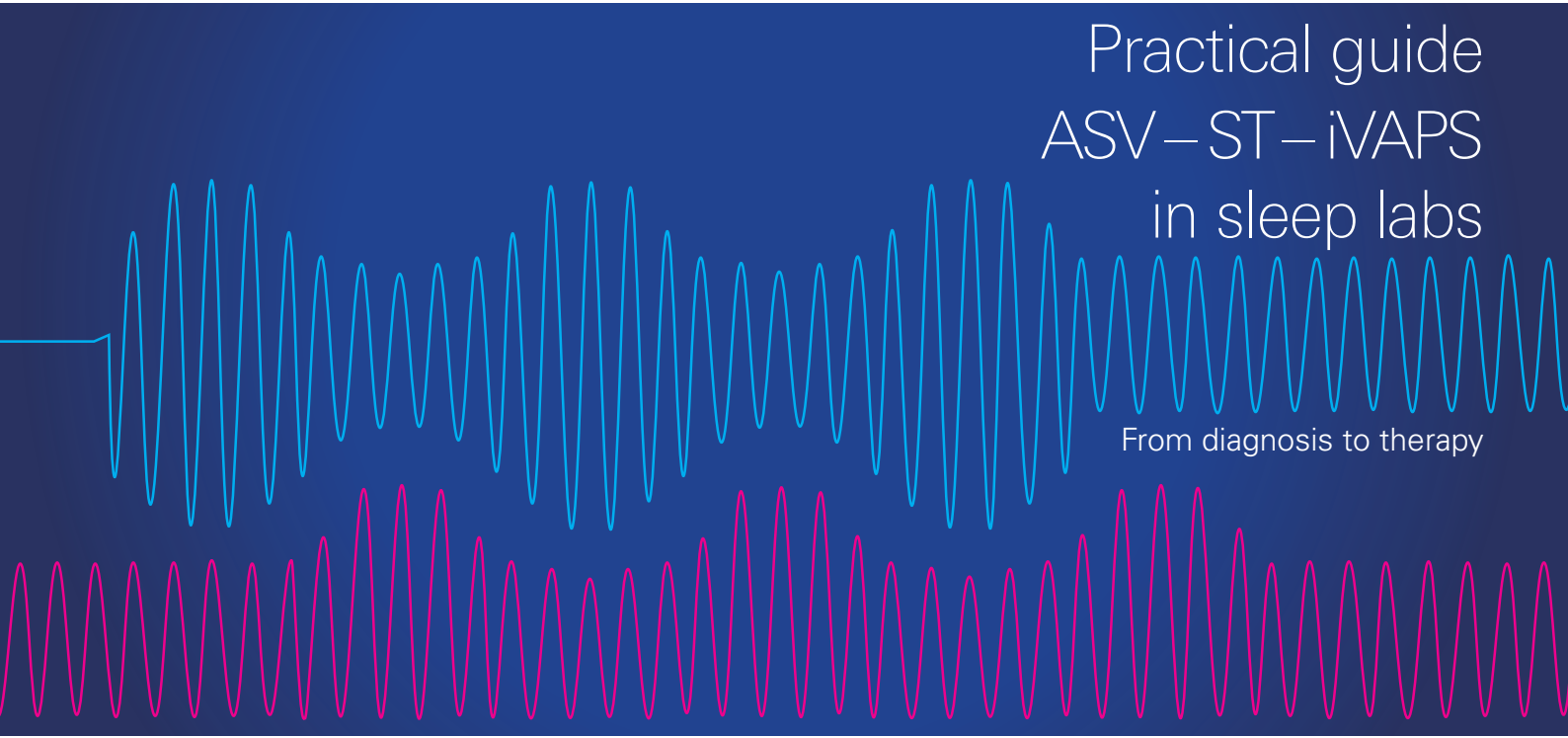
ResMed

Practical guide ASV – ST – iVAPS in sleep labs

From diagnosis to therapy



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Abbreviation key

ABG	arterial blood gas
ASV	adaptive servo-ventilation
BR	backup rate
CompSA	complex sleep apnea
COPD	chronic obstructive pulmonary disease
CSA	central sleep apnea
CSR	Cheyne-Stokes respiration
EPAP	expiratory positive airway pressure
FEV1	forced expiratory volume
FVC	forced vital capacity
FIO_2	fraction of inspired oxygen
iBR	intelligent backup rate
IPAP	inspiratory positive airway pressure
IV	invasive ventilation
iVAPS™	intelligent Volume-Assured Pressure Support
LPM	liters per minute
MIP	maximum inspiratory pressure
MSA	mixed sleep apnea
MV	minute ventilation
NIV	non-invasive ventilation
NH	nocturnal hypoventilation
NMD	neuromuscular disease
OHS	obesity hypoventilation syndrome
OSA	obstructive sleep apnea
$PaCO_2$	arterial partial pressure of carbon dioxide
PS	pressure support (IPAP – EPAP)
PSG	polysomnography
RR	respiratory rate
SaO_2	arterial saturation of oxygen
SDB	sleep-disordered breathing
ST	spontaneous-timed (ventilation mode)
TECSA	treatment-emergent central sleep apnea

Editorial

Obstructive sleep apnea (OSA) represents the most common form of sleep-disordered breathing (SDB). However, many other more challenging SDB conditions like central sleep apnea (CSA) and various forms of hypo- and hyperventilation exist. CPAP and APAP therapy – gold standard therapies for OSA – may be inadequate in these cases. More sophisticated therapy devices and modes are required.

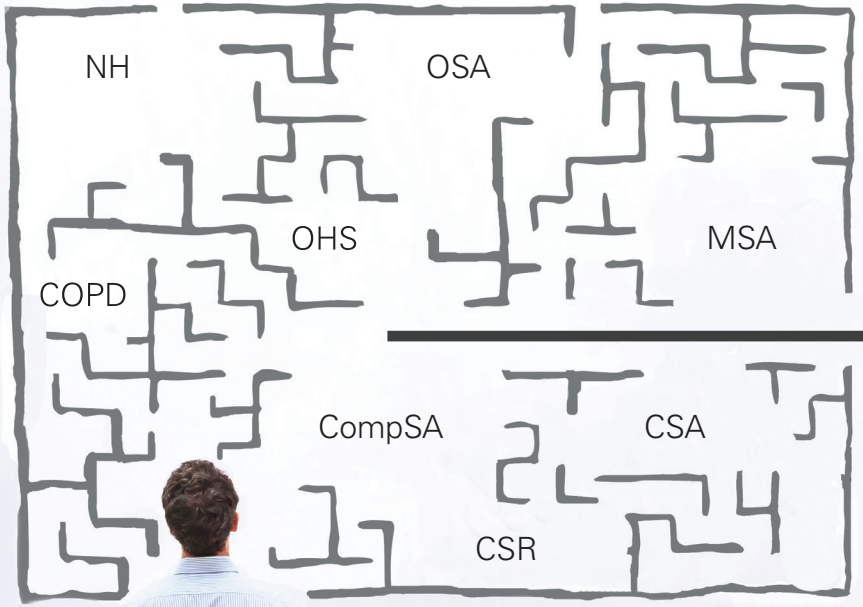
This practical guide is intended to help you diagnose various SDB conditions and treat them using appropriate therapy modes (e.g. ASV*, ST or ResMed iVAPS†) and devices in accordance with existing medical guidelines. It is built on a simplified, clearly laid out presentation that takes into account both medical practice and proven techniques. For more information, including the US Centers for Medicare and Medicaid Services guidelines, visit CMS.gov.[1]

* ASV therapy is contraindicated in patients with chronic, symptomatic heart failure (NYHA II–IV) with reduced left ventricular ejection fraction (LVEF ≤ 45%) and moderate to severe predominant central sleep apnea

† iVAPS therapy mode is indicated for patients weighing 30 kg (66 lbs) and above

[1] US Centers for Medicare & Medicaid Services. CMS.gov: License Agreements. Baltimore, MD. Accessed online on March 20, 2019: www.cms.gov/medicare-coverage-database/details/lcd-details.aspx?LCDId=33800&ver=13&CoverageSelection=Local&ArticleType=All&PolicyType=Final&s=All&CptHcpcsCode=e0601&bc=gAAAACAAAAAA&.

Indications and therapy modes



CPAP

AutoSet

BiLevel S/
VAuto

ASV
ASVAuto

BiLevel ST

iVAPS

Hypocapnia versus hypercapnia

	Hypocapnia	Hypercapnia
Respiration	**= Hyperventilation** (breathing is too fast and/or too deep)	**= Hypoventilation** (breathing is too slow and/or too shallow)
Values	• $PaCO_2$ < 35 mmHg*	• $PaCO_2$ ≥ 45 mmHg† • SaO_2 ≤ 88% for ≥ a cumulative 5 minutes, minimum 2 hours • FEV1/FVC ≥ 70%
Pathophysio-logical cause	• Hypersensitivity of the respiratory center with minor fluctuations in $PaCO_2$, therefore normocapnia to hypocapnia is stated by blood gas analysis • $PaCO_2$ below apnea threshold during sleep > reactive central apnea • $PaCO_2$ above apnea threshold during sleep > excessive restarting of respiration = hyperventilation	Reduced gas exchange through: • Hypoventilation (in association low tidal volume, inadequate ventilation) • Ventilatory insufficiency (in association with OHS, COPD, thoracic-restrictive or neuromuscular diseases)
Effect	Increased sensitivity of the respiratory center to changes of $PaCO_2$	High $PaCO_2$/low SaO_2
Therapy target	• Stabilize breathing • Reduce pronounced $PaCO_2$ fluctuations and CSA stabilizes periodic breathing	• Improve gas exchange (by supporting ventilation)
Therapy result	• Stabilized $PaCO_2$ • Ideally higher $PaCO_2$ level towards normocapnic range	• $PaCO_2$ reduction • Increased SaO_2

‡Respiratory Assist Device (RAD) Qualifying Guidelines. CMS.gov.
†Refer to full reimbursement guidelines on page 7

From diagnosis to therapy

Diagnosis & indication

Hypocapnia	Normocapnia
with central apneas	with central apneas

CSA

A diagnosis of central sleep apnea (CSA) requires all of the following:*

1. An apnea–hypopnea index ≥ 5; and
2. Sum total of central apneas plus central hypopneas > 50% of the total apneas and hypopneas; and
3. CAHI* ≥ 5 per hour; and
4. Presence of either sleepiness, difficulty initiating or maintaining sleep, frequent awakenings, or nonrestorative sleep, awakening short of breath, snoring or witnessed apneas; and
5. No evidence of daytime or nocturnal hypoventilation

Therapy approach & target

Titration

Automatic PS (target 90% MV) supported by automatic BR to:

- Stabilize breathing and to set $PaCO_2$ towards normocapnic range,
- Prevent $PaCO_2$ fluctuations,
- Eliminate central apneas

EPAP or AutoEPAP

- Eliminate obstructive apneas

Therapy devices & modes

ASV†/ASVAuto

AirCurve™10
ASV

*Per RAD Qualifying Guidelines. CMS.gov. For CSA diagnosis, central apnea–central hypopnea index (CAHI) is defined as the average number of episodes of central apnea and central hypopnea per hour of sleep without the use of a PAP device.
†ASV therapy is contraindicated in patients with chronic, symptomatic heart failure (NYHA II–IV) with reduced left ventricular ejection fraction (LVEF ≤ 45%) and moderate to severe predominant central sleep apnea

Diagnosis & indication*

Hypercapnia

- **COPD:**† After initial treatment with E0470 device, ABG shows $PaCO_2$ worsens ≥7 mmHg compared to original ABG and PSG demonstrates SaO_2 ≤88% for ≥ a cumulative 5 minutes, minimum 2 hours nocturnal recording time while on an E0470 and AHI < 5 OR no sooner than 61 days after initial use of E0470, ABG shows $PaCO_2$ ≥ 52 mmHg and sleep oximetry demonstrates SaO_2 ≤88% for ≥ a cumulative 5 minutes, minimum 2 hours nocturnal recording time.
- **Restrictive:**† Perform one of the following: Either ABG with $PaCO_2$ ≥ 45 mmHg OR SaO_2 ≤ 88% for ≥ 5 minutes for at least 2 hours nocturnal recording time OR FVC < 50% of predicted or MIP < 60 cmH_2O (NMD only).
- **Hypoventilation:**† (After initial treatment with standard bilevel) FEV1/FVC ≥ 70% and $PaCO_2$ worsens ≥ 7mmHg compared to initial ABG OR A facility-based PSG or HST demonstrates SaO_2 ≤ 88% for ≥ 5 minutes of nocturnal recording time (minimum recording time of 2 hours) that is not caused by obstructive upper airway events – i.e. AHI less than 5 while using an E0470 device.

- NMD (reduced or shallow ventilation in sleep)
- COPD and OSA (overlap syndrome)
- Additional indications for ventilatory support

Therapy approach & target

First and always

- **Provide PS (IPAP – EPAP)** to reduce $PaCO_2$
- **Backup rate** to ensure adequate minute ventilation and to relieve work of breathing if necessary

Heavily fluctuating $PaCO_2$ or OSA dependent on position or sleep stage

- **Provide required volume with sufficient PS** to reduce $PaCO_2$
- **iBR** for better patient-device synchrony

Therapy devices & modes

ST

iVAPS‡
iBR

AirCurve™ 10
ST-A

Stellar™ series

Advanced
Ventilation

Astral™ series

Not suitable for periodic breathing (or alternating hypoventilation/hyperventilation)

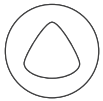
* The reimbursement information is being provided on an "as is" basis with no express or implied warranty of any kind and should be used solely for your internal informational purposes only. The information does not constitute professional or legal advice on reimbursement and should be used at your sole liability and discretion. All coding, coverage policies and reimbursement information are subject to change without notice. ResMed does not represent or warrant that any of the information being provided is true or correct and you agree to hold ResMed harmless in the event of any loss, damage, liabilities or claims arising from the use of the reimbursement information provided to you. Before filing any claims, it is the provider's sole responsibility to verify current requirements and policies with the payer.
† Per RAD Qualifying Guidelines. CMS.gov.
‡ iVAPS therapy mode is indicated for patients weighing 30 kg (66 lbs) and above

ResMed therapy device modes

	ASV / ASVAuto	ST	iVAPS* iBR
Functions			
	• PS: automatically provides 90% of MV (last 3 minutes) • RR: automatic BR • EPAP: manual in ASV mode • AutoEPAP: set min/max range in ASVAuto mode	• IPAP: manual • EPAP: manual • RR: manual	• PS: automatic for patient's alveolar ventilation target • RR: automatic BR with target patient rate (iBR)
Information for prescription	• ASV confirmed in titration • PS (min./max.) • EPAP or AutoEPAP (min./max.)	• IPAP/EPAP • BR • TiControl™: Ti Min, Ti Max, Ti • Trigger/Cycle	• iVAPS* • PS (min./max.) • EPAP • Target patient rate for iBR • Ti Min/Ti Max
Therapy device	**AirCurve 10 ASV** • Up to 25 cm H_2O 	**AirCurve 10 ST** • Up to 25 cm H_2O 	**AirCurve 10 ST-A** • Up to 30 cm H_2O 	**Stellar series** • Up to 40 cm H_2O 

* iVAPS therapy mode is indicated for patients weighing 30 kg (66 lbs) and above

Practical tips



Minimize leak

Mask adjustment or change, chin strap, full face mask

- Assures mode functionality
- Increases comfort and compliance
- Add/adjust humidification

Observe therapy

Regular re-evaluations by ResMed AirView™* or ResScan™

- Confirmation of therapeutic efficacy and compliance
- Adjust TiControls and synchrony features

ResMed offers tailored treatment options to sleep labs.
For more information about our products, visit ResMed.com.

* When a ResMed device is paired with the ResMed Connectivity Module (RCM), wireless connectivity is enabled, allowing key patient therapy data to be transmitted directly from the device to the ResMed secure, cloud-based management system, AirView

Notes

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