Online supplement

Randomised controlled trial of polysomnographic titration of non-invasive ventilation

ADDITIONAL METHODS

Daytime clinical titration

Each daytime clinical titration was performed by one of two experienced respiratory physiotherapists (LR or CC). Respiratory physiotherapists within the HMV service have greater than five years of experience and regularly initiate assisted ventilation (both invasive and non-invasive) as part of a multidisciplinary team. They are frequently involved in the acute implementation of NIV for inpatients as well as long-term weaning of invasive ventilation as part of a dedicated non-ICU weaning unit.(1) Polysomnographic titration is a routine aspect of care within the service, and physiotherapy staff are involved in the interpretation and analysis of PSG data in those using NIV. Respiratory physiotherapists routinely make setting decisions and adjustments independently of medical staff as per unit policy, although difficult cases are routinely discussed in regular multidisciplinary meetings that can include the analysis of PSG or other physiological data.

Daytime titration for this study followed a standardised procedure that was in keeping with current practice within the HMV service at the time of the study but was adapted according to patient tolerance and preference.(2) All participants used the same device (VPAP™ IV ST, ResMed, Bella Vista, NSW, Australia) unless there was a need for additional features such as an internal battery, simpler controls, or higher pressures. In this case an alternative device was used (either Stellar™ 150 or VPAP S9™ ST-A, ResMed). According to standard practice within this service, those commencing long-term NIV were offered oronasal interfaces as a first option. NIV acclimatisation typically occurred in bed, in a position that was as similar as possible to the patient's usual sleep position. Low pressures (EPAP 4cmH2O, IPAP 8cmH2O) were commenced initially and a period of acclimatisation allowed before the settings were manually titrated by the attending physiotherapist. The back-up respiratory rate was typically set one to two breaths below the user's awake respiratory rate and an S/T mode (Spontaneous/Timed) was used universally. Continuous pulse oximetry was used to monitor patients and to guide setting choices. Clinical

assessment of synchronisation, upper airway obstruction, leak and comfort was performed by the attending physiotherapist. Adjustment to the respiratory rate, inspiratory time and trigger and cycle sensitivities were made based on clinical judgement accounting for the expected underlying respiratory and upper airway mechanics and direct observations of ventilator performance and synchronisation during the use of NIV. Monitoring of device derived data – primarily tidal volume – also occurred. Patients were able to sleep during the daytime titration (during which time further adjustments may have been made to ventilator settings) however this was not universal. Arterial blood gases or transcutaneous CO2 monitoring were not used to guide setting decisions.

Each daytime clinical titration included a further education session with a respiratory nurse as part of a dedicated outreach team. Each session would typically last one hour and involve the delivery of information regarding operation and care for the mask and ventilator, provision of emergency contact details (including a 24-hour emergency telephone number) and facilitation of further clinical support after returning home. Involvement of an occupational therapist or social worker to assist in the transition to long-term NIV occurred but was directed on a case-by-case basis as deemed necessary.

Polysomnographic titration

Polysomnographic titration for this study followed a standardised procedure used in previous clinical studies performed within this HMV service.(3) These procedures are similar to those used in everyday practice within the service. The instructions provided to sleep scientists are summarised below:

- Commence EPAP and IPAP 2cmH2O lower than that determined during the daytime trial
- Leave other settings as per the daytime trial
- Carefully observe the interaction between respiratory channels when titrating (chest and abdominal movements, airflow signal, mask pressure, leak)
- Before altering settings, look for excessive leak first

EPAP

- Increase EPAP in 1cmH2O increments in the presence of obstructive events
- Trial an increase in EPAP if ineffective efforts are observed (in the absence of significant leak)
- Maintain the initial IPAP-EPAP difference until obstructive events are controlled

IPAP

- Hypoventilation should be identified and primarily addressed through an increase in IPAP (hence pressure support) – a rise in PtcCO2 of 10mmHg above awake, supine, resting PtcCO2 should prompt increases in pressure support
- If the transcutaneous CO2 signal is thought to be inaccurate, re-apply and review before acting on the result
- An increase in IPAP should be trialled to minimise non-obstructive hypopnoeas, flow limitation or to improve SpO2 - if signs of partial upper airway obstruction persist, trial a further increase in EPAP while maintaining pressure support

Patient-ventilator asynchrony

- If significant patient-ventilator asynchrony is observed, all efforts to reduce leak should be made before altering respiratory rate, trigger/cycle or inspiratory time. Pressure changes should be made before altering other parameters.
- Respiratory rate should not be increased more than 4 breaths per minute above the initial setting

As per standard practice within this service (see Figure e6), sleep scientists made changes to ventilator parameters during the titration study in order to rectify problems identified overnight. The attending scientist would typically make small incremental changes every 10-20 minutes once a problem was identified in order to determine the effect. The attending sleep scientist would make further adjustments according to the perceived response. This would include increasing or decreasing pressure levels (both PS and EPAP as required) or altering timing criteria at their discretion. These data would be used by the clinicians analysing the study to determine the optimal settings for the individual participant after reviewing all of the polysomnographic data.

Acclimatization period

The acclimatization period was defined as the day of the daytime titration up until the day of the intervention (see Figure 2). During this period, at least one routine phone contact occurred with the outreach team or a respiratory physiotherapist. Further unscheduled contacts were performed as deemed necessary by individual members of the clinical team or at the request of the participant. Unscheduled contacts could include home visits or contact via telephone as appropriate. Adjustments to settings were made during this period at the discretion of the clinical team (respiratory nurse or physiotherapist) with no input or advice from researchers involved in collection of outcome measures.

Treatment period

The treatment period was defined as the day after the intervention (PSG titration or sham PSG titration – see Figure 1) until the day of the PSG at study conclusion. During the treatment period, the clinical management of participants was not restricted by the research team or study procedures. Alterations to settings, masks or the use of additional clinical reviews, home visits or further monitoring that occurred was performed at the discretion of the clinical team or treating physician.

Outcome measures

Patient-ventilator asynchrony events

Three forms of trigger asynchrony were scored using event definitions based on those described by Fanfulla et al, Ramsay et al and Vrijsen et al.(4–6)

Ineffective effort

These were defined as a single observable respiratory movement (both rise and fall, >0.5sec duration; defined by deviations in the SUM trace of the thoracic and abdominal respiratory bands or by deviations in either the thoracic or abdominal band in the event that one of the signals was un-interpretable) that occurred without an associated mask pressurisation.(5) The mask pressure trace therefore was used as the sole determinant of the presence or absence of a 'ventilator breath' (Figure e3). The derived flow signal obtained from the ventilator was not used to identify the presence or absence of effort from the user, nor the presence or absence of a 'ventilator breath'.

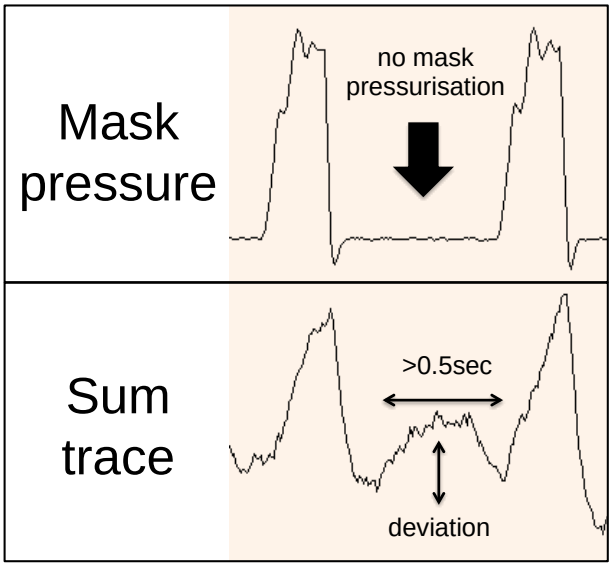

Figure e3 - Schematic representation of the ineffective effort scoring rule; mask pressure refers to measured pressure at the interface during polysomnography; sum trace refers to the additive signal of abdominal and thoracic respiratory bands

Double trigger event

This was defined as two consecutive ventilator cycles separated by an expiratory time of less than one second (Figure e4).(4) Each pair of mask pressurisations was scored as a single event.

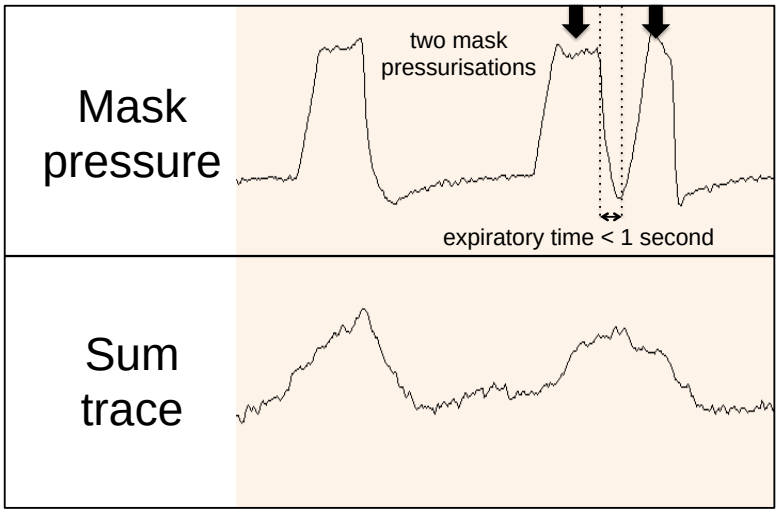

Figure e4 - Schematic representation of the double trigger event scoring rule; each pair of mask pressurisations was scored as a single event; mask pressure refers to measured pressure at the interface during polysomnography; sum trace refers to the additive signal of abdominal and thoracic respiratory bands

Multiple trigger event

These were defined as per double triggering but for sequences >2 ventilator breaths, with each three breath ‘salvo’ was scored as one event (Figure e5).(6)

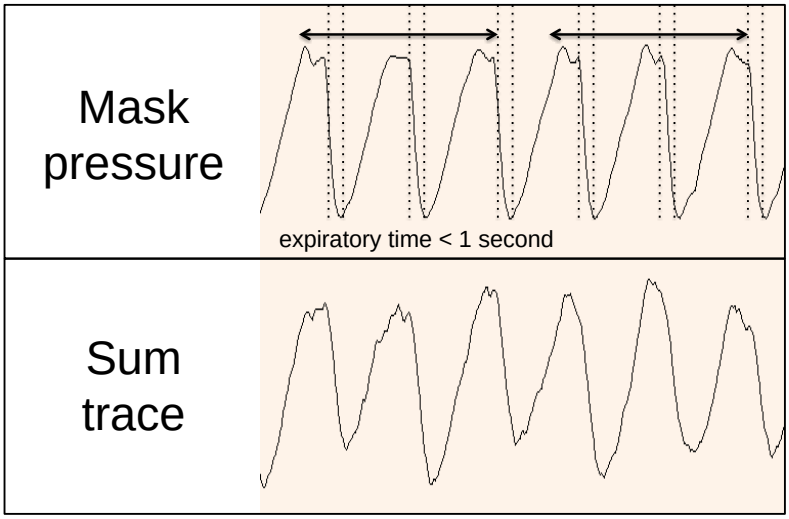

Figure e5 – Schematic representation of the multiple trigger scoring rule; each group of three breaths was scored as a separate event; mask pressure refers to measured pressure at the interface during polysomnography; sum trace refers to the additive signal of abdominal and thoracic respiratory bands

In the current study, PSG data was de-identified and a single experienced physician (LMH) scored PVA events on all studies. To ensure consistency in scoring across all studies, analysis was performed with only the relevant signals visible (i.e. mask pressure and SUM trace) and without consideration or knowledge of sleep stage.

Arousal index

Sleep staging and arousal scoring was performed after completion of PVA scoring. Analysis was performed by a single experienced sleep scientist who was unaware of the study hypothesis. All studies remained de-identified and both EEG arousal scoring and sleep staging were performed according to standard criteria.(7)

Arterial blood gases

The change in daytime partial pressure of carbon dioxide from arterial blood ($PaCO_2$) was determined by comparing the baseline measure with that obtained at study conclusion. Arterial blood gas samples were obtained from a radial artery puncture from participants while they were awake, resting, seated and

breathing room air without ventilatory support for a minimum of 30 minutes. Samples were analysed using an onsite blood gas analyser (ABL 700 Series, Radiometer Copenhagen) within ten minutes of collection.

Patient reported outcomes

Outcomes collected at baseline and at study conclusion included; The Pittsburgh Sleep Quality Index (PSQI); a 19-item, self-assessed questionnaire that is reliable and validated to assess sleep quality for individuals with sleep disorders.(8) Higher scores represent worse sleep quality. The Epworth Sleepiness Scale (ESS); a questionnaire containing eight items that evaluates the propensity of subjects to fall asleep in specific situations.(9) Higher values indicate an increased propensity to fall asleep or doze. The Karolinska Sleepiness Scale (KSS); a single item, nine-point scale evaluating sleepiness which has been validated against alpha and theta EEG activity and slow eye movement EOG activity.(10) The scale evaluates sleepiness at a single point in time, requiring respondents to gauge their current level. Higher values indicate increasing subjective sleepiness. The Fatigue Severity Scale (FSS); a questionnaire containing nine items, each using a seven-point Likert scale to evaluate the effect of fatigue on motivation, exercise, physical functioning, ability to carry out duties related to work, family or social life with higher values indicating a larger impact of fatigue.(11) The scale also includes a visual-analogue scale (VAS) for rating fatigue severity where lower ratings indicate more severe fatigue. The Modified Borg Dyspnea Scale; which provides a reliable determination of dyspnea, is simple to administer and is sensitive to change.(12) Respondents are asked to rate their current level of dyspnea using a scale from 0 - 10 where higher values indicate worsening severity of dyspnea.

Side effects of NIV were evaluated using a section of the Calgary Sleep Apnoea Quality of Life Index (SAQLI) instrument.(13) The portion used asks the respondent to rate the three most troubling side effects experienced with therapy on a seven-point Likert scale according to their severity. The three ratings are combined to provide an overall score out of 21, with higher values indicating more troubling side effects. In addition, the respondent is asked to offset the severity of side effects with any benefits obtained from therapy – again on a seven-point Likert scale – with the middle value (response = four) indicating that side effects are equivalent with the benefits of therapy.

Disease-specific health-related quality of life (HRQoL) was evaluated with the English translation of the Severe Respiratory Insufficiency Questionnaire (SRI).(14) This 49-item multidimensional HRQoL instrument was specifically designed for use in individuals receiving assisted ventilation.(14,15) It evaluates seven domains of health (respiratory complaints, physical functioning, attendant symptoms and sleep, social relationships, anxiety, psychological well-being, social functioning) and produces a summary scale based on these domain scores. Each domain is scored from 0 - 100, with higher values indicating better HRQoL.

Generic HRQoL was evaluated using the Assessment of Quality of Life Questionnaire – 8 Dimension (AqoL-8D).(16) This 35-item generic preference-based HRQoL instrument incorporates eight dimensions of health (independent living, happiness, mental health, coping, relationships, self-worth, pain, senses) and produces a global index score anchored at 0.0 (death) and 1.0 (full health). Both physical and mental 'superdimensions' are also calculated

ADDITIONAL RESULTS

Individuals excluded or not screened

From 313 individuals who were prescribed long-term assisted ventilation during the study period, 45.4% (n=142) were not screened due to commencing NIV during an inpatient admission and a further 1.0% (n=3) were commenced on long-term invasive mechanical ventilation. Of those screened, 31.9% (n=52) were excluded (Figure 2). An inability to adequately understand English (n=23) was the most common reason for exclusion. Individuals who were medically unstable (n=10), currently using NIV (n=10) or diaphragm pacing (n=2) and previously intolerant of NIV (n=3) were also excluded.

Dropouts, deaths and failure to complete the protocol.

Two individuals with MND in the PSG titration group dropped out (Figure 2). One participant with MND (n=1) in the control group was deceased during the treatment period due to the development of a lower respiratory tract infection. Three participants with MND in each study arm did not return for the final PSG. These individuals provided data (questionnaire responses, daytime arterial blood gases) but could not be included in the primary outcome analysis.

Study intervals

There was no difference between groups in the time between the initial referral for NIV and subsequent implementation (mean (SD) interval in days; Control 24.9 (17) vs. PSG titration 20.4 (15); *p*=0.317). There was also no difference in the length of the acclimatization period (mean (SD) in days; Control 20.1 (8) vs. PSG titration 20.4 (5); *p*=0.832) or length of the treatment period (mean (SD) in days; Control 53.6 (8) vs. PSG titration 54.3 (13); *p*=0.812).

Ventilator, interface and settings

Most (n=55) participants were managed with a VPAP™ IV ST (ResMed, Bella Vista). The remainder were managed with alternative devices (n=1 Stellar™ 150 and; n=4 VPAP S9™ ST-A). There were no changes in interface type during the study.

Changes in NIV settings after PSG titration

Those undergoing PSG titration were on average prescribed small increases in both pressure support and EPAP (Table e1). Changes to trigger and cycle sensitivities, inspiratory time and rise time tended to be small in magnitude and were less frequent than changes to pressure settings. Despite apparently modest group changes, on an individual level, there were often considerable adjustments (for example; EPAP range -4.0 to 8.0cmH2O; see Table e1).

Affix Patient Label Here

Surname: _____

First Name: _____

Austin UR: _____

DOB: ___/___/_____ Gender: M F _____

Bi-level Ventilation Ventilator model: _____

1. Current settings: Mode: _____ IPAP: _____ cmH_20 EPAP: _____ cmH_20
   Rate: _____ / min Ti Min: _____ sec Ti Max: _____ sec
   Rise time: _____ sec Trigger: _____ Cycle: _____
2. Current mask: _____ Chinstrap: Y / N
3. Changes to be made overnight? Y / N *(default is YES)* but no faster than every _____ *(default is 20)* mins.
4. Commence study: Mode: _____ IPAP: _____ cmH_20 Rate: _____ sec
   (default is current settings) EPAP: _____ cmH_20
5. Is EPAP to be increased to treat obstructive events? Y / N *(default is YES)*
   * If YES: Increase both EPAP & IPAP in _____ *(default is 2)* cmH_20 increments.
6. Increase IPAP in _____ *(default is 2)* cmH_20 increments if the baseline $PtcCO_2$ increases by more than _____ *(default is 10)* mmHg above _____ baseline *(default is awake/supine/off treatment)*
7. Should changes to Ti Min/Max or Trigger/Cycle be considered? Y / N *(default is YES)*
   If YES, see procedure: 'B-5-3 Sleep Studies-In Laboratory- NIV Treatment', located on H:\General\Units\Sleep Lab\Document Control\B. Laboratory Procedures\B-5 Sleep Studies- In Laboratory
8. Decrease IPAP in _____ *(default is 2)* cmH_20 increments if:
   [1] if baseline $PtcCO_2$ decreases more than _____ *(default is 10)* mmHg below ____ baseline *(default is awake/supine/off treatment)*
   [2] if $PtcCO_2$ is below _____ *(default is 30)* mmHg.
9. Other remarks:

Contact Respiratory Registrar via switchboard if any concerns or questions – see also Document B-1

Other Ventilation Ventilator model: _____

1. Current settings: Mode: _____ TV/PS: _____ mls/cm H_20 Rate: _____ / min
   Inpir Time: _____ sec PEEP: _____ cmH_20
2. Current mask: _____ Chinstrap: Y / N
3. Changes to be made overnight? Y / N *(default is YES)* but no faster than every _____ *(default is 20)* mins.
4. Commence study: Mode: _____ TV/PS: _____ mls/cm H_20 Rate: _____ / min
   (default is current settings) Inpir Time: _____ sec PEEP: _____ cmH_20
5. Increase TV/PS by _____ *(define amount)* if the baseline $PtcCO_2$ increases by more than _____ *(default is 10)* mmHg above _____ baseline *(default is awake/supine/off treatment).*
6. Decrease TV/PS (circle as appropriate)_____ *(define amount)* if:
   [1] if baseline $PtcCO_2$ decreases more than _____ *(default is 30)* mmHg below ____ baseline *(default is awake/supine/off treatment); **OR***
   [2] if $PtcCO_2$ is below _____ *(default is 30)* mmHg.
7. Other remarks (e.g. interface):

Oxygen Supplementation (NB: see also doc B-5-5)

1. Delivery point: _____ *(default for pressure studies is the pump end of tubing)*
2. O_2 to remain constant? ☐ Yes: flow _____ L/min ☐ No → *If NO, continue*
3. Commence study: _____ L/min O_2 *(default is R/A)*
   Titrate O_2 in _____ *(default is 0.5)* L/min increments to maintain SpO_2 above _____ *(default is 88)* %, but no faster than _____ *(default is 0.5)* L/min per 10 mins.
4. Maximum CO_2 rise with oxygen addition is _____ *(default is 10)* mmHg compared with the awake baseline $PtcCO_2$ level.
5. Can titration commence prior to optimal ventilator settings being reached?: Y / N *(default is NO)*
6. Maximum O2 flow to be delivered during the study is _____ *(default is 5)* L/min.
7. Other remarks (e.g. interface):

Split Implement Study

1. Commence treatment only if: _____ *(default for **CPAP** is AHI> 11/hr, default for **oxygen** is SpO_2 less than 88%, default for **ventilation** is $TcCO_2$ increases by > 10mmHg above baseline)*
2. If criteria in Q1 are met should REM be sampled prior to commencement of treatment? Y/N *(default is YES).*
3. If criteria in Q1 are met & no REM is sampled, treatment to commence _____ *(default is 3)* hours after commencement of study.

Figure e6 – Polysomnography request and instructions

Table e1 – Initial ventilator settings prescribed after daytime clinical titration; according to group allocation*

Group	n=		PS (cmH_2O)	EPAP (cmH_2O)	RR (breaths/min)	Trigger	Cycle	Ti min (seconds)	Ti max (seconds)	Rise time (seconds)
Control	30	mean (SD)	6.5 (2)	7.6 (3)	13.1 (2)	Med	Med	1.1 (0.1)	1.6 (0.2)	0.37 (0.04)
		range	4-12	4-18	10-16	(Low-High)	(Low-High)	0.9-1.3	1.4-2.0	0.3-0.5
PSG	30	mean (SD)	6.7 (2)	6.5 (2)	13.5 (2)	Med	Med	1.1 (0.1)	1.7 (0.1)	0.39 (0.05)
		range	5-13	4-12	8-16	(Low-High)	(Low-Med)	0.9-1.3	1.4-2.0	0.3-0.5

**p*-value >0.05 for all parameters; independent samples *t*-test.

PS=pressure support, EPAP=expiratory positive airway pressure, RR=backup respiratory rate, Trigger=Trigger sensitivity (Range: Very Low to Very High), Cycle=Cycle sensitivity (Range: Very Low to Very High), Ti min=minimum inspiratory time, Ti max=maximum inspiratory time

Table e2 - Adherence during acclimatization period according to group allocation and previous CPAP*

Group	Average use[a] Mean (SD)	%days zero use	%days <4 hours use	Non-adherent[b] n=
Control[c] (n=28)	305 (185)	15%	25%	9 (30%)
PSG[c] (n=28)	291 (197)	14%	30%	12 (40%)
Previous CPAP[e] (n=17)	315 (223)	20%	20%	6 (35%)
Naïve (n=39)	291 (176)	12%	30%	15 (39%)

* *p*-value >0.05 for all parameters; independent samples t-test, Pearson χ^2 for proportions

[a] Average daily use (minutes) during the acclimatization period

[b] Non-adherence defined as average use <4 hours per 24-hour period

[c] Adherence data not available for drop-outs (n=2), deceased (n=1) and one (n=1) participant in Control group due to a malfunctioning data card

[e] CPAP previously prescribed, used or evaluated in a laboratory or inpatient setting

Table e3 - Changes to settings following PSG (PSG group, n=30)

	PS	EPAP	RR	Trigger	Cycle	Ti min	Ti max	Rise time

		(cmH_2O)	(cmH_2O)	(breaths/min)			(seconds)	(seconds)	(seconds)
Alterations	Mean	0.6	1.4	0.5			0.0	0.0	0.0
	Range	(-2.0 to 6.0)	(-4.0 to 8.0)	(0.0 to 6.0)			(-0.2 to 0.2)	(-0.3 to 0.2)	(-0.2 to 0.05)
Prescribed alterations	n=	14	19	6	6	1	8	11	5
	(%)	(47)	(63)	(20)	(20)	(3)	(27)	(37)	(17)

PS=pressure support, EPAP=expiratory positive airway pressure, RR=respiratory rate, Trigger=Trigger sensitivity, Cycle=Cycle sensitivity, Ti min=minimum inspiratory time, Ti max=maximum inspiratory time

Intra-rater reliability of PVA scoring

Ten de-identified PSGs were randomly selected and scored twice by the same scorer (LMH). The two scoring procedures were performed not less than two weeks apart for each study. Intra-rater reliability was determined using a two-way mixed intraclass correlation coefficient with coefficients above 0.95 for all events (Table e3).

Table e4 – Patient-ventilator asynchrony events (per hour total sleep time) from ten overnight polysomnographic recordings from users of nocturnal NIV; results reflect repeat scoring performed by a single scorer on two occasions at least two weeks apart

	Ineffective efforts/TST		Double triggers/TST		Multiple triggers/TST	
	Score 1	Score 2	Score 1	Score 2	Score 1	Score 2
PSG1	4.7	3.0	2.6	2.6	0.4	0.4
PSG2	35.9	36.1	1.0	1.2	0.2	0.2
PSG3	24.5	25.0	10.1	10.1	4.2	3.9
PSG4	2.3	1.8	10.8	10.6	40.9	40.5
PSG5	9.1	9.3	2.6	2.3	0.0	0.0
PSG6	9.8	15.3	1.1	1.1	0.0	0.0
PSG7	9.5	12.9	21.0	20.7	2.5	2.5
PSG8	43.4	38.3	8.0	6.9	0.2	0.0
PSG9	33.5	28.3	19.6	19.6	6.3	6.3
PSG10	33.2	24.2	4.2	4.2	0.0	0.0

Table e5 – Intraclass correlation coefficient for patient-ventilator asynchrony events identified on polysomnography; results obtained from repeat scoring of ten overnight recordings with scoring on two occasions by a single scorer at least two weeks apart

PVA type	ICC*
Ineffective efforts/TST	0.955
Double triggers/TST	0.999
Multiple triggers/TST	1.000

***Single-measures Intra class correlation coefficient (two-way mixed) for absolute agreement**

Sleep and gas exchange measures on final PSG

Table e6 - Objective measures of sleep obtained during PSG at study conclusion; PSG compared with Control; values indicate median (interquartile range) unless stated

	Control (n=26)	PSG (n=25)	*p*-value[#]
Arousal index (arousals per hour TST)	14.6 (11-19)	11.4 (9-19)	0.258
Total sleep time (TST) (minutes)	289 (220-346)	274 (227-336)	0.821
Sleep efficiency (%)	69 (51-77)	63 (53-76)	0.910
Sleep latency (minutes)	18.5 (7-33)	20.0 (11-47)	0.429
Wake after sleep onset (minutes)	119 (85-153)	123 (94-172)	0.480
Awakenings (number)	29.5 (22-38)	29.0 (23-37)	0.910
Stage transitions (number)	185 (122-233)	174 (138-207)	0.843
Rapid eye movement (REM) sleep (%)	16 (11-21)	16 (11-21)	0.720
Slow wave sleep (NREM3) (%)	39 (23-59)	30 (25-41)	0.486
NREM1 and NREM2 (%)	44 (27-62)	52 (39-62)	0.356

[#] *p*-value from independent samples Mann Whitney U test

Table e7 - Measures of nocturnal gas exchange during PSG at study conclusion; PSG titration compared with Control; values indicate median (interquartile range) unless stated.

	Control (n=26)	PSG (n=25)	*p*-value[#]
Time spent with SpO_2<90% (%RT)	0.1 (0.0 to 0.8)	0.0 (0.0 to 2.6)	0.317
SpO_2 nadir	88.0 (86 to 90)	89.0 (86 to 92)	0.261
ODI 3% (RT)	2.4 (0.7 to 5.0)	0.7 (0.0 to 6.0)	0.631
ODI 4% (RT)	0.4 (0 to 1.5)	0.0 (0.0 to 2.8)	0.699
Average $PtcCO_2$	47 (43 to 50)	46 (41 to 49)	0.254
Peak $PtcCO_2$	50 (47 to 54)	49 (43 to 53)	0.221
Morning $PaCO_2$	44 (38 to 46)	42 (38 to 46)	0.522
% TST with leak>24L/min	0.0 (0 to 25)	0.0 (0 to 16)	0.602

[#] *p*-value from independent samples Mann Whitney U test

ODI=oxygen desaturation index, $PtcCO_2$=partial pressure of transcutaneous carbon dioxide, RT=recording time, SpO_2=oxygen saturation from pulse oximetry

Generic HRQoL instrument

No significant between group differences were identified using the AQoL-8D. There were also no within group changes in this HRQoL instrument, either in the overall index score or within the dimension scores.

Table e8 - Change in the index score, dimension scores and superdimension scores of the Assessment of Quality of Life Instrument (AQoL-8D); mean difference indicates the final measure (at study conclusion) minus the baseline measure (prior to commencing NIV); positive values represent an improvement in the respective measure

AQoL-8D Dimensions[a]	Control (n=29)	PSG titration (n=28)	
	Mean difference (SD)*	Mean difference (SD)*	*p*-value[#]
Index score	-0.002 (0.10)	0.000 (0.10)	0.961
Independent Living	-0.027 (0.08)	-0.029 (0.10)	0.932
Happiness	-0.039 (0.12)	-0.018 (0.10)	0.460
Mental Health	0.015 (0.11)	0.026 (0.09)	0.677
Coping	-0.015 (0.13)	0.024 (0.15)	0.293
Relationships	-0.008 (0.11)	0.001 (0.10)	0.739
Self Worth	-0.016 (0.10)	-0.009 (0.10)	0.794
Pain	0.062 (0.17)	-0.024 (0.23)	0.111
Senses	-0.002 (0.07)	-0.018 (0.10)	0.484
Mental Superdimension	-0.005 (0.10)	0.005 (0.11)	0.732
Physical Superdimension	0.010 (0.08)	-0.029 (0.13)	0.181

* All within group comparisons $p>0.05$; related samples *t*-test

[#] Between group *p*-value from independent samples *t*-test

[a] Index scores and dimension scores range from 0.0 to 1.0

References

1. Hannan LM, Tan S, Hopkinson K, Marchingo E, Rautela L, Detering K, et al. Inpatient and long-term outcomes of individuals admitted for weaning from mechanical ventilation at a specialised ventilation weaning unit. Respirology. 2013 Oct 18;18:154–60.
2. Sheers N, Berlowitz DJ, Rautela L, Batchelder I, Hopkinson K, Howard ME. Improved survival with an ambulatory model of non-invasive ventilation implementation in motor neuron disease. Amyotroph Lateral Scler Front Degener. 2014 Feb;15(3–4):180–4.
3. Howard ME, Piper AJ, Stevens B, Holland AE, Yee BJ, Dabscheck E, et al. A randomised controlled trial of CPAP versus non-invasive ventilation for initial treatment of obesity hypoventilation syndrome. Thorax [Internet]. 2017;72(5):437–44. Available from: http://thorax.bmj.com/lookup/doi/10.1136/thoraxjnl-2016-208559
4. Ramsay M, Mandal S, Suh E-S, Steier J, Douiri A, Murphy PB, et al. Parasternal electromyography to determine the relationship between patient-ventilator asynchrony and nocturnal gas exchange during home mechanical ventilation set-up. Thorax. 2015;70(10):946–52.
5. Fanfulla F, Delmastro M, Berardinelli A, Lupo ND, Nava S. Effects of different ventilator settings on

sleep and inspiratory effort in patients with neuromuscular disease. Am J Respir Crit Care Med. 2005;172:619–24.
6. Vrijsen B, Testelmans D, Belge C, Vanpee G, Van Damme P, Buyse B. Patient-ventilator asynchrony, leaks and sleep in patients with amyotrophic lateral sclerosis. Amyotroph Lateral Scler Front Degener. 2016;17(5–6):343–50.
7. Iber C, Ancoli-Israel S, Chesson AL, Quan SF. The AASM Manual for the scoring of sleep and associated events: Rules, terminology and technical specifications. 1st Ed. American Academy of Sleep Medicine; 2007.
8. Buysse DJ, Reynolds III CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. Psychiatry Res. 1989 May;28:193–213.
9. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Vol. 14, Sleep. 1991. p. 540–5.
10. Åkerstedt T, Gillberg M. Subjective and objective sleepiness in the active individual. Int J Neurosci. 1990;52:29–37.
11. Krupp LB, LaRocca NG, Muir-Nash J, Steinberg AD. The Fatigue Severity Scale: Application to patients with multiple sclerosis and systemic lupus erythematosus. Arch Neurol. 1989;46:1121–3.
12. Burdon JG, Juniper EF, Killian KJ, Hargreave FE, Campbell EJ. The perception of breathlessness in asthma. Am Rev Respir Dis. 1982;126:825–8.
13. Flemons WW, Reimer MA. Measurement properties of the Calgary Sleep Apnea Quality of Life Index. Am J Respir Crit Care Med. 2002 Jan 15;165(2):159–64.
14. Ghosh D, Rzehak P, Elliot MW, Windisch W. Validation of the English Severe Respiratory Insufficiency Questionnaire. Eur Respir J. 2012;40:408–15.
15. Windisch W, Freidel K, Schucher B, Baumann H, Wiebel M, Matthys H, et al. The Severe Respiratory Insufficiency (SRI) Questionnaire: a specific measure of health-related quality of life in patients receiving home mechanical ventilation. J Clin Epidemiol. 2003;56(8):752–9.
16. Richardson J, Iezzi A, Chen G, Khan MA, Maxwell A. Population norms and Australian profile using the Assessment of Quality of Life (AQoL) 8D utility instrument [Internet]. Vol. 72, Centre for Health Economics. 2013. Report No.: Research Paper 72. Available from: http://www.buseco.monash.edu.au/centres/che/pubs/researchpaper72.pdf