

SIM – PHYSIOLOGY E-BOOK

(SIM LAB GUIDE for 2nd YEAR MEDICAL STUDENTS)

- **Purpose of these coursebooks:**

- ✓ To help students orient themselves with the tentative plan and objectives of the lab.
- ✓ Overview materials for students before attending the class.
- ✓ To ensure everyone has the same baseline level of subject knowledge to ensure the smooth transition and running of the SIM block.
- ✓ Reference material to overview before the monthly block tests.

- **Simulation**

An artificial representation of a real-world process to achieve educational goals through experiential learning.

- **Simulation Medicine**

Simulation based medical education is any educational activity that utilizes simulation aides to replicate clinical scenarios.

CONTENT - SYLABUS

B1

- Introduction to Simulation Medicine in Physiology Course
- Examination, Primary assessment
- Evaluation, Condition assessment

B2

- Handover (SBAR)
- Circulation, Blood Pressure, Determinants of Blood Pressure

B3

- Respiration
- Respiration – Circulation relation
- Oxygen Supply (DO₂)
- Oxygen Delivery (DO₂) determinants

B4

- CO₂ elimination
- Capnometry
- etCO₂ variables
- Patient Monitoring during General Anesthesia
- Reaction to a Change in Patient's Condition

B5

- Invasive Blood Pressure Measurement
- Determinants of Glomerular Filtration

B6

- Consciousness (determinants and evaluation)
- Acid – Base Balance, Intrinsic Environment

B1: EXAMINATION, CONDITION ASSESSMENT

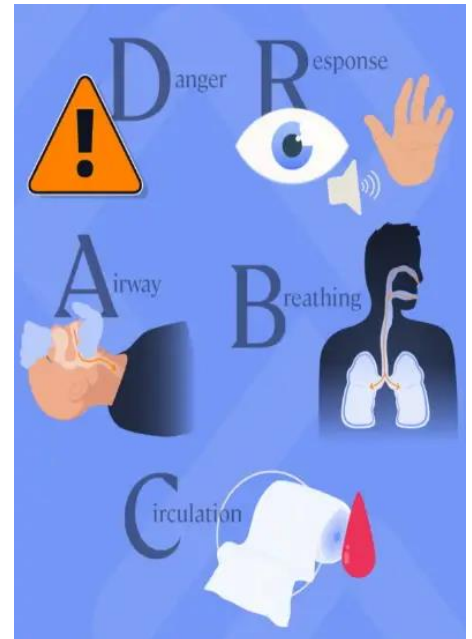
AIMS

- Examining a person and evaluating his/her vital parameters (consciousness, breathing, circulation, etc.) is a method by which we assess the overall condition of the patient.
- There are innumerable examination methods and tools available for such patient evaluation.
- Today you will be introduced to the first (using your own senses, observing, touching etc.) without the use of any external tools yet.
- Principle of all such evaluations remains the same regardless of the tools used:

EXAMINATION	Detection of vital parameters
EVALUATION	Comparison with the normal and general determination of the degree of threat (see traffic light below)
REACTION	Response of the examiner aimed at stabilizing the patient
THINK OVER	WHY and by what mechanism the malfunction occurred
HANDOVER	Communication of information to a more experienced colleague in a structured format (SBAR)

DR ABC - Basic Patient Examination (And Interpretation)

- When a care giver, responder, or first aider initially arrives to the patient, the first thing to do is to assess the situation at hand. This assessment is known as the primary survey.
- It is recommended to follow a uniform procedure during the primary investigation in a manner of priority, and to ensure that important things are not forgotten.
- Depending on the **specific** condition and severity, different priority is given to individual points.
- This protocol is repeated multiple times because condition is dynamic and can change any time.
- The principle of the procedure is suitable not only for first aid, but also for other orientation examinations.



NOTE: In the case of critical findings, their resolution takes precedence over compliance or continuation of the procedure. (E.g.: surrounding danger, foreign body in airways, obstructed airways, life-threatening bleeding)

1. DANGER

- Before the examination begins, it is necessary to evaluate any potential risk that would immediately threaten the patient (fall, suffocation) or the examiner (risk of infection, violence).
- If so, its removal/reduction should be given top priority.

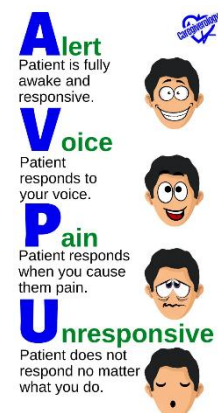
2. RESPONSE

(Consciousness Evaluation)

- Definition of Consciousness: The ability to perceive oneself and the environment and react to environmental stimuli.

EXAMINATION - output

- **A** Alert
- **V** Voice responsive (responsive to voice stimulus)
- **P** Pain responsive (responsive to pain stimulus)
- **U** Unresponsive



- In the primary assessment, we use a brief evaluation scale (AVPU) to determine whether the conditions of brain function (see protocol B6) are good enough to allow full wakefulness (A) or so bad that the patient cannot be woken up even by a strong painful stimulus (U).
- **EVALUATION of**
 - How much the detected condition is far from the normal condition (A)
- **RESPONSE to**
 - the risks of unconsciousness.
 - Activity of the examining person, aimed at optimal care of the unconscious patient:
 - Prevention of upper airway obstruction accompanying unconsciousness (due to loss of muscle tone)
 - Prevention of aspiration of gastric contents during suppression of defensive reflexes, which may also be present in unconsciousness.
 - Therefore, additional attention is focused on airway and breathing control, opening of airways (see further Airway section)
- **THINK OVER**
 - WHY did the unconsciousness occur?
 - (see B6)

Conditions required for consciousness – proper functioning of the brain
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Oxygen supply

Blood flow

Energy - Glycemia

Indoor environment

Organic and functional integrity

3. AIRWAYS

- **EXAMINATION**
 - We need to check that the airway is open and clear.
- **EVALUATION**
 - If the chest rises and we do not hear any sounds suspicious of obstruction (e.g. snoring, stridor ...), the airway is probably patent.
 - In unconsciousness, airway can collapse simply because of the loss of muscle tone of the pharynx (will be explained later) So we have to constantly check the airway throughout.
- **REACTION**
 - Open the airway by placing one hand on the forehead to tilt the head back and use two fingers from the other hand to lift the chin.
 - If they are unresponsive, you need to move on to breathing as quickly as possible

4. BREATHING

- **EXAMINATION**
 - Regularity of the breathing and symmetry of the rising chest with an optimal head position
 - Perception of the air flow coming from the mouth/nose (preferably using the palm of the hand to keep the head tilted back)

- Respiratory rate,
- Listening to breath sounds during the breathing cycle (without stethoscope yet),
- Evaluation of the color of the skin as a sign of sufficient breathing (pink – sufficient oxygenation, blue – insufficient oxygenation)

■ EVALUATION

- In the extreme case, the absence of respiratory activity is assessed as a critical condition that requires an immediate response.

■ REACTION

- If we have no direct clue about the state of the circulation, we assume the most common cause of respiratory arrest in adults, which is circulatory arrest, and hence, in addition to breathing, we also aid the circulation with cardiopulmonary resuscitation (CPR). Whereas the layman only focuses on circulatory replacement.
- If we have information about preserved circulation, we only aid and correct the ventilation (see B3).

- If there is a minor deviation from the normal state (for example, signs of reduced blood oxygenation), we react adequately (see B3)

Conditions for proper supply of O2 to tissues
Ventilation
Diffusion
Perfusion
Transport

■ THINK OVER

- WHY was there a failure of the oxygen supply?
- (see B3)

5. CIRCULATION

■ EXAMINATION

Pulsations

- The presence of pulsations on the **carotid** artery is a sign of **non-zero cardiac output**.
- The presence of pulsations on the **radial** artery is a sign of **sufficient blood pressure**. (>80 SBP)
- This happens when no tissues suffer from insufficient flow and glomerular filtration does not decrease in the kidneys (see B5).
- The value of blood pressure, which we call still sufficient, can be lower than physiological, but it is within the regulatory range, and therefore the organism is not damaged due to hypotension.
- The **regularity** of the pulsations is a sign of **regular electrical activity** of the heart.

Heart Rate

- **By determining the heart rate**, we find either a normal value or an abnormal value.
- Interpretation of abnormal heart rate values (at rest, without physical load):
 - We notice compensatory tachycardia in the setting of low blood pressure as a sign of a stress reaction (see B2)
 - We evaluate the level of cardiac workload: longer-lasting tachycardia means an increase in the metabolic demands of the heart's performance (this may not be good for the patient)

Blood pressure

- The blood pressure value is used for the quantitative assessment of circulatory sufficiency. Without a BP cuff, we can roughly say that:
- If there is a palpable pulse on **the radial artery**, the **systolic pressure is >80 mmHg**
- If the pulse is not palpable on the radial artery, but it can be felt **in the groin**, it is **systolic. pressure>60mmHg**
- If it is palpable only on **the carotid artery**, it means **systolic pressure > 40 mmHg**.
- The value of blood pressure is partially correlated with the amount of cardiac output (see B2)

Capillary Refill Time

- **By examining the capillary return (CRT: capillary refill time)** we can roughly determine the flow of blood through the microcirculation.
- Method: Press the nail of the finger for 5 seconds in such a way as to squeeze blood from the tip of the finger. After releasing the pressure, the nail should turn pink again within 2 seconds due to the return of blood to the microcirculation.

EVALUATION

- We consider a completely non-functional circulation (e.g., circulatory arrest) as a critical condition.
- Its consequences are manifested during the examination before the direct control of circulatory manifestations (pulsations, etc.) occurs, namely loss of consciousness and respiratory arrest, as described earlier.

RESPONSE to this situation is cardiopulmonary resuscitation.

- If the circulation is preserved but insufficient, i.e., we do not feel pulsations on the radial artery, then the blood pressure is low, and we assess such a condition as critical (see below traffic light and B2) and respond to it according to the cause that caused the hypotension (see determinants of pressure and B2).

THINK OVER

- WHY the pressure is low

Determinants of blood pressure
Blood volume
Cardiac Output
Peripheral resistance

OVERALL CONDITION ASSESSMENT

- Condition assessment is an evaluation of the severity of the patient's condition, necessary for the next step in patient care and the determination of the examiner's priorities.
- This skill takes years of education and experience.
- However, from the beginning of medical training, it is necessary to learn **a systematic approach to the patient**. (At least a simplified classification of the degree of seriousness of the patient's overall condition)
- It can be classified into, for example, as follows:
 - **Critical**: Patient is in direct danger of life, requires immediate care.
 - **Threatening**: There is no immediate threat to life, but the condition could develop unfavorably, patient needs further medical attention (further investigation and treatment during hospitalization)
 - **Satisfactory**: may not be completely healthy, but has sufficient reserves to seek care independently.

CRITICAL (meets any of the conditions below)

- unconsciousness
- respiratory arrest
- circulatory arrest
- life-threatening bleeding
- critically low blood pressure



THREATENING (everything between critical and satisfying)



SATISFACTORY (meets all the conditions below at the same time)

- conscious, oriented (not confused)
- not dyspneic (does not complain of breathing difficulties)
- has sufficient blood pressure to move while standing

