History: Noninvasive Ventilation

Part I

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Suncoast Pulmonary Symposium

September 10, 2014

How did we get here?

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Olden Times

no.203.078 THE WORLDS OLDEST NEWSPAPER - since 1879 -

In early 1700's Young Alan Cunningham uses a bellows-type device demonstrating the most commonly used form of respiratory assistance

In libris graecis appetere mea. At vim odio lorem omnes, pri id iuvaret partiendo. Vivendo menandri et sed. Lorem volumus blandit cu has.Sit cu alia porro fuisset.

Ea pro natum invidunt repudiandae, his et facilisis vituperatoribus. Mei eu ubique altera senserit, consul eripuit accusata has ne. Ignota verterem te nam, eu cibo causae menandri vim. Sit rebum erant dolorem et, sed odio error ad.Vel molestie corrumpit deterruisset ad, mollis ceteros ad sea.

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Dr Elsberry in his RT lab testing early methods of artificial respiration

History

- The concept of mechanical ventilation first evolved with negative pressure ventilation. 1876 - Woillez first developed a workable iron lung.
- 1880 -Alexander Graham Bell designed a vacuum jacket; 1889 prototype of iron lung.
- 1928- Drinker introduced negative-pressure ventilation and popularized the iron lung.

Drinker-Shaw iron lung in 1928, was the first widely used negative-pressure ventilator.

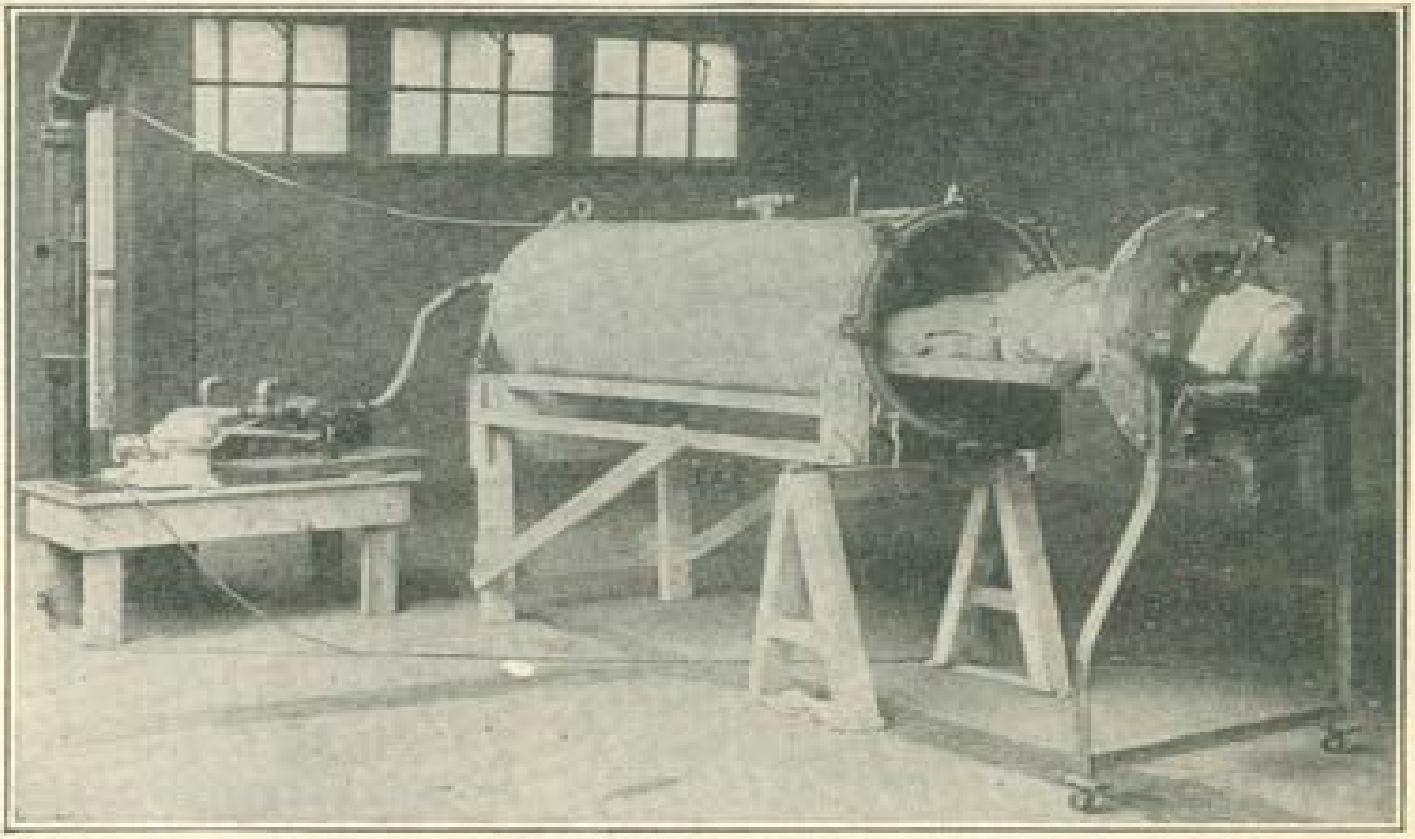
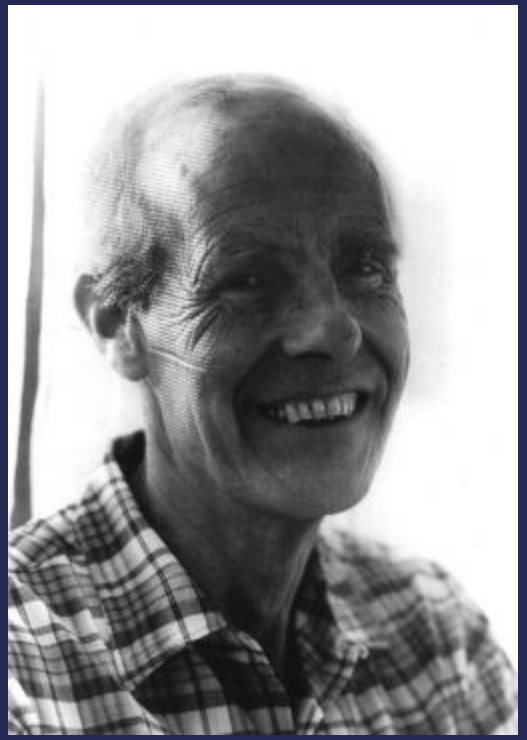


Fig. 1.—The mechanical respirator, showing patient ready to be pushed into the tank. The pumps and manometer for controlling the pressure are shown in the background, to the left.

Jack Emerson

02/05/1906 – 02/04/1997



In 1931, Jack Emerson modified these large devices, and the Emerson tank ventilator became the standard for ventilatory support. The Emerson tank ventilator was especially crucial in the treatment of polio victims.

Negative-pressure ventilators were the predominant method of ventilatory support until the polio epidemics overwhelmed their capacity in the 1950s.

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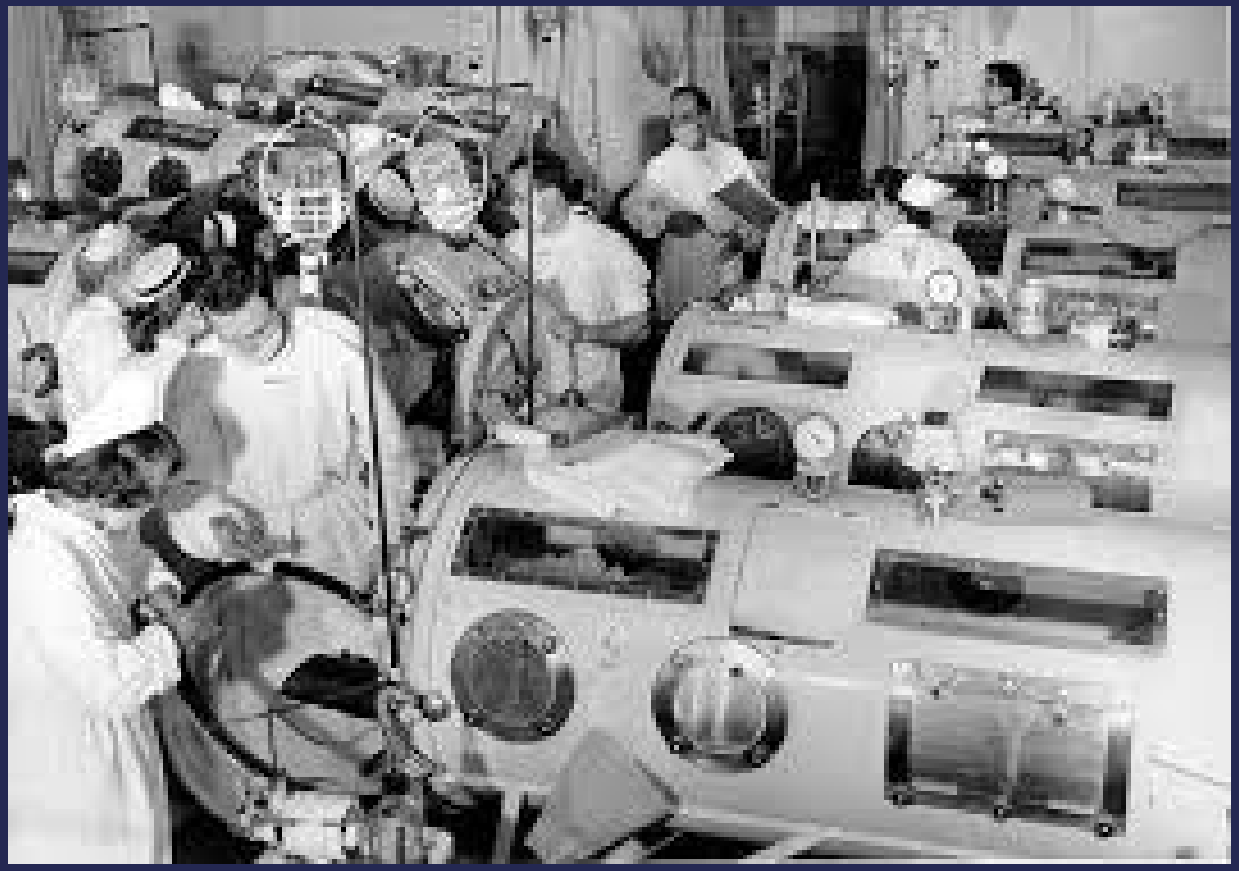


Development of positive-pressure delivered through tracheostomy tubes permitted the delivery of intermittent positive pressure during inspiration

Get The Bird!

Dr. Forrest Bird

On television every week in the 1960s, Dr. Kildare committed himself to making his patients better. But try as he might, some would still not respond to his treatment.

At those times his hospital's slogan was, when all else fails,

‘get the Bird!’

'The Bird' was that little green box which became familiar to hospital patients throughout the world after Dr Bird introduced it in 1958

Dr. Forrest M. Bird Inventor and Innovator
PERCUSSIONAIRE® CORPORATION

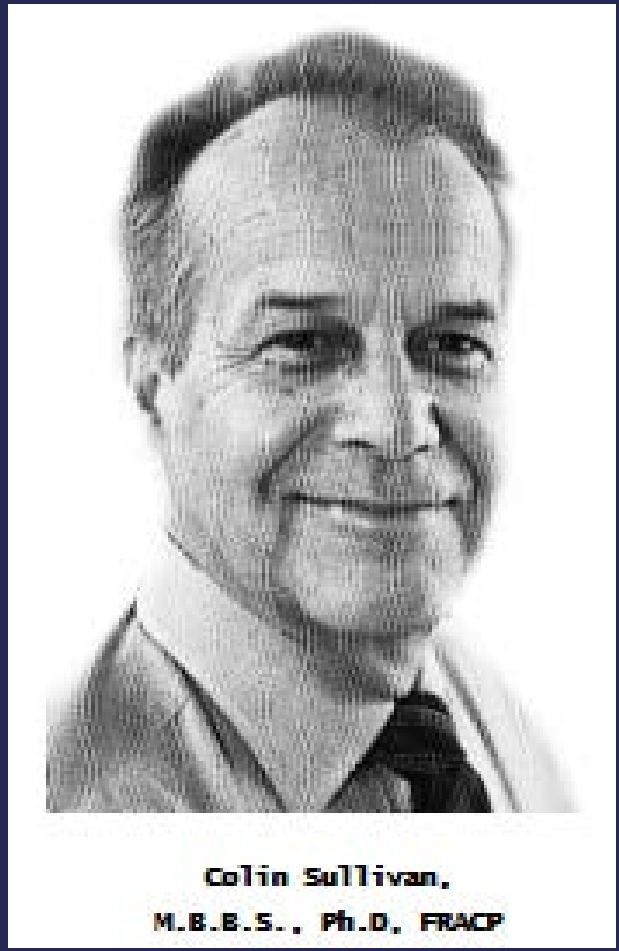
1960s

- Popularity of ‘noninvasive’ positive pressure ventilation increased .

- But was overshadowed by :

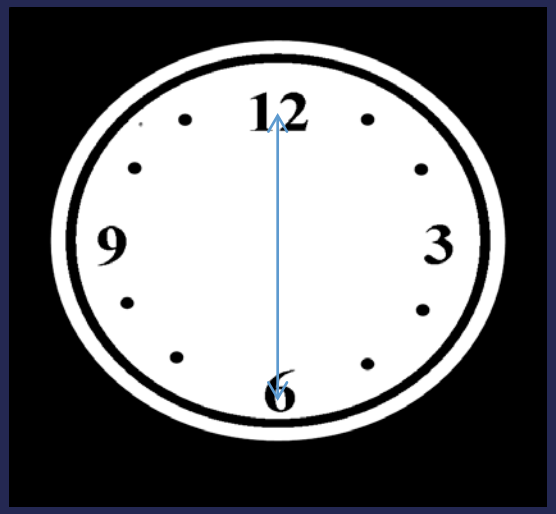
CPAP for Obstructive Apnea discovered

June 1980 when Dr. Sullivan first tested the idea that positive pressure, applied just through the nasal airway, could stop obstructive apnea.



Gerry McGinnis

- Developed the first continuous positive airway pressure (CPAP) machine for the treatment of sleep apnea in 1985



In the ensuing 25 years, noninvasive positive-pressure ventilation delivered via a mask has been widely adopted, to the point where it is a first-line therapy in most medical centers

PHILIPS


3B™


Your CPAP Mask is Dirty.
Clean it.

Ventilators

- The choice of ventilators available to provide noninvasive ventilatory support has continued to expand.
- Early noninvasive ventilatory support used either large bedside critical care volume ventilators or smaller volume or pressure specialty ventilators devoted to noninvasive ventilation.
- While the critical care ventilators had more options, they were also less tolerant of leaks.
- The specialty ventilators had fewer options and range, but they were more leak tolerant and more in sync with the patient's breath cycle

Noninvasive ventilation (NIV) has been used in a number of clinical situations, but it seems to be most effective in patients with

acute respiratory failure due to underlying

COPD

CHF

OSA

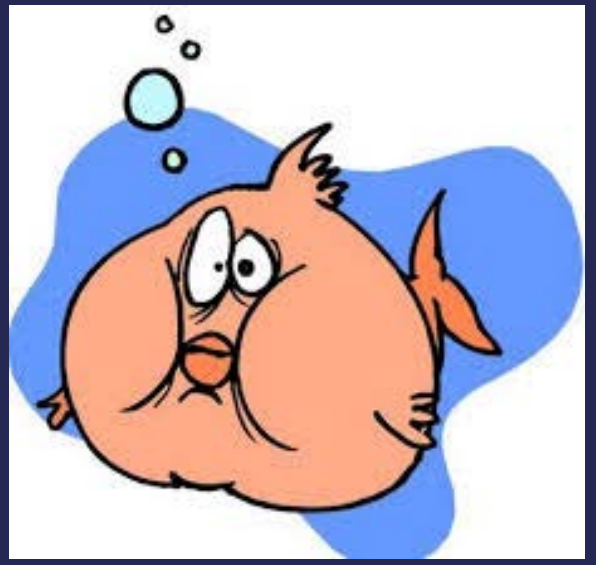
These represent the hypercapnic and hypoxemic conditions best suited for noninvasive ventilation

Over the years… NIV

- Demonstrated to be cost-effective
- Avoids costs of endotracheal intubation and mechanical ventilation
- Shorter ICU and hospital stays
- Eliminates costs associated with infectious complications - Episodes of ventilator-associated pneumonia reduced by half or more

- COPD is the most suitable condition for noninvasive ventilation.
- Noninvasive ventilation is most effective in patients with moderate-to-severe disease

One of the few remaining contraindications for NIV is no spontaneous breathing!



Noninvasive ventilation

"There is arguably more evidence to support the use of noninvasive ventilation (NIV) than any other practice related to the care of patients with acute respiratory failure"[1]

[1]Hess, D.; Patient –ventilator interaction during noninvasive ventilation. *Respir Care 2011;*56(2):153:165

Used extensively in Europe, with use increasing over time - Noninvasive ventilation (NIV) use exceeds 80% of patients in some European ICUs

Used less in Canada and United States (20-50%)

Some areas 0%

Lower NIV utilization attributed to:

- Unfamiliar to physicians and other staff
- Lack of proper equipment
- Inaccurate perception of increased time commitment
- Respiratory therapy and nursing work load not adjusted
- Practice guidelines not used
- Coding and reimbursement issues

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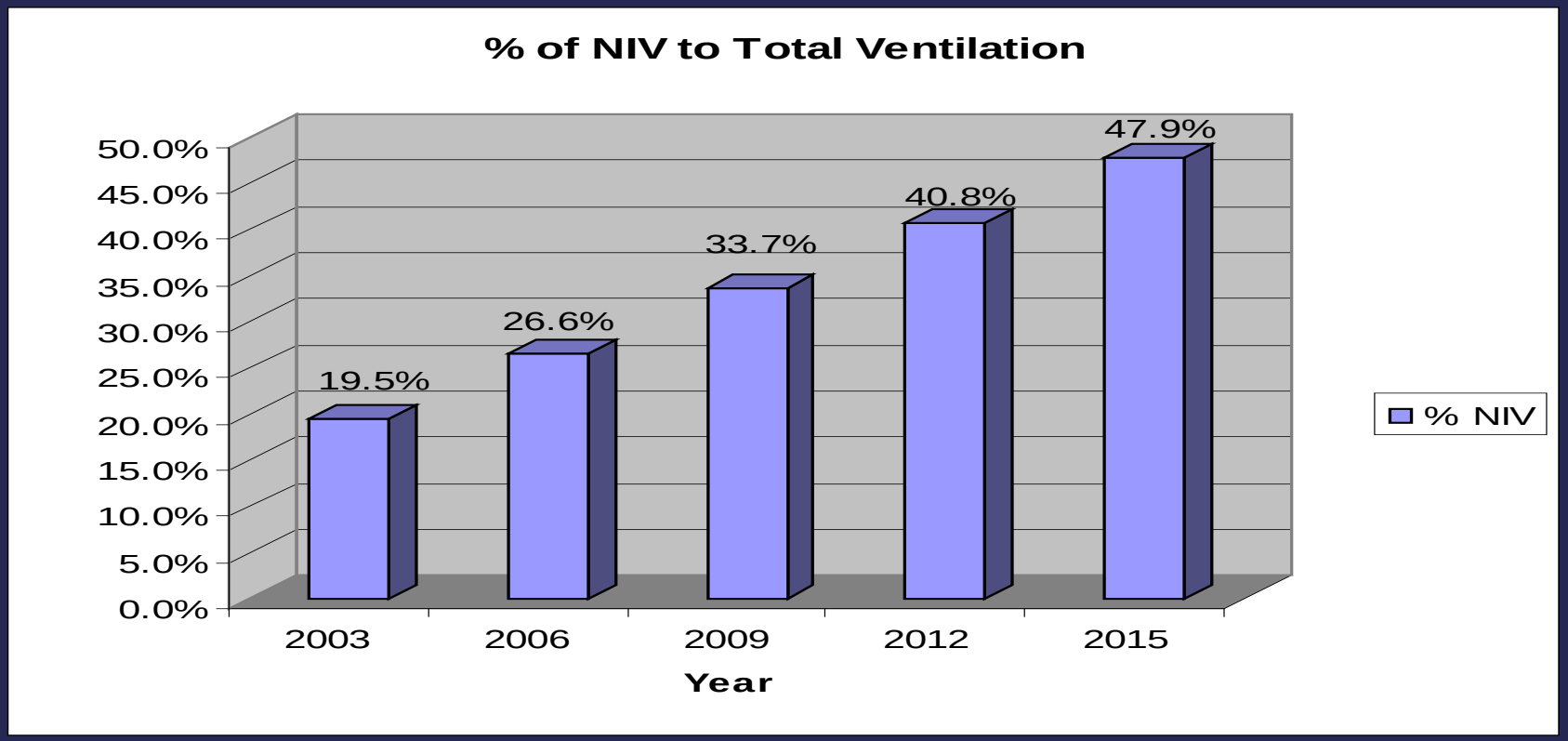
What percentage of your ventilated patients do you use NIV?



With progress there will be challenges

Complications: Pressure Points

NIV can also be associated with skin breakdown, leading to formation of hospital-acquired pressure ulcers

Example of necrosis

- Pressure Ulcers- 257,412 cases stage 3 & 4, $43,180 Avg Cost per Hospitalization. (2007 Data)

And Many Advantages

Reduces Intubation uo to 80%

- Decrease rate of VAP by up to 28%
- Decrease hospital length of stay
  - 3 to 8 less ventilator days
  - 9 to 12 less ICU day

Am J Respir Crit Care Med 163:874-880, 2001

More NIV modes than ever before…

- S
- S/T
- CPAP
- BPAP
- AVAPS
- AVAPS – AE
- PPV
- TryPAP (Mike Gentile Duke Univ)

Yesterday starts Today

about 60 years ago

1955

S Afr J Lab Clin Med. 1955 Jun;1(2):126-31.
A modified face mask unit for use in ventilation tests.
GOLDMAN

2014

Non-invasive mechanical ventilation and epidural anesthesia for an open cholecystectomy. Rev Bras Anestesiol. 2014.

Noninvasive Ventilation

Part II

What is next?

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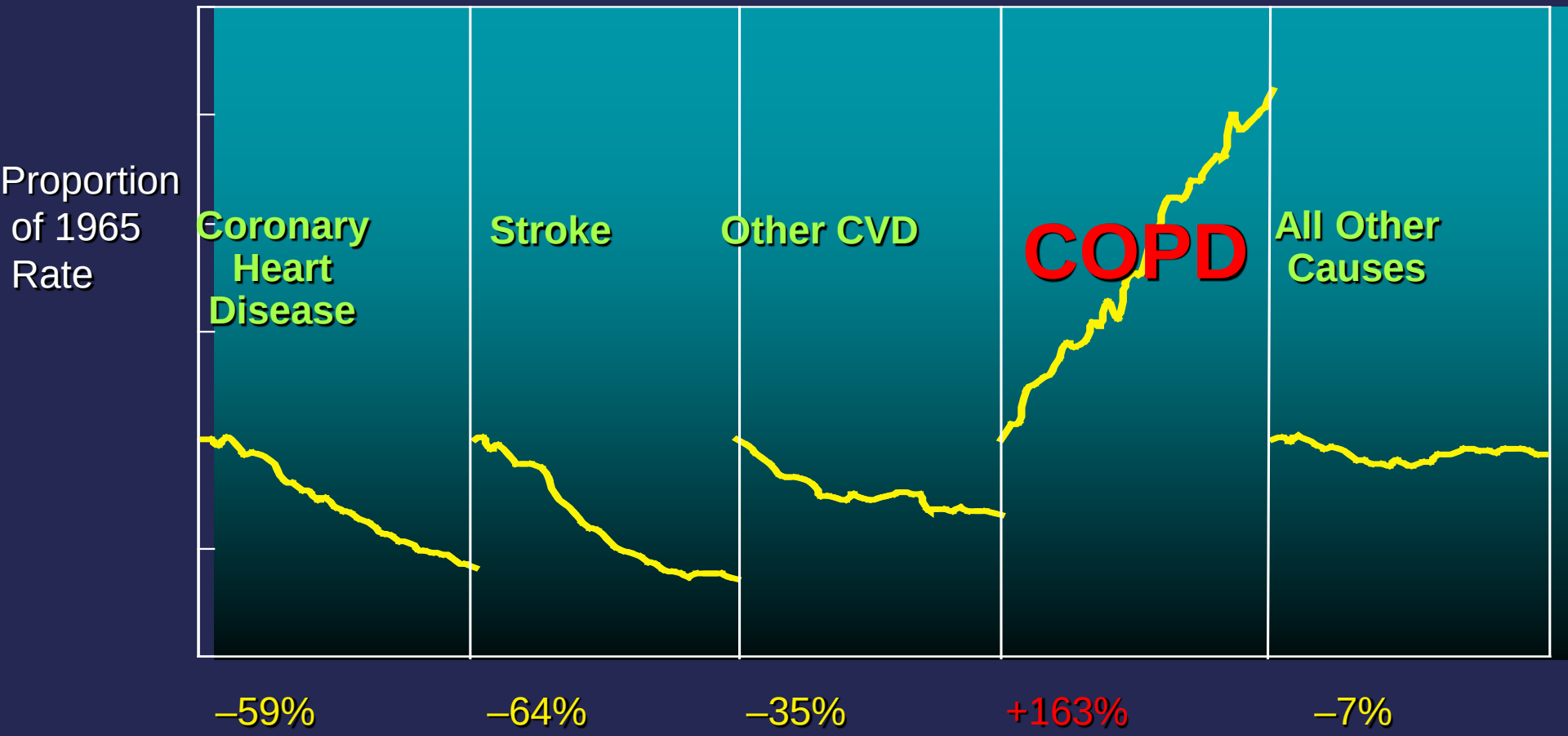
Old news... New problem

COPD is the third leading cause of death in America, claiming the lives of 134,676 Americans in 2010

The risk of death goes up with the severity of a person's obstructive sleep apnea

Percent Change in Age-Adjusted Death Rates, U.S., 1965-1998

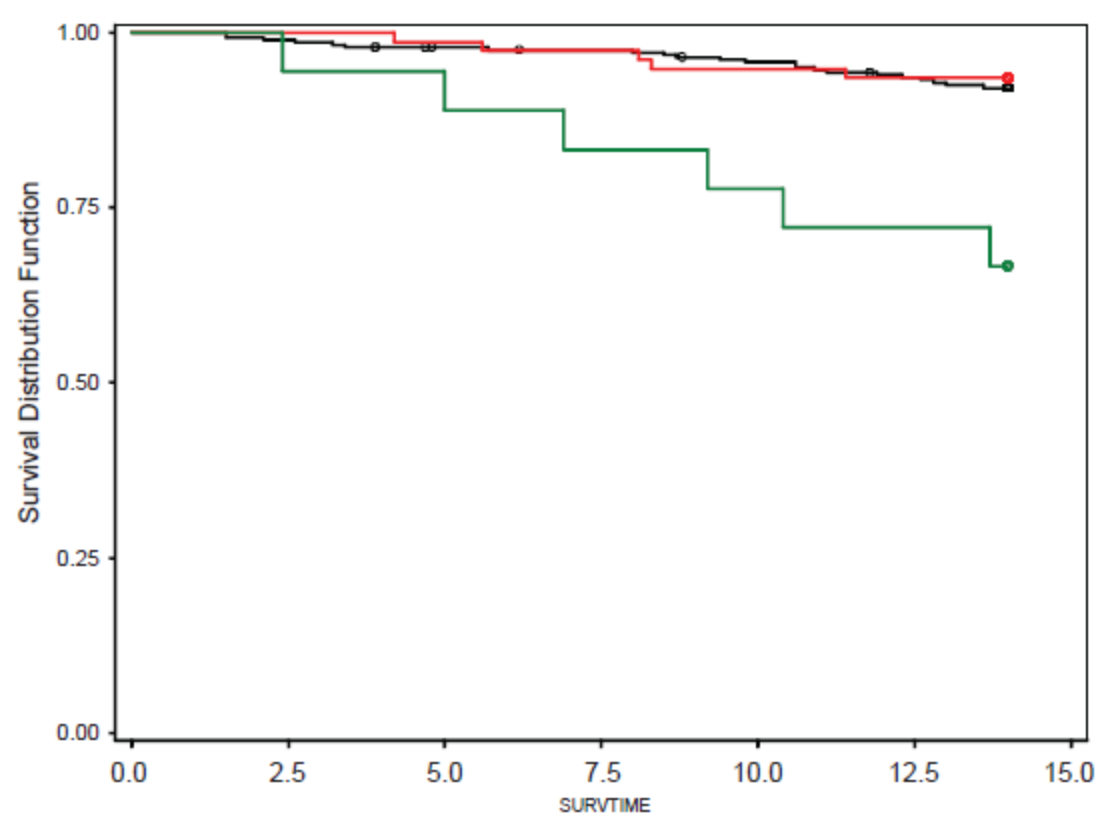


While the rate of death of the most common diseases (THE BIG KILLERS) have decreased in the past 30 years, **COPD is the only one that has increased**.

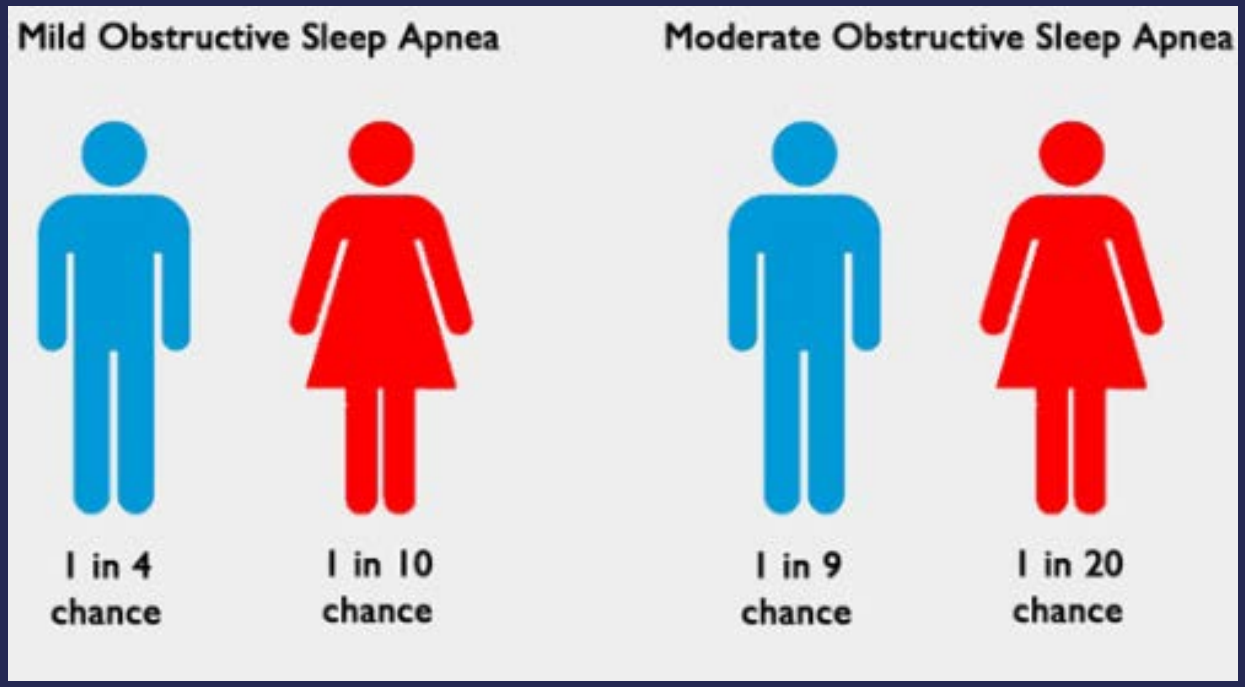
In 2020 it will be the # 2 or 3 CAUSE of DEATH

OSA survival distribution

SLEEP, Vol. 31, No. 8, 2008 Sleep Apnea and All-Cause Mortality—Marshall et al



Prevalence and Incidence



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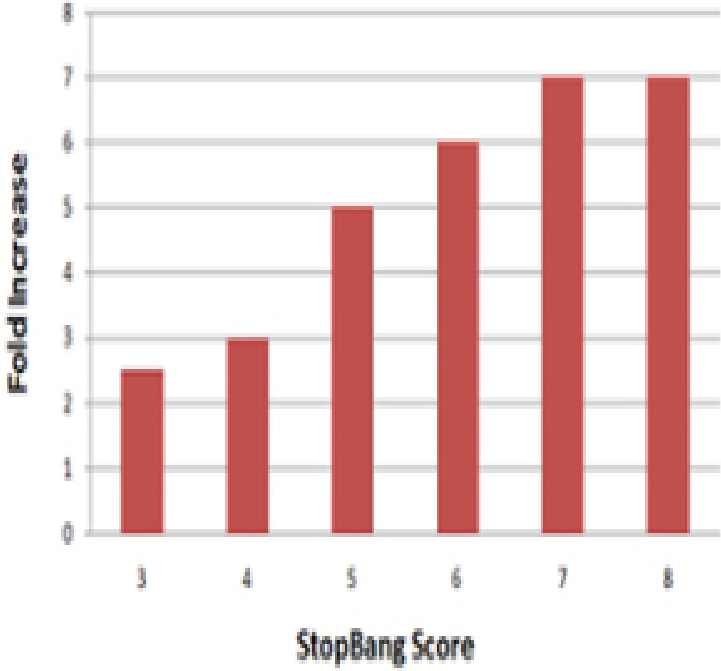

If the STOPBang score is 3 vs. 0-2, the risk of obstructive sleep apnea is **2.5 fold**.

If the STOPBang score is **4** vs. 0-2, the risk of obstructive sleep apnea is **3 fold**.

If the STOPBang score is **5** vs. 0-2, the risk of obstructive sleep apnea is **5 fold**.

If the STOPBang score is **6** vs. 0-2, the risk of obstructive sleep apnea is **6 fold**.

If the STOPBang score is **7** or 8 vs. vs. 0-2, the risk of obstructive sleep apnea is **7 fold**.

Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun Y. Br J Anaesth 2012; 108:768-75