

Nursing of long-term ventilated SCI-patients - needs, goals and limitations

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Conference Theme: **Quality of Life:** *Can the SCI Nurse Make a Difference?*

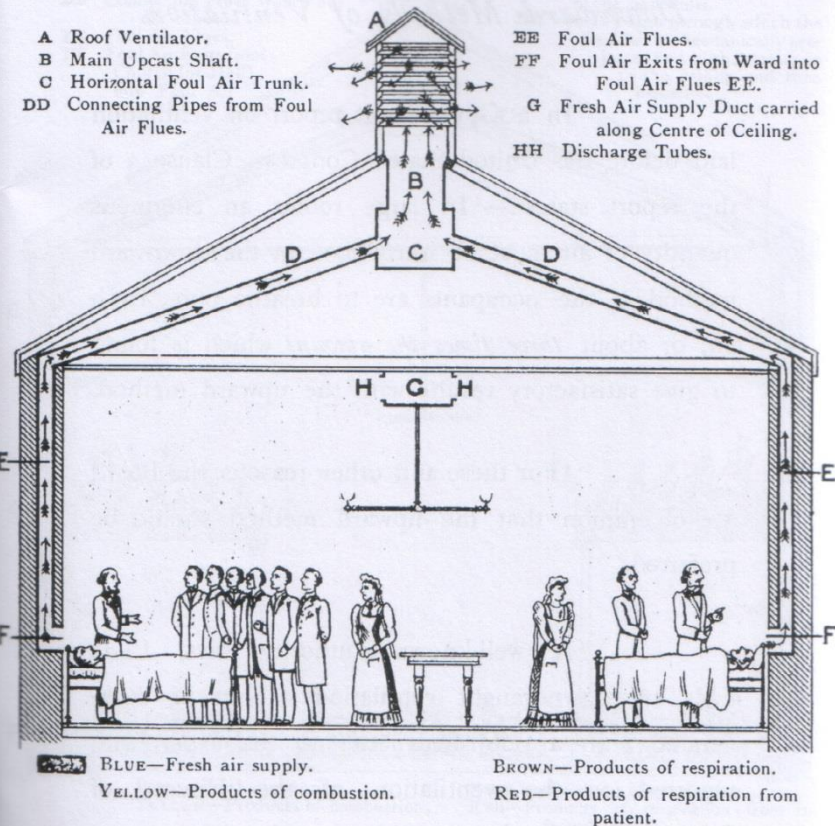
Resources for preparation:

- Own experience
- German literature
- English literature
- A historic book:

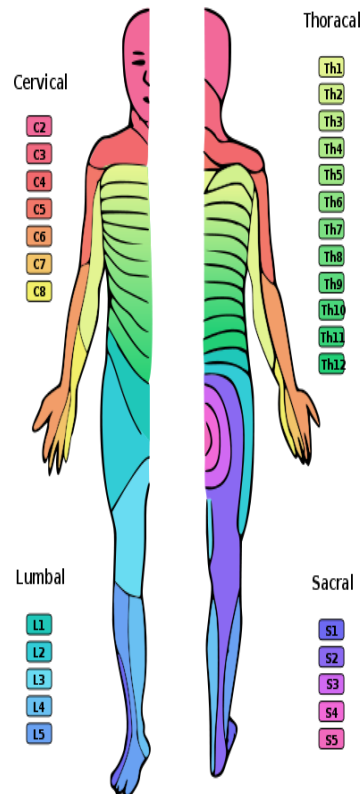
„Natural and artificial methods of ventilation“ (1899). Chapters:

- ... Volume air required for ventilation
- ... Air analysis
- ... Testing ventilators
- ... Natural v. mechanical ventilation
- ... Hot air heating
- ... Cost of mechanical and natural systems of ventilation as applied to hospitals

“MECHANICAL VENTILATION ON THE DOWNDRAUGHT PRINCIPLE, BY IMPULSION, OR THE ‘PLENUM’ SYSTEM, APPLIED TO A HOSPITAL WARD.



A quick glance at the respiration system and SCI

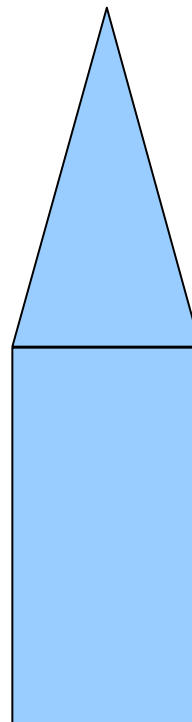


C2 and higher

Tetraplegia

Paraplegia

Pedestrian



Diaphragm paralyzed, platysma-breathing possible

Diaphragm intact, no intercostals (C3-C4)

Intercostals paralyzed level-wise (C5-C8)

Weak cough (T1-T12)

No impairment (L1 and below)

AIS-grade?

Complete or incomplete?

applicable
respiratory musculature

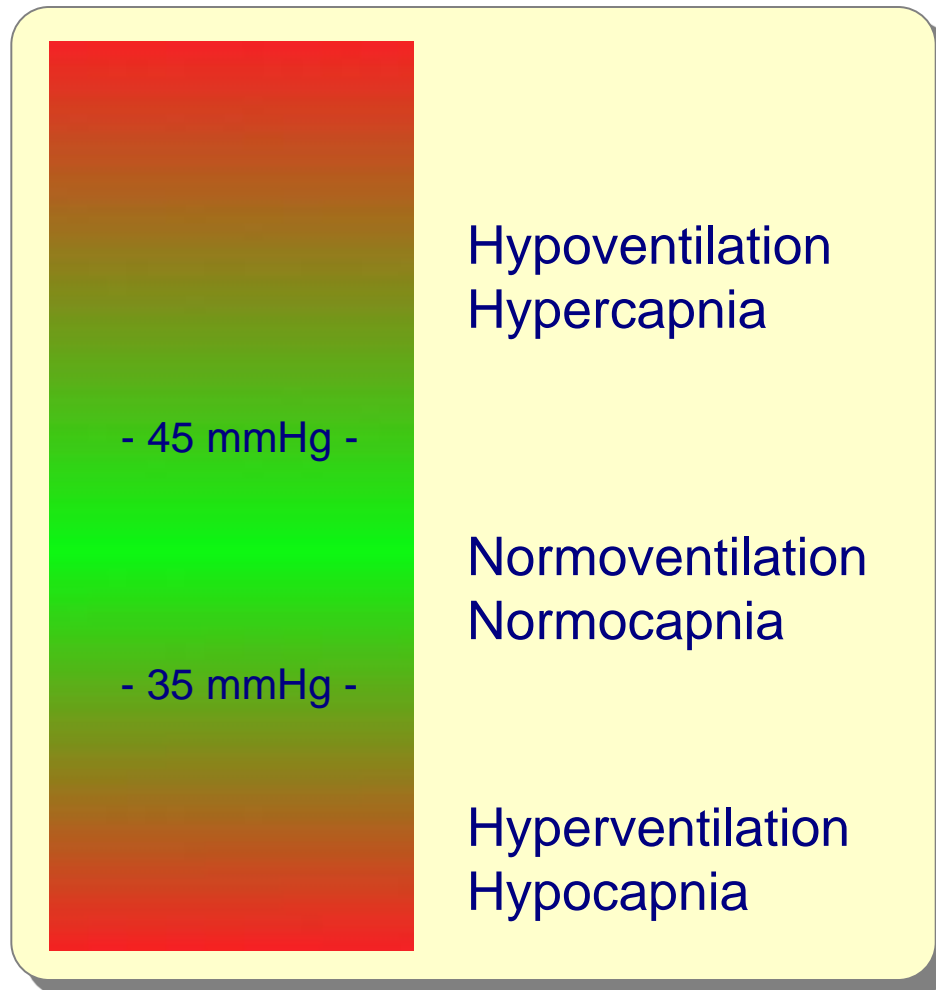
What other things do affect the respiratory system in SCI?

- The failure of respiratory muscles
- A paradox movement of the thoracic cage
- Vagotonus → **A blood pressure of 80 / 40 mmHg is normal for tetraplegia**
- Bronchospasm → **makes breathing difficult or also impossible**
- Increased amount of intestinal gases
- Thermoregulatory dysfunction (profound above T6)

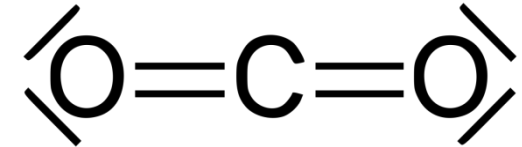


**Every degree more temperature means
13-14% more carbon dioxide in the blood.
What means greater urge to breathe.**

Facts about carbon dioxide and ventilation



Graphic by S. Tiedemann



Quelle: Wikimedia
Autor: Yikrazuul
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Picture by S. Tiedemann

Normal
diaphragm
movement:

6-8 cm!

**Less
movement of
the diaphragm
means less
tidal volume!**

So, where do we find ventilated SCI-patients?

Place of accident
(no issue today)



Picture by Thue - Eigenes Werk, Gemeinfrei,
<https://commons.wikimedia.org/w/index.php?curid=164725>

**Intensiv care unit (ICU) /
operation theatre (no issue today)**



Picture by Blogotron (Eigenes Werk) [CC0],
via Wikimedia Commons

Respiratory care ward *or* **rehabilitation ward**
or **special ward for SCI tetraplegic patients**
(high dependency ward) *or* ...



Picture by S. Tiedemann

Outside the hospital:

- @home
- in a nursing home



Picture by courtesy of Franz Benten

Options for long-time ventilation with SCI-patients

Invasive via an tracheal cannula

Non invasive via mask (nasal or fullface)

... really an issue by itself!

Via phrenic nerve stimulation (or direct diaphragm pacing?)

... really an issue by itself!

Invasive long time ventilation – what is different???



Picture by courtesy of Franz Benten

- A very high technical dependency
- A vital threat every moment! Safety!
- Air hunger (dyspnea), how to help?
- It's difficult to speak out loud
- Mood & psyche

Quality of life as long time ventilated human being?!

Things to know about if you take care of these patients

Anatomy & physiology of the respiratory system
which is effected by SCI

Basics of artificial ventilation

Knowledge about tracheal cannulas,
ventilators & (basic) monitoring

Airwaymanagent

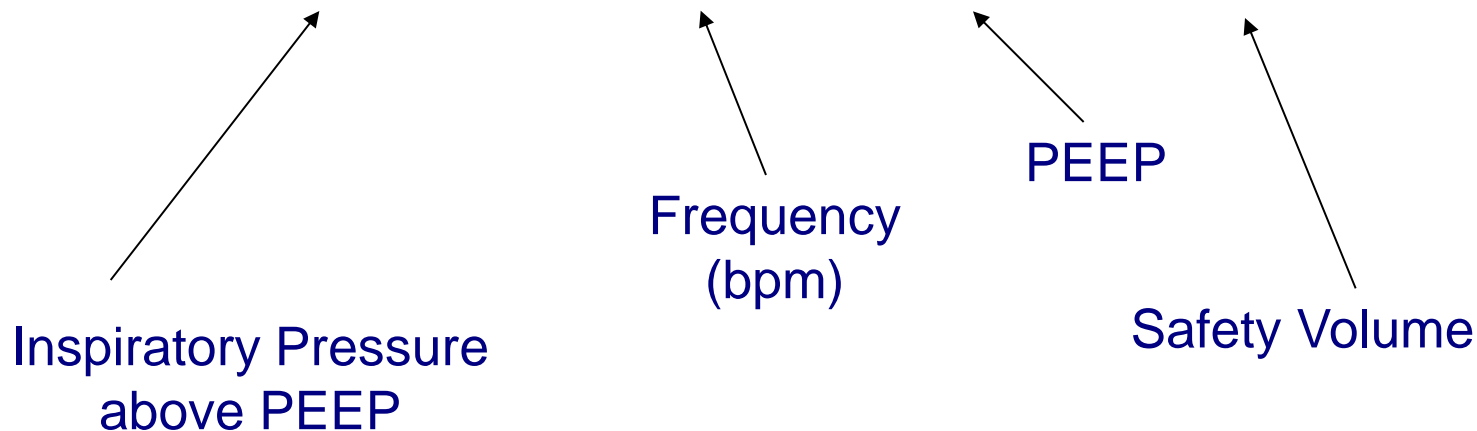
How to react in case of ventilatory problems?

Manipulation of the ventilation (!?)

Important: How to ventilate a SCI-Patient – the respirator settings*

(Invasive longterm ventilation, no ICU setting)

12 / 12 / 5 / 500



Mode: Assisted Pressure Controlled Ventilation

* These settings are a good point to start. But take care for the individual settings!

What is the goal for the tidal volume in SCI ventilation?

Standard formula: (ideal) **body weight** *multiplied* by a **factor** ...

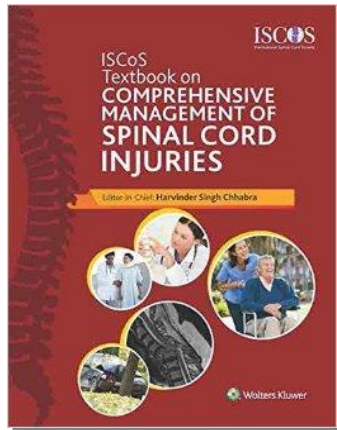
Normal **spontaneous** tidal volume **factor: 6,3** 80 kg → **Tv = 504 ml**

ICU-Ventilation,

for example shock lung ventilation (ARDS): **Factor = 4-8** (lung protective)

Example: 80 kg → Tv between 320 to 640 ml





“For mechanically ventilated patients, larger tidal volumes (**> 30 ml/kg**) decreases atelectasis.” (p. 136, Acute Care)

80 kg x **30 ml** → Tv = **2400 ml (!)**

How long??? Now answer ...

“Optimal ventilator settings in persons with SCI are not known”

“In SCI individuals with healthy lung, Tv **10-15 ml/kg** is set as a standard ...” (p. 465, Mechanical Ventilation)

80 kg x **10-15 ml** → Tv = 800 - 1200 ml

My recommendation/experience:

Tv *minimum* = 500 ml **and** Tv *maximum* = ibw x 10

For ibw = 80 kg → Tv between 500 and 800 ml

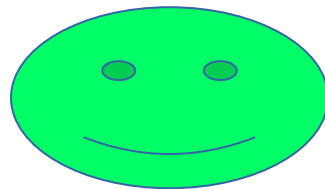
More Important: does the ventilator setting fit with my patient?

(Invasive longterm ventilation, no ICU setting)

First of all

After a quick look to the oxygen saturation ($>94\%$), have a ***look at your patients face and chest!*** What can yo see?

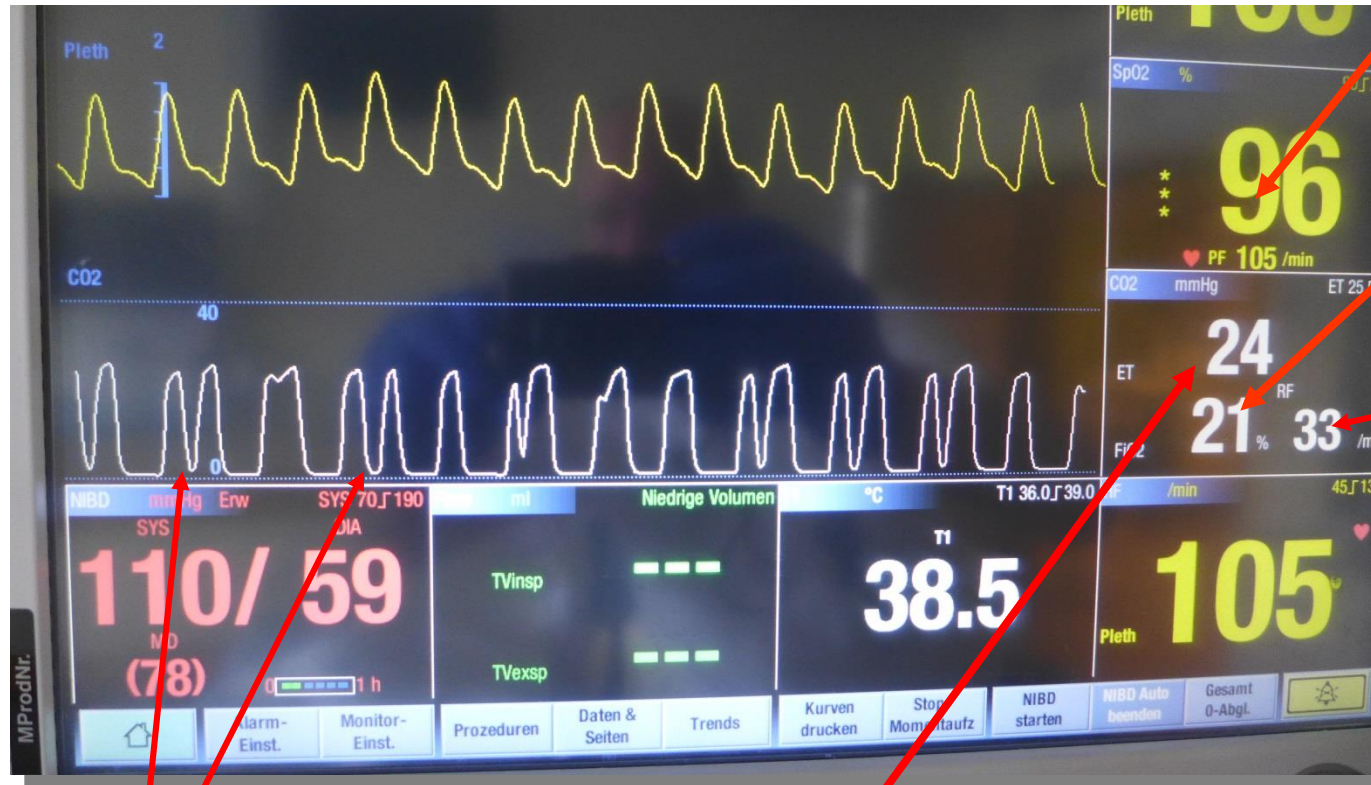
- A relaxed face?
- Calm chest movement?



- A stressed face?
- Beads of sweat?
- Restless / uneven chest movement?



And now the monitoring ...



Picture by S. Tiedemann

Saturation is ok
with room air

Tachypnoe

The patient is hyperventilated

The ventilator is not synchronized with the patient

How a monitor looks, if everything is fine:



Picture by S. Tiedemann

... ventilation is an dynamically process. You always have to adjust!

By the way, where remains all the CO₂???

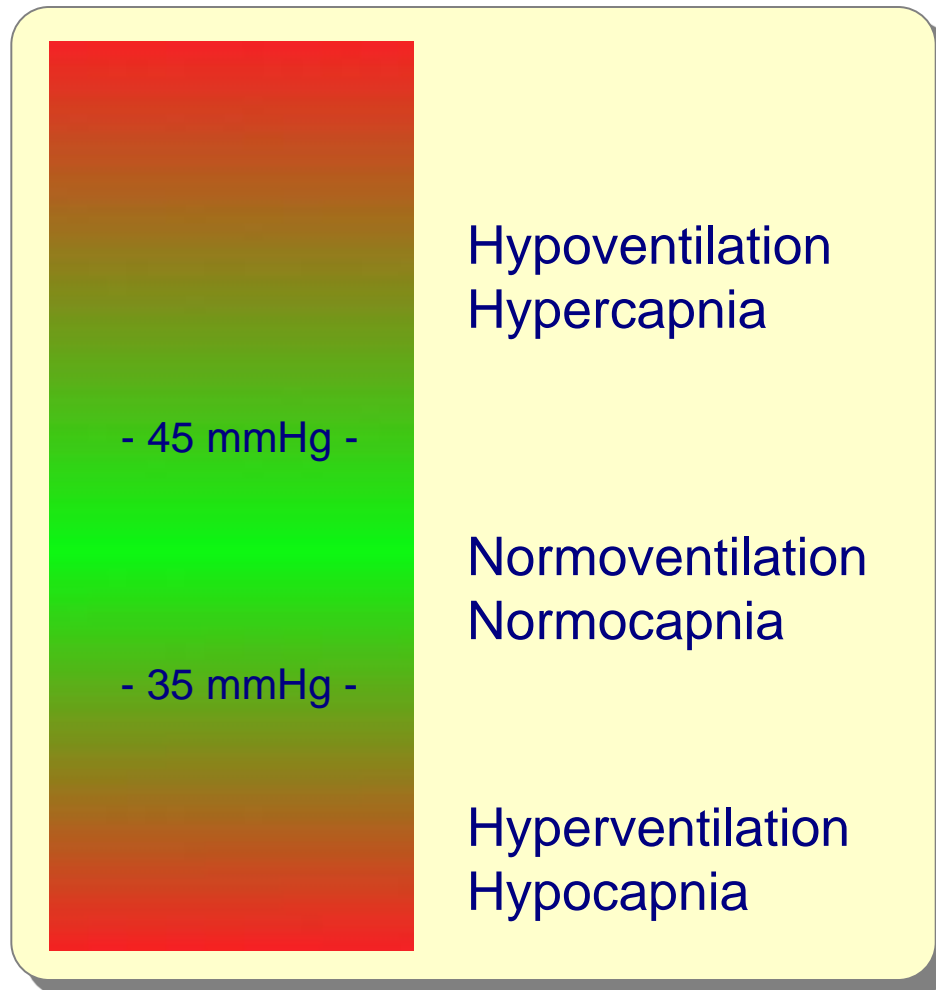


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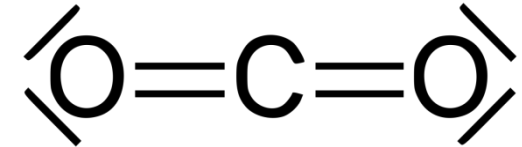
What a nurse could (should?!) do ...

- Increase or decrease the tidal volume by adjusting the inspiratory pressure
- Increase or decrease the frequency depending on the capnometry
→ Air hunger! (Dypnea)
- Suctioning (also deep if necessary)
- Humidification
- Changing of the tracheal cannula
- Know to make the ventilated patient speak loudly

Facts about carbon dioxide and ventilation



Graphic by S. Tiedemann



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Autor: Yikrazuul
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Adapting the minute volume to the CO₂:

- Increase tidal volume or frequency (or both)
- Decrease tidal volume or frequency (or both)

Active humidification in long time ventilation



Picture by S. Tiedemann



BG Unfallklinik Hamburg
Querschnittgelähmtenzentrum

Beatmungsverordnung

(Beatmungs-) Relevante Nebendiagnosen:

Respirator: ☐ Elisee 150 ☐ _____ ☐ PNS
Beatmungspflichtigkeit: ☐ 24 Stunden ☐ 20⁰⁰ - 8⁰⁰ Uhr
☐ Intermittierend bei Bedarf (siehe Bemerkungen)
☐ Invasiv ☐ Maskenbeatmung (NIV)
☐ Aktive Befeuchtung ☐ Passive Befeuchtung

Beatmungsziel: ☐ Respiratoradaptierung ☐ Weaning ab: _____
☐ Weiterführung der Langzeitbeatmung

Beatmungsmodus: ☐ (A)PCV ☐ PSV ☐ _____

Inspirationsdruck: P_{insp} / P_S: _____ bis _____ PEEP: _____ (max. 8)
☐ cmH₂O P_{max}-Alarm: _____ P_{min}-Alarm: _____
☐ hPa ☐ _____ (Flow-) Kurve / Rampe: frei wählbar, situationsabhängig

Tidalvolumen in ml: (geblockt) Zielvolumen: _____ bis _____
 Mindestvolumen = V_{tmin}: _____ (V_t-Alarm = -50 ml)
 Maximalvolumen = V_t-Alarm: _____

Frequenz in AZ / Min: _____ bis _____ F_t-Alarm: _____

Trigger (Druck/Stufe): T_{gl}: _____ T_g Exsp: _____ % des F_t

Inspirationszeit in Sek.: T_i min: _____ T_i max: _____

Atemzeitverhältnis: I:E = 1: _____ bis 1: _____ (angestrebt)

Bemerkungen / Verlauf / PNS-Verordnung

Datum _____ HZ _____

Datum/Unterschrift:

And where are the limitations???



Tiedemann
 mungstherapeut (DGP) / Respiratory Therapist
 xaminierter Krankenpfleger
 Querschnittgelähmten-Zentrum



Where are the limitations???

- Where is the point I need help as a nurse?
- What can happen?
- Who can help?

Simple, but really good questions!!!

Where is the point I need help as a nurse?

What can happen?

- Did you do everything right, according to your experience?
 - Check the patients airway! (Mucus? Cannula? Circuit? Respirator?)
 - No Solution???
- Keep calm (always good)
 - Use a **bag (mask) device** via the tracheal cannula
 - Increase FiO_2 (if possible)
 - **Call HELP** (however ... shout out loud, via telephone ...)



Where is the point I need help as a nurse?

What can happen?

- Technical problems → There is a solution: Bag valve (AMBU)
- Patients problems (more dangerous ...)
 - Persisting low saturation of oxygen and nothing helps
 - Atelectasis?
 - Aspiration?
 - Pneumonia?
 - Embolism?
 - Pulmonary oedema?
 - ...

Quality of life: speaking loudly under invasive ventilation

First step: visit the related workshop today or tomorrow! ;-)

... don't be afraid to:

- Deflate the cuff and tolerate a leakage ventilation
- Adjust the inspiratory pressure and the peep
- Use a talking tracheal cannula/tube
- Use a speaking valve in the circuit

... and the **listen!**

Vielen Dank!!! 😊



Picture by courtesy of Franz Benten

By the way, I have no conflict of interests ...