

APPLICATION OF THE PARETO PRINCIPLE TO RECREATIONAL DIVING DEATHS

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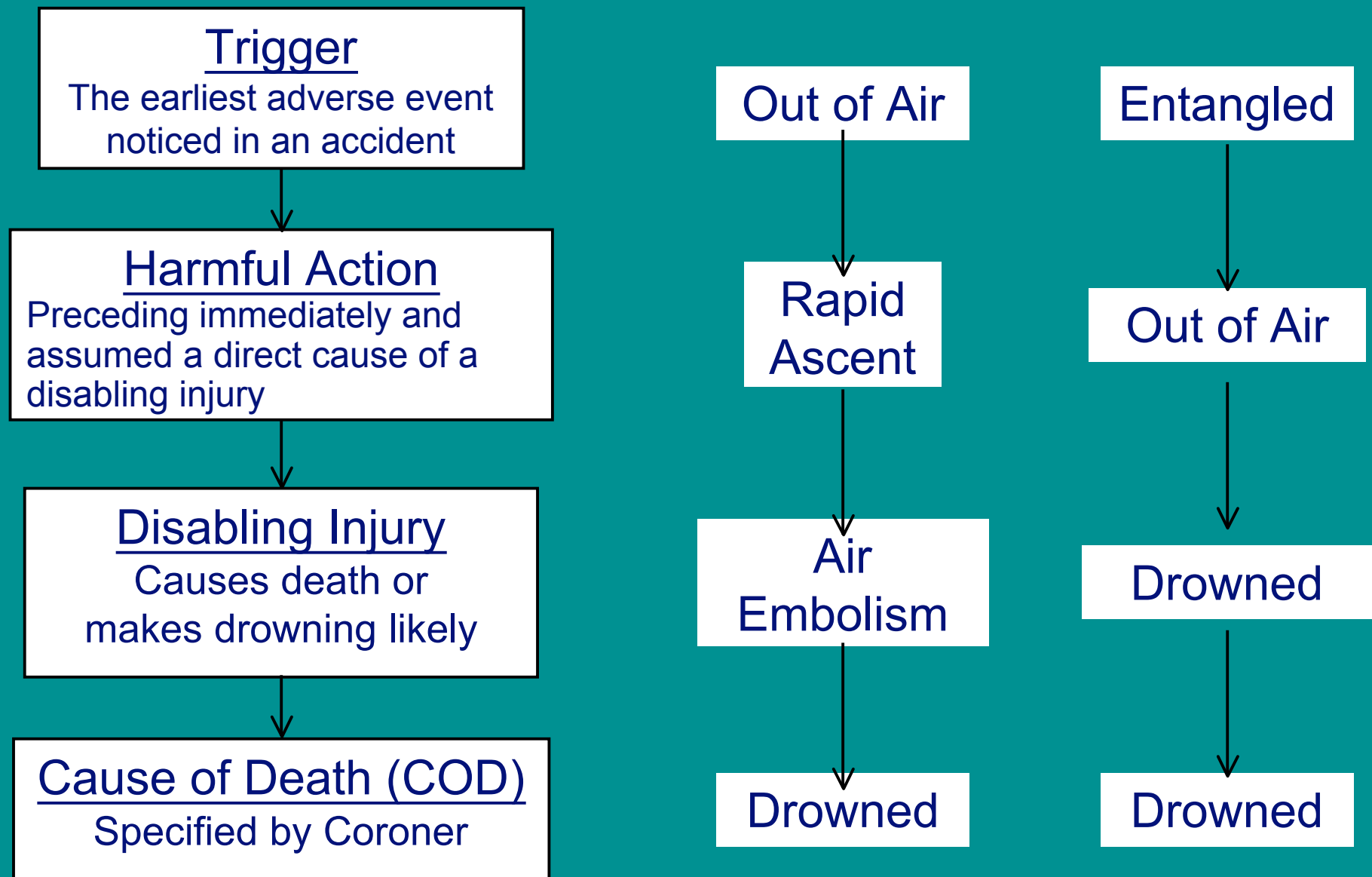
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BACKGROUND

- ▶ Accidents in recreational diving are commonly caused by multiple factors
- ▶ Initial adverse event triggers action that may correct situation or start a chain of adverse events leading to a fatal outcome
- ▶ Proper intervention at any link could prevent fatal outcome
- ▶ The aim of this study was to identify most common, actionable links of accidents

RCA for Diving Fatalities

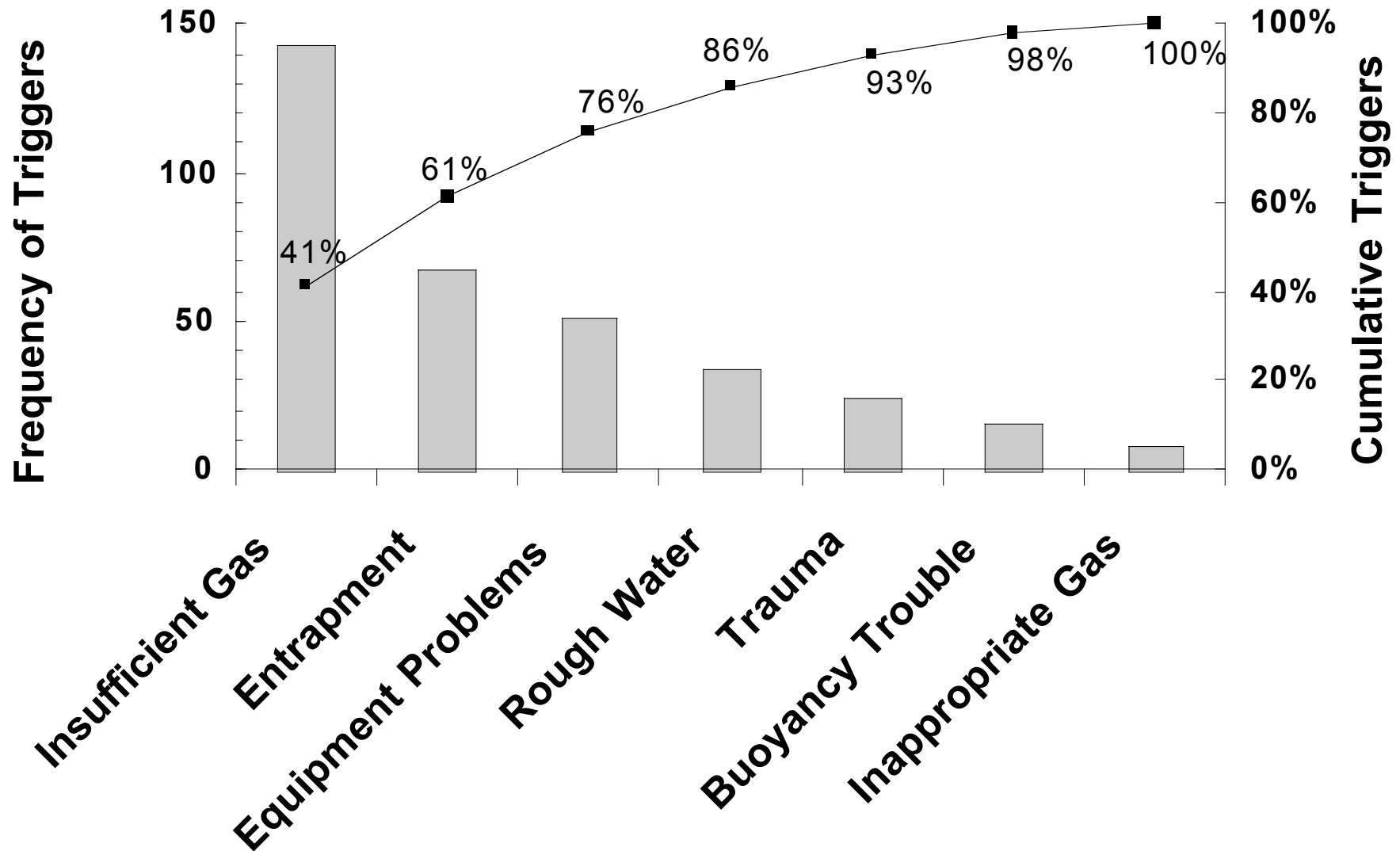


METHODS

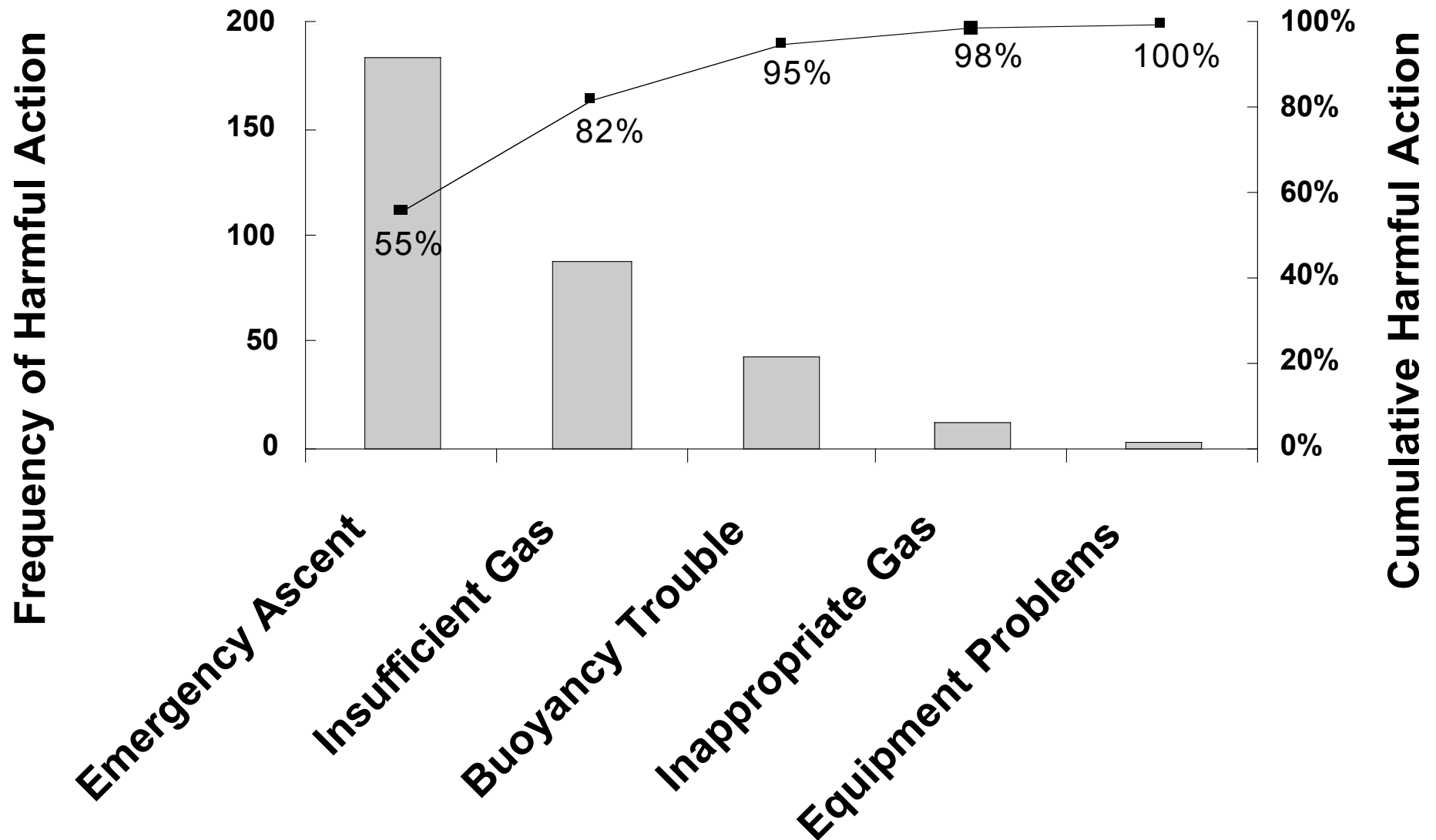
Pareto Analysis

- ▶ Pareto principle assumes that only a few root causes are responsible for most accidents.
- ▶ We identified the most common triggers, harmful events and disabling injuries.
- ▶ Both RCA and Pareto analysis assume causality.
- ▶ We tested statistical associations of root causes for each Disabling Injury using logistic regression
 - $p \leq 0.05$ and odds ratio (OR) > 2
 - Also tested health, certification, experience, suit type, buddy system, diving activity, and breathing gas

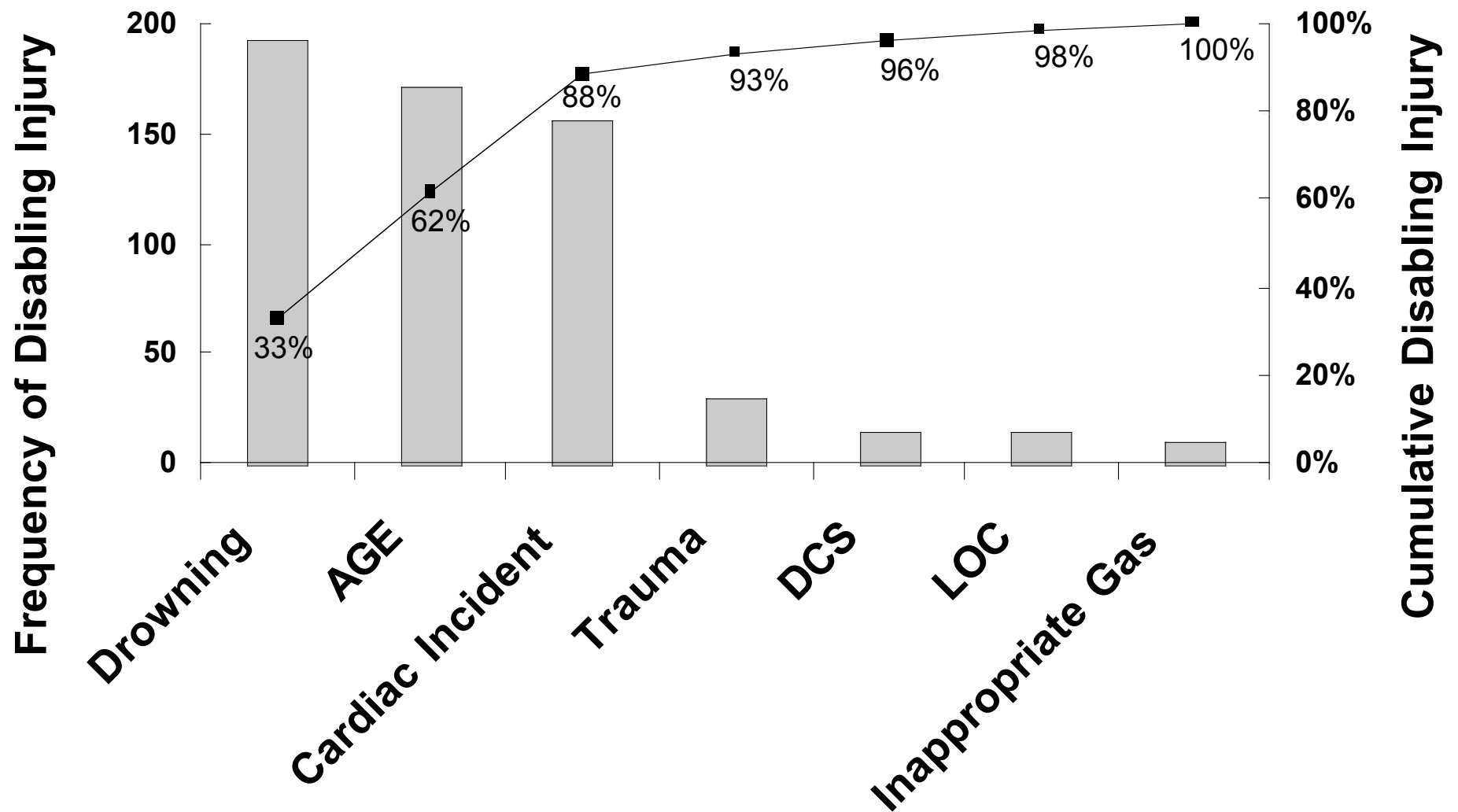
Triggers



Harmful Actions



Disabling Injuries



Associations

Incapacitating Injury	Root Cause	OR
Drowning	Entrapment	≥30
	Insufficient gas	16
	Equipment trouble	4.5
	Rough water	2
	Female	2.1
AGE	Emergency ascent	≥30
	Depth less than 80 fsw	2
Cardiac event	History of CVD	≥30
	Age over 40	6.4

Discussion

- There are a few preventable causes common to most drowning and AGE accidents
- Preventative interventions should aim to:
 - minimize need for and improve emergency ascent
 - improve gas management
 - avoid entrapment, train disentanglement
 - learn more about equipment, improve maintenance
- Death due to cardiac incidents in diving
 - even benign diving conditions may be a trigger for divers with pre-existing heart disease
 - at risk individuals must be medically evaluated prior to participation



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Triggers

Primary Disabling Injuries

	<u>Drowning</u>	<u>AGE</u>	<u>Cardiac</u>
Insufficient gas	32%	63%	Triggers were rare
Entrapment	40%	9%	
Equipment trouble	15%	17%	
Rough water	11%	2%	
Buoyancy trouble	1%	6%	
Trauma	1%		
Inappropriate gas		1%	
Emergency ascent			

Harmful Actions

Primary Disabling Injuries

	<u>Drowning</u>	<u>AGE</u>	<u>Cardiac</u>
Emergency ascent	13%	97%	Harmful Actions were rare
Insufficient gas	62%	1%	
Buoyancy trouble	17%	1%	
Rough water	11%		
Equipment trouble	3%		
Trauma	5%	1%	
Entrapment	1%		