Approach to Palpitations

Constancia Macatangay-Geronilla, M.D.

Cardiac Electrophysiologist Sentara
Cardiology Specialists

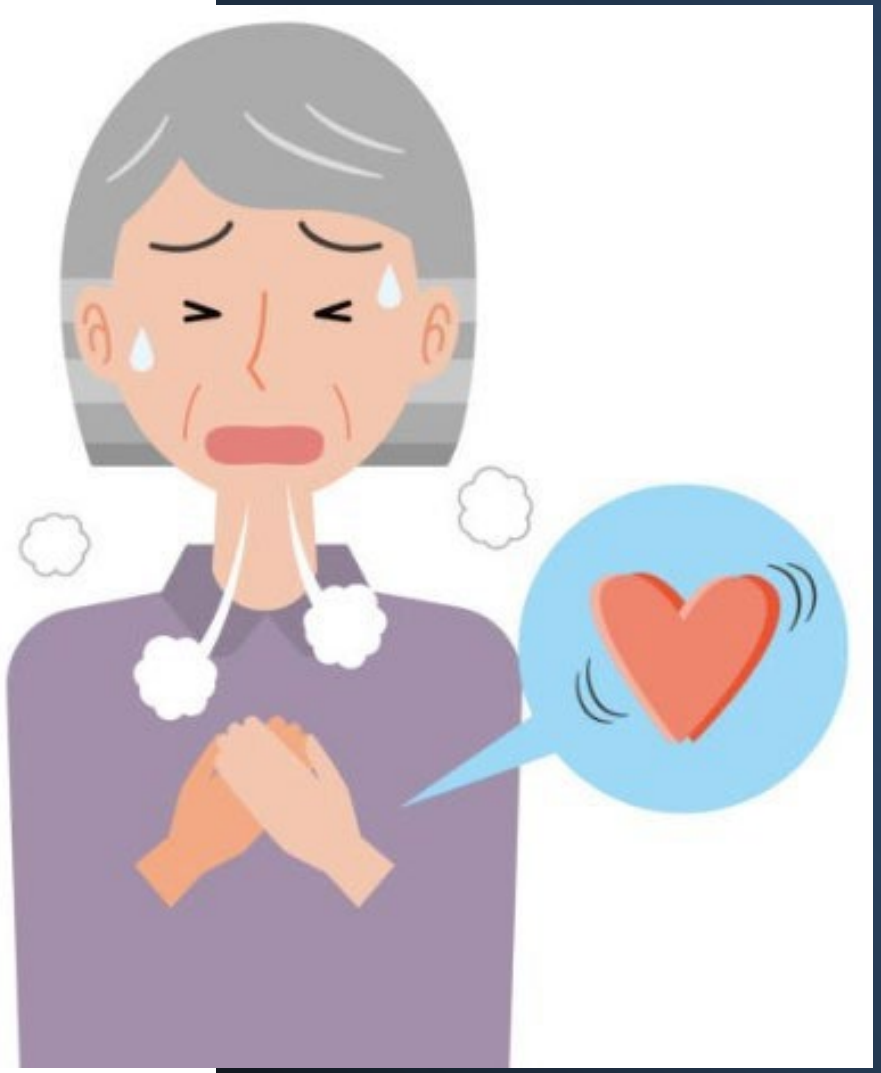
DISCLOSURES

None

Palpitations

- One of the most common symptoms of patients presenting to PCPs and cardiologists

- Subjective symptom: awareness of a forceful, rapid, or irregular heartbeat



Cardiac Disorders	*Arrhythmias - Others: pacemaker settings, heart failure, structural heart problems
High output states	-Anemia -Pregnancy -Fever
Metabolic and Endocrine	-Hyperthyroidism -Hypoglycemia -Pheochromocytoma
Catecholamine excess	-Stress -Exercise
Substance Use	-Cocaine -Alcohol -Caffeine -Amphetamines -Nicotine
Medications	- Beta-agonists - Anticholinergics - Vasodilators - Sympathomimetic agents
Psychiatric Disorders	- Generalized anxiety/panic disorder - Somatization disorder

190 consecutive patients with CC: palpitations (Etiology 84%)

- 43% cardiac
- 31% psychiatric
- 10% miscellaneous (medication, metabolic, caffeine, cocaine, anemia, amphetamine)

Weber et al AM J Med 1996

Initial Evaluation

HISTORY

PHYSICAL EXAMINATION

12 L EKG

LIMITED LABORATORY TESTING

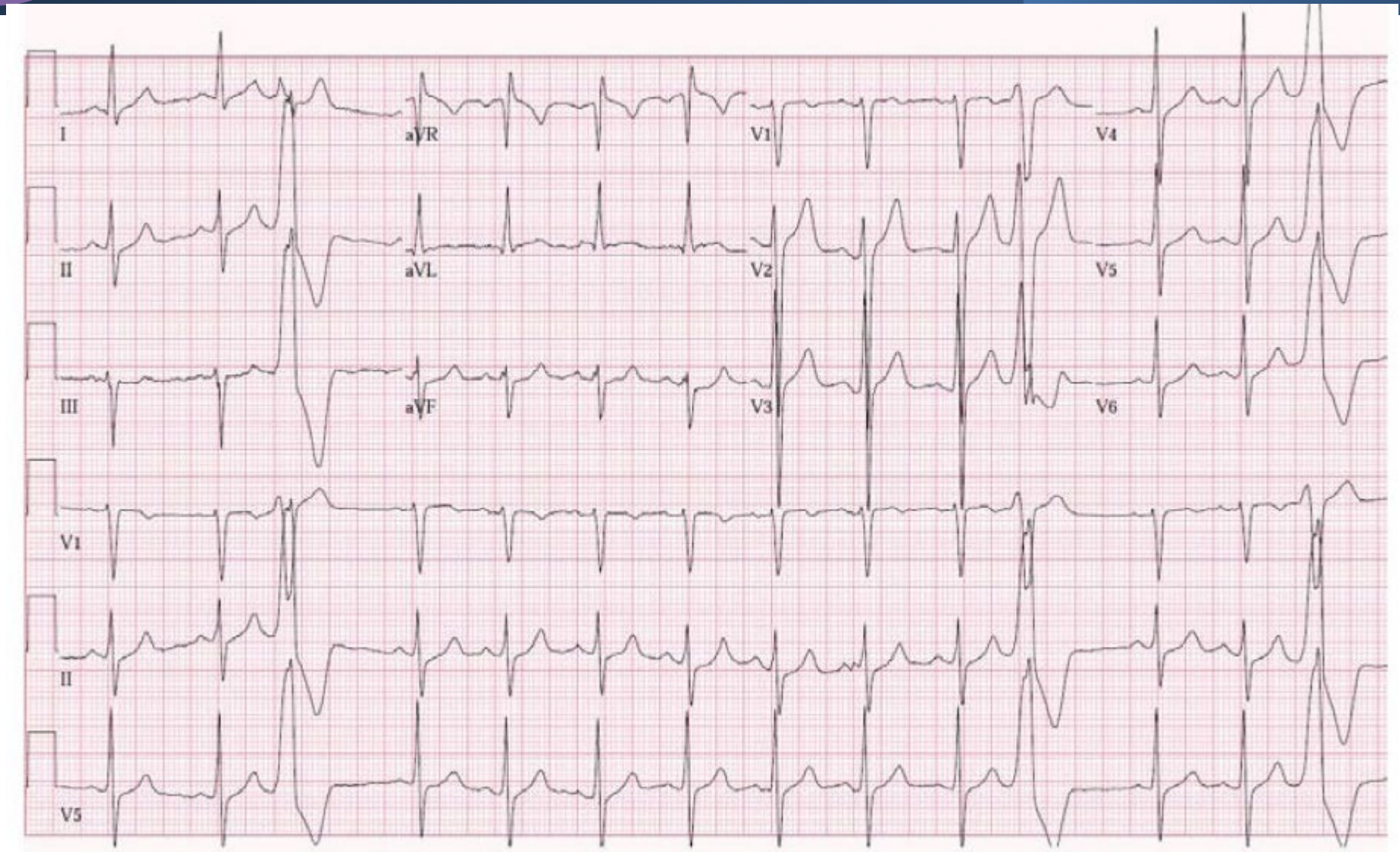
History

- Currently experiencing palpitations
- Palpitation characteristics – age of onset, duration, abruptness, regularity, triggers
- Associated symptoms: prodrome, syncope/presyncope, positional changes, self-termination
- Personal or family history of cardiac diseases
- Past medical history: high output cardiac state, metabolic disorders, COPD, psychiatric disorder
- Medications and substance use

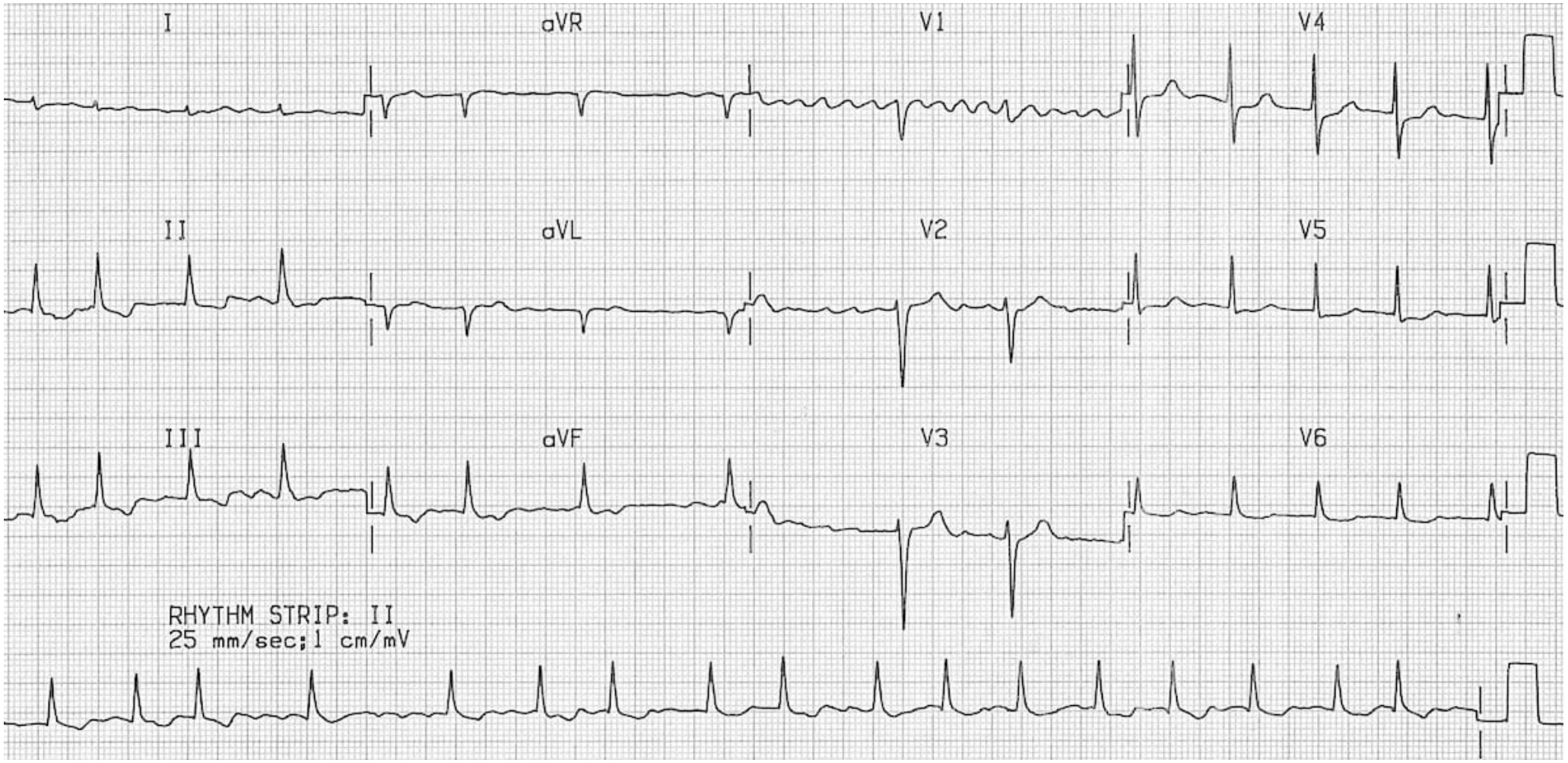
Focused Physical Exam

- Vital signs
- Cardiovascular Exam
- Respiratory Exam
- Signs of endocrine abnormalities

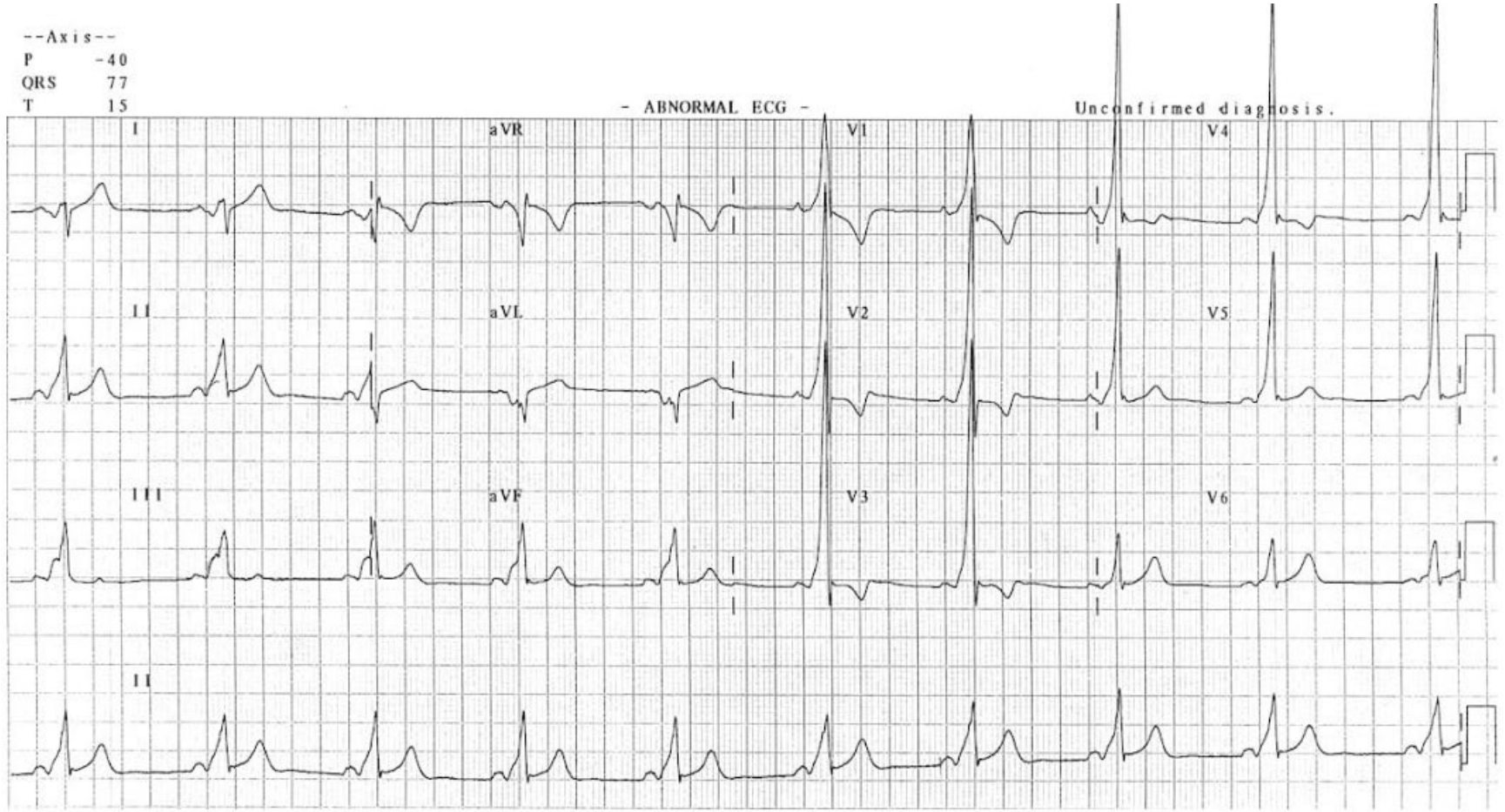
12 L EKG



12 L EKG


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

12 L EKG

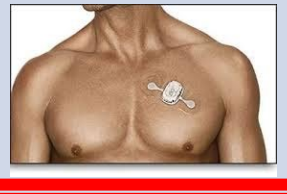
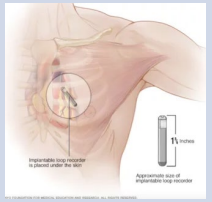

--Axis--
P -40
QRS 77
T 15
- ABNORMAL ECG -
Unconfirmed diagnosis.
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

Laboratory testing

- No evidence-based guidelines
- **Limited testing**: rule out anemia , hyperthyroidism , toxicology testing

Cardiac Monitors

- Palpitation - 31% to 43% of indications for outpatient AECG monitoring
- Types of monitor: how often symptoms are, need for real time monitoring, how involved the patient is
- Outcomes:
  - Typical symptoms = cardiac arrhythmia. Finding is most useful and may help to direct therapy.
  - Typical symptoms = no arrhythmias
  - No symptoms = cardiac arrhythmia
  - No symptoms = no arrhythmias. Finding is not useful

Device	How/Where It's worn	Duration	Things to Keep in Mind	Examples
Holter Monitor	Around neck with strap	1-3 days 	-**short term**, best if symptoms happen almost daily, **records continuously** -avoid getting wet **-Non-live**	
External Event Recorder	**Event monitor**: sensors attach to chest using adhesive, wires connect sensors to handheld monitor in pocket	2-6 weeks (longer) 	- **Does not record continuously** - You have to **activate the recording when you have a symptom** - Some devices start recording automatically when an abnormal heart rhythm is detected	
Patch Recorders *similar to Holter but longer	**Patch recorder**: placed on skin with adhesive, no visible wire	2-4 weeks 	- Patient triggered events + bradycardia + tachycardia - **Longterm continuous monitoring :** - **Symptomatic + asymptomatic events** - **Non-live**	- Zio patch (XT) - Vital Connect
Mobile Cardiac Outpatient Telemetry (MCOT)	Patch applied to chest	2-4 weeks 	- **Higher risk patients** - **Live monitoring** - Automatically records and sends data to a base monitor, sends to technicians who monitor ECG (live monitor) - **Symptomatic + asymptomatic events** - Good internet connection is important to transmit data, keep base monitor within 30 feet of your sensor	- Zio patch (AT) - Vital Connect - CardioNet MCOT (Biotel) - LifeStar MCOT
Implantable Loop Recorder	Inserted under the skin by the chest (outpatient)	Up to 4 years 	-records all the time but stores only (**symptoms + bradycardia + tachycardia, AF, PVC**) - Sends data from a home monitoring system through secure website to central monitoring station	-Medtronic -Biotronik -Abbott -Boston Scientific

ACC.12
61st Annual Scientific Session & Expo
ACC-i2 with ICE

E646
JACC March 27, 2012
Volume 59, Issue 13

Arrhythmias

CLINICAL EXPERIENCE AND DIAGNOSTIC YIELD FROM A NATIONAL REGISTRY OF 14-DAY AMBULATORY ECG PATCH MONITORING

ACC Moderated Poster Contributions
McCormick Place South, Hall A
Monday, March 26, 2012, 9:30 a.m.-10:30 a.m.

Session Title: Monitoring Arrhythmia Patients: Externally, via Implanted Devices and Wearable Defibrillators
Abstract Category: 18. Arrhythmias: Devices
Presentation Number: 1245-513

Authors: *Mintu Turakhia, Donald Hoang, Peter Zimetbaum, Felix Yang, Victor Froelicher, Paul Heidenreich, Veterans Affairs Palo Alto Health Care System, Palo Alto, CA, USA, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA*

Background: We characterized the diagnostic yield, arrhythmia type, and time to arrhythmia using a national registry of ambulatory ECG data.

Methods: We evaluated the findings of 18,236 consecutive patients in the United States wearing first-time 14-day ambulatory ECG Zio® patch monitors (iRhythm Inc, San Francisco, CA) prescribed for clinical indications from October 2010 to October 2011. Arrhythmia adjudication was performed and coded by trained Holter technicians, and de-identified data was extracted from a clinical registry for analysis. Episodes were classified into three categories based on type of arrhythmia: first, first symptom-triggered, and longest duration.

Results: The mean age was 60±18 years; 54% were female. The mean wear time was 7.1±3.3 days and the median analyzable time was 95%. Arrhythmias were identified in 64% of patients with the following prevalence: SVT≥4 beats (77.1%), SVT≥8 beats (51.1%), paroxysmal AF (PAF) (16.0%), chronic AF (12.8%), VT≥4 beats (19.9%), VT≥8 beats (7.5%), pause>3 sec (6.2%), Mobitz II or complete AV block (2.2%). After adjustment for age, women compared to men were more likely to have SVT detected (OR 1.30, $p<0.001$) than any of the other arrhythmias (OR 0.50, $p<0.001$ for all). Excluding patients with chronic AF, the mean time to first arrhythmia and first symptom-triggered arrhythmia from the start of monitoring was 40±51 hours and 66±64 hours. For symptomatic episodes, time to first occurrence was longest for VT (82±68h) and SVT (74±64h), followed by PAF (62±64h), pauses (53±47h), and AV block (43±54h). 27.6% of first arrhythmias and 41.9% of first symptom-triggered arrhythmias occurred beyond 48 hours from the start of monitoring.

Conclusions: There was high variation in time to first and first symptomatic arrhythmia; 41.9% of patients had their first symptomatic arrhythmia beyond 48 hours from the start of monitoring. Extended (14-day) monitoring can increase diagnostic yield, regardless of arrhythmia type.

- 41.9% had first symptomatic arrhythmia beyond 48 hours
- Extended (14 day) monitoring increases diagnostic yield

Acta Cardiol Sin 2020;36:251–259
Original Article
doi: 10.6515/ACS.202005_36(3).20190903A

EP & Arrhythmia

Comparison of Arrhythmia Detection by 24-Hour Holter and 14-Day Continuous Electrocardiography Patch Monitoring

Su-Kiat Chua,[1,2] Lung-Ching Chen,[2] Li-Ming Lien,[3,4] Huey-Ming Lo,[2] Zhen-Yu Liao,[2] Shu-Ping Chao,[2] Cheng-Yen Chuang[2] and Chiung-Zuan Chiu[1,2]

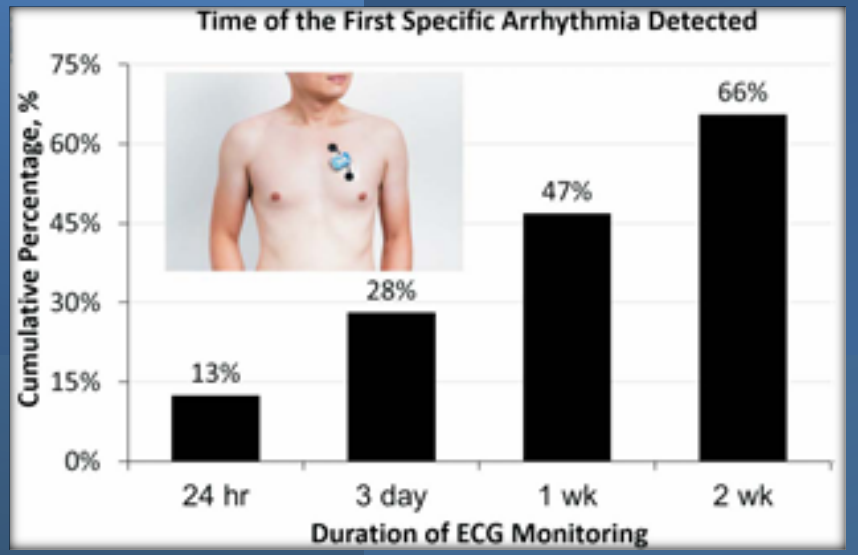
Background: Although 24-hour Holter monitoring is routinely used for patients with suspected paroxysmal arrhythmia, its sensitivity in detecting such arrhythmias is insufficient.

Methods: We compared a 14-day electrocardiography (ECG) monitor patch — a single-use, noninvasive, waterproof, continuous monitoring patch — with a 24-hour Holter monitor in 32 consecutive patients with suspected arrhythmia.

Results: The 14-day ECG patch was well tolerated, and its rates of detection of relevant arrhythmias on days 1, 3, 7, and 14 were 13%, 28%, 47%, and 66%, respectively. The detection rate of paroxysmal arrhythmias was significantly higher for the 14-day ECG patch than for the 24-hour Holter monitor (66% vs. 9%, $p < 0.001$). Among the 32 patients, 202 atrial fibrillation or atrial flutter episodes were detected in 6 patients (22%) with the 14-day ECG patch; however, only 1 atrial fibrillation episode was detected in a patient (3%, $p < 0.05$) with the 24-hour Holter monitor. Other clinically relevant arrhythmias recorded on the 14-day ECG patch included 21 (65.5%) episodes of supraventricular tachycardia, 2 (6.3%) long pause, and 2 (6.3%) ventricular arrhythmias. The mean dermal response score immediately after removal of the 14-day ECG patch from the patients was 0.64, which indicated minimal erythema.

Conclusions: The 14-day ECG patch was well tolerated and allowed for longer continuous monitoring than the 24-hour Holter monitor, thus resulting in improved clinical accuracy in the detection of paroxysmal arrhythmias. Future studies should examine the long-term effectiveness of 14-day ECG patches for managing selected patients.

Key Words: Arrhythmia • Atrial fibrillation • ECG monitoring patch • Holter monitor



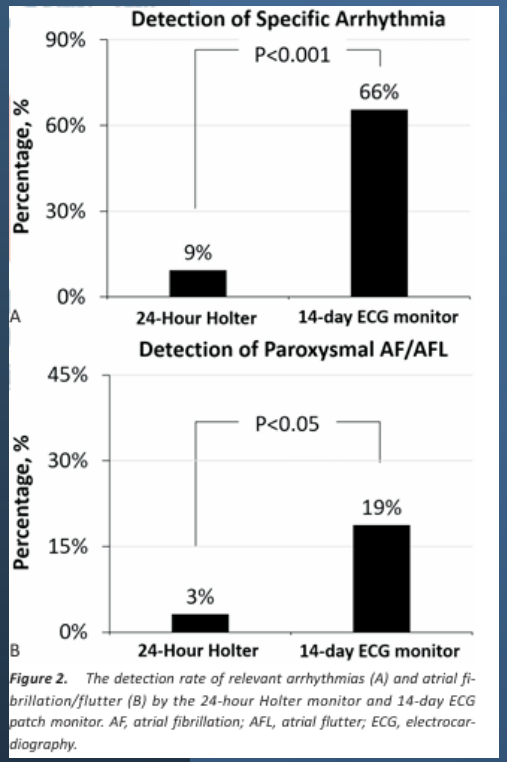


Figure 2. *The detection rate of relevant arrhythmias (A) and atrial fibrillation/flutter (B) by the 24-hour Holter monitor and 14-day ECG patch monitor. AF, atrial fibrillation; AFL, atrial flutter; ECG, electrocardiography.*

ZIO®

Zio monitor Final Report for
Sample Report, Patient #1

1

iRhythm Technologies
Tel: (888) 693-2401

iRHYTHM

Date of Birth	Patient ID	Gender	Primary Indication (R94.31)
12/12/67 (56 yrs)		Female	Abnormal electrocardiogram

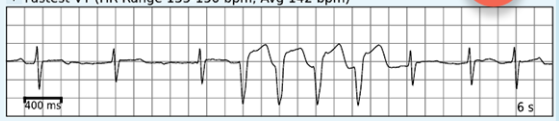
Prescribing Clinician	Managing Location
Dr. E. Physician	San Francisco

Enrollment Period	Analysis Time
13 days 19 hours 03/22/24, 05:24am to 04/05/24, 12:40am	13 days 19 hours (after artifact removed)

Ventricular Tachycardia (4 beats or more)

2

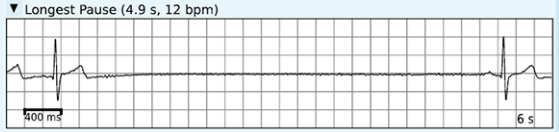
▼ Fastest VT (HR Range 135-150 bpm, Avg 142 bpm)



Episodes **5**
HR Range **116-150 bpm**
Avg **132 bpm**

Pauses (3 secs or longer)

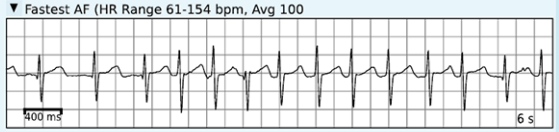
▼ Longest Pause (4.9 s, 12 bpm)



Episodes **3**
Range **3.9-4.9 s**

Atrial Fibrillation

▼ Fastest AF (HR Range 61-154 bpm, Avg 100



AF Burden **37%**
Longest Duration **1 d 19 h**
HR Range **50-154 bpm**
Avg **97 bpm**

AV Block (2nd° Mobitz II, 3rd°)

None found

Supraventricular Tachycardia (4 beats or more)

4

None found

Heart Rate

Overall	Max	**154 bpm**	09:49am, 03/25
	Min	**50 bpm**	11:59pm, 03/22
	Avg	**78 bpm**	
Sinus	Max	**96 bpm**	11:14am, 03/24
	Min	**50 bpm**	11:59pm, 03/22
	Avg	**66 bpm**	

Patient Events

Total Triggers:2 **Total Diaries:1**

Findings within ± 45 sec of triggered events or diary entries:

	Range	Trigger	Diary
AF	59-126 bpm	✓	✓
Pause(s)	3.9 s	✓	
Sinus	56-73 bpm	✓	
SVE(s)		✓	
VE(s)			✓

3

Ectopics

	Rare <1%	Occasional 1% to ≤5%	Frequent >5%
Supraventricular Ectopy (SVE/PACs)			
Isolated	**Rare**	<1.0%	6723
Couplet	**Rare**	<1.0%	141
Triplet	**Rare**	<1.0%	9
Ventricular Ectopy (VE/PVCs)			
Isolated	**Rare**	<1.0%	1716
Couplet	**Rare**	<1.0%	192
Triplet	**Rare**	<1.0%	26

Longest Ventricular Bigeminy Episode	0 s
Longest Ventricular Trigeminy Episode	0 s

Preliminary Findings Prepared by Sample Technician, CCT 04/12/24

Patient had a min HR of 50 bpm, max HR of 154 bpm, and avg HR of 78 bpm. Predominant underlying rhythm was Sinus Rhythm. 5 Ventricular Tachycardia runs occurred, the run with the fastest interval lasting 4 beats with a max rate of 150 bpm, the longest lasting 4 beats with an avg rate of 127 bpm. Episodes of Ventricular Tachycardia may be possible Atrial Fibrillation with aberrancy. Atrial Fibrillation occurred (37% burden), ranging from 50-154 bpm (avg of 97 bpm), the longest lasting 1 day 19 hours with an avg rate of 97 bpm. 3 Pauses occurred, the longest lasting 4.9 secs (12 bpm). Atrial Fibrillation and Pause were detected within +/- 45 seconds of symptomatic patient event(s). Isolated SVEs were rare (<1.0%, 6723), SVE Couplets were rare (<1.0%, 141), and SVE Triplets were rare (<1.0%, 9). Isolated VEs were rare (<1.0%, 1716), VE Couplets were rare (<1.0%, 192), and VE Triplets were rare (<1.0%, 26).

Final Interpretation

1. Agree with above interpretation
2. Underlying Sinus rhythm with normal rates average =78/min
3. 5 runs of VT some of which could be AF with aberrancy
4. Atrial fibrillation with 37% burden and longest run of 42 hours
5. Pauses of up to 4.9 seconds likely post conversion related
6. Triggered events consistent with AF, Pauses

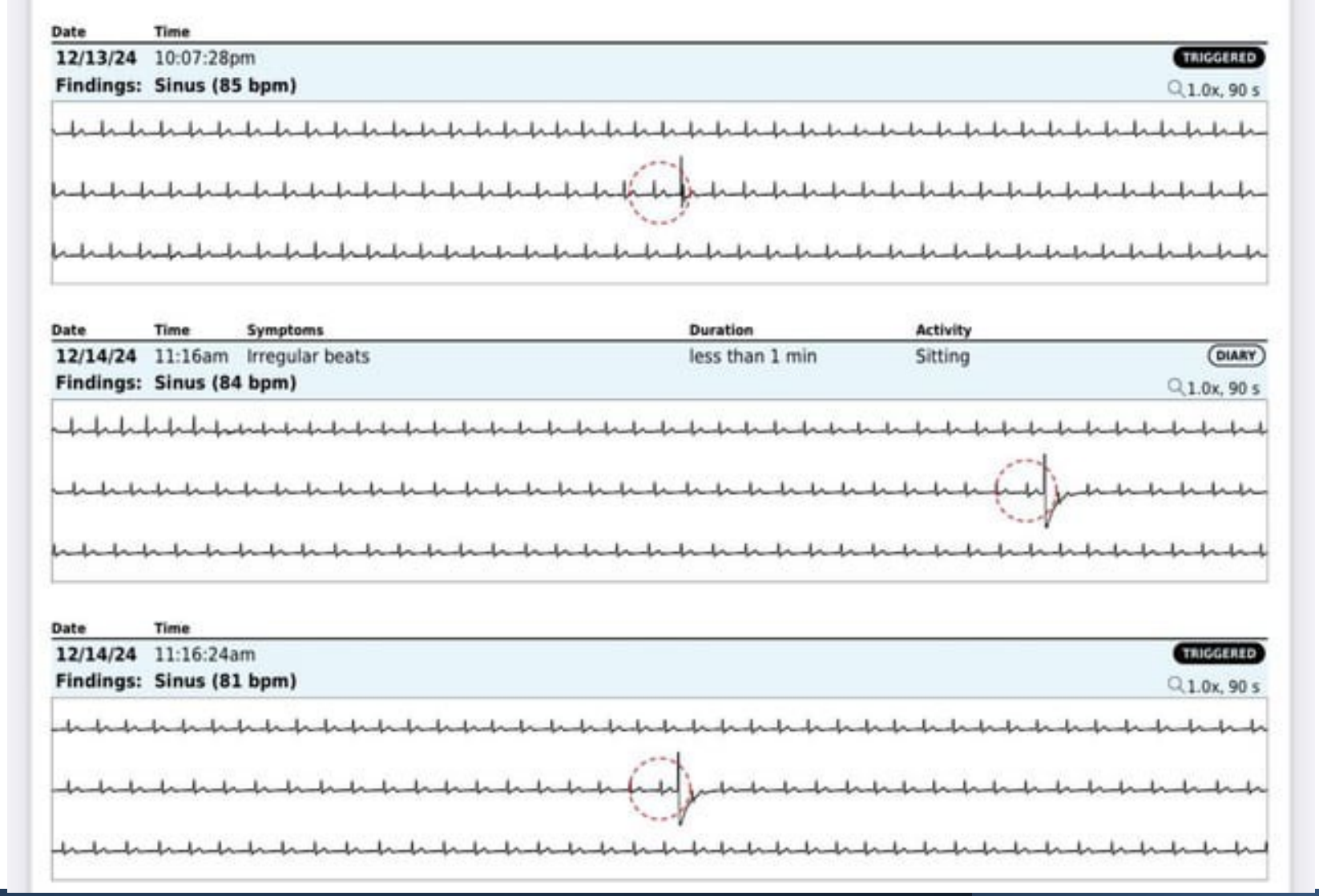
Electronically signed by Dr. Example Physician 04/12/24 06:18 PM (CT)
SIGNATURE

S/N: **DAA1234ABC**

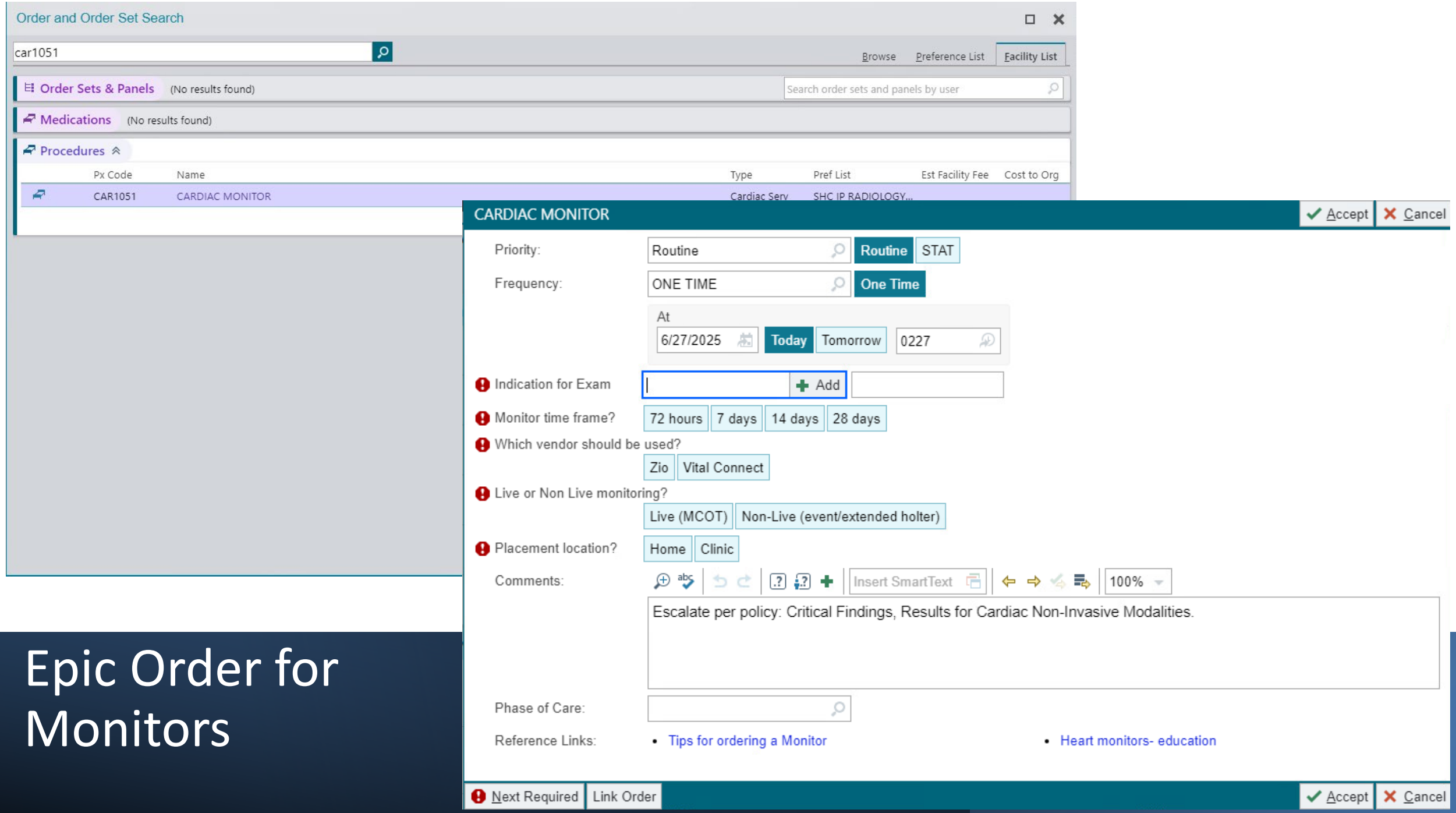
1. The Zio ® Report cover page ,right upper-hand corner with wear time
2. Sample strips
3. Patient triggered events
4. The Zio Preliminary Findings are generated by an FDA-cleared deep-learned algorithm validated by Certified Cardiographic Technicians (CCT). [1-4]

SAMPLE FINAL INTERPRETATION:

- **Predominant rhythm is _____ with average HR of _____ bpm.**
- **There were no sustained arrhythmias. (>6 minutes for SVT, >=30 seconds for VT, PVC>10% burden)**
- **Patient's symptoms correlated with _____.**



Patient Events



Epic Order for Monitors

Recurrent Unexplained Palpitations (RUP) Study

Comparison of Implantable Loop Recorder Versus Conventional Diagnostic Strategy

Franco Giada, MD,* Michele Gulizia, MD,† Maura Francese, MD,† Francesco Croci, MD,‡ Lucio Santangelo, MD,§ Maurizio Santomauro, MD,‖ Eraldo Occhetta, MD,¶ Carlo Menozzi, MD,# Antonio Raviele, MD*

Venice, Catania, Lavagna, Naples, Novara, and Reggio Emilia, Italy

Table 3 Diagnostic Outcome

	Conventional Diagnostic Strategy (n = 24)	Implantable Loop Recorder (n = 26)
Diagnosis, n (%)	5 (21)	19 (73)*
Supraventricular tachycardia	4	6
Atrial fibrillation/atrial flutter	1	6
Sinus tachycardia	0	4
Sinus bradycardia	0	2
Paroxysmal AV block	0	1
No diagnosis, n (%)	19 (79)	7 (27)
No palpitation recurrence during monitoring	16	6
Patient error in activating the recorder	5	1
Recorder malfunctioning	1	0
Negative EPS	19	—

*$p < 0.001$.

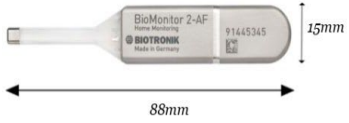
AV = atrioventricular; EPS = electrophysiological study.

Giada et al *JACC* 2007

Implantable Loop Recorder

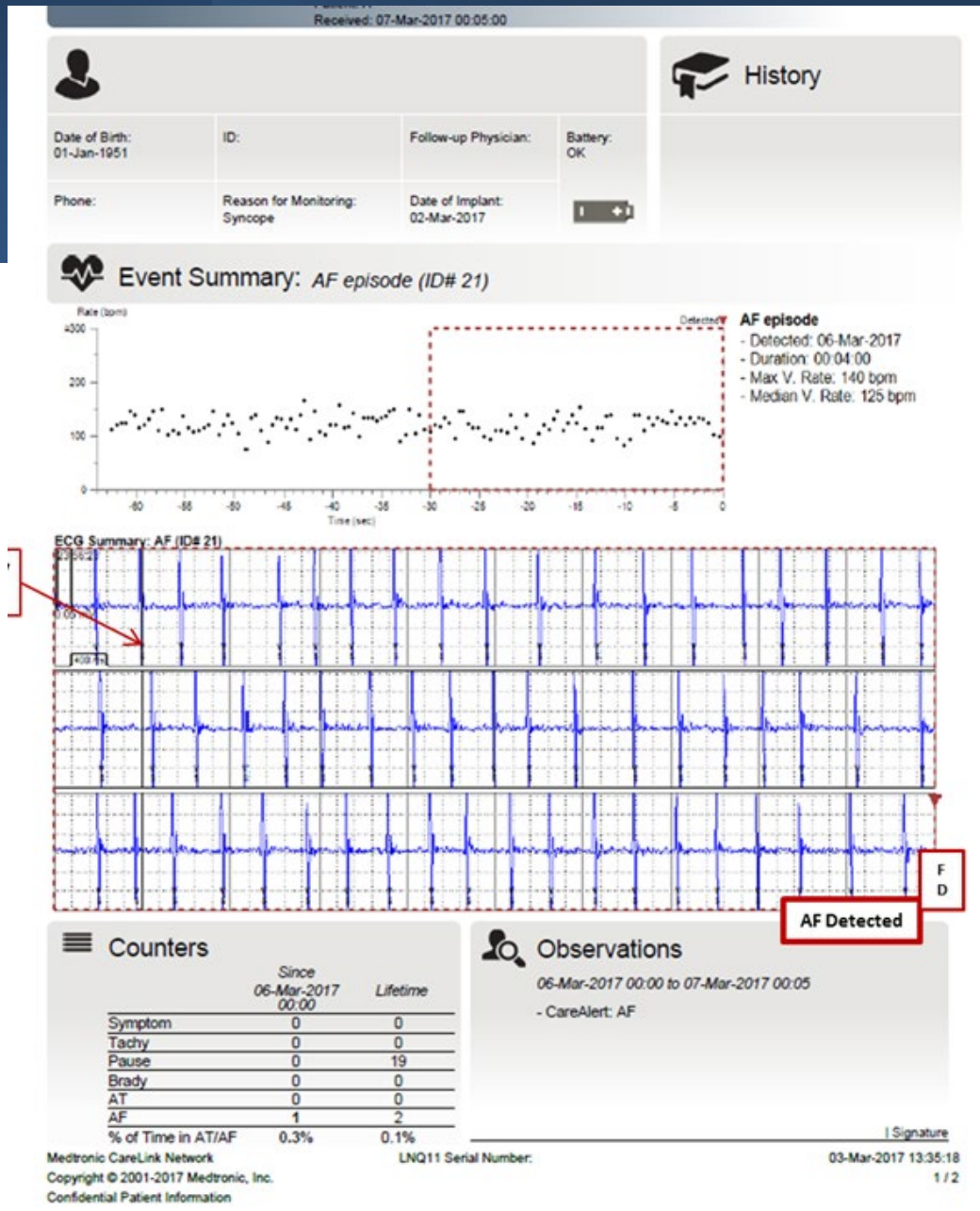
Reveal LINQ (Medtronic, Minneapolis, USA)

BioMonitor II (Biotronik SE & Co., Berlin, Germany)



Reveal XT (Medtronic, Minneapolis, USA)

Confirm RX ICM (St. Jude Medical, Minnesota, USA)



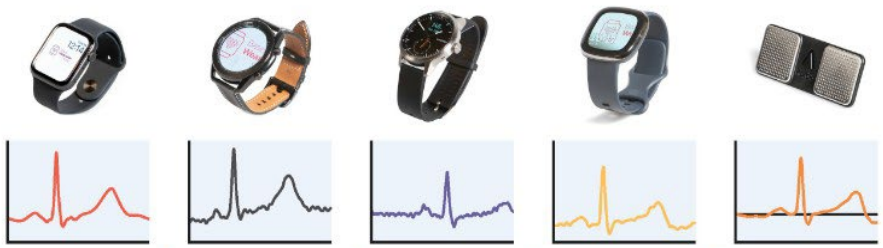
Clinical Validation of 5 Direct-to-Consumer Wearable Smart Devices to Detect Atrial Fibrillation: BASEL Wearable Study

Arrhythmia Monitoring

Diego Mannhart, Mirko Lischer, Sven Knecht, Jeanne du Fay de Lavallaz, Ivo Strebel, Teodor Serban, David Vögeli, Beat Schaer, Stefan Osswald, Christian Mueller, Michael Kühne, Christian Sticherling, and Patrick Badertscher

J Am Coll Cardiol EP. 2023 Feb, 9 (2) 232–242

CENTRAL ILLUSTRATION: 5 Compared Devices

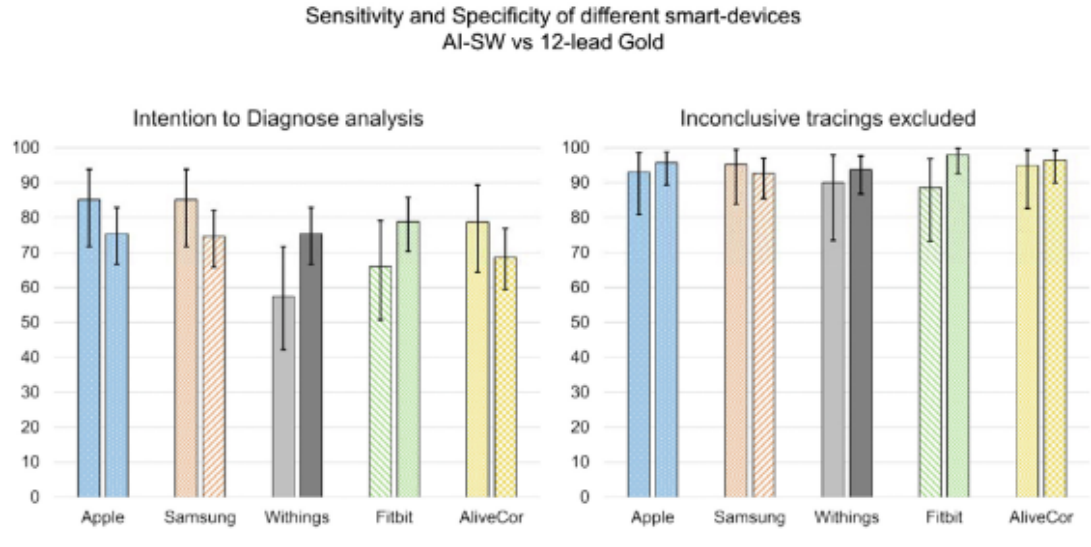


Manufacturer	Apple	Samsung	Withings	Fitbit	AliveCor
Version	Watch 6	Galaxy Watch3	ScanWatch	Sense	Kardia Mobile
Sensitivity (95% CI)	85% (72%-94%)	85% (72%-94%)	58% (42%-72%)	66% (51%-79%)	79% (64%-89%)
Specificity (95% CI)	75% (67%-83%)	75% (66%-82%)	75% (67%-83%)	79% (70%-86%)	69% (60%-77%)
Inconclusive tracings	18%	17%	24%	21%	26%
Preferred Choice*a	39%	12%	24%	15%	5%
Limit of HR interpretation*b	50-150 beats/min	50-120 beats/min	No information	50-120 beats/min	50-100 beats/min
Battery capacity*c	18 h*d	45 h*d	720 h*d	144 h*d	90 h / 2 y*e
Price*d	449	265	303	244	147

*a: Out of 165 analyzed patients, 10 patients were not able to decide between the available devices
*b: Information obtained from manufacturers website, 11/21
*c: Time with GPS disabled
*d: Information obtained on digitec.ch on 12.11.21, no discounts / special offers were included in the price, price includes tax / all prices in CHF
*e: 90 h net operating time, under regular use up to 2 years

Mannhart D, et al. J Am Coll Cardiol EP. 2023;9(2):232-242.

FIGURE 1 Device-Recorded Electrocardiogram AI Interpretation and 12-Lead Electrocardiogram Comparison



Graphical illustration of sensitivity **(bar on left)** and specificity **(bar on right)** of devices and 95% CI. Only significant differences in sensitivity and specificity are reported through the intention-to-diagnose comparison of the device's sensitivity and specificity. *P* values were calculated using McNemar's chi-square test. 12-lead-Gold = gold standard diagnosis by cardiologist from a 12-lead electrocardiogram; AI = artificial intelligence; SW = smartwatch/smart device single-lead electrocardiogram.

- High diagnostic accuracy when excluding inconclusive tracings
- In clinical setting, manual review of tracings is required in about one-fourth of cases for all assessed devices

Conclusion

- The work up for palpitations starts with careful history and physical exam
- Important to correlate frequency/duration of palpitations to type of cardiac monitor
- The yield of EKG and short-term monitoring is low but can provide important clues
- Digital health will play an increasing role in diagnosis and workup of palpitations and syncope over time

Thank you!

Questions? cfmacata@sentara.com