Nepean Blue Mountains Local Health District

Evolution of the Neonatal Resuscitation Trolley (NRT)

A Journey of Innovation and Safety

Glenn Daines
Senior Technical Officer - Mechanical

25th March 2025

Acknowledgement of Country

The Nepean Blue Mountains Local Health District acknowledges the traditional custodians of the lands and waterways within its boundaries including the Darug, the Gundungurra and the Wiradjuri people. We acknowledge and pay respects to Elders past and present. We extend that respect to our local Aboriginal community and staff. We celebrate their strength and enduring connection to culture.

Artwork: ‘We All Share the Same Water’ by Leanne Watson, Shay Tobin and Leanne Tobin

Introduction

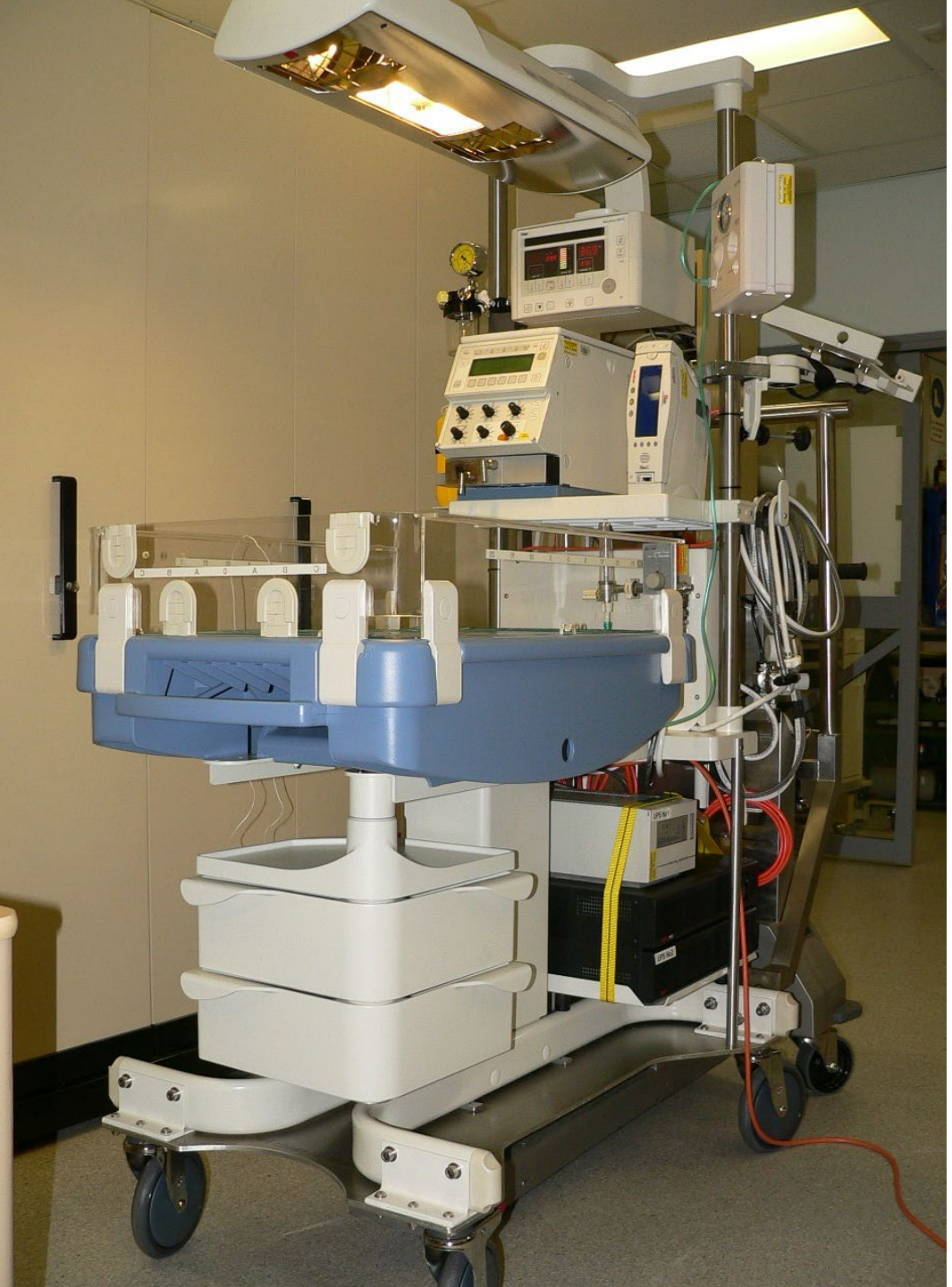
Problem:
Accidents caused when clinical staff handle multiple trolley devices while transporting newborns requiring ventilation and warming.

Solution:
Integration of equipment on one platform called the Neonatal Resuscitation Trolley (NRT).

Four Generations

1st Generation

- Built at Nepean Hospital.
- Spearheaded by Robert Madafiglio 2004.
- Incorporated:
  - Draeger Babytherm
  - Guzunda drive system
  - Draeger Babylog 2000 ventilator
  - Bird Low Flow blender
  - Single UPS
  - Wall to 1set C size gas cylinders Auto change over.
- Retired in 2016 due structural issues.



2nd Generation

- Built at Westmead Children's Hospital.
- Consultation with Murray Hinder Nepean NICU Biomedical Technician 2007
- Incorporated:
  - Draeger Babytherm
  - Guzunda drive system
  - Draeger Babylog 8000 ventilator
  - Bird Low Flow blender
  - Humidifier
  - Single UPS
  - 2 set C size gas cylinders manual change to wall
- Retired in 2022 due to unavailability of spare parts.

3rd Generation

- Built at Nepean Hospital.
- Spearheaded by Darren Watson 2017
- Incorporated
  - GE Giraffe open care
  - Guzunda drive system
  - Draeger Babylog 8000 ventilator
  - Giraffe Infant Resuscitation System
  - Humidifier
  - GE B20 patient monitor
  - Dual UPS System
  - Wall to 2 set C size gas cylinders Auto change over.
  - Isolation Transformer
- Still in service.

Design Considerations for Upgrade

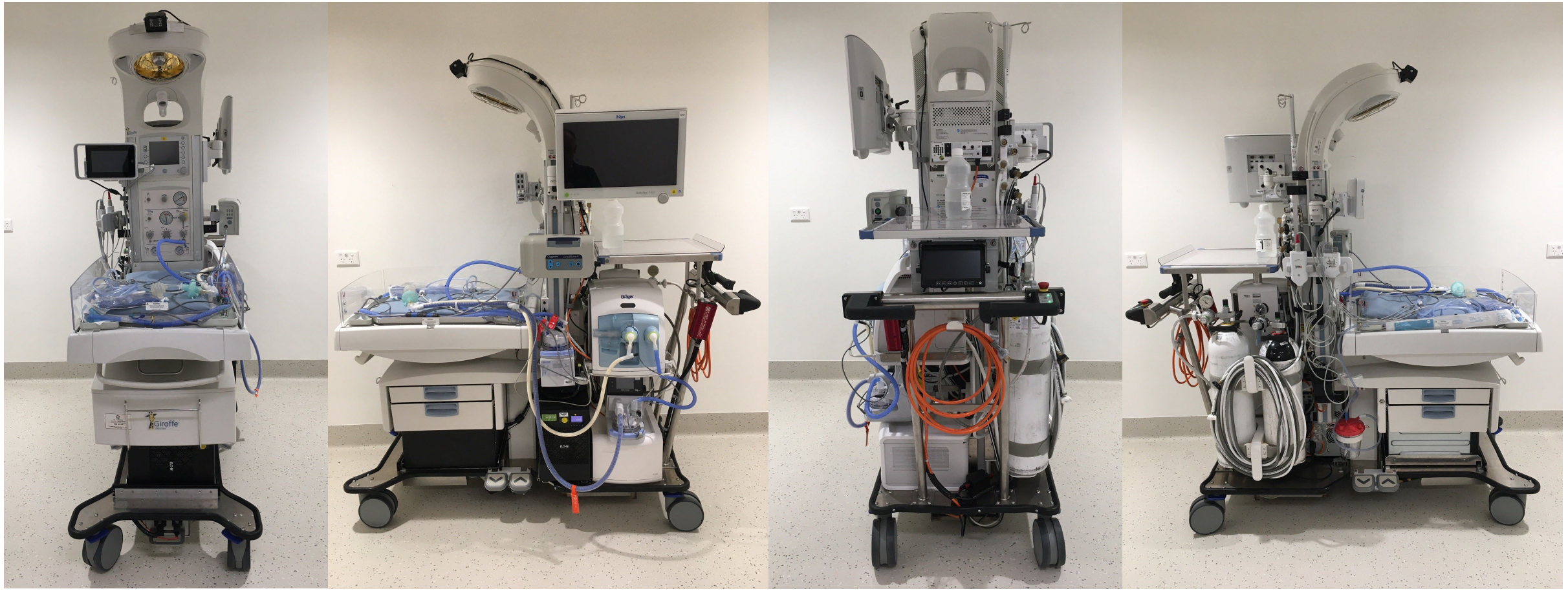
Clinical wish list:

- Drager VN800 Ventilator
- Retention of GE Giraffe open care
- Separate circuits including 2 x Humidifiers; 1 for vent and 1 for Giraffe Infant Resuscitation System
- Use of Giraffe radiant warmer while on the move
- Better manoeuvrability
- Avg. run time 45, Max. 60 minutes off mains

Engineering improvement

- Improved UPS battery duty
- Flat Bogie bed to mount equipment
- Equipment accessibility for clinical use and Service, i.e. gas cylinder change over, access to UPS for repair/battery change over.
- Forward camera and monitor for drivers
- Integrated drive system in Bogie
- Emergency Braking and central drive/steer

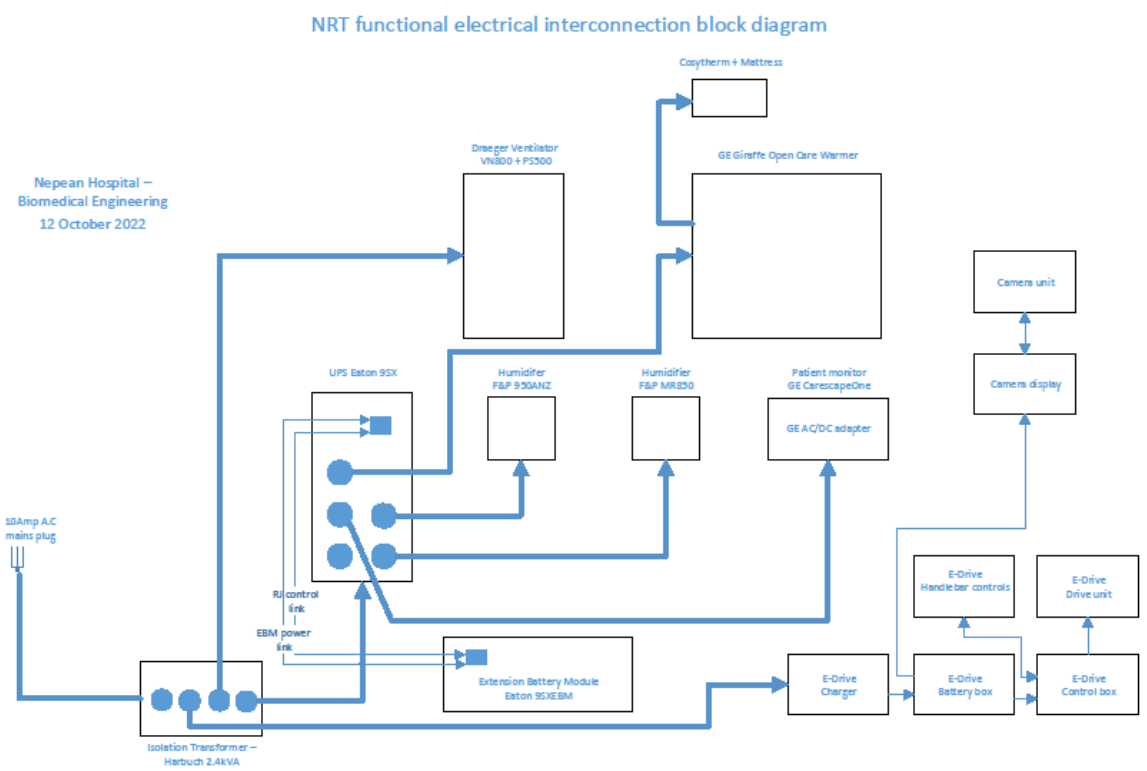
4th Generation

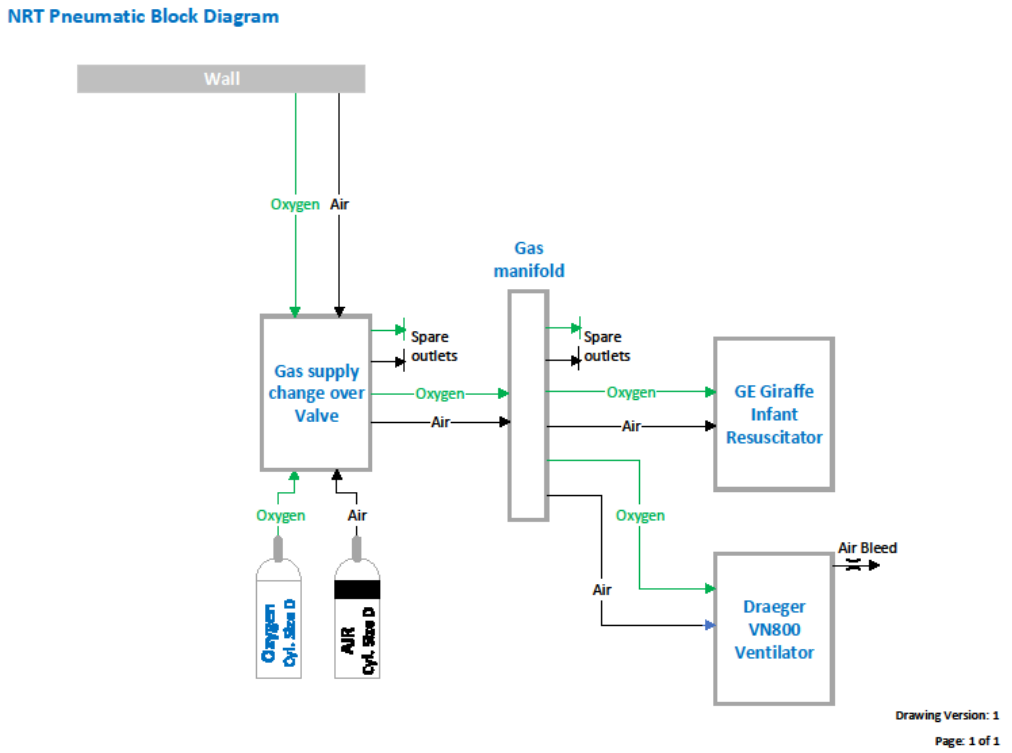


Equipment Inventory List

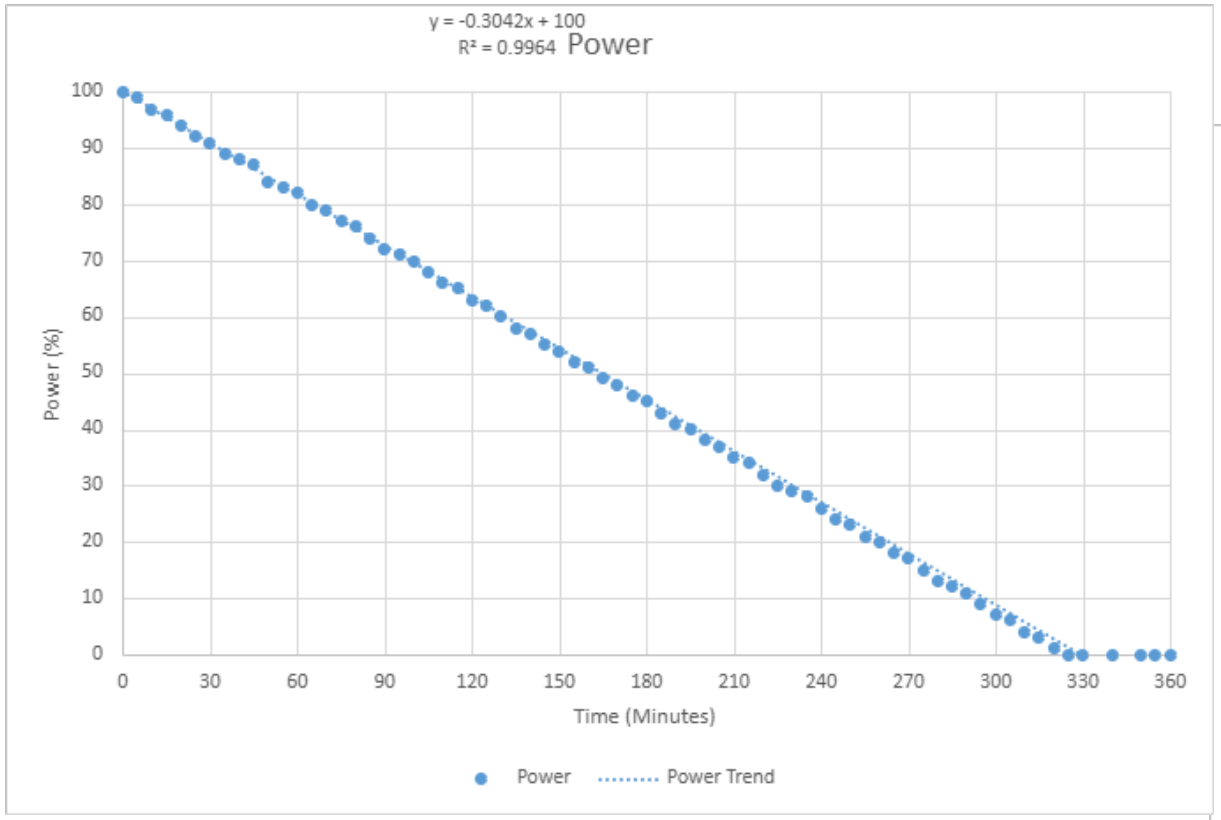
EquipTitle	BMENo	ModelNum	GenericName	ManufacturerName	Weight	Cost
Neonatal Resusitation Trolley	N019856	NRT	Neonatal Resuscitation Trolley	NBMLHD Biomedical Engineering	53	$30,331.77
Warmer, Mattress, Infant, Portable	N010346	CCU200	COSYTHERM	Inditherm Medical	12	$2,590.00
Warmer, Infant, Resus	N014615	M1118179	GIRAFFE WARMER	Ohmeda Medical	62	$30,131.00
Ventilator, Time Cycled	N014719	VN800	BABYLOG VN800	Draeger Medical Australia Pty Ltd	66	$58,490.96
Light, Transilluminator	N014919Y	DIA 120	ASTODIA	Stihler Electronics	0.75	$2,200.00
Monitor, Physiological, Multi Parameter	N015240	2078006-001	CARESCAPE ONE	Ge Healthcare	1.85	$6,375.00
Humidifier, Heated	N015785Z	MR850 AEA		Fisher & Paykel Healthcare Pty Ltd	3.1	$3,419.00
Humidifier, Heated	N015835	950ANZ		Fisher & Paykel Healthcare Pty Ltd	3.45	$2,700.00
Sensor, Cartridge	N015835A	950S01		Fisher & Paykel Healthcare Pty Ltd	0.2	$395.00
Docking Station, Monitor	N017469	2062475-001	CARESCAPE DOCK F0	Ge Healthcare	0.5	$745.00
Transformer, Isolation	N018674	ISM240/240/2K4-AU-IEC-4	Isolation Transformer 2400VA	Harbuch Electronics	28	$1,910.50
Power Supply, Uninterruptible	N018677	9SX3KVA	Power Supply, Uninterruptible	Eaton	82.1	$6,391.00
Module, Spo2	N018717	4184	Carescape SpO2 Masimo	Ge Healthcare	-	$1,400.00
Module, Ecg	N018718	2099884-001	CARESCAPE MKE101	Ge Healthcare	-	$1,500.00
Trolley, Powered	N019816	E-DRIVE	E-DRIVE	Tente	6	$4,780.00
D size, Oxygen & Medical Air Cylinder set, regs, hoses outlet manifold and Auto wall changeover				Comweld & inhouse	51	$1,150.00
					370	**$154,509**

Electrical and Pneumatic Circuits

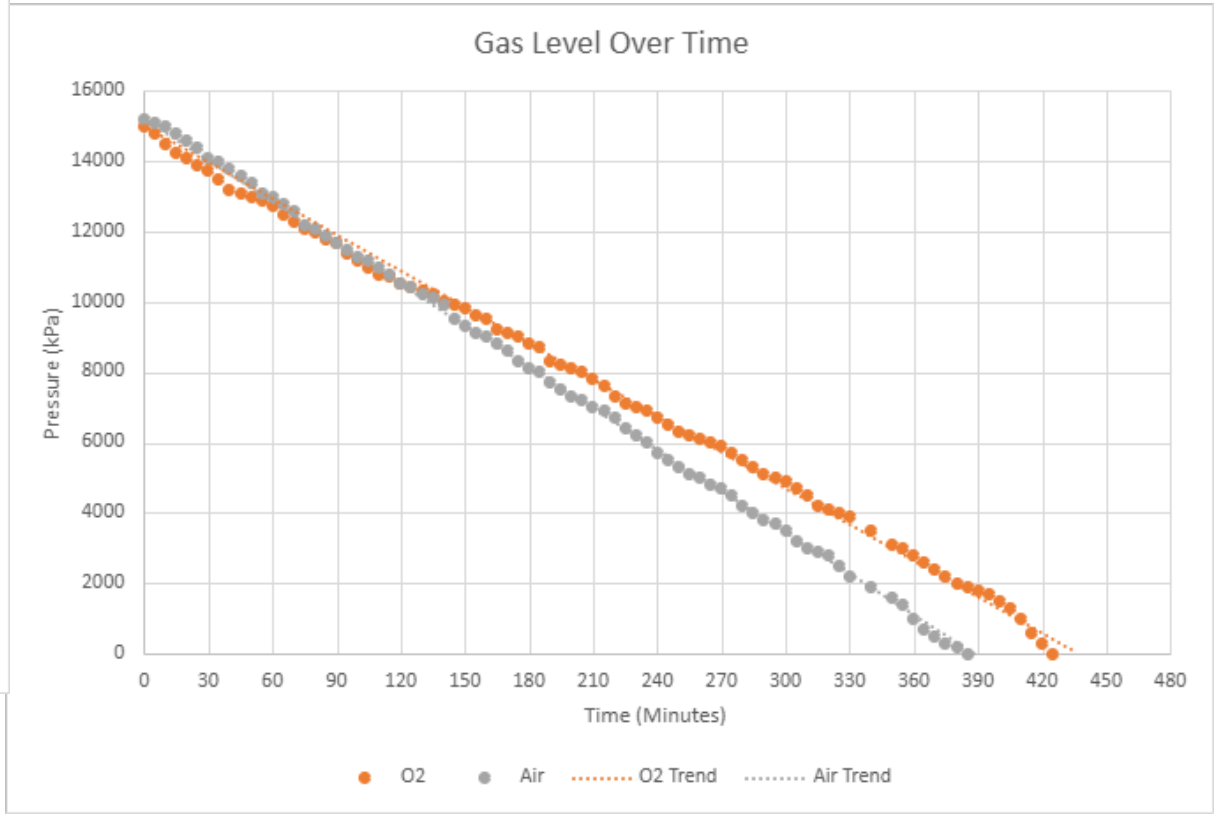




VN800 Power and Gas Readings

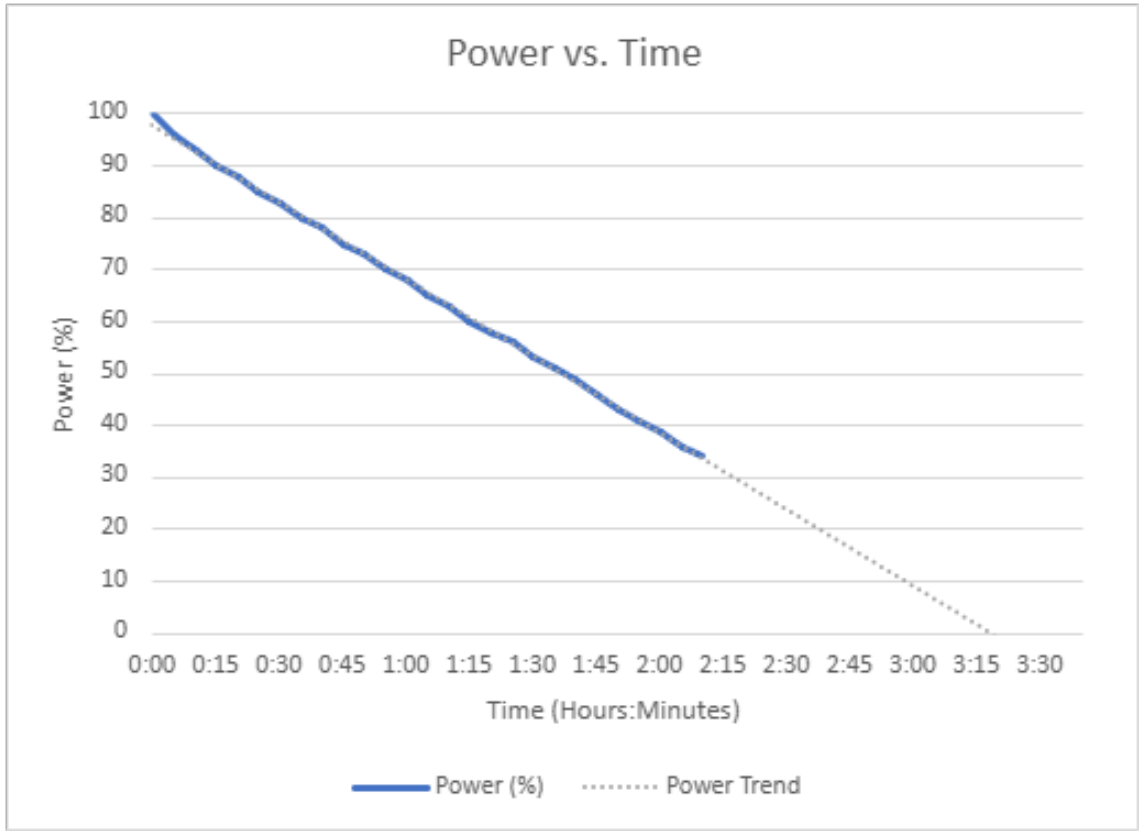


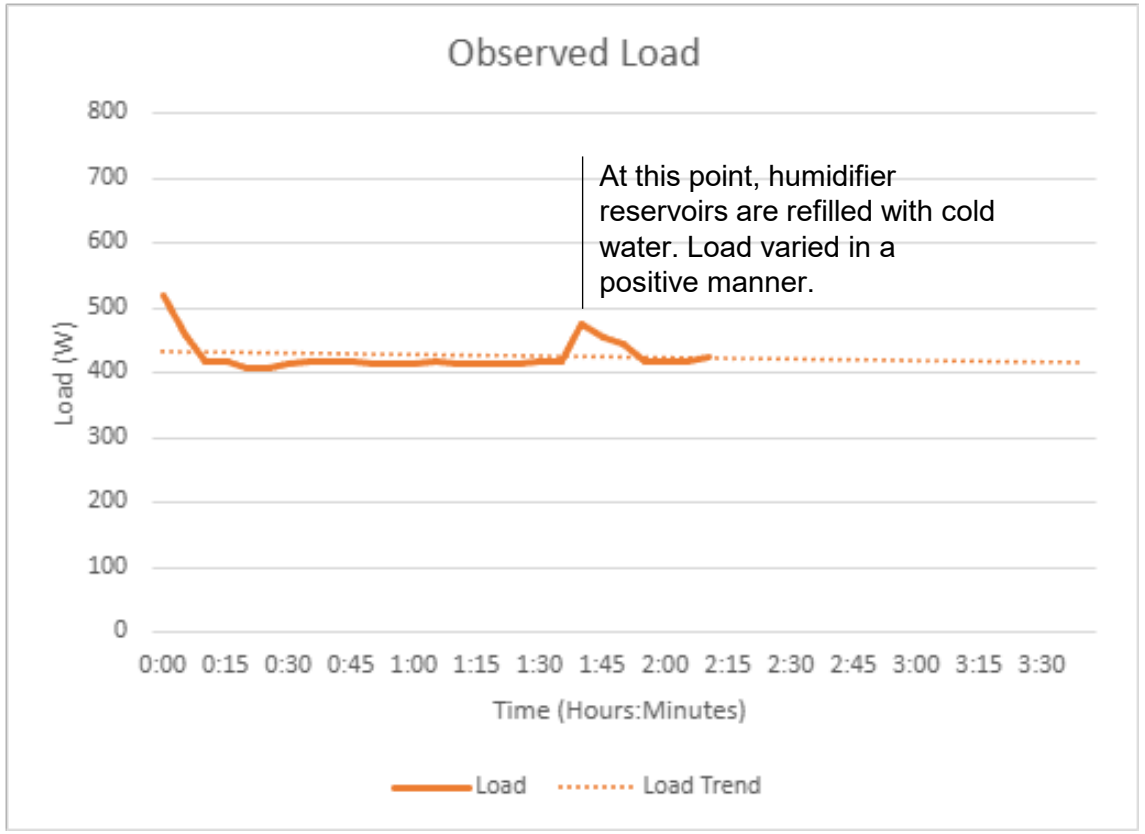
O2 Flow rate: 60%, P_{insp}: 20, Ti: 0.3, RR: 40,
PEEP: 5, Slope: 0.11, mode PC-AC



UPS Power Consumption Assessments

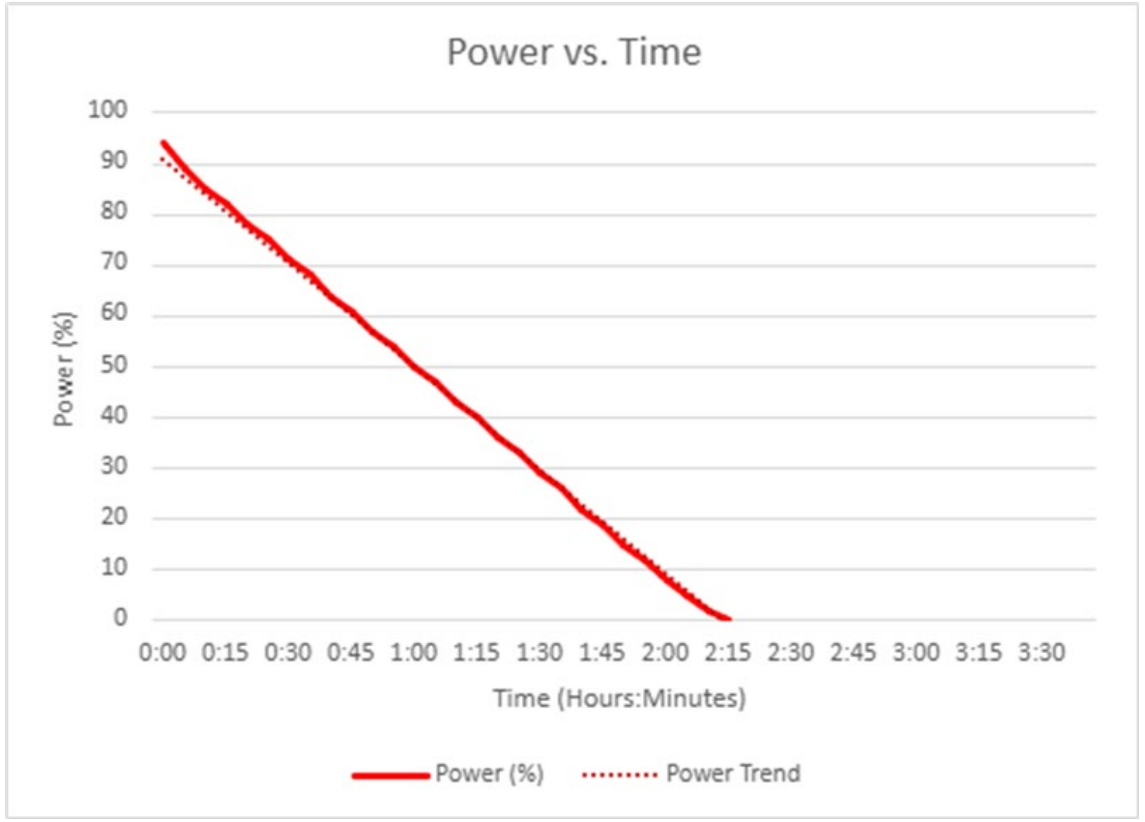
1. Typical usage with EBM: Initial Load 520W, Average Load 430W.

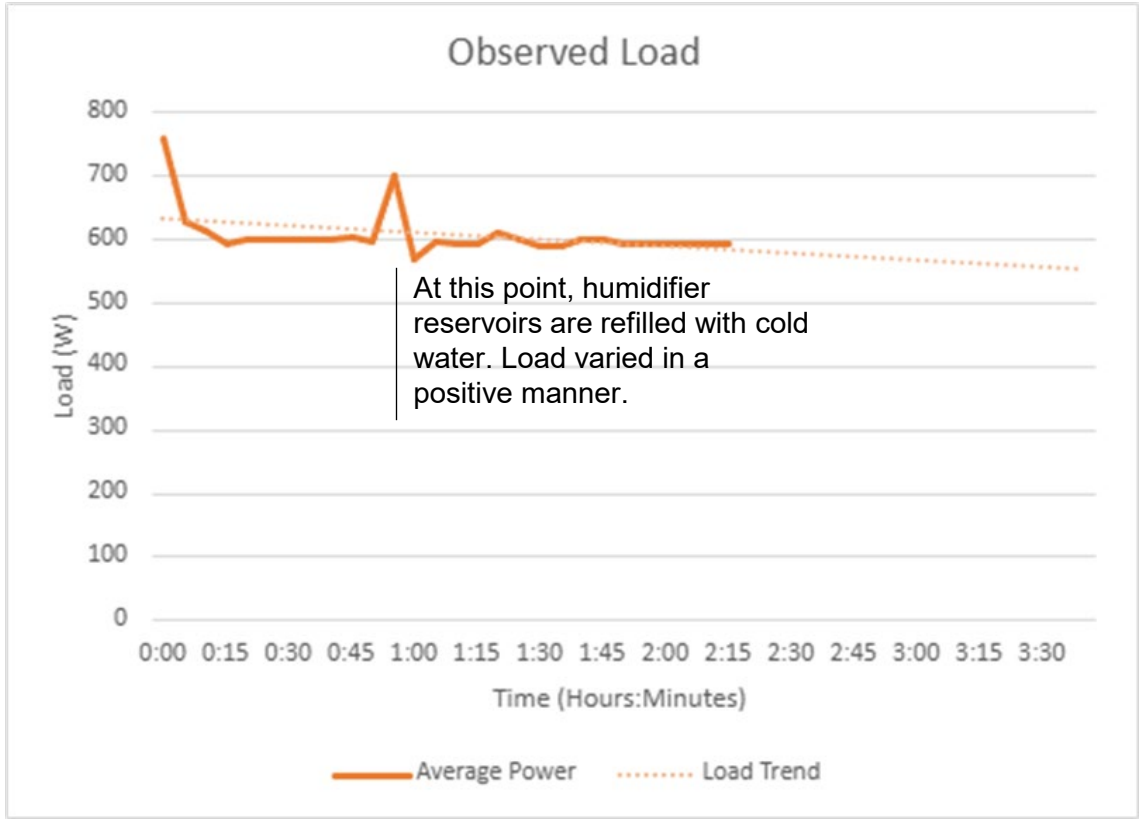




UPS Power Consumption Assessments

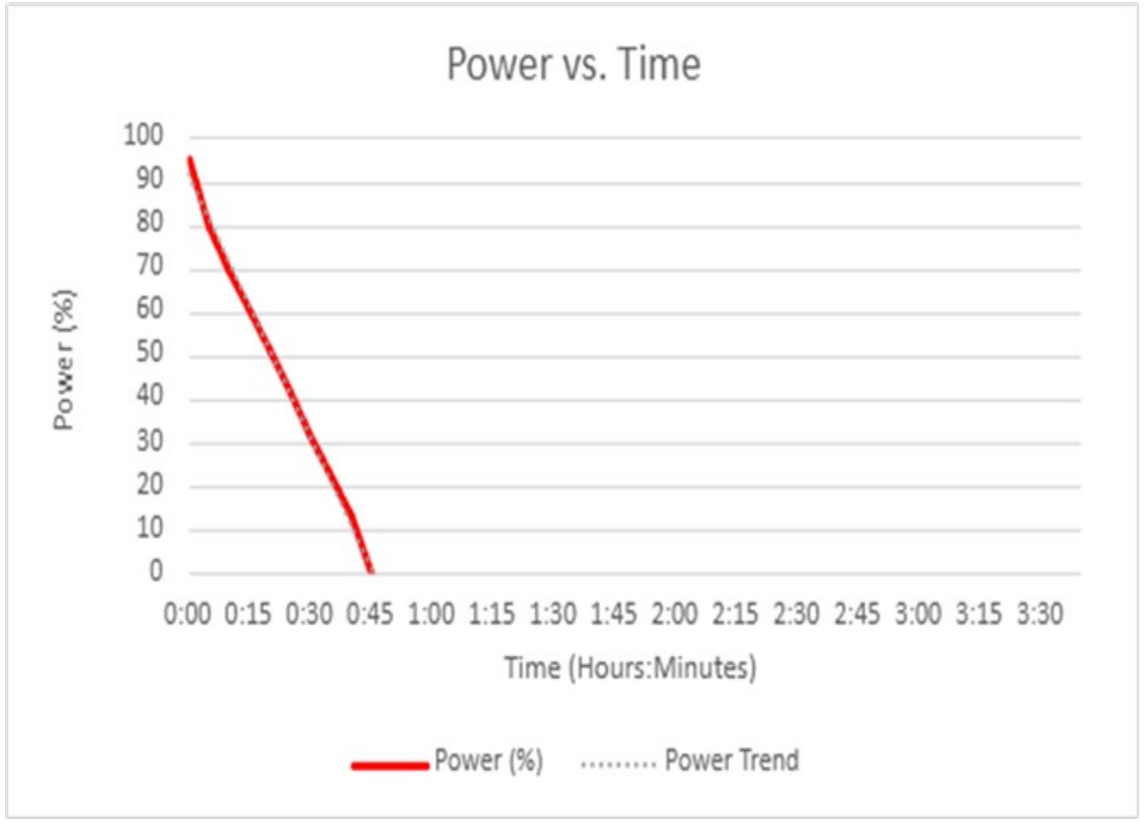
2. Worst Case with EBM: Initial Load 760W, Average Load 610W.

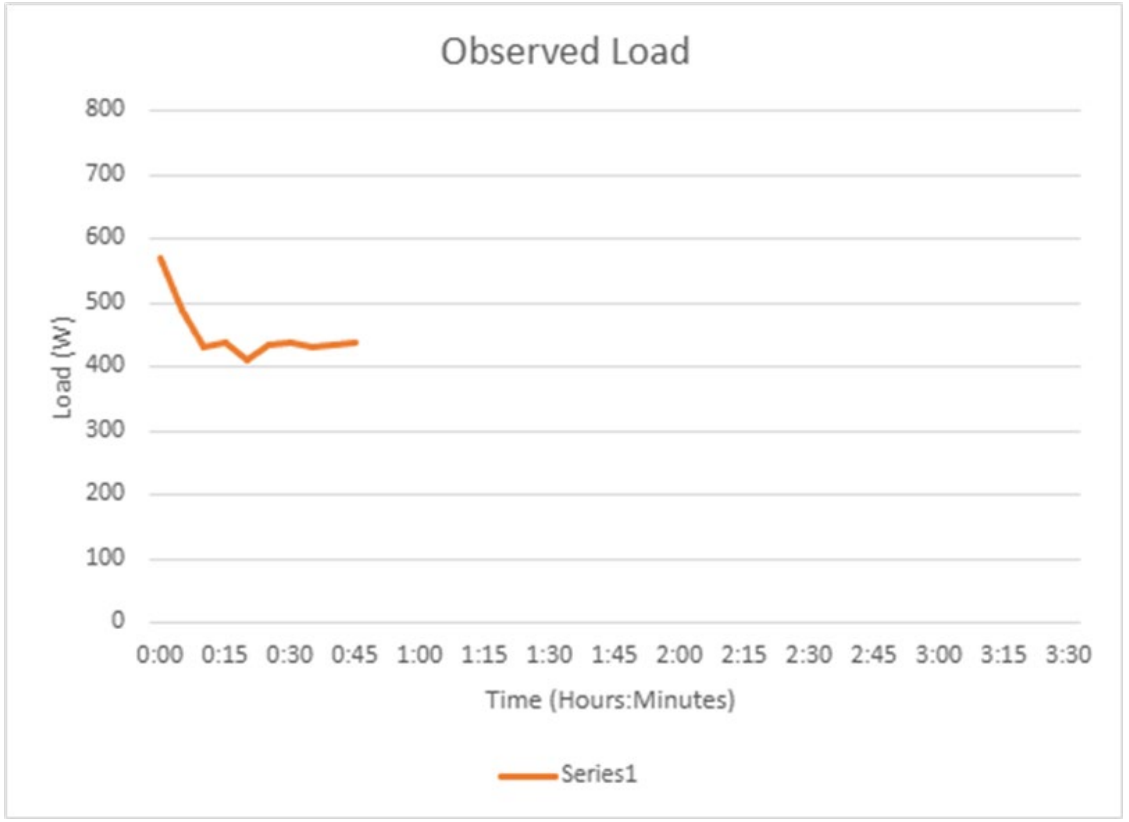




UPS Power Consumption Assessments

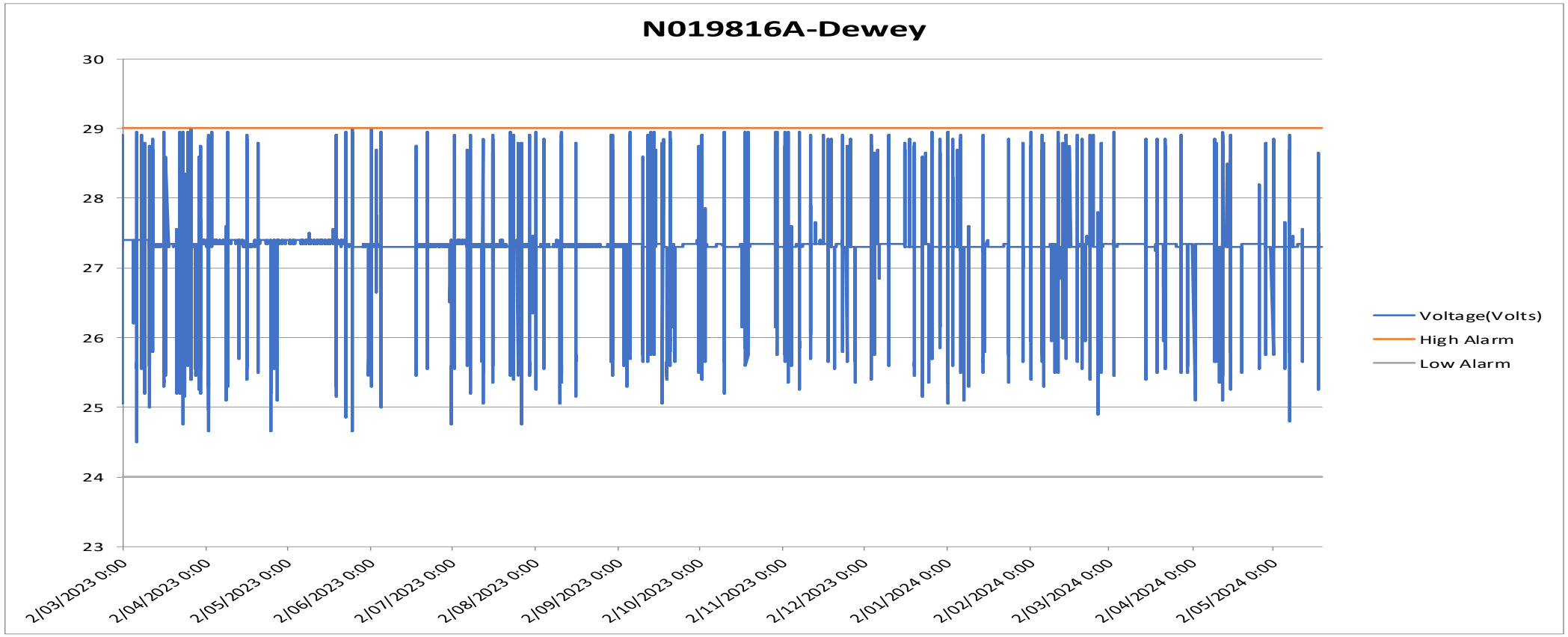
3. Typical usage without EBM: Initial Load 570W, Average Load 450W.





Ongoing Assessment

e-Drive Voltage datalogging device fitted to monitor performance and recharge cycle.



Clinical Feedback

Initial Review (30 June 2022):

Feedback on height, brakes, camera module, exposed metal edges, and additional shelf.

Manual Handling Newsletter (May 2023):

Easy manoeuvrability, promotes confidence in reliability and reduced risk to staff.

Issue 6
May 2023

Nepean Blue Mountains Local Health District
Workforce People and Culture

Manual Handling Biannual Newsletter

Welcome to the mid-year Manual Handling Newsletter.

Read on for good news articles and information.

Introducing "Huey, Dewey and soon to arrive Louie"

Huey saves neonates and staff

Getting neonate shuttles to theatres for emergency caesareans is an important and time critical task. If the equipment is cumbersome to move, costly accidents to staff may occur.

Biomedical engineering have worked on providing the best equipment for baby and staff. The new neonate shuttle has a powerdrive and a camera so that one staff can safely transport it.

Staff Training

- **Training Avenues:**
  - User Training and Service Training.
  - Guides for face-to-face delivery and reference.

OPERATOR INSTRUCTIONS

NOTE: Each piece of equipment on the NRT has its own Operator manual. It is recommended to familiarize yourself with its instruction prior to their operation.

Basic instruction – when preparing to move trolley

1. Check **Perspex sides are UP** and any loose/protruding items are stowed
2. Check **Giraffe is lowered fully**(up/down foot pedal) so top clears doorway
3. Check **wheel brakes are OFF**. Brake on all 4 wheels, Blue tab 'Up'= off
4. **Unplug A.C. mains orange cable** from wall – UPS beeps will be heard
5. **Disconnect O2 + Air hoses and stow** on provided hook system
6. **Turn ON E-Drive** system – use thumb control for direction & speed
7. Option: Camera system may also be used – Press **ON** on display screen

Basic instruction – when trolley is stationary mid-use

1. **Plug in A.C. mains orange cable** to wall outlet – UPS beeps will cease
2. If continuing treatment also **connect O2 + Air hoses** to wall gas outlets

Parking when transport completed – when system no longer required

1. **Return trolley** to Birth Unit (or NICU) dedicated NRT parking bay
2. **Plug in A.C. mains orange cable** to wall outlet – UPS beeps will cease
3. **Ensure gas hoses are neatly rolled and stow** on provided hook system
4. **Turn OFF E-Drive** system
5. Further instruction for Clinical staff – Clean-up NRT, used supplies etc
6. Replenish stock and perform checks per Setup checklist
7. Leave system with mattress warmer on 37degC

Setup considerations

- Replace gas cylinders which contain <10000kPa (2/3rds full). Check gauge.
- Confirm GE modules for SpO2 & ECG are in their holders (under monitor)
- Ensure ventilator system check has been performed (new neonate)
- Plug in electrical A.C. mains orange cable to wall outlet and is charging

Transport scenarios and guide to duration of gas/electricity supply-with full charge

A. Ventilator PC/AC. flow=10LPM, O2=60%, RR=40 no suction, no Resus/GE Warmer @ 50%, exam lights, both humidifiers
   Electrical = 3.5 hours + reserve | Gas = 5.5 hours

B. Resuscitation via Giraffe gas panel - flow=10LPM, O2=60%, suction(5mins) Warmer @ 100%, exam lights, both humidifiers
   Electrical = 2.3 hours + reserve | Gas = 4 hours

Troubleshooting

For any alarms on medical devices refer to troubleshooting guides contained in the manufacturer's operator manual as shown below in NRT equipment list detail.

Note the Emergency Stop button on handlebar only cuts power to the E-Drive system, NOT the power to other devices. ONLY press it in an Emergency e.g. if NRT is driven into person or collides with an object to cutoff power to drive system.

E-Drive – no power/won't turn on – release Emergency stop button(turn/release) The trolley can still be pushed manually even with no power to the E-Drive system

Infant Warmer sides don't lower – Lift slightly, open out then lower. Do not force.

Gas – low pressure – replace D-size cylinders(Air and/or Oxygen). Connect to wall.

Electricity – No power/UPS not charging – Plug to wall outlet and ensure power is available at wall outlet. Power check can also be done by viewing Green ON switch under rear of NRT(Isolation transformer).

NRT equipment list detail:

- GE Giraffe Open Care Warmer with integrated gas resuscitation panel
- Draeger neonatal ventilator VN800 with PS500 power supply
- Fisher & Paykel humidifiers
  - MR850(older style) for resus panel
  - MR950(newer style) for ventilator
- GE CarescapeOne patient monitor with SpO2 + ECG modules
- Stihler Electronics Astodia Diaphanoscope transilluminator DIA100
- Inditherm Cosytherm CCU200 mattress warmer with mattress
- E-Drive system by Tente
- Electrical supply UPS 9SX 3kVA by Eaton with Extension Battery Module
- Electrical isolation transformer by Harbuch FP-ISOL-240V-240V-2400VA
- Gas panel & hoses interface by Biomedical Engineering
- D-size Oxygen and Air cylinders by Air Liquide

Assembly & Support of NRT system by Biomedical Engineering who can be CONTACT Ph **xtn 42202** or 4734 2202 or raise AFMOnline requisition.

12 Oct 2022 pg 3

INTRODUCTION

Nepean's Neonatal Resuscitation Transport trolley provides a unique solution to meet the intra-hospital transport needs of Neonatal Services at Nepean Hospital.

Known as NRT for short, it comprises a range of Neonatal medical devices and other gas and electrical support solutions to effectively form a mobile NICU bed.

Assembled locally by Biomedical Engineering, the three NRT's allow transportation of the pre-term infant between Birth Unit / ED, Neonatal ICU, MRI.

The centerpiece to the NRT is the GE Giraffe open care warmer with integrated resuscitation gas panel. Ventilation is provided by Draeger VN800. Humidification by F&P. Patient monitoring by GE CarescapeOne. Oxygen + Air supplied by D-size cylinders/wall outlet. Electricity from Uninterrupted Power Supply (UPS) by Eaton /hospital outlet. Mattress warmer is Cosytherm and Diaphanoscope (transilluminator) by Astodia. The NRT also has an electronic drive system via convenient thumb speed and direction control allowing easy walk-along drive support. Finally, a drive camera system is available to increase visibility of what's ahead.

It is envisaged two NRT's will reside in Birth Unit(Level1) and one NRT reside in Neonatal(Level6). All systems must be left on-charge and routinely checked for appropriate setup and supplies to ensure they are ready at a moment's notice.

NOTE: This overview is a guide only to the NRT system however each medical device and equipment Instructions for Use must be consulted and appropriate training undertaken by staff prior to use.

ELECTRICAL SUPPLY

The system should only be used in designated Patient treatment areas as recognized by these symbols.

Cardiac protected (Heart in box) or Body protected (Person in box) is where medical equipment must be used.

A patient should only be treated using NRT when either stationary in such areas or when in transport unplugged.

Whilst stationary the NRT must always have its orange power lead connected to medical grade outlet to ensure maximum capacity of UPS & drive system is maintained.

GAS SUPPLY

Oxygen and Air supply is achieved from hospital gas wall outlets when stationary and will automatically switch to D-size cylinders supply when wall outlets are disconnected.

A gas manifold (on rear right side) is available to interconnect the Giraffe resus gas panel, the Draeger ventilator with additional outlets available for the MRI ventilator.

Whilst stationary the NRT must always have its O2 + Air gas lines connected to hospital gas outlets to ensure D-size cylinders gas are preserved for use-in-transport.

12 Oct 2022 pg 2

TGA Compliance

Assessment Hierarchy

- Device not a new medical device.
- Assembly does not fit under SOPP.
  - Device Intended Purpose of use unchanged
  - Manufactures intended method of use is changed
- Point-of-care manufacturing of medical devices.
- Ongoing consultation with TGA and SMBE NSW.

TGA Three key pillars

Design and construct according to safety principles and risk mitigation,

Develop solutions that are state-of-the-art and best practice, and

Ensure that the benefits of the device outweigh its risks.

Managing Risk

1. Device has a proven Legacy

2. Annual Performance Review

- 20-point functional assessment and maintenance regime.
- Review anomalies and update NBMLHD Work Health & Safety Risk evaluation.

Conclusion

Summary: 4 evolutions and improvements of the NRT.

Future Directions: Potential future upgrades.

Thank you for your time

Questions and Answers:

Open floor for questions from the audience.

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