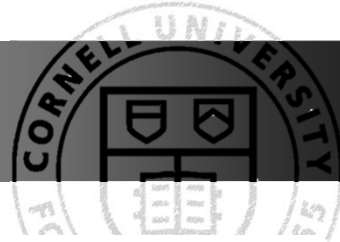


Cornell nutriPhone & KS-Detect
Pictures of Health



Smartphone Based Technologies for Mobile and Global Health

David Erickson
Associate Professor
Sibley School of Mechanical and Aerospace Engineering
www.ericksonlab.org



David's Odyssey
The last time I got my bloodwork done

Timeline

June – Time to get my Cornell Plan for Healthy living physical

October 1st – Cancelled phlebotomist appointment (overlap with teaching).

October 11th – Visit phlebotomist, have blood drawn, ~ 2hrs.

October 23rd – Visit doctor, get results, vitamin D deficient, need to take supplement (2000 IU).

1Y – Next scheduled blood test to see if actually working.

Lab Acquired: 10/11/12	Test Name	Result	Reference Range
	CBC ELECTRONIC (FMA)	-- Profile --	
	WBC		3.6-9.6
	RBC		3.90-5.70
	HEMOGLOBIN (FMA/CMC/CTX)		12.1 - 17.2
	HEMATOCRIT (FMA/CMC/CTX)		36.1 - 50.3
	PLATELETS		150-400
	LYMPH%		20.5-51.1
	MIXED%		
	NEUTROPHILS %		
	MEAN CORPUSCULAR VOL		82.2-97.4
	MEAN CORPUSCULAR HEMOGLOBIN		27.6-33.3
	MEAN CORPUSCULAR HEMO CONCE		32.0-36.0
	RDW		11.6-13.7
	MEAN PLATELET VOLUME		6.5-11.0
	Lab Acquired: 10/11/12		
	Test Name	Result	Reference Range
	VITAMIN D, 25 OH		30.0-100.0
	Lab Acquired: 10/11/12		
	Test Name	Result	Reference Range
	COMPREHENSIVE METABOLIC PROF	-- Profile --	
	ALBUMIN		3.8-5.5
	ALK. PHOS.		22-95
	ALT (SGPT)		10-40
	AST (SGOT)		5-34
	BUN		6-26
	CALCIUM		8.6-10.2
	CHLORIDE		94-112
	CREATININE		0.6-1.4
	CARBON DIOXIDE		21-32
	GLUCOSE		70-105
	SODIUM		134-149
	TOTAL BILIRUBIN		0.2-1.3
	TOTAL PROTEIN		6.3-8.1
	POTASSIUM		3.6-5.5
	GLOBULIN		2.0-4.8
	LIPID PROFILE	-- Profile --	
	CHOLESTEROL		120-200
	HDL		30-70
	TRIGLYCERIDES		30-200
	LDL (CALCULATED)		0-129
	VLDL (CALCULATED)		0-50

Personalized Molecular Diagnostics
Glucose Meters and Pregnancy Tests



Personalized Molecular Diagnostics
Glucose Meters and Pregnancy Tests



David's Odyssey
 What it would be nice to know without having to go through this process

Cholesterol

- 60% of American's have high cholesterol, 37 million have very high.

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- Vitamin A, B₁₂, D
- Iron

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Pregnancy & Conception

- Luteinizing Hormone (LH)
- Folic Acid and DHA

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- Folic Acid and DHA

Many Others...

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- Viral Loading (HIV)

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Smartphone Based Molecular Diagnostics

Can help reduce costs and improve the accessibility of healthcare

smartphone adoption in the US



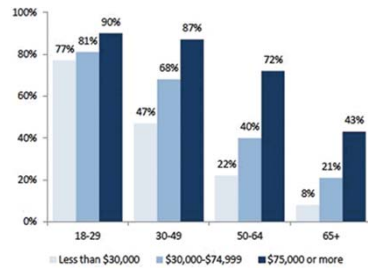
It has everything

- GPS, High-res, Camera, Email, Facebook, computation, power, etc.
- Extremely rugged

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You are already trained on it

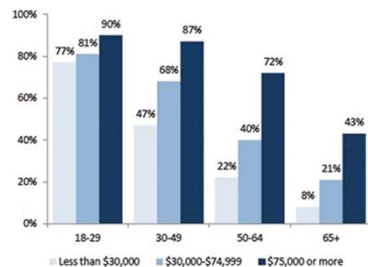
- Technology designed to be easy to use by nearly all age groups



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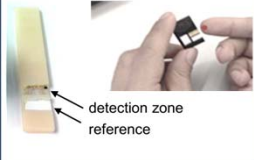
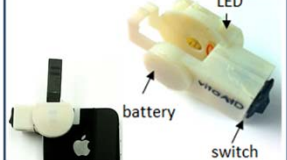

You already own it

- 260 million active smartphones in US by 2016
- Everybody is carrying one all the time



the SmartCard and NutriPhone platforms for cholesterol and micronutrient monitoring

Technology - 3 part system

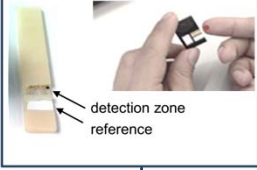
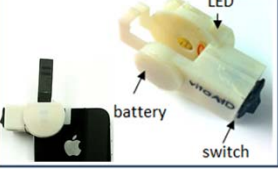

Test Strip	Smartphone Accessory	Smartphone App
<ul style="list-style-type: none">to detect micronutrients 	<ul style="list-style-type: none">to read out the test strip 	<ul style="list-style-type: none">to analyze data and display for users 


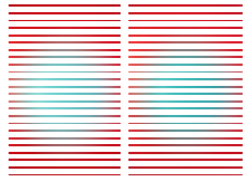
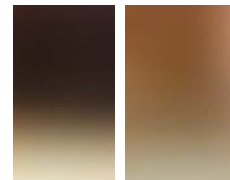



the SmartCard and NutriPhone

platforms for cholesterol and micronutrient monitoring

Technology – 3 part system


Test Strip	Smartphone Accessory	Smartphone App
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<p>pH</p>  <p>Chemical reaction</p>	<p>cholesterol</p>  <p>Enzymatic reaction</p>	<p>vitamin D</p>  <p>Gold nanoparticle immunoassay</p>
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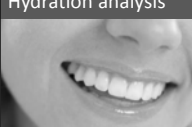


Hydration analysis for athletes

Sweat pH can be related to sodium levels and sweat rate

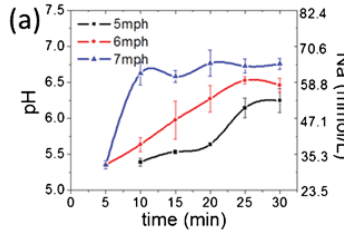


Hydration analysis

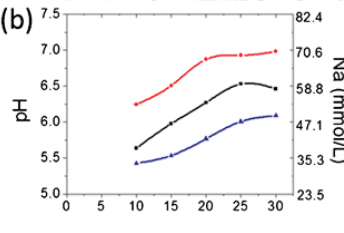


enamel decalcification below pH 6.2

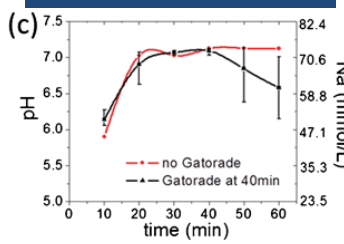
Different running speeds




Different runners (6mph)



Gatorade?




Oncescu, V., Erickson, D. " A smartphone platform for cholesterol colorimetric testing" *Lab-on-a-Chip* (2013)




monitoring cholesterol levels

high serum cholesterol increases coronary heart disease mortality

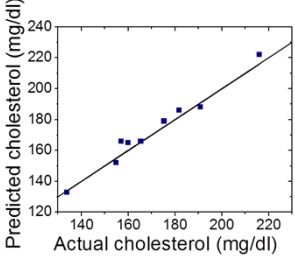


increase in mortality rate for serum cholesterol levels above 210mg/dl

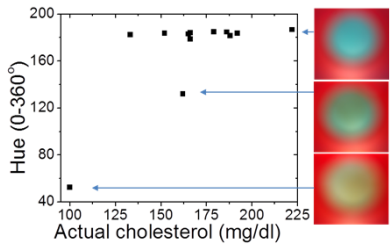


expensive devices
low accuracy
low tracking ability


accuracy in user trials



Detecting erroneous measurements




Oncescu, V., Mancuso, M., Erickson, D. "A smartphone platform for cholesterol colorimetric testing" *Lab-on-a-Chip* (2013)




vitamin D deficiency testing

deficiency is highly prevalent and has been linked to many health issues

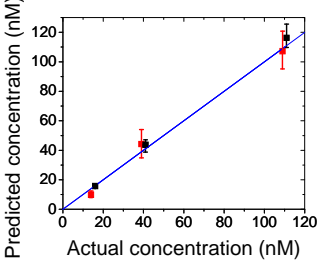


chronic deficiencies

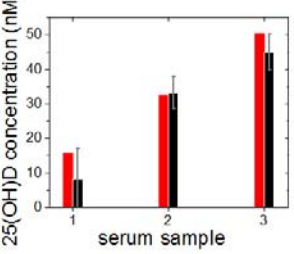


hard to quantify supplement effects


accuracy vs ELISA kit



serum samples



Lee, S., Oncescu, V., Mancuso, Mehta, S., Erickson, D. "A smartphone platform for the quantification of vitamin D levels" *Lab-on-a-chip* (2014)



24-06-2013

Mobile Internet Penetration in Nigeria Stands at 28percent

Thursday, April 4th, 2013

Africa's smartphone revolution



Smartphone use in Africa is on the rise, and major distributors are starting to pay attention to the emerging market by producing devices that cater to the needs of the continent. How will increased smartphone use revolutionise the continent?

By Matthew Labrooy

Smartphone growth in Africa has increased by 43% every year since 2000, and experts predict that smartphone use in Africa will have Internet access by 2014. As a result, smartphone manufacturers have increased interest in the region in a bid to gain their share of half a billion potential customers. A simple budget smartphone produced for the African market is available on the streets of Nigeria for €37 (US\$50) and has sold more than 300,000 units across the country.

Smartphone penetration in Africa is estimated between 17-19%, though rates vary by country. Nigeria, Africa's most populous nation, has a smartphone penetration as high as 19%, according to a report by Samsung Electronics West Africa explains the sudden influx of smartphones saying: "The advent of new privately owned submarine cables and their landing on the continent, and West African nations, including Nigeria, have significantly reduced the cost of smartphones and increased the adoption of smartphones on the Continent."

African Smartphone Penetration to Reach 40 Per cent by 2017

By Vince Matinde | Friday, June 21st, 2013 at 11:04am | 0 Comments |



Africa on the brink of a smartphone revolution

by Eric Van Rookhuyzen
3 June 2013
Mobile

Africa is on the brink of a smartphone revolution with renewed mass market penetration into the African and South African market already underway thanks to a host of new entry level models from well-known brands like Samsung, Nokia, Blackberry and others as well as numerous 'unknowns' from China.

Against this backdrop the Starcom MediaVest Group's digital division Liquid Thread, under the stewardship of strategist Eric Van Rookhuyzen, is championing the rise of digital in the local market.

The local market for smartphones is diversifying. Whereas before it was a purely high end segment there are now also distinct middle and entry level brands. This means the price of smartphones is definitely dropping, in fact they're becoming so ubiquitous that consumers can now even buy them on their clothing account.

23 15 34 1

Tweet Share Like +1



Kaposi's sarcoma

- Kaposi's sarcoma is an AIDS related cancer of lymphatic endothelial origin.
- Caused by infection with KS Herpes Virus (HHV-8) in immune compromised people
- One of the most prevalent cancers in sub-Saharan Africa



KS Detect

Self-Contained Low Power Smartphone Driven PCR Based Diagnostics

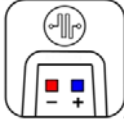
1. Biopsy Collection



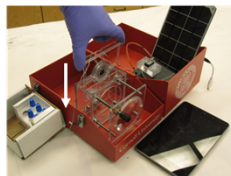
2. Solar-thermal PCR



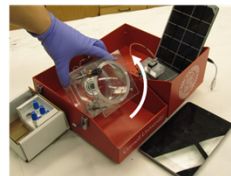
3. Smartphone Assay



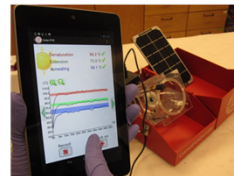
1. Insert cassette



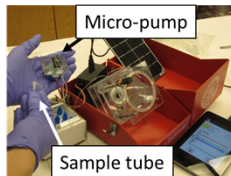
2. Tilt stage towards sun



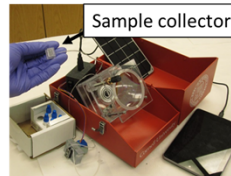
3. Read temperatures



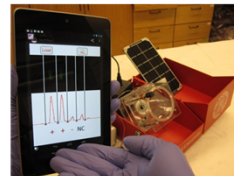
4. Pump sample through



5. Collect sample



6. Read out results



Solar-Thermal PCR

How it works

Solar-Thermal Molecular Diagnostics

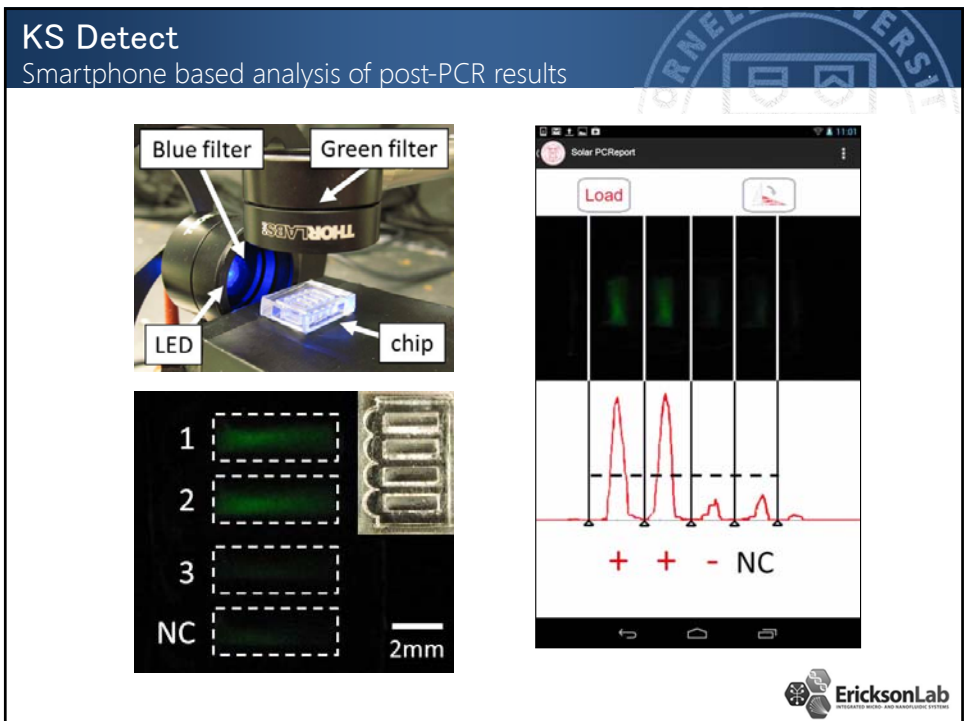
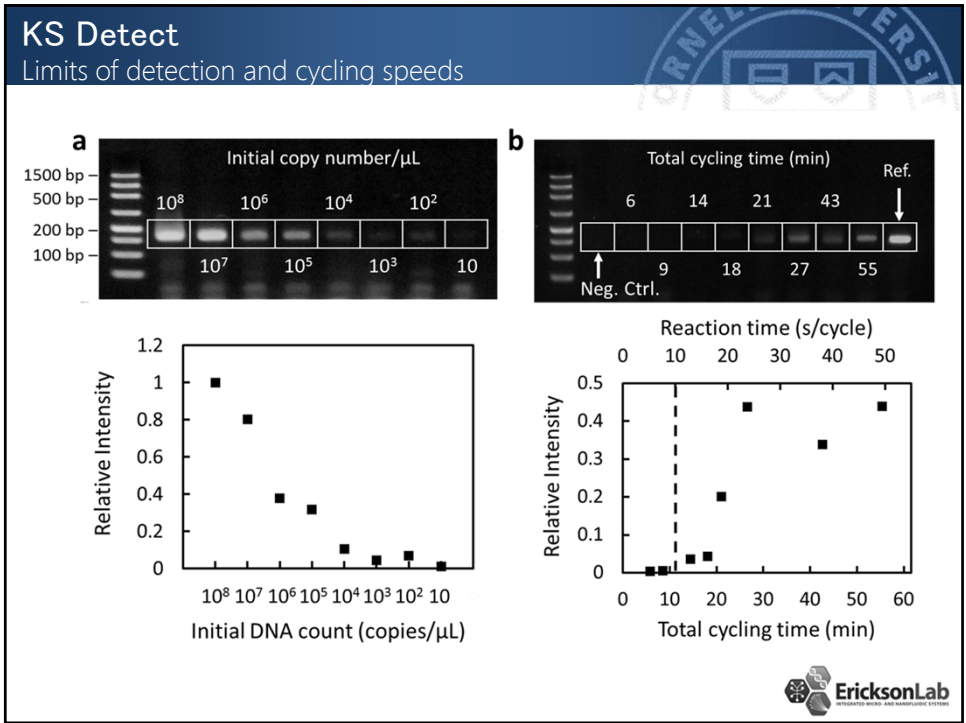
Solar energy and Smartphones for PCR

Ithaca, NY (42°N)

Kampala, Uganda (0°N)


Ithaca, NY (42°N)		Kampala, Uganda (0°N)		Durban, South Africa (30°S)	
Wed May 22	84° 67' PM T-Storms	Wed May 22	84° 67' Mostly Sunny	Wed May 22	80° 53' Sunny
Thu May 23	74° 47' Scattered T-Storms	Thu May 23	84° 67' Sunny	Thu May 23	77° 58' Mostly Sunny
Fri May 24	53° 42' Partly Cloudy	Fri May 24	82° 66' Sunny	Fri May 24	76° 55' Mostly Sunny
Sat May 25	58° 41' Mostly Cloudy	Sat May 25	81° 66' Sunny	Sat May 25	79° 58' Sunny
Sun May 26	61° 41' Partly Cloudy	Sun May 26	81° 67' Mostly Sunny	Sun May 26	76° 56' Partly Cloudy

Weather data retrieved from weather.com




KS Detect

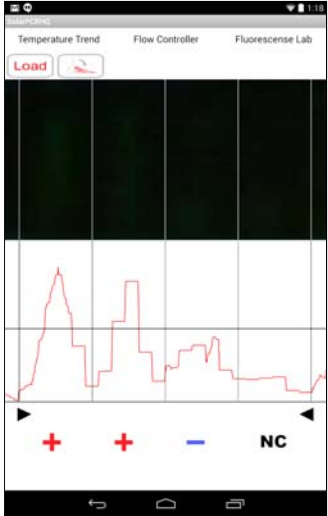
Field testing in Eldoret Kenya and Kampala Uganda





AMPATH
Eldoret, Kenya

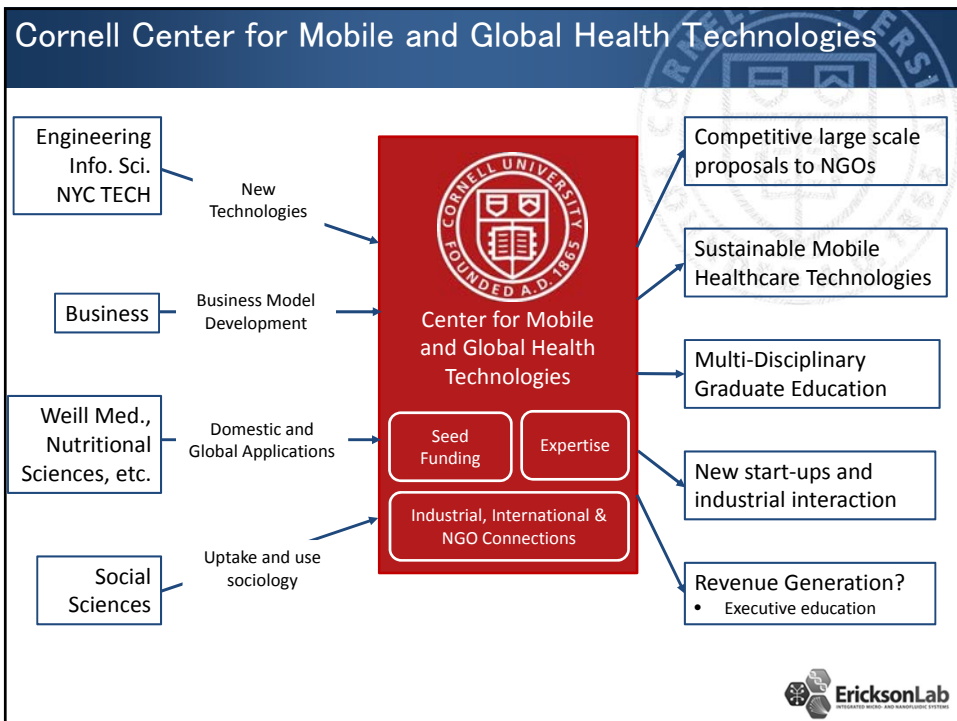


Infectious Diseases Institute
Kampala, Uganda










Cornell Center for Mobile and Global Health Technologies

Engineering
Info. Sci.
NYC TR

Competitive large scale
proposals to NGOs



Busi


mobile
chnologies

Weill N
Nutrit
Sciences

ary
cation

Social
Sciences

and
raction





Uptake and use
sociology

Revenue Generation?
• Executive education

Key Differentiators

1. Focus on mobile enabled technologies.
2. Focus on sustainable business case development from day #1.
3. Exploitation of broad Cornell expertise.





Optofluidics, Inc.

Cornell Start-up on Nanoparticle Analysis (opfluid.com)




2009 – Nature paper

LETTERS



Optical manipulation of nanoparticles and biomolecules in sub-wavelength slot waveguides

Alan H. J. Yang¹, Sean D. Moore¹, Bradley S. Schmidt¹, Matthew Klug¹, Michal Lipson¹ & David Erickson¹


2011 – Begin operation in PHL, NSF + DARPA SBIR PI, private seed


2012 – Series A, sign license with Cornell.

2013 – NanoTweezer Product launch, first sales revenue.



2014 – Growth, planned series B, V2 system, foreign sales.




VitaMe Technologies, Inc.
Smartphone-based diagnostics




vitaMe
Technologies


Thank you
Any questions?




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Mathew Mancuso
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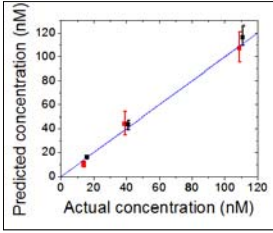


EricksonLab
INTEGRATED MICRO- AND NANOFUIDIC SYSTEMS

Smartphone Based Molecular Diagnostics

Edge over current technologies

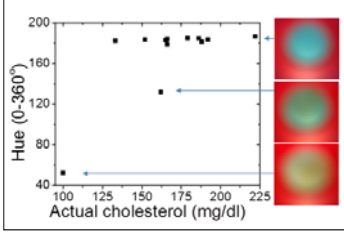
- 1) Accessibility & mobility — testing @ home, resource-limited settings
- 2) Cost savings — replaces the need for expensive readers
 - * *Smartphones come with the necessary computing power!*
 - one platform does it all – app can be re-programmed.
- 3) Accuracy —



Actual concentration (nM)


Predicted concentration (nM)


- compares well with commercial tests (left)
 - built-in check for erroneous results (right)




Actual cholesterol (mg/dl)

Hue (0-360°)
- 4) Tracking ability — smartphones can easily store the data for tracking over time
- 5) Easier communication of results — results can be e-mailed to a physician or uploaded online (SNS)




WATCH THE VIDEO
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EXPLORE THE SCENT
● ● ● ● ●

Transform Your iPhone® into a Bacon Scent Alarm Clock



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TO GET THE DEVICE

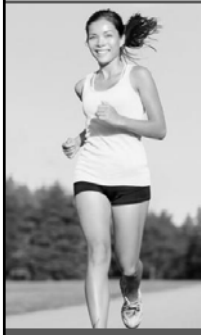
[APPLY](#)

SCROLL TO EXPLORE THE SCENT

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Apple, Inc. is not a Sponsor or Participant of this Promotion.

diet alkalinity monitoring

important in preventing enamel decalcification below a critical saliva pH

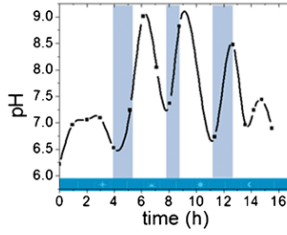


Hydration analysis

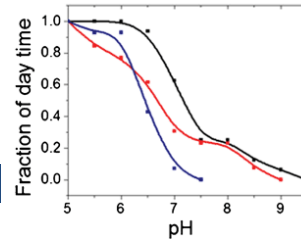


enamel decalcification below pH 6.2

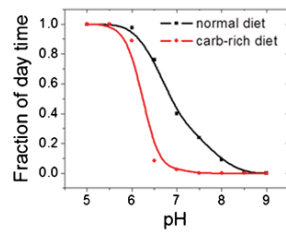
saliva pH variations



average pH for different users



Effect of different diets



Oncescu, V., Erickson, D. "A smartphone platform for cholesterol colorimetric testing" *Lab-on-a-Chip* (2013)

