

Usability INTELLiVENT-ASV versus Conventionele beademing

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Inhoud

Amsterdam UMC

Research

- Aanleiding
- Methodiek
- Resultaten
- Discussie
- Conclusie
- Aanbevelingen

Functie als Ventilation Practitioner

- Micro, meso, macro
- Intentie/ambitie



Amsterdam UMC

- AMC en VUmc
- ~38.000 opnames
- ~19.500 medewerkers

AMC

- Academisch ziekenhuis (Level 3 Traumacentrum)
- Universiteit van Amsterdam (UvA)
- 1100 bedden





Amsterdam UMC locatie 'AMC'

Intensive Care AMC

- 50 beademingsbedden
 - Cardiopulmonale chirurgie
 - Neurochirurgie
 - VA/VV-ECMO

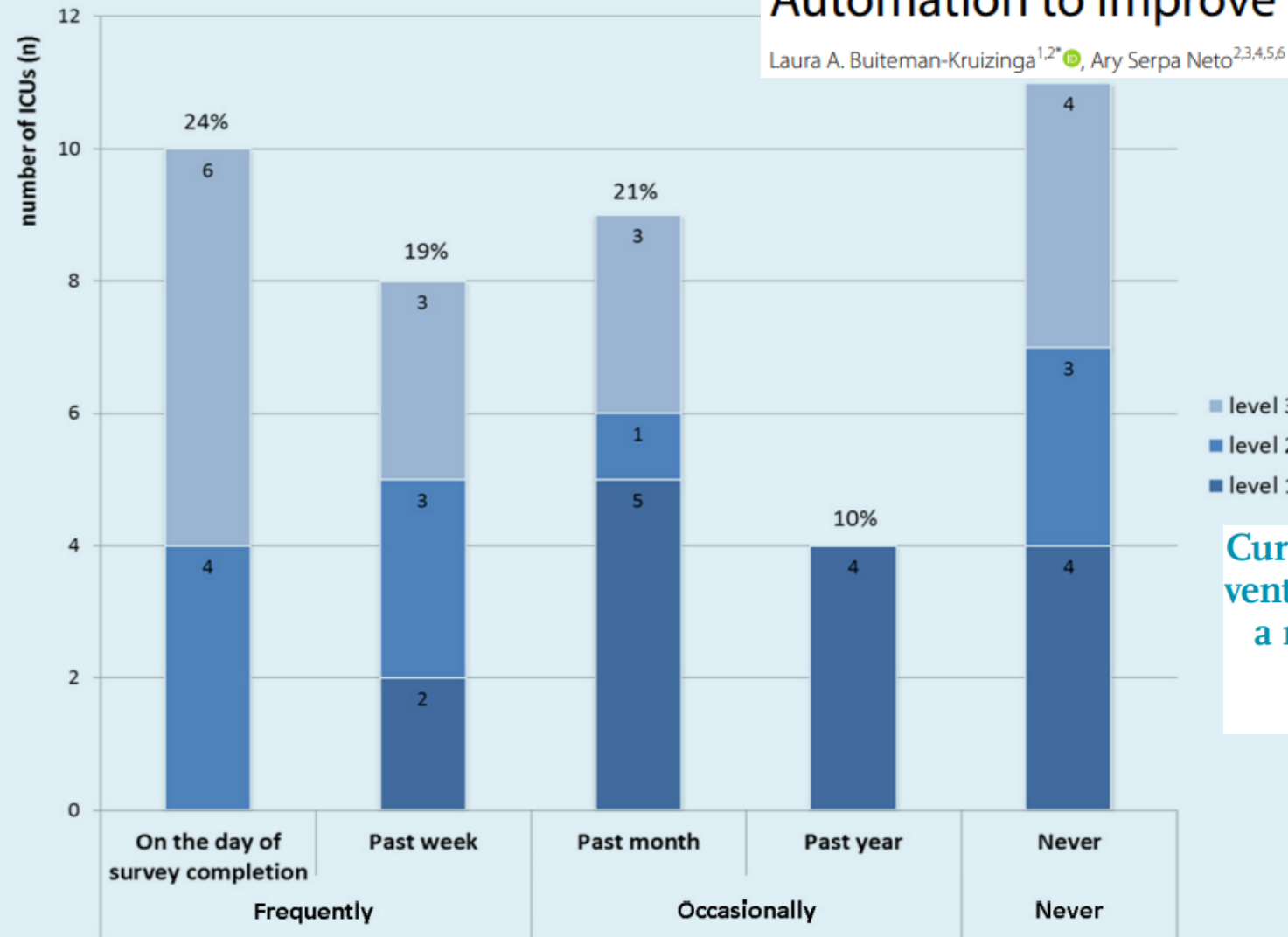
Personele bezetting

- Intensivisten 19 FTE
- Fellows 5 FTE
- AIOS/ANIOS 20 FTE
- IC-verpleegkundigen 112 FTE
- IC-Practitioners 5 FTE
- MC-verpleegkundigen 18 FTE

	2022	07-2023
IC opnames	2349	1083
Opname dagen	10437	4460
Beademingsdagen	7354	3126

Automation to improve lung protection

Laura A. Buiteman-Kruizinga^{1,2*}, Ary Serpa Neto^{2,3,4,5,6} and Marcus J. Schultz^{2,7,8,9}



Current practice of closed-loop mechanical ventilation modes on intensive care units – a nationwide survey in the Netherlands

E.F.E. Wenstedt^{1*}, A.J.R. De Bie Dekker¹, A.N. Roos¹, J.J.M. Verberne¹, H.H.M. Korsten¹, M.J. Schultz^{2,3}, A.J.G.H. Bindels¹

monitors V_T , RR, and $etCO_2$
reduction of PS and performs SBT



2011

INTELLiVENT-ASV

automated selection of V_T and RR according to the least WOB (Otis) and FOB (Mead)
monitors V_T , RR, $etCO_2$ and SpO_2
automated titrations of AMV, PEEP and FiO_2
reduction of AMV via reduction of PS, performs SBT



2002

NAVA

monitors P_{aw} and V_T



1998

ASV

automated selection of V_T and RR according to the least WOB (Otis)

PAV+

monitors flow and volume
assist in proportion to patient's effort



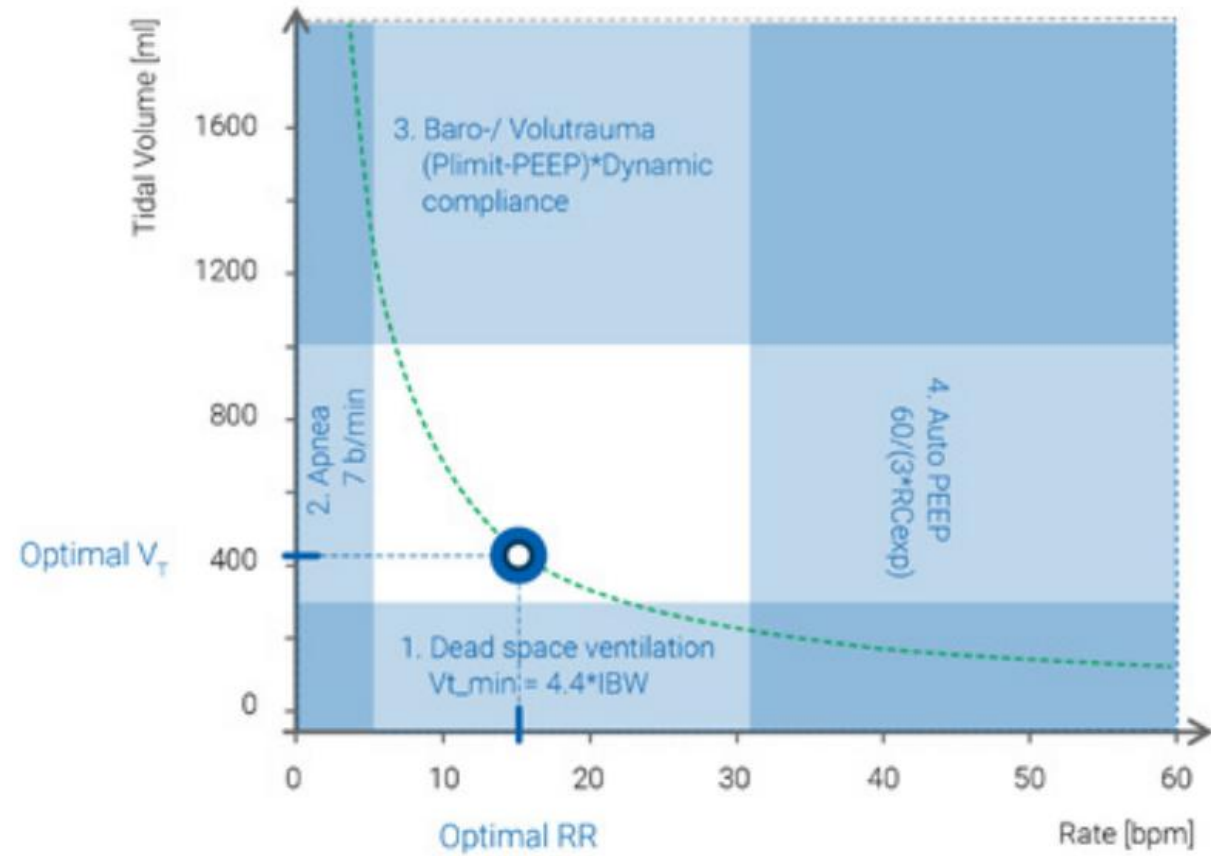
1992

The last time a closed-loop ventilation mode was used on the different levels of ICUs with access to a closed-loop ventilation mode (n = 42). The use was classified as frequently, occasionally or never if respondents with a closed-loop ventilation mode had applied this mode at least once in the preceding week, month to year, or never, respectively.



INTELLiVENT-ASV

- Laagste WOB o.b.v Otis en Meade
- 2 externe sensoren
- 3 controllers
 - %MinVol
 - PEEP
 - FiO_2





Aanleiding

- Outcome
 - Botta et al 2021

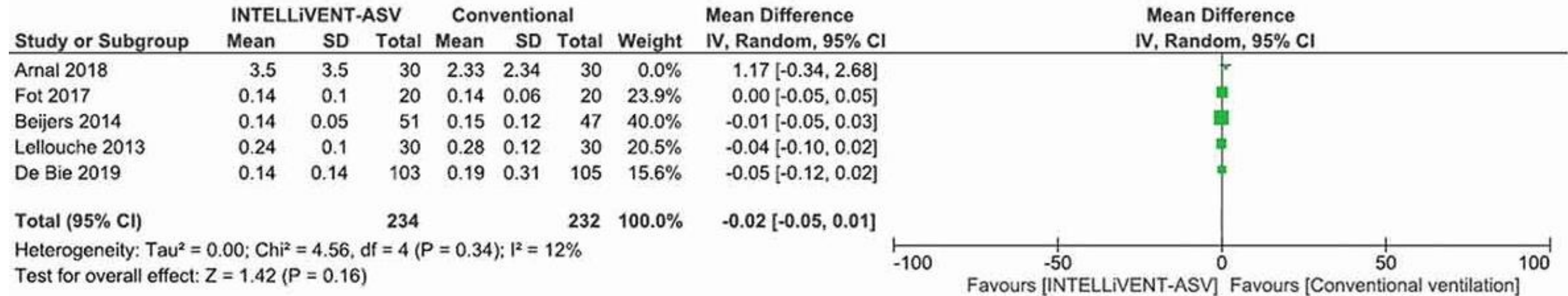
STUDY PROTOCOL

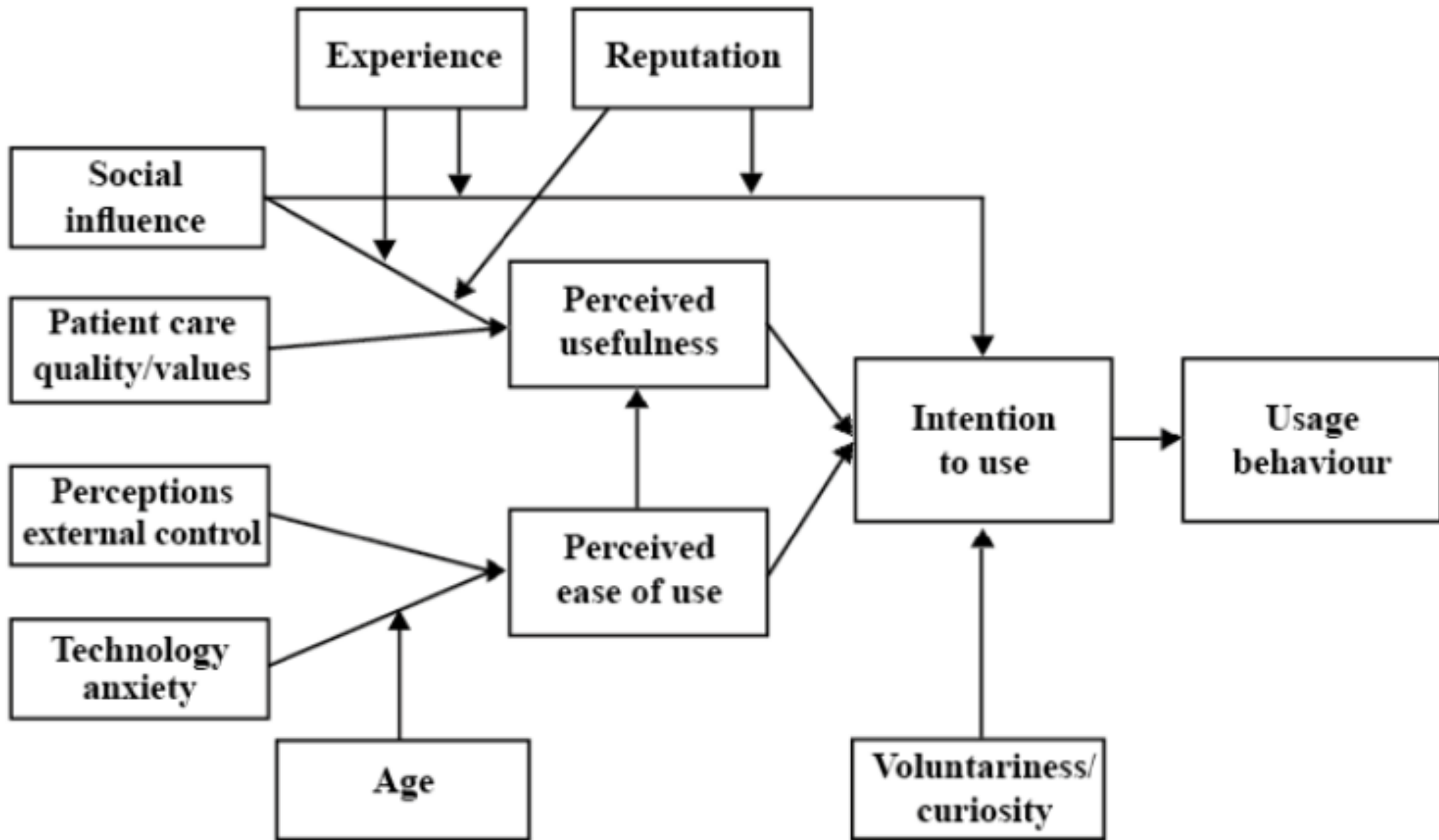
Open Access

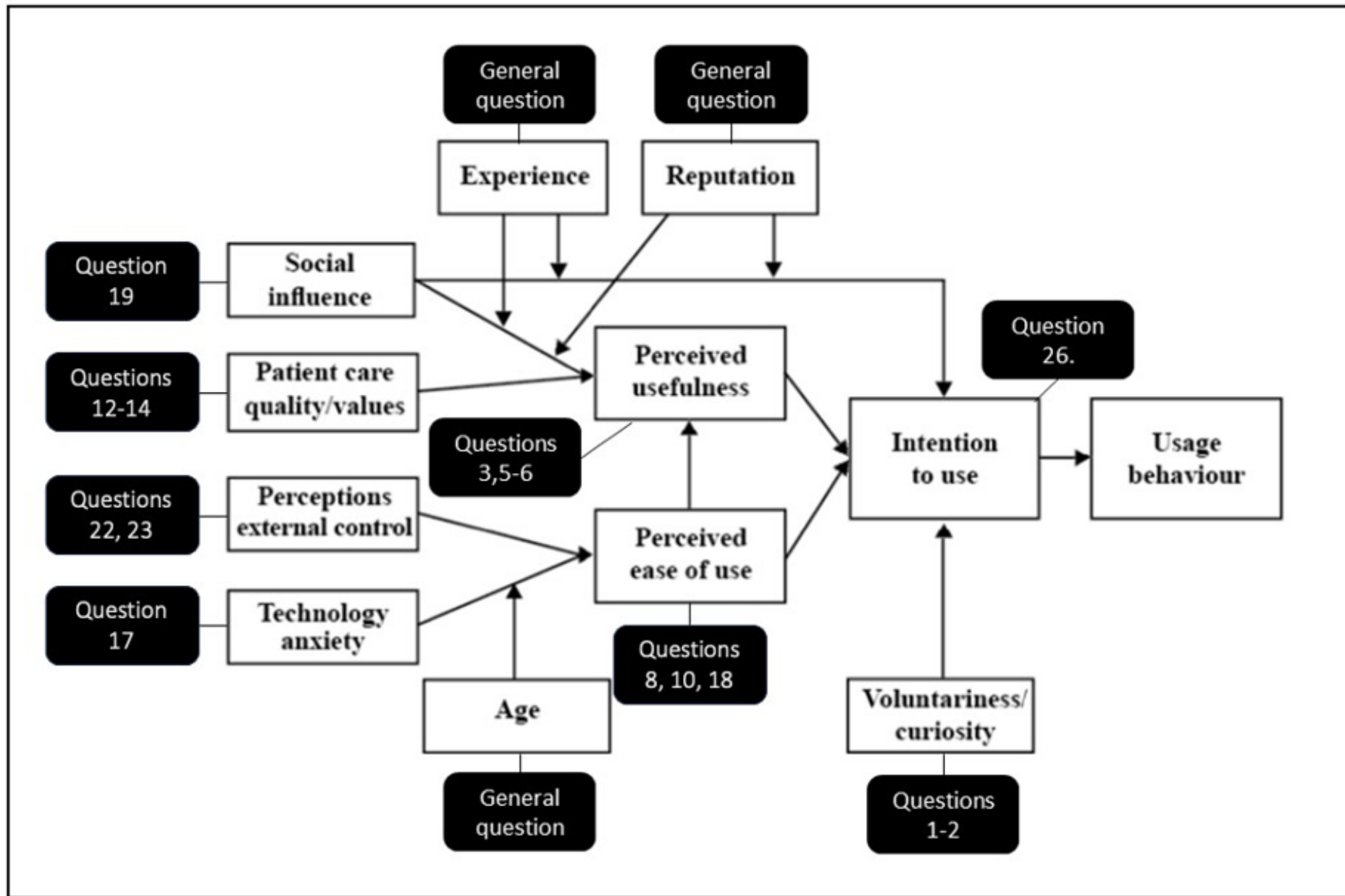
Effect of Automated Closed-loop ventilation versus conventional VEntilation on duration and quality of ventilation in critically ill



Forest plot of duration of weaning









Vraagstelling

- Gebruikersscore en SUS onder IC-verpleegkundigen
- Inzicht in barrières t.a.v. iASV en conventionele beademing

Hypothese

- Gebruikersscore en SUS is hoger bij iASV beademing



Methodiek

Convenience sampling tussen 01-05-2023 en 31-06-2023

- Gebruik ACTiVE inclusie

Infomeren team via nieuwsbrief en klinische lessen

Vragenlijst

- Poster met QR-code
- Opdracht in PDMS

Interviews

ONDERZOEK

INTELLIVENT-ASV
Versus
Conventioneel

Help mee door vragenlijst in te vullen!!

Dit onderzoek vergelijkt gebruiksvriendelijkheid van INTELLIVENT-ASV versus conventionele beademing.
Hoe help je??
Je hoeft alleen de vragenlijst in te vullen, kost maximaal 5 minuten!!!

SCAN MIJ!!!

Conventionele beademing

IASV beademing

Vragen?? Mail t.d.vanleijssen@amsterdamumc.nl



Methodiek

Vraag 7, 11, 15, 20 en 21

- Likert-schaal score - 1

Vraag 4, 9, 16, 24 en 25

- 5 - Likert-schaal score

Totaal X 2,5

$$\text{SUS totaal} = ((\text{vraag } 7 - 1) + (\text{vraag } 11 - 1) + (\text{vraag } 15 - 1) + (\text{vraag } 15 - 1) + (\text{vraag } 20 - 1) + (\text{vraag } 21 - 1) + (5 - \text{vraag } 4) + (5 - \text{vraag } 9) + (5 - \text{vraag } 16) + (5 - \text{vraag } 24) + (5 - \text{vraag } 25)) * 2,5$$



Data verzameling

Vragenlijst

- Castor EDC
- Vragenlijst en beademingsdata
- Elke dienst (behalve dienst van inclusie)
- SPSS

Interview

- Thematische analyse via ATLAS.ti



Resultaten

- 25 patiënten
- 227 diensten → 118 compleet ingevulde vragenlijsten (51,9%)
- 57 verschillende IC-verpleegkundigen

Verpleegkundigen karakteristieken

Tabel 1: IC-verpleegkundigenkarakteristieken

	INTELLiVENT-ASV	Conventioneel	P-waarde
Leeftijd N (%)			
<30 jaar	25 (37,8%)	17 (39,0%)	0.152
30-45 jaar	29 (39,2%)	13 (23,7%)	
>45 jaar	16 (23,0%)	18 (37,3%)	
Ervaringsjaren N (%)			
<5 jaar	42 (60,3%)	22 (45,8%)	0.035
5-10 jaar	14 (19,2%)	6 (13,6%)	
10-20 jaar	5 (6,8%)	3 (6,8%)	
>20 jaar	9 (13,7%)	17 (33,8%)	
Geslacht N (%)			
Man	19 (29,1%)	16 (40,6%)	0.369
Vrouw	51 (70,9%)	32 (59,4%)	
Functie N (%)			
IC verpleegkundige	69 (98,7%)	47 (96,6%)	0.787
IC verpleegkundige i.o.	1 (1,3%)	1 (3,4%)	

N = numerieke aantallen, % = percentage



Tabel 2: Patiëntkarakteristieken

	INTELLiVENT-ASV	Conventioneel	P-waarde
Aantal patiënten (N)	13	12	
Aantal diensten beademing (N)	125	102	
Reden van opname (N)	12 medische conditie 1 electieve chirurgie	10 medische conditie 2 spoed chirurgie	
Reden van mechanische beademing (N)	1 respiratoir falen 5 hartstilstand 6 verminderd bewustzijn 1 luchtwegbescherming	1 respiratoir falen 3 hartstilstand 6 verminderd bewustzijn 2 luchtwegbescherming	
APACHE II	22 (IQR 17,5-28)	19,5 (IQR 16-23,75)	0.954
Leeftijd >60 (N)	7	4	
Gebruikte beademingsmodi (N)	125 INTELLiVENT-ASV	17 Pressure Controlled 84 Pressure Support 1 Volume Controlled	

Data wordt gepresenteerd als mediaan (interquartile range), N = numerieke aantallen, APACHE II = Acute Physiology and Chronic Health Evaluation II, RASS = Richmond Agitation and Sedation Scale score, AMV = Ademminuutvolume, PEEP = Positive End Expiratory Pressure, Pmax = maximal pressure, P_{insp} = Inspiratory pressure, FiO₂ = Fraction of inspired oxygen, eTCO₂ = End Tidal CO₂.

Patiënten karakteristieken



Patiënten karakteristieken

Tabel 2: Patiëntkarakteristieken

	INTELLiVENT-ASV	Conventioneel	P-waarde
RASS	-4 (IQR -5 - -3,75)	-3 (IQR -5 - -1)	<0.001
Sedativa en analgesie (N)			
	14 Geen	14 Geen	
	38 Propofol	26 Propofol	
	1 Midazolam	0 Midazolam	
	1 Dexmedetomidine	1 Dexmedetomidine	
	18 Opiaten	10 Opiaten	

Data wordt gepresenteerd als mediaan (interquartile range), N = numerieke aantallen, APACHE II = Acute Physiology and Chronic Health Evaluation II, RASS = Richmond Agitation and Sedation Scale score, AMV = Ademminuutvolume, PEEP = Positive End Expiratory Pressure, Pmax = maximal pressure, P_{insp} = Inspiratory pressure, FiO₂ = Fraction of inspired oxygen, eTCO₂ = End Tidal CO₂.



Tabel 2: Patiëntkarakteristieken

	INTELLiVENT-ASV	Conventioneel	P-waarde
Teugvolume (ml)	515 (IQR 415-710)	507 (IQR 455-554)	0,420
Ademfrequentie	16 (IQR 13-21)	22 (IQR 16-28)	<0,001
AMV (L)	9,03 (IQR 7,73-10,21)	11,11 (IQR 8,35-13,67)	<0,001
PEEP (cm H ₂ O)	6 (IQR 5-8)	6 (IQR 5-8)	0,010
Pmax (cm H ₂ O)	23 (IQR 17,5-26)	19 (IQR 16-21)	<0,001
Pinsp (cm H ₂ O)	14 (IQR 11-17)	10 (IQR 8-12)	<0,001
FiO ₂ (%)	29 (IQR 22-35)	40 (IQR 30-45)	<0,001
PaO ₂ (kPa)	10,5 (IQR 9,45-11,40)	10,5 (IQR 9,48-12,03)	0,475
PF-ratio (mmHg)	287,07 (IQR 212-342)	195,94 (IQR 165-301)	<0,001
EtCO ₂ (kPa)	5,2 (IQR 4,7-5,4)	5,1 (IQR 4,7-5,5)	0,515
pH	7,44 (IQR 7,40-7,47)	7,44 (IQR 7,39-7,47)	0,890

Data wordt gepresenteerd als mediaan (interquartile range), N = numerieke aantallen, APACHE II = Acute Physiology and Chronic Health Evaluation II, RASS = Richmond Agitation and Sedation Scale score, AMV = Ademminuutvolume, PEEP = Positive End Expiratory Pressure, Pmax = maximal pressure, Pinsp = Inspiratory pressure, FiO₂ = Fraction of inspired oxygen, eTCO₂ = End Tidal CO₂.

Patiënten karakteristieken



Primaire uitkomst

Tabel 3: Gebruikersscore en SUS totaal

	INTELLiVENT-ASV	Conventioneel	P-waarde
Gebruikersscore			
SUS			

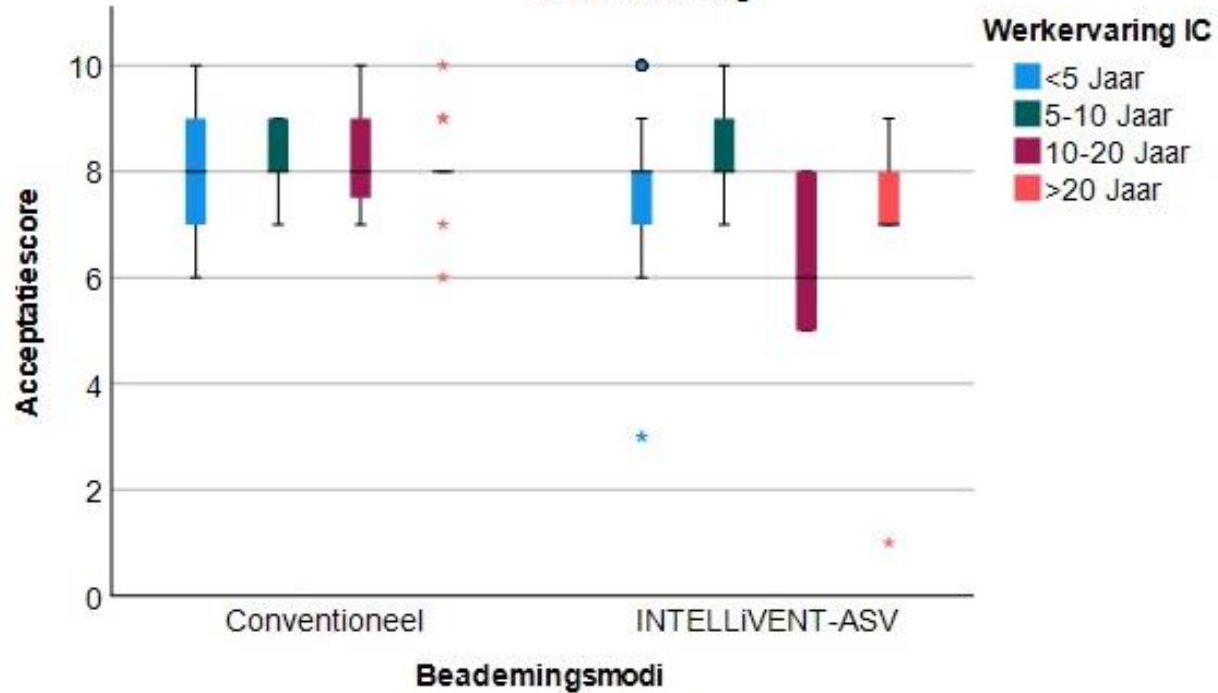
SD = Standard deviation



Subanalyse

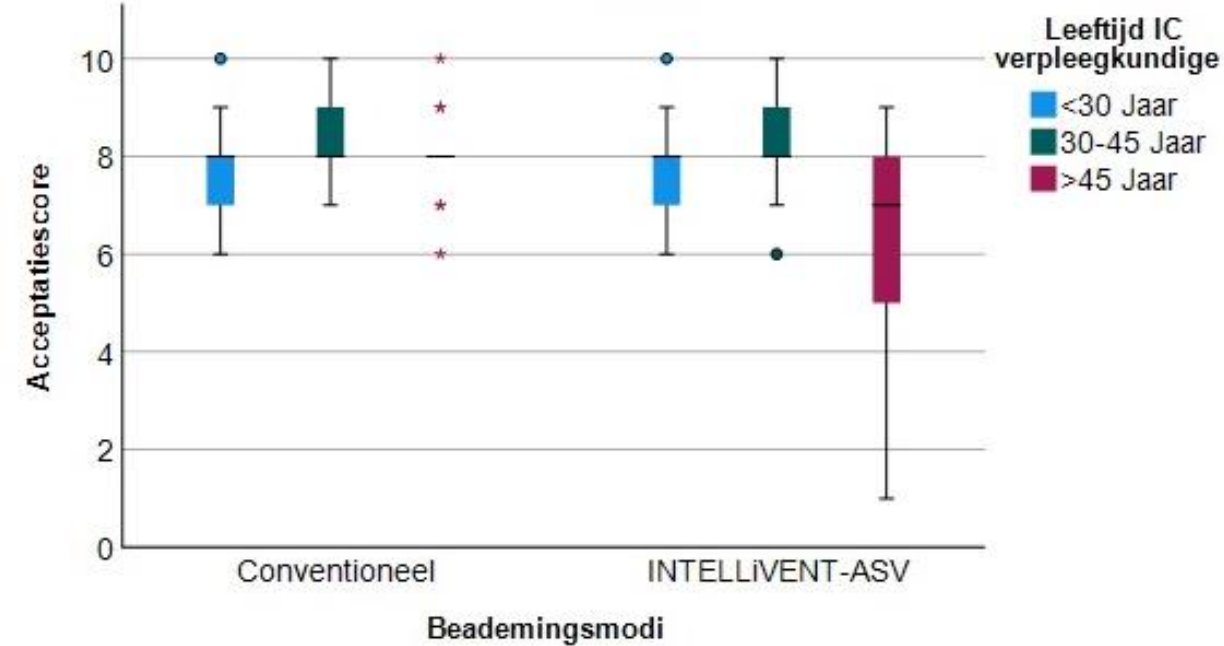
Boxplot acceptatiescore

IC werkervaring



Boxplot acceptatiescore

Leeftijd





Interviews

iASV

Nadelen

- Afhankelijkheid sensoren
- Extra training en kennis
- Overmatige alarmen

Conventioneel

Nadelen

- Handmatige aanpassingen
- Beperkte feedback
- Afhankelijk van verpleegkundige kennis



Discussie

64 patiënten

- iASV versus conventioneel
- Endpoints: handmatige aanpassingen, user acceptance, sedatiebehoefte en beademingsduur

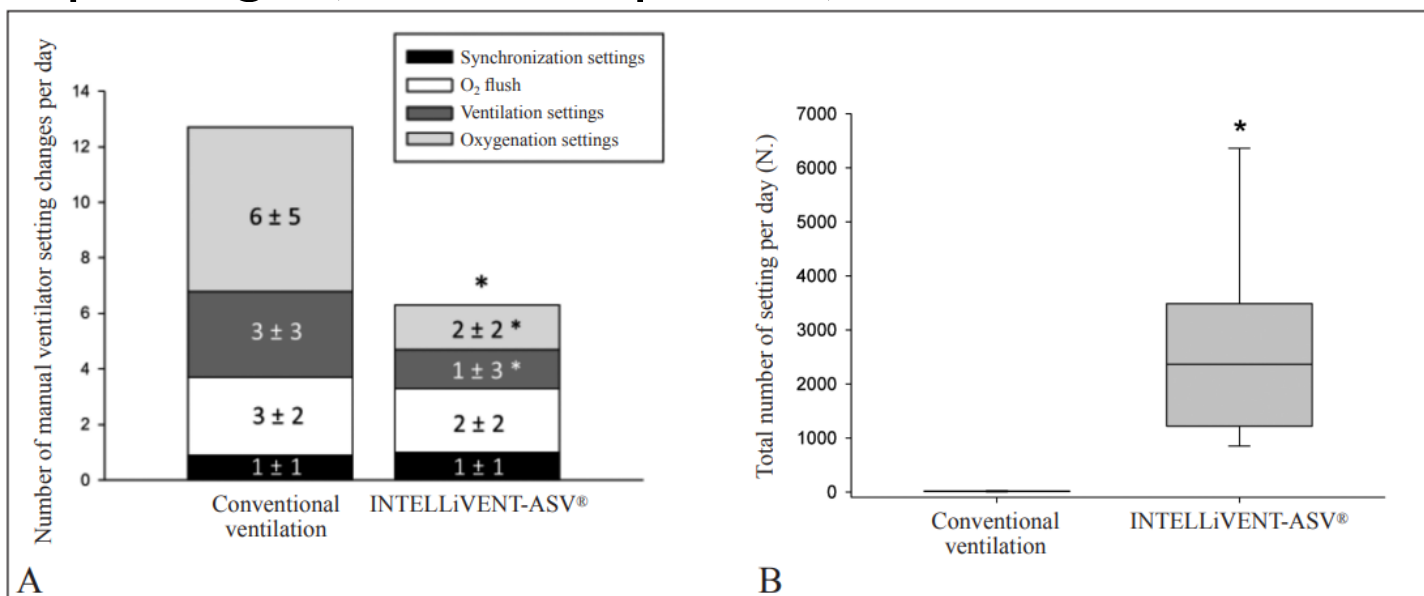
User acceptance score

- Likert schaal (0-10)
- IC-verpleegkundigen: 0 (0-1)
- Intensivisten: 0 (0-1) iASV versus conventioneel
- Ander bevoegdheden IC-verpleegkundigen

Closed loop ventilation mode in Intensive Care Unit: a randomized controlled clinical trial comparing the numbers of manual ventilator setting changes

Jean-Michel ARNAL^{1,2*}, Aude GARNERO¹, Dominik NOVOTNI²,
Gaëlle CORNO¹, Stéphane-Yannis DONATI¹, Didier DEMORY¹, Gabrielle QUINTANA¹,
Laurent DUCROS¹, Thomas LAUBSCHER², Jacques DURAND-GASSELIN¹

Minerva Anesthesiologica 2018 January;84(1):58-67
DOI: 10.23736/S0375-9393.17.11963-2





Discussie

- Non-response bias
 - Selectie bias
 - Recall bias
-
- Start vragenlijst na dienst inclusie
 - Koppeling ventilator en monitor
-
- iASV sinds 3 jaar in opleiding



Conclusie

Hypothese = Gebruikersscore en SUS is hoger bij iASV beademing

- SUS en gebruikersscore statistisch lager bij iASV beademing
- SUS van >68 bij iASV en conventioneel



Aanbevelingen

Verder onderzoek

- Grotere groep patiënten
- Zelfde onderzoek, multicenter
- Verband beademingsvoorwaarde op SUS en gebruikersscore
- Verband spontane ademhaling op SUS en gebruikersscore

Onderzoek reeds gestart in Reinier de Graaf ziekenhuis en Catharina ziekenhuis



Functie als Ventilation Practitioner

- Scholing
- Management
- Implementatie
- Innovatie
- Research
- Persoonlijke ontwikkeling



Functie als Ventilation Practitioner

Micro

- Verschillende implementatie-projecten
- Trainingen/scholing

Meso

- Harmonisatie protocollen en materialen
- VP netwerk Amsterdam UMC

Macro

- Practitioners netwerk
- Congressen en symposia
- Research

Projecten:

- Aerogen verneveling
- Continue verneveling epoprostenol
- Cuffles tracheacanules
- PDMS
- Oesofagusballon
- ULTRA-nurse



Dankwoord

Medisch begeleider: R. Tepaske

Praktijk begeleider: K. Grimbergen

Verpleegkundig afdelingshoofd: S. Heijmenberg

Medisch afdelingshoofd: A. Vlaar

Senior verpleegkundig onderzoeker: F. Paulus

Complete IC team

Care Training Group: Hans Sloot & Rianne de Clerck

Studiegenoten



Referenties

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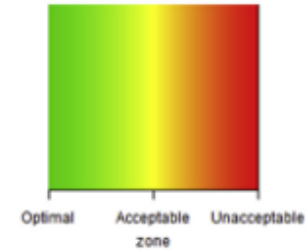
Bedankt voor uw aandacht





Fully automated postoperative ventilation in cardiac surgery patients: a randomised clinical trial

Ashley J. R. De Bie^{1,2,*}, Ary Serpa Neto^{3,4}, David M. van Meenen³, Arthur R. Bouwman¹, Arnout N. Roos¹, Joost R. Lameijer⁵, Erik H. M. Korsten^{1,2}, Marcus J. Schultz^{3,6,7} and Alexander J. G. H. Bindels¹

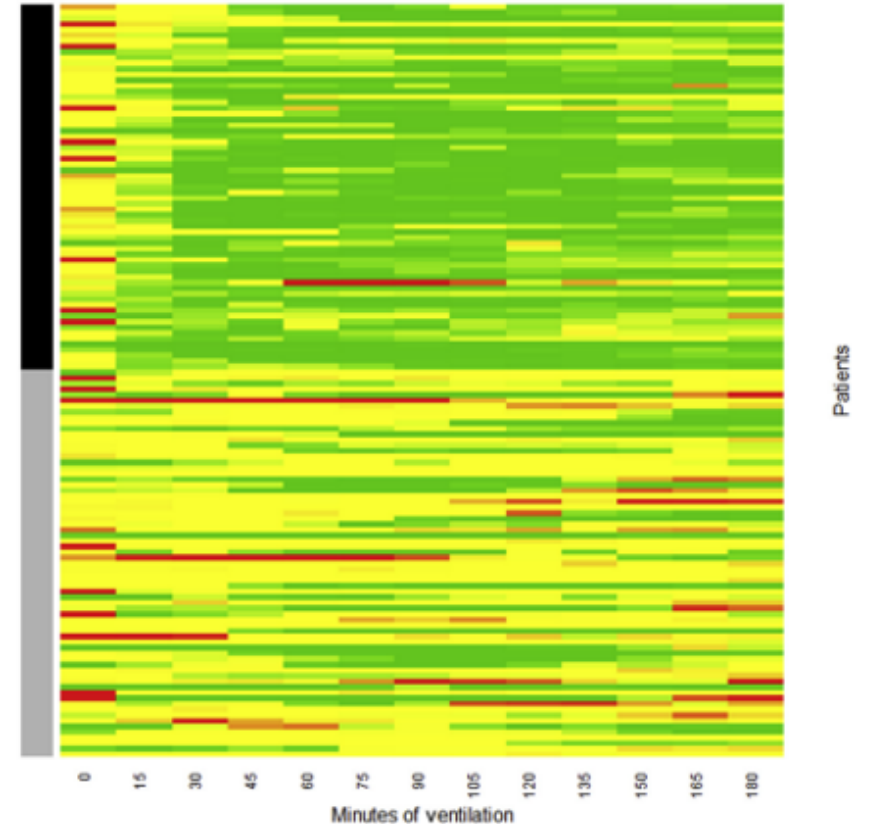


Zones of ventilation



Table 1 Zones of ventilation used to define the primary outcome (adapted from Lellouche and colleagues²³). EtCO₂, end-tidal carbon dioxide; F_{IO}₂, inspired fraction of oxygen; PBW, predicted body weight; SpO₂, oxygen pulse oximetry.

	Optimal zone	Acceptable zone	Critical zone
Tidal volume (ml kg ⁻¹) PBW	≤8	8–12	>12
Maximum airway pressure (cm H ₂ O)	<31	31–36	≥36
EtCO ₂ (kPa)	4.0–6.1	3.3–4.0 or 6.1–6.8	<3.3 or ≥6.8
SpO ₂ (%)	93–98 or ≥93 if F _{IO} ₂ ≤40%	≥98 or 85–93	<85
Definition	If any present: <i>critical zone</i>	If not in the <i>optimal zone</i> and none of the <i>critical zone</i> is present: <i>acceptable zone</i>	All must be present: <i>optimal zone</i>
Missing	If all parameters are missing, <i>zone</i> is missing. If parameters are missing, but one is available and it is in the <i>critical zone</i> , <i>zone</i> is defined as <i>critical</i> . If parameters are missing, but one is available and it is not in the <i>critical zone</i> , <i>zone</i> is defined as <i>missing</i> .		





Otis Formule

Otis' formula

Minimum work of breathing*

$$f \approx \frac{k}{RC_{rs}}$$

f – Rate

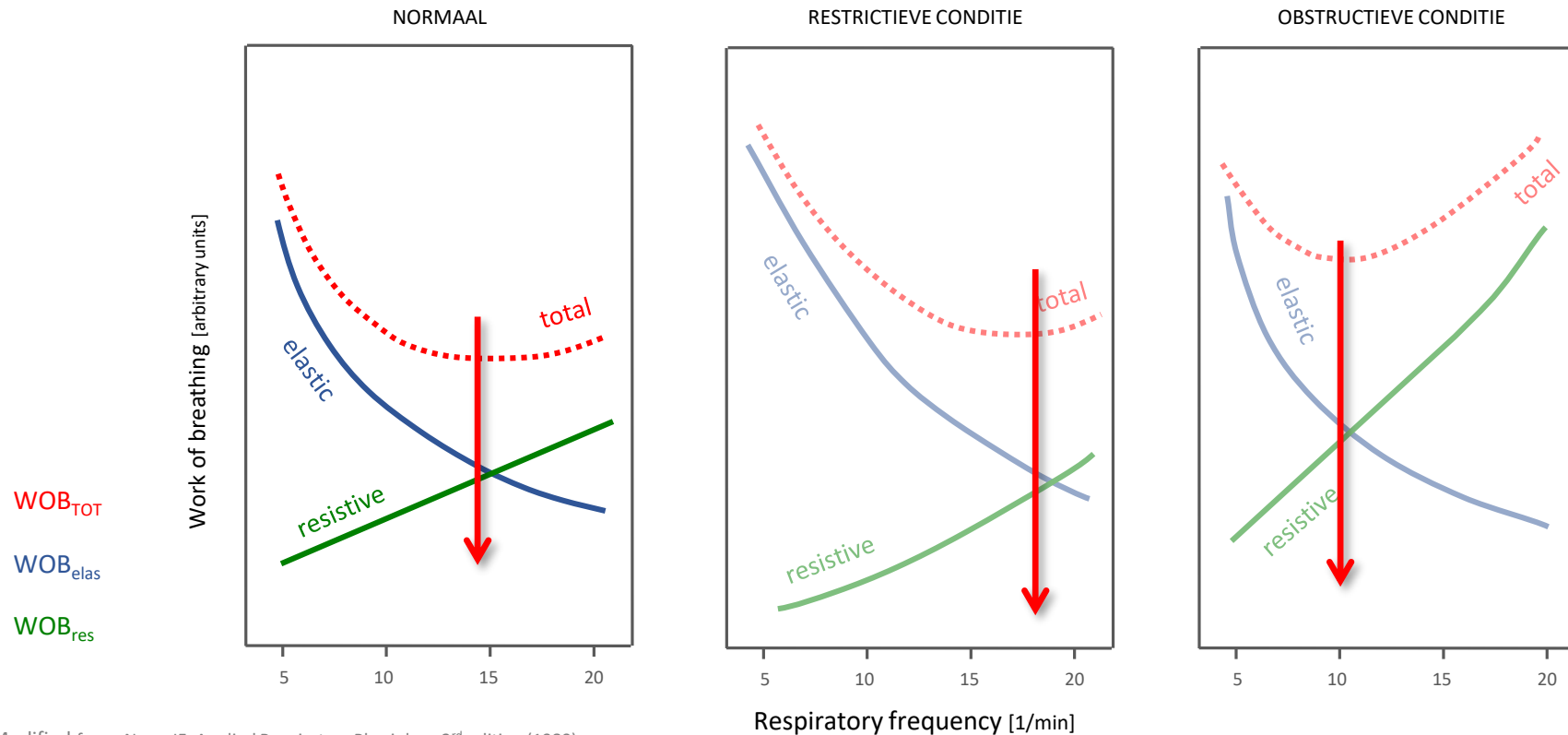
k – Constant

R – Resistance

C_{rs} – Compliance



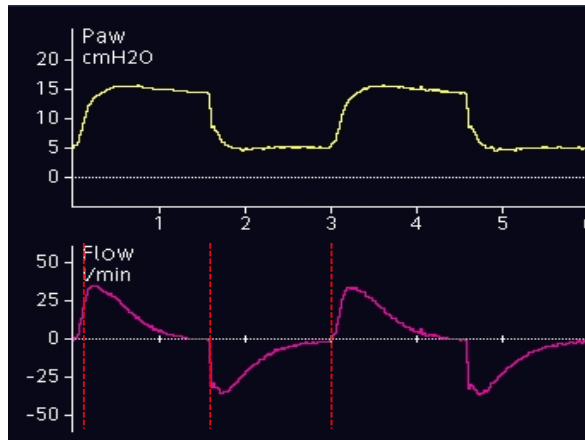
WOB en respiratory-rate afhankelijkheid





RC_{exp}

Korte tijd constante
RC_{exp} < 0.6 sec



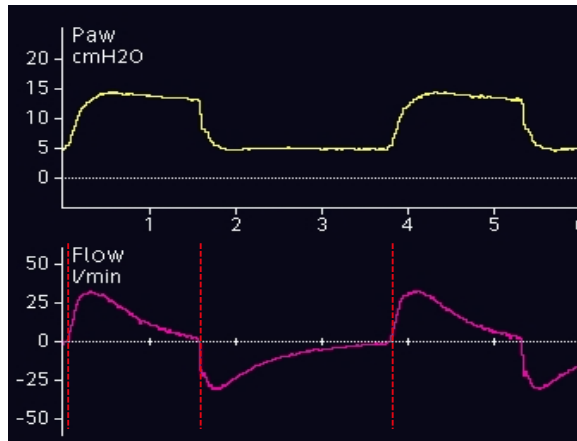
Restrictive disease

Decreased C_{stat}: ARDS, atelectasis,
chest wall stiffness

C_{stat} = 22 ml/cmH₂O

R_{insp} = 10 cmH₂O/l/sec

Normale tijd constante
RC_{exp} 0.6–0.9 sec



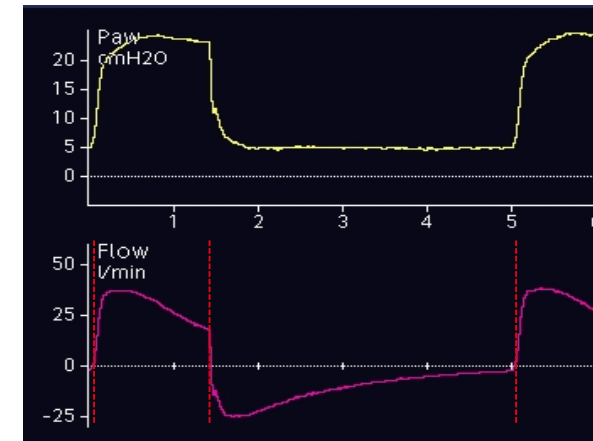
Normal

Normal C_{stat} and R_{insp} or
combination of decreased C_{stat} and
increased R_{exp}

C_{stat} = 60 ml/cmH₂O

R_{insp} = 10 cmH₂O/l/sec

Lange tijd constante
RC_{exp} > 0.9 sec



Obstructive disease

Increased R_{exp}: COPD, asthma, or
bronchospasm, ETT obstruction or
incorrect positioning

C_{stat} = 70 ml/cmH₂O

R_{insp} = 30 cmH₂O/l/sec



Normale tijd constante
RC_{exp} 0.60 sec

Normale long conditie

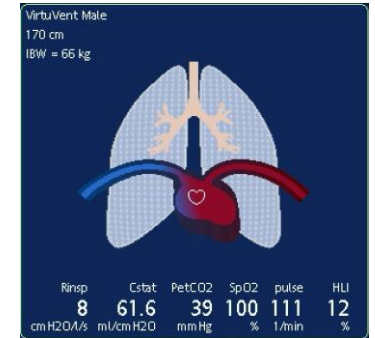
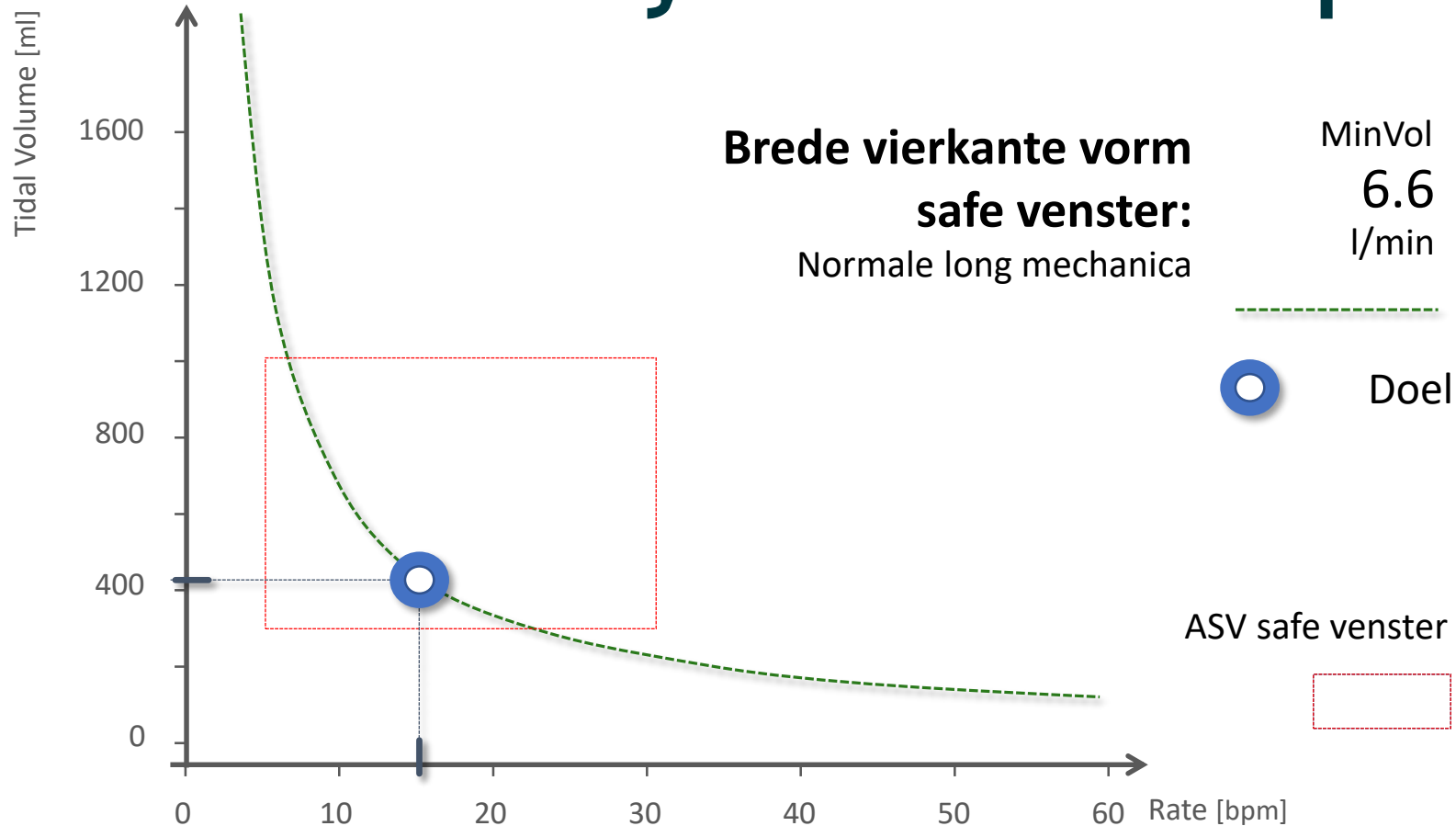
Normale Cstat and Rinsp of combinatie van verminderde Cstat en toegenomen Rinsp.

Cstat = 60.7 ml/cmH₂O

Rinsp = 10 cmH₂O/l/sec



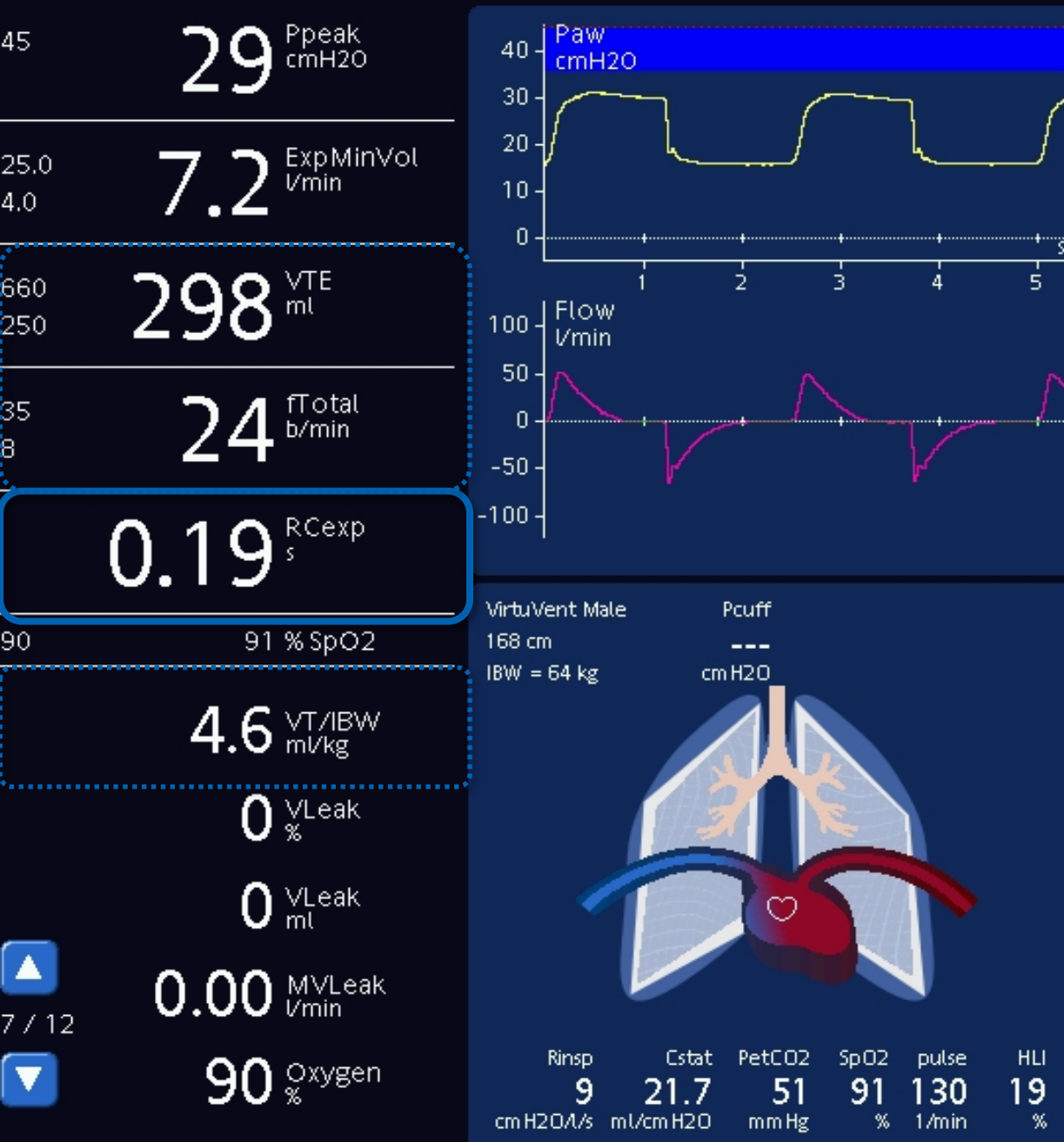
Safe venster - dynamische aanpassing



RCexp: 0.67 s

Cstat: 61.8 ml/cmH2O

Rinsp: 8 cmH2O/l/s



Korte tijd constante
 $RC_{exp} < 0.19 \text{ sec}$

Restrictieve ziekte

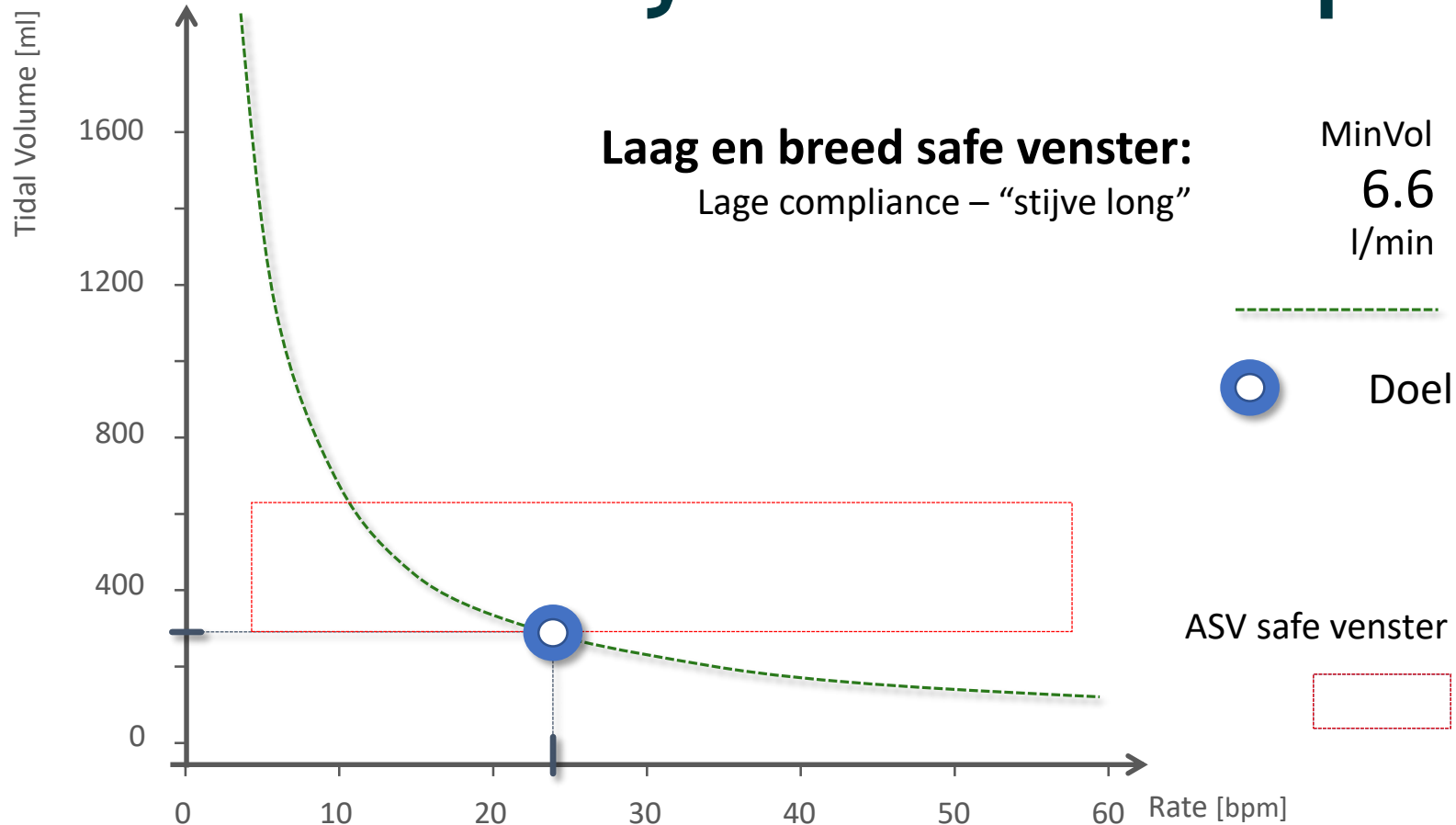
Verlaagde Cstat: ARDS, atelectase, chest wall stiffness

Cstat = 21 ml/cmH2O

Rinsp = 9 cmH2O/l/sec



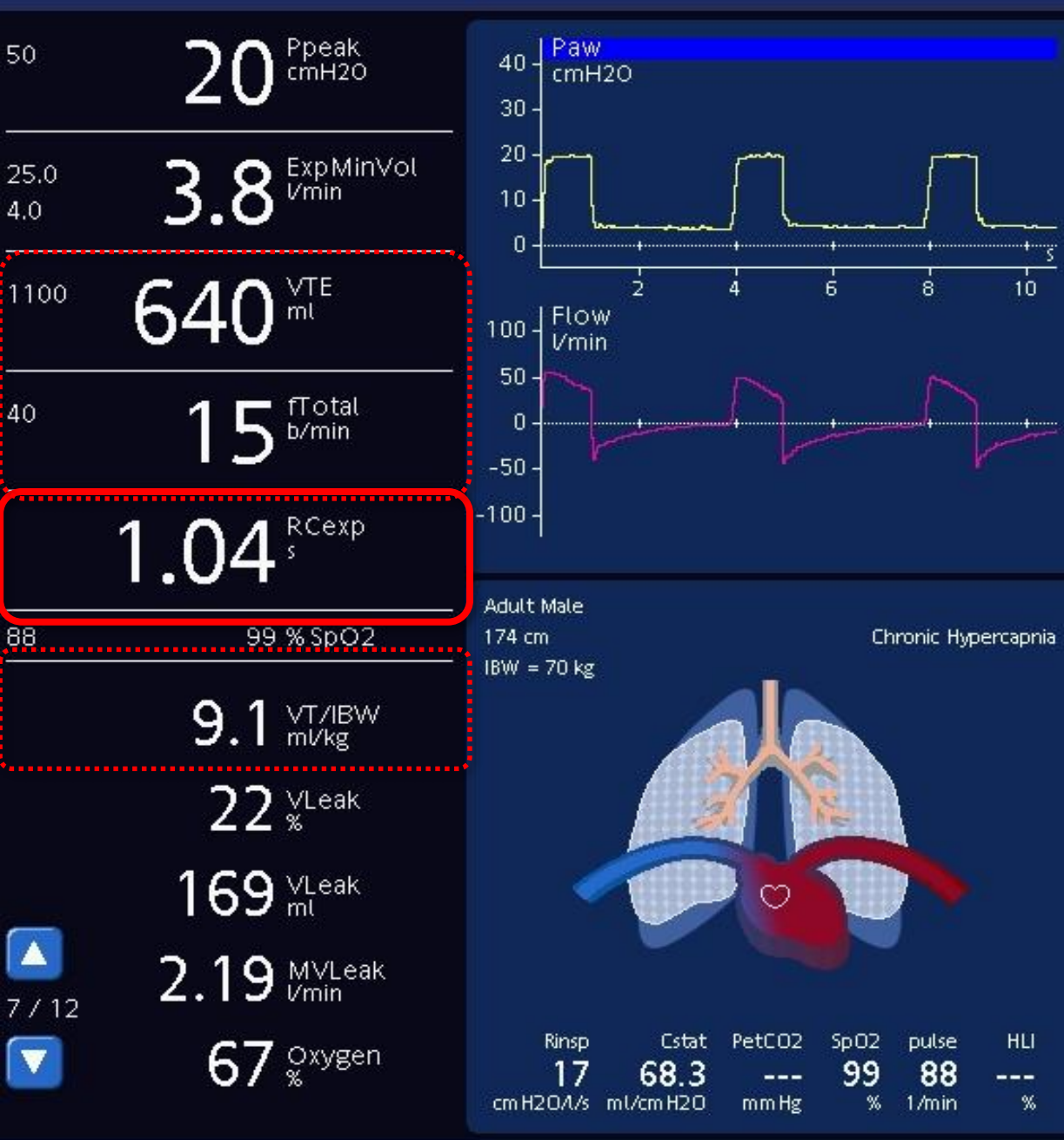
Safe venster - dynamische aanpassing



RCexp: 0.18 s

Cstat: 18 ml/cmH2O

Rinsp: 7 cmH2O/l/s



Lange tijd constante
 RC_{exp} 1.04 sec

Obstructieve long ziekte

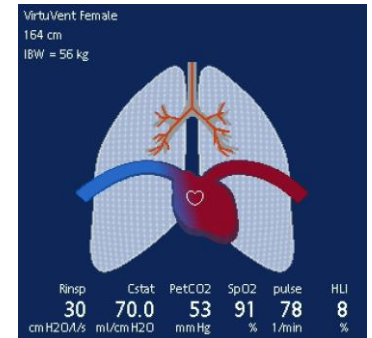
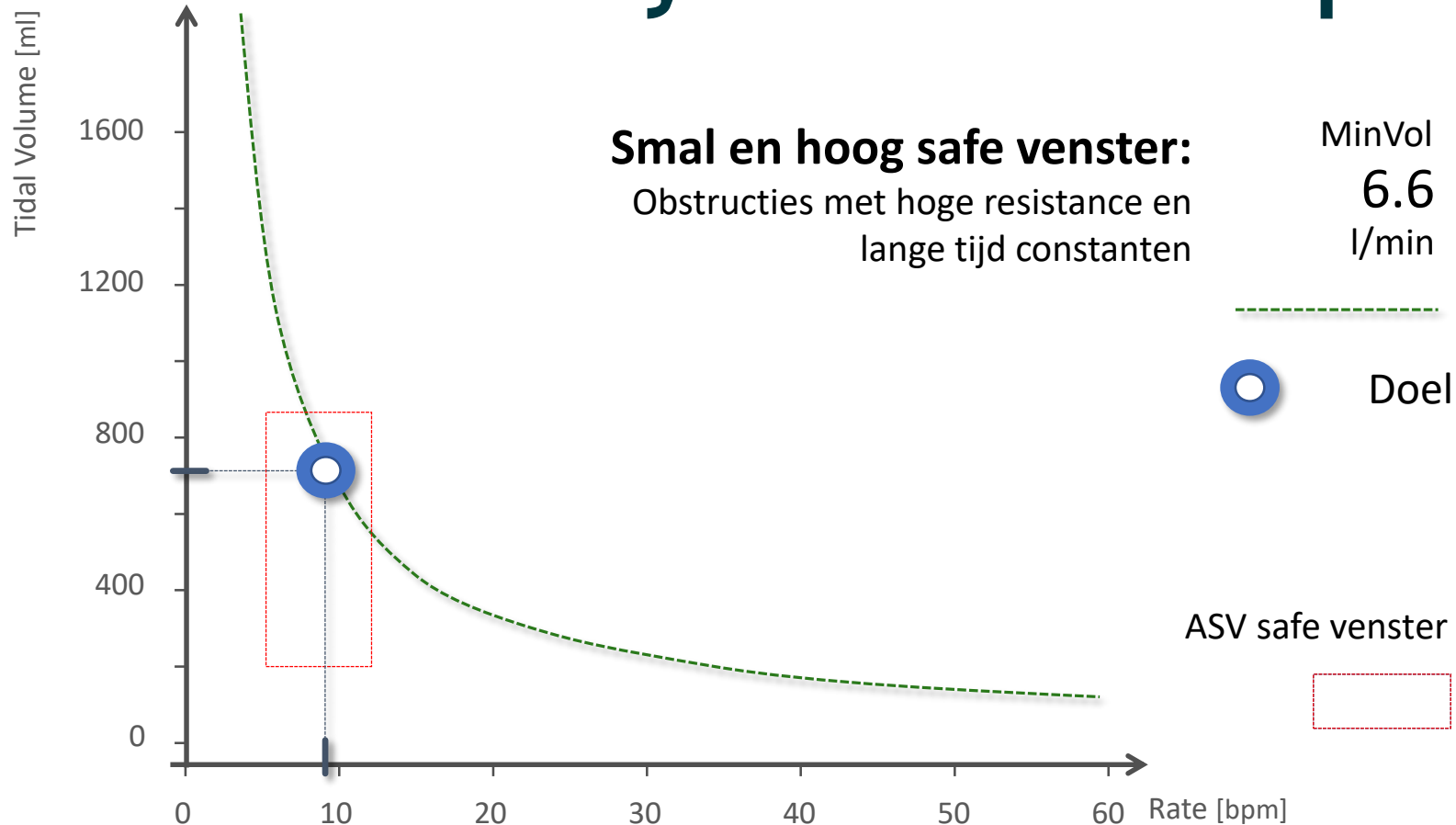
Toegenomen Rinsp: COPD, asthma, of bronchospasme, ETT obstructie of foutieve positionering

Cstat = 68.3 ml/cmH₂O

Rinsp = 17 cmH₂O/l/sec



Safe venster - dynamische aanpassing



RCexp: 2.45 s

Cstat: 70 ml/cmH2O

Rinsp: 30 cmH2O/l/s