The Hamilton T1 and MR1 non-invasive mechanical ventilators

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Breathing Control for Motion Management

in Radiotherapy and Imaging

Hamilton T1 and MR1 non-invasive mechanical ventilators

Resmed mask holders & head straps

Battery or mains powered

Takes in and filters room air,
Also has an oxygen input port from an oxygen cylinder or wall supply

12 years of NIMV publications in Radiotherapy research on healthy volunteers

Parkes, Green, Stevens, Clutton-Brock (**2014**)
Assessing and ensuring patient safety during breath-holding for radiotherapy BrJRadiol 2014;87:20140454.

West, **Parkes**, Snowden, Prentis, McKennam, Iqbal, Cashmore, Walker **2019**)
Mitigating Respiratory Motion in Radiation Therapy: Rapid, Shallow, Non-invasive Mechanical Ventilation for Internal Thoracic Targets
https://doi.org/10.1016/j.ijrobp.2018.11.040

Parkes, Green, Kilby, Cashmore, Ghafoor, Clutton-Brock (**2019**)
The feasibility, safety and optimization of multiple prolonged breath-holds for radiotherapy https://doi.org/10.1016/j.radonc.2019.06.014

Parkes, DE Neve, Vakaet, Heyes, Jackson, Delaney, Kirby, Green, Kilby, Cashmore, Ghafoor, Clutton-Brock (**2021**)
Safely achieving single prolonged breath- holds of > 5 minutes for radiotherapy in the prone, front crawl position 10.1259/bjr.20210079

van Kesteren, Veldman, **Parkes**, Stevens, P. Balasupramaniam, van den Aardweg, van Tienhoven, Bel,van Dijk (**2022**)
Quantifying the reduction of respiratory motion by mechanical ventilation with MRI for radiotherapy https://doi.org/10.1186/s13014-022-02068-5

Veldman, van Kesteren, Gunwhy, **Parkes**, van den Aardweg, van Tienhoven, Bel, van Dijk (**2023**),
Accuracy of abdominal organ motion estimation in radiotherapy using the right hemidiaphragm top as a surrogate during prolonged breath-holds quantified with MRI DOI:10.1002/mp.16403

Veldman, **Parkes**, Stevens, van Duren, van Kesteren, van den Aardweg, van Schuppen, van Tienhoven, Bel, van Dijk, (**2023**)
Rapid non-invasive mechanical ventilation appears superior to non-invasive high-frequency jet ventilation in reducing respiratory motion for radiotherapy https://doi.org/10.1016/j.jcadva.2024.100059

Veldman-Landegent, van Kesteren, **Parkes**, Stevens, van den Aardweg, Dieleman, Versteijne, van Tienhoven, Bel, van Dijk (**2025**)
Non-invasive Mechanical Ventilation Is a Promising Way to Improve Lung Cancer Radiation Therapy https://doi.org/10.1016/j.adro.2024.101679

and on patients (& older NIMV ventilators & in submission)

Parkes, Green, Stevens, Parveen, Stephens, Clutton-Brock (**2016a**)
Safely prolonging single breath-holds to >5min in patients with cancer; feasibility and applications for radiotherapy BrJRadiol2016;89:20160194.

Parkes, Green, Stevens, Parveen, Stephens, Clutton-Brock (**2016b**)
Reducing the within-patient variability of breathing for radiotherapy delivery in conscious, unsedated cancer patients using a mechanical ventilator
BrJRadiol2016;89:20150741.

Non-invasive mechanical ventilation reduces respiratory motion and increases heart-stomach distance for stereotactic arrhythmia radiotherapy (2026)
(In submission)

Non-invasive mechanical ventilation in conscious individuals for improved radiotherapy and diagnostiv imaging an evidence map (2026)
(In submission)

Available for respiratory motion management anatomically everywhere

- all chest and abdominal sites
- breast, mediastinum, lung, oesphagus, liver, kidney, panceas

- Cardiac ablation

Possible respiratory motion management strategies with Hamilton T1 & MR1

- All ventilation frequencies, positive inflation pressures and inflation volumes
- < 2 brpm, 5 brpm, 12 brpm, 30 brpm, 45 brpm, 60 brpm
- All inflation volumes (~ 3L to 0.3 L)
- PEEP and CPAP
- Can administer 21- 60% oxygen
- Can mechanically hyperventilate to achieve prolonged breath holds with preoxygenation and hypocapnia (> 5 minutes)
- Can leave patient being ventilated in treatment room while staff exit

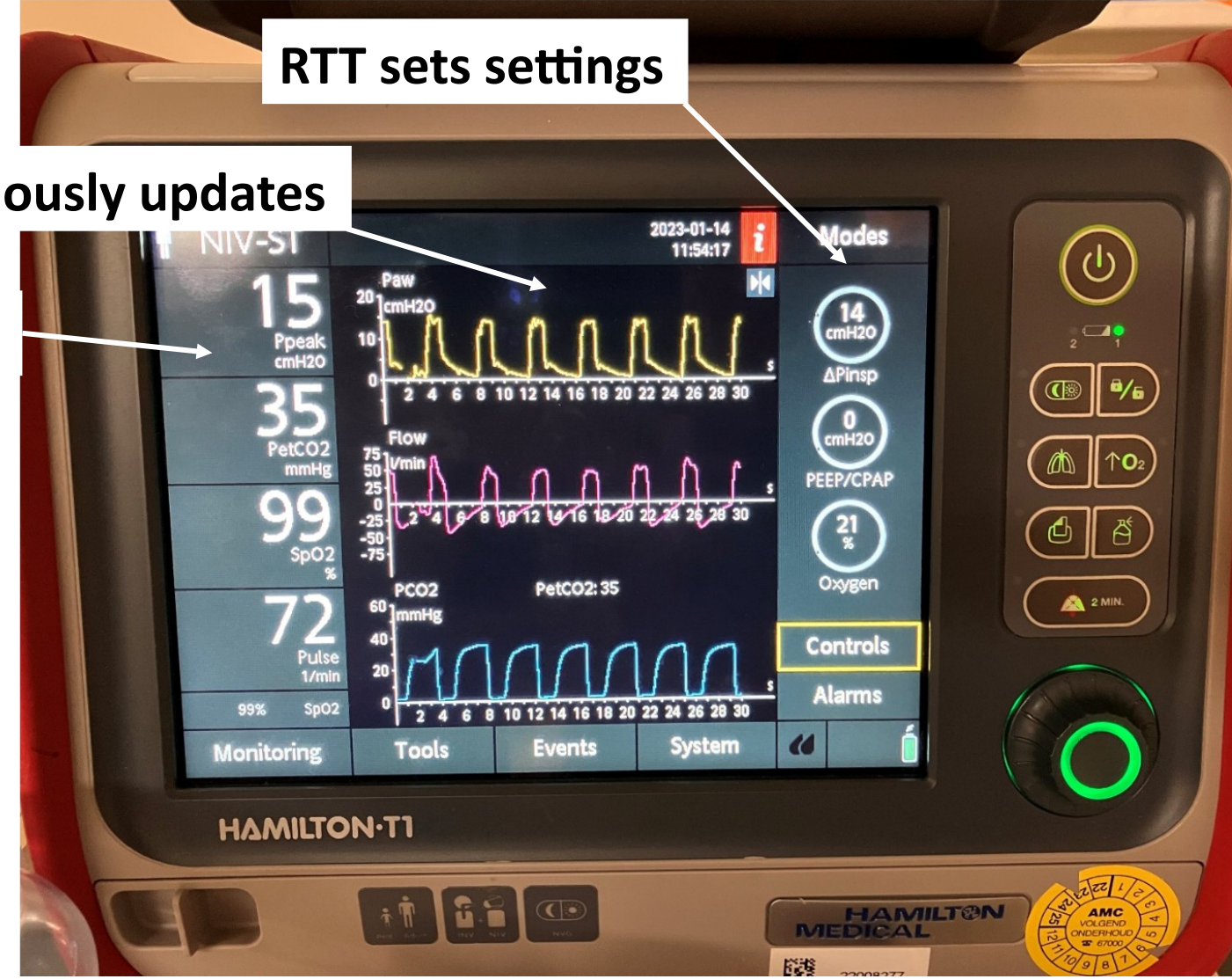
Screen shots

RTT sets settings

30 sec polygraph continuously updates

Measured by the ventilator

Screen is customisable



Hamilton ventilator settings

- Pressure controlled ventilator with SpO_2 and $P_{et}CO_2$ monitoring
- Control knob with double click to confirm
- NIV-ST, APRV, NIV settings (& many more),
- Adjustable Safety limits (pressure),
- Alarms audible, visible and overridable (SpO_2 and PCO_2),
- Multiple screen menus
- Calculates and displays inflation pressure, volume, PCO_2, SpO_2
- 30 seconds live polygraph view that continuously updates
- Can continuously download all ventilator settings to remote computer
- Can save single screen shots to penstick

Pros & more of Hamilton T1 & MR1 ventilators

Pros

- portable
- MR1 is MRI compatible
- Ease of use
- International availability
- Offers every conceivable NIMV strategy
- Hamilton representatives available

more

- ITU specialist use
- Sophisticated
- Remote control & monitoring
- Not yet programmable
- Radiotherapy specific menus
- Hamilton involvement