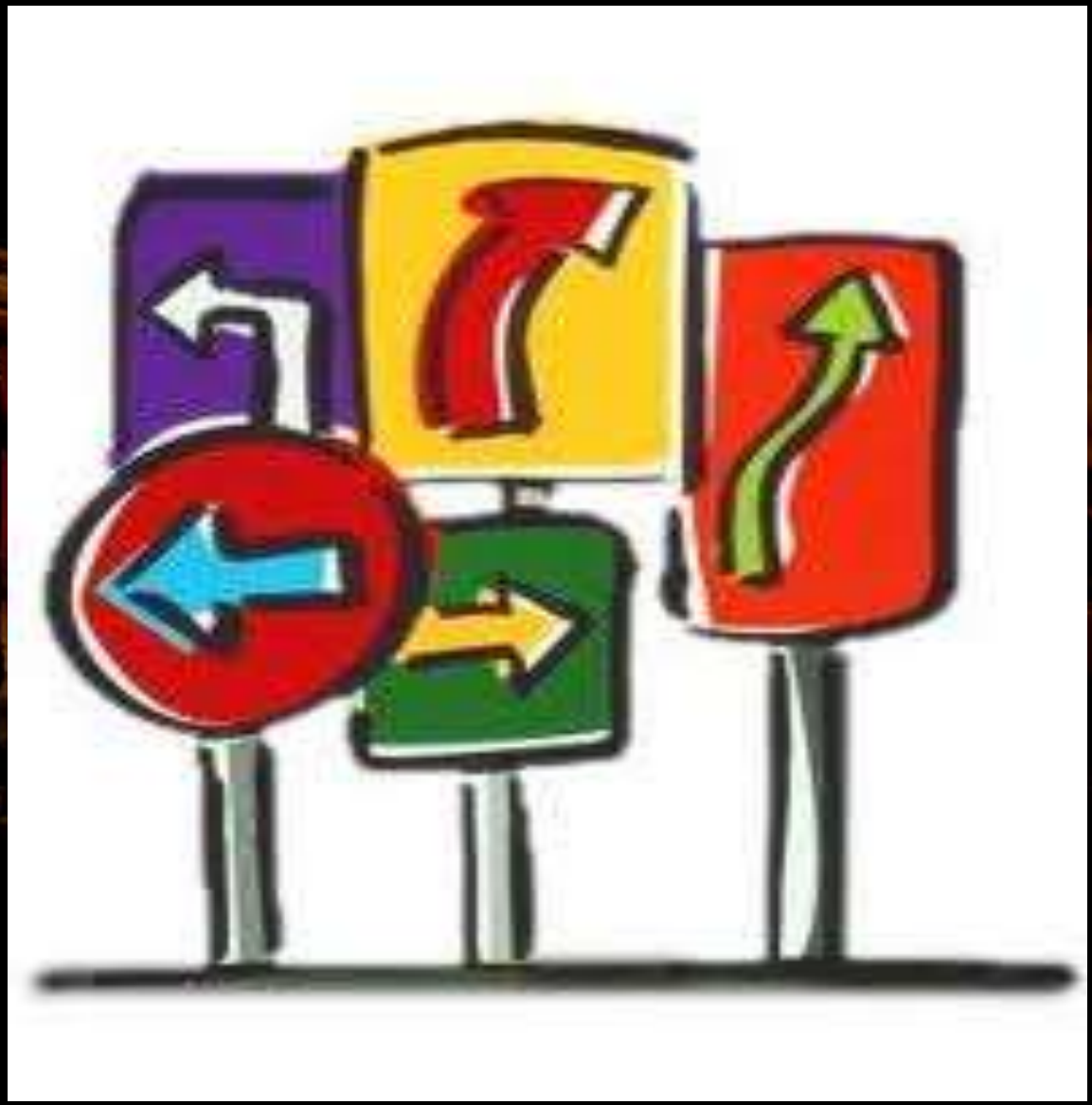
OR

A CALL TO ACTION?

BOTH?

Drowning Chain of Survival

Where to go?



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The Science of Drowning Prevention: Circle of Drowning Prevention

Supervision

75-88% of pediatric drownings occur when supervision is absent or lapsed (WA state, China, Singapore)

Poor /absent supervision increased

- risk of drowning death in 5-14 yo (OR 1.9; 95% CI 1.3 to 5.6) (Yang, 2007, China)
- a higher level of care (HD and ICU) (OR 3.4, RR 1.28 95%CI 1-1.7).(Oh, 2010, Singapore)

What is adequate supervision?

- Close, arm's reach if non-swimmer (Saluja)
- Attentive/Impaired
  - Distracted
  - Old(grandparents) or young child
  - Alcohol or other drug use

Life guards

Control Patrons' behaviors; prevent risk taking

Recognize a drowning in progress

Perform rescue

Start CPR

Efficacy:

USLA estimates risk of drowning death is 1/18 million visits

Seattle lifeguarded beaches: No drowning deaths for 10 years

Barriers/ Pool Fencing

- Highest incidence of drowning is in <5 years old who fall into the pool
- Fencing must include:
  - Four sided fencing
  - Self-latching, self-closing gate

Efficacy

- Decrease drowning deaths by 50% (Australia, US)
- Need Enforcement of laws

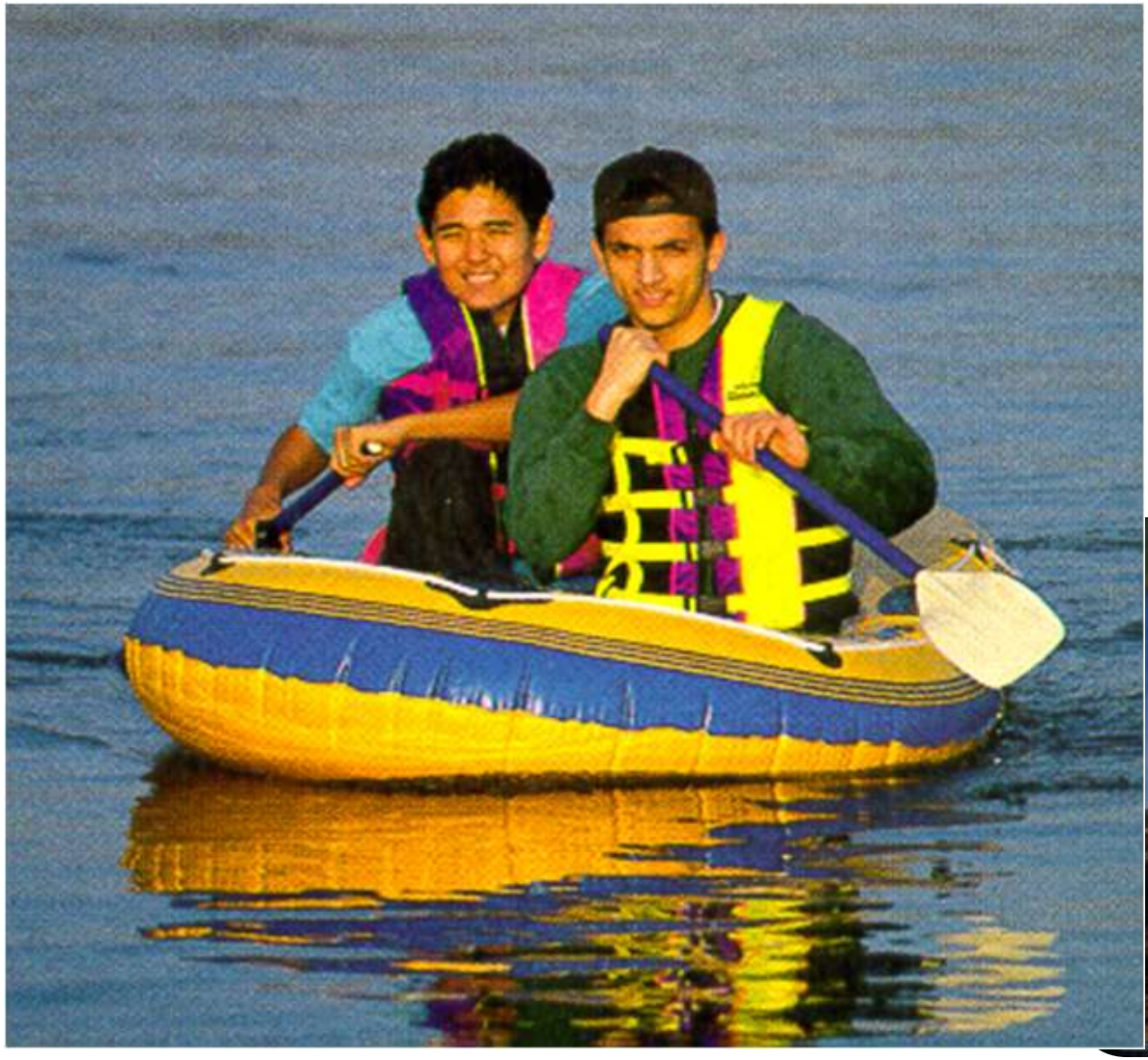
Life Jackets (PFDs)

- Must be USCG approved
- Must be worn
- Must fit
- Must be secured

Efficacy:

- Decrease drowning death risk in boats by 50% (Cummings 2009 USA)
- Decrease drowning death risk in boating accidents by 40% (Stempski USA)
- Decrease drowning risk in < 5 yo (Yang 2007 China)

Need: Increase Life jackets wear for On and Near Water



Swimming Lessons

Decreased drowning deaths in < 5 years old children

- No swim lessons increased likelihood of death RR=2.3 (1.4 to 4.5) Yang 2007- China
- Any swim lessons decreased likelihood by 50% (Brenner 2010- USA)
- We do not know the impact in older children?

What are the components of Water Competency?

1. Entry – with total submersion
2. Recovery to the surface and remain there for at least one minute (floating or treading)
3. Orientation – position to be able turn 360 degrees and orient to the exit
4. Propulsion – level off and move on front and/or on back position for at least 25 yards
5. Exit from the water

Water competency…

- …is influenced by conditions of the aquatic environment (water temperature, movement, depth, clothing, distance, etc.) into which the person may be introduced.
- …may not transfer from one aquatic environment to another.

American Red Cross Guideline

American Red Cross

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Recognize Swimmer in Distress

Instinctive Drowning Response

- Frank Pia – *On Drowning*
  - First film evidence of drowning – 1960s/1970s
  - Hypothesized “instinctive drowning response”
  - Contradicted prevailing notions that
    - most victims struggle at the water surface,
    - they can call for help, or
    - they actively attack rescuers
  - Recognized victims’ primitive movement patterns
  - Single-minded attempt to get air

Aquatic Readiness Assessment (ARA)

Langendorfer & Bruya (1995) (Langendorfer, Roberts, & Ropka, 1987) identified key developmental components of aquatic readiness and water competency that included

- **Body position** – from vertical to horizontal
- **Arm actions** – from ineffective to effective
- **Leg actions** – from ineffective to effective
- **Combined actions** – little/no progress to efficient forward progress

Drowning Prevention Components

Body Position component

- Step 1 - vertical position (trunk 90^{o} – 45^{o} from horizontal
- Step 2 – inclined position (trunk 44^{o} to 20^{o} from horizontal)
- Step 3 – level position (trunk 19o - 10o from horizontal)
- Step 4 – horizontal position (trunk <10o from horizontal)

Arm propulsion component

- Step 1 – no arm action – arms not used effectively in propulsion
- Step 2 – short downward push – hand and arm push downward rapidly with little or no backward pull
- Step 3 – long push-pull paddle – initial downward push followed by long back
- Step 4 – lift propulsion – “S” pull with catch and acceleration

Drowning Prevention (*cont.*)

Leg action component

- Step 1 – *no effective leg action*
- Step 2 – *plantar push* "bicycling" motion
- Step 3 – *rudimentary flutter* – excessive flexion at hips and knees with little or not effective propulsion
- Step 4 – *bent-knee flutter* – action from knee flex-extend
- Step 5 – *straight leg flutter* – action initiated from hip; minimal knee flexion

Combined action component

- Step 1 – *no effective locomotion*
- Step 2 – *dog paddle*
- Step 3 – *beginner or human stroke* – lengthened arm action, level position, bent knee flutter
- Step 4 – *rudimentary crawl* – overwater recovery
- Step 5 – *advanced crawl or other recognizable stroke*

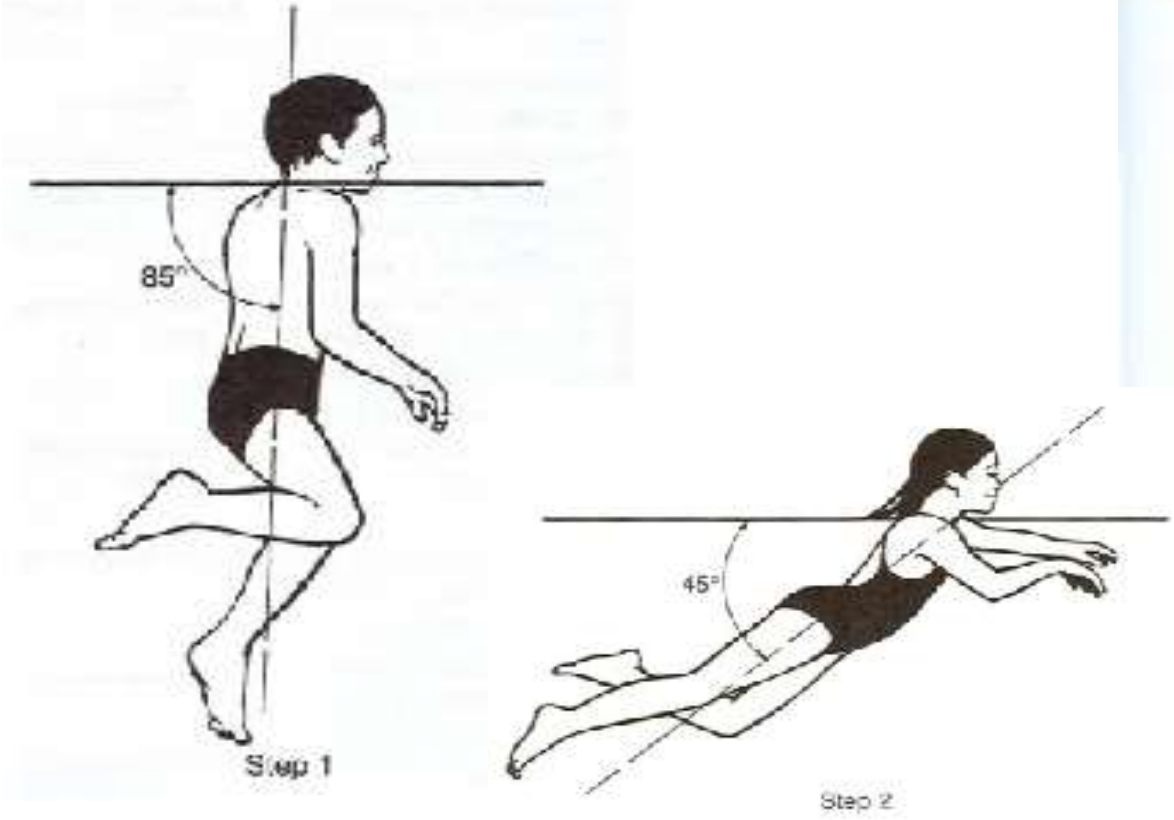
Drowning Risk Assessment (DRA)

Using the developmental principle of *regressive change*, Langendorfer (2010) identified recognizable elements of a person at *high risk of drowning* to include

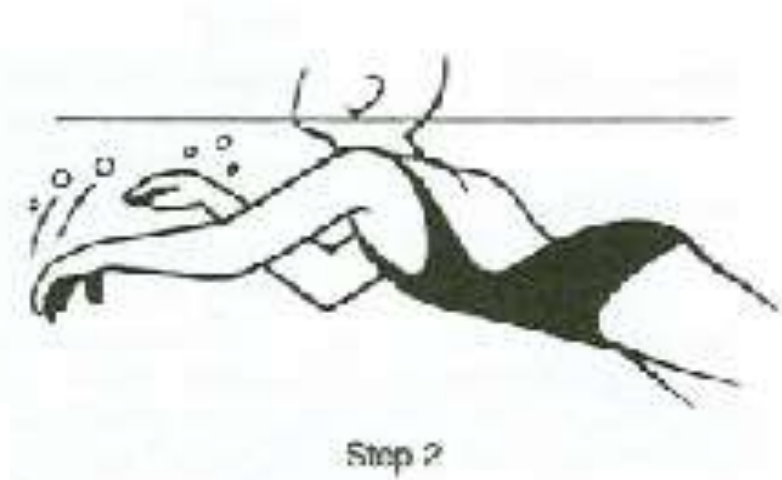
- *Near vertical body position*
- *Ineffective downward arm movements*
- *Ineffective pedaling or kicking leg actions*
- *Little or no forward progress in movement*

High Drowning Risk

Vertical/near vertical position

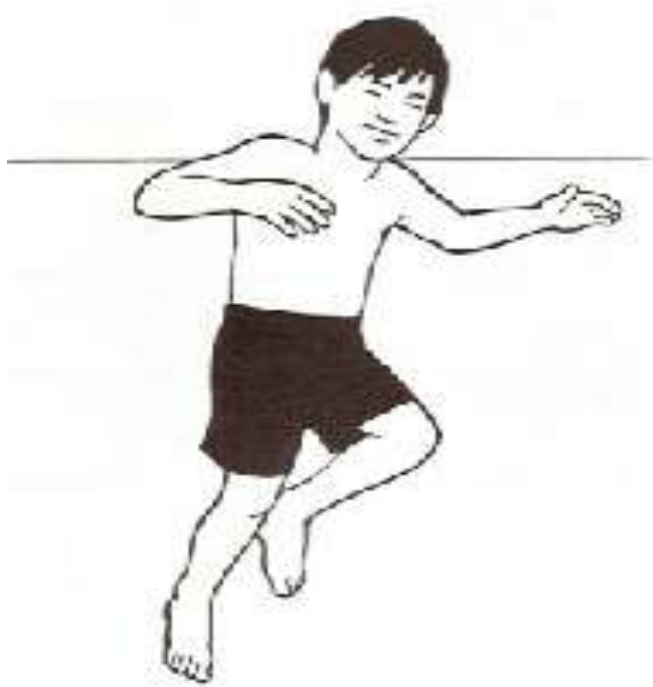


Ineffective arm action



High Drowning Risk (*cont.*)

Ineffective leg action



Step 1

Inefficient progress in water

Step 2

Failure to Recognize

- Too many lifeguarding programs fail to adequately train lifeguard observation skills
- Lack of recognition of at-risk drowning behavior
- Lanagan-Leitzel (2011, 2012) demonstrated that
  - trained lifeguards and lifeguard instructors were unable to identify drowning victims in video scenarios.
  - Untrained persons were equally likely to identify as lifeguards.
- Better observation training of lifeguards needed
- Laypersons need to know drowning risk signs

Call for Help

- Key element in the drowning response chain is activating the Emergency Management System immediately upon recognizing a person in distress
- Delay in activating EMS increases the risk of fatal drowning
- Lifeguards and laypersons need to recognize need to immediately activate EMS

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Provide Flotation

To prevent submersion

- The **strategic goal** in drowning always has, and always will be to remove the victim from the water
- The tactical goal in drowning, however, is to **interrupt the drowning process** and prevent submersion
- Most rescuers tend to focus on the **strategic goal**
- Victims can go from the instinctive drowning response (critical) to low/moderate distress **as soon as flotation is provided**

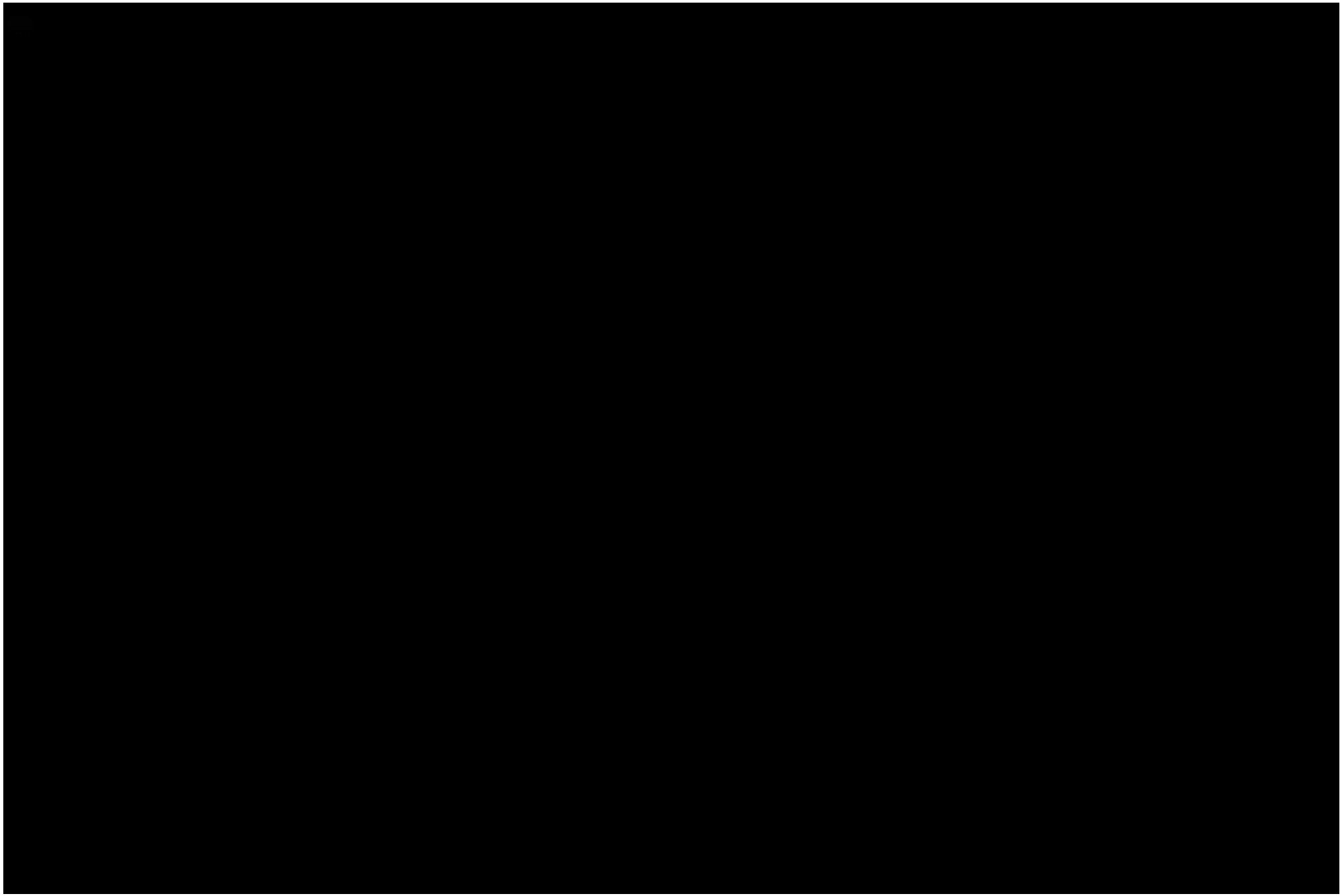
Buoyancy Support

An interim measure

- Should be considered a **first-line** intervention for lay rescuers, and a back-up/concurrent strategy for professional rescuers
- In addition to preventing submersion, **buys valuable time** to plan the rescue and/or allow emergency services time to arrive
- Flotation aids can be made from **improvised materials**
- Is closely linked to the next link in the chain (as the flotation can be **used by the rescuer** if they get into difficulty, or to facilitate a safe rescue)

Buoyancy Support

Examples:



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Removing a Drowning Victim from the Water

Should we discourage the lay person from entering the water to rescue someone?

To enter the water is a personal decision

Several Factors Influence a Lay Person's decision to enter the water to provide help

- Relationship with victim
- Depth of water / distance to victim
- Swimming and rescue skill of lay responder
- Level of dangerous associate with the rescue
- The consequence of not providing immediate aid to the victim
- Others

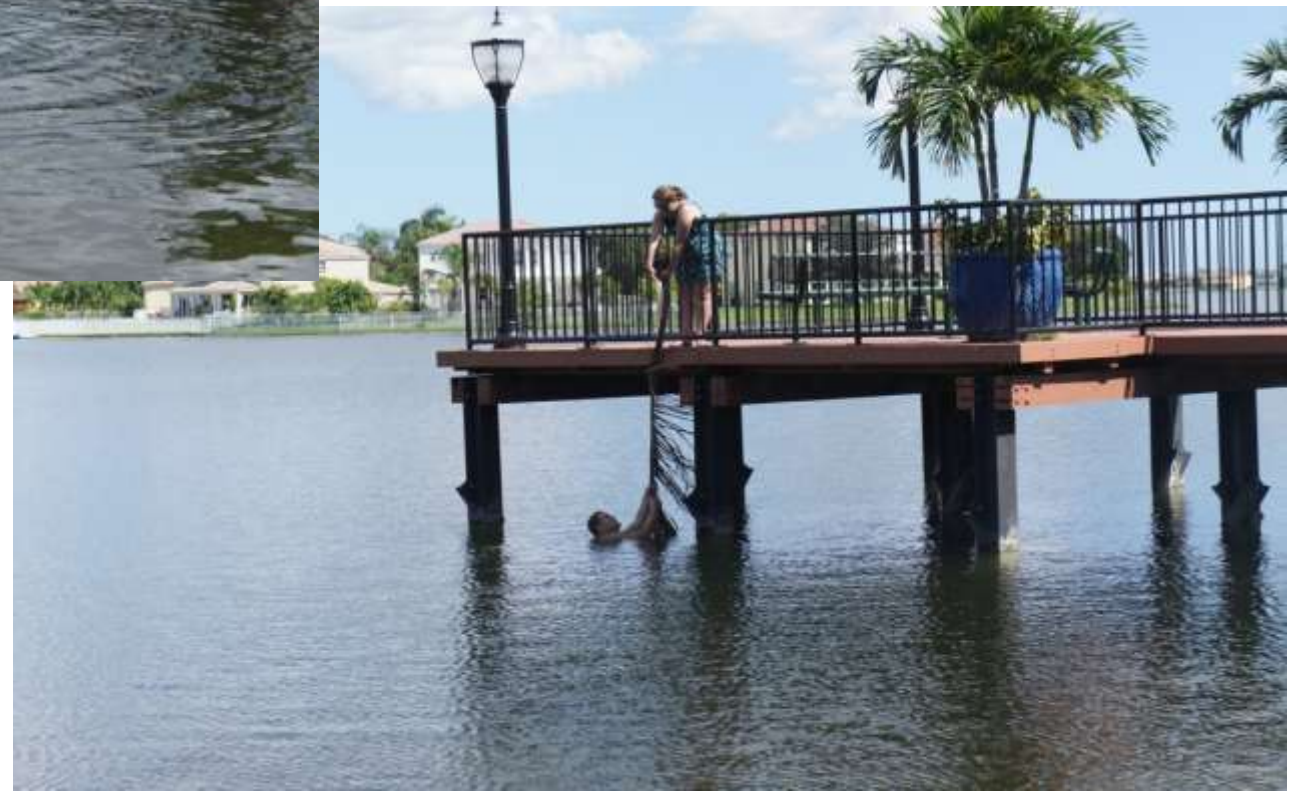
We can’t prohibit a mother from trying to rescue her child, but we can recommend a safe approach.

Ring Buoys

Shepherd's Crooks

Reaching with a pole (+ wading)

Reach with a tree branch



When unsafe, leave it for the professionals

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Provide care as needed

2006

2013

1. If not breathing, start CPR with ventilation immediately.
2. If breathing, stay with victim until emergency services arrives.
3. Seek medical aid/hospital, if any symptoms are present.

Provide care as needed

Who needs medical care?

Resuscitation: ABC vs CAB vs CCO-CPR

Provide care as needed

Who needs medical care?

Resuscitation: ABC vs CAB vs CCO-CPR

Who needs care?

Any person who lost consciousness

Any person who required rescue breathing

Any person who required CPR

When a serious medical condition is suspected

International Life Saving Federation Medical Position Statements 06.

Provide care as needed

Who needs medical care?

Resuscitation: ABC vs CAB vs CCO-CPR

Resuscitation - ABC

If not breathing, start CPR with ventilation

CCO-CPR (Hands-only) NOT for drowning

ABC-CPR (CAB-CPR) for drowning

Resuscitation - ABC

Drowning

Drowning is a preventable cause of death for more than 3500 Americans annually.[266] Over the last 25 years, the incidence of fatal drowning has declined significantly from 3.8 deaths per 100 000 population in 1970 to 1.2 in 2006.[266] The duration and severity of hypoxia sustained as a result of drowning is the single most important determinant of outcome.[267,268] Rescuers should provide CPR, particularly rescue breathing, as soon as an unresponsive submersion victim is removed from the water (Class I, LOE C). When rescuing a drowning victim of any age, it is reasonable for the lone healthcare provider to give 5 cycles (about 2 minutes) of CPR before leaving the victim to activate the EMS system.

Circulation 2010;122[supp 3]: S295

The same modifications of 5 initial breaths and 1 min of CPR by the lone rescuer before getting help, may improve outcome for victims of drowning. This modification should be taught only to those who have a specific duty of care to potential drowning victims (e.g. lifeguards). Drowning is easily identified. It can be difficult, on the other hand, for a layperson to determine whether cardiorespiratory arrest is a direct result of trauma or intoxication. These victims should, therefore, be managed according to the standard BLS protocols.

Resuscitation 2010;81:1288

American Heart Association®
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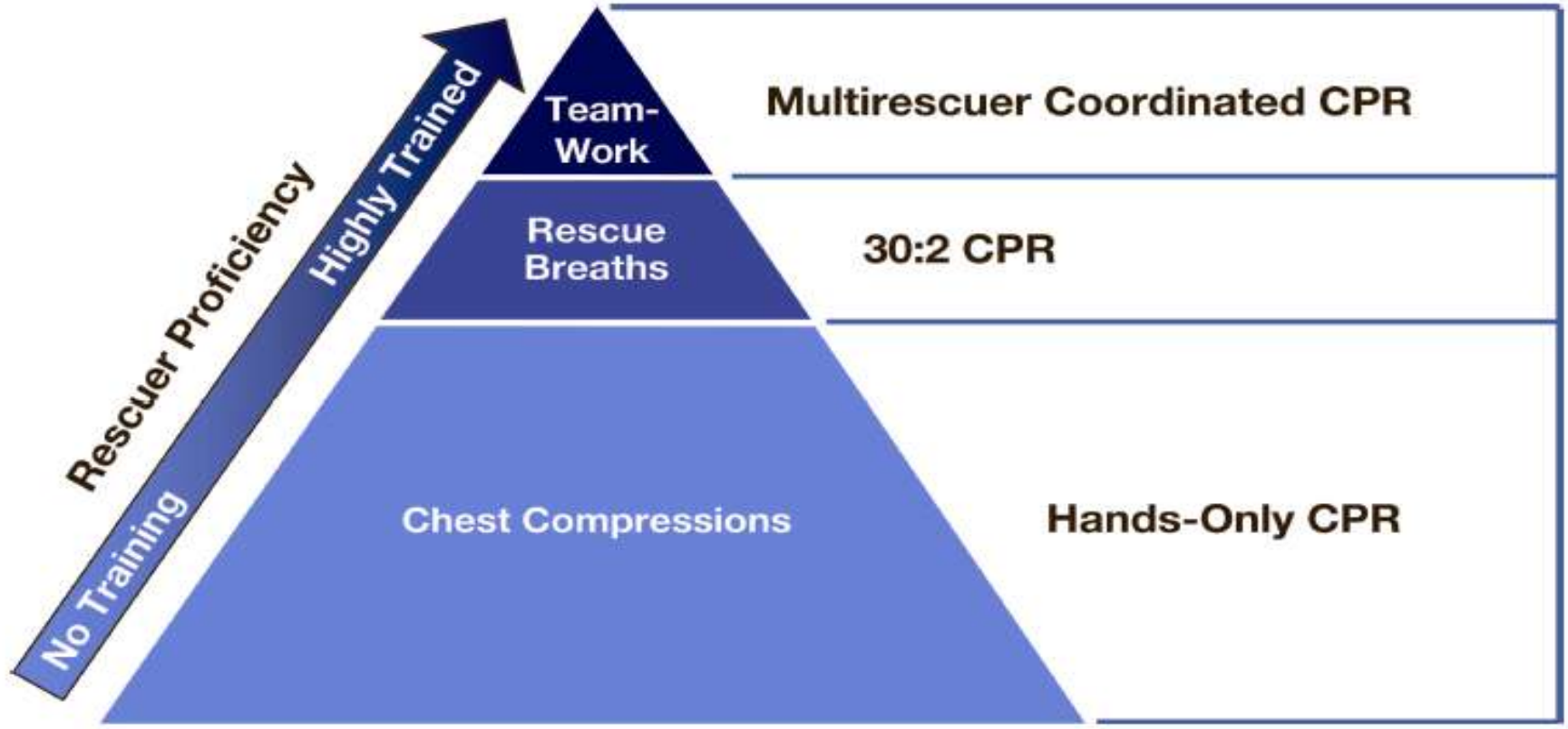
EUROPEAN RESUSCITATION COUNCIL

Resuscitation - ABC



Circulation 2010;122[supp 3]: S678

1. If not breathing, start CPR with ventilation immediately.
2. If breathing, stay with victim until emergency services arrives.
3. Seek medical aid/hospital, if any symptoms are present.

Part 2 – Brainstorming Session - 30 min session

1. What are the important goal(s) of the drowning chain of survival?
2. Do proposed drowning links achieve these goals or do some need to be included/excluded/separated or expanded?
3. Are the proposed links addressing all key audiences?
4. Is the image/icon for each link the most helpful, clear and representative?
5. Any comment on subtitles text explanation of the education chain? (see full version

Part 3 – Conclusion - 35 min session

1. A summary report by the head/co-author of all the relevant ideas that arose for each group (maximum 5 min per group).
2. Identify alternative ideas and unresolved issues.
3. Feasibility to propose a final version to be further evaluated and tested for compliance with international