

## Supplementary Appendix 1: Categorisation of diagnostic impressions

Category	Diagnostic impression
1	Sepsis
2	Cold & flu, Febrile illness, Meningitis, Pyrexia of unknown origin, Chest infection-pneumonia, UTI
3	Catheter problems, COPD, Convulsion/Fitting, Collapse-reason unknown, Confused/distressed/upset, Diarrhoea/Constipation, Dizzy/near faint/ loss of coordination, Shortness of Breath, Generally unwell, Haematuria, Headache, Hypotension, Other medical condition, Urinary Retention, Shock (hypovolemic), Transient Loss of Consciousness, Unconscious, Vomiting
4	Abdominal pain, Alcohol related, Allergic reaction/rash, Anaphylactic shock, AAA, Asthma, Bite/sting, Bleeding PR, Bleeding PV, Cardiac arrest, Cardiac STEMI, Cardiac chest pain (ACS), Cardiac NSTEMI, Choking, Carbon monoxide poisoning, Dental, Drug overdose, End of life care / Palliative, Epileptic fit, Epistaxis, Eye injury/eye problem, Falls, Gynaecological, Haematemesis, Haemoptysis, Haemorrhage/lacerations, Hyperglycaemia, Hypertension, Hypoglycaemia, Neurological problems, Pain – back non-traumatic, Pain – other, Panic attack, Poisoning, Pulmonary embolism, Rape/sexual assault, Pneumothorax (spontaneous), Renal problems/colic, Respiratory arrest, Seizures (non-EP), Smoke inhalation, Solvent related, Stroke – FAST positive, Unable to cope, No injury or illness, Cardiac Arrhythmia, Vascular Emergency (Non AAA), Dead on EMS arrival - signs inconsistent with life, Resuscitation unsuccessful
Excluded	Burns, Drowning, Electrocutation, Fracture/possible fracture, Hanging, Head injury, Major trauma, Minor cuts & bruising, Minor injuries – other, Multiple injuries Obstetric – BBA, Obstetric – birth imminent, Obstetric – miscarriage, Obstetric – normal labour, Obstetric – premature labour, Obstetric emergency (other), Psychiatric problems, Spinal injury, Sprain/strain/dislocation, Stabbed/shot/weapon wound, Wound Closure, Non accidental injury

## Supplementary Appendix 2: Details of each early warning score

### 90-30-90

Dichotomous assessment, positive if any of the following criteria are met:

1. Systolic BP < 90mmHg
2. Respiratory rate > 30/minute
3. Oxygen saturation < 90%

#### Modification:

If the oxygen saturation is measured on supplemental oxygen, it is assumed to be < 90% on air (i.e. the criteria is positive).\*

#### Missing data:

Assume any missing criterion is negative/normal.

### The Borelli strategy

Dichotomous assessment, positive if three or more criteria are met:

- Respiratory rate > 20/minute
- Heart rate > 90/minute
- Systolic BP < 90 mmHg
- Documented fever or temperature >38.3°C or <36°C
- New onset of mental status change
- O<sub>2</sub> saturation < 90%
- Suspected infection

#### Modification:

Documented fever or temperature >38.3°C or <36°C, is effectively just temperature >38.3°C or <36°C

New onset of mental status change assumed if the GCS verbal scale is <5. If the GCS verbal scale is missing, then mental status change is assumed if GCS<15 or AVPU<A.

If the oxygen saturation is measured on supplemental oxygen, it is assumed to be < 90% on air (i.e. the criteria is positive).

#### Missing data:

Assume any missing variable is negative

## Critical illness score (CIS)

Score	0	1	2
Respiratory Rate	12-23	<12 or 24-35	>35
Heart Rate	<120	≥120	
Systolic BP	>90	≤90	
Age	<45	≥45	
SpO2	≥88	<88	
GCS	15	8-14	<8

Thresholds of >4 or >0 are suggested, depending upon whether specificity or sensitivity are to be optimised

## Modification:

If the oxygen saturation is measured on supplemental oxygen, it is assumed to be < 88% on air (i.e. scores 1 point).

## Missing data:

Assume any missing variable scores zero.

## Hamilton Early Warning Score (HEWS)

Score	3	2	1	0	1	2	3
Respiratory Rate	<8	8-13		14-20		21-30	>30
Oxygen saturation	<85		85-91	>91			
Heart Rate		<40	40-50	51-100	101-110	111-130	>130
Systolic BP	<70	71-90		91-170		171-200	>200
Temperature	<35.0		35.1-36.4	36.5-38.0	38.1-39.0	>39.0	
Neurology				Alert	Voice	Pain	Unresponsive
Air or Oxygen				Air	≤ 5 L/min or ≤ 50% by mask		>5 L/min or >50% by mask

\*CAM positive removed as not routinely recorded

Threshold > 4

Modification:

If AVPU is missing, infer from GCS.

If on oxygen but amount unknown, score 2 points

Missing data:

Assume any missing variable scores zero

### Modified Early Warning Score (MEWS)

MEWS has five parameters, each of which are scored from zero to two or three providing an overall score between zero and 14.

Score	3	2	1	0	1	2	3
Respiratory Rate		<9		9-14	15-20	21-29	≥30
Heart Rate		≤40	41-50	51-100	101-110	111-129	≥130
Systolic BP	≤70	71-80	81-100	101-199		≥200	
Temperature		<35.0		35.0-38.4		≥38.5	
AVPU				Alert	Voice	Pain	Unresponsive

A threshold of 5 or more has been shown to be associated with an increased risk of death

#### Modification:

If AVPU missing, infer AVPU from GCS

#### Missing data:

Assume any missing variable scores zero.

## National Early Warning Score, version 2 (NEWS2)

The NEWS2 has seven parameters, each of which are scored from zero to three providing an overall score between zero and 20.

Score	3	2	1	0	1	2	3
Respiratory Rate	≤8		9-11	12-20		21-24	≥25
Oxygen saturation	≤91	92-93	94-95	≥96			
Heart Rate	≤40		41-50	51-90	91-110	111-130	≥131
Systolic BP	≤90	91-100	101-110	111-219			≥220
Temperature	≤35.0		35.1-36.0	36.1-38.0	38.1-39.0	≥39.1	
Neurology				Alert			Confusion, Voice, Pain, Unresponsive
Air or Oxygen		Oxygen (based on FiO <sub>2</sub> >21%, or FiO <sub>2</sub> >0 L/min)		Air			

We will not use the scale for patients with confirmed hypercapnic respiratory failure.

## Modification:

If AVPU is missing, infer AVPU from GCS

## Missing data:

Assume any missing variable scores zero.

## NHS pre-alert

Pre-alert if any of the following are present:

- Respiratory rate  $\leq 8$  or  $\geq 25$
- O<sub>2</sub> saturations on oxygen  $< 92\%$  (Patients usually running normal oxygen saturations)  $< 84\%$  (Patients with chronic hypercapnic respiratory failure)
- Systolic  $< 90$ mmHg OR downward-trending systolic where symptomatic
- Tachycardia  $\geq 131$
- GCS motor  $< 4$

Sepsis red flag criteria evaluated as part of UK Sepsis Trust criteria

Modification:

Drop  $< 84\%$  oxygen saturation threshold for patients with chronic hypercapnic respiratory failure

Drop downward-trending systolic where symptomatic

Missing data:

Assume any missing criterion is negative



### Prehospital ANTibiotics Against Sepsis (PHANTASi)

Dichotomous assessment, positive if both the following criteria are met:

1. Temperature  $>38$  °C or  $< 36$  °C
2. Heart rate  $> 90$  beats per minute or respiratory rate  $> 20$  per minutes

Modification:

None required

Missing data:

Assume any missing variable is negative/normal.

Paramedic Initiated Treatment of Sepsis Targeting Out-of-hospital Patients clinical trial (PITSTOP)

Dichotomous assessment, positive if all the following three criteria are met:

1. Paramedic suspects possible infection
2. Temperature  $\geq 38.0$  °C
3. Systolic BP < 100mmHg

Modification:

None required

Missing data:

Assume any missing criterion is negative/normal.

### Prehospital Sepsis Assessment Tool (PreSAT)

Dichotomous assessment, positive if both the following criteria are met:

1. Presentation suggestive of infection
2. Any two from (a) temperature  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$ , (b) heart rate  $> 90/\text{min}$ , (c) respiratory rate  $> 20/\text{min}$ , (d) systolic BP  $< 90\text{mmHg}$

Modification:

None required

Missing data:

Assume any missing variable is negative/normal.

## Prehospital Early Sepsis Detection (PRESEP)

Parameter	Score
Temperature > 38°C	4
Temperature < 36°C	1
SaO <sub>2</sub> < 92%	2
RR > 22 breaths/min	1
HR > 90 beats/min	2
BP < 90 mm Hg	2

Recommended threshold >3

## Modification:

If the oxygen saturation is measured on supplemental oxygen, it is assumed to be < 92% on air (i.e. score 2 points).

## Missing data:

Assume any missing variable scores zero.

## Prehospital Severe Sepsis (PRESS)

The score is only applied to patients meeting all three of the following criteria, so patients not meeting these criteria should score zero:

- Heart rate >90/min
- Respiratory rate >20/min
- Systolic blood pressure BP <110 mmHg

Score	0	1	2	3	4	5
Age	<40		≥60		40-59	
SpO2	≥90	80-89		70-79	60-69	<60
Systolic BP	100-109	90-99	80-89	70-79	60-69	<60
Hot tactile temperature				X		
ED chief concern: sick person				X		
Nursing home transport					X	

Threshold > 1

## Modification:

If the oxygen saturation is measured on supplemental oxygen, it is assumed to be < 90% on air and scored 2 points.

Infer hot tactile temperature from recorded temperature > 38°C

Drop ED chief concern sick person – address this through diagnostic impression

Drop nursing home transport

## Missing data:

Assume any missing variable scores zero

## Prehospital Sepsis Project (PSP)

Parameter	Score
Temperature > 38°C	1
Heart rate / systolic BP $\geq$ 0.7	2
Respiratory rate > 22/min	1

Low risk = 0-1 point, moderate risk = 2 points, high risk = 3-4 points

## Modification:

None required

## Missing data:

Assume missing temperature or respiratory rate scores zero.

Assume heart rate / systolic BP scores zero unless either (a) heart rate is > 100 and systolic BP is missing, or (b) systolic BP is <100 and heart rate is missing.

## qSOFA

Parameter	Score
GCS <15	1
Respiratory rate $\geq 22$	1
Systolic BP $\leq 100$	1

Total score 0-3

Low risk = 0 or 1

High risk = 2 or 3

Modification:

None required

Missing data:

Assume any missing variable scores zero

## Rapid Emergency Medicine Score (REMS)

Score	0	1	2	3	4	5	6
Age	<45		45-54	55-64		65-74	>65
MAP	70-109		50-69 or 110-129	130-159	>159 or <50		
Heart rate	70-109		55-69 or 110-139	40-54 or 140-179	<179 or <40		
Respiratory rate	12-24	10-11 or 25-34	6-9	35-49	<6 or >49		
SpO2	>89%	86-89%		75-85%	<75%		
GCS	>13	11-13	8-10	5-7	3-4		

High risk (REMS  $\geq 3$ ): patient may need aggressive treatment

Low risk (REMS <3): patient may be appropriate to triage for routine treatment

## Modification:

If the oxygen saturation is measured on supplemental oxygen, it is assumed to be < 89% on air and scored 2 points.

## Missing data:

Assume any missing variable scores zero



### Robson Screening Tool (RST)

Dichotomous assessment, positive if presentation suggestive of infection and any two of:

1. Temperature  $> 38.3^{\circ}$  or  $< 36^{\circ}$
2. Heart rate  $> 90$  beats/min
3. Respiratory rate  $> 20$  breaths/min
4. Acutely altered mental status
5. Plasma glucose  $> 6.6$  mmol/l (unless diabetic)

#### Modification:

Criterion 5 applies regardless of whether they are diabetic

Acutely altered mental status change assumed if the GCS verbal scale is  $< 5$ . If the GCS verbal scale is missing, then acutely altered mental status is assumed if  $GCS < 15$  or  $AVPU = A$ .

#### Missing data:

Assume any missing criterion is negative

## Screening to Enhance Prehospital Identification of Sepsis (SEPSIS)

Parameter	-1	0	1	2
Age		≤60	>60	
Respiratory rate		≤20 or >60	21-40	40-60
SpO2		≥94	<94	
Heart rate		≤100	101-140	141-160
Systolic BP	>160	<60 or 100-160	60-99	
GCS		13-15	3-12	
Temperature		<37.5	37.5 to 39.5	>39.5
Skin			Jaundice, pallor, mottling	

High risk if score > 4

Modification:

Skin features dropped from the score (not recorded on ePFR)

Missing data:

Assume any missing variable scores zero

Give 1 point if SpO2>94% on oxygen

### Sepsis Alert

At least two systematic inflammatory response syndrome (SIRS) criteria:

- Temperature > 38C or < 36C
- Pulse > 90 beats/min
- Respiratory rate > 20 breaths/min or mechanically ventilated

And

Suspected or documented infection

And

Hypoperfusion, as manifested by one of the following:

- Systolic BP < 90 mm Hg
- Mean arterial pressure < 65 mm Hg
- Lactate level  $\geq$  4 mmol/L

Modification:

Drop lactate level  $\geq$  4 mmol/L

Missing data:

Assume negative if missing

## Simple Triage Scoring System (STSS)

Parameter	Score
Age >65 yrs	1
Altered mental status	1
Respiratory rate of >30 breaths/min	1
Low oxygen saturation	1
Shock index of >1 (heart rate > systolic BP)	1

## Modification:

Altered mental status change assumed if the GCS verbal scale is <5. If the GCS verbal scale is missing, then altered mental status is assumed if GCS<15 or AVPU<A.

Score 1 point for low oxygen saturation if oxygen saturation is <94% or measured on supplemental oxygen.

## Missing data:

Assume any missing variable scores zero

### Suffoletto strategy

Dichotomous assessment, positive if any of the following criteria are met:

- Systolic BP <100 mmHg
- History or suspicion of fever
- Prehospital judgment of infection

Modification:

Infer history or suspicion of fever from temperature >38

Missing data:

Assume any missing criterion is negative

### UK Sepsis Trust Red Flags

Any of the following gives a positive score:

- Objective evidence of new or altered mental state
- Systolic BP  $\leq$  90 mmHg (or drop of  $>40$  from normal)
- Heart rate  $\geq$  130 per minute
- Respiratory rate  $\geq$  25 per minute
- Needs O<sub>2</sub> to keep SpO<sub>2</sub>  $\geq$  92% (88% in COPD)
- Non-blanching rash / mottled / ashen / cyanotic
- Lactate  $\geq$  2 mmol/l
- Recent chemotherapy
- Not passed urine in 18 hours

#### Modification:

New or altered mental state assumed if the GCS verbal scale is  $<5$ . If the GCS verbal scale is missing, then new or altered mental state is assumed if GCS $<15$  or AVPU $<A$ .

Drop BP change from normal and just use systolic BP  $\leq$  90 mmHg

Simplify O<sub>2</sub> criteria to SpO<sub>2</sub>  $<$  92% or measured on supplemental oxygen

Drop non-blanching rash / mottled / ashen / cyanotic

Drop lactate  $\geq$  2 mmol/l

Drop recent chemotherapy

Drop not passed urine

#### Missing data:

Assume any missing criterion is negative.