

# Hackathon Prog5/6 2024

Advanced Life Support / Patient Monitor Simulation



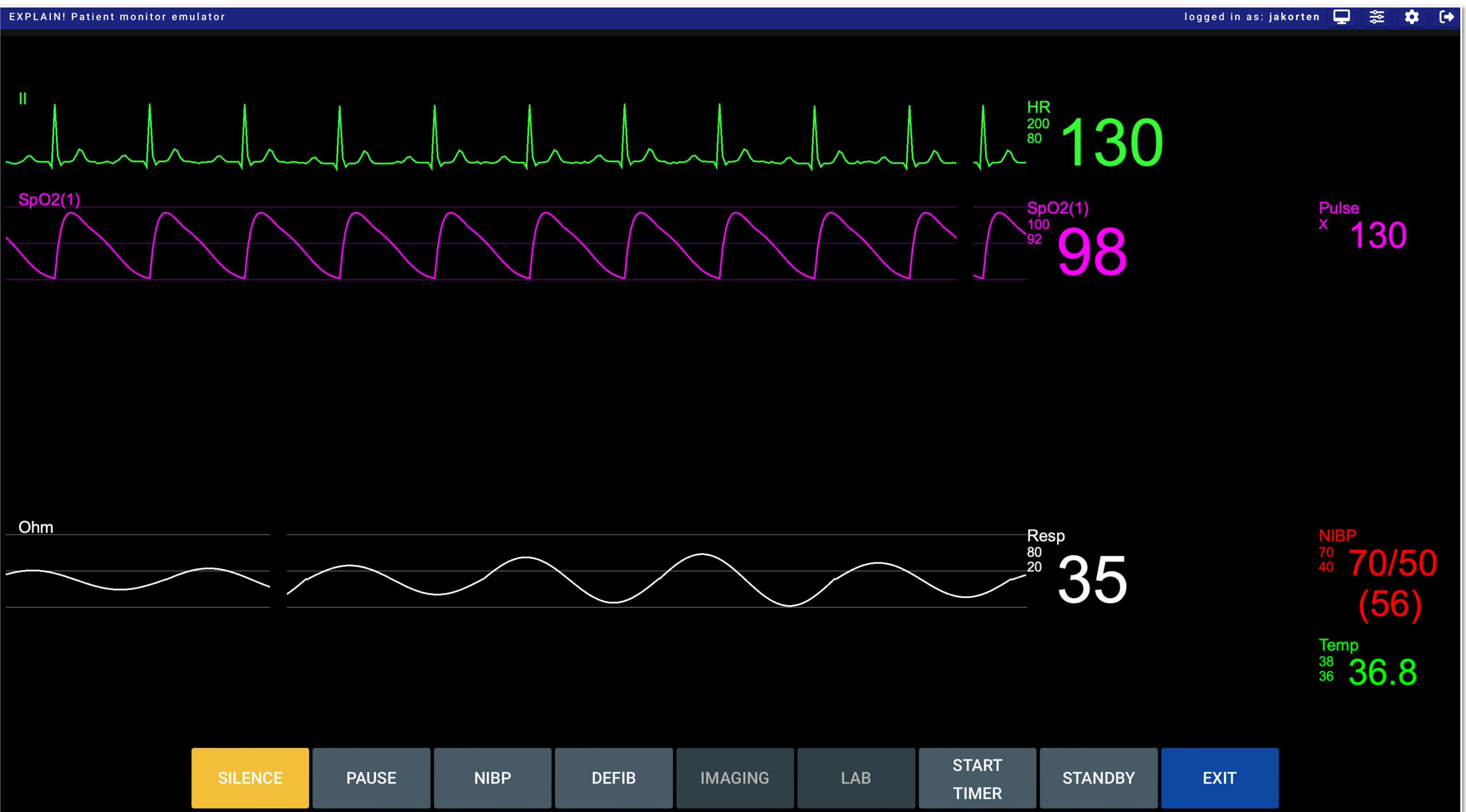
**UMC Utrecht**  
Wilhelmina Kinderziekenhuis  
**NEONATAL INTENSIVE CARE UNIT**



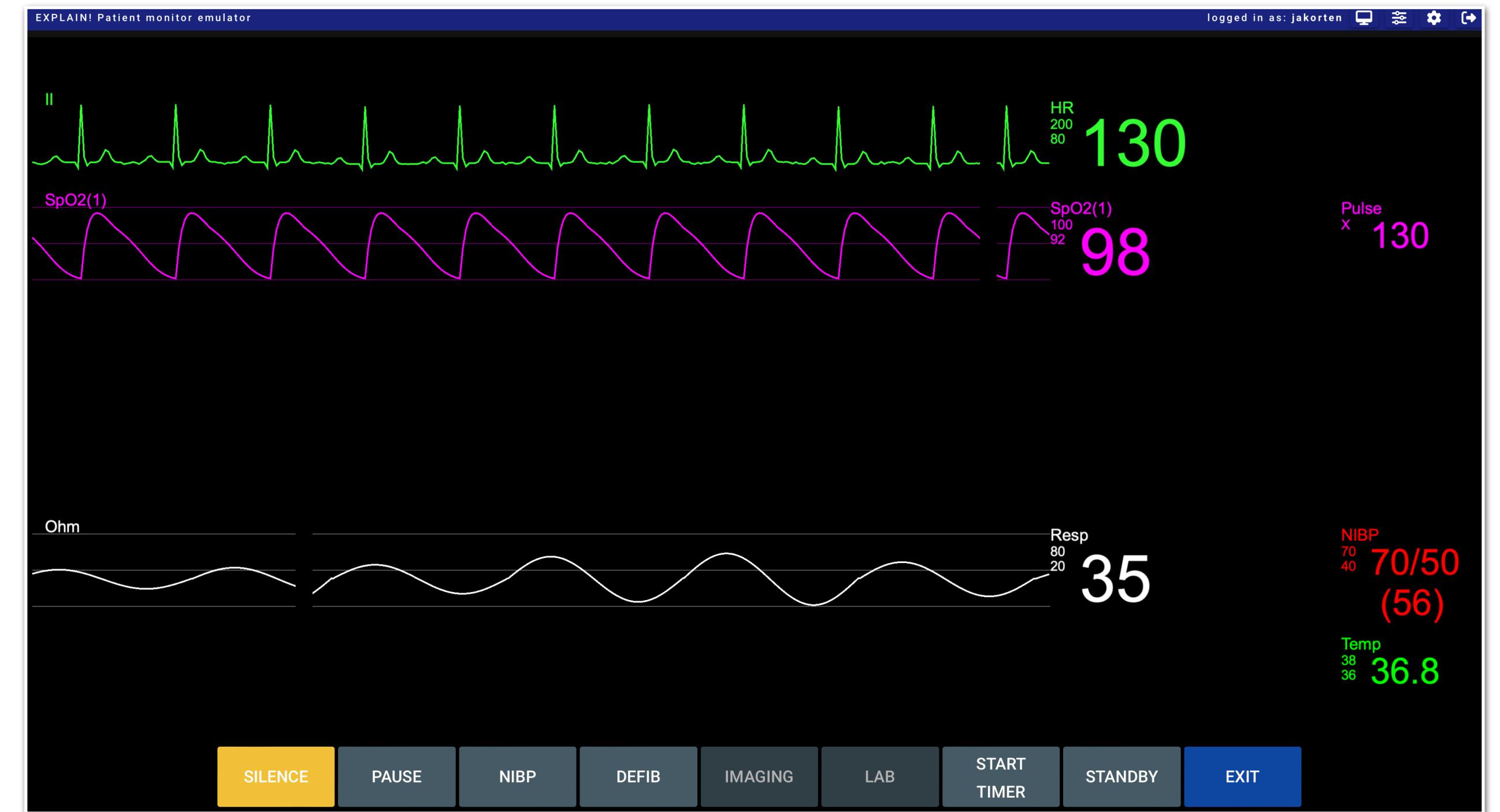
**HEALTH CONCEPT LAB**

**Capgemini**





- Model-based version from RadboudUMC NICU (Neonatologist Tim Antonius)



- Left: iSimulate
- Right: Model-based version from RadboudUMC NICU (Neonatologist Tim Antonius)

# Background

- Basic Life Support simulation:
  - From Arduino to FreeRTOS using our own HAL (with Victor Hogeweij and Richard Kroessen)
- (Basic) Advanced Life Support:
  - Using the same hardware and software principles to extend a low-cost but reliable basic simulator for advanced life support as well.

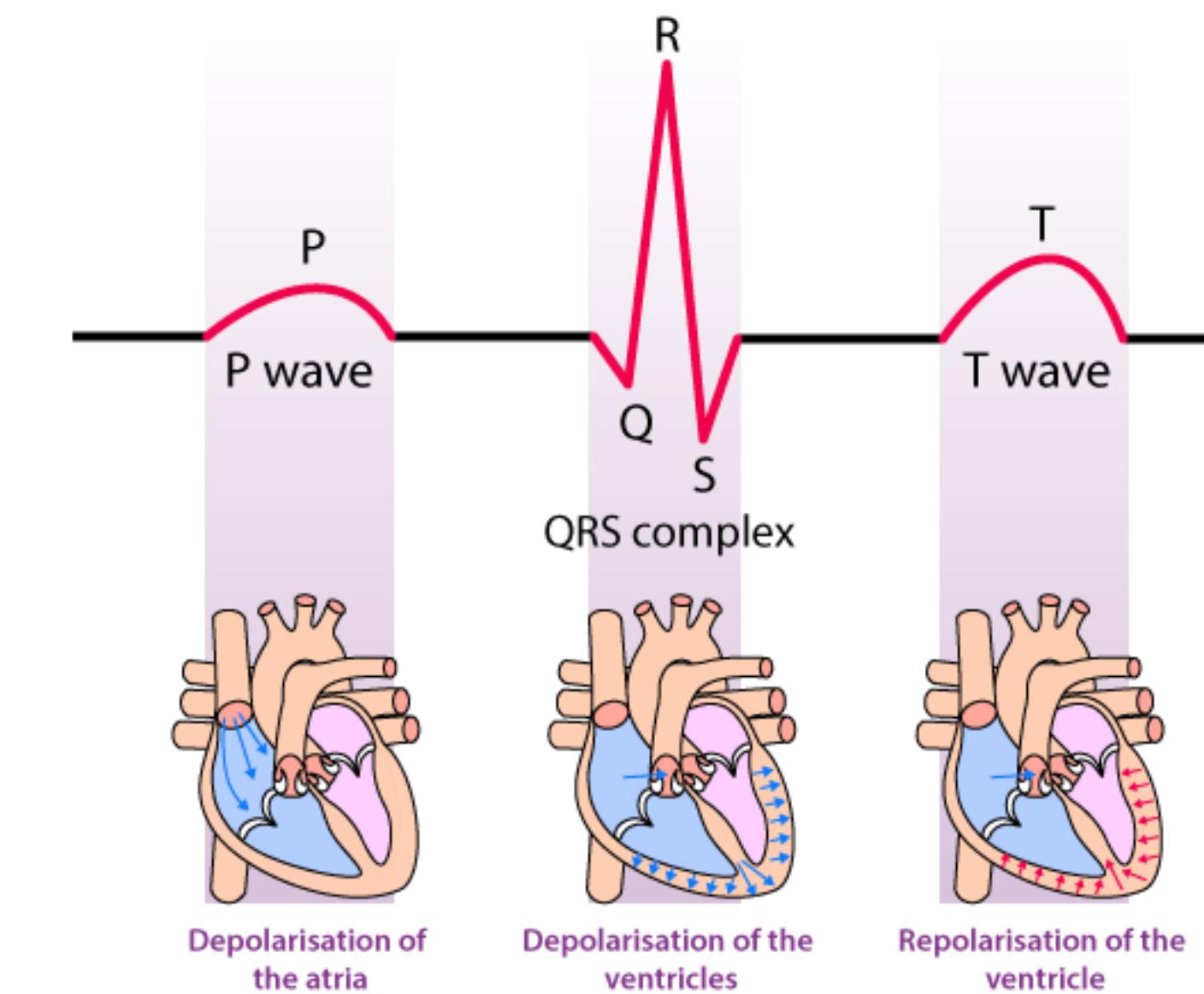
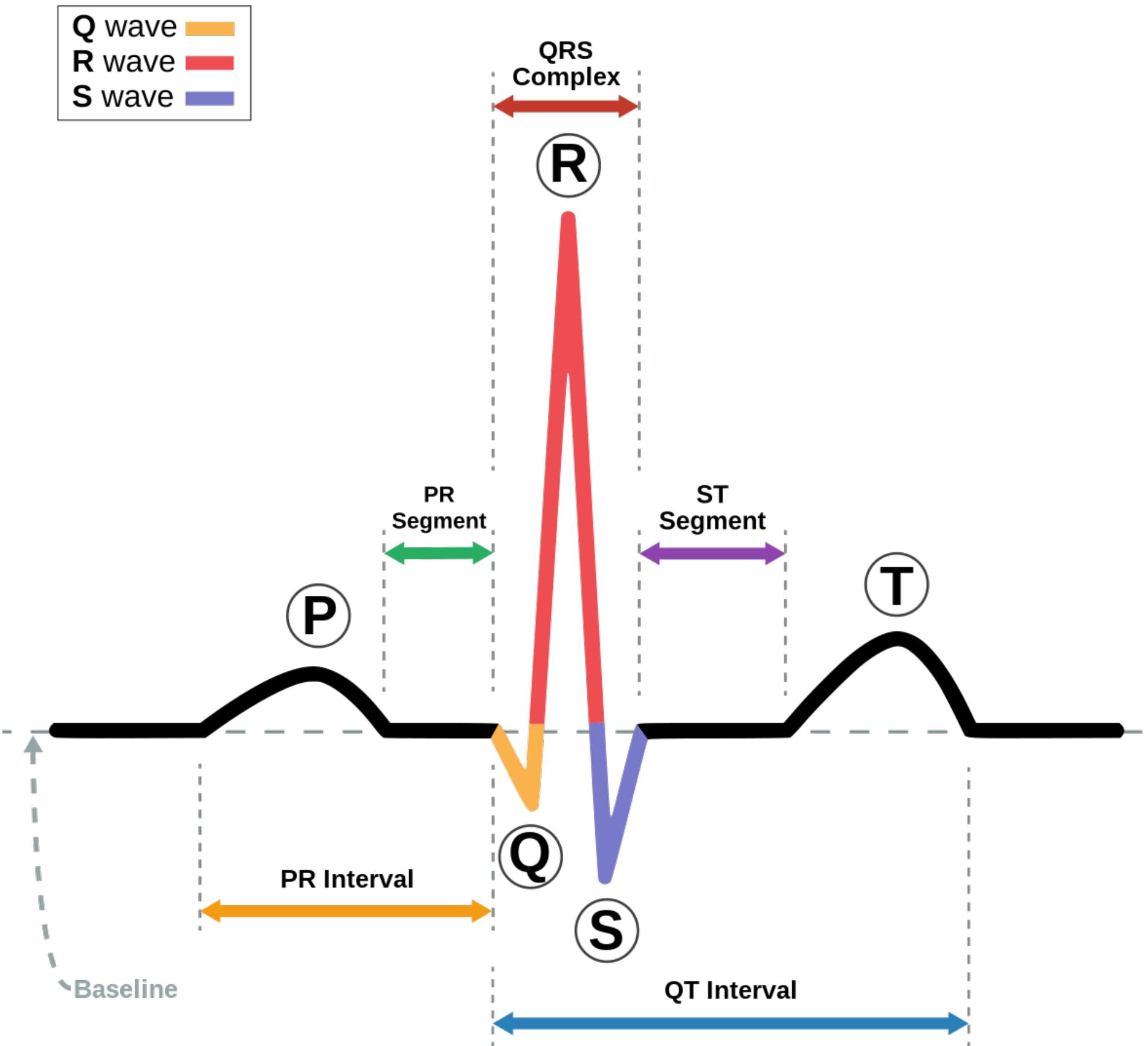
# WKZ Wishlist

- Must: ECG patterns
  - Electrocardiograms - If the 3 leads of the ECG module are detected...
  - Breathing patterns - same leads
  - Temperature - if surface and/or cavity probe(s) are connected
  - Non-Invasive Blood Pressure - if cuff is connected
- Could:
  - SpO<sub>2</sub>, Arterial Blood Pressure, CO<sub>2</sub>

# WKZ Wishlist

- Instructors:
  - Setting the same parameter (neonates) (ECG, SPO2, Breathing)
  - Possibility to automatically vary parameter just a little bit
  - Timers: start of incident, this is also the case in of ‘catching’ a newborn baby
- Extra: apgar clock, saving monitor values at 1, 5, 10 min and being able to represent them afterwards.

# ECG

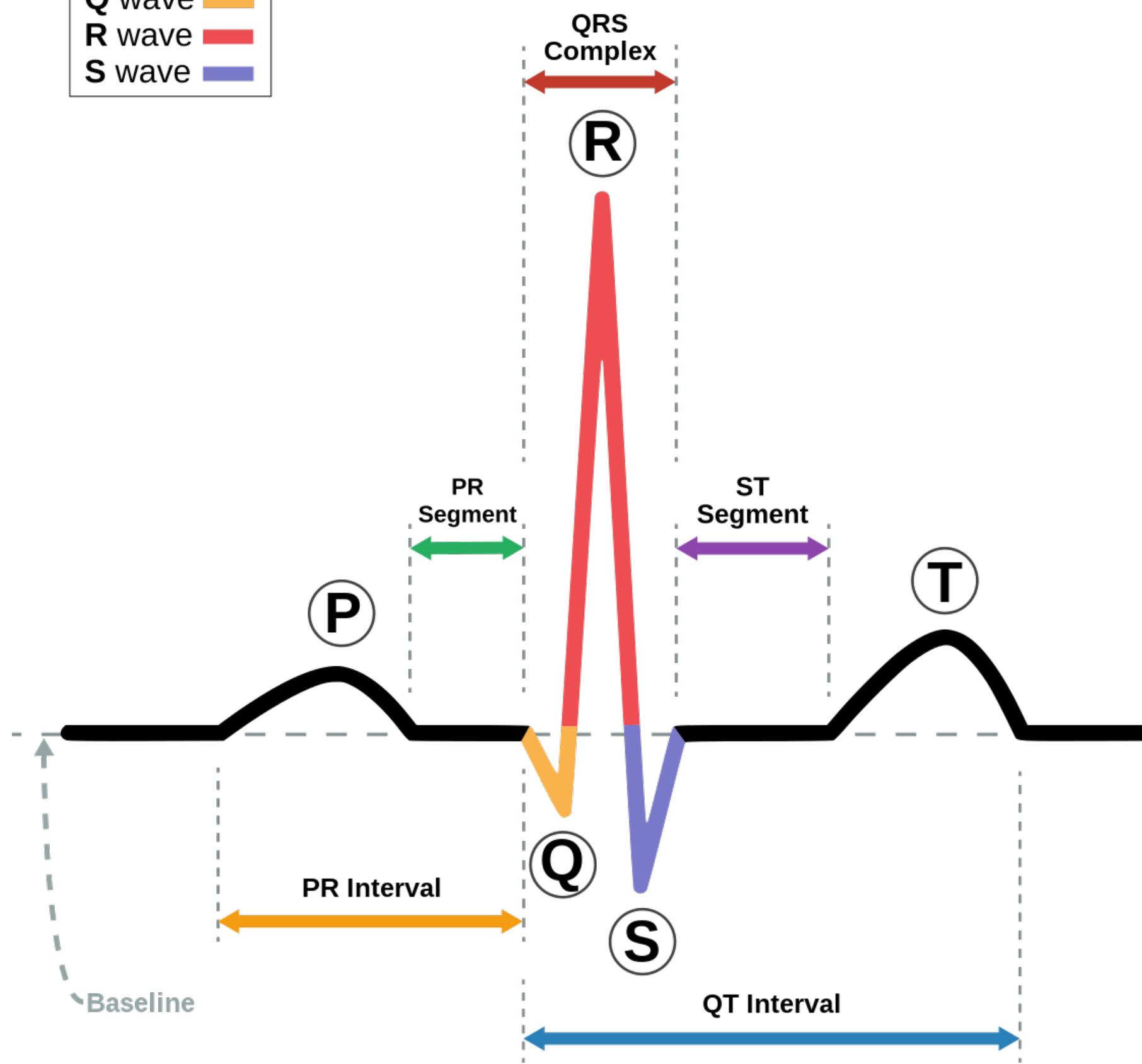


# ECG

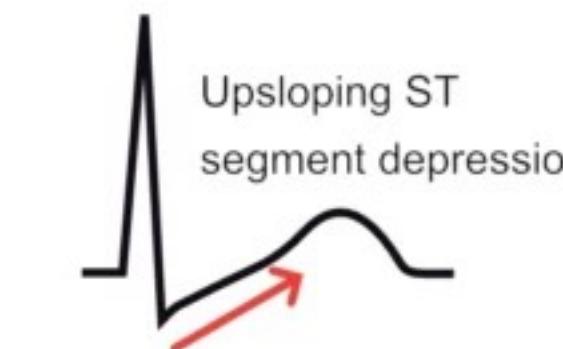
**Q wave** —

**R wave** —

**S wave** —

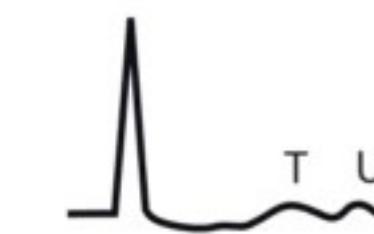


## A Physiological ST depressions (normal)

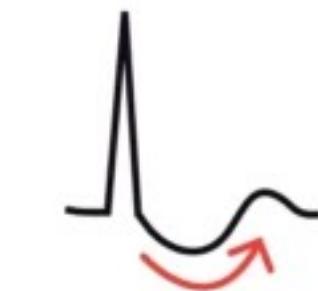


Upsloping ST segment depression is a normal finding during exercise. These should be considered normal, provided that T-waves are not inverted. Hyperventilation and tachycardia may cause similar ST-segment depressions.

## B Non-specific ST depression



Hypokalemia and high sympathetic tone cause ST-segment depressions with flat T-waves and more marked U-waves. A high sympathetic tone also causes tachycardia.



Digoxin (a drug used to treat atrial fibrillation) causes curved ST-segment depressions.

## C ST depressions in acute myocardial ischemia

### Characteristics



**Horizontal**  
Very typical of ischemia.



**Downsloping**  
Typical of ischemia.



Horizontal depression with distinct ST-segment.



Downsloping with positive T-wave.



Downsloping with inverted T-wave.



Horizontal depression with short ST-segment.

### De Winter's sign



de Winter's sign is an exception to the rule that upsloping ST-segment depressions are not ischemic. de Winter's sign implies the presence of upsloping ST-segment depressions with prominent T-waves in the majority of the precordial (chest) leads. This is a sign of acute ischemia, most often caused by a proximal occlusion of the left anterior descending (LAD) artery.

## D Secondary repolarization abnormalities (secondary ST- and T-wave changes)



Left bundle branch block (V6)



Left ventricular hypertrophy (V5-V6)



Right bundle branch block (V1)



Pre-excitation (delta wave)



Right ventricular hypertrophy  
Large R-waves and ST depressions in V1-V3.

# Newborn Early Warning Score

SCORE	RESPONSE	ESCALATION PROCESS
All in Green (Score of 0)	Continue observation Q4H (Paediatric), Q6H (Ob-Gynae/ Maternity) as per unit practice or as requested by paediatric specialist.	Based on clinical judgement inform charge nurse and notify paediatric specialist.
1-2 in Yellow  (Combined score of 1-2)	Inform the Charge nurse and Paediatric specialist. Repeat observation every 30 min until patient condition is stable. If the newborn is not settled within 1 hour, transfer the baby to NICU for observation	<b>Maternity &amp; OBG ward</b> Primary Nurse to inform Charge Nurse Charge Nurse Inform NICU Paediatric specialist (3 calls/ 5 min apart) If no response within 15min, contact NICU consultant STAT.  <b>ER &amp; Paediatric ward</b> Primary Nurse to inform Charge Nurse Charge Nurse Inform Paediatric specialist (3 phone calls/5 min apart) If no response within 15min, contact NICU Paediatric specialist If no response within 5min, contact NICU consultant STAT.
3- 4 in Yellow OR Any 1 in Orange  (Combined score of 3 - 4 or Single score of 2)	Immediate review and inform Paediatric specialist and NICU CN. Repeat NEWS Q15 min with identified plan of care until stable. If the newborn is not settled within 30 min, transfer the baby to NICU for observation/ Admission.	<b>Maternity &amp; OBG ward</b> Primary Nurse to inform Charge Nurse Charge Nurse Inform NICU Paediatric specialist (2 calls/ 5 min apart) If no response within 10min, contact NICU consultant STAT.  <b>ER &amp; Paediatric ward</b> Primary Nurse to inform Charge Nurse Charge Nurse Inform Paediatric specialist (2 phone calls/5 min apart) If no response within 10min, contact NICU Paediatric specialist If no response within 5min, contact NICU consultant STAT.
Any 1 in Red (Single score of 3 or Combined score of $\geq 5$ )	Call RRT Newborn immediately	Primary Nurse to notify Charge Nurse and to <u>Activate Rapid Response-Newborn</u>

## \*RISK ASSESSMENT (*✓ - whichever is applicable*)

Maternal	Previous babies with
PROM > 18hours Preterm	<input type="checkbox"/> Congenital anomalies
PROM > 24 hours Term	<input type="checkbox"/> Heart disease
Temperature > 38°C	<input type="checkbox"/> G6PD deficiency
Chorioamnionitis	<input type="checkbox"/> Invasive GBS sepsis
Pethidine < 6 hours before delivery	<input type="checkbox"/> Newborn
GBS in vaginal swab/ Urine or Unknown	<input type="checkbox"/> Small for gestational age
Multiple gestation	<input type="checkbox"/> Large for gestational age
Diabetes (GDM/ DM type 1and 2)	<input type="checkbox"/> IPPV > 5 minutes
On $\beta$ Blockers	<input type="checkbox"/> < 37 weeks gestation
No Prenatal care	<input type="checkbox"/> Meconium Stained Liquor (requiring intervention)
Adolescent pregnancy	<input type="checkbox"/> Cord arterial pH $\leq 7.1$
Eclampsia	<input type="checkbox"/> Base Excess $\geq - 12 \text{ mmol/l}$
Placenta Previa	<input type="checkbox"/> APGAR $\leq 7$ at 5 minutes
Placental abruption	 <i>Infants that need immediate review by Doctor</i>
Cord prolapse	<input type="checkbox"/> Jaundice $< 24$ hours
H/O Neonatal death	<input type="checkbox"/> Bilious Vomiting
Delivery outside the hospital	<input type="checkbox"/> Abnormal Movements
Suspicious/pathological CTG	<input type="checkbox"/> Hypoglycaemia
	<input type="checkbox"/> Apnoea

\*These criteria should be considered to heighten the surveillance in newborns.

# **Kick-start**

**Thomas Randwijk & Lucas Bolwidt**

# Programming

- Final thing:
  - Make designs even if they are napkin designs
  - Refactor at least parts of your code
  - Use the GitHub environment extensively

# **Kick-start**

**Thomas Randwijk & Lucas Bolwidt**