1 Death 3 Mechanisms

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The Question: Defining Death

1. Viability – when can we resuscitate? Where do we focus our resuscitation?
2. Non-viability – when do we stop resuscitating?
3. Sanctity and Dignity of life – and of course the Dead Donor Rule
4. (Legal) definition of life and the agency of a person
Scope in the Concept of Death

• History and cultural diversity of this concept
• Modern moral blurring
• Local popular lack of clarity
• Professionalism and public trust
Const. Andrew Rosbrook was dead for seven minutes. He remembers nothing. No white light, no pearly gates.

He cannot remember the last five kilometres of his run before collapsing. He recalls waking up in the ambulance briefly and telling paramedics he was a police officer before blacking out again. His first name on his runner’s bib and his job was enough for officials to locate his wife who was waiting at the finish line of the Toronto Marathon’s half-marathon event in May.

“The first question I asked: was I still able to get married?” he says. “The second question: will I be able to run again? And the answer to both was ‘Yes.’”
Andrew Rosbrook is a dead man running and he hopes to keep it that way.

On Monday, the 48-year-old Toronto Police constable finished a 470-kilometre run from Ottawa to Toronto to raise awareness for the Mikey defibrillator device, which brought him back from the dead last year.
After an anxious weekend spent watching her come back to life, doctors in Edmonton now think a 13-month-old girl found frozen outside does not have brain damage. But they won't know for several weeks if severe frostbite will force them to amputate limbs. The child remains in serious but stable condition.

"I think to be fair I'm using the miracle word now," said Dr. Allan De Caen, a pediatric intensive care specialist at Edmonton's Stollery Children's Hospital. "It's not as if she's not going to have things that have to be dealt with and problems down the road, but this is an outcome we were all praying for and I think we've got it," he told a news conference on Sunday.

Girl wandered outside
The child, whose name has not been released, slipped into the backyard alone wearing only a diaper sometime late Friday night or early Saturday morning. It was 20 C. She ended up collapsing on the snow-covered lawn before being found by distraught family and friends.

The mother, who had been sleeping with the girl and a two-year-old sister in a bed at a friend's house, woke up and noticed the youngest child missing. It took about 45 minutes to find the toddler's body.
She was clinically dead, with no pulse and her toes frozen together. Her internal body temperature was 16 C, less than half of the body's normal level of 37 C. Very few children have ever survived under those conditions, according to physicians. Paramedics failed to revive her on the way to the hospital. It took a team of doctors and nurses about 90 minutes to get the child's heart beating again. Saturday night, physicians said the girl was very lucky to be alive. But as her body slowly warmed, they were concerned about possible swelling around the brain. There was also worry over the risk of infection.
Don’t Know

‘Benefit of the Doubt’

is Alive  Don’t Know  has Died

Not the point of death. The time on the certificate.
Resuscitation Science

is Alive

= is viable

Don’t Know

has Died
Don’t Know
Science of criteria of “has died”
Summary so far

• We don’t really know when people die
• The question may not be a productive one
• Resuscitation Science includes the question:
  – What are the characteristics of someone who can be resuscitated
  – What are the characteristics of someone who cannot be resuscitated
• ‘Time of death’ should likely read the (first) time we can say the person had died; or is dead.
Science of criteria of “has died”

• Criteria do not include:
  – Ability to gestate
  – Respond to infection
  – Grow
Complexity Theory

- Non-linear, dynamic network, feedback loops
- Emergence phenomena
Researchers at Ohio State University (OSU) have grown a nearly complete human brain equivalent in size and structure to that of a five-week-old fetus. It was bioengineered using adult human skin cells and is the brain model yet created.

Human 'mini brains' grown in labs may help solve cancer, autism, Alzheimer's...
Complexity Theory

• Non-linear, dynamic network, feedback loops
• Emergence phenomena
• Alive occurs as an emergent phenomenon
• No longer alive is the loss of that phenomenon
Science of determining the state of “has died”

Defined as:
• Permanent loss of capacity for consciousness and all brainstem functions

Which in turn is inferred by criteria including
• Cessation of consciousness and brainstem function and the permanent cessation of intracranial circulation
• Cessation of consciousness and brainstem function and the permanent loss of capacity for its return (brainstem resuscitation)
Science of determining the state of “has died”

• Functional criteria versus anatomic or static criteria
International guideline development for the determination of death
Death is the permanent loss of capacity for consciousness and all brainstem functions. This may result from permanent cessation of circulation or catastrophic brain injury. In the context of death determination, ‘permanent’ refers to loss of function that cannot resume spontaneously and will not be restored through intervention [22].
Catastrophic Brain Injury (CBI)

Mechanical ventilation (may occur prior to CBI) and neuro-protective interventions

N-1
Continuing deterioration and progressive loss of brain function despite intervention

N-2
Cessation of brain function

N-3
Cessation of brain function with no possibility to resume

Catastrophic brain injury with consideration for withdrawal of life sustaining therapies

Biological events after death

Fig. 1 Neurological sequence in the dying process
A. Cardiorespiratory arrest without CPR
   (end-of-life care / withdrawal / withholding of life sustaining therapies)

B. Cardiorespiratory arrest following termination of CPR
   (hypoxic or primary cardiac arrest)

C-1
Cessation of circulation and breathing

If CPR provided, resumption of circulation theoretically possible

C-2
Cessation of circulation and breathing with no possibility to resume spontaneously

C-3
Cessation of circulation and breathing with no possibility to resume

Biological events after death
Circulatory Arrest Leading to Death

N-2
Cessation of brain function

C-1
Cessation of circulation and breathing

C-2
Cessation of circulation and breathing with no possibility to resume spontaneously

N-3
Cessation of brain function with no possibility to resume

C-3
Cessation of circulation and breathing with no possibility to resume spontaneously

Biological events after death
One Death, Three Mechanisms

Fig. 1 Neurological sequence in the dying process
• **Intracranial loss of circulation:**
  • Sufficient time passed; persistent observation over time
  • Not possible to resuscitate brainstem function

• **Cessation of circulation after progressive hypoxia:**
  • At five minutes: No brainstem function and no chance for spontaneous return of circulation

• **Cessation of circulation after sudden cardiac arrest:**
  • At 7-10 minutes: No brainstem function and no chance for spontaneous return of circulation
• Intracranial loss of circulation:
  • Sufficient time passed; persistent observation over time
  • Not possible to resuscitate brainstem function

• Cessation of circulation after progressive hypoxia:
  • At five minutes: No brainstem function and no chance for spontaneous return of circulation

• Cessation of circulation after sudden cardiac arrest:
  • At 2-10 minutes: No brainstem function and no chance for spontaneous return of circulation
Progressive hypoxia

- In a rodent model of progressive hypoxia we demonstrated what we generally already knew:
  - Tissues (and their functions) have different vulnerability to hypoxemic hypoxia
  - Brain is more vulnerable than the heart
Progressive hypoxia

- Loss of brainstem function coincided with apnea
- Period when brainstem was able to be resuscitated continued after apnea
- This period ended prior to pulselessness
- Rodent died prior to pulselessness
Death is the permanent loss of the **capacity** for consciousness and all brainstem functions.

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<th>5 min pulseless after progressive hypoxia</th>
<th>7-10 min pulseless after sudden arrest</th>
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<td>Permanent loss of circulation</td>
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<td>Permanent loss of capacity of brainstem to be resuscitated</td>
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