

# **Fatalities in Divers Using Rebreathers**

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# Introduction

- ❖ Diving deaths involving rebreathers appear to be increasing worldwide
- ❖ We compared fatalities for divers using rebreathers with divers using open-circuit breathing apparatus

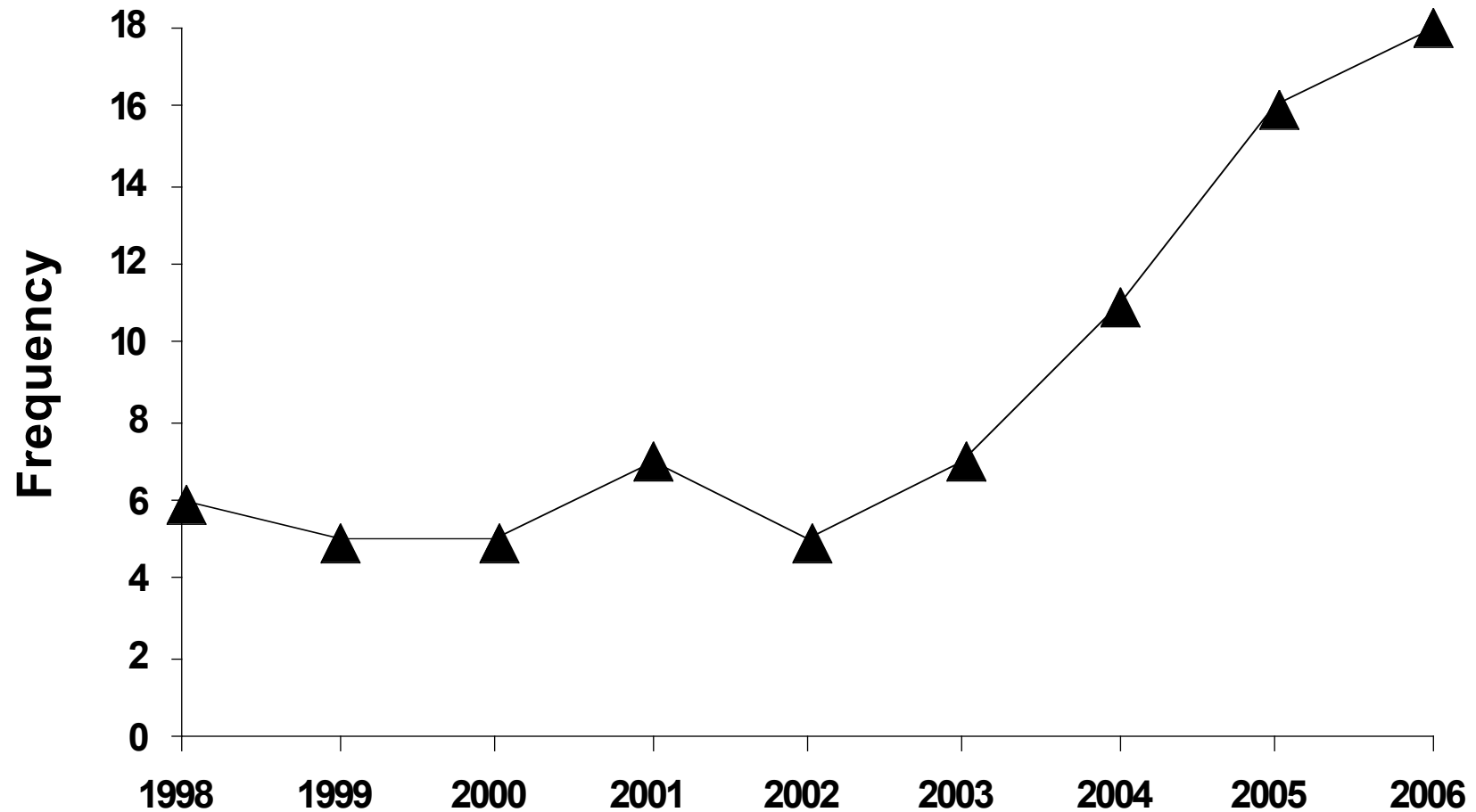
# Methods

- ❖ We applied Root Cause Analysis to DAN diving fatality surveillance data
- ❖ Objective: identify & compare Triggers, Harmful Actions, and Disabling Injuries

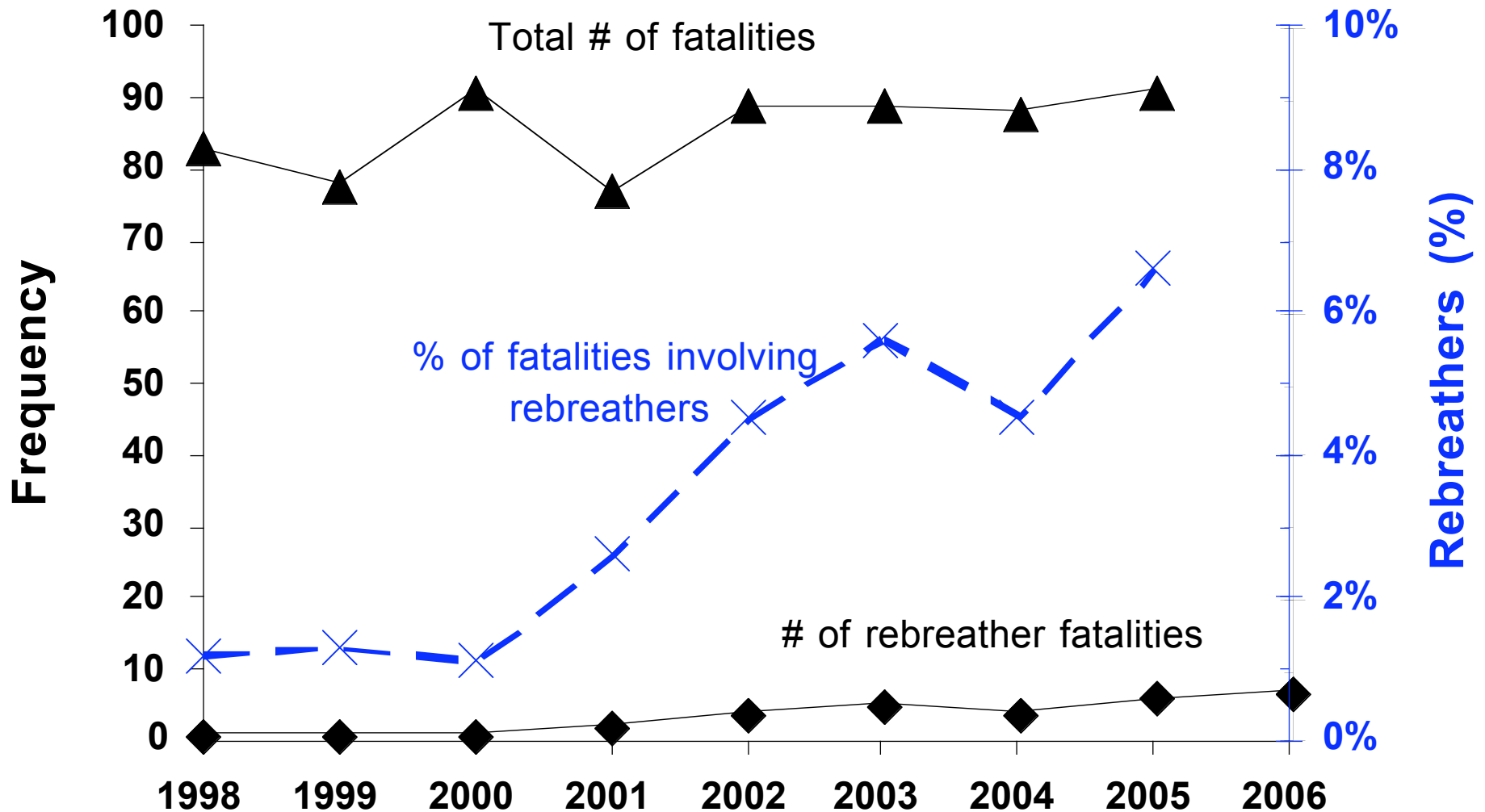
	<u>Rebreather</u>	<u>Open-Circuit</u>
<b>Cases (years)</b>	<b>80 (1998-2006)</b>	<b>947 (1992-2003)</b>
<b>Age (y; mean±SD, range)</b>	<b>45±11 (24-72)</b>	<b>43±13 (12-79)</b>
<b>Female (%)</b>	<b>3%</b>	<b>19%</b>
<b>US/Canada Cases (%)</b>	<b>40</b>	<b>100</b>

- ❖ Information about non-US/Canada residents was difficult to obtain

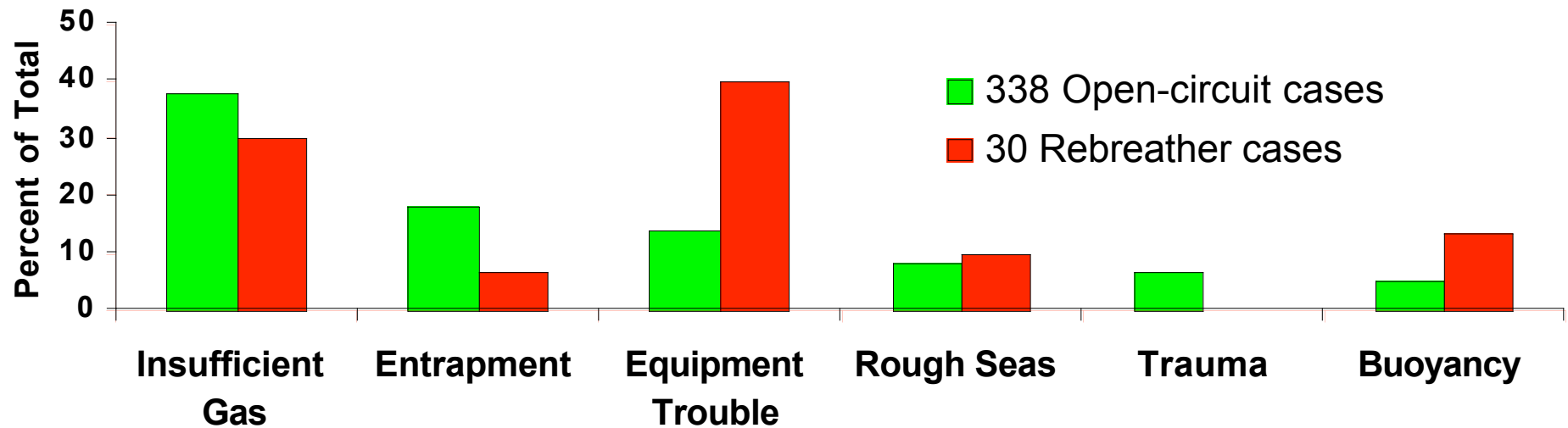
# Rebreather Deaths per Year Worldwide



# Rebreather Deaths as a Fraction of All US/Canada Deaths

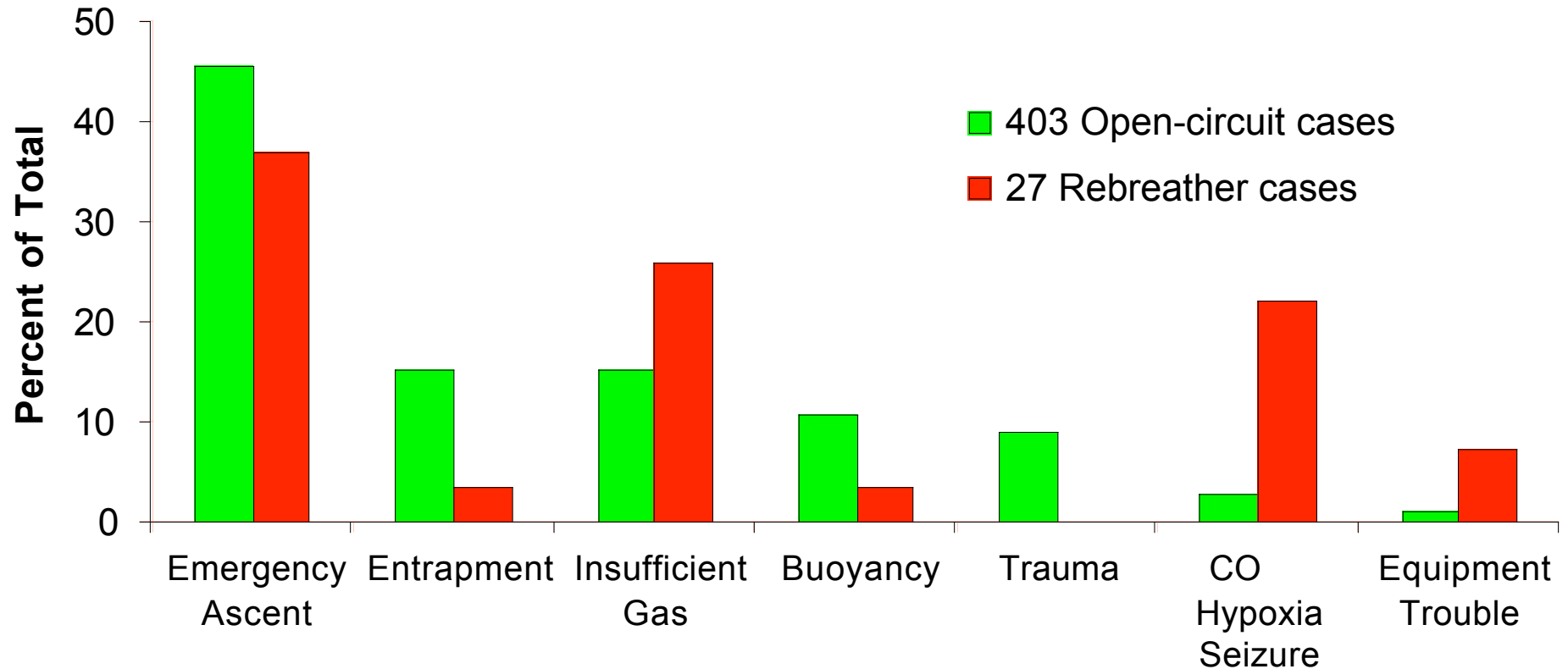


# Triggers

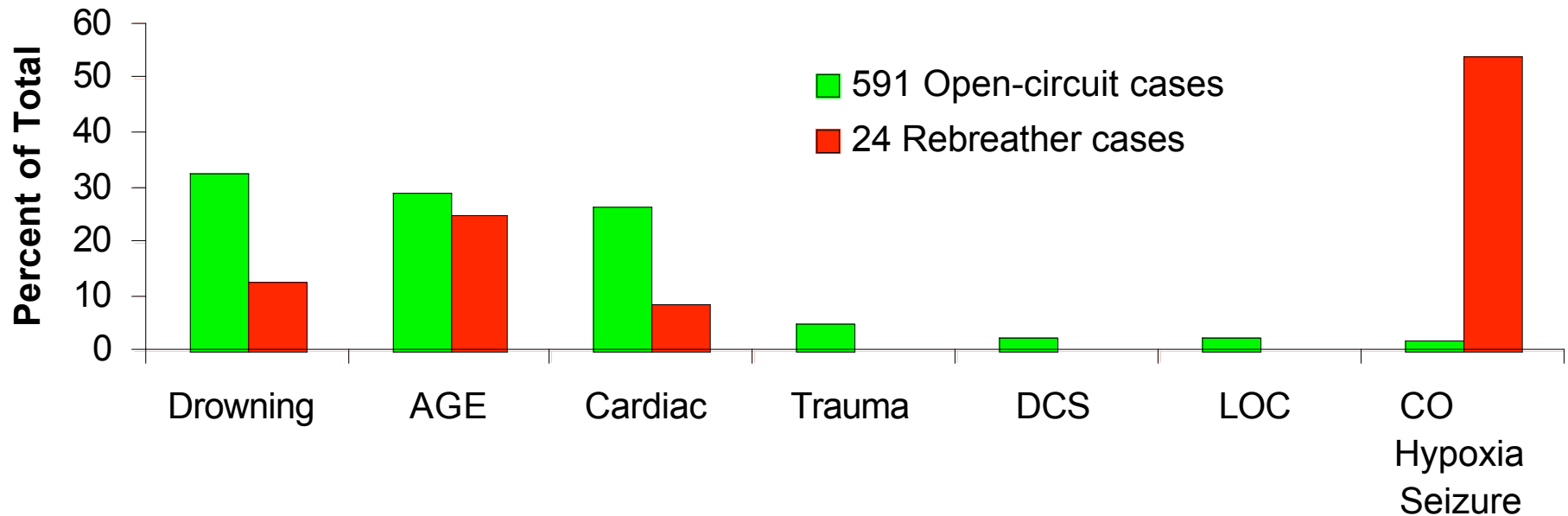


- ❖ 11 equipment procedure problems (e.g., gas or power off, incorrect set-up, gas leak)
- ❖ 3 equipment malfunctions (e.g., flooded display, O<sub>2</sub> supply failure)
- ❖ 4 buoyancy problems specific to rebreathers (i.e., surfaced, left mouthpiece open, lost buoyancy, sank)
- ❖ 3 general buoyancy problems (drysuit blow-up, lift bag entanglement)

# Harmful Actions




# Disabling Injuries



- ❖ 13 rebreather divers lost consciousness early in the dive, suggesting hypoxia
- ❖ 5 rebreather divers were observed to have seizures, suggesting oxygen toxicity



# Discussion

- ❖ Rise in rebreather deaths probably due to growing popularity
- ❖ By Pareto principle, greatest reduction in rebreather deaths achieved by emphasizing training & safety guidelines related to equipment & hypoxia/seizures
  - Equipment procedural problems (diver error) seemed more common than equipment malfunction 
- ❖ Limitations
  - Number of missed rebreather deaths is unknown
  - Investigation of non-US/Canadian cases was difficult
    - Cooperation with International DANs may help
  - Equipment recovered after a fatality should enter a formal chain of custody

# Conclusions

- ❖ Focus on most common Root Causes should have the greatest impact on reducing rebreather fatalities
- ❖ Inferences concerning rebreather fatalities are preliminary due to limited data