



# HOME MECHANICAL VENTILATION IN CANADA:

WHERE WE WERE AND WHERE WE ARE NOW

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# **Financial Interest Disclosure**

(over the past 24 months)

**Karen Rimmer**

I have no conflict of interest.



# Objectives



- To understand the development of HMT in Canada
- To appreciate regional differences
- To be aware of current guidelines for HMT and plans and challenges of upcoming revision

# Hospital to home for post polio pts

## Where it all started...





# Why home?

- Initially: QOL
- NOW:
  - Pressure on acute and LTC beds
  - Cost
  - Availability of small inexpensive equipment
  - Ultimately though....QOL

# Prevalence of HMOV

- Eurovent 2005 = 6.6/100,000
- National Canadian survey 2015 = 12.9/100,000
  - 18% invasive (recent data suggests less invasive starts)
  - 21% children
  - Marked variability in practice patterns



# Prevalence

- Increasing prevalence over time
  - Patients living longer
  - Increasing numbers from the pediatric world
  - Obesity requiring NIV
  - Champions raising awareness
- Awareness of the benefits eg in ALS UK survey→3.4 fold rise in 12 years (2000 to 2012)

# Incidence of Ventilation in Ontario

Povitz, Respiratory Care April 2018; 63(18),380.

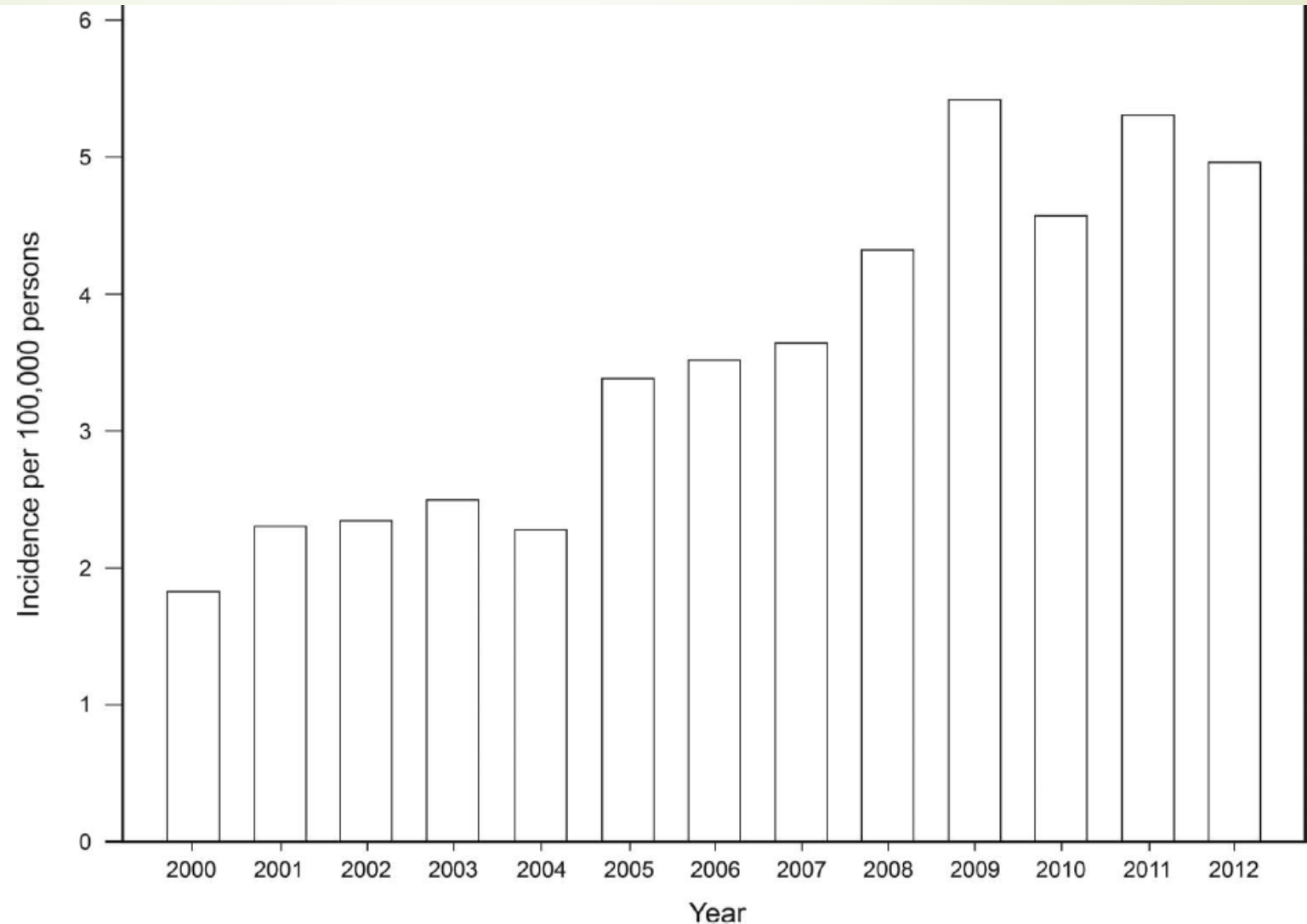


Fig. 1. Incidence of newly approved assistive device program ventilator applications per 100,000 adults  $\geq 18$  y old.  $P < .001$  for trend. Incidence was calculated as the number of new approvals/fiscal year/100,000 adults  $\geq 18$  y old based on population.





# Back when...and now

Back when....

- Ventilation occurred when daytime hypercapnia found
- Studies focused on predictors of daytime hypercapnia


Now...

- Trend towards earlier ventilation → improve outcomes?
- Studies looking at predictors of nocturnal hypoventilation
- Studies looking at timing of initiation to improve outcomes



# CTS HNV guideline 2011

- Recognized variability in practice and need for standardization
- Recognized differences in patients with different diagnoses (kyphoscoliosis ≠ ALS ≠ DMD)
- Organised according to disease process
- Common themes were ethics, transition, clearance
- Quality of the literature was NOT high
- Acknowledged gaps and areas requiring further research
- Surveys since suggest that adoption of the guideline may be suboptimal




# Citations, but are the “worker bees” looking at it?

- **Home Mechanical Ventilation: A Canadian Thoracic Society Clinical Practice Guideline 2011 – 68 citations**
- Optimizing Pulmonary Rehabilitation in Chronic Obstructive Pulmonary Disease – Practical Issues: A Canadian Thoracic Society Clinical Practice Guideline 2011 - 53 citations
- Canadian Thoracic Society 2012 Guideline Update: Diagnosis and Management of Asthma in Preschoolers, Children and Adults -115 citations



# Provincial and regional variability (and International)

- Prevalence varies from province to province – recent national survey (Rose et al. 2015)
  - Funding models for equipment and services variable
  - Much relies on regional expertise and “history” of ventilation regionally
- 



# Current trends

- Towards more programmatic approach
  - Defined structure improves transitions and errors
- Increase in community care
  - Strategies to avoid admission
  - Includes increased community support
  - Telehealth and remote monitoring
- NIV increasing and invasive ventilation decreasing



# Current issues

- **Poor knowledge of HMO patients amongst healthcare providers → puts HMO pts at risk during admissions and transports by EMS**
- Uncommon technology such as pacing for the diaphragm



# CTS HMOV guidelines 2018/2019

- 7 years since last publication
  - Time for a revision
  - Priority areas:
    - Clearance
    - ALS
    - COPD
    - OHS
- 



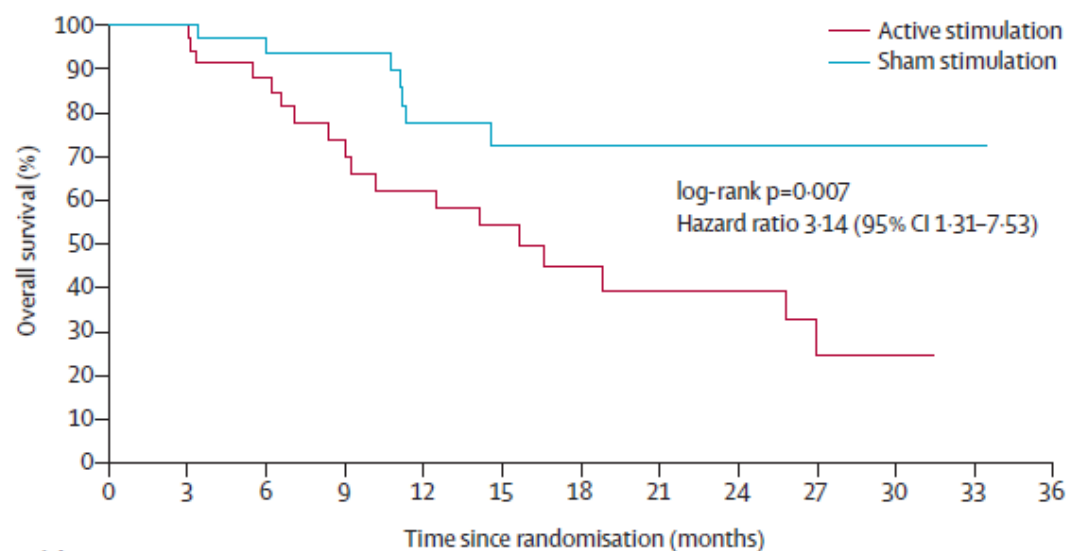
# Amyotrophic lateral sclerosis

- Focus more on patient factors or testing that predict survival with NIV
- Predictors of tolerance to NIV
- Assessing models of initiation and monitoring of NIV
- RCTs addressing diaphragm pacing
- RCTs addressing respiratory muscles training
- Attempts to address timing or criteria for initiation



# DiPALS

## UK- NIV±Pacer



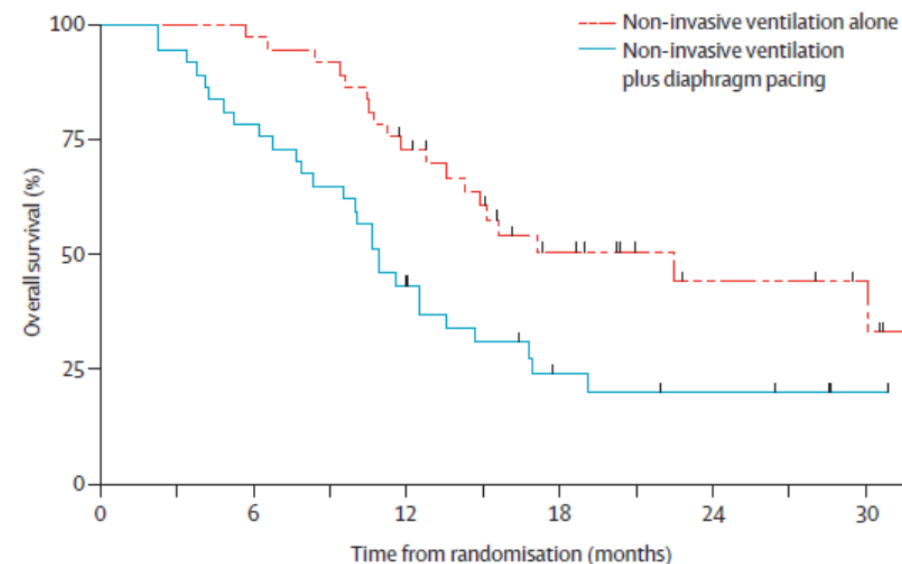
Number at risk	0	3	6	9	12	15	18	21	24	27	30	33	36
Active stimulation	37	35	26	18	16	12	9	7	7	3	2	0	0
Sham stimulation	37	35	29	25	18	14	12	10	9	7	1	1	0

**Figure 3: Overall tracheostomy-free survival**

Because none of the patients had tracheostomy, overall survival and tracheostomy-free survival were identical. Patients not included had either died before randomisation or were still alive but with shorter follow-up (28 patients censored before 15 months).

# RespistimALS

## French-NIV/pacer



Number at risk	0	6	12	18	24	30
Non-invasive ventilation	37	36	26	13	6	4
Non-invasive ventilation plus diaphragm pacing	37	29	14	6	4	1

**Figure 2: Overall survival**

Vertical lines indicate censored patients



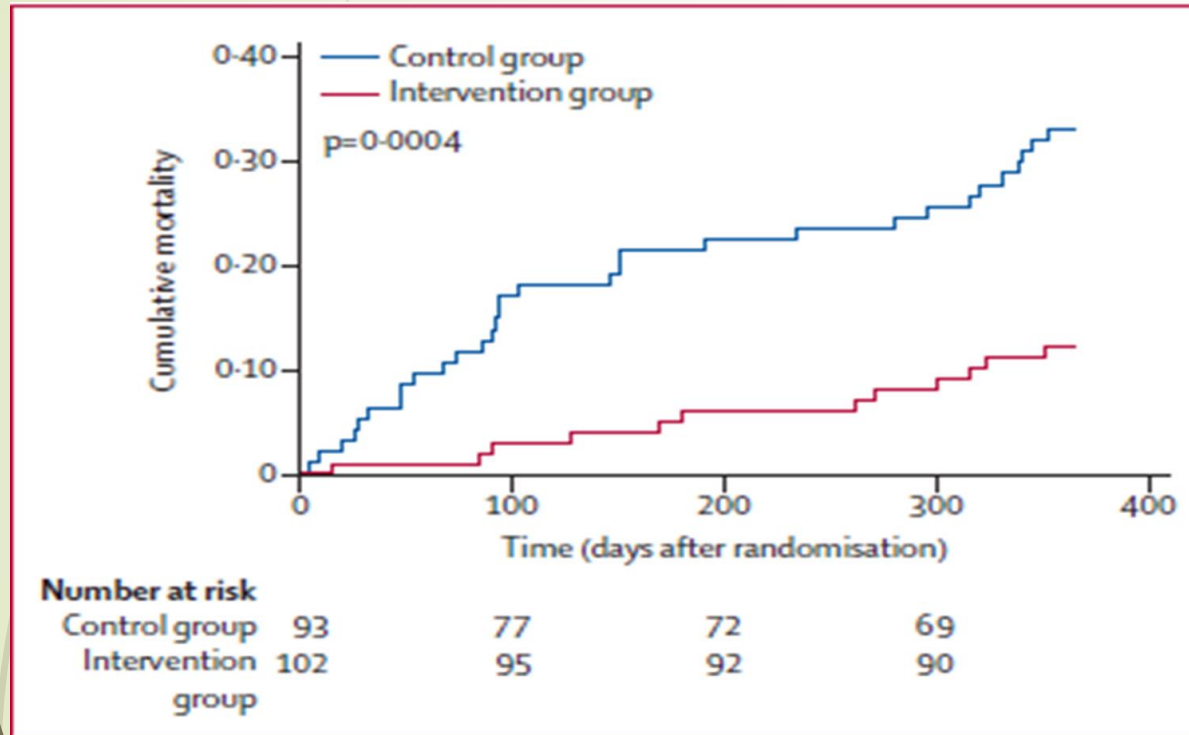
# COPD and NIV

- Clear evidence for use of NIV in **acute** exacerbation
- If it works in AECOPD → why not for chronic use?
- GOAL?
  - Prolong survival
  - Improve QOL
  - Decrease hospitalizations and hence costs

# RCTs

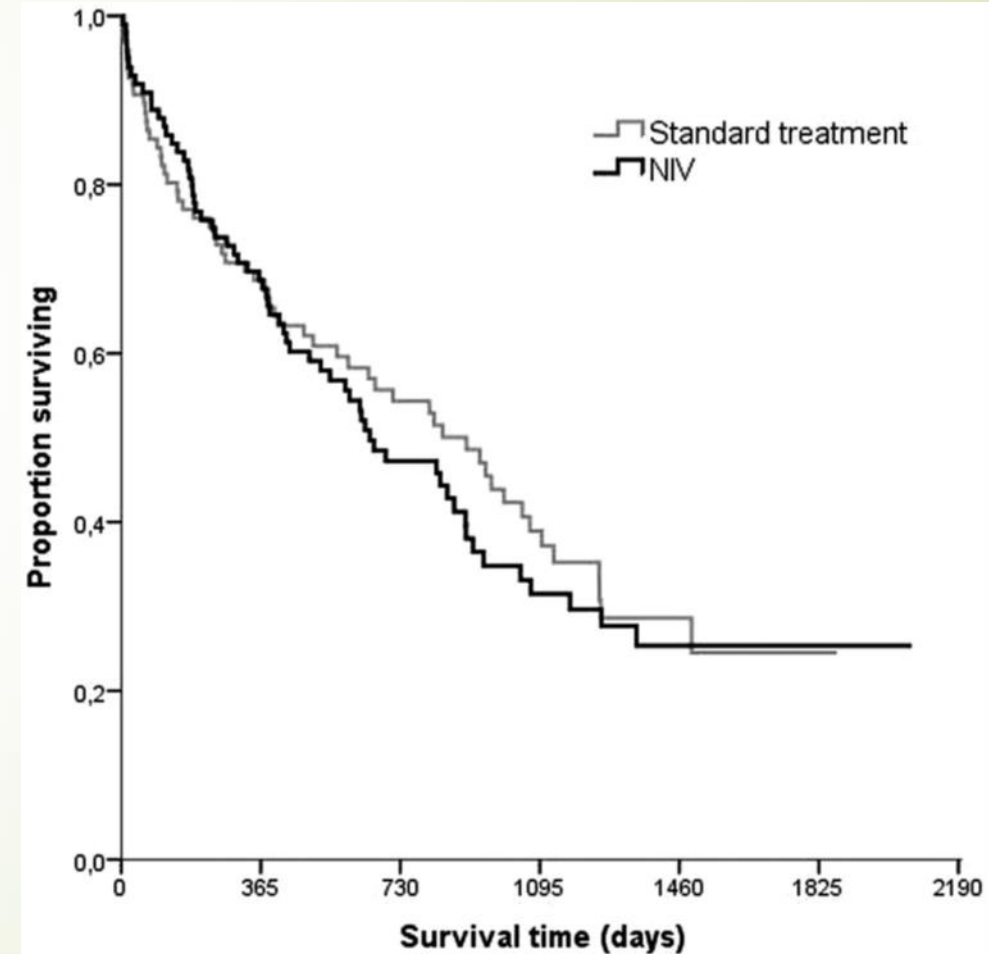
Author	Timing	Population	Initiation	Settings
Struik 2014	>48 hrs	FEV1~26% pCO2~59	Inpt	IPAP 19 RR15
Kohnlein 2014	>4 weeks	FEV1~27% pCO2~58	Inpt	IPAP 21.6 RR 16
Murphy 2017	2-4 weeks	FEV1~24% pCO2~59	Inpt	IPAP 24 RR 14

## Mortality: Kohnlein



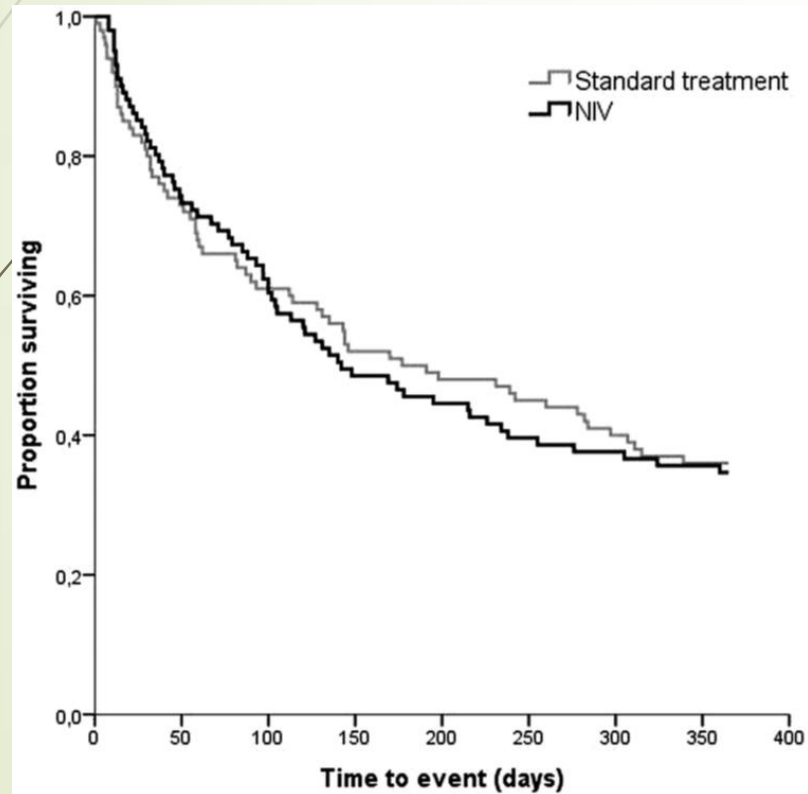
**Figure 2: Kaplan-Meier estimate of cumulative all-cause mortality during the first year after randomisation (primary outcome)**  
The p value results from a log-rank test of the between-group difference.

## Survival: Struik



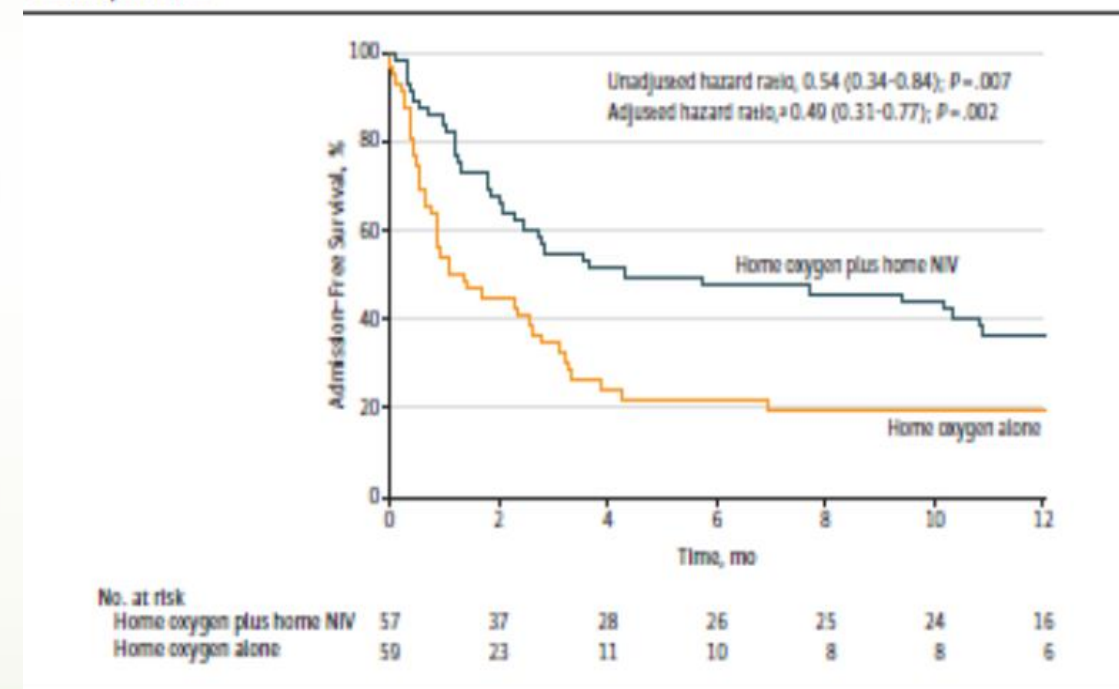
# Readmission or death

Struik: 2014



Murphy: 2017

Figure 2. Kaplan-Meier Survival Plot of Time to Readmission or Death From Randomization to the End of Trial Follow-up at 1 Year





# COPD conclusions

- Recent studies are not consistent between studies
- Reduce mortality? Maybe! 1/3 recent studies
- Reduced admissions? Maybe 1/3 recent studies
- HRQOL? Not convincingly different with NIV
- NOTE: VERY select population could fit these studies – very severe ( $FEV_1 \sim 25\%$ ,  $pCO_2 > 56$ , recurrent exacerbator requiring NIV acutely)
- Guideline committee has a tough job here!



# Pacing of the phrenic nerve/diaphragm

- Interesting and promising for selected populations
- Many respirologists are interested in seeking out this option, but are unaware of indications
  - Eg “I have a patient with bilateral phrenic palsy with diaphragm paralysis, would you please see for diaphragm pacing?”



# Advantages of pacing over chronic vent

- Distribution to dependent lung (post/basal) is better
- Speech is better
- Reduced noise
- Sense of smell preserved
- Cosmetic
- Mobility
- Reduced costs of care



# Who?

- High spinal cord injury
- Central hypoventilation – acquired or congenital
- MUST HAVE INTACT PHRENIC MOTOR NEURONS/NERVES

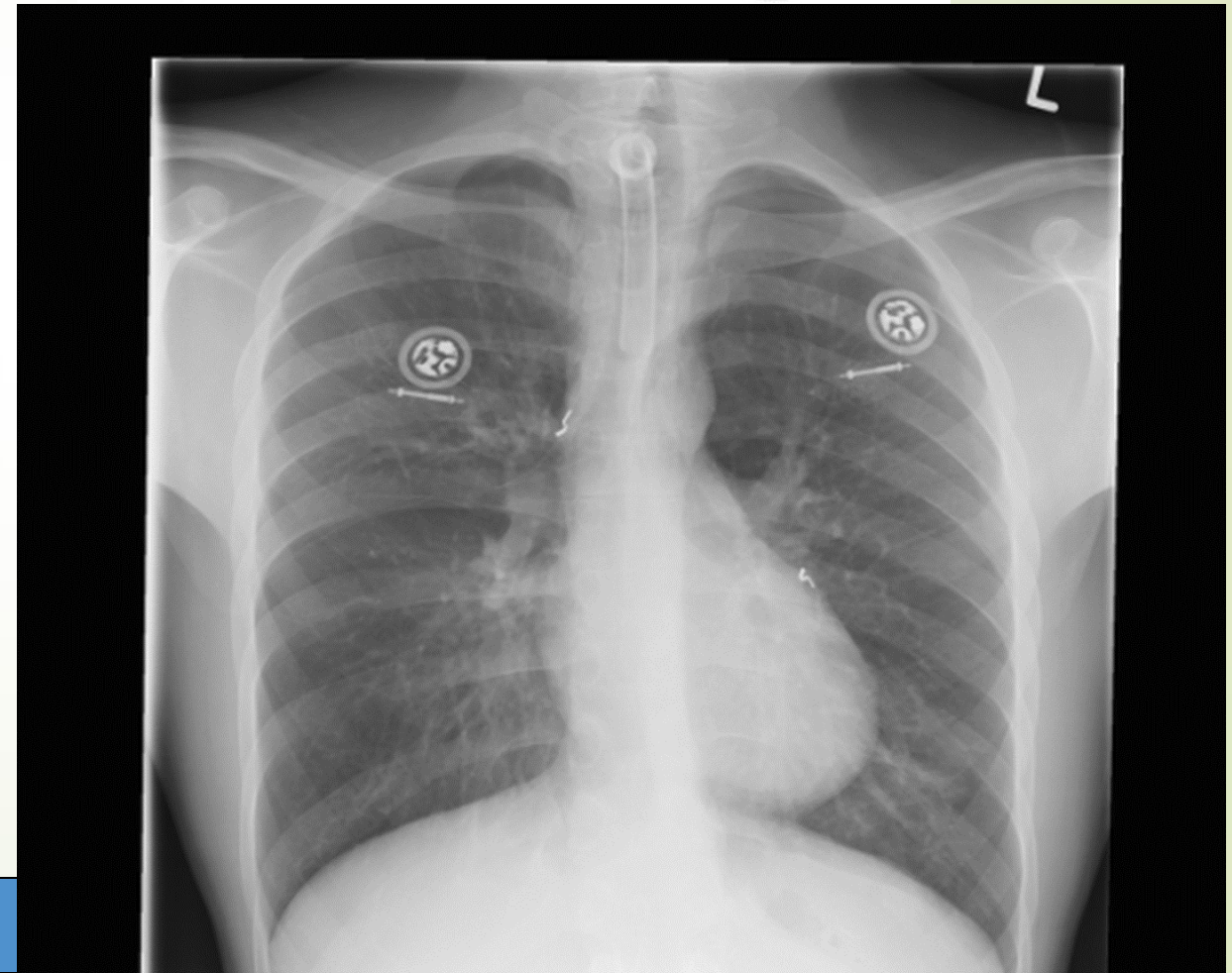
External Transmitter



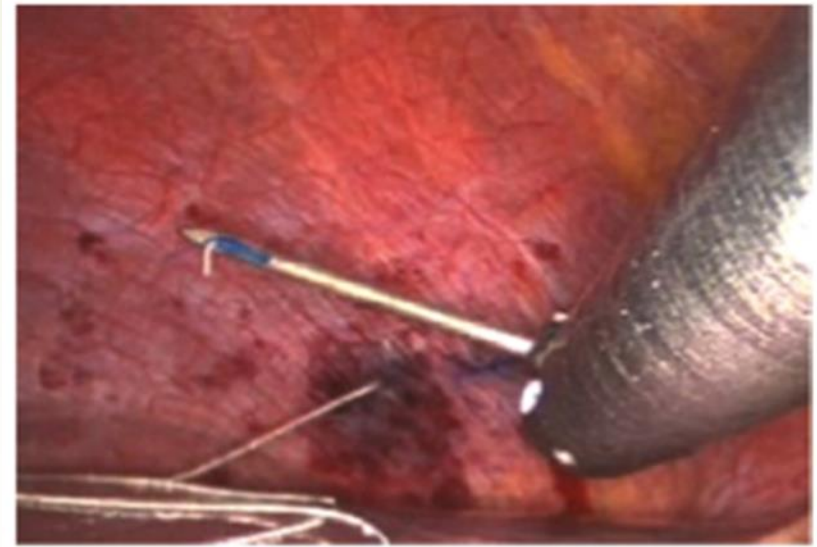
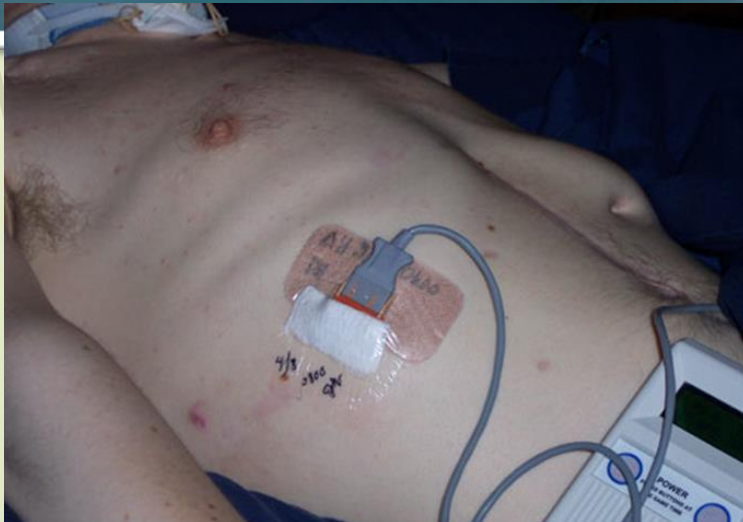
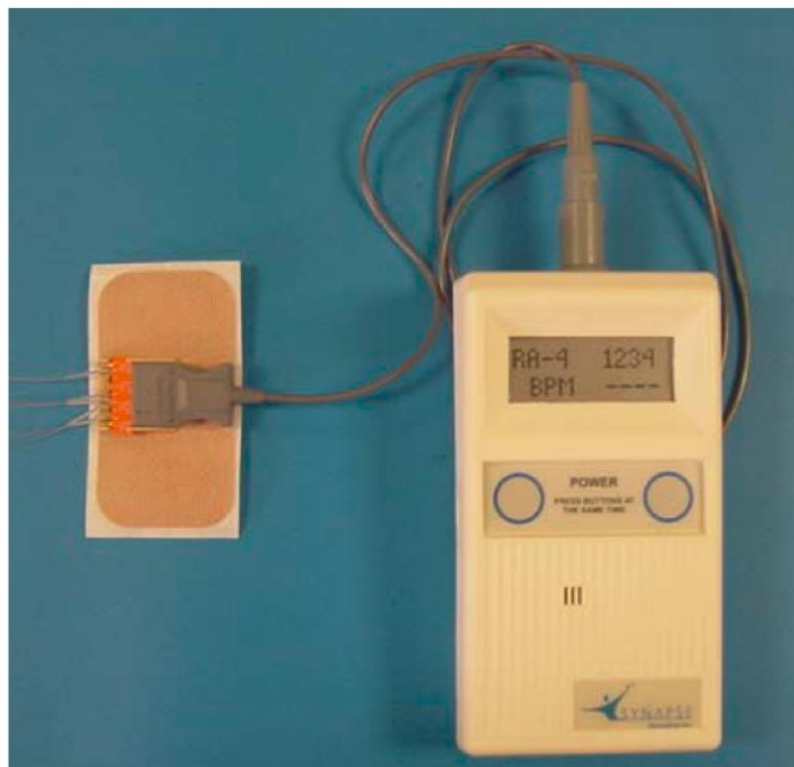
External Antenna



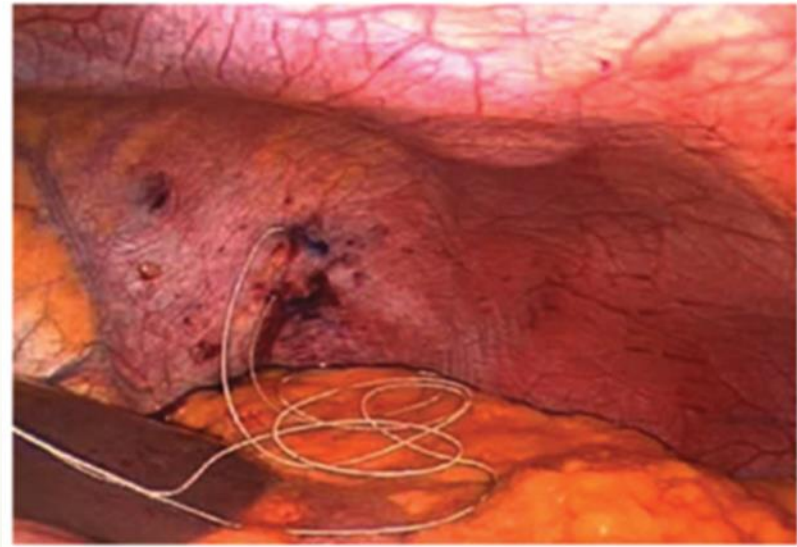
Implanted  
Receiver and Electrode



# Synapse unit



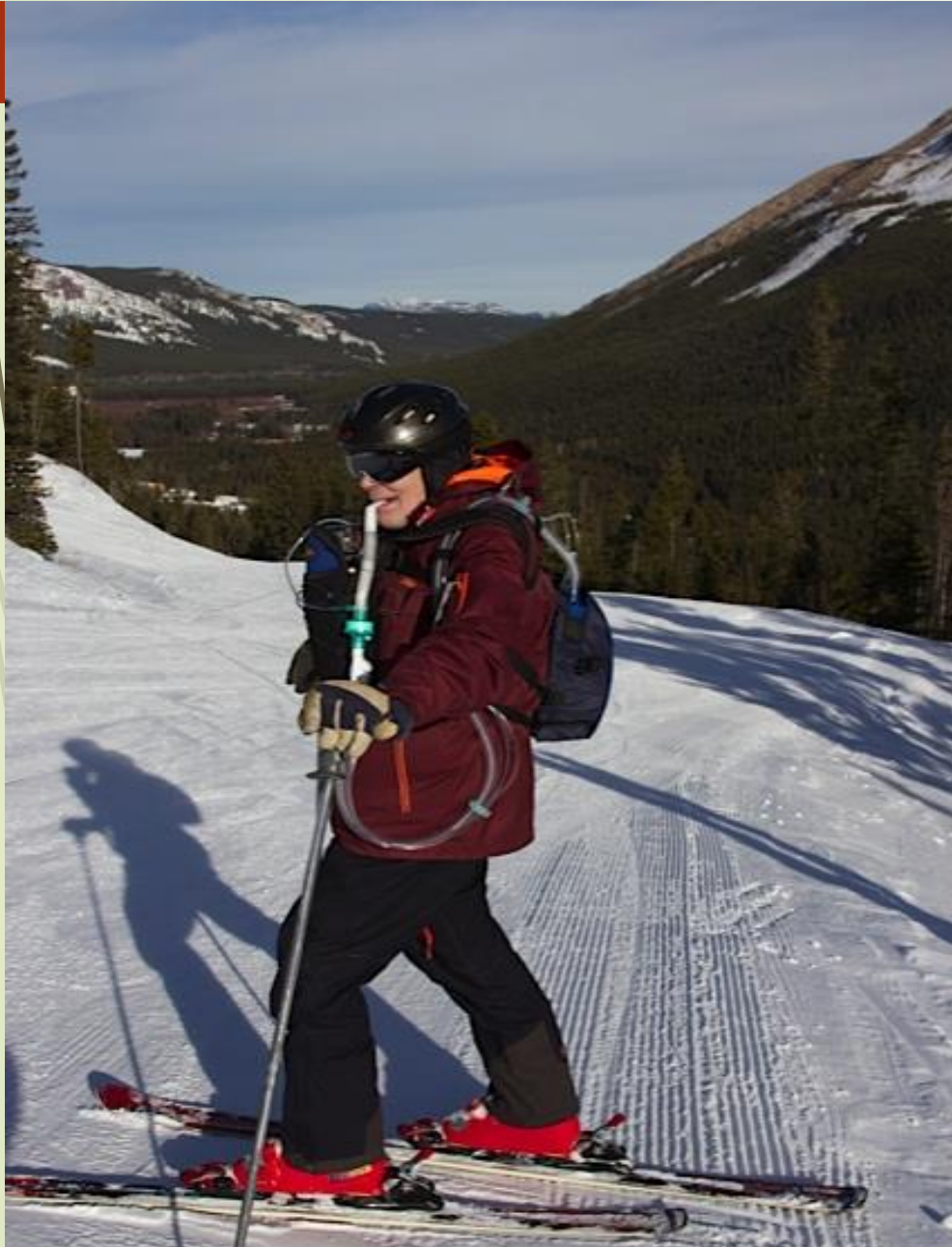
**Figure 1** - Laparoscopic implantation of an intra-diaphragm phrenic stimulation electrode in the right hemidiaphragm.



**Figure 2** - Laparoscopic view of an intra-diaphragm phrenic stimulation electrode successfully implanted in the left hemidiaphragm.



# Why we do this HMV stuff!





# 1 and 3 yr trends in mortality

Povtiz 2018, Respiratory Care

Years	Incident HMV users (N)	Crude 1 year mortality	Crude 3 year mortality
Ages: 18 – 39			
2000 - 2003	129	8.53	18.60
2004 - 2007	139	8.63	15.11
2008 - 2012	228	8.33	14.04
		P=1.00	P=0.51
Ages: 40 – 64			
2000 - 2003	417	13.91	30.46
2004 - 2007	669	11.81	26.61
2008 - 2012	1343	15.93	25.99
		P=0.04	P=0.19
Ages: 65 and older			
2000 - 2003	281	24.56	49.82
2004 - 2007	453	26.93	46.36
2008 - 2012	1011	25.52	43.82
		P=0.75	P=0.18