

Foundations ECG - How to Read an ECG

ECG interpretation is a difficult skill that requires deliberate practice to gain mastery. A formulaic method for interpretation minimizes missed diagnoses and provides a strategy for dealing with ECGs when the diagnosis is not immediately apparent. Below are two example interpretation strategies.

The Rule of Fours is adapted from Dr. Gerard Fennessy ([@doctorgerard](#)) and [Life in the Fast Lane](#).

Rule of Fours

Four Initial Features:

- History/Clinical Picture
- Rate
- Rhythm
- Axis

Four Waves:

- P Waves
- Q/R/S Waves
- T Waves
- U Waves

Four Intervals/Segments:

- PR Interval
- QRS Width
- ST Segment
- QT Interval

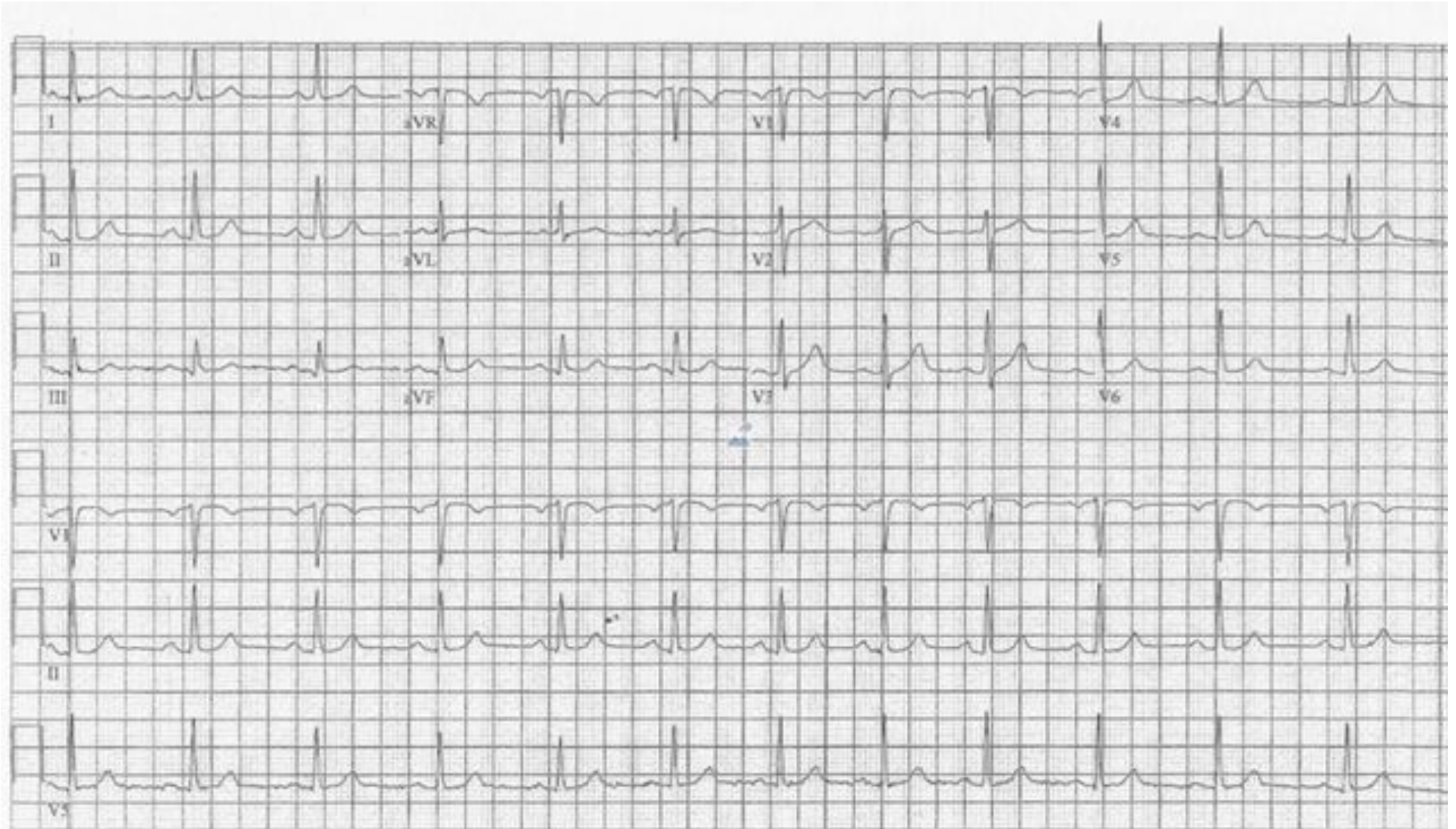
“Standard”

- Rate
- Rhythm
- Axis
- Intervals
- Hypertrophy
- Ischemia

Example Case

39yF with no PMHx with chest pain.

HR: 95 BP: 160/110 RR: 18 O2 Sat: 96%



Four Initial Features

History/Clinical Picture—39 year old woman with no known comorbidities or risk factors

Rate

Option 1: Count each QRS complex in rhythm strip and multiply by 6 (ECG is 10 sec. long). Ex: $12 \times 6 = 72$.

Option 2: “Rule of 300.” For regular (and only regular) rhythms count large boxes between QRS complexes and estimate.

1 Box = $300/1 = 300$ bpm

5 Boxes = $300/5 = 60$ bpm

2 Boxes = $300/2 = 150$ bpm

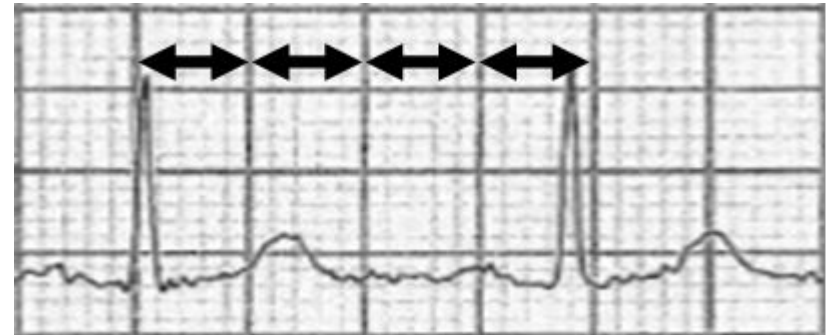
6 Boxes = $300/6 = 50$ bpm

3 Boxes = $300/3 = 100$ bpm

7 Boxes = $300/7 = 43$ bpm

4 Boxes = $300/4 = 75$ bpm

8 Boxes = $300/8 = 37$ bpm



Rhythm—Normal Sinus Rhythm is defined by morphologically identical P waves with a constant PR interval before every QRS.

Four Initial Features

Axis—Modern ECG machines are generally quite good at determining the axis value but it is still important to know how axis deviation is defined. Machine read was 50 on this ECG.

Axis can be often be manually determined by evaluating whether leads I & aVF are positive, equiphasic or negative. However when the axis is unclear, like the difference between pathologic and physiologic left axis deviation the tie breaker is lead II.

	Normal	Left Axis Deviation	Right Axis Deviation
Lead I	Positive	Positive	Negative
Lead II	Positive	Negative	Positive
Lead III/aVF	Positive	Negative	Positive

Four Waves (or complexes)

P Waves

Are P waves present? Yes, P waves are present.

Morphology—do all P waves look the same or do they vary? All look the same.

Are the P waves normal—do they look enlarged (>1.5mm tall in V1-6 or >2.5mm in any other lead) or are they peaked? Yes, they look normal.

Q, R, S Waves

Low voltage R waves? (V1-6 R waves are all less than 10mm tall or I/II/III R waves are all less than 5mm tall)? No

High voltage R waves (are the R waves in V1-6 excessively tall)? No

T Waves

Inversion (normally inverted in V1 and aVR, can be inverted in III if QRS complexes are negative)? No.

Peaked/Hyperacute? No

Flattened? No

U Waves (small deflection after the T wave)

Present? No

Four Intervals (or segments)

PR Interval

Machine read was 178 on this ECG.

Normal PR? Yes, normal range is 120-200ms.

QRS Complexes

Normal width (70-100ms)? Yes, the QRS complexes are 94 ms

Critical diagnoses that affect QRS morphology (Brugada, WPW, new bundle branch block, TCA Overdose)? No.

ST Segments

Any ST elevation? No.

Any ST depression? No.

QT Interval

Machine read was 424 on this ECG.

Normal QTc? Yes, normal upper limit is 440 ms for men and 460ms for women.