

# P1752.2 Standard for Mobile Health Data

## *Cardiorespiratory Subgroup*

### Scope

The P1752.2 Cardio–Respiratory (CR) Subgroup will review Open mHealth schemas related to CR measures and propose updates and additional schemas as needed. The scope includes but is not restricted to the following measures of CR health: blood pressure, heart rate, heart rate variability, RR interval, respiratory rate, and O2 saturation. *The focus of this Subgroup’s work is on modeling data pertaining to CR function, not on current or future individual devices or apps that measure various aspects of CR health.*

### Duties

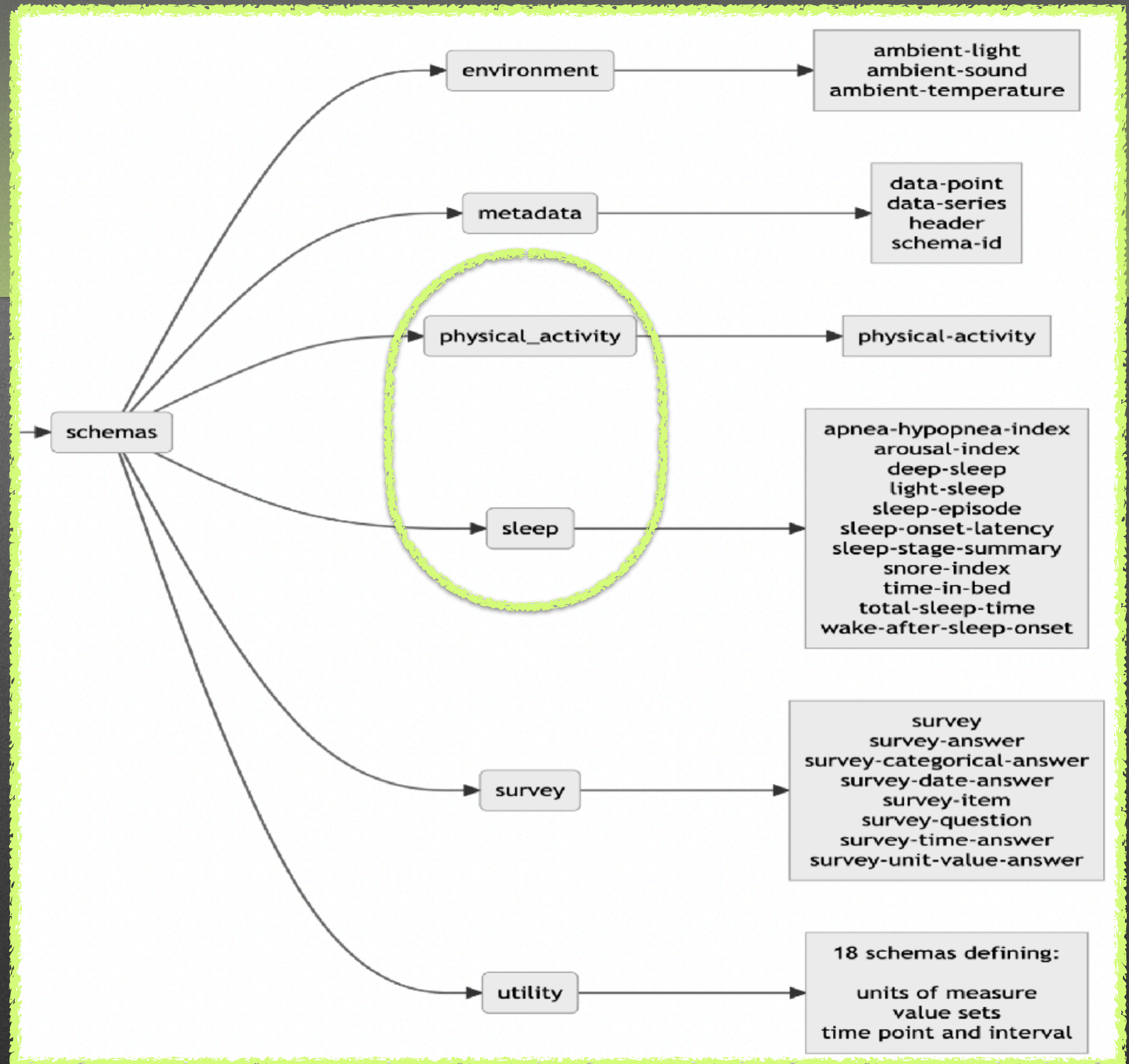
By reviewing the clinical aspects of cardio–respiratory health and existing relevant devices and apps, the Subgroup shall deliver a list of common attributes as well as a list of clinically important attributes in the cardio–respiratory domain as scoped above. The Subgroup shall propose modified and new schemas relating to CR health, including examples as informed by use cases and the list of common and clinically important attributes. Finally, the Subgroup shall deliver a review of mappings and/or relationships to non–Open mHealth CR schemas.

# IEEE 1752.1 Standard for Mobile Health Data

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# IEEE 1752.2 Standard for Mobile Health Data

- *Metabolic*
- *Cardiorespiratory*



# Cardiorespiratory Schema

Cardiac  
“Systolic  
Event”

Electrical  
~

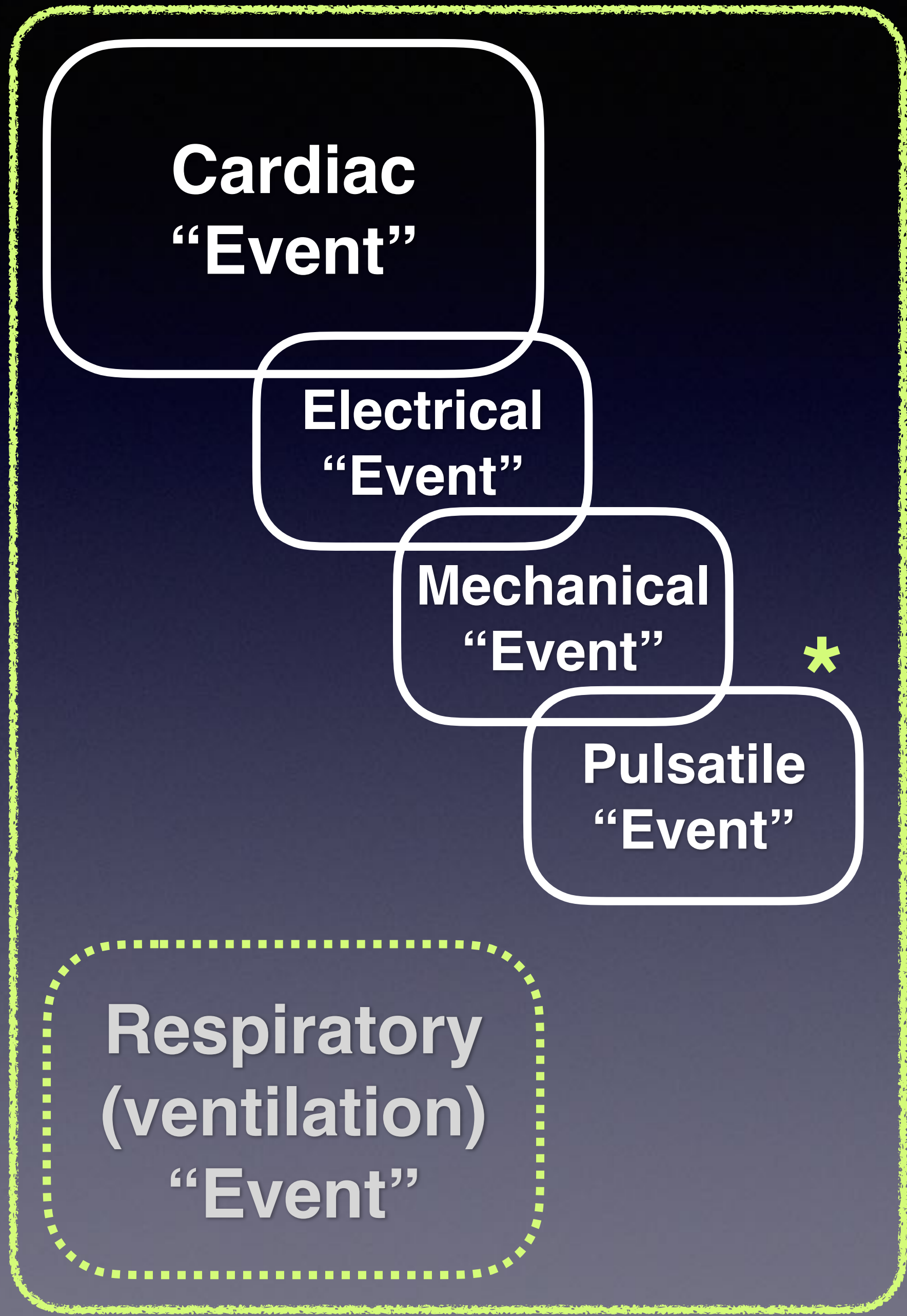
Mechanical  
~

Pulsatile  
~

Respiratory  
(ventilation)  
“Event”

\*

# P1752.2 CR Schema



## Assessing Secondary Dependencies

*Autonomic  
Tone &  
Modulation*

*Maladaptation  
& Patho-  
physiology*

*Physical  
Activity  
& Mobility*

*Externalities*

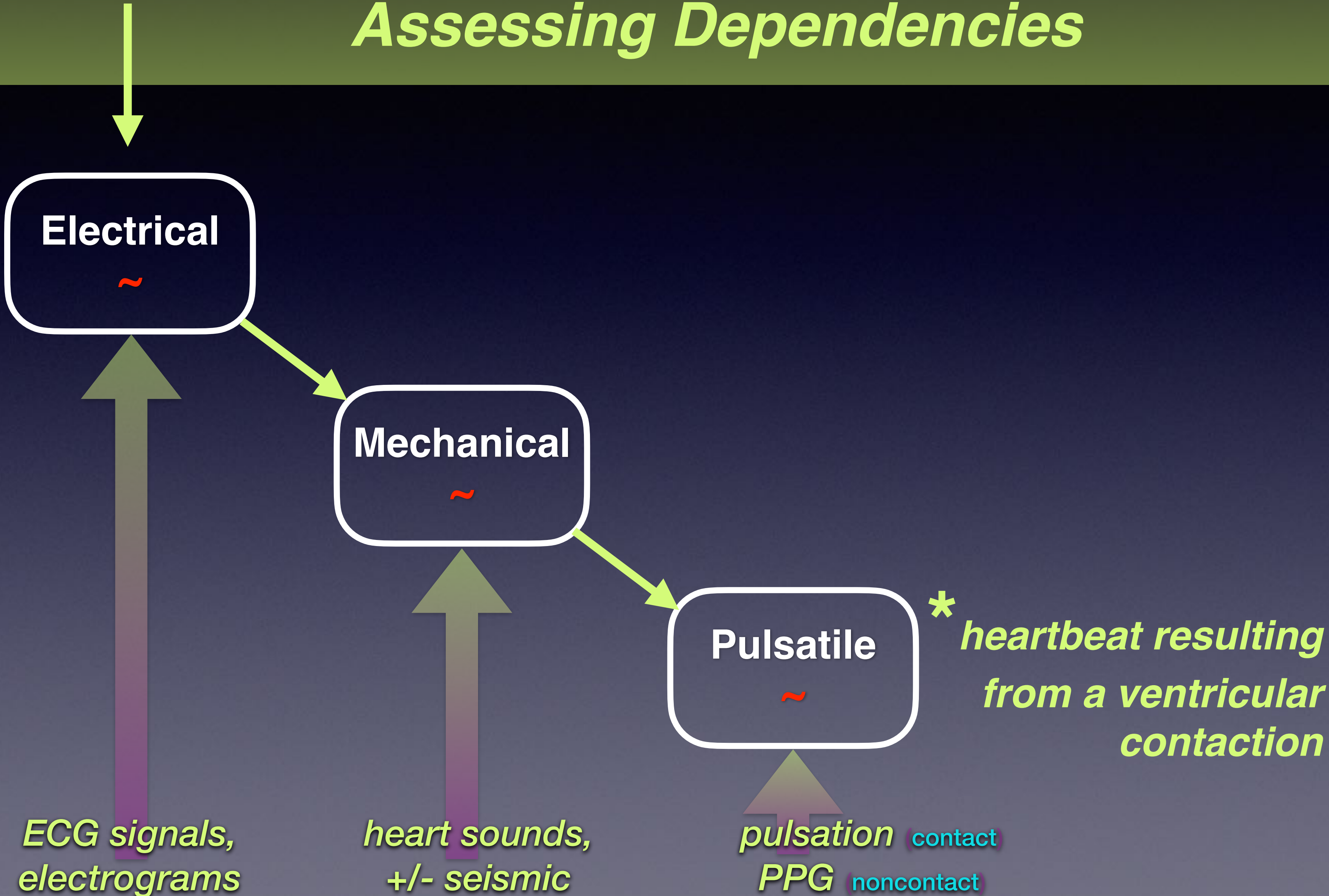
⋮

*other relevant schemas  
(contextuality)*

Location  
Altitude  
Temperature  
Humidity  
⋮

# Cardiac Systolic Event

## *Assessing Dependencies*



# Consider Common Use Case Contexts: **Irregular Rhythms & Ectopy**

**Heart beat** —————

(... *always ventricular systole*)

**VE** {

*Conducted*

*Premature* → ? **“PVC”**

*Paced*



# Consider Common Use Case Contexts:

## Irregular Rhythms & Ectopy

**Heart beat** —————

(... always ventricular systole)

VE



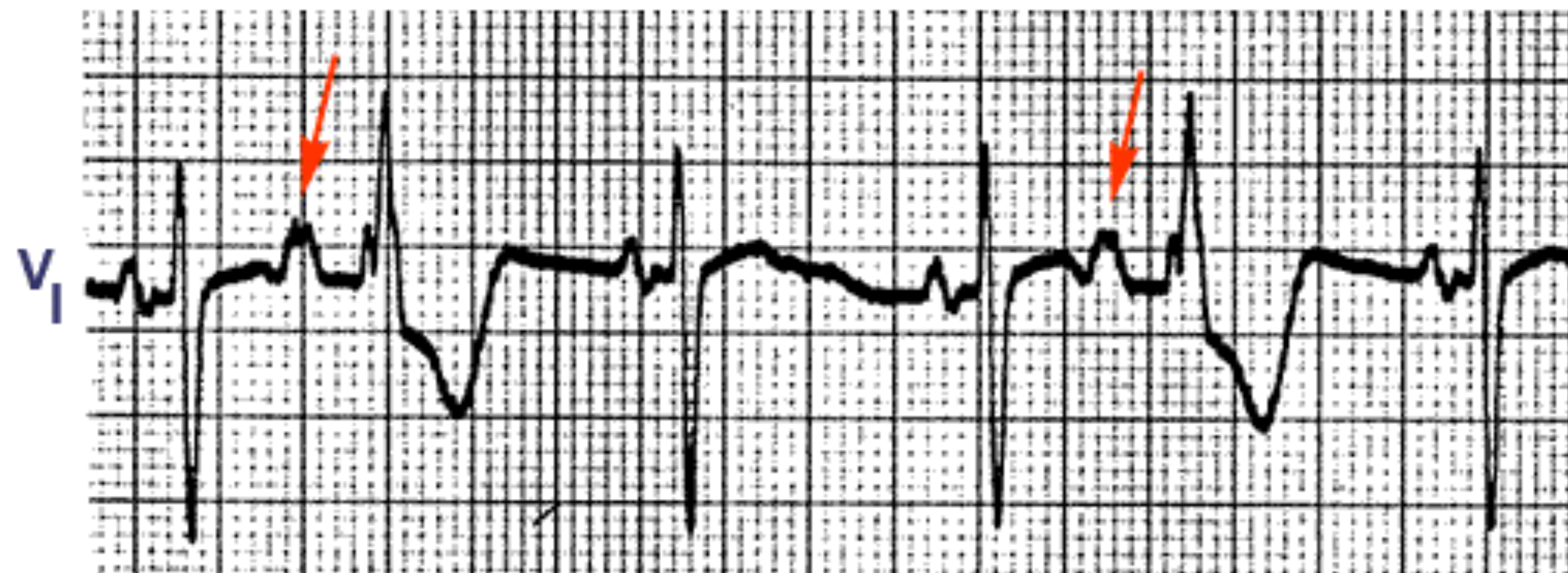
*Conducted*

*Premature* → ?

*Paced*

?

“PVC”



PAC's (arrow) with atypical RBBB aberration

# Consider Common Use Case Contexts: **Irregular Rhythms & Ectopy**

## **Atrial**

*Atrioventricular linked*

*Atrioventricular dissociated*

## **AE**

*Sinus*

*Premature* → ? **“PAC”**

*Paced*

## **Ventricular**

*Ventrioculo-atrial linked*

*Ventrioculo-atrial dissociated*

## **VE**

*Conducted*

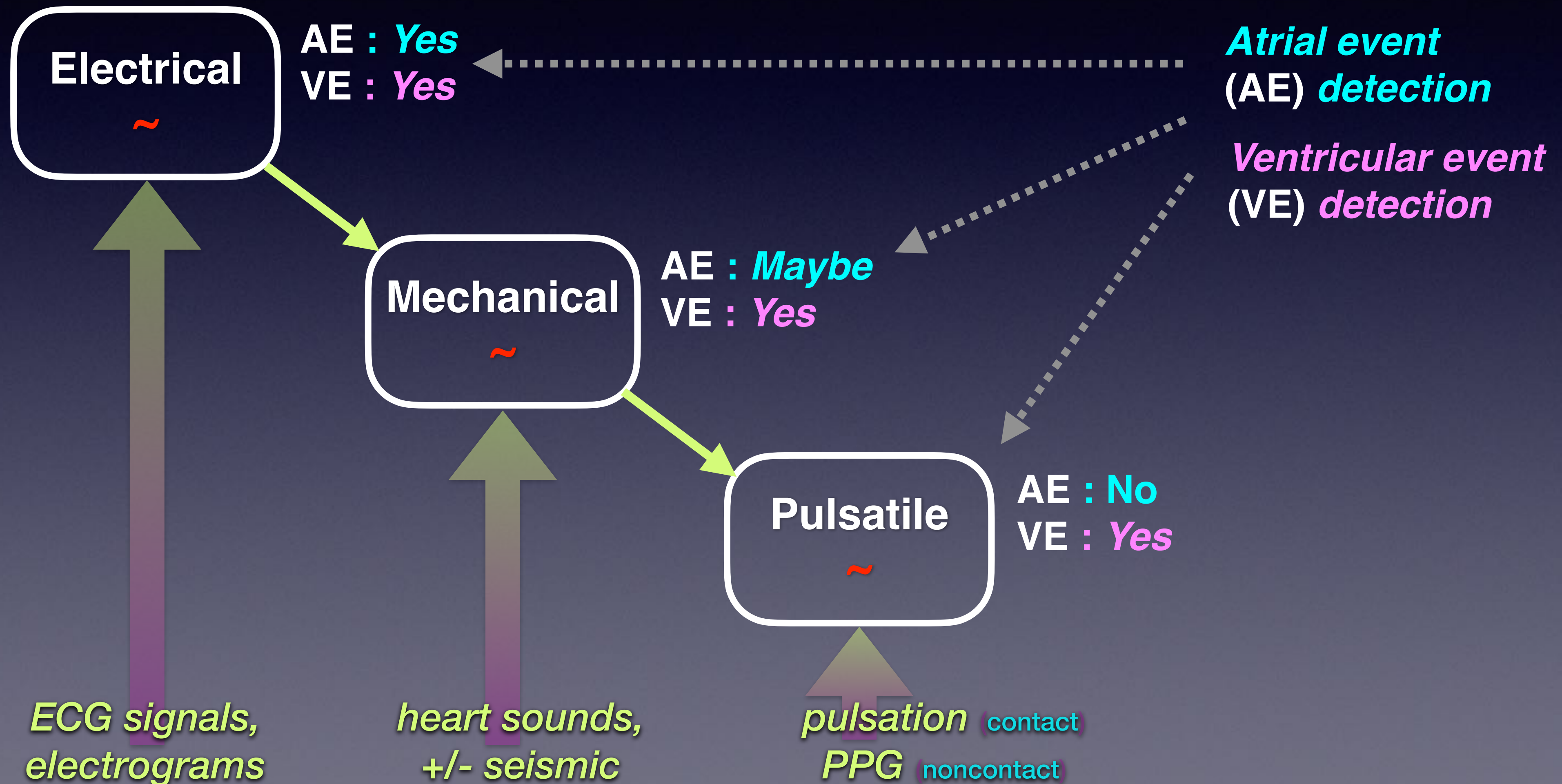
*Premature* → ? **“PVC”**

*Paced*



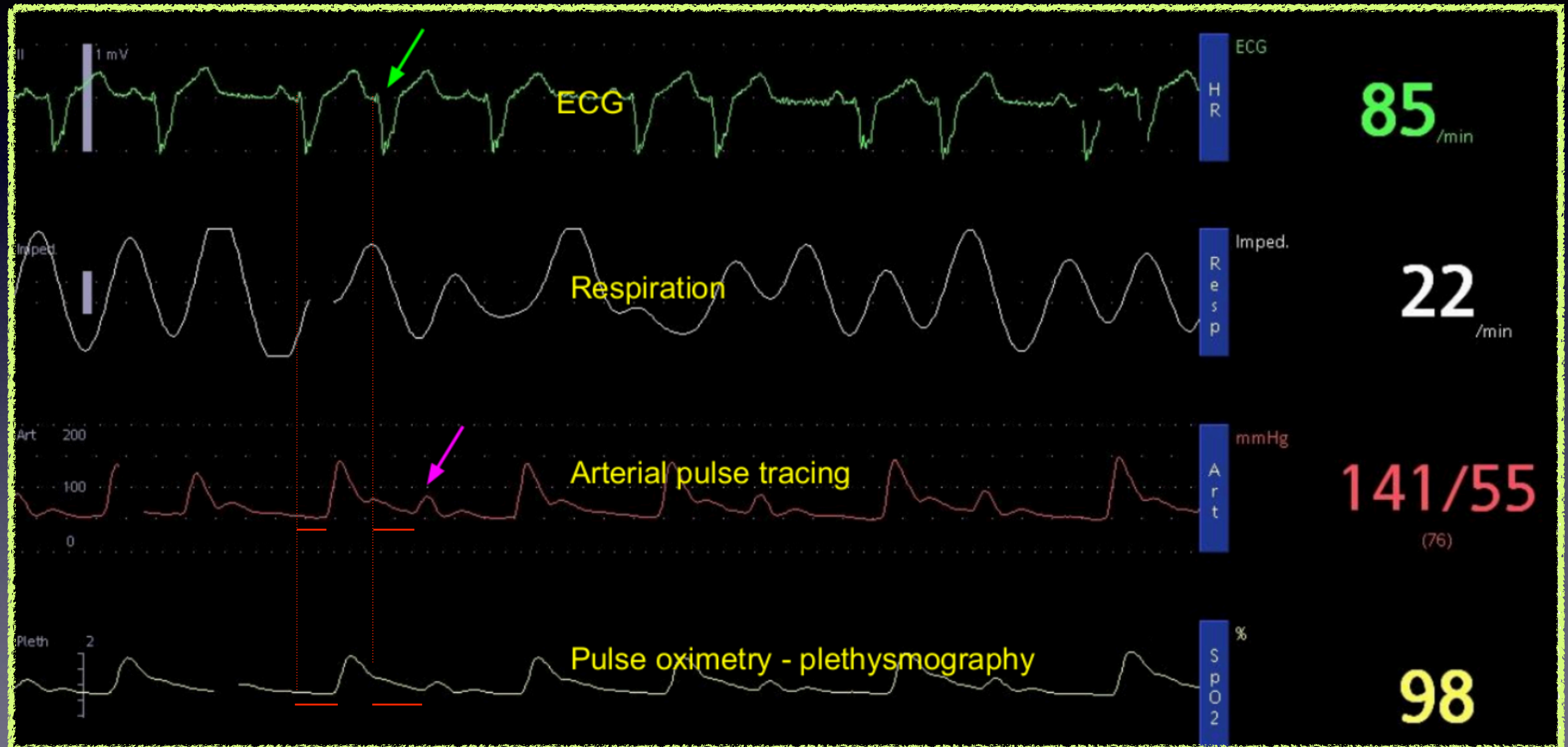
# Cardiac Systolic Event

*Dependencies -> Extensibility*

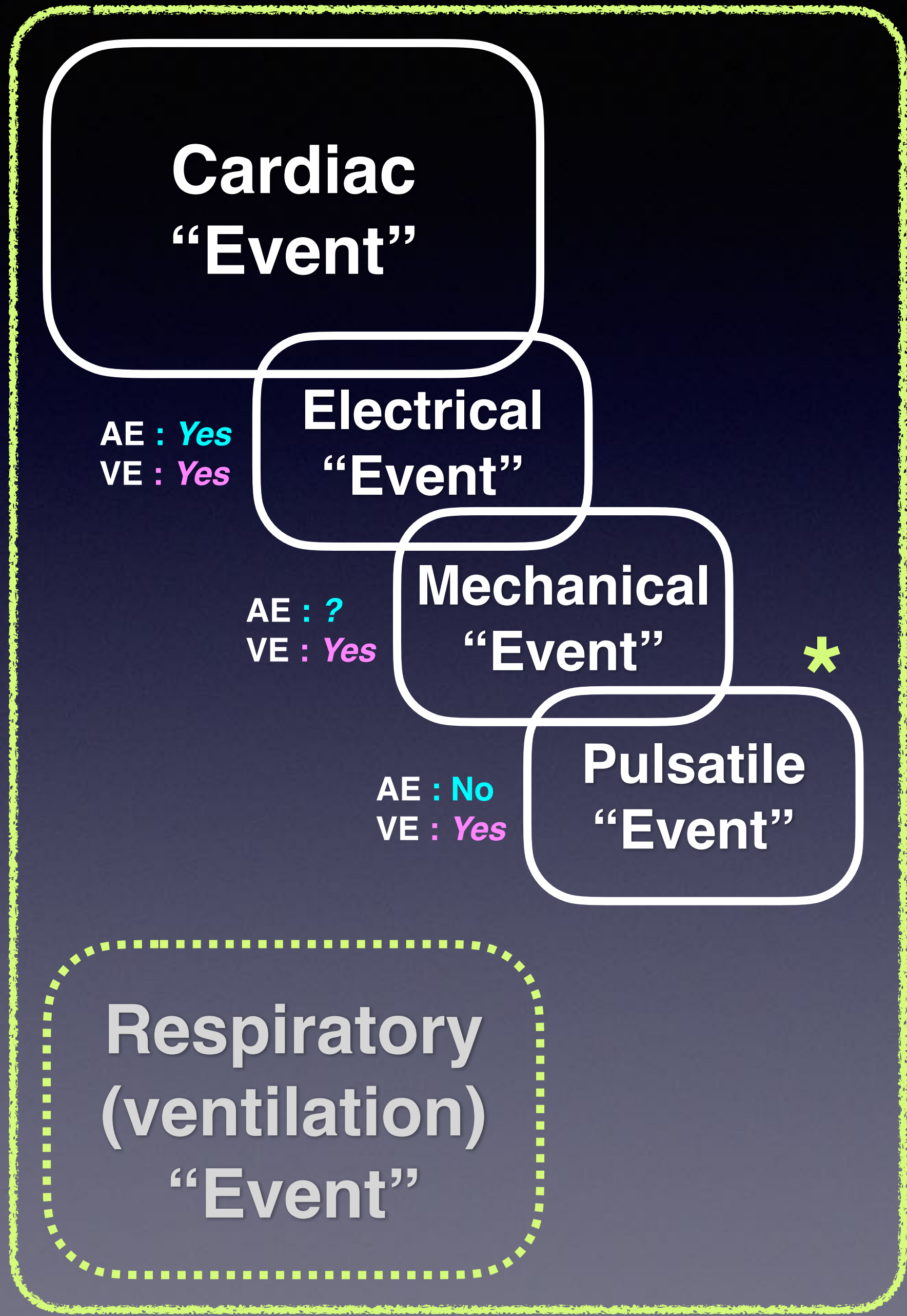


# Supraventricular Ectopy

## *Tracing Manifestations*



# P1752.2 CR Schema



## Assessing Secondary Dependencies

*Autonomic  
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*Maladaptation  
& Patho-  
physiology*

*Physical  
Activity  
& Mobility*

*Externalities*

⋮  
*other relevant schemas  
(contextuality)*

Location  
Altitude  
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Humidity  
⋮

# SCHEMA DESIGN PRINCIPLES

## Atomicity

- *Determine desired granularity of schema's data representations*

## Balancing parsimony and complexity

- *Pragmatics and the 80/20 rule*
- *Example: OmH explicitly determined relationship of physical activity to glucose to be outside 80/20 region...*

## Balancing permissiveness and constraints

- *Pragmatics for value sets units, cardinality*

## Designing for data liquidity

- *Data interchange: Data's **meaning** same for sender and receiver*
  - Header schema: Operational context for metadata - data payload
    - : *Data point creation and identification*
    - : *Acquisition provenance (informed by M2DK mPROV ?)*
  - Measurement schema: Clinical context for metadata

## Alignment with clinical data standards

- ***Semantic interoperability** by relying on existing vocabularies (ex. SNOMED, LOINC, etc) and units of measure (UCUM Codes)*

## Modeling of time

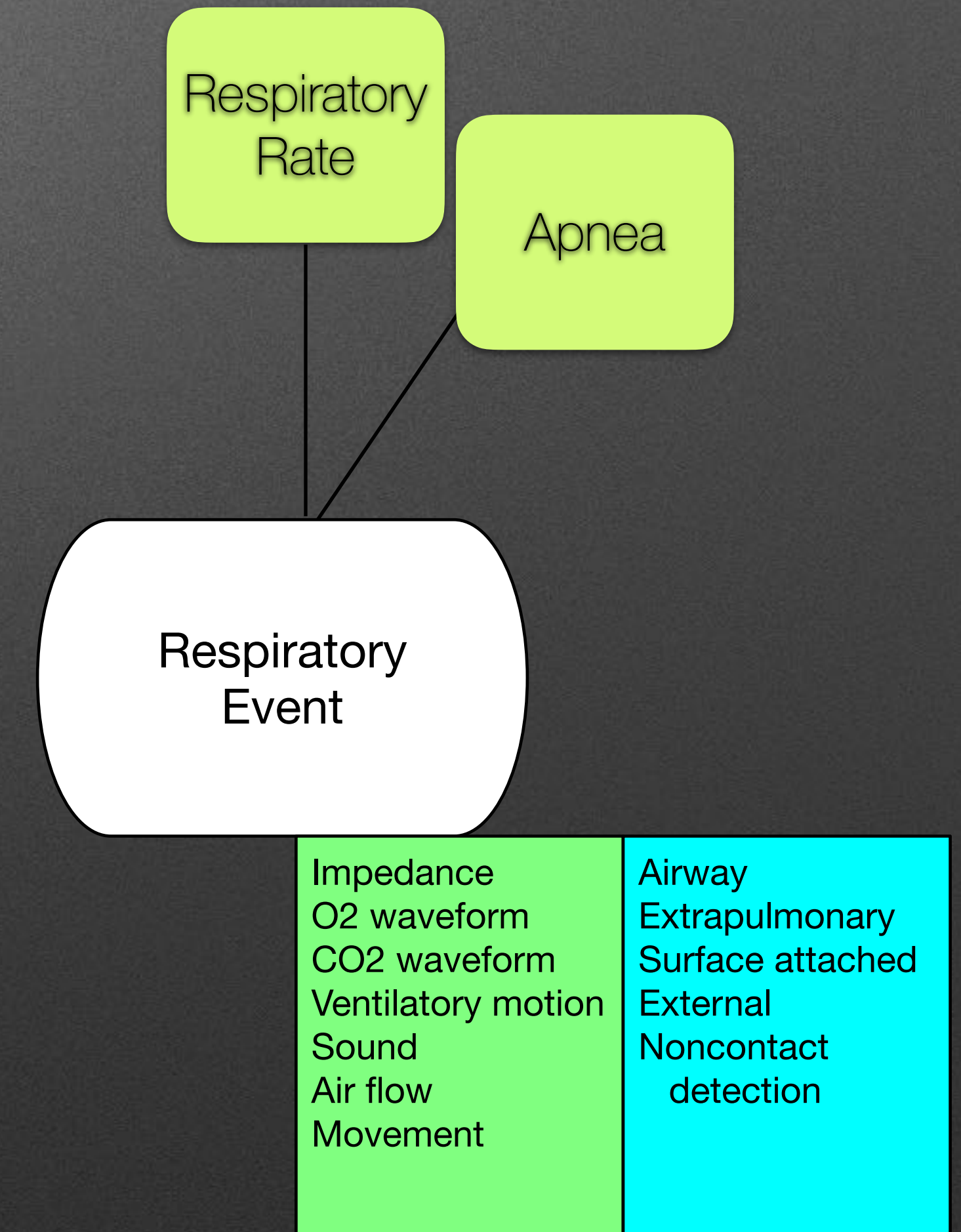
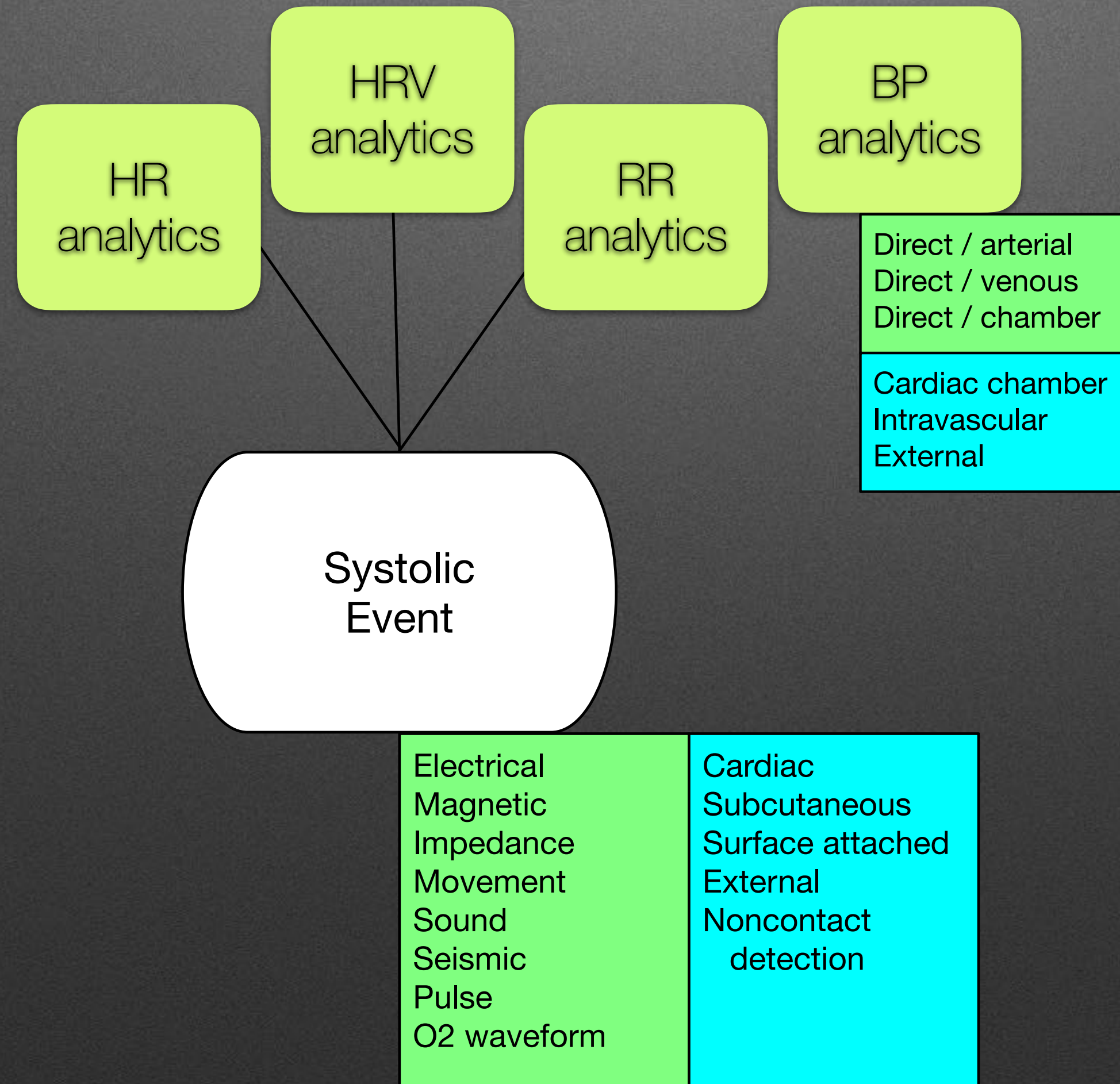
<https://www.openmhealth.org/documentation/#/schema-docs/schema-design-principles>

# Proposal

- Tiered Structure for the Cardiac Schema
- Separate schemas for Cardiac and Respiratory

**Tier 1:**  
Derived *or* ~~declared~~  
declared

**Tier 0:**  
Currency  
(*granularity*)

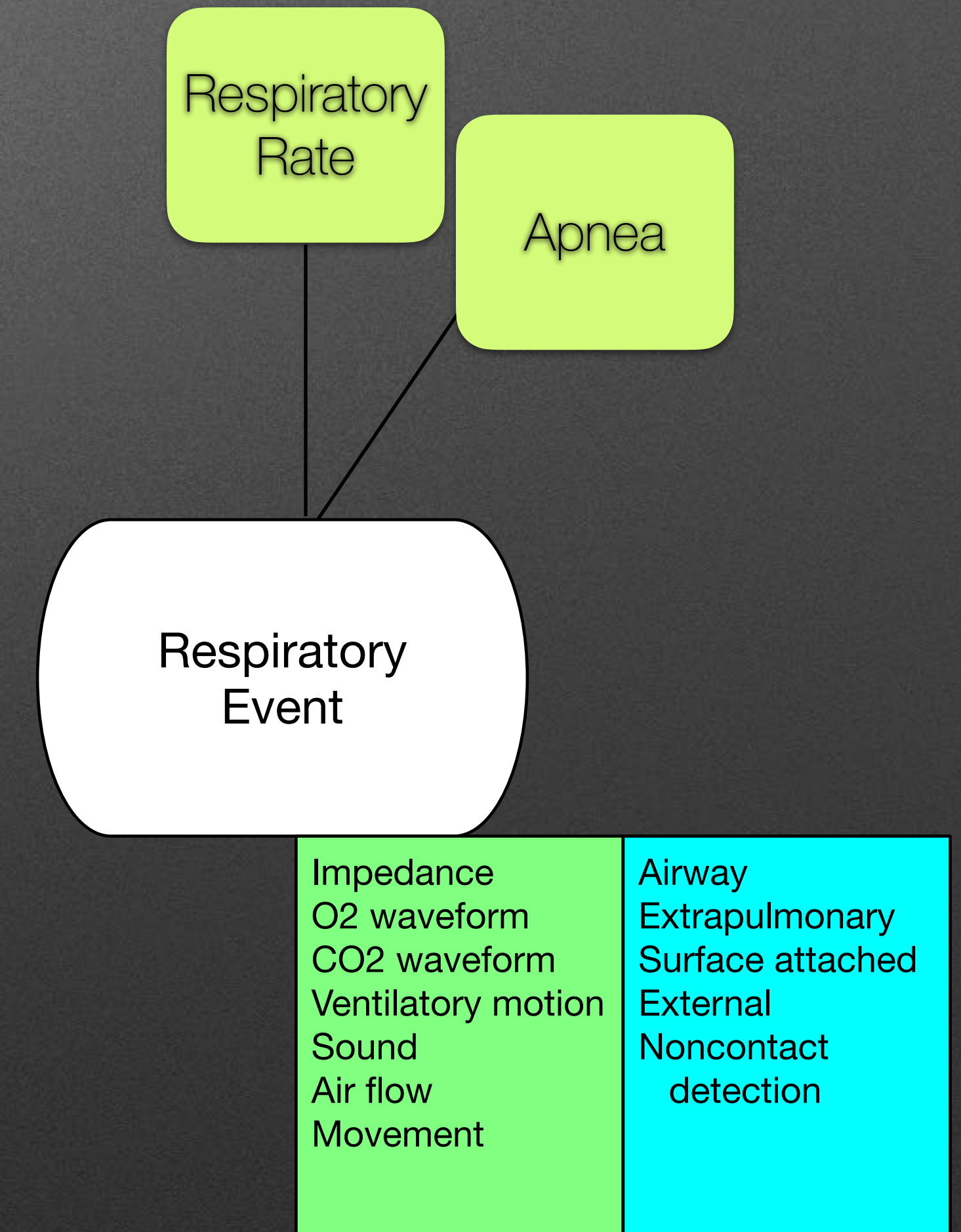
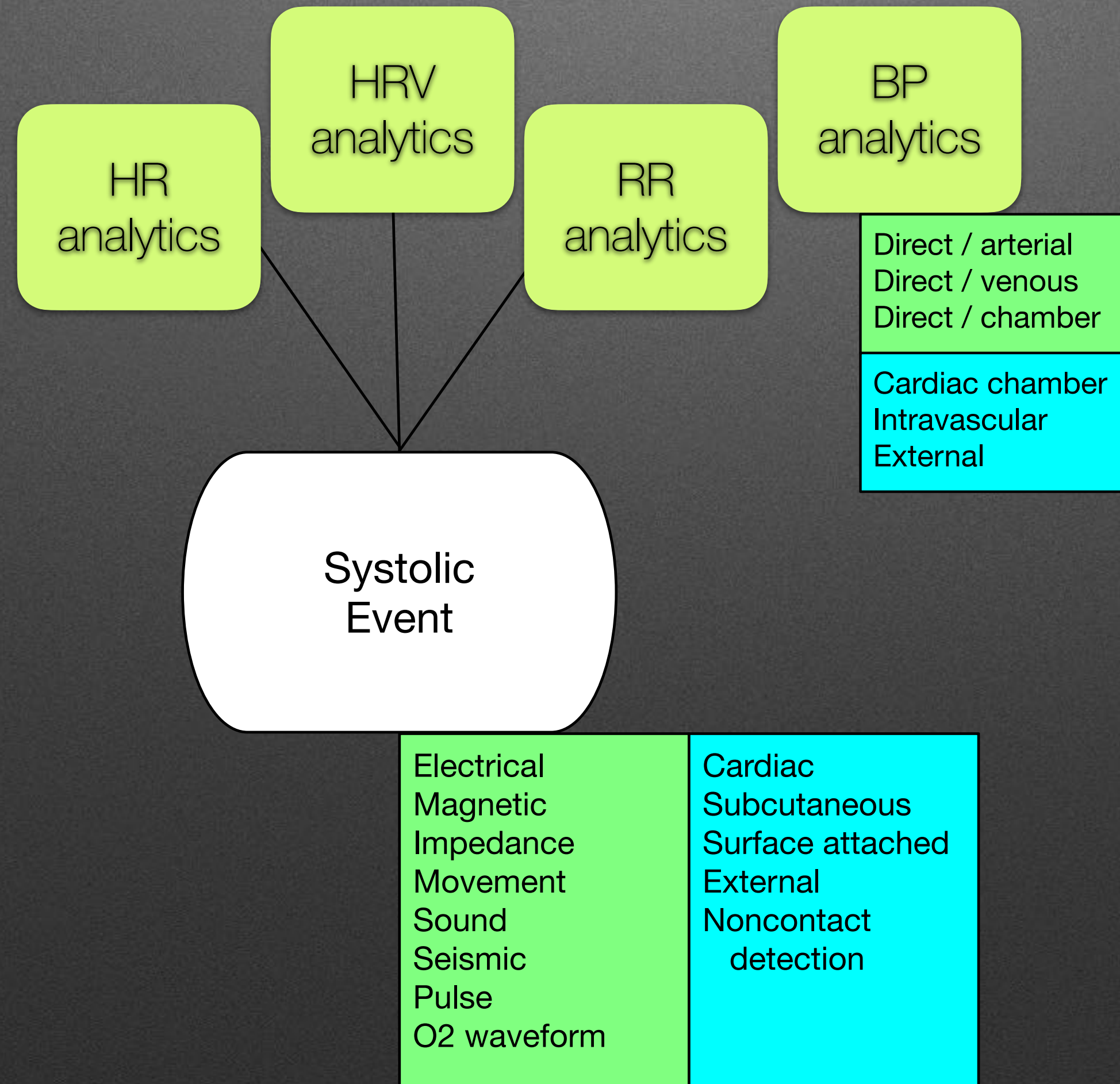


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# Compatible extensibility layers

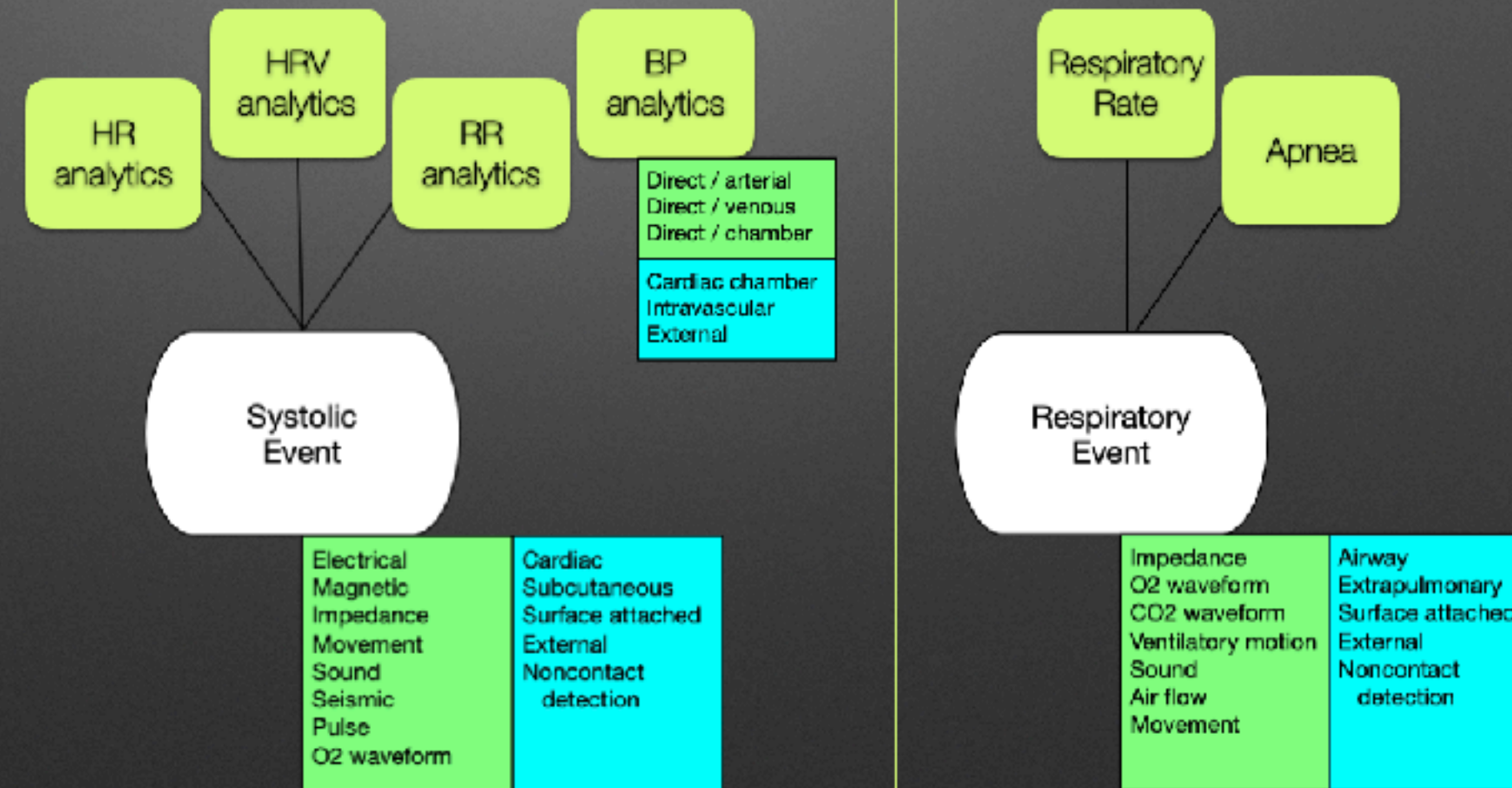
# Future Proofing

## Proposal

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Tier 1:  
Derived or declared

Tier 0:  
Currency  
(granularity)



Enhanced clinical relevance

Examples :

- Differentiate atrial, atrial-paced, ventricular, ventricular paced (all types)
- Waveform morphology analytics

## Data Point:

- A discrete measurement (or observation) on a *single unit of observation*
- Discrete: “distinct in time of acquisition, location, or origin/source”
- May be multidimensional +/- directionality

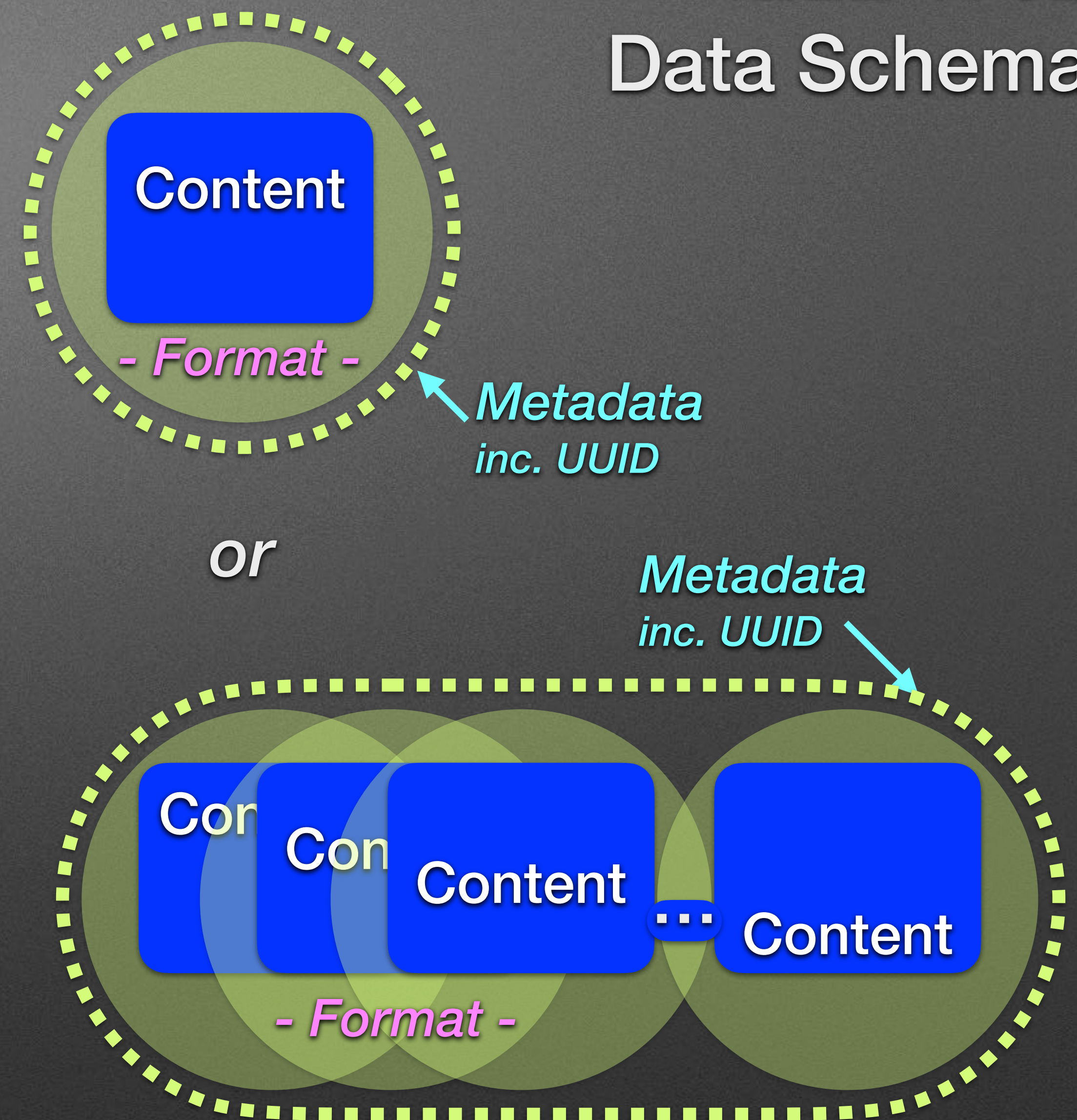
## Data Point Series:

- An ordered sequence of data points that share the same metadata

## Content:

- An instantiation of a single unit of observation

## IEEE 1752 Data Schema





# SCHEMA DESIGN PRINCIPLES

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## Modeling of time

# NIH “Big Data-to-Knowledge” (BD2K) *Centers of Excellence*

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- BDDS
- BD2K-LINCS DCIC
- CCD
- CEDAR
- The Mobilize Center
- CPCP
- **MD2K** →
- ENIGMA
- Heart BD2K
- KnowEnG
- PIC-SURE
- BDTG

To develop tools to make it easier to gather, analyze, and interpret data from mobile and wearable sensors to reliably quantify physical, biological, behavioral, social, and environmental factors that contribute to health and

## MD2K Projects

- *mDOT*
- *mProv*
- *mGuard*
- *mPerf*
- *MD2K/BD2K*

# Timeline / Stakeholder Engagement

- *MedTech Industry*
- *Data Industry*
- *Advocacy Organizations*
- *Professional Organizations*

IEEE EMBS Conference

(July 24-28, 2023, in Sydney)

ESC Congress

(August 25-28, 2023, in Amsterdam)

HRX Conference

(September 21-23, 2023, in Seattle)

AHA Scientific Sessions

(November 11-13, 2023, in Philadelphia)

*Initial  
Draft*

?



# Next regular subgroup meeting : April 27, 2023



**April 27, 2023** --> (16:00 UTC, 9:00 PST) ?

# Hexoskin Health Sensors



# Hexoskin Health Sensors

## 3-Lead ECG

250 Hz, 6.5uV Resolution

Heart rate: 30-220 BPM, 1 Hz

QRS event detection: 4 ms resolution

RR intervals: 4 ms resolution



### Research Applications

- Detection of Heart Conditions
- Heart Rate Variability (HRV)
- Stress Monitoring

## Respiration

(RIP) 125 Hz

Breathing Rate: 3-60 BPM, 1 Hz

Minute Ventilation: 80-65000 mL, 1 Hz

Tidal Volume (last inspiration): 80-10000 mL, 1 Hz, 20 mL resolution

Inspiration and Expiration Events: 8 ms resolution



### Research Applications

- Lung Capacity Observation
- Effects of Altitude

## Pulse Oxymetry

Oxygen saturation (SpO2%): 1Hz

Photoplethysmography (PPG): 75 Hz

Heart rate: 1 Hz



### Research Applications

- Hypoxia
- Sleep Research

## Blood Pressure

Systolic Blood Pressure

1 Hz

Pulse Transit Time computation



### Research Applications

- BP captured at every heartbeat
- Hypertension
- Hypotension
- Rest
- Arousal

## Skin Temperature

1Hz, 0.1 Celsius resolution



### Research Applications

- Arousal
- Mental & Physical Performance
- Heat Stress
- Sleep Circadian Cycles

## 3-Axis Accelerometer

50Hz, +/-16g range, 0.004g resolution.

Actigraphy: 1 Hz

Step counting: reported at each step detection: 30-240 SPM

Cadence: 1 Hz (0, 30-240 SPM, calculated on the 8 last steps)



### Research Applications

- Actigraphy
- G-Force
- Step Counts
- Cadence
- Position