EMERGENCY LUNG-PROTECTIVE VENTILATION IMPLEMENTATION STRATEGY
The ELVIS Project

Background: Endotracheal intubation and mechanical ventilation are utilised in severely injured and critically ill patients who present to the Emergency Department (ED). There is a significant body of evidence demonstrating that lung protective ventilation strategies (tidal volumes of 6-8mL/kg of ideal body weight and plateau pressures of <30cmH_2O) decrease mortality and increase the number of ventilator free days in patients with acute lung injury (ALI) and acute respiratory distress syndrome (ARDS)[1-5].

Mechanically ventilated patients in the ED often have no features of ALI or ARDS at the time of intubation (ie. non-injured lungs). They are however at high risk for developing ventilator-induced lung injury (VILI) through various mechanisms including interventions such as blood transfusion, general anaesthesia and surgery or coinciding pathology such as sepsis, trauma or brain injury[6]. The implementation of lung protective ventilation strategies in this population can decrease the development of ARDS, pulmonary infection and atelectasis but not in-hospital mortality[6-11]. Evidence suggests that lung protective ventilation is uncommon in the ED, regardless of ALI status[12-14]. Furthermore, only a minority of ventilated patients actually have adjustments made to their ventilation whilst still in the ED[13-14].

Currently, ventilation strategies in our Emergency Department are non-standardised and are largely dependent upon the treating clinician. The frequency with which lung protective ventilation is utilised remains unknown and is currently under investigation by way of a retrospective audit.

Objectives: To implement a mechanical ventilation care bundle *(Appendix A)* including a lung-protective ventilation strategy (ELVIS) aide-memoire designed to prompt the bedside emergency medicine clinician to optimise their ventilation strategy for their intubated patients in line with current accepted lung-protective ventilation practices.

Methods: Following the implementation of ELVIS, all patients who are mechanically ventilated in Liverpool Hospital Emergency Department (with the exception of those excluded by clinician discretion) will have their ventilation strategy optimised by the ELVIS aide-memoire. Following a twelve month trial period clinical data will be reviewed to establish the effectiveness of this strategy including patient demographics, intubation details, physiological observations, ventilation parameters and blood gas results. Ethics approval will be sought and this data will be collated and compared to our current, pre-ELVIS ventilation practices.

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APPENDIX A.

MECHANICAL VENTILATION CARE BUNDLE

Date	
Time	
Patient MRN	

This bundle is aimed at patients requiring intubation and mechanical ventilation in the ED.

Please find enclosed:

- RSI checklist
- Airway registry form
- Mechanical ventilation care set
- Ventilation observation chart
- Fluid order
- Drug chart

A tape measure and ideal body weight (IDW) nomogram will be available in each resus bay.

EXCLUSIONS:

There may be clinical scenarios where the clinician may select an alternate ventilation strategy in the patient's best interests. If so please complete the box below.

	Please tick	Document reason for clinical exclusion
Clinical Exclusion	☐	

****** please affix patient label to ELVIS Project register ******

LUNG PROTECTIVE MECHANICAL VENTILATION GUIDELINE

Measure patient height (cm): _____

Calculate IDW (kg): _____
(*see attached nomogram*)

VENTILATION

Calculate V_T - Target 6mL/kg IBW: _____ mL
- Acceptable: 6-8mL/kg IBW

Check Plateau Pressure <30cmH_2O: ☐
(please specify if other limit used:_____ cmH_2O)

Set RR:_____ (breaths/min)
(*suggest 20-25, titrate to achieve pCO_2/pH goals*)

pCO_2 target: _____mmHg **pH target: >7.3**

For patients with excessive V_T (>12mL/kg) or spontaneous breaths over prescribed rate:
- **Review V_T and RR settings.**
- **Consider increasing sedation, additional analgesia or use of NMB.**

OXYGENATION

Set PEEP:_____ cmH_2O (*suggest ≥5cmH_2O*)

Consider 8-10cmH_2O in BMI>30, severe hypoxia or APO.

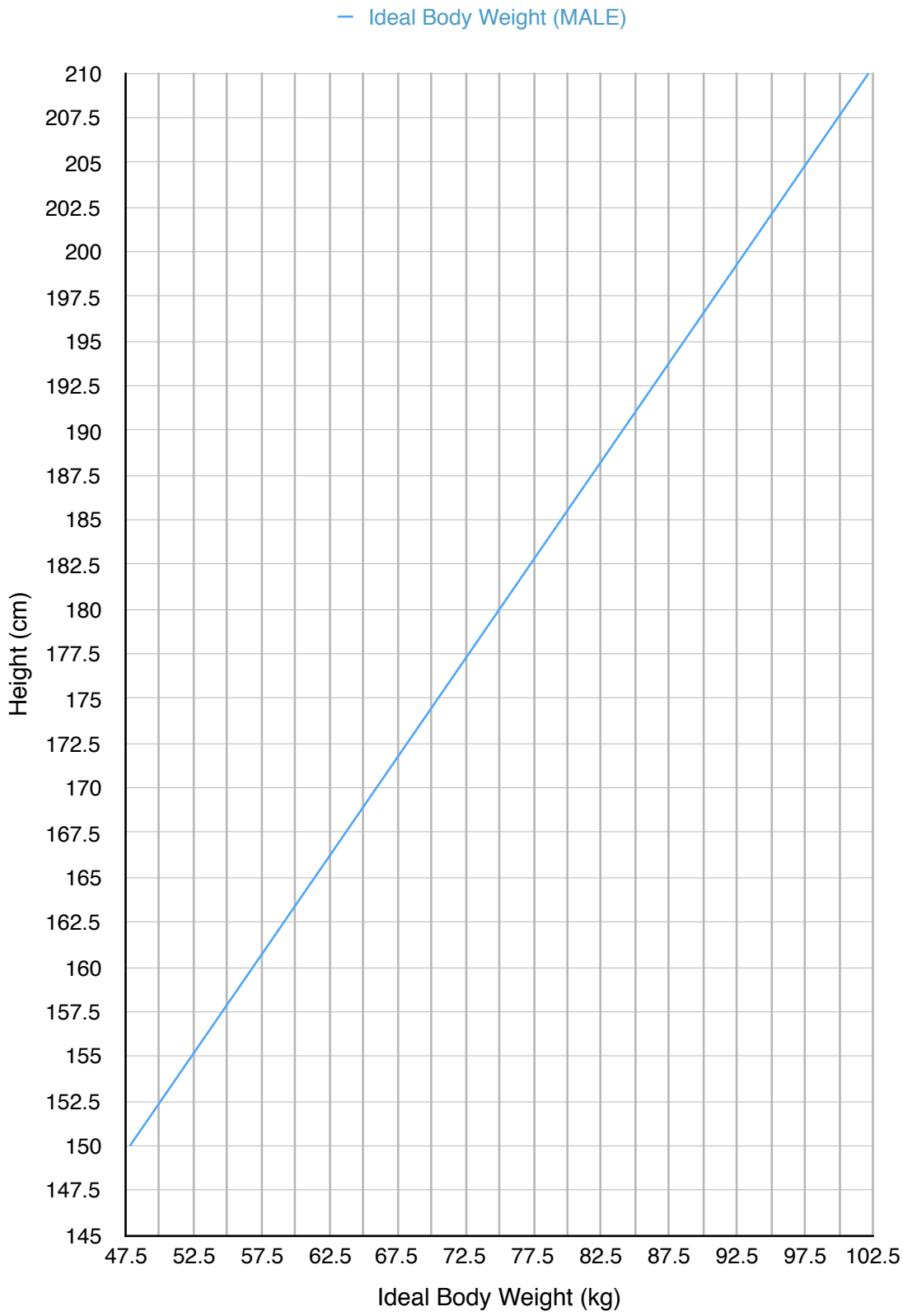
Titrate FiO_2:_____
Aim to achieve SpO_2 targets below.

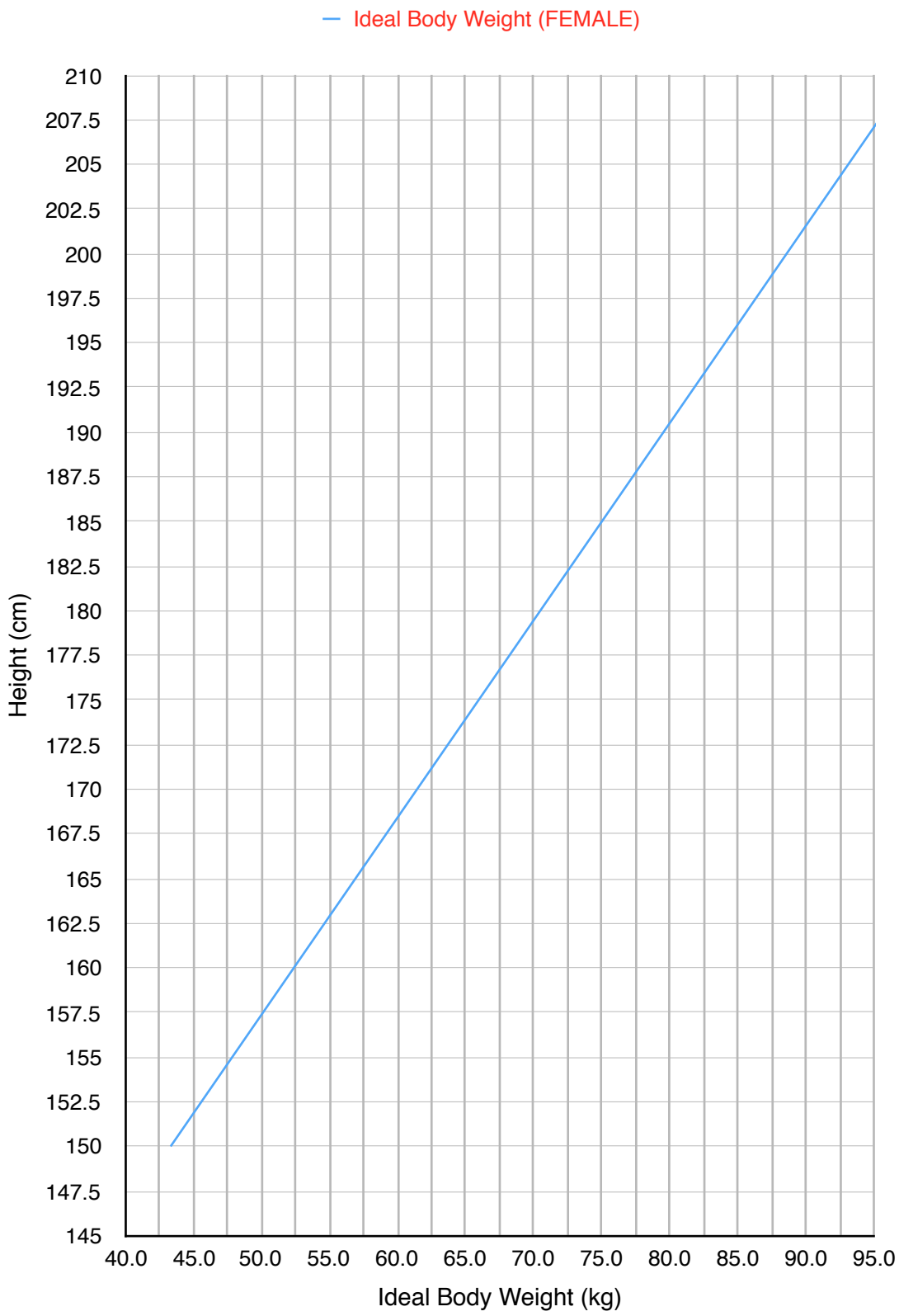
Target SpO_2 (please circle):

88-92% 94-98%

For refractory hypoxia, refer to Emergency Action Checklist (attached).

Prescribe ongoing sedation	
Consider further muscle relaxation where indicated	
Check cuff pressure (20-30cmH_20)	
Head-up *or* bed-tilt unless contraindicated	
NG/OG tube sited	
Post-intubation ABG (consider placement of arterial line)	


Ideal Body Weight (MALE)
Height (cm)
210
207.5
205
202.5
200
197.5
195
192.5
190
187.5
185
182.5
180
177.5
175
172.5
170
167.5
165
162.5
160
157.5
155
152.5
150
147.5
145
47.5
52.5
57.5
62.5
67.5
72.5
77.5
82.5
87.5
92.5
97.5
102.5
Ideal Body Weight (kg)


Ideal Body Weight (FEMALE)
Height (cm)
210
207.5
205
202.5
200
197.5
195
192.5
190
187.5
185
182.5
180
177.5
175
172.5
170
167.5
165
162.5
160
157.5
155
152.5
150
147.5
145
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
Ideal Body Weight (kg)

REFRACTORY HYPOXIA
EMERGENCY ACTION CHECKLIST

1. Notify Intensive Care.

You may require their ventilator or expedited transfer to ICU.

2. Titrate PEEP.

Incremental increase in PEEP above 10cmH_2O.
Watch for associated hypotension (consider fluid bolus or vasopressors).
(ARDSnet PEEP/FiO_2 table below for reference.)

OXYGENATION GOAL: PaO_2 55-80 mmHg or SpO_2 88-95%
Use a minimum PEEP of 5 cm H_2O. Consider use of incremental FiO_2/PEEP combinations such as shown below (not required) to achieve goal.

Lower PEEP/higher FiO2

FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
PEEP	5	5	8	8	10	10	10	12

FiO_2	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

3. Trial of recruitment manoeuvres.

Manual ventilation with BVM & PEEP valve (titrated up to 20cmH_2O)
Repeated inspiratory hold (20-30sec) with PEEP set to 20cmH_2O
(Caution hypotension)

4. Detect & correct "DOPES" causes.

Dislodged or displaced Endotracheal Tube or cuff
Obstructed Endotracheal Tube (e.g. mucous plugging, blood in tube)
Pneumothorax
Equipment failure (Ventilator, tubing)
Stacking of breaths (incomplete exhalation in Asthma or COPD)

5. Consider ventilator setting adjustment.

AutoFlow: trial off
Check I:E settings
Tolerate higher PAW in Bariatric patients
Consider reduction in PEEP (single lung pathology, pulmonary HTN)