



Indirect Calorimetry in Self-Ventilating Trauma Patients: The Gold Standard or Digging for Gold?





Trauma across Australia

DEMOGRAPHICS

10,211 severely injured



34%
occurred on the
WEEKEND



median
AGE 53



73%
MALE

CAUSE OF INJURY



3.2%
penetrating
trauma
<1% BURNS



44% TRANSPORT
RELATED

95.6%
BLUNT
trauma



39.2%
FALLS



PLACE OF INJURY



44.8% streets &
highways

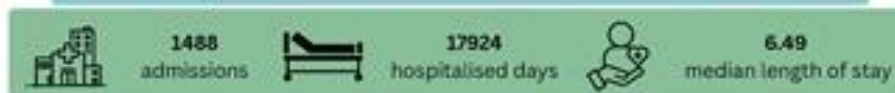


29.9% home



Trauma at RPH

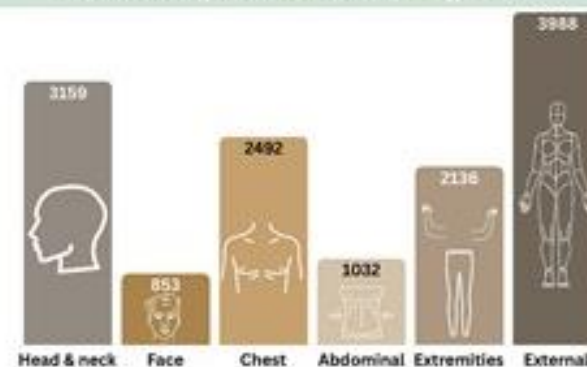
State major trauma admissions (ISS >12) for 2023



Trauma admissions and severity by ISS groups

Injury severity score	Admissions	Acute care days	Deaths	% Category deaths
Moderate (ISS 13 - 24)	1039	9368	43	4.14%
Severe (ISS 25 - 40)	399	6798	92	23.06%
Critical (ISS 41 - 75)	50	1758	15	30.00%

Trauma injuries to body regions

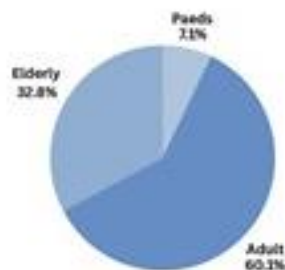


Total Trauma injuries to body regions in 2023: 13660



Age group and trauma admissions

Age group	Admissions	Acute care days
Paediatrics (<16 years)	106	1476
Adult (16 - 65 years)	894	11047
Elderly (> 65 years)	488	5401



Sex at birth and trauma admissions



	Admissions	Acute care days
Male	1033	12628
Female	455	5296



WA State Trauma Registry



Indirect Calorimetry



Weir Equation

$$REE = (3.94 \times VO_2) + (1.1 \times VCO_2)$$

All parties consented to photos being used in this presentation

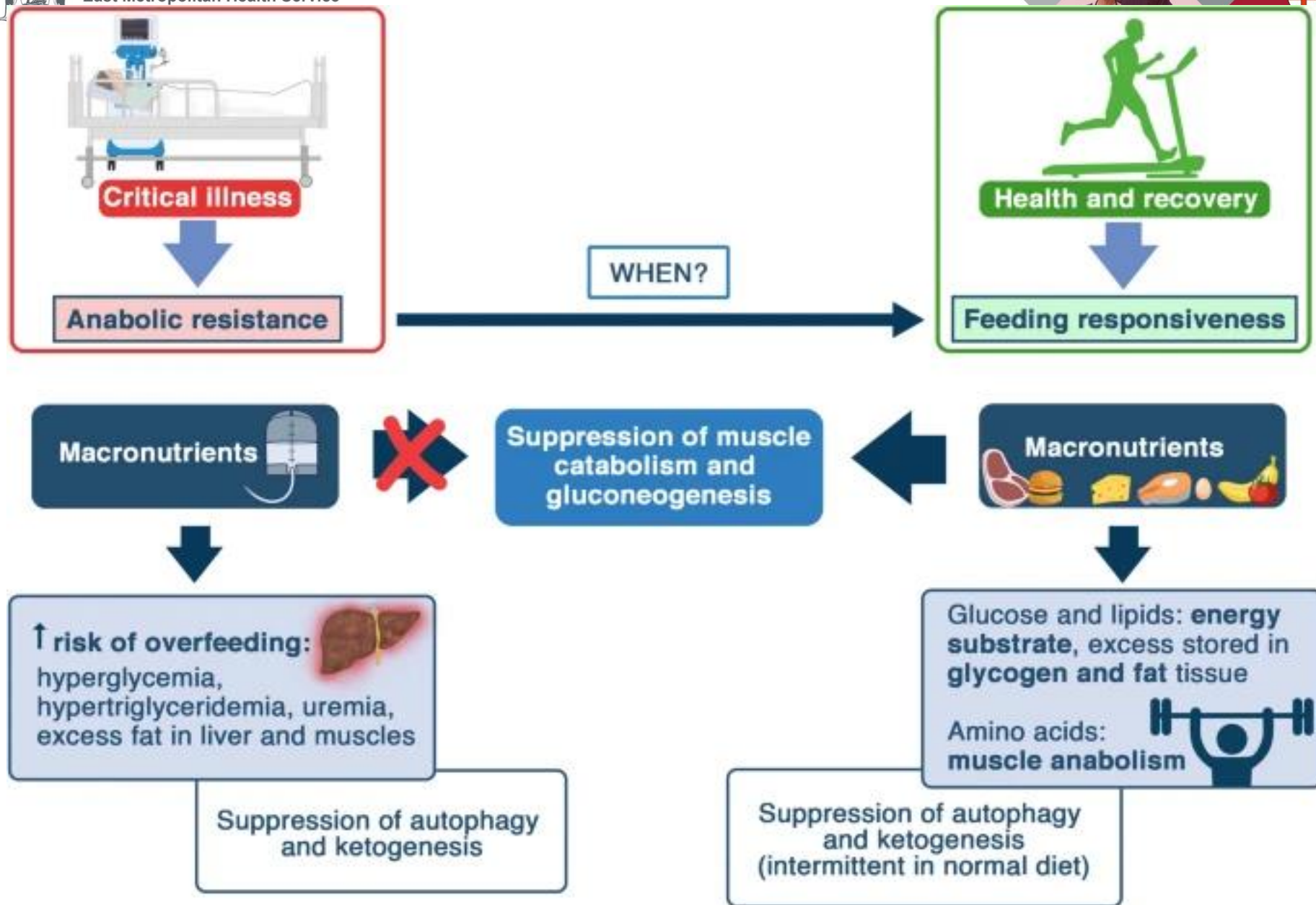


Predicting Energy Expenditure

Variable Injuries

- Head
- Spine
- Pelvis
- Long Bones
- Solid organs
- Bowel







Aim

Investigate the application of
IC in self-ventilating trauma
patients

Study Design

Single-centre (RPH Trauma
Unit)
Prospective Observational
Pilot project

Methodology

Q-NRG+ metabolic monitor
(canopy hood)

Valid

- >5 mins
- $\leq 10\%$ variation in VO_2 & VCO_2



Consent

Obtained for all participants
deemed eligible

Exclusion Criteria

<18y

Unable to give valid consent

Known claustrophobia

Pregnant

Agitated or aggressive

Supplemental oxygen

Infectious precautions

Inclusion criteria

≥18y

Admitted to SMTU

Breathing for themselves



Assessed for eligibility (n=353)

Excluded (n=301)

IC done on
median day 5
(IQR 3,10)

Indirect Calorimetry Attempted (n=52)

Measurement abandoned (n=11)

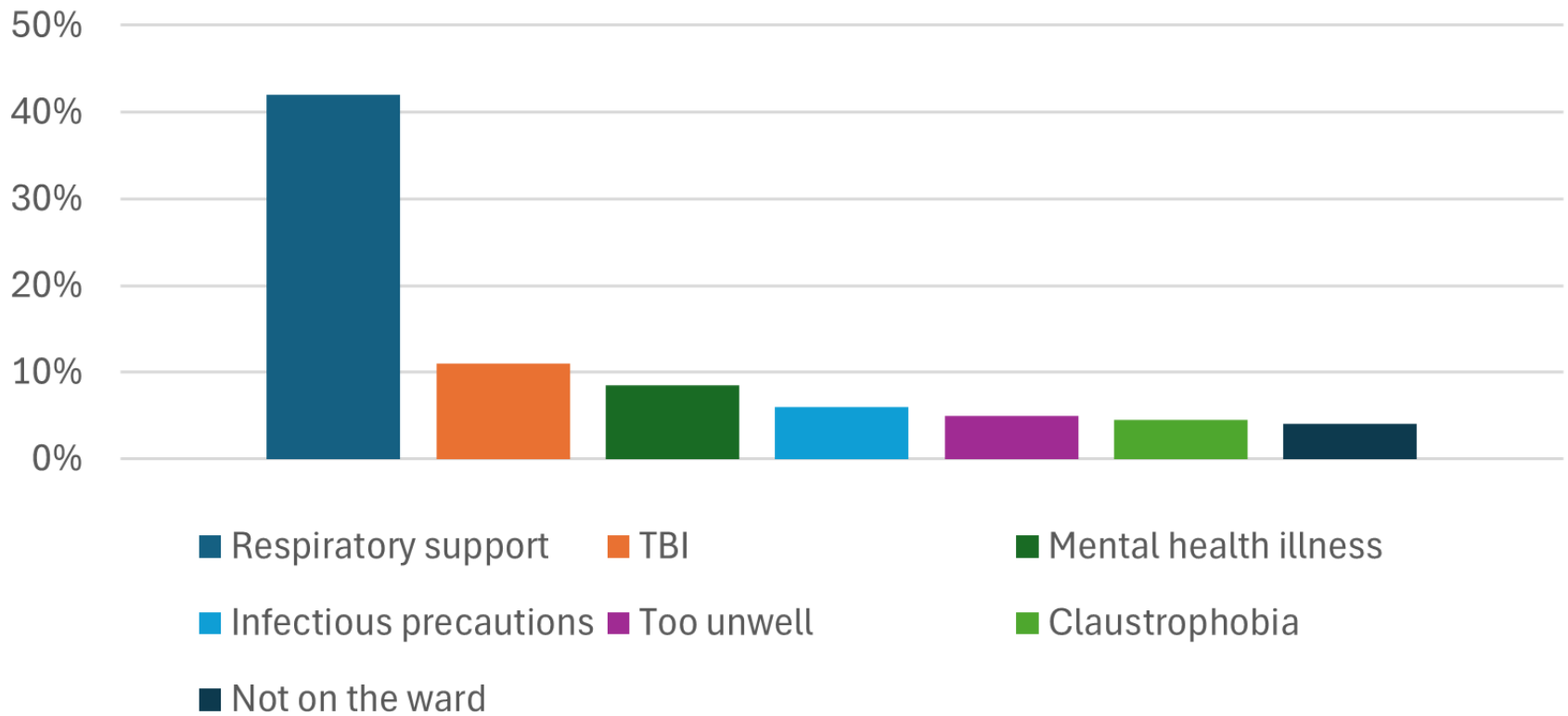
> 5 min IC measurement completed (n=41)

Excluded due to VO_2/VCO_2 variability >10% (=8)

Valid IC measurements (n=33)



Barriers to completing indirect calorimetry measures





Conclusion

Aim for IC on
day 10-14

⚠ Challenges to Indirect Calorimetry (IC)

- › Performing IC is particularly **difficult** in trauma patients who are acutely unwell or agitated.
- › Patient instability and lack of cooperation **limit measurement feasibility** during **early admission**.

✅ When IC Should Be Considered

- › IC remains valuable for patients with **prolonged hospitalisation**.
- › Measurement is feasible **once respiratory support is no longer required** and the patient can **actively participate**.



Indirect Calorimetry in Self-Ventilating Trauma Patients at Royal Perth Hospital

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Background

- Clinical guidelines recommend nutrition (as delivered based on measured energy expenditure (MEE) via indirect calorimetry (IC) which is the gold standard).
- Trauma patients are highly heterogeneous due to the varying signs and severity of injuries making predicting energy requirements in this population particularly challenging.
- Currently, predictive equations (PTE) are used to estimate energy expenditure. However, these are known to be inaccurate, often resulting in underfeeding or overfeeding, which may have deleterious effects.
- Therefore, the aim of this study was to compare MEE obtained via IC with PTE in self-ventilating trauma patients.



Method

- Prospective observational study conducted at Royal Perth Hospital's State Major Trauma Unit.
- Energy expenditure measured using IC (NCPG+; metabolic monitor via sample flow).
- IC measurements were considered valid if:
 - >3 minutes duration
 - <10% VCO₂/VCO₂ variability
- Where necessary, an activity factor and diet induced thermogenesis were included to calculate MEE.
- PTE was calculated using 25 or 30 kcal/kg based on injury severity.
- <10% difference between MEE and PTE was considered clinically significant.

Results

Total patients measured	41
Excluded	8 due to high VCO ₂ /VCO ₂ variability
Sample size	33
Gender	75% male
Mean age	47 ± 16.2 years
Mean BMI	26.1 ± 4.1 kg/m ²
Day of IC measurement	Median day 2 of admission (IQR 1-10)



Only 30% of PTE values fell within ±10% of MEE (p=0.004).

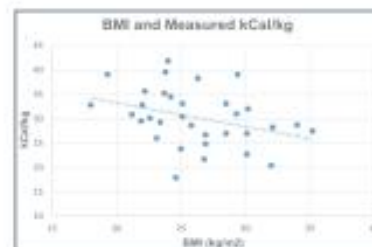
No significant difference observed in females (p=0.724). May be due to small sample size.

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Conflict of interest

The authors declare no conflict of interest.



Weak inverse correlation between BMI and MEE (r=-0.33, p<0.04), suggesting an increased BMI may be associated with reduced MEE.

No correlation found between injury severity score and MEE.

Conclusion

- Predicting energy requirements in trauma patients is challenging, highlighting the need for IC.
- This study suggests that IC should be prioritised for:
 - Critically injured patients
 - Patients predicted to have a hospital stay longer than two weeks
 - Patients receiving artificial nutrition
- Larger studies are required to validate these findings and to identify additional sub-groups who may derive the greatest benefit from IC.

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