Surgical Expert Systems:

Sepsis

Sepsis, a state of life-threatening organ dysfunction, is one of the most common causes of death worldwide[1]. The condition arises when the body's response to an infection injures its own tissues, and is shaped by a variety of pathogen and host factors[2]. Specific risk factors include advanced age, male sex, and chronic medical conditions, outlining patient profiles requiring heightened awareness[3].

According to 2020 data, approximately 48.9 million cases and 11 million sepsis-related deaths occured worldwide, representing a jarring 20% of all deaths[4].

Sepsis risk scores provided by Stream Care™ are selected based on a thorough and extensive review of existing literature, incorporating:

- ✓*98 Peer Reviewed Papers*
- ✓*10 Systematic Reviews*
- ✓*4 Textbooks*

Impact

Sepsis significantly affects General and GI surgical populations as a frequent and serious outcome[5]. In bariatric patient populations, incidence ranges from 0.3-1.2%[6,7], while in esophageal populations, it spans 1.9-19.0%[8,9]. Similarly, 1.8-19.0% of colorectal patients develop the deadly condition[10,11].

The onset of sepsis is particularly burdensome for healthcare providers, with 15/1000 hospitalized patients developing sepsis as a result of receiving health care[12]. Its diagnosis is difficult and often delayed, further amplifying the resource-intensive nature of the complication and posing a strain to clinical workloads[13,14]. Furthermore, with an estimated expense of $32,000 USD per patient, sepsis proves to be a costly complication[15]. In the Medicare population alone, its annual cost is more than $57 billion USD[16]. As sepsis is a leading cause of hospital death, the magnitude of this complication warrants urgent action to improve mitigation strategies[17].

*Enabling **round-the-clock** automated patient monitoring for early signs of sepsis.*

Dynamic Risk Scores

SOFA

The **Sepsis-related Organ Failure Assessment (SOFA)** score predicts the **risk of mortality** following postoperative sepsis starting at the **time of ICU admission** and updates **every 24h**[18].

Source
SOFA was developed by Vincent et al. and validated by Toker et al., and Seymour et al.

Patient Population
SOFA was developed using patients who were admitted to the ICU[18].

Data Set
European/ North American Study of Severity System (ENAS) data base[18]

Sample Size
1,643[18]

Inputs
- PaO2/FiO2
- Platelets
- MAP/ Vasoactive Agents
- Bilirubin
- Creatinine/ Urine Output
- Glasgow Coma Scale

qSOFA

The **Quick Sepsis-related Organ Failure Assessment (qSOFA)** score predicts the **risk of mortality** following postoperative sepsis starting at the time of diagnosed/ suspected sepsis for patients in a **non-ICU setting**[19] and updates with **every 12 hours.**

Source
qSOFA was developed by Seymour et al. and validated by Schertz et al. and Perman et al.

Patient Population
qSOFA was developed using patients with suspected infection in and outside of the ICU[19].

Data Set
UPMC health care system data base[19]

Sample Size
148,907[19]

Inputs
- Glasgow Coma Scale
- Respiratory Rate
- Systolic BP

mSOFA

The **Modified Sepsis-related Organ Failure Assessment (mSOFA) predicts the risk of mortality** following postoperative sepsis starting at the **time of ICU admission** and updates **every 24h**[20].

Source
mSOFA was developed by Grissom et al. and validated by Youssry et al. and Khwannimit et al.

Patient Population
mSOFA was developed using patients admitted to a medical, surgical, and trauma ICU[20].

Data Set
The Latter-day Saints (LDS) Hospital and Intermountain Medical Center EHR systems[20].

Sample Size
Retrospective: 718[20]
Prospective: 1,770[20]

Inputs
- PaO2/FiO2
- Platelets
- MAP/ Vasoactive Agents
- Jaundice
- Creatinine/ Urine Output
- Glasgow Coma Scale

NEWS

The **National Early Warning Score (NEWS) predicts the risk of postoperative clinical deterioration** in hospitalized patients starting at the initial assessment **upon hospital admission**[21] and updates **every 12 hours**.

Source
NEWS was developed by the NEWSDIG and validated by Wang et al. and Hincapié -Osorno et al.

Patient Population
NEWS was developed using acute medical admissions[21].

Data Set
Portsmouth Hospitals NHS Trust data base[21].

Sample Size
35,585[21]

Inputs
- Respiratory Rate
- SpO2
- Hear Rate
- AVPU
- Systolic BP
- Temperature
- Supplemental Oxygen

NEWS2

The **National Early Warning Score 2 (NEWS2) predicts the risk of postoperative clinical deterioration** in hospitalized patients starting at the initial assessment **upon hospital admission**[22] and updates **every 12 hours.**

Source
NEWS2 was developed by the NEWSDIG and validated by Wallgren et al., and Pimental et al.

Patient Population
NEWS2 was developed using acute medical admissions[22].

Data Set
Portsmouth Hospitals NHS Trust data base[22]

Sample Size
35,585[22]

Inputs
- Respiratory Rate
- SpO2
- Heart Rate
- AVPU
- Systolic BP
- Temperature
- SpO2 (for Hypercapnic Respiratory Failure)

Performance Metrics

Risk Score	Cited By	Reference	Validation Type	AUC	Specificity	Sensitivity	NPV	PPV
FluidAI Recommended SOFA	12,990	Vincent et al.	Internal	0.847	80	78	–	–
		Toker et al.	External	–	79	100	100	57.8
		Seymour et al.	External	0.79	–	–	–	–
NEWS	*	NEWSDIG	Internal	0.89	–	–	–	–
		Wang et al.	External	–	52	73	–	–
		Hincapié -Osorno et al.	External	0.86	–	–	–	–
NEWS2	*	NEWSDIG	Internal	0.72	–	–	–	–
		Wallgren et al.	External	0.73	61	74	74	60
		Pimental et al.	External	0.86	80.6	73.2	–	–
qSOFA	4,614	Seymour et al.	Internal	0.81	–	–	–	–
		Schertz et al.	External	–	72	61	56.7	73.3
		Perman et al.	External	0.62	55.5	69	91.5	20.6
mSOFA	205	Grissom et al.	Internal	0.84	–	–	–	–
		Youssry et al.	External	0.97	96	92	96	92
		Khwannimit et al.	External	–	74.6	85.6	–	–

*The original NEWS and NEWS2 scores were developed in internal NHS England reports, which are not formally published in academic literature and therefore do not have citation counts.

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