FOCUS ON TECHNOLOGY

Τεχνολογία στον Σακχαρώδη διαβήτη
(αντλίες ινσουλίνης μετρητές σακχάρου)

Π.Γ.ΧΑΛΒΑΤΣΙΩΤΗΣ

Β΄ ΠΡΟΠΑΙΔΕΥΤΙΚΗ ΠΑΘΟΛΟΓΙΚΗ ΚΛΙΝΙΚΗ – ΜΟΝΑΔΑ ΕΡΕΥΝΑΣ
& ΔΙΑΒΗΤΟΛΟΓΙΚΟ ΚΕΝΤΡΟ ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΑΘΗΝΩΝ
ΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΓΕΝ.ΝΟΣΟΚΟΜΕΙΟ "ΑΤΤΙΚΟΝ"

Δεν υπάρχει σύγκρουση συμφερόντων

ICE AGE & DIABETES

- **Υψηλή κατανομή ΣΔ1 βόρειες Χώρες**
- **Εξελικτική θεωρία διάσωσης (κρύο)**
- **Παγωμένο σταφύλι & γλυκό κρασί**
- **Canadian Freezing frog (αφυδάτωση,ΣΔ)**
- **Υπεργλυκαιμία, φαιό λίπος, θερμότητα**

The sweet thing about Type 1 diabetes: a cryoprotective evolutionary adaptation
Moalem S et al, Med Hypotheses. 2005;65(1):8-16.

ΡΥΘΜΙΣΗ ΔΙΑΒΗΤΙΚΟΥ ΣΥΝΔΡΟΜΟΥ

ΑΥΤΟΜΕΤΡΗΣΗ ΕΠΙΠΕΔΩΝ ΓΛΥΚΟΖΗΣ

ΑΥΤΟΜΕΤΡΗΣΗ ΣΑΚΧΑΡΟΥ

- **έγινε δυνατή το 1962 και η τεχνολογία οδήγησε στους πλήρως αυτοματοποιημένους «έξυπνους» μετρητές γλυκόζης**
- **Γνωρίζοντας τα επίπεδα σακχάρου του ο διαβητικός προσαρμόζει αναλόγως με την διατροφή του, την ένταση της άσκησης του αλλά και αντιδιαβητική του θεραπεία.**
- **Η αυτομέτρηση προσφέρει ποιότητα ζωής με την πρόληψη των απώτερων επιπλοκών του διαβήτη, αλλά και βραχυπρόθεσμα με την αποφυγή των οξέων επιπλοκών**

DIABETES CONTROL & COMPLICATION TRIAL (DCCT)

- **1441 τύπου 1 ΣΔ**
- **Εντατικοποιημένη –Συμβατική Ινσουλινοθεραπεία**
- **Θεραπευτικοί στόχοι αποδείχθηκαν με:**
  - **α) 4 αυτομετρήσεις ημερησίως**
  - **β) GHbA1c**
- **Παρακολούθηση για 6,5 έτη**

Συχνότητα αυτομετρήσεων σε τύπου 1 διαβητικούς?
Minder et al

- Κάθε μέτρηση υπολογίσθηκε ότι επέφερε μια μείωση της HbA1c κατά - 0.19%

(95% confidence interval (CI) -0.42, 0.05)

Diabetes Res Clin Pract. 2013. pii: S0168-8227(12)00522-0. doi: 10.1016/j.

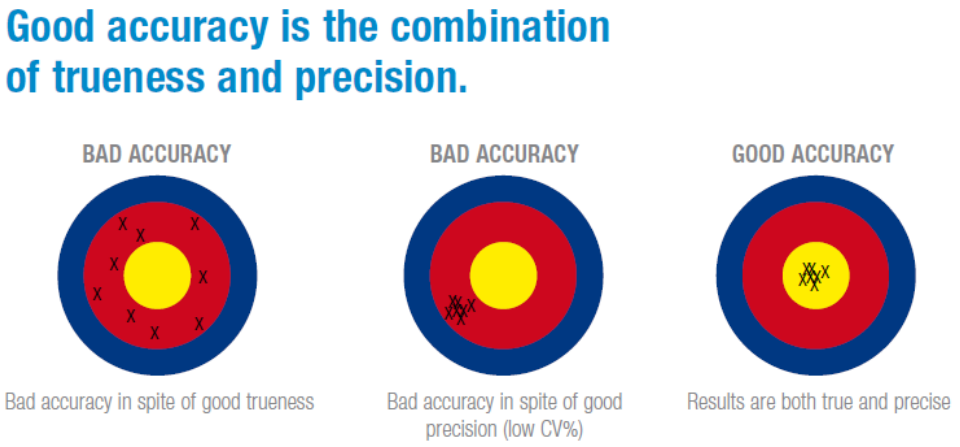
Recommendations: Glucose Monitoring (1)

- Patients on multiple-dose insulin (MDI) or insulin pump therapy should do SMBG **B**
  - Prior to meals and snacks
  - Occasionally postprandially
  - At bedtime
  - Prior to exercise
  - When they suspect low blood glucose
  - After treating low blood glucose until they are normoglycemic
  - Prior to critical tasks such as driving

ADA. V. Diabetes Care. Diabetes Care 2014;37(suppl 1):S21

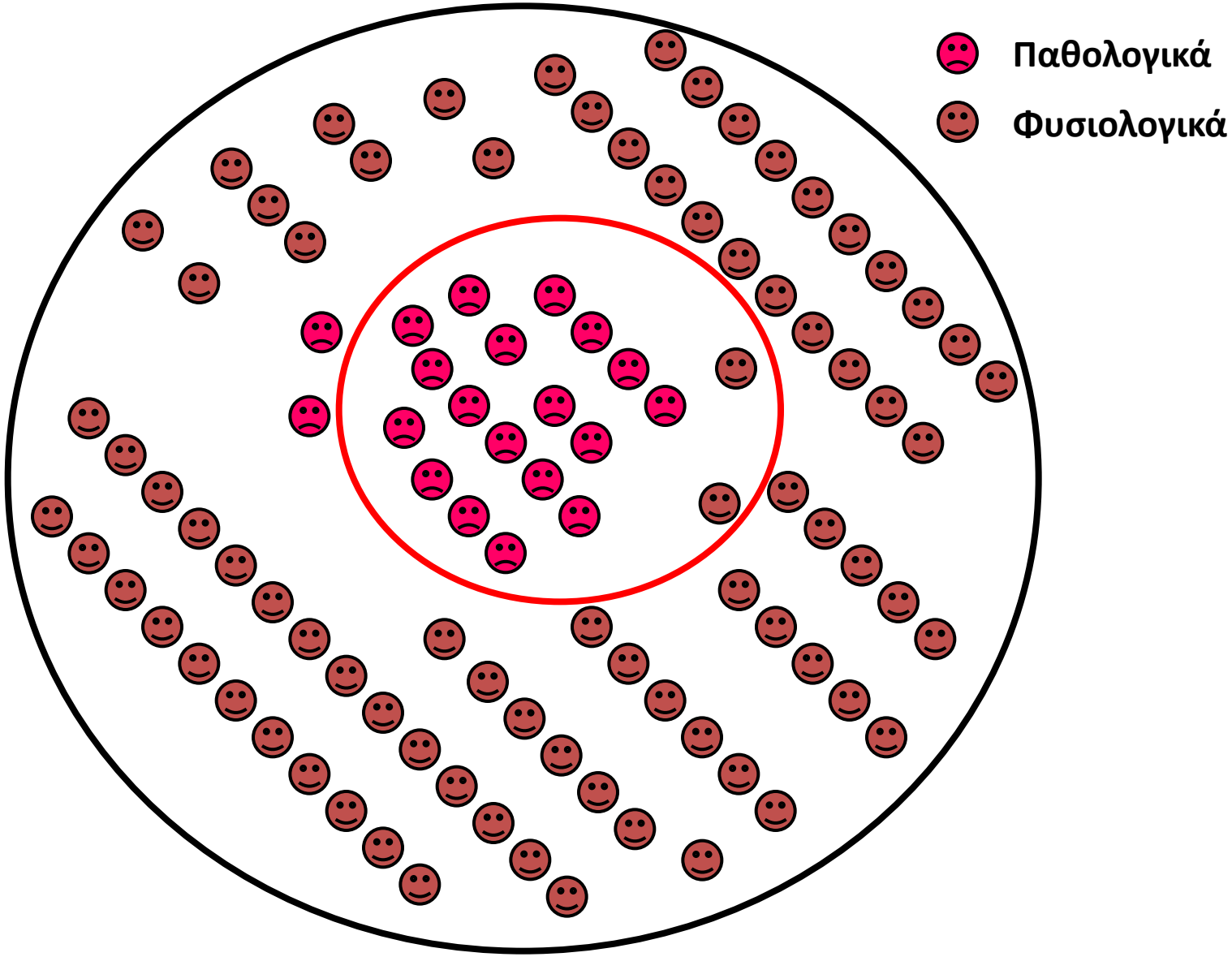
International Organization for Standardizations (ISO)

- **Προαπαιτούμενο εμφάνισης στην αγορά οιασδήποτε φορητής συσκευής αυτομετρήσεως η οδηγία 15197**
- **Το 2013 νέα αναθεωρημένη έκδοση η οποία από τον Απρίλιο του 2016 θα είναι πλήρως δεσμευτική**
- **Οι πιο αυστηρές σχετικές αναθεωρήσεις των τεχνικών αναλυτικών προδιαγραφών επιβλήθηκαν για την <u>διόρθωση προβλημάτων</u> σχετιζομένων με την <u>ευαισθησία</u> και την <u>ειδικότητα</u> των μετρήσεων**



ΕΥΑΙΣΘΗΣΙΑ -ΕΙΔΙΚΟΤΗΤΑ

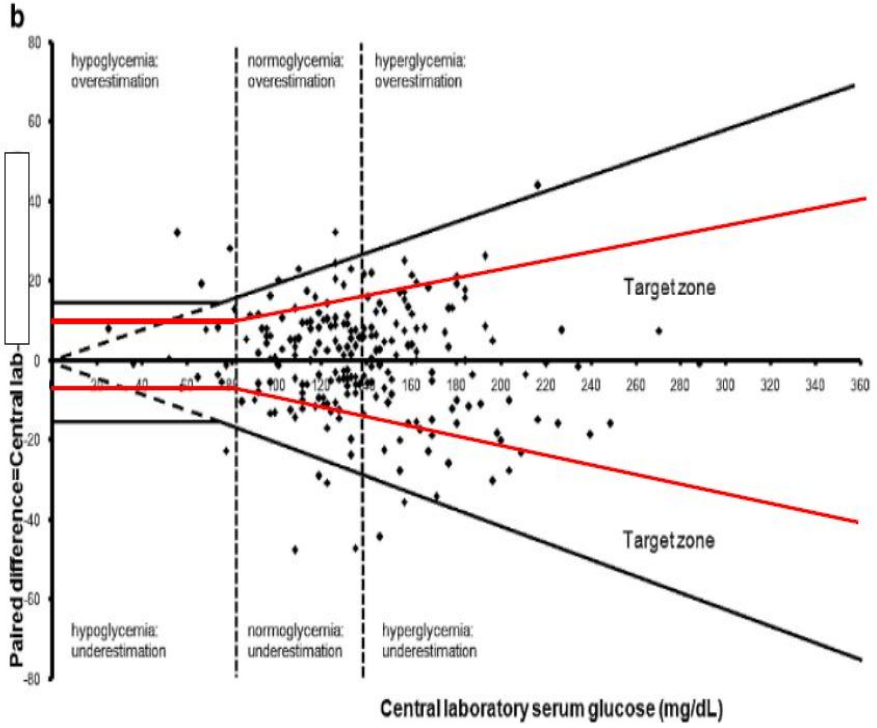
Αληθή θετικά & Ψευδώς αρνητικά



International Organization for Standardizations (ISO)

οι νέες οδηγίες ISO απαιτούν για τιμές αίματος κάτω των 75 mg/dl, οι 99 (95) επαναλαμβανόμενες μετρήσεις μιας συσκευής να κυμαίνονται ± 15 mg/dl.

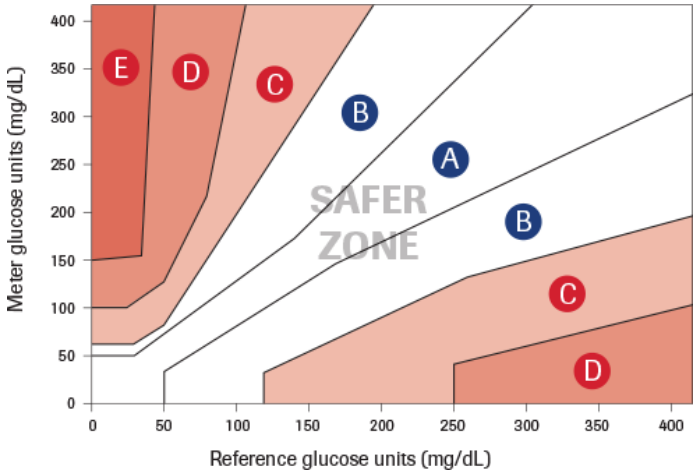
Άρα μια πραγματική τιμή γλυκόζης αίματος των 70 mg/dl απαιτείται για να είναι ένας μετρητής αξιολογήσιμος να δίνει τιμές στο εύρος 55-85 mg/dl.



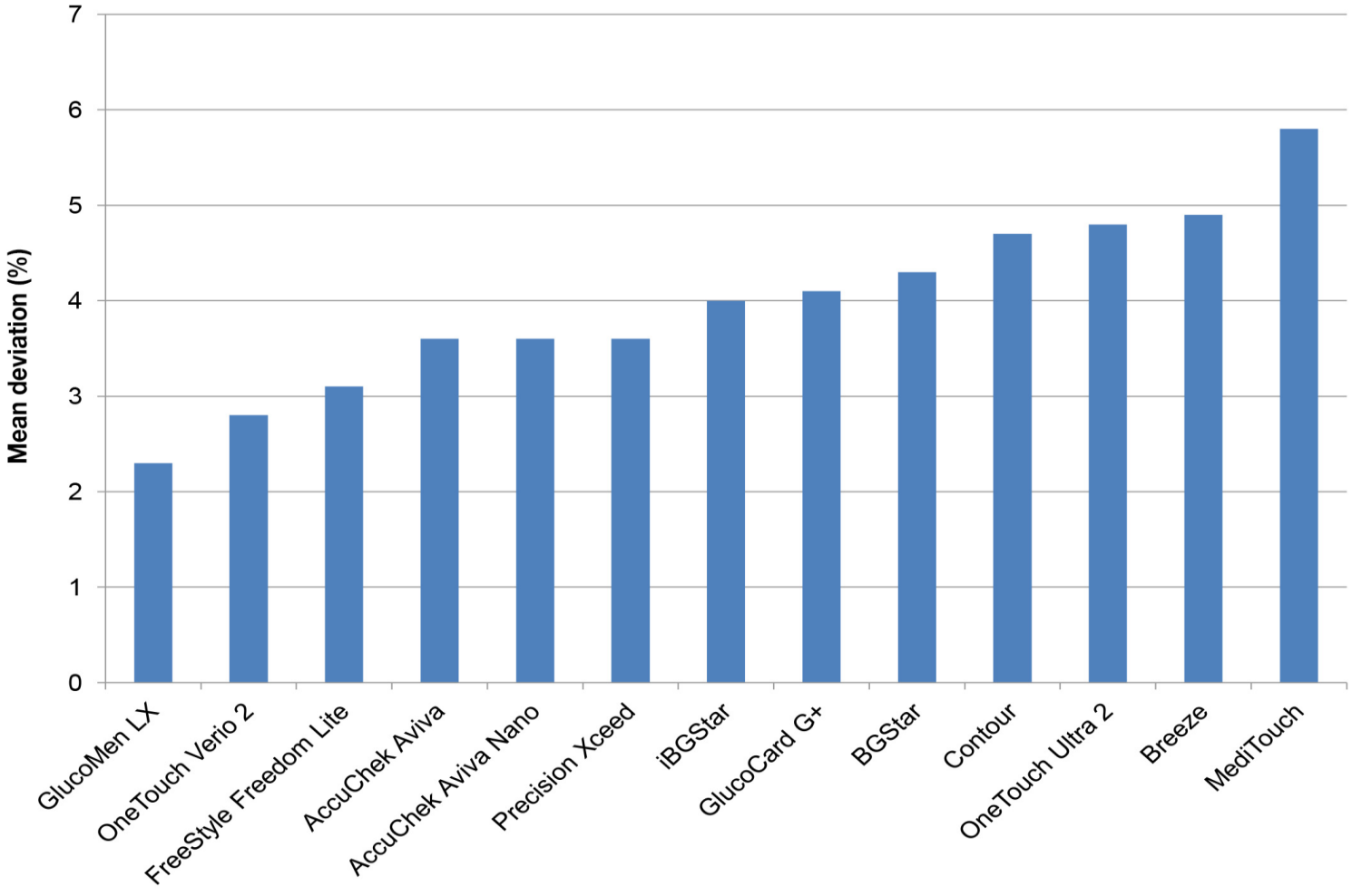
International Organization for Standardizations (ISO)

Αντίστοιχα για τις μετρήσεις πάνω από τα 75 mg/dl, οι 99 επαναλαμβανόμενες μετρήσεις μιας συσκευής θα πρέπει να βρίσκονται σε ένα εύρος τιμών του ± 15 % (20) της πραγματικής

Επομένως για το επίπεδο γλυκόζης 180 mg/dl του εργαστηρίου αναφοράς ο υπό αξιολόγηση μετρητής θα πρέπει να δώσει τιμές από 153 έως 207 mg/dl.



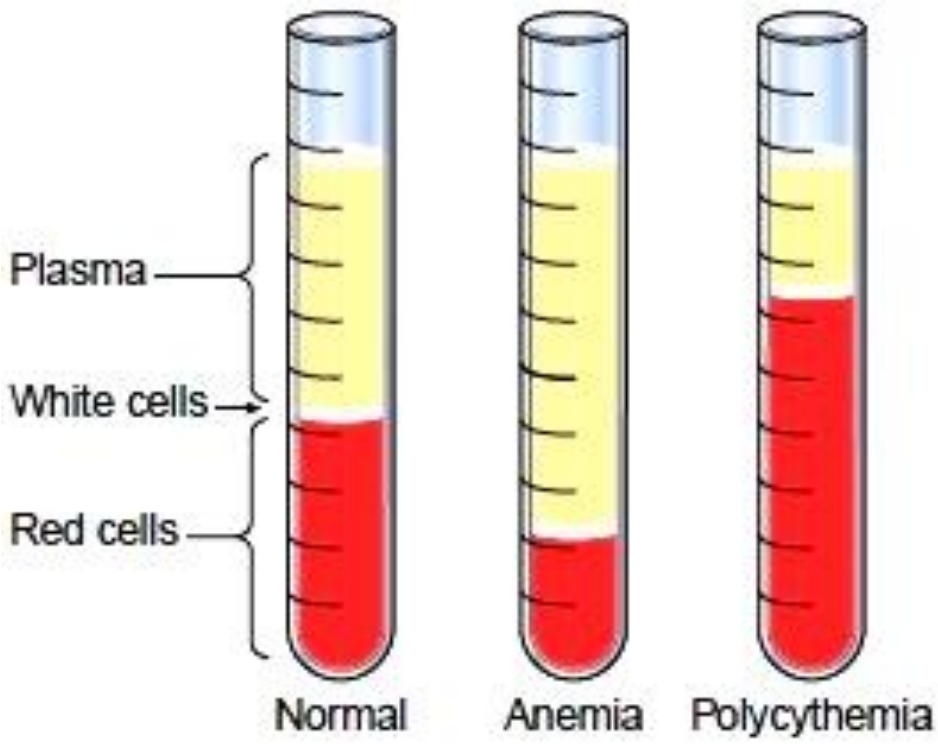
ΜΕΣΗ ΑΠΟΚΛΙΣΗ
ΑΠΟ ΤΟ ΕΡΓΑΣΤΗΡΙΟ ΑΝΑΦΟΡΑΣ



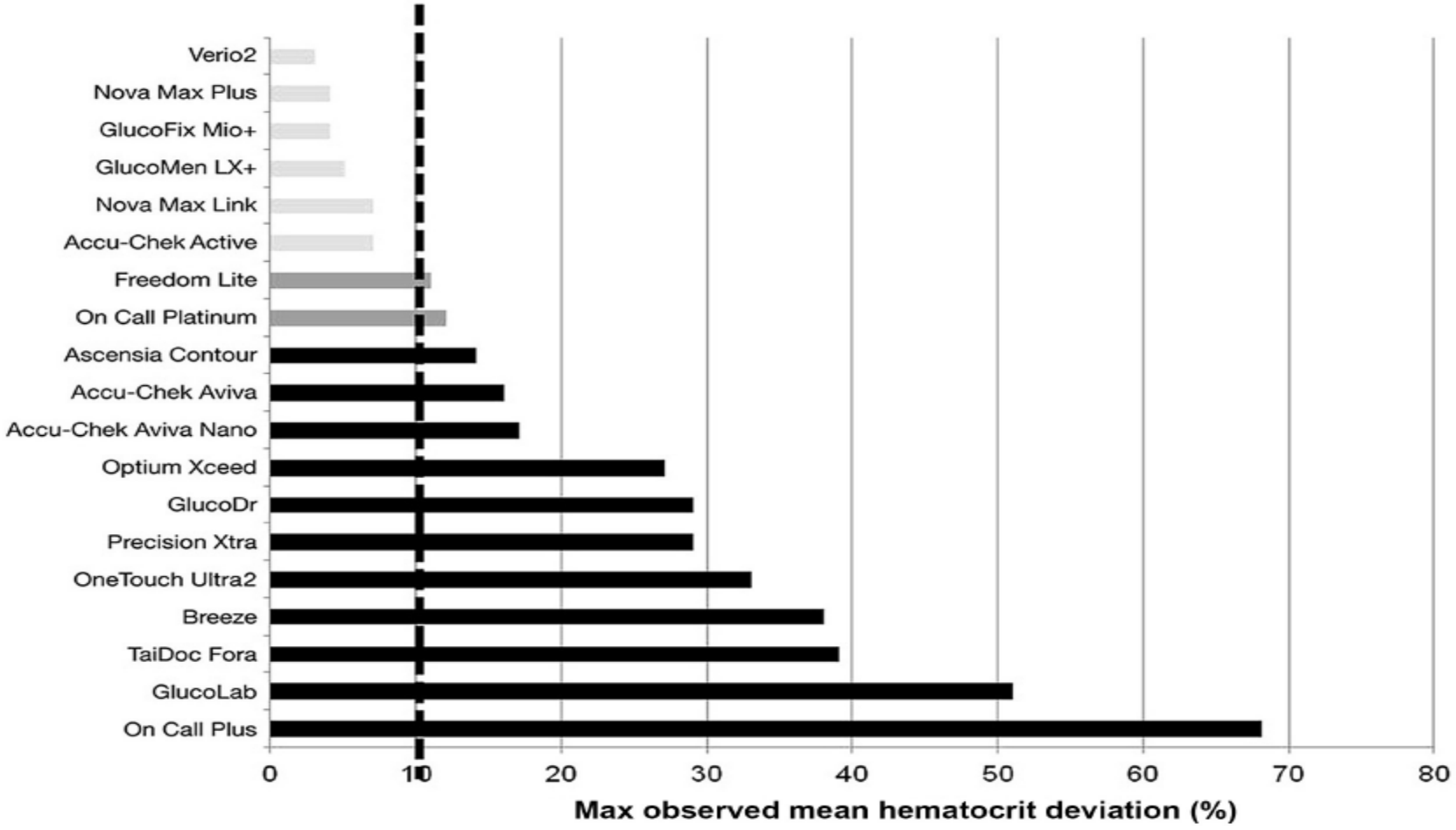
J Diab Sci Tech , Issue 1, Jan 2013

International Organization for Standardizations (ISO)

Τέλος η αξιολόγηση της επίδρασης του Ht με έλεγχο σε ένα ελάχιστο 5 επιπέδων Ht για 3 διαφορετικές συγκεντρώσεις γλυκόζης.



HAEMATOCRIT INTEFERENCE OF BLOOD GLUCOSE METERS



J Diab Sci Technol 7(1): 179-89, 2013

Percentage of Blood Glucose Meter Results Meeting ISO 15197 Criteria for Altitude

ACCU-CHEK Aviva	**94.4 %**
Optium Xceed	**87.5 %**
OneTouch Ultra Easy	**80.5 %**
GlucoMen	**100 %**

Journal of Diabetes Science and Technology
Volume 6, Issue 4, July 2012

Emergency Hospitalizations for Adverse Drug Effects in Older Americans

365(21)2002-12, 24 Nov 2011

Table 4. National Estimates of Medications Commonly Implicated in Emergency Hospitalizations for Adverse Drug Events in Older U.S. Adults, 2007–2009.*

Medication	Annual National Estimate of Hospitalizations (N=99,628)		Proportion of Emergency Department Visits Resulting in Hospitalization
	no.	*% (95% CI)*	%
Most commonly implicated medications†			
Warfarin	33,171	33.3 (28.0–38.5)	46.2
Insulins	13,854	13.9 (9.8–18.0)	40.6
Oral antiplatelet agents	13,263‡	13.3 (7.5–19.1)	41.5
Oral hypoglycemic agents	10,656	10.7 (8.1–13.3)	51.8
Opioid analgesics	4,778	4.8 (3.5–6.1)	32.4
Antibiotics	4,205	4.2 (2.9–5.5)	18.3
Digoxin	3,465	3.5 (1.9–5.0)	80.5
Antineoplastic agents	3,329‡	3.3 (0.9–5.8)‡	51.5
Antiadrenergic agents	2,899	2.9 (2.1–3.7)	35.7
Renin–angiotensin inhibitors	2,870	2.9 (1.7–4.1)	32.6
Sedative or hypnotic agents	2,469	2.5 (1.6–3.3)	35.2
Anticonvulsants	1,653	1.7 (0.9–2.4)	40.0
Diuretics	1,071‡	1.1 (0.4–1.8)‡	42.4
High-risk or potentially inappropriate medications§			
HEDIS high-risk medications	1,207	1.2 (0.7–1.7)	20.7
Beers-criteria potentially inappropriate medications	6,607	6.6 (4.4–8.9)	42.0
Beers-criteria potentially inappropriate medications, excluding digoxin	3,170	3.2 (2.3–4.1)	27.6

ΝΟΣΗΛΕΙΑ ΛΟΓΩ ΥΠΟΓΛΥΚΑΙΜΙΑΣ ΣΤΟ «ΑΤΤΙΚΟ» 2007-2012 ΑΣΘΕΝΕΙΣ ΗΛΙΚΙΑΣ >65

- 158 (325)
- 49,1% νευρολογική σημειολογία
- 23,6% λοίμωξη
- 3,6% ΑΕΕ
- 3,6% ΚΡΔ
- 3,6% ΧΝΑ
- 5,5% ΟΓΚ
- ΧΑΠ-ΗΠΑΤΙΚΗ ΑΝ.

4 ΘΑΝΑΤΟΙ

This Precious Service Dog Learned How To Save His Diabetic Owner's Life

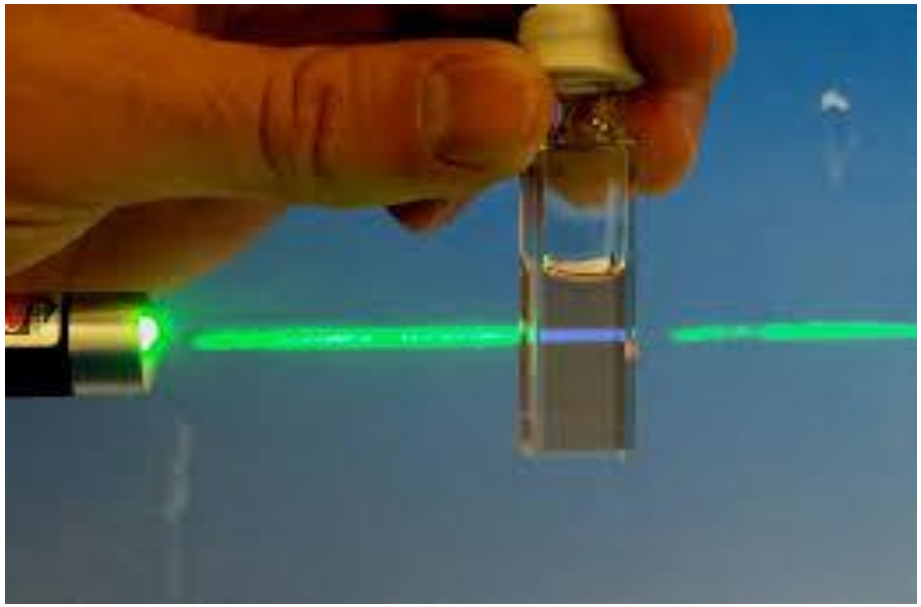
HuffPost Live
09/30/2015 05:23 PM EDT

- **Elle Shaheen diagnosed with DM1 when she was 8 with the constant fear that her blood sugar could reach dangerous levels**
- **But 5 y later, they adopted a dog named Coach who, after nearly 2,000 hours of training, can smell when blood sugar levels have risen or dropped, before the symptoms even hit**
- **He gets her attention by circling her body, licking her hand or jumping onto her lap**

ΥΠΟΓΛΥΚΑΙΜΙΑ

- **Η αυστηρή ρύθμιση μειώνει τον κίνδυνο εμφάνισης χρόνιων επιπλοκών και βελτιώνει τους δείκτες έκβασης μιας διαβητικής κύησης**
- **Ο κίνδυνος υπογλυκαιμίας αυξάνεται όταν είμαστε σε αυστηρή ρύθμιση**
- **Δυσεπίγνωστη υπογλυκαιμία**
- **Η βαρειά υπογλυκαιμία σχετίζεται με υψηλή θνητότητα (ΕΜ), νοσηρότητα (άνοια), κίνδυνος σε τρίτους (οδήγηση)**
- **Η αυτομέτρηση η τελευταία μας αντικειμενική βοήθεια**

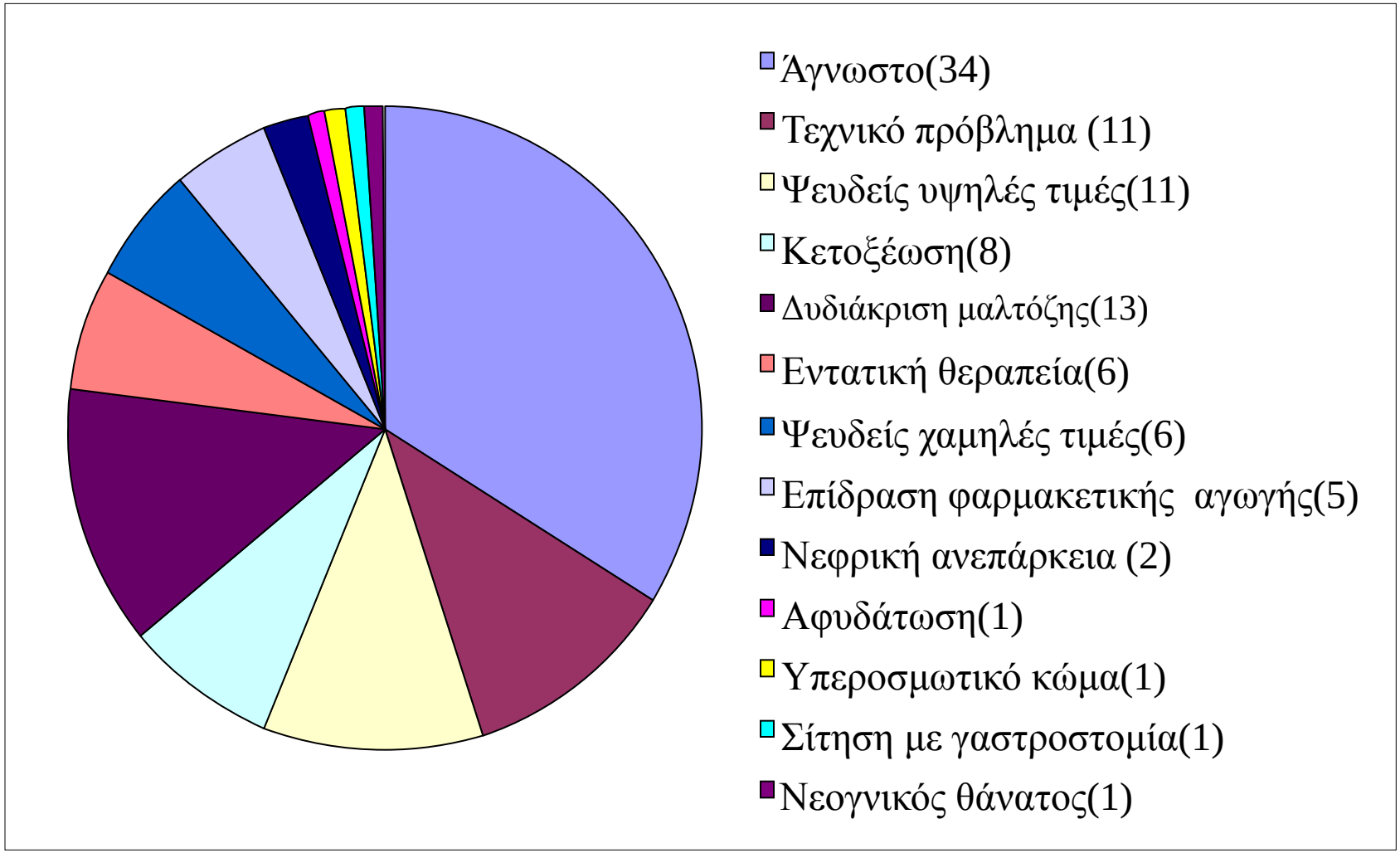
ΕΙΔΙΚΟΤΗΤΑ



- **Substances or Conditions**
  - Acetaminophen (therapeutic drug levels)
  - Ascorbic acid
  - Dopamine
  - Fluorescein IV
  - Mannitol
  - Salicylate
  - Therapeutic products with non-glucose sugars
    - maltose, galactose, and xylose
    - problem with glucose dehygrogenase pyrroloquinoline quinone (GDH-PQQ) test strips

Παρενέργειες - Θνητότητα

1992-2009: 100 θάνατοι σχετιζόμενοι με την αυτομέτρηση



Where are the problems?

ΠΡΟΒΛΗΜΑΤΑ ΣΧΕΤΙΖΟΜΕΝΑ ΜΕ ΤΟΝ ΑΣΘΕΝΗ

- **Αφυδάτωση**
- **Υπόταση**
- **Αλκοόλη τοπικά**
- **«Άπλυτα» χέρια**
- **Αιμοδιύλιση**
- **Αιμόλυση**
- **Οξέωση**
- **Βιολογικό δείγμα (φλεβικό, τριχοειδικό, αρτηριακό)**

ΠΡΟΒΛΗΜΑΤΑ ΣΧΕΤΙΖΟΜΕΝΑ ΜΕ ΤΟ ΠΕΡΙΒΑΛΛΟΝ

- Έκθεση των ταινιών σε μη προφυλαγμένους χώρους
- «Γενόσημες» ταινίες
- «Ηλικία» ταινιών
- Επαναχρησιμοποίηση ταινιών
- Υψόμετρο
- Ατμοσφαιρική υγρασία & θερμοκρασία

ΠΡΟΛΗΨΗ ΥΠΟΓΛΥΚΑΙΜΙΑΣ & ΕΞΟΙΚΟΝΟΜΗΣΗ ΠΟΡΩΝ

- **Τύπου 1 διαβητικοί** **390.000**
- **Ετήσιο κόστος αυτομέτρησης (x4)** **1164,2 €**
- **Διόρθωση λάθους αυτομέτρησης από 20% σε 5% μειώνει τις υπογλυκαιμίες κατά** **10%**

J Diabetes Sci Technol Vol 7, Issue 4, July 2013

ΠΡΟΛΗΨΗ ΥΠΟΓΛΥΚΑΙΜΙΑΣ & ΕΞΟΙΚΟΝΟΜΗΣΗ ΠΟΡΩΝ

Κόστος βαρειάς υπογλυκαιμίας

Ασθενοφόρο	**€ 520**
Νοσηλεία	**€2021**
Μέσο κόστος	**€1227**

Κόστος εμφράγματος

Οξύ	**€ 9767**
Παρακολούθηση (1 έτος)	**€ 4032**
Επιτυχής θεραπεία	**€13,799**

Clinical implications and economic impact of accuracy differences among commercially available blood glucose monitoring systems.

Budiman et al

- **Annual** difference of 296,000 severe **hypoglycemic** episodes from BG measurement errors for T1DM (105,000 for T2DM MDI) patients for the estimated U.S. population of 958,800 T1DM and 1,353,600 T2DM MDI patients, using **the least accurate BGM system** versus patients using the most accurate system in a U.S. health care system. This resulted in **additional direct costs** of approximately $339 million for T1DM and approximately $121 million for T2DM MDI patients per year.

J Diabetes Sci Technol. 2013 Mar 1;7(2):365-80.

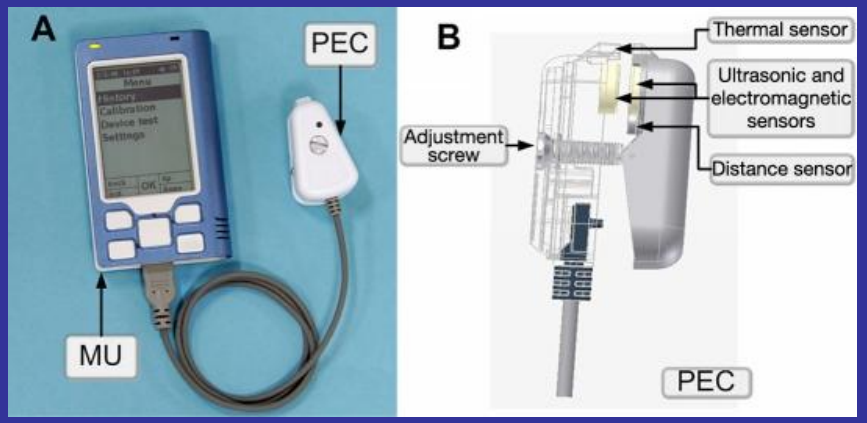
i-Health for iphones & smartphone

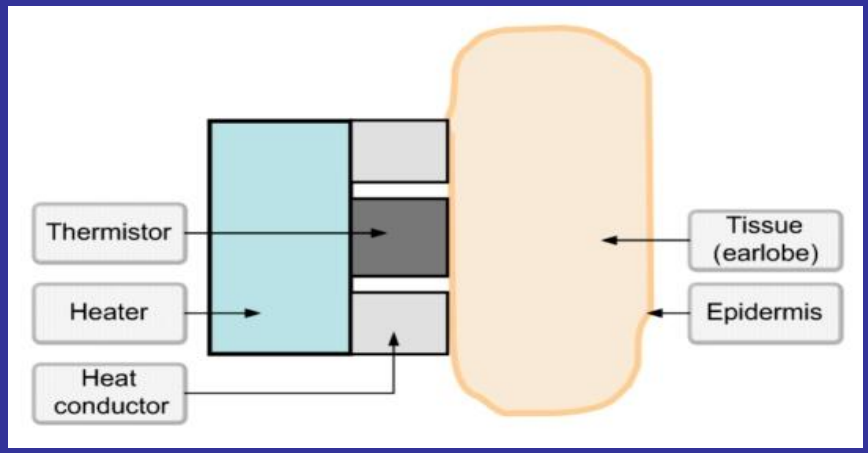
Bluetooth or WiFi, people worry, 'Did I really connect properly?'
With the hard connection, people think 'Wow, this is really that simple'."

iHealth Align will retail for $16.95, compared to the $29.95 price tag on the Wireless Smart Gluco-Monitoring System.

Non-Invasive techniques

- No blood or intestitial fluid glucose
- Electromagnetic, Thermal, Ultrasonic
- High accuracy

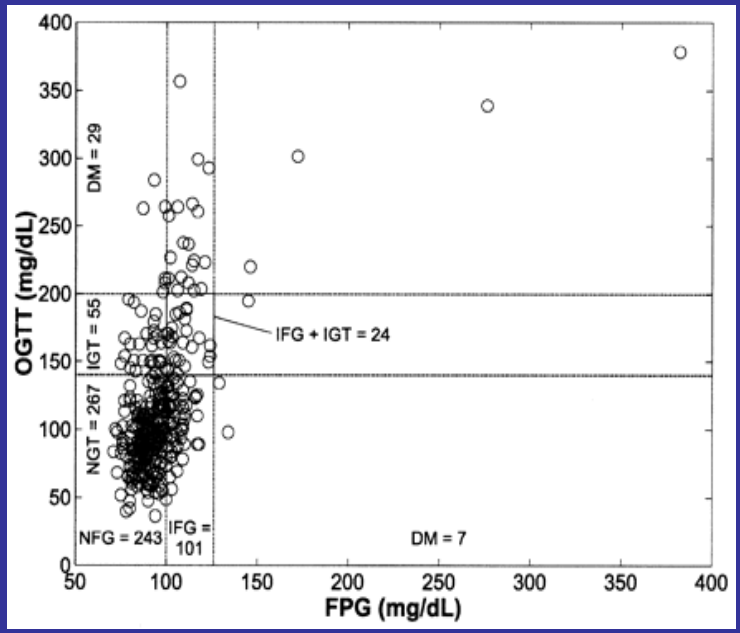




Harman-Boehm et al,
J Diabetes Sci Technol. 2010;4(3):583–595.

Noninvasive Diabetes Screening Tool

- forearm, within a min.
- fluorescence spectroscopy
- concentrations of AGEs



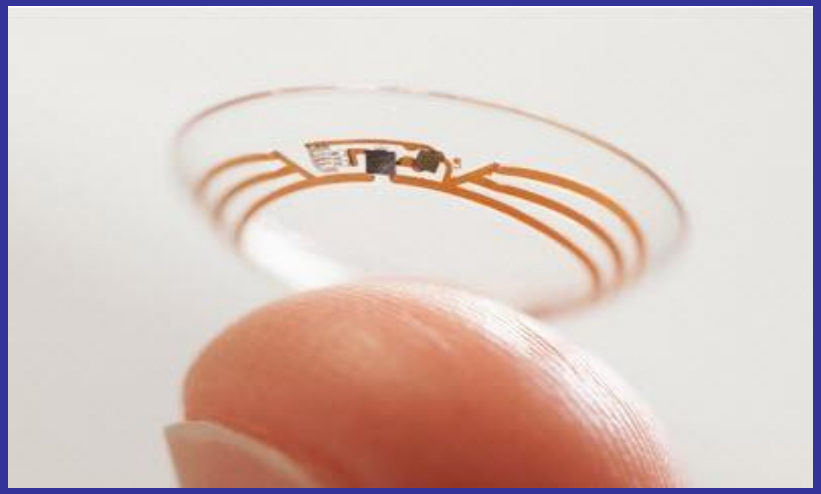
POTENTIAL DRAWBACKS

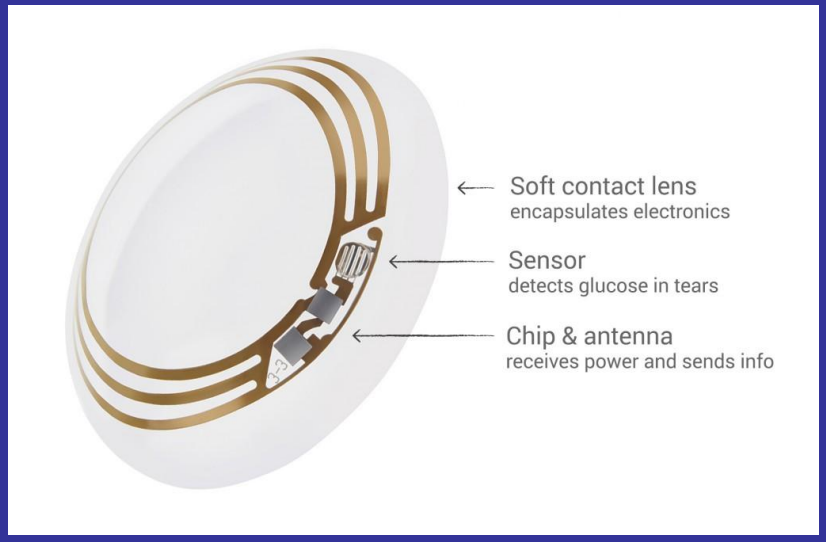
- darker skin pigmentation
- tattoos

American Diabetes Association.

DIABETES, OBESITY, CVD DOCNEWS

Google glucometer (Novartis)



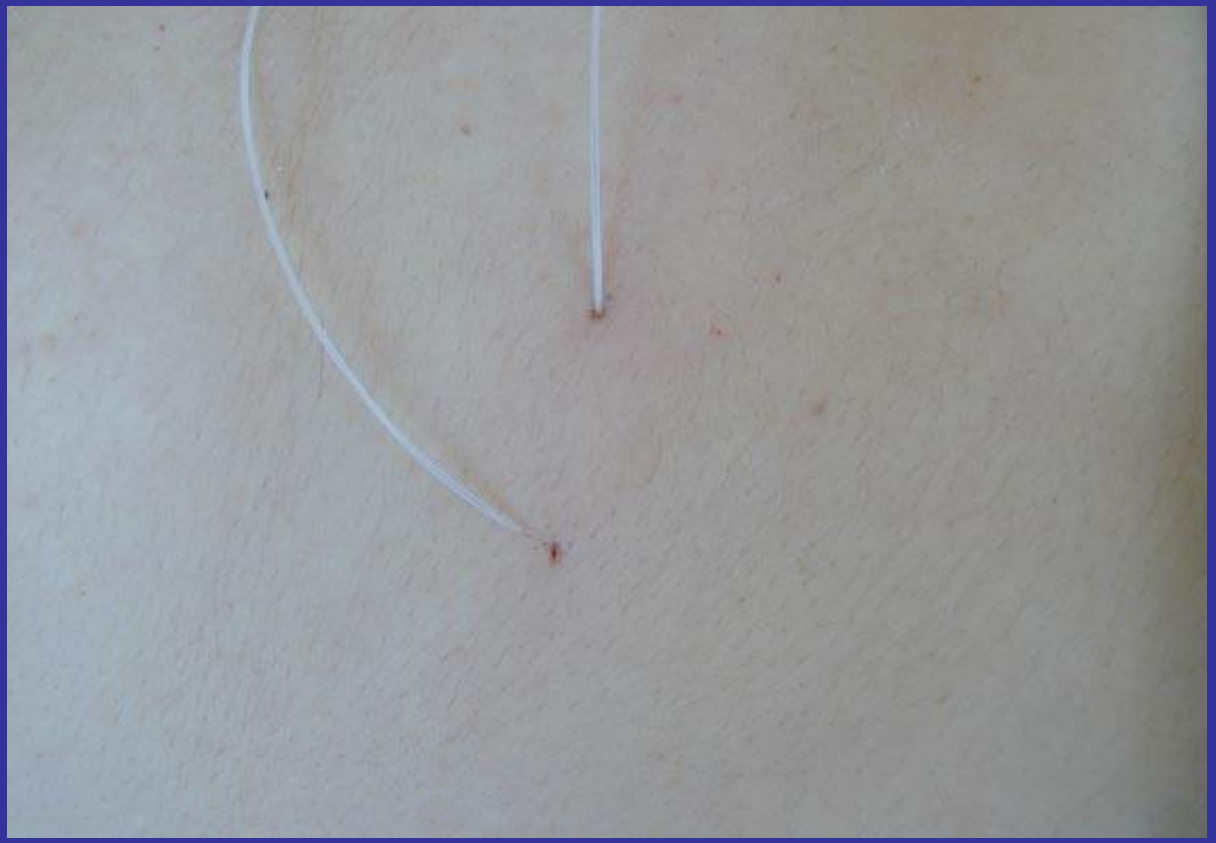


Cost Comparison

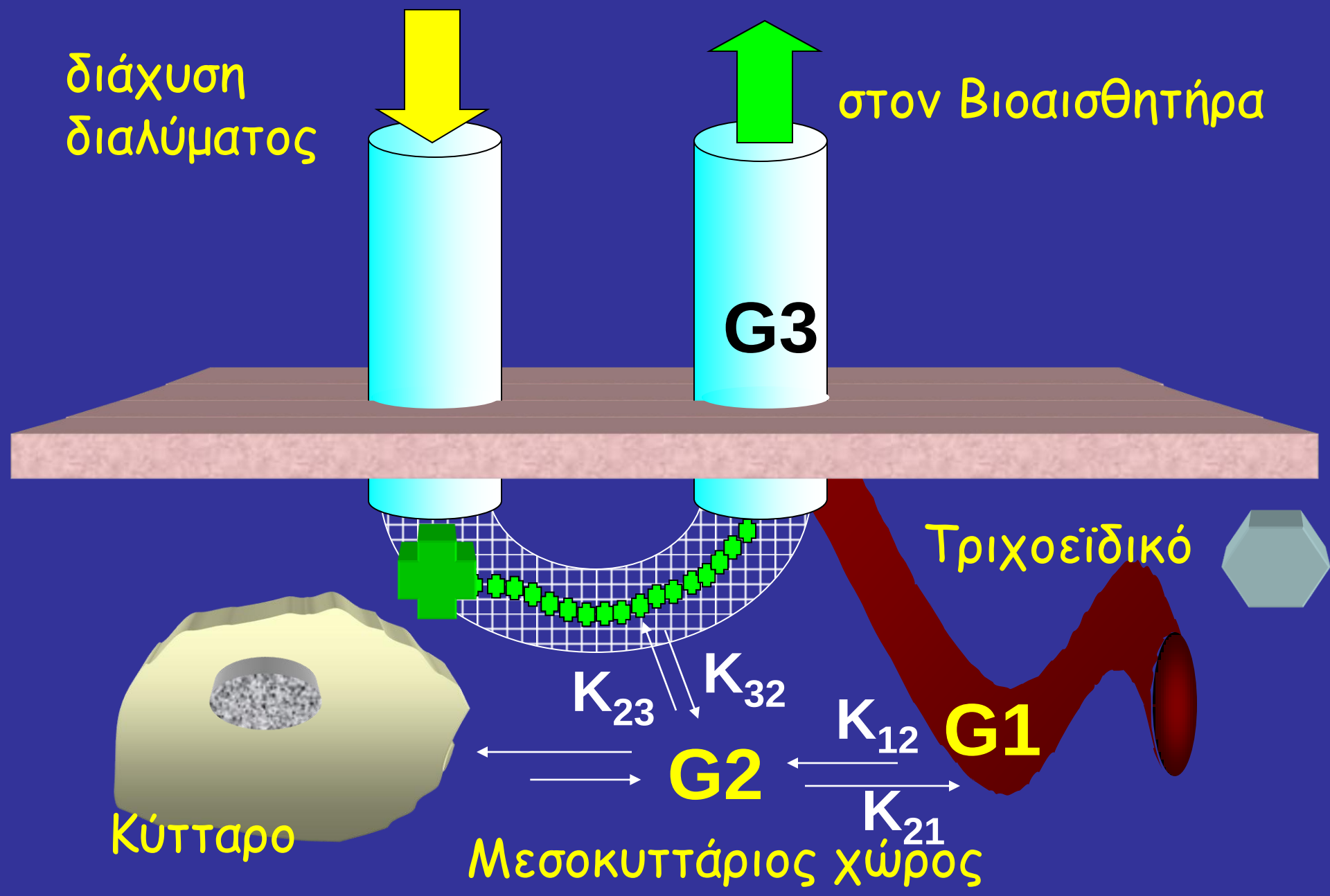
Contact Lens	GlucoWatch	Glucose meter	Continuous Glucose Monitoring – Medtronic Enlite	Google Smart lens
$40 (Monthly disposables)	Watch $140 Sensor pad $240 (monthly, $4 per pc)	Reader $20-$70 Test strips $85 Monthly (4x/ day testing, 75 cents per test strip.	Transmitter unit $375 Sensor $473 Monthly (5 pcs)	$100 Monthly (1 pair with 1 sensor)

ΣΥΝΕΧΗΣ ΚΑΤΑΓΡΑΦΗ ΕΠΙΠΕΔΩΝ ΓΛΥΚΟΖΗΣ

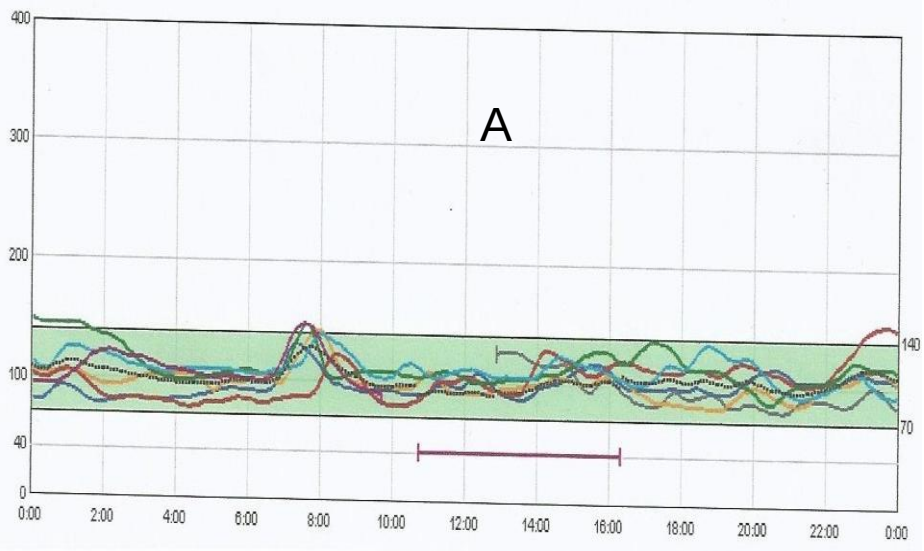
Τοποθέτηση στον ασθενή

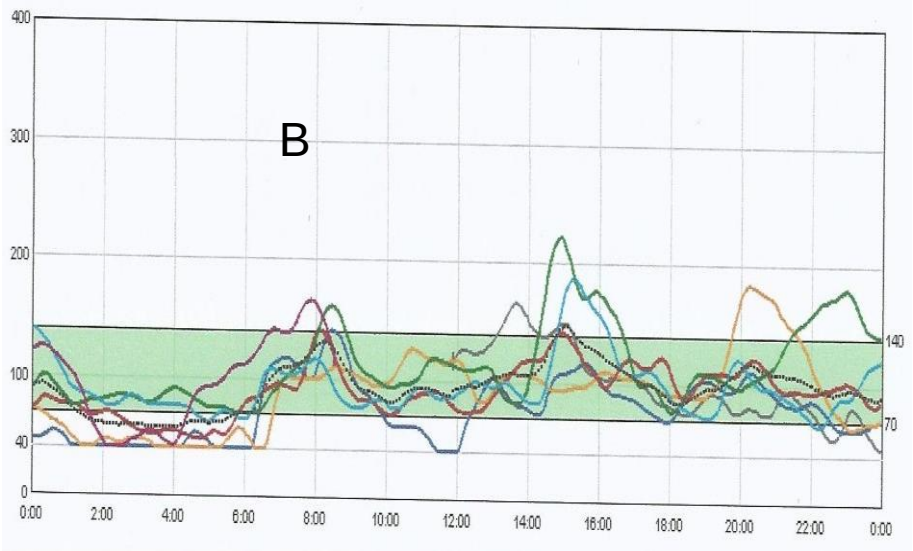


Τεχνική της Μικροδιάλυσης



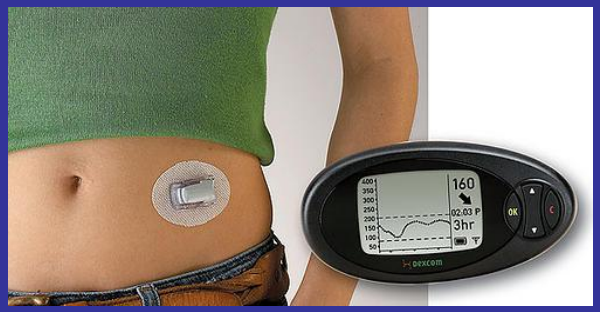
GLUCOSE VARIABILITY





	A		B		
	Mean	*SEM*	*Mean*	*SEM*	*p*
FPG	***110,9***	3,4	***114,6***	*6,1*	***0,67***
PPG	***113,5***	3,8	***124,6***	*7,3*	***0,17***
GHbA1c	***6,04***	0,2	***6,3***	*0,1*	***0,25***

ΕΝΔΕΙΞΕΙΣ



- Διαβητικοί Ασθενείς με ΣΔ τύπου Ι
- Διαβητικοί Ασθενείς με ΣΔ τύπου ΙΙ και Ασταθή Μεταβολική Διακύμανση
- Νυχτερινές Υπογλυκαιμίες, alarm
- Μη Ανιχνεύσιμες Υπογλυκαιμίες (μείωση 50%)
- Έναρξη Ινσουλινοθεραπείας, αλλαγές σχημάτων
- Σακχαρώδης Διαβήτης Κυήσεως
- Έλεγχος επίδρασης Αθλητικής Δραστηριότητας

J Clin Endocrinol Metabol. 2011;96:2968-2979.

Θετικές Θεωρήσεις

Οι ασθενείς μπορούν να μάθουν πώς

- η δίαιτα
- η άσκηση
- τα δισκία
- η ινσουλίνη
- ο τρόπος ζωής τους

επηρεάζουν
το γλυκαιμικό τους
προφίλ

Οι θεράποντες μπορούν να βελτιστοποιήσουν τη θεραπευτική αγωγή έτσι ώστε να μειωθούν οι χρόνιες και άμεσες επιπλοκές που συνοδεύουν το Σακχαρώδη Διαβήτη.

Αρνητικές Θεωρήσεις

- Ακριβή επιλογή
- Αλλαγή του αισθητήρα συχνά (3-7 ημέρες)
- Κλασσικές μετρήσεις (2-3 ημερησίως)

JDRF Continuous Glucose Monitoring Study Group (2009). The effect of continuous glucose monitoring in well-controlled type 1 diabetes. Diabetes Care, 32(8): 1378–1383

ΑΝΤΛΙΕΣ ΣΥΝΕΧΟΥΣ ΕΓΧΥΣΕΩΣ ΙΝΣΟΥΛΙΝΗΣ

COMPANY	Pump	Size/Weight	Battery	Reservoir	Infusion Set	Basal Range		Bolus Range	Food Database	Interacts With Blood Glucose Meter?	Interacts With CGM?	Details
Roche Insulin Delivery Systems	**Accu-Chek Spirit** 	3.2 x 2.2 x 0.8 in. 4 oz. with battery, full reservoir, and infusion set	(1) AA	315-unit cartridge	Compatible with all standard, Luer-lock connectors.	From 0.1 to 25 units per hour in 0.1-unit increments		0.1 to 25 units in increments of 0.1, 0.2, 0.5, 1, and 2 units for standard boluses. Extended or Multiwave boluses are adjustable in increments of 0.1 units.	Yes, with use of Accu-Chek Pocket Compass software and personal digital assistant (PDA). Database includes over 900 preloaded common foods and stores up to 1,200 items, including user-selected foods.	No	No	Display can flip 180 degrees for easy reading on different areas of the body. Package includes a backup pump that operates for up to 180 days and a PDA that can calculate boluses. Pump and meter can send data to PDA wirelessly. "Skins" available to customize pump. Works with Accu-Chek 360° software, insulin pump configuration software, and Smart Pix device reader for data management. Software and reader are compatible with Windows (except Windows 7), but are not Mac compatible.
Social Development	**Dana Diabecare IIS** 	2.95 x 1.77 x 0.75 in. 1.8 oz. without battery	(1) 3.6-volt DC lithium	300-unit cartridge	Compatible with Sooil infusion sets only.	From 0.01 to 16 units per hour in 0.01-unit increments		0.1 to 10 units in 0.1-unit increments. From 10 to 87 units in 1-unit increments.	No	No	No	Menu uses icons instead of words. Available in a choice of five colors. Does not work with data management software.
Medtronic Diabetes	**MiniMed Paradigm Real-Time Revel** 	**Model 523:** 2 x 3 x 0.8 in. 3.53 oz. **Model 723:** 2 x 3.6 x 0.8 in. 3.81 oz. Both with battery and full reservoir	(1) AAA	**Model 523:** 176-unit reservoir **Model 723:** 176- or 300-unit reservoir	Compatible with Medtronic infusion sets as well as sets from select brands (p. 52). Using a Fifty50 Medical reservoir allows pump to connect to all standard, Luer-lock connectors.	From 0.025 to 35 units per hour in 0.025-unit increments		0.025 to 25 units. Increments of 0.025 units up to 0.975 units. Increments of 0.05 units for amounts larger than 0.975 units.	No	Yes, the OneTouch UltraLink meter wirelessly sends test results to the pump.	The Real-Time Revel is a combination pump and CGM.	The Real-Time Revel uses a sensor to wirelessly transmit continuous glucose readings to pump. For more information on the Revel's CGM functions, see page 46. Hundreds of "skins" are available to customize pump. Works with CareLink Personal software to upload and manage pump and CGM data. Software is compatible with Windows, but is not Mac compatible.
Insulet Corp.	**OmniPod** 	**Pod:** 1.6 x 2.4 x 0.7 in. **Personal Diabetes Manager (PDM):** 2.5 x 4.5 x 1 in. **Pod:** 1.2 oz. with full reservoir **PDM:** 4.4 oz. with batteries	**Pod:** battery integrated **PDM:** (2) AAA	Pod includes built-in reservoir that holds 200 units.	Does not use tubing. Pod comes with a built-in infusion set, cannula, and automated inserter.	From 0.05 to 30 units per hour in 0.05-unit increments		0.05 to 30 units in increments of 0.05, 0.1, 0.5, or 1 unit	Yes, PDM contains more than 1,000 common foods and their nutrition information, and stores up to 36 preset carb values for user-selected foods.	Yes, a FreeStyle blood glucose meter is built into the PDM.	No	No tubing required: System includes a "pod" that's used for 72 hours and then discarded and a PDM that controls the pod's functions. Pod is waterproof for up to 8 feet deep, so there's no need to disconnnect when swimming or bathing. Seven "skins" are available to customize PDM. Works with Abbott's CoPilot data management software. Software is compatible with Windows (except Windows 7), but is not Mac compatible.
Animas Corp.	**OneTouch Ping** 	**Pump:** 2 x 3.25 x 0.85 in. **Meter remote:** 3.8 x 2.46 x 1.12 in. Pump: 3.9 oz. with battery and full reservoir Meter remote: 3.88 oz. with batteries	**Pump:** (1) 1.5-volt lithium AA or (1) AA **Meter remote:** (2) AAA	200-unit cartridge	Compatible with all standard, Luer-lock connectors.	From 0.025 to 25 units per hour in 0.025-unit increments		0.05 to 35 units in 0.05-unit increments	Yes, meter remote stores up to 500 foods and their nutrition information. Added software allows users to customize food database.	Yes, meter remote sends results wirelessly to pump.	No	Both meter remote and pump are fully functional. Meter remote controls pump functions from up to 10 feet away. Pump is waterproof for up to 12 feet deep, so there's no need to disconnnect while swimming or bathing. Eight pump and 8 meter remote "skins" are available to customize. Works with ezManager Max data management software. Software is compatible with Windows (except Windows 7) and Mac operating systems. Compatibility with Windows 7 is expected early this year.

ΑΝΤΛΙΕΣ ΙΝΣΟΥΛΙΝΗΣ

ΘΕΤΙΚΑ ΣΗΜΕΙΑ

- Συνεχής υποδόρια έγχυση
- Υποδόριο λίπος κοιλιακού τοιχώματος
- Συνεχής χορήγηση και δόσεις bolus
- Βελτίωση ποιότητας ζωής (γεύματα)
- Ταχείας δράσεως ανάλογα ινσουλίνης

ΑΡΝΗΤΙΚΑ ΣΗΜΕΙΑ

- Κόστος
- Αύξηση ΒΣ
- Κετοξέωση (καθετήρας)
- Τη «φοράς» αδιαλείπτως
- Εισαγωγή στο νοσοκομείο για την αρχική εκπαίδευση

Hacking insulin pump

- (Reuters) - Medtronic Inc has asked software security experts to investigate the safety of its insulin pumps, as a new claim surfaced that at least one of its devices could be hacked to dose diabetes patients with potentially lethal amounts of insulin.
- Since then, a research team at Intel Corp's McAfee said it has developed code that allows it to gain complete control of the functions of one Medtronic insulin pump model from as far away as 300 feet.

REUTERS *BOSTON | Tue Oct 25, 2011*

From the Flight Deck: Diabetics, Watch Your Insulin

- **Changes in cabin pressure** during flights may cause insulin pumps to deliver **too much or too little** of the medication
- **disconnecting** the pump before take-off and after landing and making sure there are no air bubbles in the insulin before reconnecting it
- 10 insulin pumps on a commercial flight, during **takeoff** (when air pressure was decreasing), the pumps delivered about 1 to 1.4 extra units of insulin, on average. And during **descent**, when pressure was increasing, some insulin was sucked back into the pumps causing them to give out too little insulin, by less than 1 unit
- more of a problem for **children** and people who use low doses of insulin to begin with

Diabetes Care 2011

NEW DEVICES

Novo Nordisk's NovoPen Echo

a proprietary feature that not only records the time and dose amount when delivered,
but also allows injections in half-unit increments.
The pen is specially designed to appeal to children,

Patch Pump

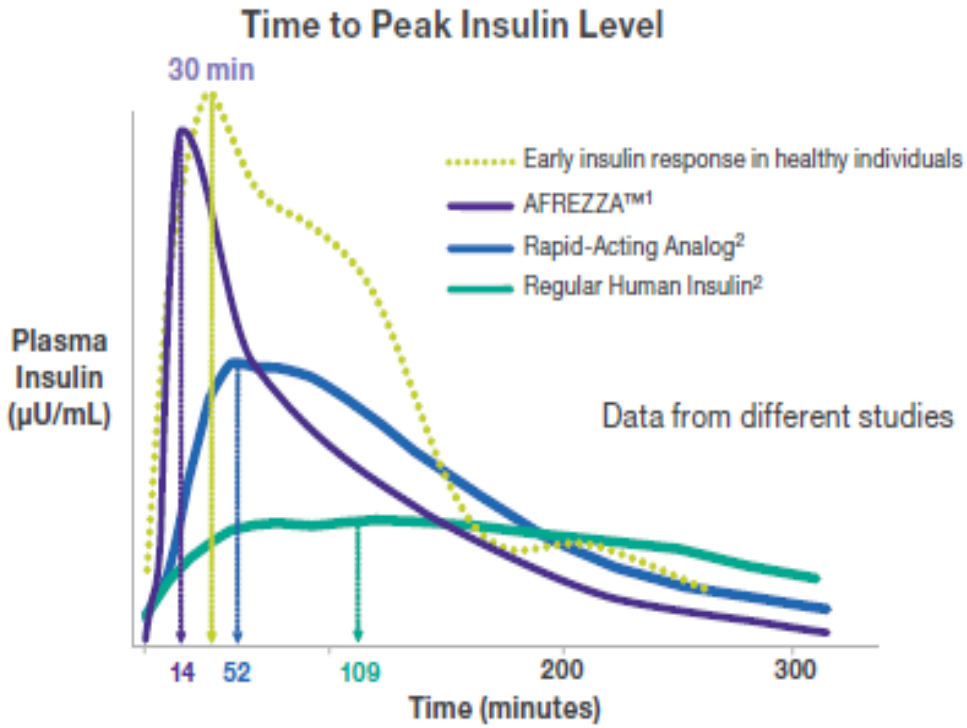
a simple, tubeless device created specifically for people with type 2 diabetes and delivers preset basal and bolus doses and a reusable messenger unit that notifies users when it's time to replace the device

Pharm Res (2011) 28:2157–2164
DOI 10.1007/s11095-011-0443-4

RESEARCH PAPER

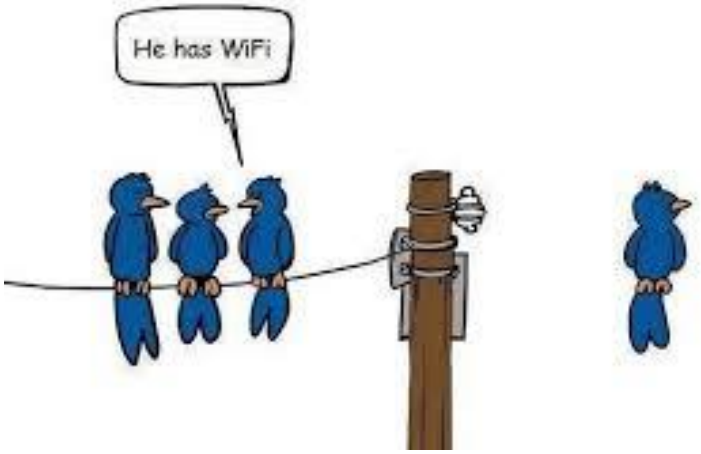
Insulin Lung Deposition and Clearance Following Technosphere® Insulin Inhalation Powder Administration

James P. Cassidy • Nikhil Amin • Mark Marino • Mark Gotfried • Thomas Meyer • Knut Sommerer • Robert A. Baughman



1. Non-diabetic obese subjects after 100 g oral glucose. Adapted from Kipnis D. *Ann Intern Med.* 1968;69:891-900.
2. Insulin Aspart, 0.2 U/kg. Regular Human Insulin, 0.2 U/kg units. Subcutaneous injection in abdomen. Adapted from Mudaliar SR et al. *Diabetes Care.* 1999;22:1501-1506.

Wireless Therapy



iGlucose!!!

- Blood glucose meter – cellular phone – doctor's computer
- Smartphone,android,iphone
- Alert SMS what to do the pt
- Improoved glycemia

- ***Ho****ward University, Washington, DC*
- *Indiana University*
- *University of Maryland*
- *ATT*

mHealth Apps Linked to Well-Being

Gallup Nov 7, 2014

- People are increasingly using mobile health technology to improve their well-being, according to new Gallup research
- About 1/2 of smartphone users have downloaded at least 1app, & 19 % of all adults have downloaded and routinely used at least 1such app. This means that 1 out of 5 people are regularly using mobile technology
- Out of 11 popular types of apps the most common use is for calorie counting (18%): but 6% routinely use the app. Health recipes and food/exercise diaries are the next most common type of apps used

Mobile Health Apps Can Improve Patient Care

PhisiciaN SURVEY Oct. 8 in Medical Economics.

1/3 of physicians have recommended the use of mobile health apps *(diet & fitness)*

FDA has approved about 100 mobile health apps

40% of physicians believe digital communication technologies, including mobile apps, can help improve patient outcomes.

Mobile telehealth program helped shift behavior in patients with diabetes

Nundy S.
Diabetes Educ. 2014;
doi:10.1177/0145721714551992
University of Chicago Medical Center
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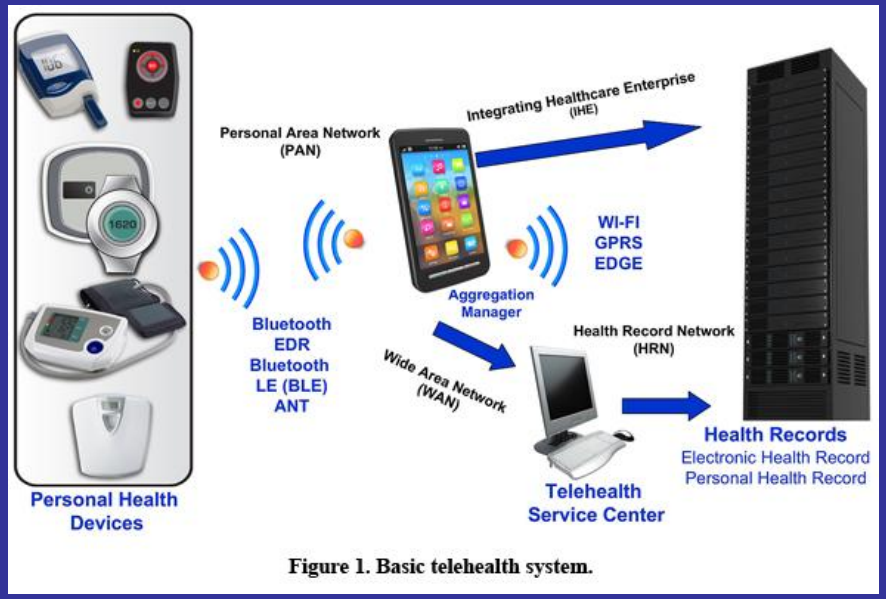


Figure 1. Basic telehealth system.

- **74 pt with type 1 or type 2 DM 54 yo from working-class, urban black community for 6 mo**
- **Automated text messaging and remote nursing through an interactive system** for medication adherence, glucose monitoring, foot care, exercise and healthy eating
- **The program has been shown to improve diabetes control and reduce health care costs**

More IT applications

- Food labeling (barcodes)

Ουρές πεσκανδρίτσας τηγανητές,
με πατάτες, κρέμα γλυκού σκόρδου
& λάδι καπνιστής πάπρικας !

700 kcal

- Record (photo) of dietary intake

- Virtual reality gaming and exercise (calories expenditure)

How Many Bites Do You Take a Day?
Try for 100

South Carolina's Clemson University

Aug 6 2014

A bite of pizza is very different from a bite of salad !!!!

ΤΕΧΝΗΤΟ ΠΑΓΚΡΕΑΣ

Klin Wochenschr (1986) 64:405–410

Klinische Wochenschrift

Originalien

Effects of Two New α-Glucosidase Inhibitors on Glycemic Control in Patients with

G. Dimitriadis, S. Raptis, S. Ladas, and I. Hillebran
Second Department of Internal
"Evangelismos" Hospital, Athe

Summary. BAYo1248 ar
new α-glucosidase inhibit
tolerance was significant
prandial insulin requireme
duced as compared to pla
lunch when 20 mg BAYo
prior to breakfast and af
dinner when 50 mg BAY
to all three main meals.
concentrations were mild
α-glucosidase inhibitors w
complained of any adver
lence, abdominal pain o
and BAYm1099 might be
in the treatment of patient
diabetes mellitus.

Key words: α-glucosidase
Glycemic control

Alpha-glucosidase inhibit
glucose absorption increa
subcutaneously administe
with insulin-dependent di
11, 13]. When α-glucosid
prior to meals their insulin
panied by improvement of
cose profiles in both norm
jects [4, 5, 11, 14, 15, 17, 2
Acarbose has been th

* This work was supported by
istry, Athens, Greece; Depar
University of Ulm, Germa
meinschaft SFB87 Endokrino
Alexander S. Onassis Founda
** Presented in part during the 20th Annual Meeting of the EASD in London, 12–15 September, 1984

Ireland) for connection to the Biostator. A wrist vein was used for continuous blood glucose moni-

«Artificial Pancreas»
«Closed Loop»

- 1974 η πρώτη δημοσίευση
- Canada, Germany, France, Australia, Japan
- Open loop (meal announcement)
- Implantable SC pumps & sensors

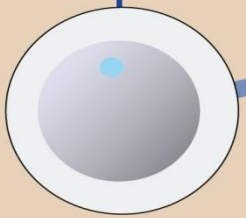
Artificial pancreas *at a glance*

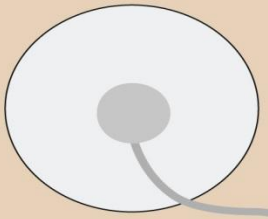
1 CGM sensor

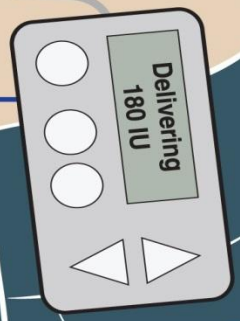
Continuous glucose monitoring (CGM) sensor is inserted under the skin to continuously measure glucose concentrations in the patient's cells

2 CGM receiver

CGM receiver displays the updated readings as graphs and trends minute-by-minute, and translates the readings from USB to Bluetooth







4 Insulin pump

The CAD communicates with a body-worn insulin pump that automatically administers the correct insulin dose via a cannula inserted under the skin

3 Control algorithm device (CAD)

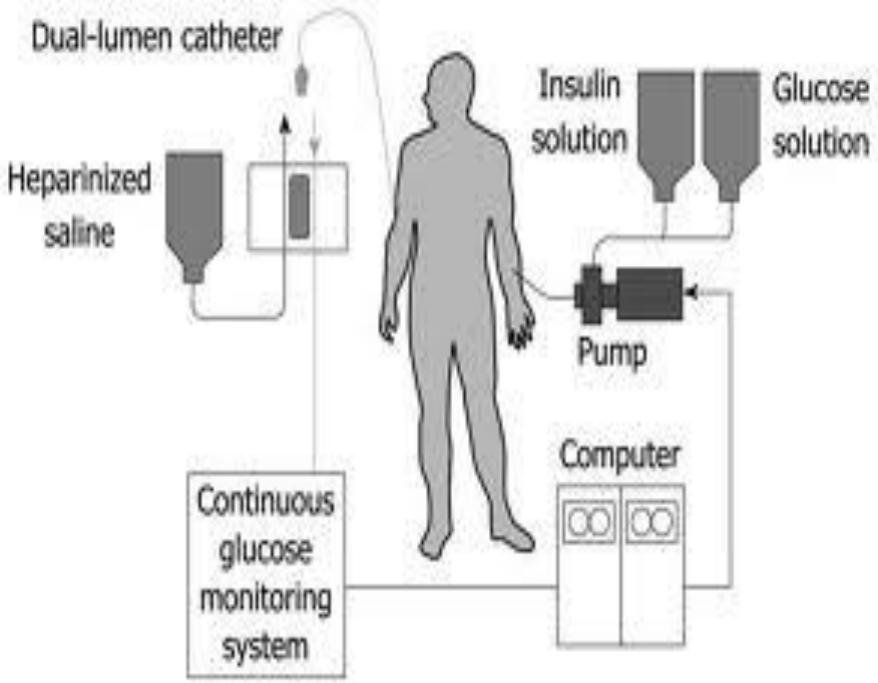
Readings are sent to a control algorithm device (CAD) - eg a smartphone, tablet or PC - where an algorithm analyses them and calculates the correct insulin dose, if required

Τεχνητό Πάγκρεας

Μονο-ορμονικό

(ινσουλίνη)

(διάλυμα γλυκόζης)



Αλγόριθμοι

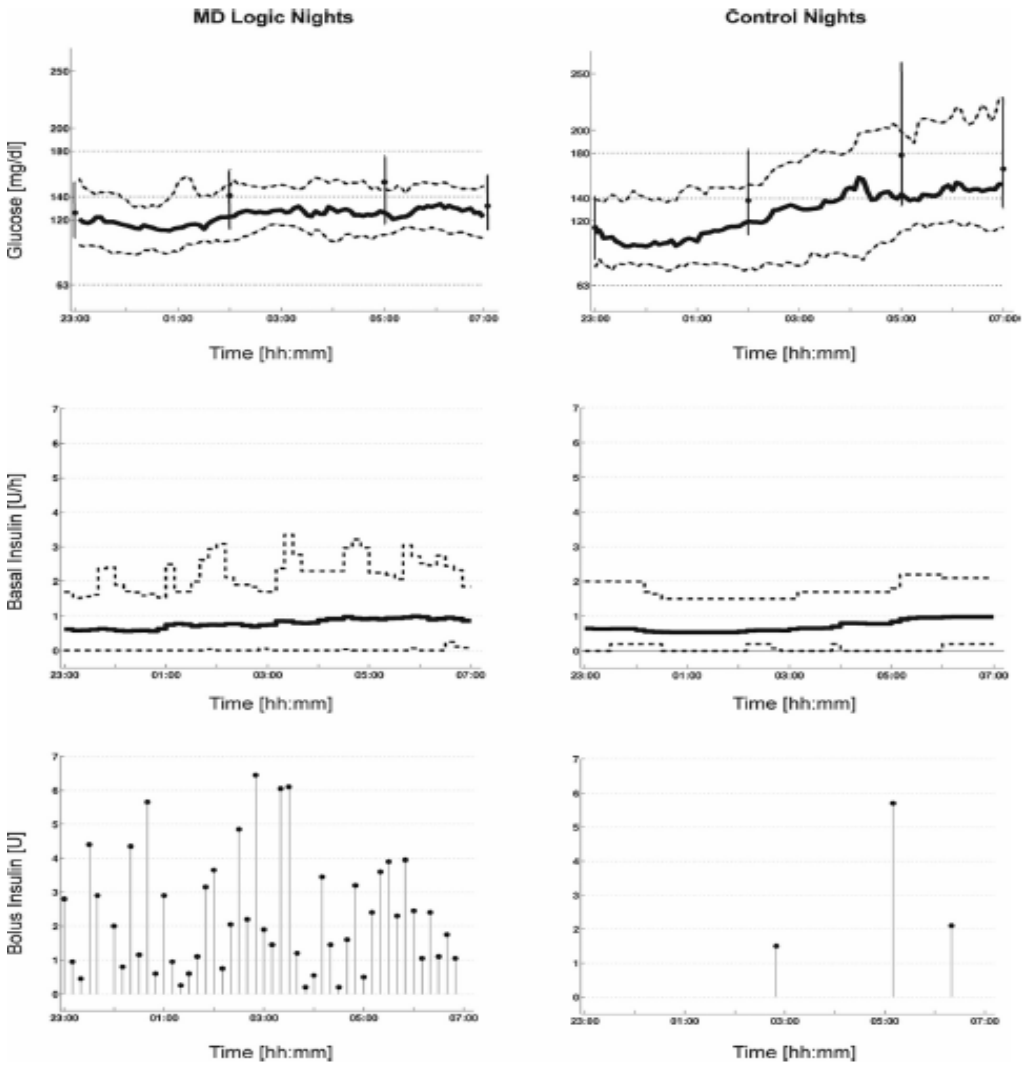
- **Ανοικτό**
- **Κλειστό σύστημα**

Closed – Open Loop systems

BG

Basal IMI

Bolus IMI



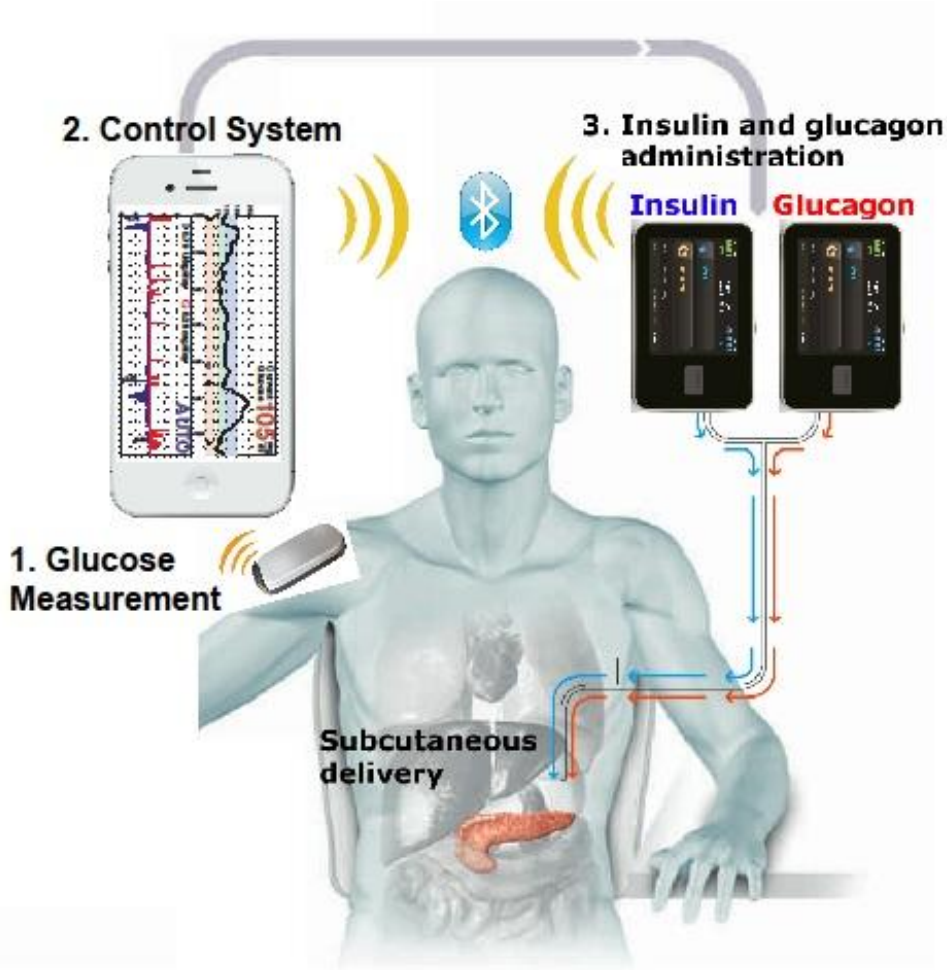
Overnight

(A): closed-loop

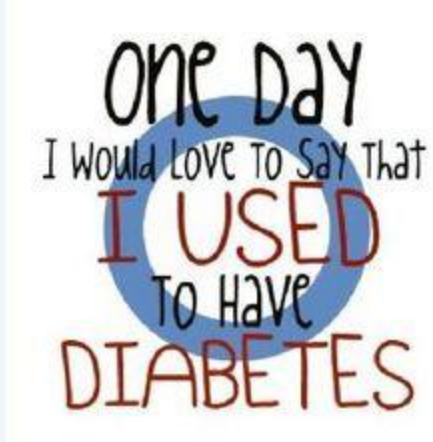
(B): open-loop

Phillip, M. *et al*. 2013. *N. Engl. J. Med.* **368:**824–833.

BIONIC PANCREAS



Outpatient Glycemic Control with a Bionic Pancreas in Type 1 Diabetes
N Engl J Med 2014; 371:313-325



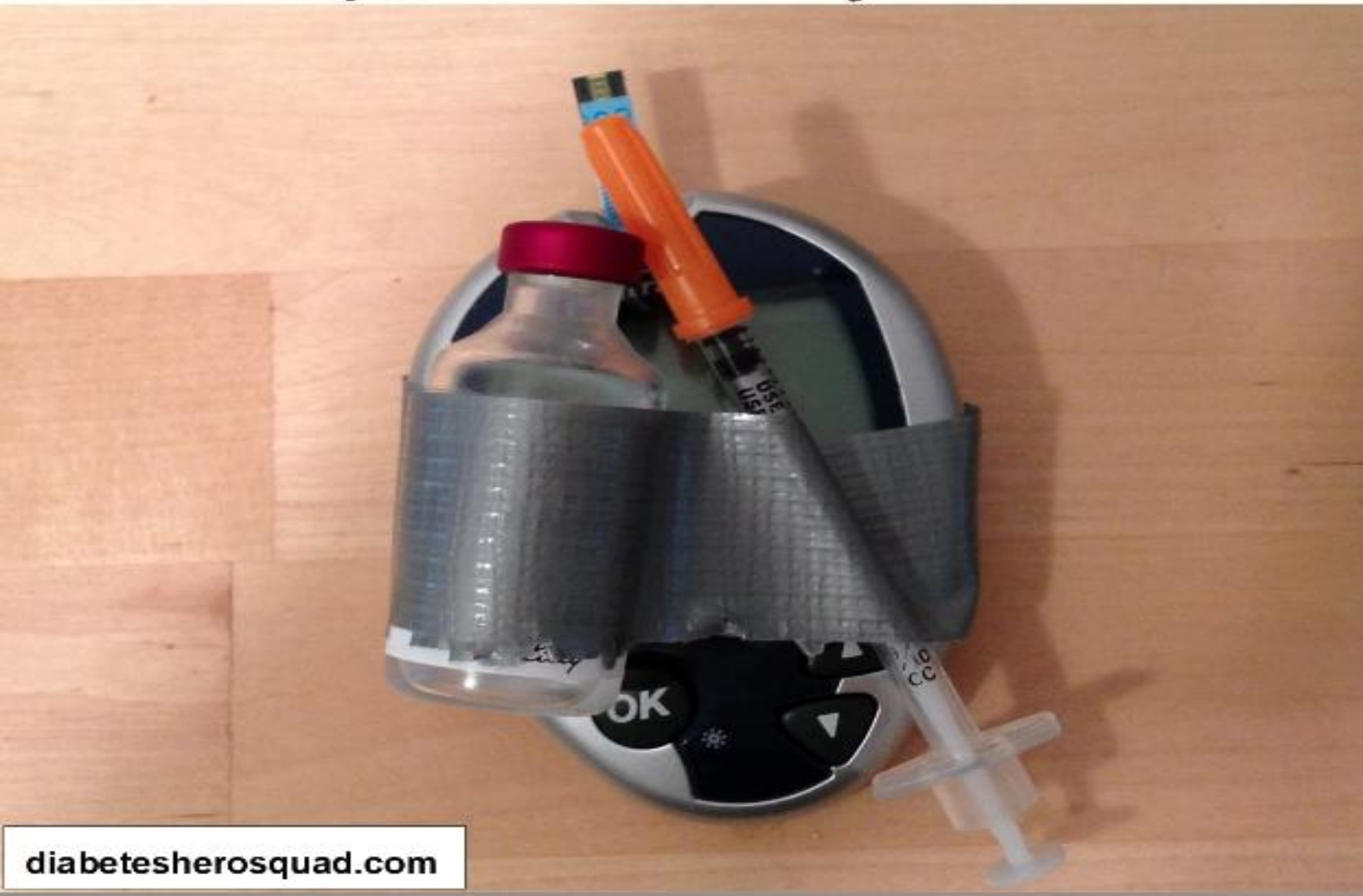
CONCLUSIONS

- Advances in the **accuracy** and performance of continuous glucose **monitoring** systems
- Advances in the safety and effectiveness of control **algorithms**
- Overnight **closed loop** systems for the prevention of hypo- hyper- glycemia

“Are we there yet?”

“no, but we are getting very close.”

I asked my health insurance company for an artificial pancreas and they sent me this.



diabetesherosquad.com