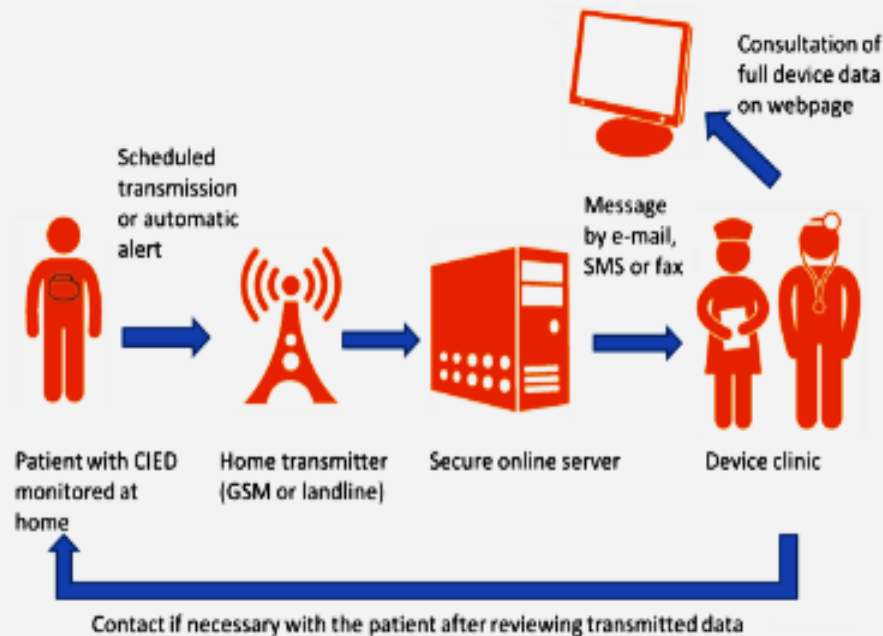


# ΨΗΦΙΑΚΗ ΕΠΟΧΗ ΣΤΗΝ ΥΓΕΙΑ ΨΗΦΙΑΚΗ ΙΑΤΡΙΚΗ

Ι.Π.ΛΕΚΑΚΗΣ  
ΟΜΟΤΙΜΟΣ ΚΑΘΗΓΗΤΗΣ ΕΚΠΑ  
ΔΙΕΥΘΥΝΤΗΣ ΚΑΡΔΙΟΛΟΓΙΚΟΥ ΤΟΜΕΑ ΚΚΑ  
ΠΡΟΕΔΡΟΣ ΕΕΨΙ

# ΚΑΡΔΙΑΓΓΕΙΑΚΕΣ ΠΑΘΗΣΕΙΣ

# Remote device management: definitions



- **Remote follow-up:** full remote device interrogation at scheduled intervals
- **Remote monitoring:** unscheduled transmission of pre-defined alert events
- **Patient-initiated follow-up:** non-scheduled interrogations as a result of a patient experiencing a real or perceived clinical event

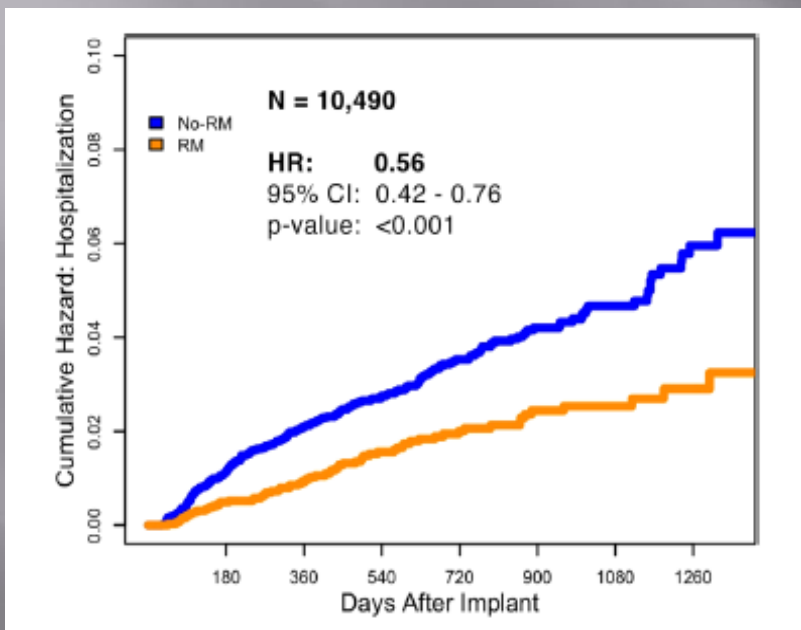
# Home monitoring of devices



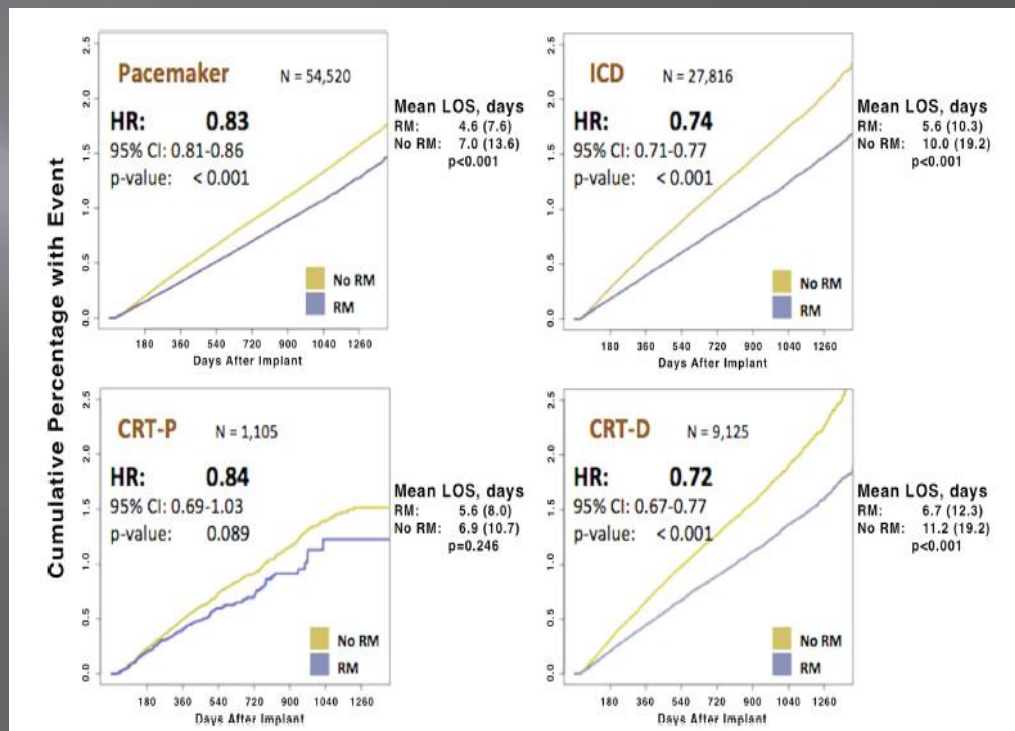
# Impact of remote monitoring on clinical events and associated health care utilization: A nationwide assessment <sup>e</sup>

Jonathan P. Piccini, MD, MHSc, FHRS,<sup>\*</sup> Suneet Mittal, MD, FHRS,<sup>†</sup> Jeff Snell, AB,<sup>‡</sup> Julie B. Prillinger, PhD,<sup>§</sup> Nirav Dalal, MS, MBA,<sup>§</sup> Niraj Varma, MD, PhD, FHRS<sup>||</sup>

Heart Rhythm 2016;13:2279–2286



Hospitalization for stroke in patients with new-onset atrial fibrillation according to RM use.



All-cause hospitalization according to remote monitoring utilization, by device type.



# Remote management of arrhythmias and device

Recommendations	Class	Level
Device-based remote monitoring should be considered in order to provide earlier detection of clinical problems (e.g. ventricular tachyarrhythmias, atrial fibrillation) and technical issues (e.g. lead fracture, insulation defect).	Ila	A

Study	No (pts)	Mean Age	Device	Company	Transmission	FU	Endpoints
TRUST 2010	1339	63	ICD	Biotronik	Automatic daily monitoring	12m	↓ time to evaluation ↓ hospital visits
CONNECT 2011	1997	65	ICD	Medtronic	Automatic alerts	15m	↓ time to clinical decision ↓ hospital stay
EVOLVO 2012	200	67	ICD	Medtronic	Automatic alerts	16m	↓ ED visits ↓ total healthcare use ↓ time to clinical decision

# Remote Monitoring Becomes Standard of Care (HRS Class 1A Recommendation)

- New Class 1A recommendation for remote interrogation and monitoring of all device patients (including IPGs)
- The consensus paper highlighted also the recent findings (Varma et al. 2015) regarding the **"dose dependency" of remote monitoring**, i.e. the higher the transmission success the greater the survival advantage

## HRS Remote Monitoring Consensus Statement Recommendations

Device Follow-up Paradigm	Class of Recommendation	Level of Evidence
A strategy of remote CIED monitoring and interrogation, combined with at least annual IPE, is recommended over a calendar-based schedule of in-person CIED evaluation alone (when technically feasible).	I	A
All patients with CIEDs should be offered RM as part of the standard follow-up management strategy.	I	A



# HRS Expert Consensus Statement on remote interrogation and monitoring for cardiovascular implantable electronic devices

Heart Rhythm 2015;12:e69–e100

Device and Disease Management	Class of Recommendation	Level of Evidence
RM should be performed for surveillance of lead function and battery conservation.	I	A
Patients with a CIED component that has been recalled or is on advisory should be enrolled in RM to enable early detection of actionable events.	I	E
RM is useful to reduce the incidence of inappropriate ICD shocks.	I	B-R
RM is useful for the early detection and quantification of atrial fibrillation.	I	A
The effectiveness of RM for thoracic impedance alone or combined with other diagnostics to manage congestive heart failure is currently uncertain.	IIb	C



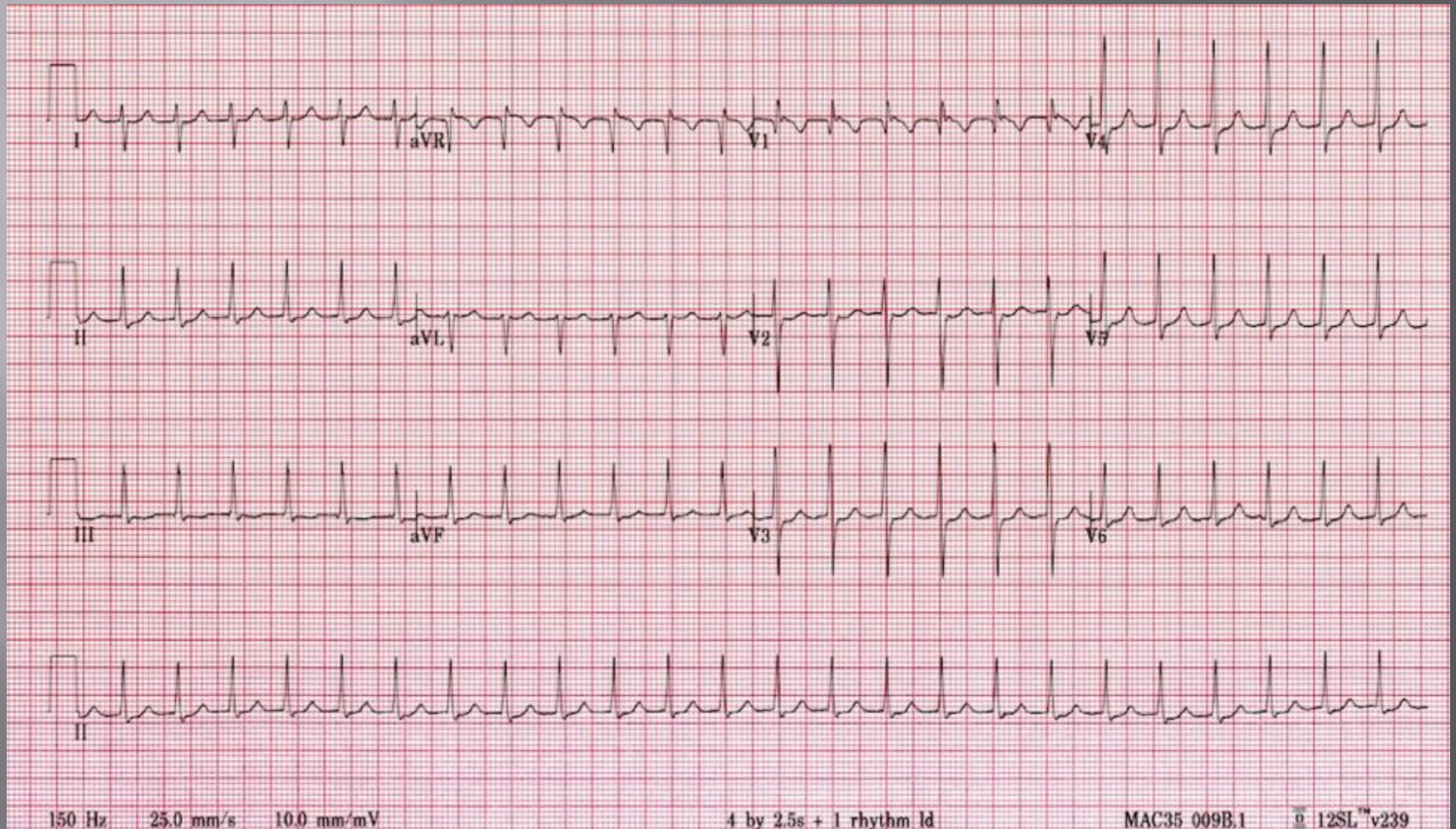


# *The classic (1)...*





# The classic (2)...



# Tools to Catch Arrhythmias (1)

a.



Traditional Holter Monitor

b.



Auto-Triggered Loop Recorder

c.



Patch-Based Holter Monitor

d.



Insertable Cardiac Monitor

e.



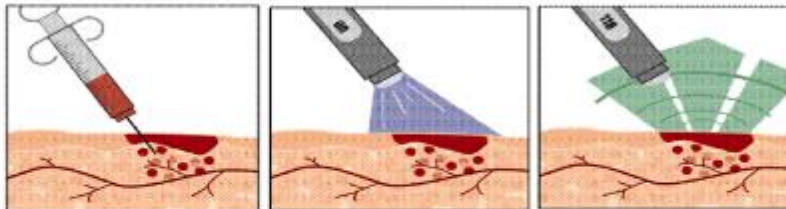
Transtelephonic Monitoring



# Tools to Catch Arrhythmias (2)

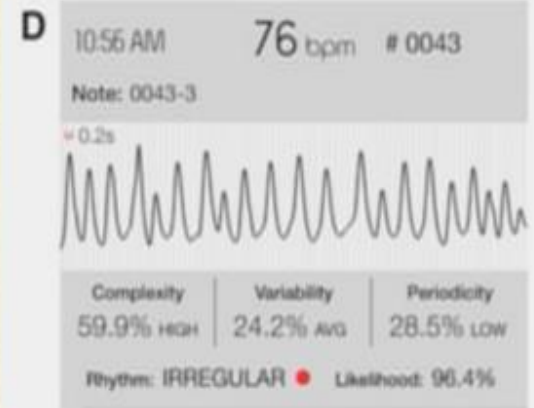


- Wearables
  - Smart Tattoos
- Dermally implanted Sensors
- Subcutaneous implants





# Photoplethysmography

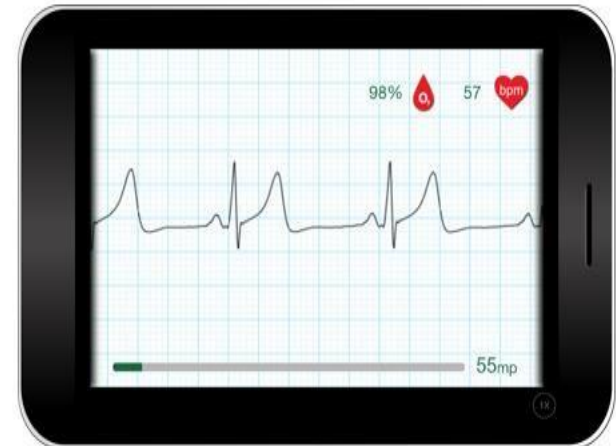


# Bands & Watches



# ALIVECOR ALIVECOR SYSTEM







# Telemonitoring and Heart Failure

1. Use of specific architecture ( phone/web based) to connect patients to their nurse, GP or hospital
2. Monitoring (daily, weekly) of vital signs such as weight, pressure, pulse and symptoms (breathlessness, fatigue, oedema)
3. Close monitoring of fluid status and therapy
4. Monitoring of brady and tachyarrhythmias
5. Advices by telephone on diuretic dosage, diet, training, behaviour



# HF EVALUATION:WEARABLE DEVICES

- ▣ Multiple Parameter Testing
- ▣ Breath analysis
- ▣ Wireless invasive pressure monitoring
- ▣ Wireless non-invasive congestion monitoring

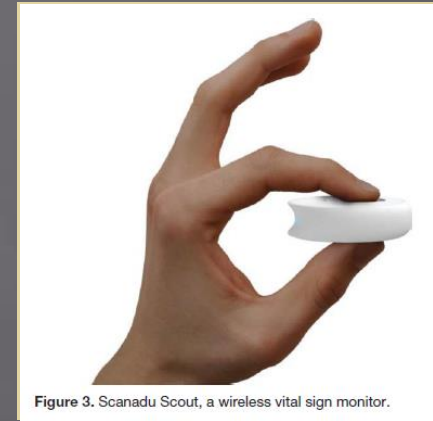


Figure 3. Scanadu Scout, a wireless vital sign monitor.

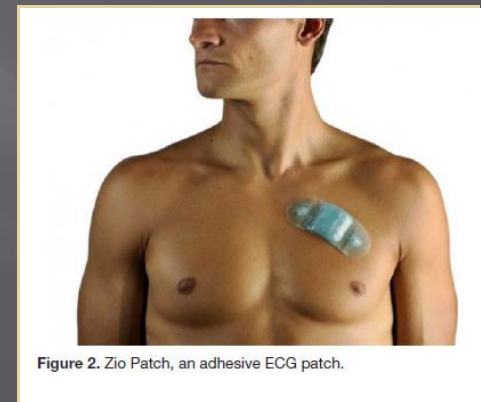
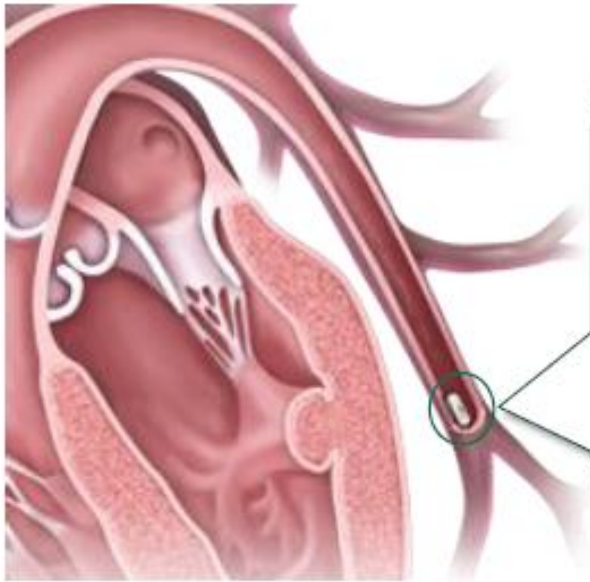
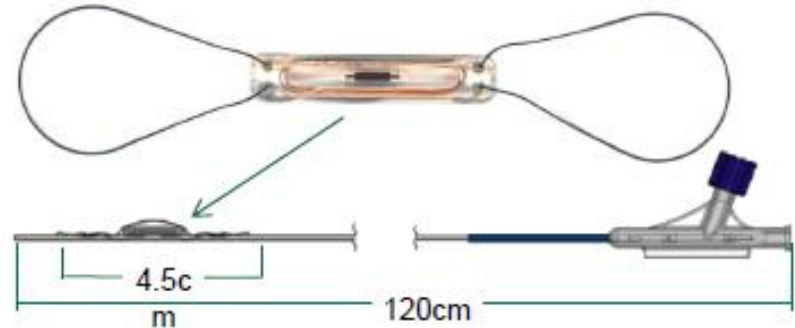


Figure 2. Zio Patch, an adhesive ECG patch.

# CHAMPION Trial IHM



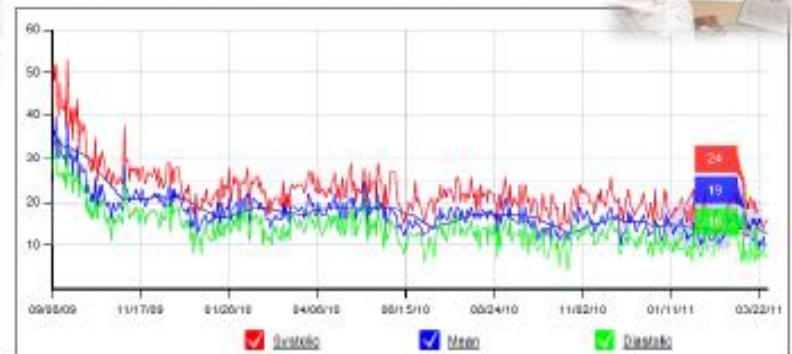
PA Pressure Sensor on Catheter Delivery System



Patient Home Electronics Unit



PA Pressure Database

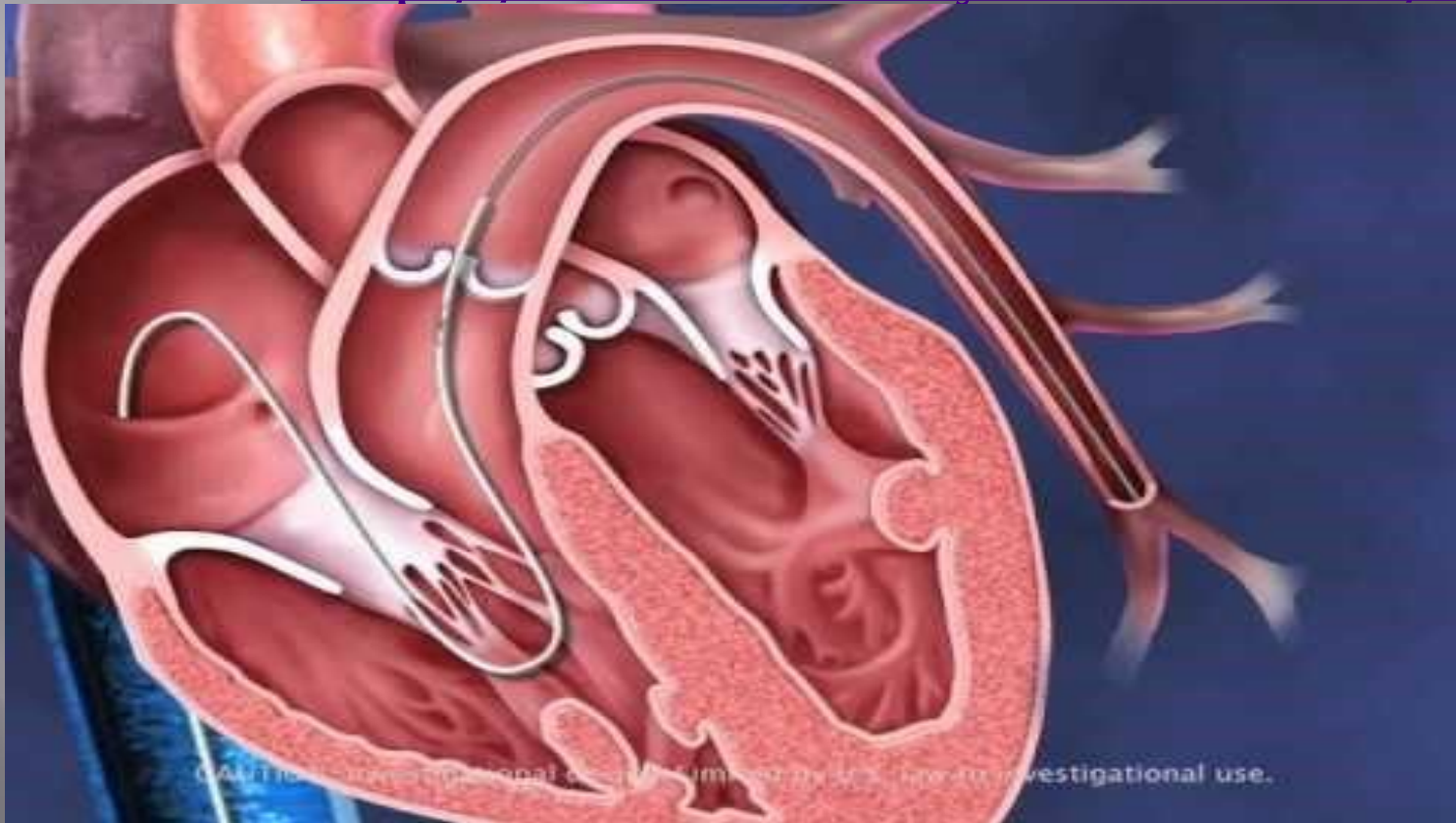


Physician Access Via Secure Website

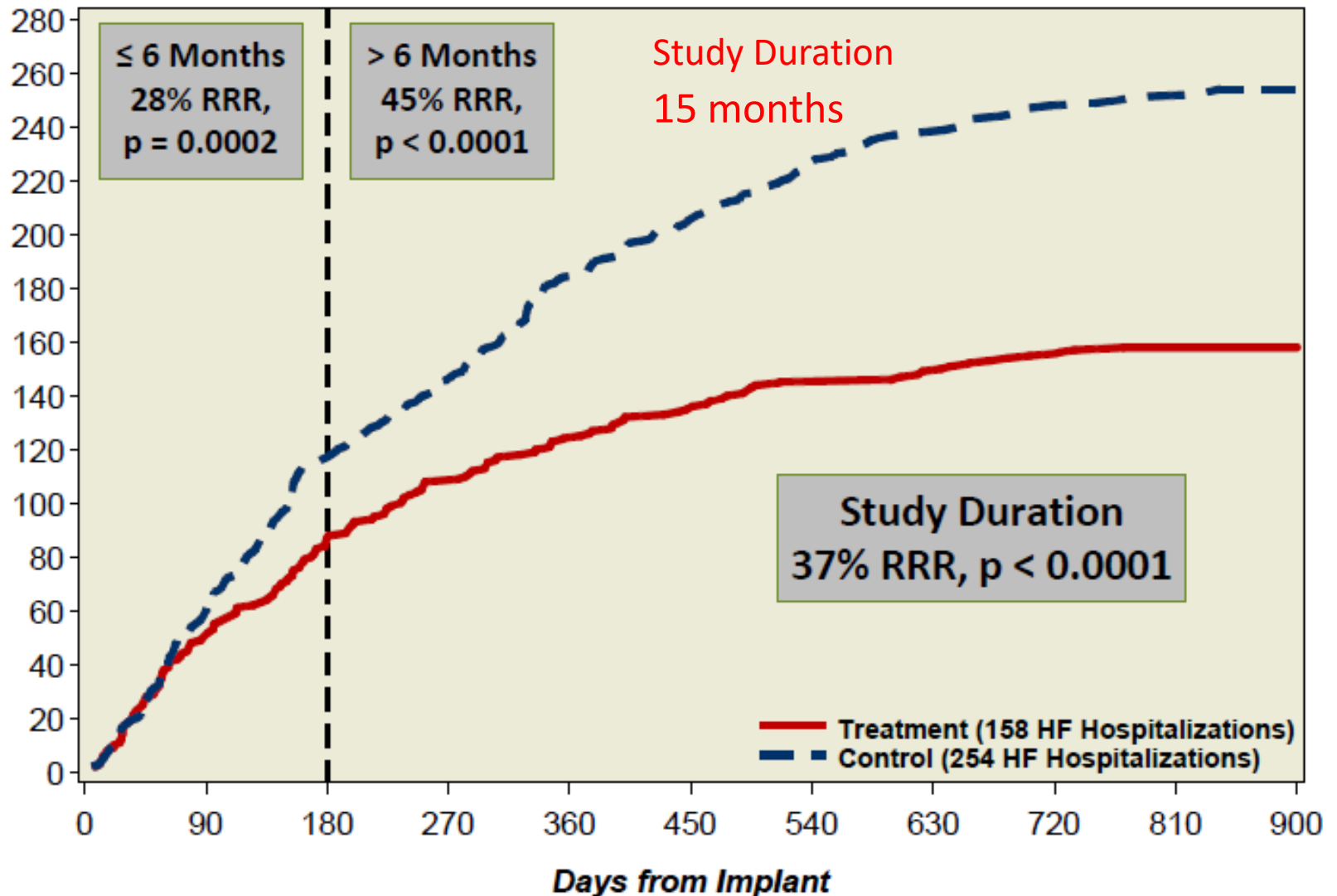
# CardioMEMs at Community Health Network

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- ▣ <http://www.theindychannel.com/lifestyle>



# Cumulative HF Hospitalizations Reduced At 6 Months and Full Duration of Randomized Study



**No. at Risk**

**Treatment**  
**Control**

270	262	244	210	169	131	108	82	29	5	1
280	267	252	215	179	137	105	67	25	10	0

al  
r



# Digital Medicine and Arterial Hypertension (3)

Device	Drawbacks	Notes
Hypertension apps for mobile devices	Poorly regulated, most do not share data with physician offices, may encourage unwarranted self-titration of medication or provide factitious blood pressure measurements	Only 3 % of reviewed hypertension management apps were developed by health-care agencies [19**]
Self-use wireless upper arm blood pressure monitors	Cost, bluetooth technology often requires troubleshooting	Examples of validated devices include Withings, QardioArm, iHealth [29]
Text messaging	Cost, requires physician oversight	Home blood pressure monitor measurement self interpretation through text messaging [30]
Remote monitoring	Cost, requires physician oversight	SIMCARD study achieves lower systolic blood pressure using smartphones and community health workers [27]
Cuffless blood pressure devices	Cost, insufficient accuracy Wrist or fingers	Examples that are FDA approved include Sotera, Somnotouch-NIBP

\*\*Although many wireless sensors have been validated and FDA approved for clinical use, measurements can vary as much as 20 mmHg from blood pressures derived using brachial cuff. When they are inaccurate, they tend to underestimate blood pressure particularly at the higher end of the scale (i.e., greater than 160 mmHg systolic)





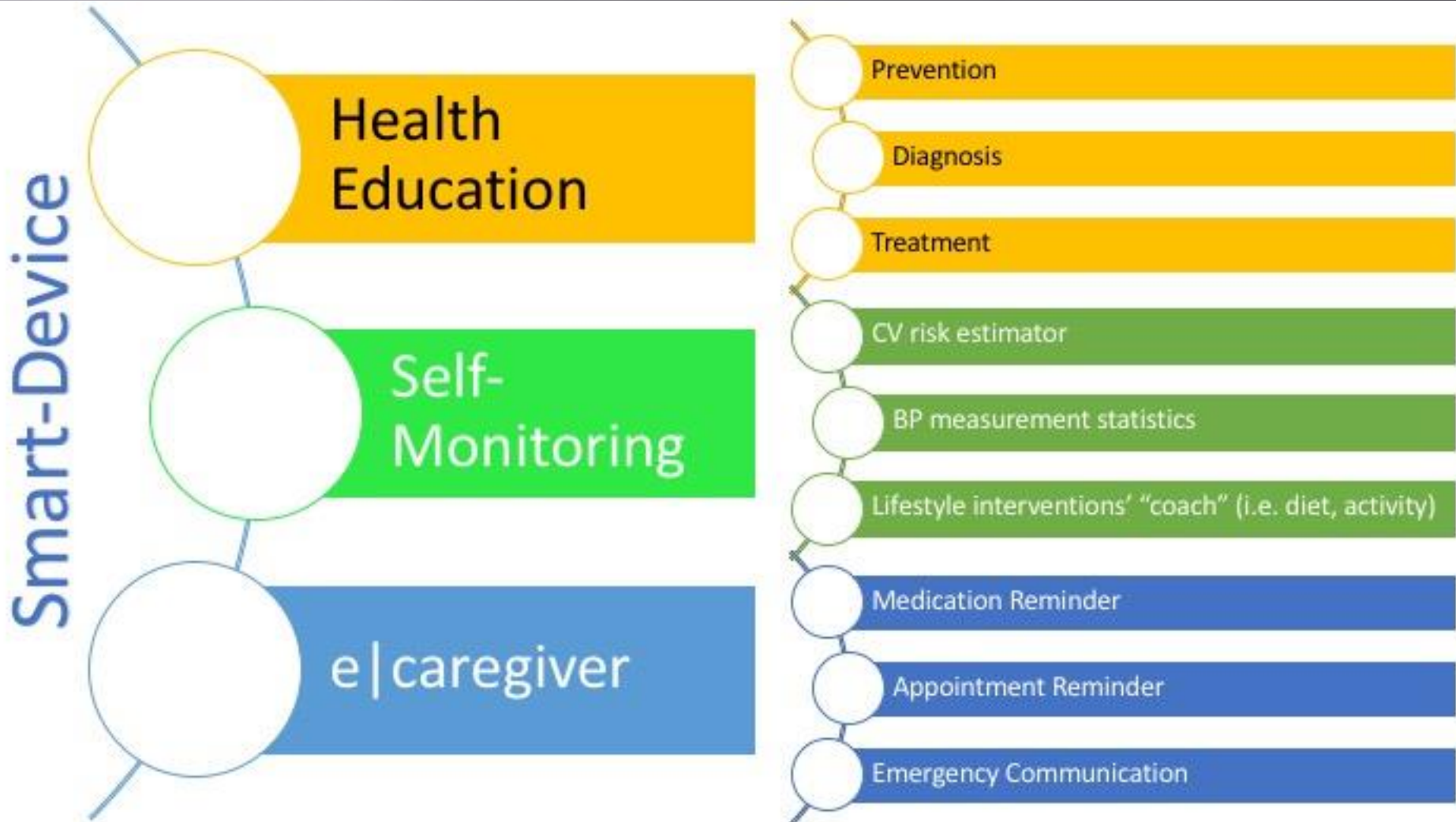
\*\*Although many wireless sensors have been validated and FDA approved for clinical use, measurements can vary as much as 20 mmHg from blood pressures derived using brachial cuff. When they are inaccurate, they tend to underestimate blood pressure particularly at the higher end of the scale (i.e., greater than 160 mmHg systolic)

# Digital Medicine and Arterial Hypertension (4)

While there is insufficient evidence to recommend cuffless devices to patients at present, **there are over 1000 clinical trials currently registered with [www.clinicaltrials.gov](http://www.clinicaltrials.gov)** to evaluate the feasibility, accuracy, and safety of various sensor technologies.

Not surprisingly, there are growing concerns that, if left unchecked, mHealth-based hypertension apps may be misleading to users providing false and potentially dangerous information

# Use of Smartphones in Arterial Hypertension Management



# ΣΑΚΧΑΡΩΔΗΣ ΔΙΑΒΗΤΗΣ

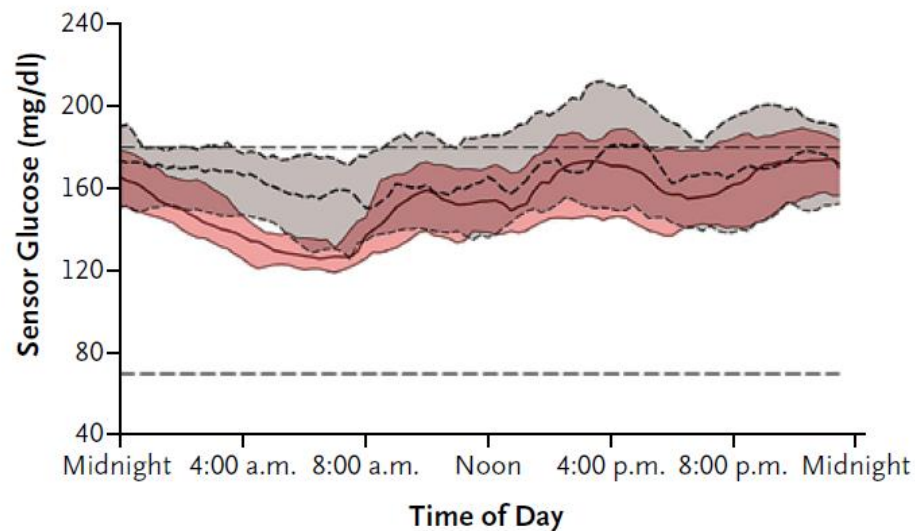
# Αντλία χορήγησης ινσουλίνης

- ▣ Συσκευή που χορηγεί συνεχώς ινσουλίνη υποδορίως
- ▣ Πολύ μικρές δόσεις βάσει ενός αποθηκευμένου πρότυπου ρυθμού έγχυσης (βασικός ρυθμός [basal rate])
- ▣ Μεγαλύτερες δόσεις ινσουλίνης σε διάστημα λίγων λεπτών (δόσεις εφόδου [bolus doses]), για τη διόρθωση τυχόν υπεργλυκαιμιών (διορθωτικές δόσεις) ή την προληπτική αντιμετώπιση της μεταγευματικής υπεργλυκαιμίας

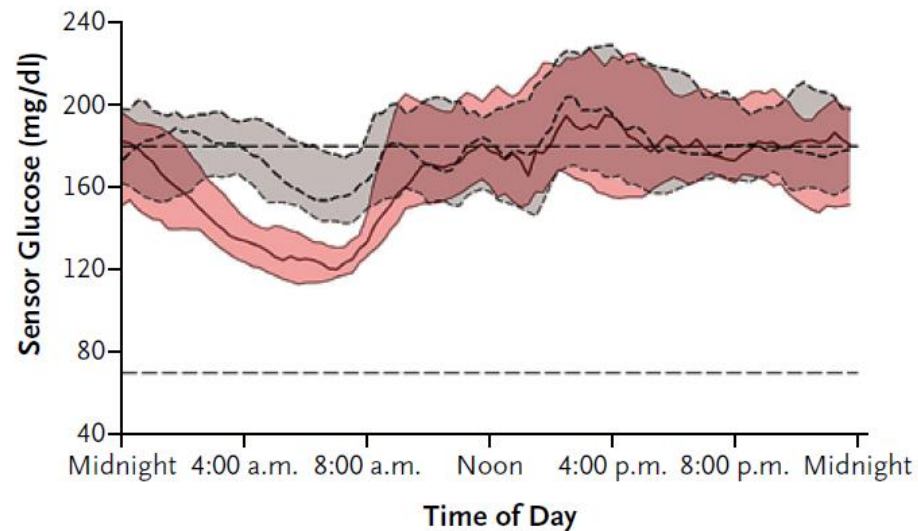




### A Adults



### B Children and Adolescents



#### End Point

#### Adults

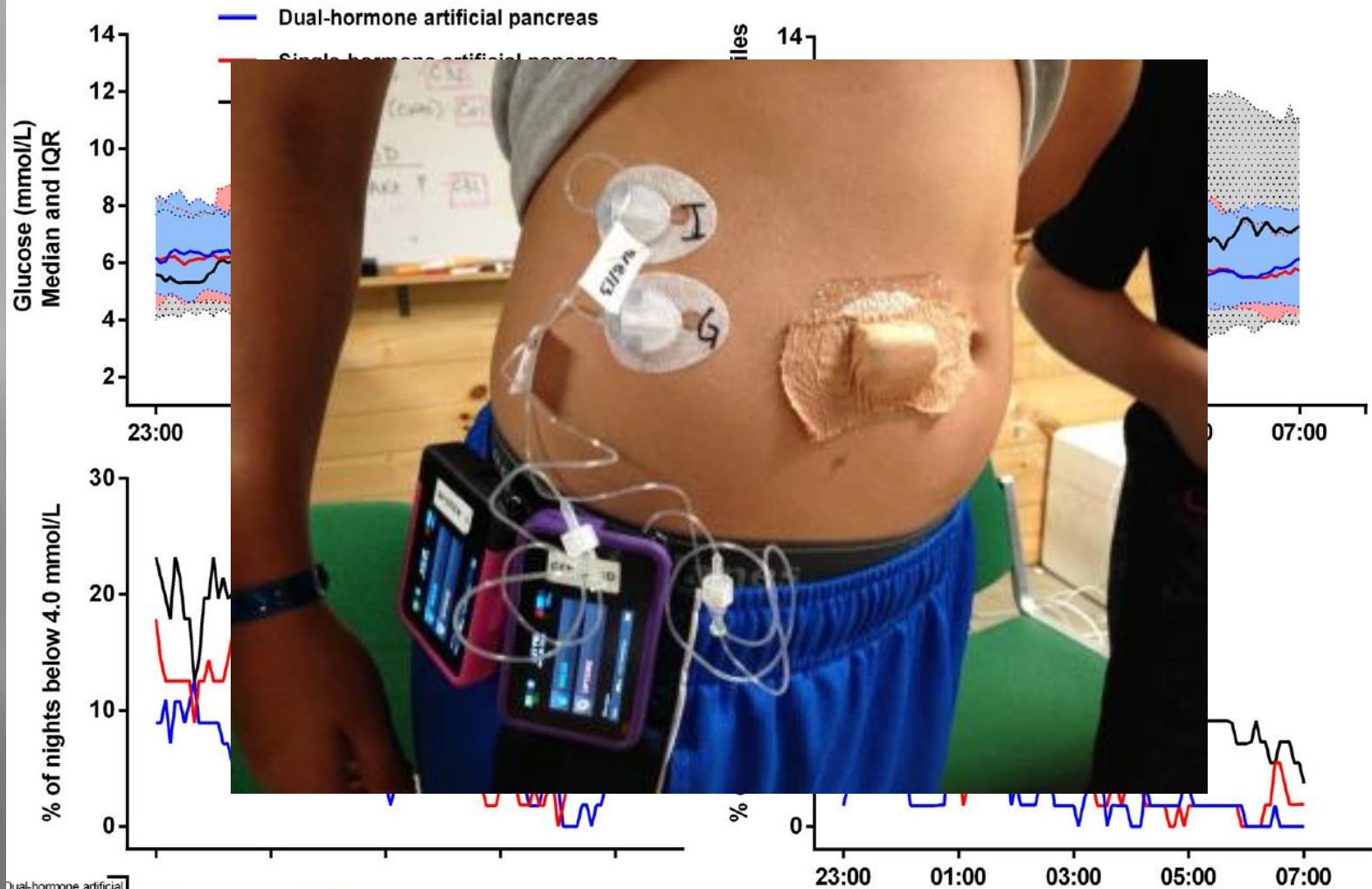
#### Nighttime

Percent of time with glucose level in range

	Closed-Loop Period (N=32)	Control Period (N=33)	Paired Difference or Paired Ratio (95% CI)†	P Value
70 to 145 mg/dl¶	59.1±9.5	39.4±13.3	19.4 (15.5 to 23.3)	<0.001
>145 mg/dl	38.0±9.4	55.6±15.8	-17.1 (-21.4 to -12.8)	<0.001
<70 mg/dl — median (interquartile range)	2.4 (1.1 to 3.7)	4.0 (1.8 to 5.8)	0.59 (0.44 to 0.78)	0.001
<50 mg/dl — median (interquartile range)	0.3 (0.1 to 0.6)	0.4 (0.2 to 1.2)	0.46 (0.28 to 0.76)	0.004

# Κλειστό κύκλωμα με μία vs. Κλειστό κύκλωμα με δύο ορμόνες

*J Clin Endocrinol Metab* 101: 214–223, 2016



# Smart Socks



Λειτουργεί με ανιχνευτές θερμοκρασίας ποδιού.



Η εφαρμογή εντοπίζει τα σημεία υψηλού κινδύνου για φλεγμονή.



Προλαμβάνει τα έλκη και τους ακρωτηριασμούς.

ΑΣΚΗΣΗ



# Current State of Commercial Wearable Technology in Physical Activity Monitoring

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Number of articles found in the original search and after assessment for relevance to wearable technology, validity, accuracy, and reliability.

Device	Articles found	Pertinent articles
Fitbit	41	24
Garmin	11	11
Apple	106	9
Misfit	68	5
Samsung Gear	2	2
TomTom	4	2
Lumo	0	0

# Wearable devices in sports medicine

Wearable Device	Functional Mechanism
<b>Movement sensors</b>	
Pedometer	“Step” recorded each instance the vertical acceleration of a spring-loaded lever arm exceeds the force sensitivity threshold
Accelerometer/gyroscope	Acceleration causes deflection of a seismic mass between 2 electrodes, causing a change in capacitance
GPS	Signal transmissions from multiple orbiting satellites are acquired by a ground-based receiver; the relative delay is used to calculate the speed and position of the receiver
<b>Physiologic sensors</b>	
Heart rate monitor	<ol style="list-style-type: none"><li>1. Electrical activity from the heart recorded by electrodes in a chest strap</li><li>2. Peripheral pulse detected by optical-sensing technology in a wristband</li></ol>
Temperature monitor	<ol style="list-style-type: none"><li>1. Ingestible capsule transmits readings to external data log system</li><li>2. Armband measures skin convective heat flux in temperature</li></ol>
Integrated sensors	Multimodal platforms that incorporate components of movement and physiologic sensors

GPS, global positioning satellite.

# Blood Pressure Monitor

Measures blood pressure, Heart Rate



It communicates with Smartphone via Bluetooth



# Cardiorespiratory monitoring technology

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Measures: HR, ECG data, blood oxygen, respiration rate, skin temperature



*A useful device for monitoring irregular heart rhythm...*



# Exercise tracking watches

Measures: RHR, HR, recovery time,  $V_{O_2}$  max, movement, sleep



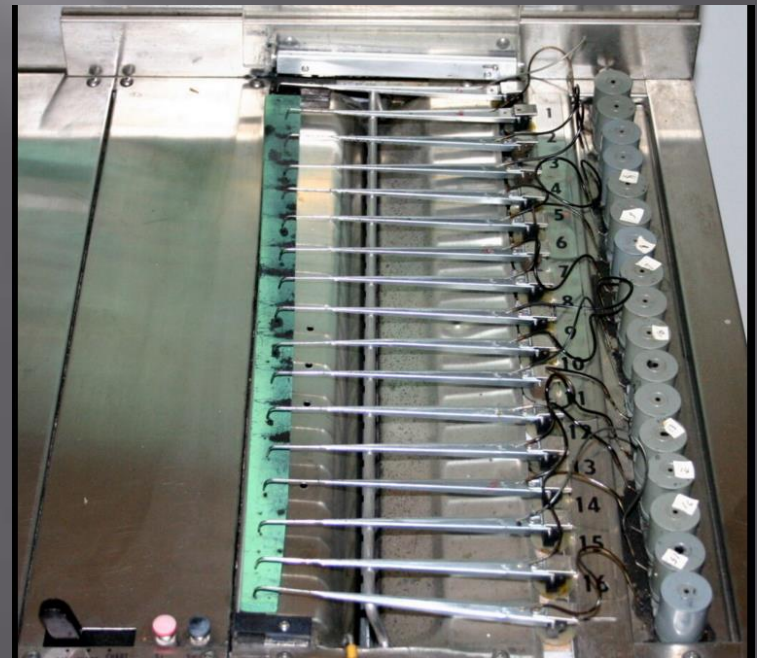
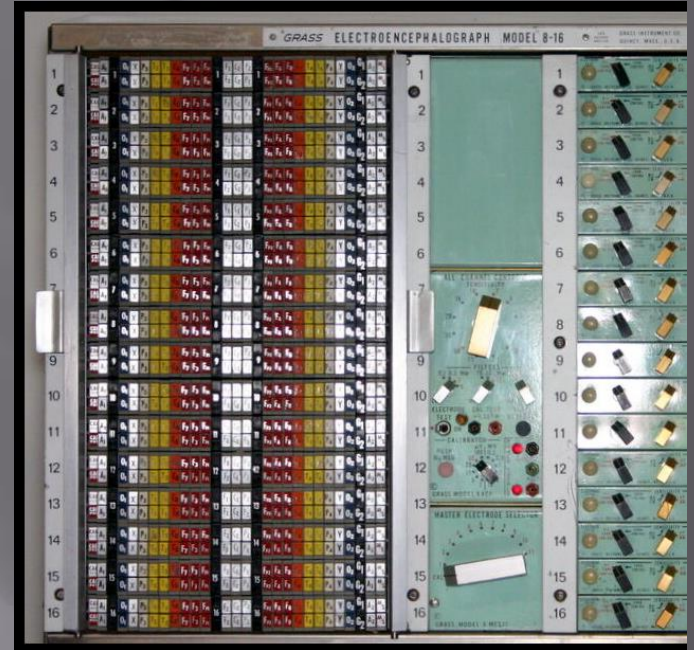
Measures: RHR, HR, movement, sleep



Connects to smartphone app

# ΔΙΑΤΑΡΑΧΕΣ ΥΠΝΟΥ

# Αναλογική συσκευή Grass





# Ψηφιακή συσκευή Grass



NCC MEDICAL PRODUCTS



Portable NOX A1





# ΙΑΤΡΙΚΗ ΑΚΡΙΒΕΙΑΣ

# Ιατρική Ακριβείας (Precision Medicine)

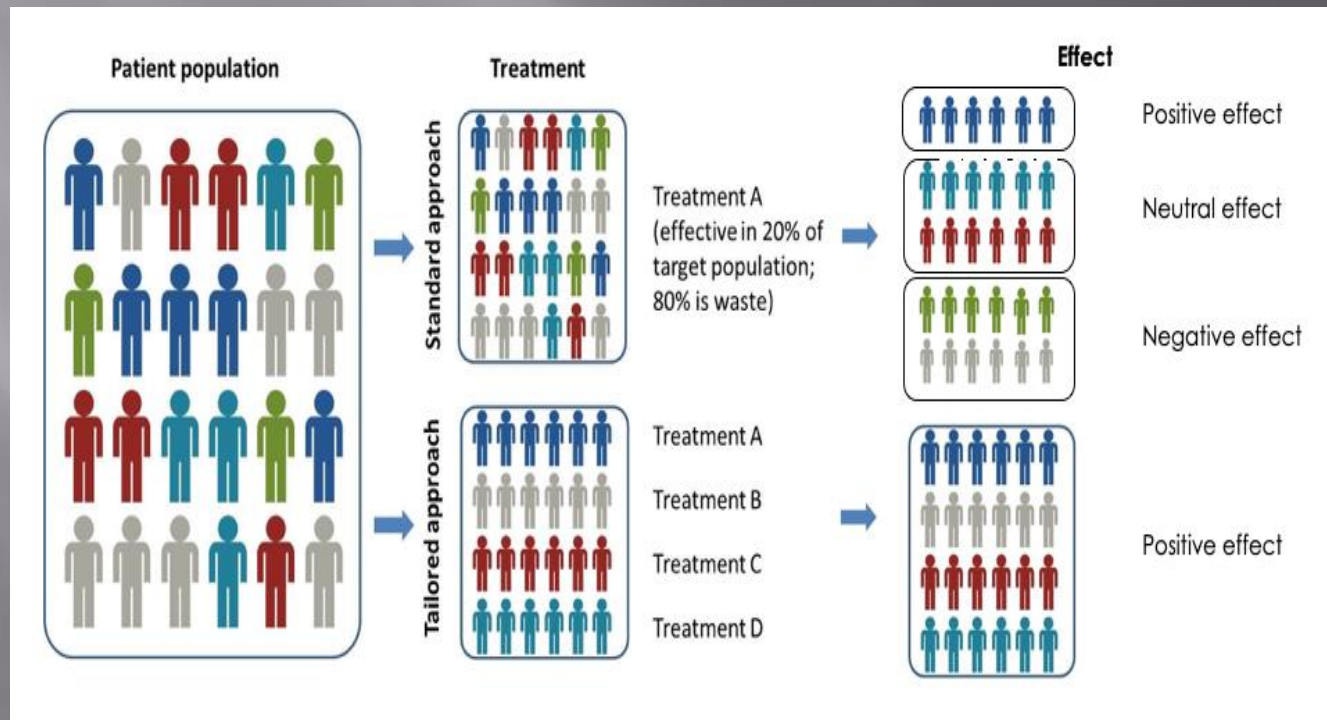
“Precision medicine is an emerging, transformational approach to disease treatment and prevention, focusing on identifying which strategy will be effective for which patients, based on genetic, environmental, and lifestyle factors. It integrates evidence from advanced data on myriad clinical samples with the individual genomics, e-record, imaging and other data-rich -omic parameters to enable discovery and tailored therapies.” – University of Edinburgh

“Precision medicine begins with the observation that individuals vary in their genetic makeup and that their diseases and responses to medications differ as a result. It then aims to find the right drug, for the right patient, at the right time, every time.” – Scientific American

# Απαραίτητα δεδομένα

- ▣ Διάφοροι τύποι δεδομένων
  - Genomics (Γονιδιωματικά)
  - Transcriptomics (Μεταγραφικά)
  - Proteomics (Προτεομικά)
  - Clinical (Κλινικά)

# Υποομάδες ασθενών – Ενδότευπτοι





ΕΚΠΑΙΔΕΥΣΗ



ΠΑΝΕΠΙΣΤΗΜΙΟ  
FREDERICK



Scientronics  
Better Diagnostics | Better Care | Better Life



## Σχεδιασμός Κέντρου Κλινικής Προσομοίωσης Υψηλής Πιστότητας στην Ιατρική Εκπαίδευση: Από το Α έως το Ω

Δημητρακόπουλος Ιωάννης <sup>RN, MSc</sup>

Σαρπέτσας Μάριος <sup>MEng, MSc</sup>



# ΑΜΕΤΡΗΤΕΣ ΔΥΝΑΤΟΤΗΤΕΣ ΓΙΑ ΤΗΝ ΔΗΜΙΟΥΡΓΙΑ ΚΛΙΝΙΚΩΝ ΣΕΝΑΡΙΩΝ



Ρεαλιστικά μάτια  
Κυάνωση  
Διασωλήνωση  
Οίδημα Γλώσσας  
Οίδημα Φάρυγγα  
Λαρυγγόσπασμος  
Χειρουργικός αεραγωγός  
Τραχειοστομία  
Αισθητήρας EtCO<sub>2</sub>  
Αυθόρμητη αναπνοή  
Εκπτυσσόμενος θώρακας  
Αναπνευστικοί Ήχοι  
Καρδιακοί Ήχοι  
Ψηλαφητοί Παλμοί  
Έντερικοί Ήχοι  
Επιληπτικές Κρίσεις  
Αναπαραγωγή φωνής

Συμβατότητα με Πραγματικό  
Αναπνευστήρα  
Παρακέντηση θώρακα  
Αισθητήρας ΑΠ  
Αισθητήρας Κορεσμού  
Οξυγόνου  
ΗΚΓ 12 απαγωγών  
Απινίδωση  
Βηματοδότηση  
Φλεβοκέντηση  
Χορήγηση φαρμάκων IV / IM  
Ένδομυϊκή Προσπέλαση  
Αναγνώριση φαρμάκων  
Διάταση Στομάχου  
Καθετηριασμός U/C  
Trauma Care  
Wireless and tetherless

# Οι 3 άξονες της ψηφιακής τεχνολογίας που αλλάζουν την κλινική έρευνα...



ΗΜΕΡΙΔΑ ΕΛΛΗΝΙΚΗΣ ΕΤΑΙΡΕΙΑΣ  
ΨΗΦΙΑΚΗΣ ΙΑΤΡΙΚΗΣ ΦΑΡΜΑΚΕΥΤΙΚΗΣ  
LILLY, Αθήνα  
Φεβρουάριος 2019

Source: <https://www.pharma-iq.com/clinical/articles/digital-clinical-trials>, <http://www.pharmatimes.com/magazine/2016/october/the-clinical-trial-of-the-future>

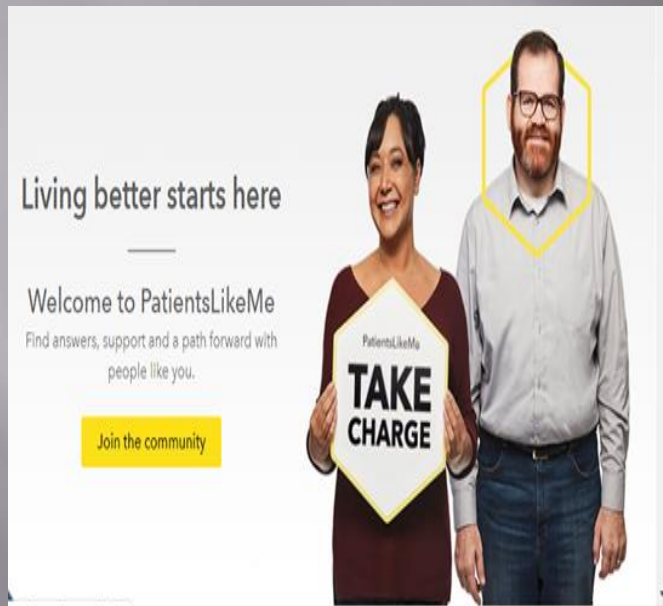


# Medication Adherence

- ▣ Proteus “Smart Pills”
  - Microchipped medication tablets that track patient adherence with a smartphone app
  - Can also detect information about the body’s response to the medicine



# PatientsLikeMe



Living better starts here

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Welcome to PatientsLikeMe  
Find answers, support and a path forward with  
people like you.

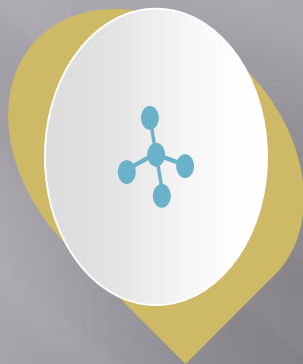
[Join the community](#)

PatientsLikeMe  
**TAKE  
CHARGE**

The banner features a woman on the left and a man on the right. The man is outlined with a yellow hexagon, and the woman is holding a white hexagonal sign with the text 'PatientsLikeMe TAKE CHARGE'.

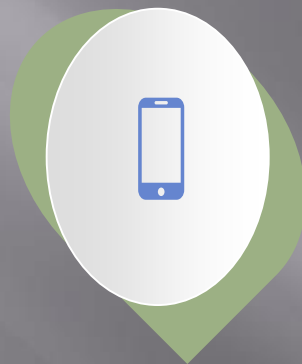
- Πλατφόρμα για ασθενείς με χρόνιες παθήσεις.
- Αξιοποίηση δεδομένων για καλύτερη κατανόηση των χρόνιων παθήσεων.
- Μοίρασμα των δεδομένων με εταιρείες.

# Επίπτωση στη σχέση Ασθενών - Ε.Υ

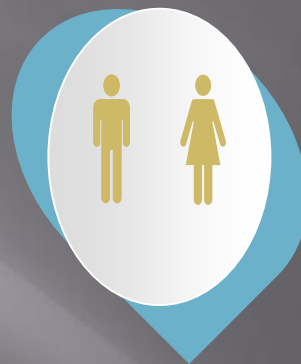


Μείωση επισκέψεων  
ρουτίνας

Αύξηση παρακολούθησης  
εξ' αποστάσεως



Μείωση κόστους  
ιατρικής φροντίδας



Ενδυνάμωση των  
ασθενών

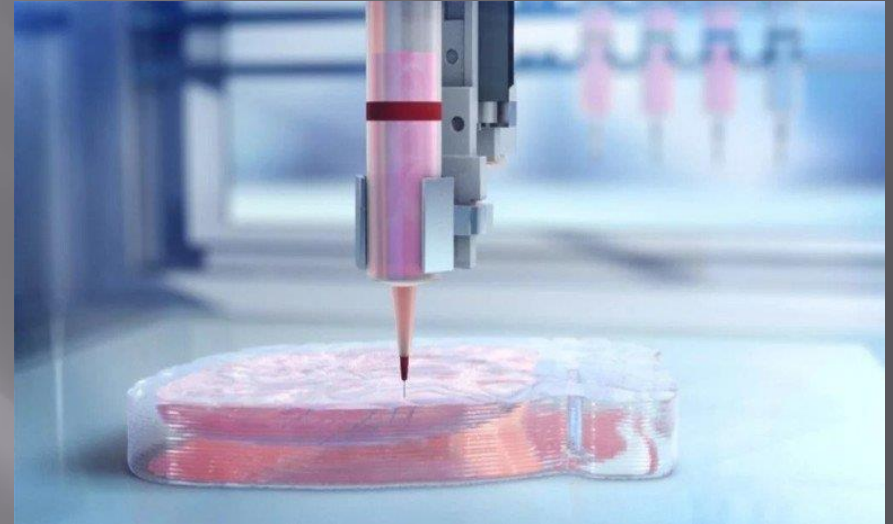


Εκπαίδευση Ε.Υ &  
ασθενών μέσω online  
courses

ΕΥΧΑΡΙΣΤΩ



# 3D Printing



# WIRELESS SENSORS

- ▣ Blood glucose
- ▣ Heart rhythm monitoring
- ▣ Vital signs
- ▣ Asthma attacks
- ▣ Sleep apnea
- ▣ Mood disorders

# GENOMICS

- ▣ Pharmacogenomics
- ▣ Personal consumer genomics
- ▣ Combining wireless sensors and genomics