

Innovation in the Medical Home: How Mobile and Social Technologies Can Accelerate Health Behavior Changes

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The Big 6

60% of all spending on
Chronic Disease

Diabetes

High Blood Pressure

Kidney Disease

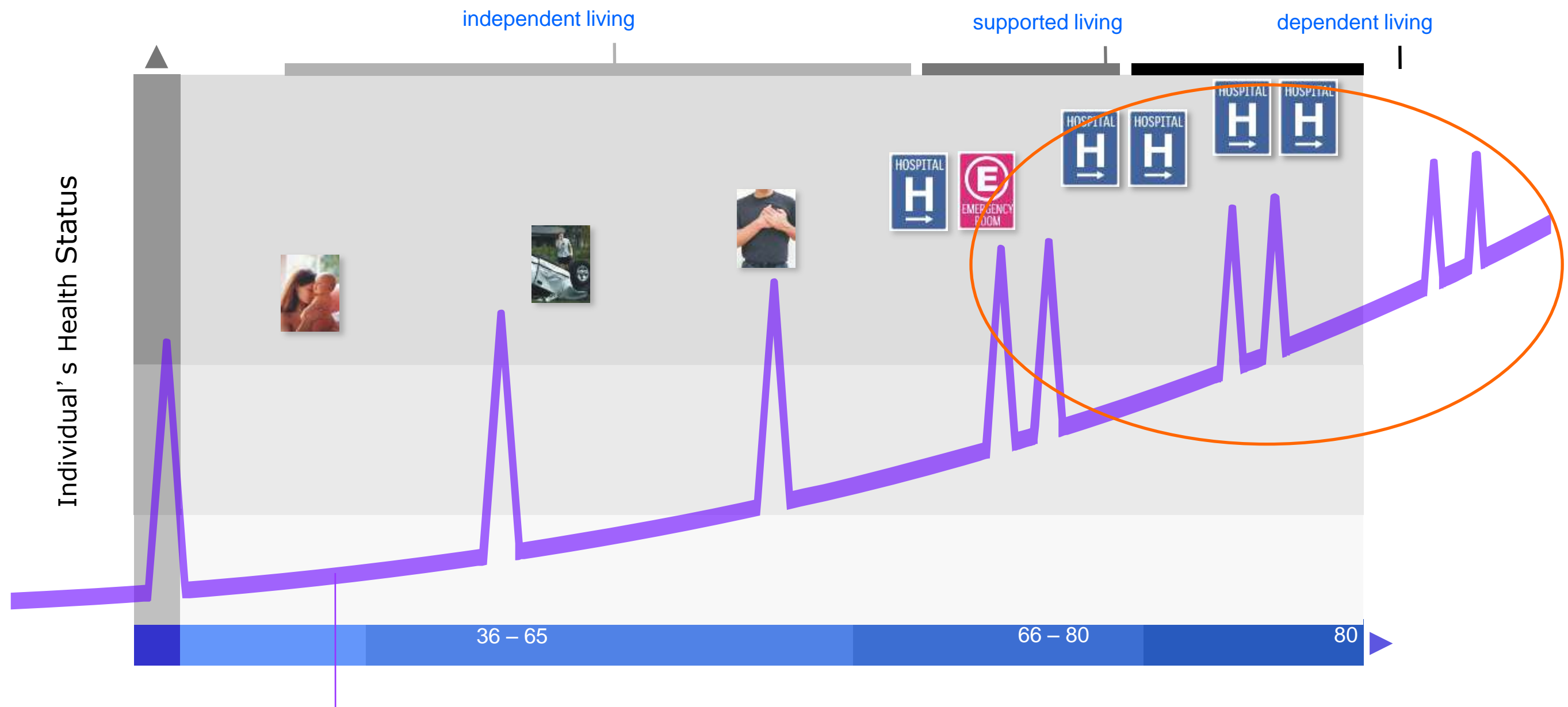
Heart Failure

Lung Disease

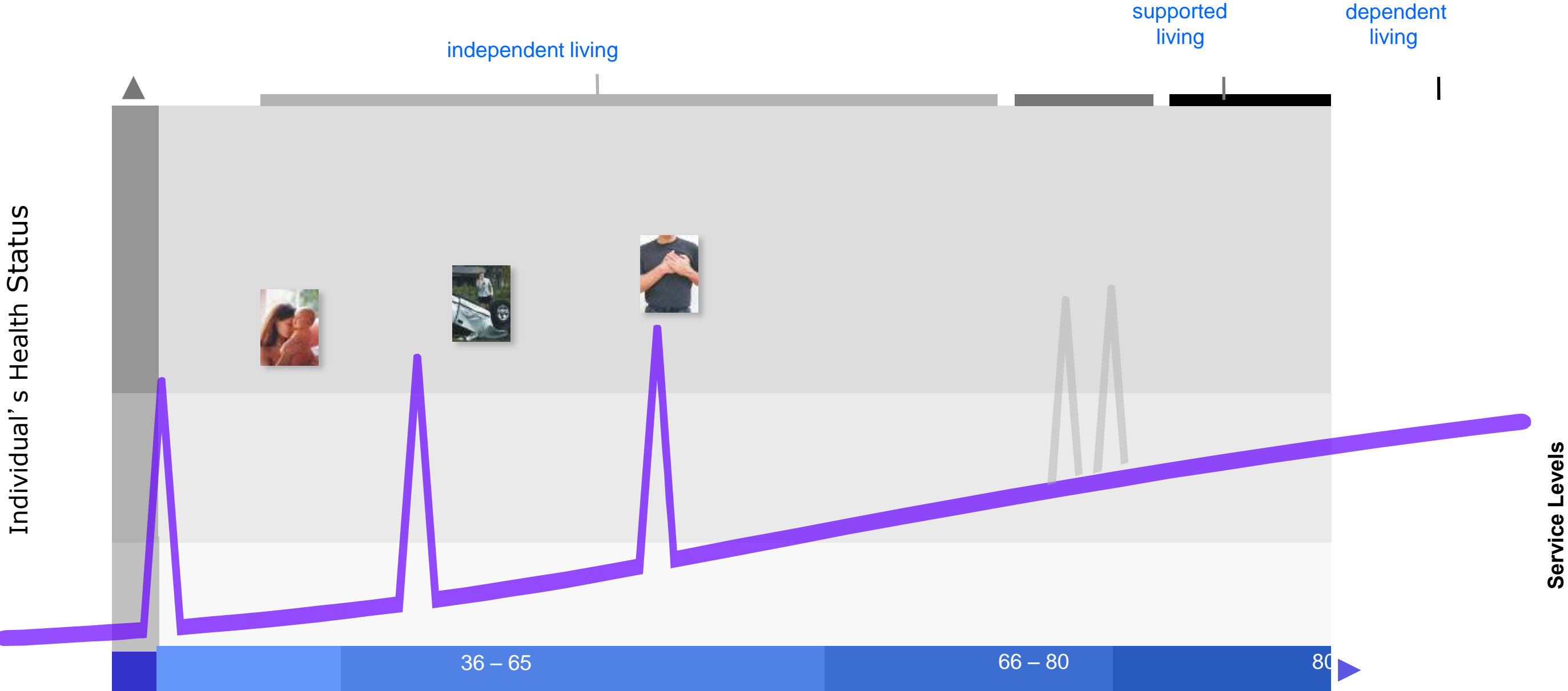
Mental Health

HOSPITAL

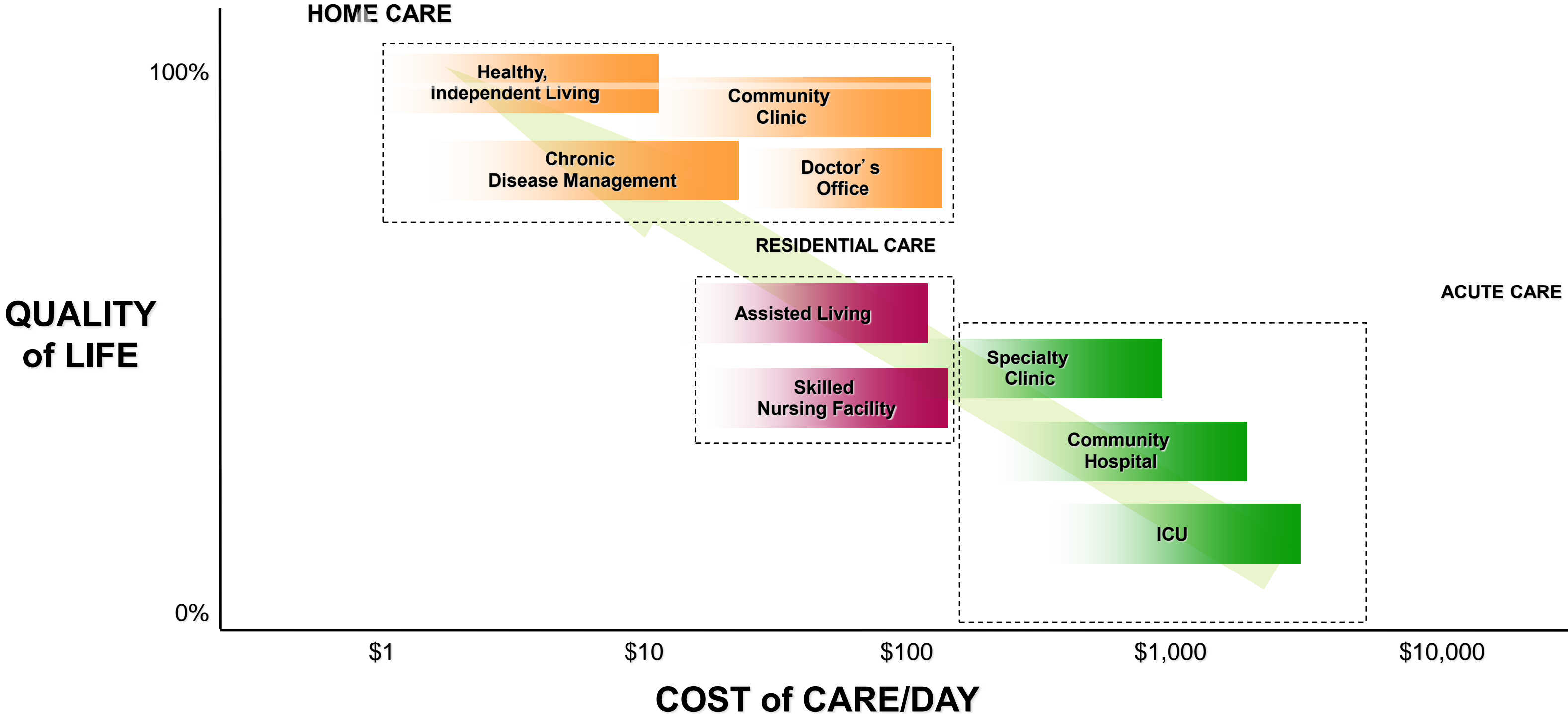
Current care models focus primarily on acute care



Can we suppress these acute events?



'Shift Left' of Healthcare through Technology¹



1) from Intel, and Center for Aging Services Technologies (CAST)



Improved Health Outcomes : Home Hemodialysis

- Normalization of blood pressure without the need for anti-hypertensive medications
- Normalization of abnormal wall thickness of the heart
- Restoration of impaired heart function
- Improvement in peripheral circulation
- Improvement in sleep quality
- Improvement in nutritional determinants
- Elimination of dietary restriction
- Patient autonomy
- Cost effective modality

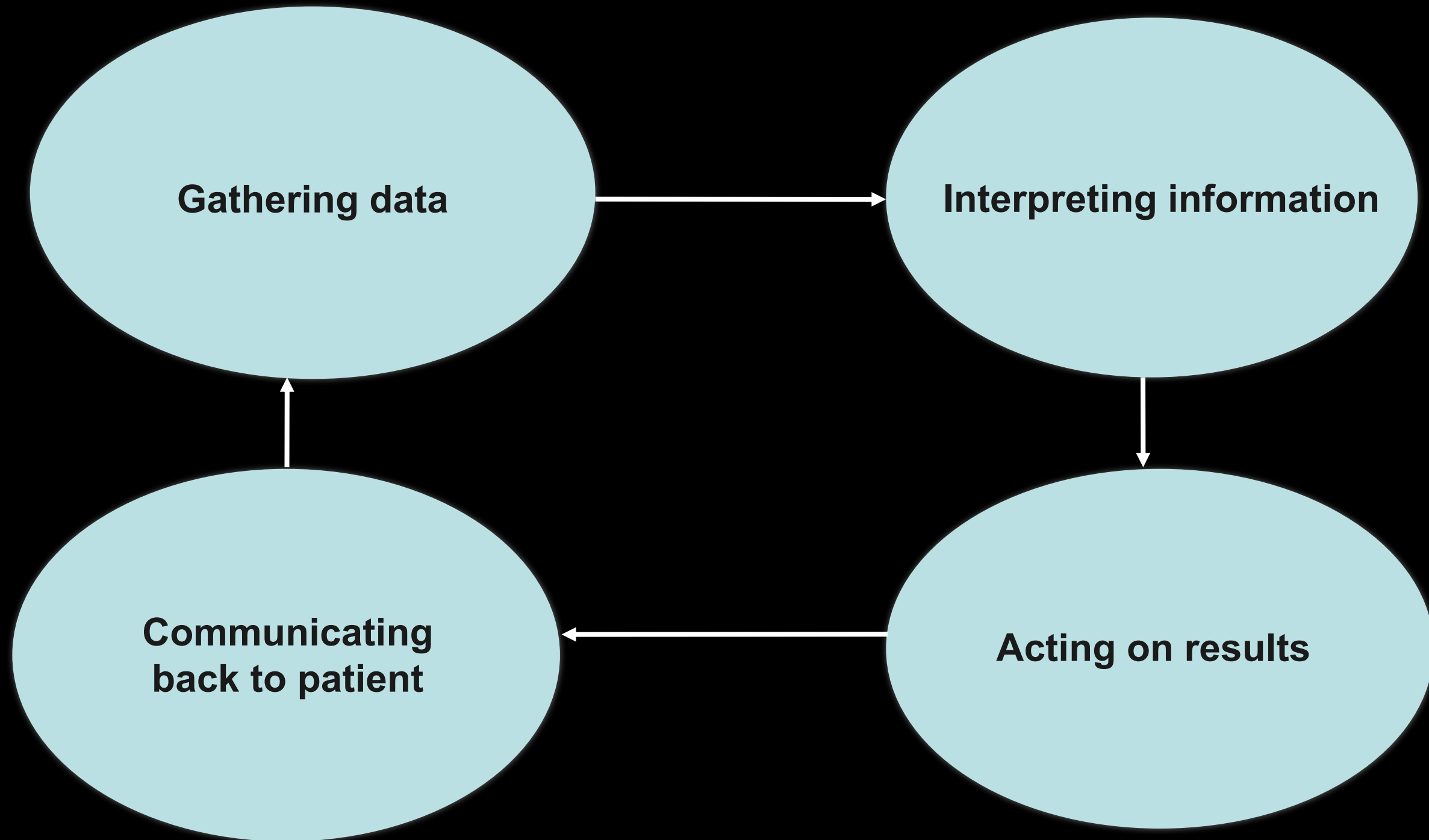
Chan et al : KI, 2002, Chan et al: NDT, 2003 Chan et al: AJKD, 2003,
Hanly et al: NEJM, 2001
Pierratos et al: JASN, 1998

Patient-Perceived Barriers to Home Hemodialysis

- Perceived burden on family members
- Fear of self-cannulation
- Fear of a catastrophic event in the absence of nursing support
- Low self-efficacy



Patient-Provider Feedback Loop



Remote Monitoring and Self-Care

“Classic” Remote Patient Monitoring

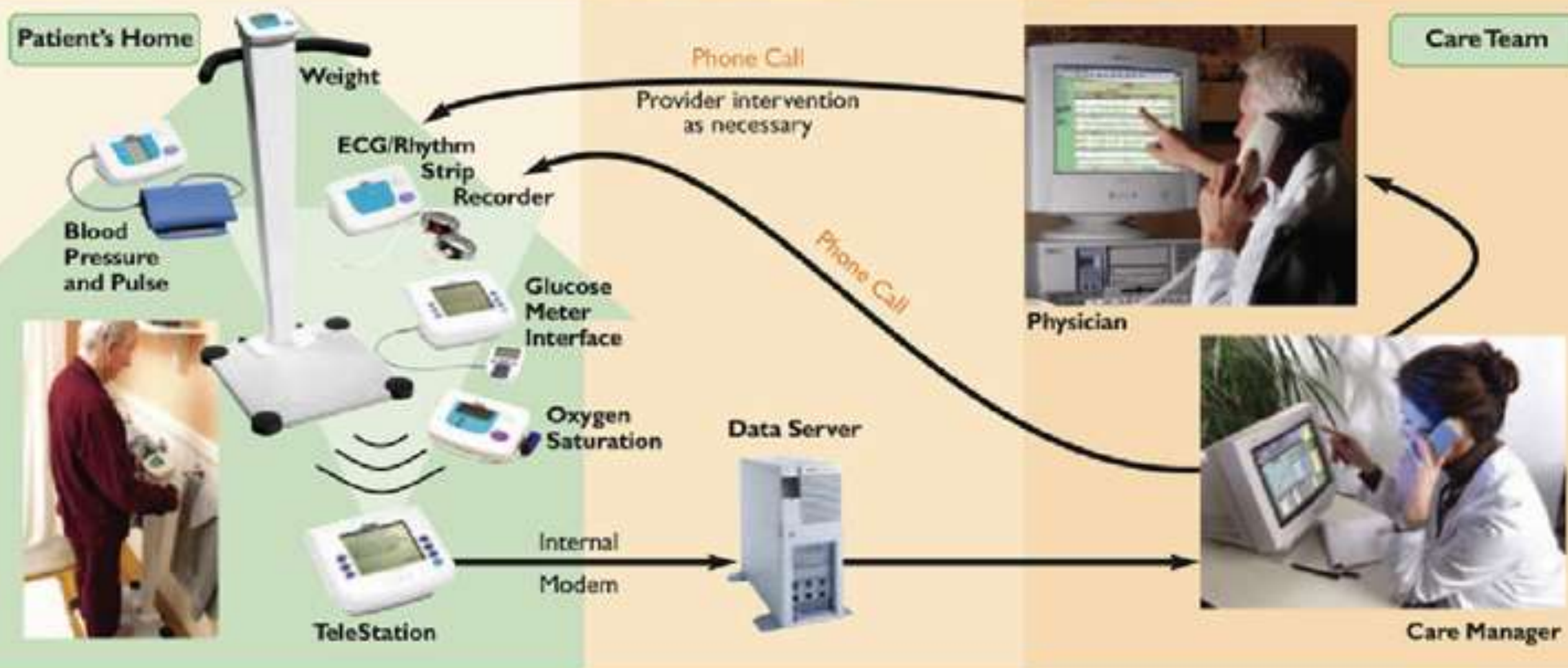


Joseph Hayduk, 86, is heart failure and uses a device that transmits his vital signs to a RN at Meridian Health. The RN calls all 18 patients in program daily. The New York Times Feb 13, 2009

VITAL SIGNS MEASUREMENTS AND SURVEY RESPONSES

AUTOMATIC DATA COLLECTION AND TRANSMISSION

DATA PRESENTATION AND CLINICAL REVIEW SOFTWARE

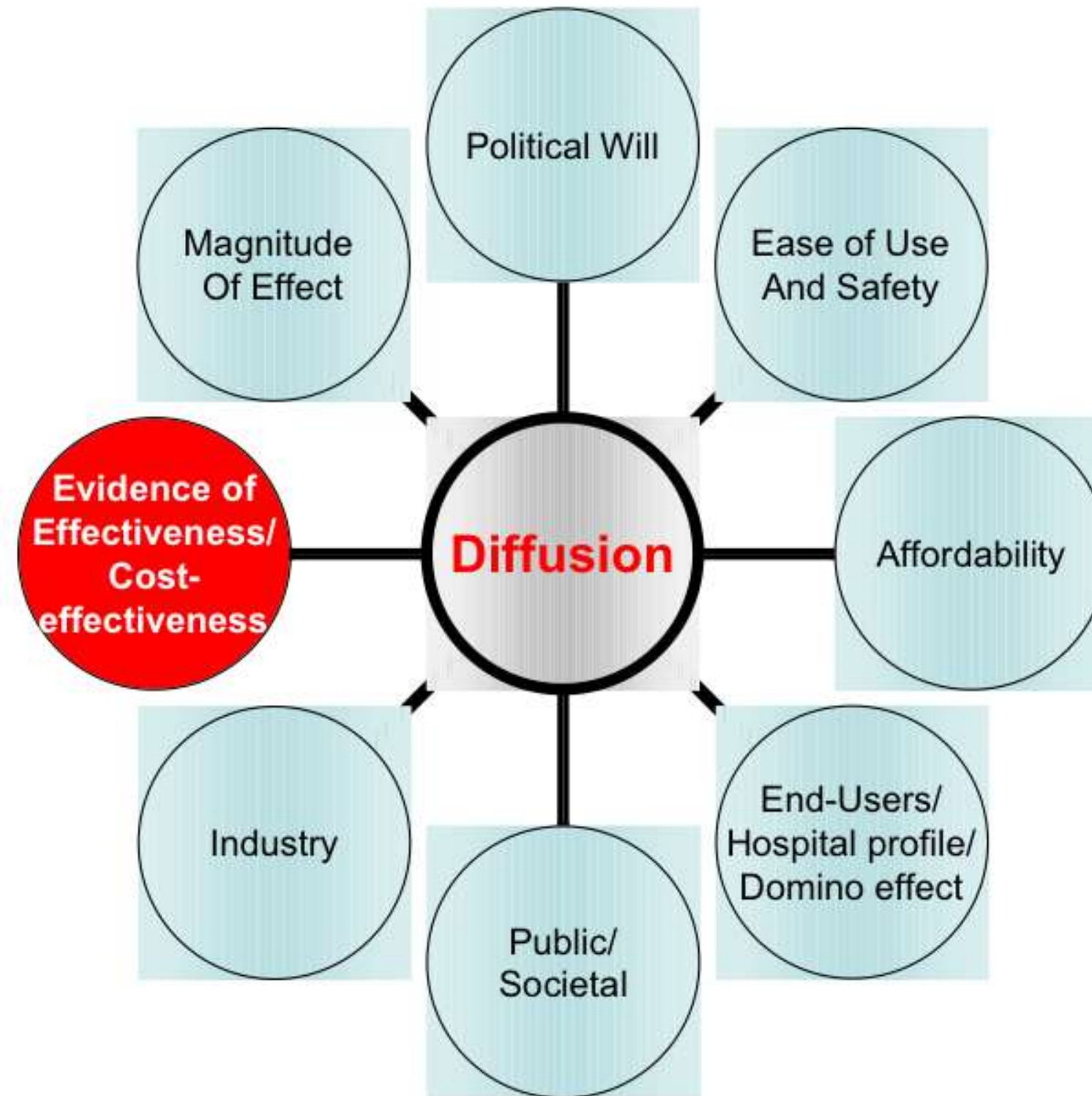


Members take their own measurements at home using the Philips Patient Telemonitoring Set.

Results are automatically transmitted via modem using an ordinary home telephone line to a dedicated server.

A care manager reviews patient information, and follows up with a phone call to members or their physician, as needed.

Forces Affecting the Diffusion of Health Technologies



Shea et al. Study

Research Paper ■

A Randomized Trial Comparing Telemedicine Case Management with Usual Care in Older, Ethnically Diverse, Medically Underserved Patients with Diabetes Mellitus

STEVEN SHEA, MD, RUTH S. WEINSTOCK, MD, PhD, JUSTIN STARREN, MD, PhD, JEANNE TERESI, EdD, PhD, WALTER PALMAS, MD, LESLEY FIELD, RN, MSN, PHILIP MORIN, MS, ROBIN GOLAND, MD, ROBERTO E. IZQUIERDO, MD, L. THOMAS WOLFF, MD, MOHAMMED ASHRAF, BA, CHARLYN HILLIMAN, MPA, STEPHANIE SILVER, MPH, SUZANNE MEYER, RN, DOUGLAS HOLMES, PhD, EVA PETKOVA, PhD, LINNEA CAPPS, MD, RAFAEL A. LANTIGUA, MD, for the IDEATel Consortium

Abstract **Background:** Telemedicine is a promising but largely unproven technology for providing case management services to patients with chronic conditions who experience barriers to access to care or a high burden of illness. **Methods:** The authors conducted a randomized, controlled trial comparing telemedicine case management to usual care, with blinding of those obtaining outcome data, in 1,665 Medicare recipients with diabetes, aged 55 years or greater, and living in federally designated medically underserved areas of New York State. The primary endpoints were HgbA1c, blood pressure, and low-density lipoprotein (LDL) cholesterol levels.

Results: In the intervention group ($n = 844$), mean HgbA1c improved over one year from 7.35% to 6.97% and from 8.35% to 7.42% in the subgroup with baseline HgbA1c $\geq 7\%$ ($n = 353$). In the usual care group ($n = 821$) mean HgbA1c improved over one year from 7.42% to 7.17%. Adjusted net reductions (one-year minus baseline mean values in each

Shea et al. Study

- RCT, n=844, 1 year duration
- Poor, under-served, minority population
- Study noted improvements in:
 - HgA1c
 - Blood pressure
 - LDL cholesterol levels

ORIGINAL ARTICLE

Telemonitoring in Patients with Heart Failure

Sarwat I. Chaudhry, M.D., Jennifer A. Mattera, M.P.H., Jephtha P. Curtis, M.D.,

In summary, a telemonitoring strategy failed to provide a benefit over usual care in a setting optimized for its use. Previous claims of success of similar strategies, based on studies with small populations of patients and methodologic weaknesses, are not supported by the results of our large, multicenter trial.

Forbes

HEALTHCARE

Why Remote Patient Monitoring Is Overhyped

Nov. 18 2010 - 9:55 am | 1,422 views | 0 recommendations | 13 comments

Telemonitoring of patients with chronic conditions is a hot concept in the tech world. Companies like Intel, General Electric, Philips, and numerous upstarts are pursuing various gadgets that aim to provide seamless communication between patients and their doctors. The premise is that people with chronic diseases like heart failure and diabetes will do better and avoid complications if there are better means to communicate daily fluctuations in symptoms with their health providers. But two big new studies show, shockingly, that better communication may not be enough. Yale cardiologist





Structured telephone support or telemonitoring programmes for patients with chronic heart failure (Review)

Authors' conclusions

Structured telephone support and telemonitoring are effective in reducing the risk of all-cause mortality and CHF-related hospitalisations in patients with CHF; they improve quality of life, reduce costs, and evidence-based prescribing.

Back to Shea *et al*

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SHEA ET AL., Randomized Trial Comparing Telemedicine Case Management

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Cost of intervention:

\$3,425 US

per patient

Spyglass Study of 100 Care Organizations

“A few barriers have to be removed for remote monitoring to really take hold... the cost of devices and peripherals at about \$3,000 to \$5,000 now has to come down to a more affordable price of \$300 to \$500.”

“They should be sold through stores like Wal-Mart or Best Buy”







Congestive Heart Failure Client

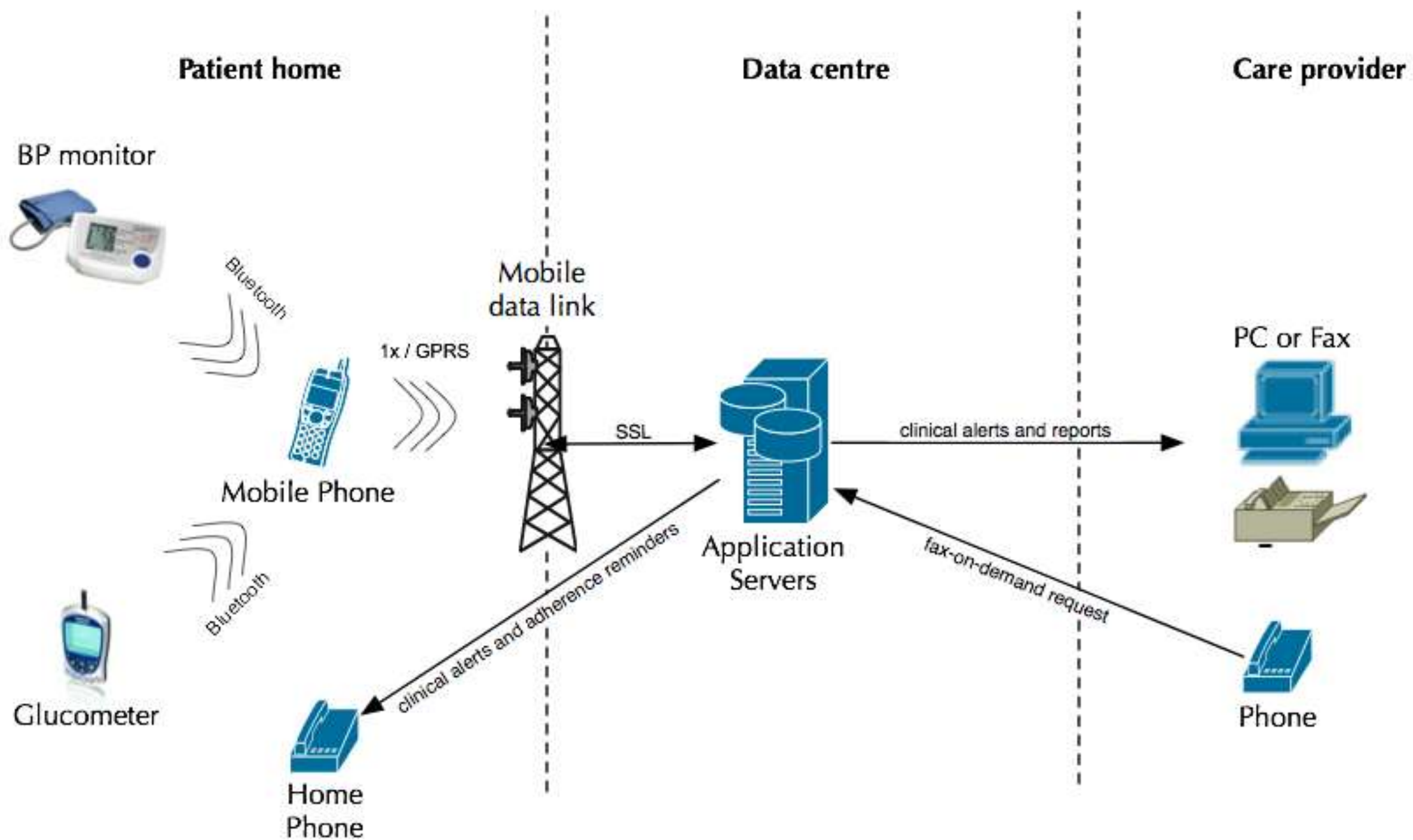



















 BlackBerry

Symptoms

Have you fainted?

- 1 No
- 2 Yes
- 3 Cancel

BlackBerry

Symptoms

Has your breathing at night worsened?

- 1** No
- 2** Yes
- 3** Cancel

BlackBerry

Summary

Weight **154.4** (-0.2)

BP **105**
78

Pulse **74** /min

Sympt. **Abnormal**

Contact HF Clinic/ family
Dr. Go to Emerg Dept if
you feel you should

Press 1 for menu

BlackBerry

Details Needed

110 / 80

Pulse: 74 /min

Taken Today 10:00 AM

Was this?

- 1 First thing in the morning
- 2 During the day



EXIT

EXIT

→ Cardiac

↑ Hospital Lobby
↑ Cardiac Administration
↑ Ambulatory Cardiac Clinics
↑ Cardiac Imaging
↑ Cardiac Services

Cardiac Administration
← Ambulatory Cardiac Clinics



Fred

Heart Failure Patient

Study Participant



Heather Ross MD, MHS, FRCP(C)

Project Clinical Champion

Medical Director, Cardiac Transplant Program

University Health Network

Clinical trials

- Diabetic hypertension pilot - complete
- Blood sugar and hypertension - complete
- Gestational diabetes pilot - complete
- **Diabetic hypertension RCT - complete**
- **Congestive heart failure RCT - complete**
- **Gestational diabetes RCT - complete**
- **Adolescent type 1 diabetes pilot - complete**

Clinical trials

Diabetic Hypertension RCT

Blood Pressure
automatically
transmitted to
BlackBerry



Blood Sugar readings
automatically sent to
BlackBerry



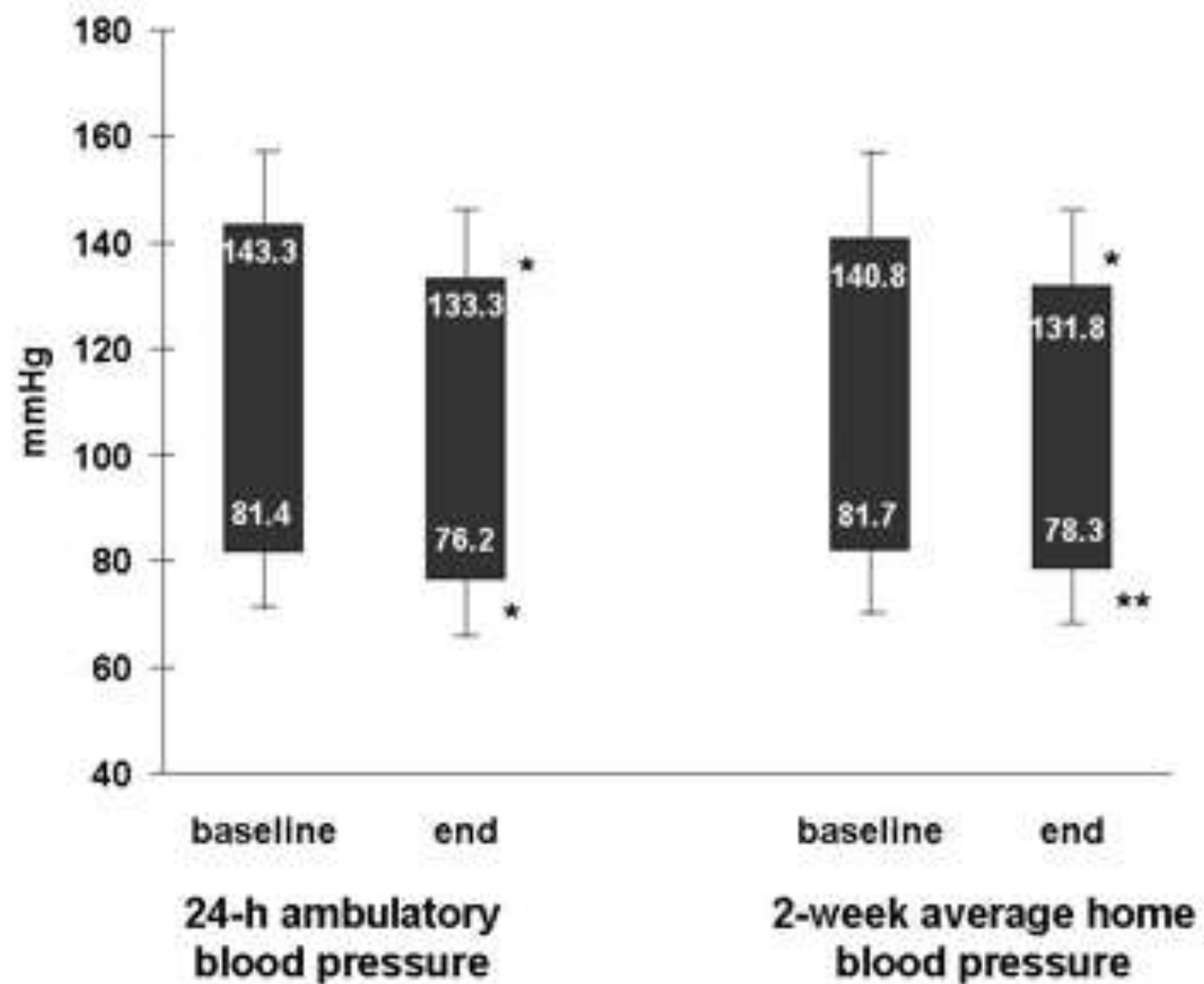
Results can be graphed to show progress and trends



Pilot Results

Diabetic Hypertension

American Journal of Hypertension,
20(9), pp. 942-948, 2007



Intervention group
(55 patients)

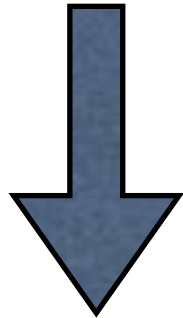


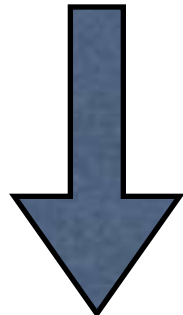
Control group
(55 patients)



Intervention group
(55 patients)

Control group
(55 patients)

systolic  -9.1 mmHg

diastolic  -3.2 mmHg

no change

What else did we learn?

the physicians weren't responsible for the improvement

no additional meds
no significant changes in management

What else did we learn?

the mechanism appears to be
patient self-awareness, accountability

an adherence mechanism is important

giving them a monitor isn't enough

Clinical trials

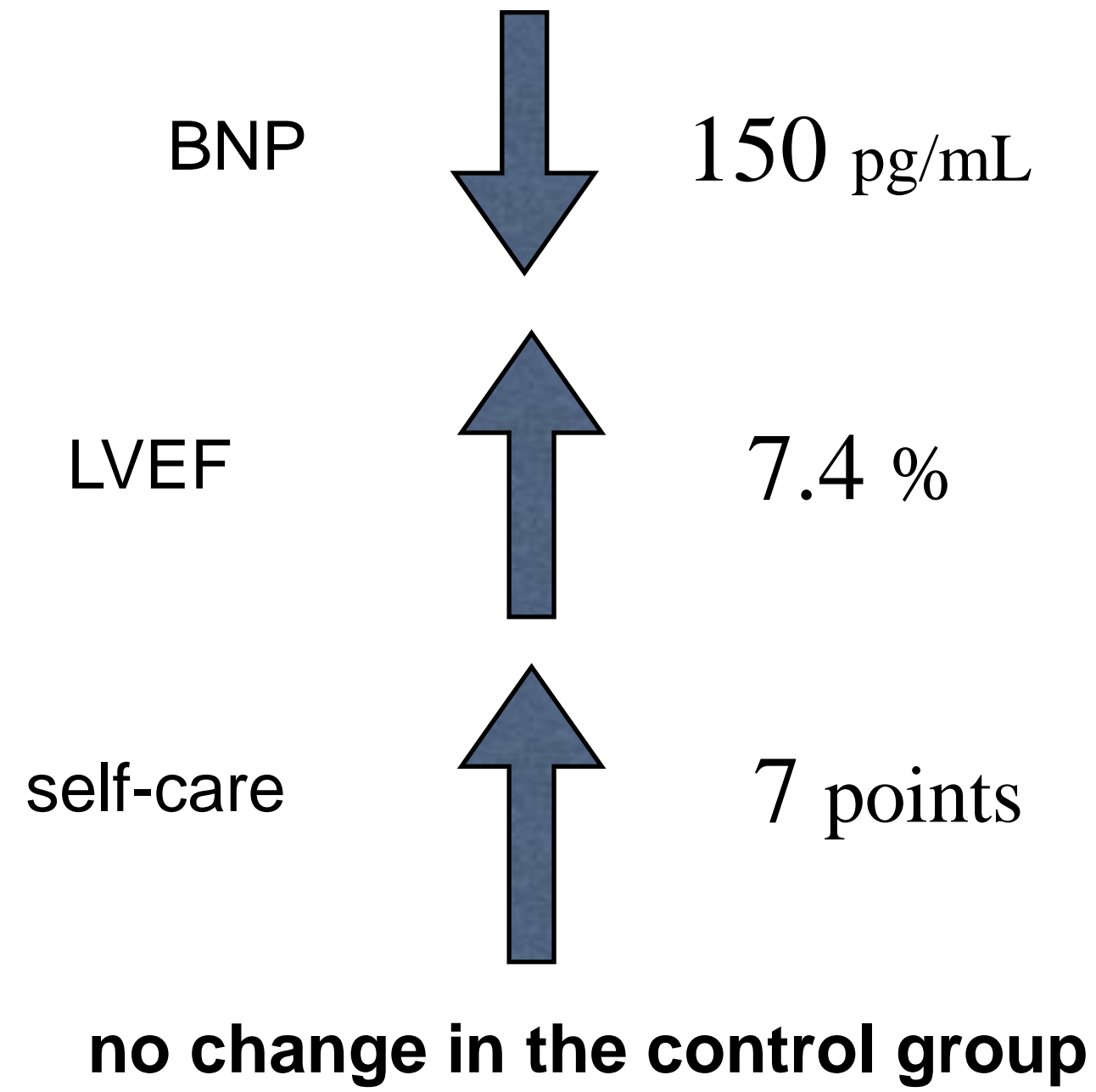
Heart Failure RCT

RCT Study design

- N=100
- duration 6 months
- daily measurements before 10 am - reminder call
- alert algorithm - messages direct to cardiologist
- control group - usual care

RCT Results

Congestive Heart Failure



Conclusion

mHealth and RPM needs
rigorous, evidence-based design

passive monitoring doesn't work

“active” monitoring is required

The future of mHealth is patient-focused,
social, and consumer-initiated

Mobile apps are a natural, ubiquitous means for the potential delivery of health services to young diabetes patients.





Diabetes apps already flooding the market from both hobbyists and diabetes product providers.



These apps are poorly differentiated and more or less simply electronic versions of their paper counterpart: the paper log



For clinicians, the routine, passive logging of blood sugar, whether paper-based or electronic, is often ineffective in aiding young patients with self-care and glycemic control

SickKids[®]

THE HOSPITAL FOR SICK CHILDREN



Time	09:15	12:50	13:30	16:05	18:00	20:15	22:35
> 300 mg/dl							
> 250 mg/dl							
> 200 mg/dl							
> 130 mg/dl	170						136
> 100 mg/dl							
> 70 mg/dl							
Event	11	56	14	45	47	50	
Carbs	66	24	60	36	36+84	36	
Bolus	2+10		7		9		
Basal	9						12
Lipos	142/72/7						
Exercise			Mountain				
Kcal							
Trinkmenge							
Kopfchvater?	Yes						

35



University Health Network

SickKids[®]

a diabetes app
for the ePatient

The next generation diabetes app is ...



mobile

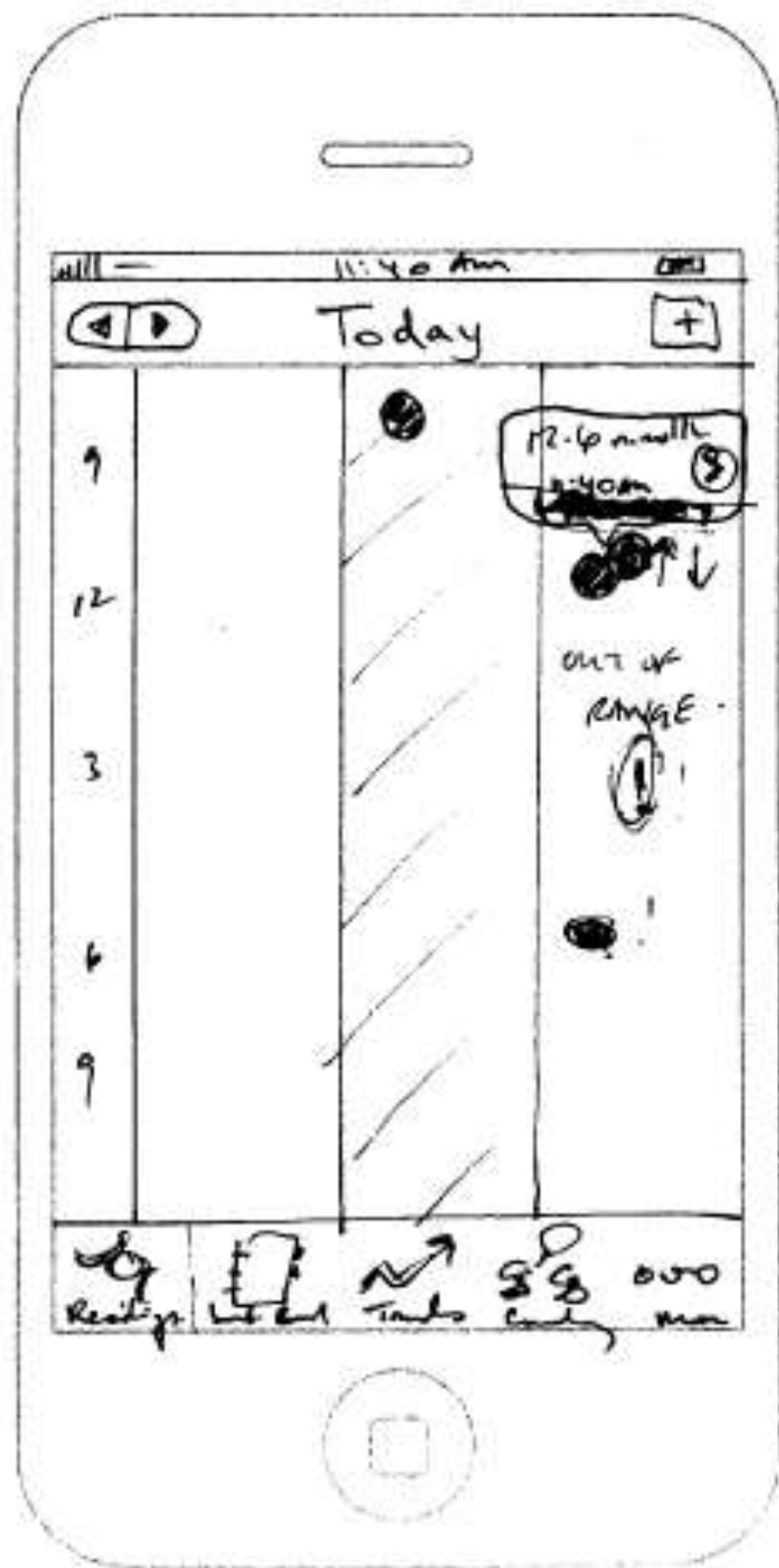
encourages active self monitoring

provides “teachable moments”

allows communication with
parents and providers

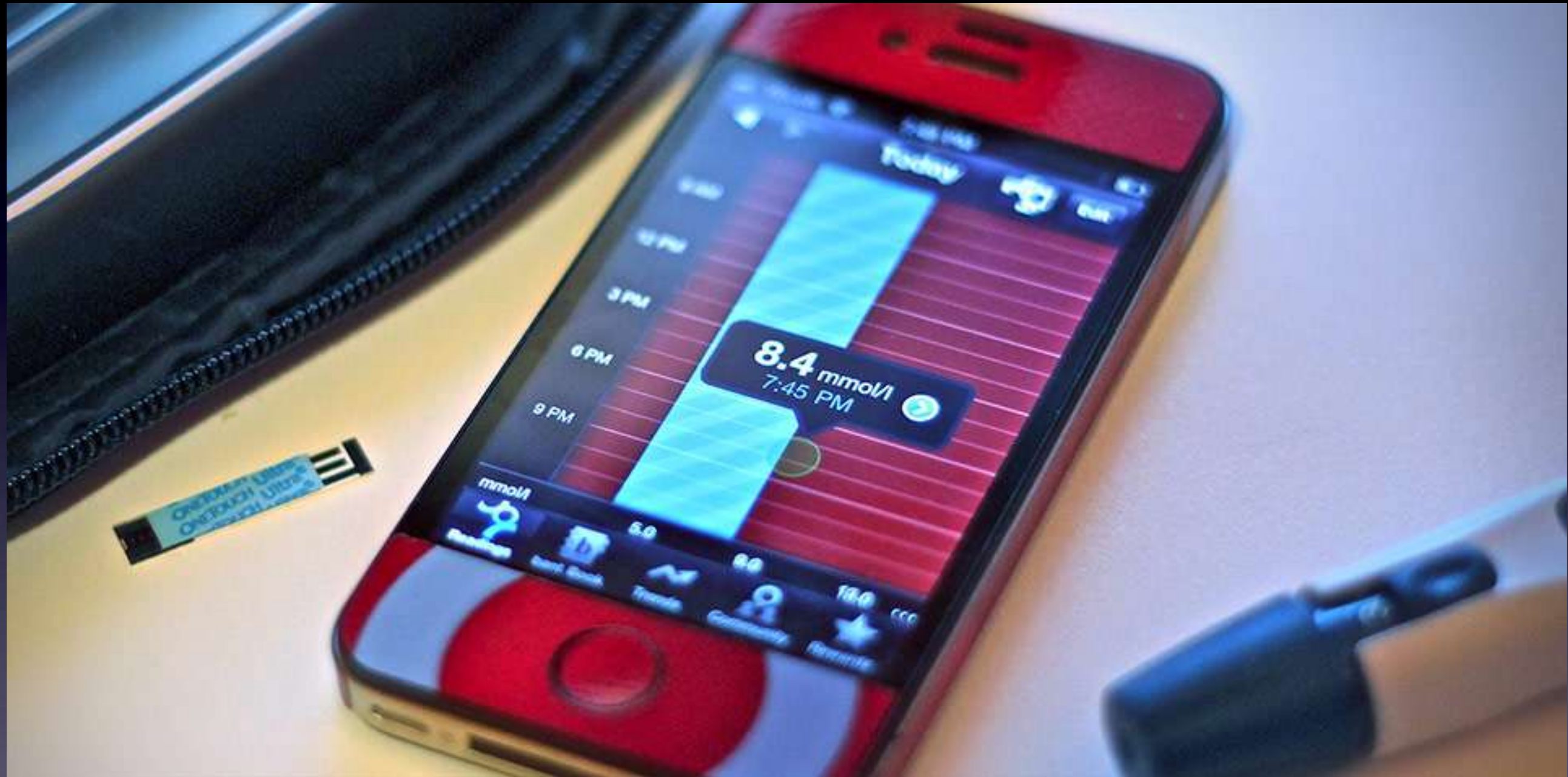
creates engagement and adherence through a social community

promotes positive health behaviors
through *rewards*





Version 1



twitter



LeighannMMM DD was 76 before her 45 min hip hop class. Gave 2 snacks – hope it's enough to get her through.

[#diabetes](#) [#bgnow](#)

about 7 hours ago from TweetDeck



diabetesalic [#bgnow](#) 86

about 7 hours ago from web



cdalexander had a BG reading of 89 mg/dL at 02:36PM (Afternoon) [#bgnow](#) [#diabetes](#)

about 7 hours ago from Twitter4R



rainbow_goddess [#bgnow](#) 3.2 mmol/l No wonder I feel like going to sleep here at my desk.

about 8 hours ago from web



babscampbell 198 [#bgnow](#)

about 8 hours ago from TweetDeck

Partnered with Google and Microsoft



Shares data securely with Google Health and Microsoft HealthVault



Social Networking via diabetes community on Twitter



Available in ten languages

Nî hâu

Néih hóu

Zdravstvuite

Hello

Buenos días

Annyong ashimnikka

Bonjour

Guten Tag



Available on the
App Store

Downloads:
>42000

more than
8000 active
daily users

COUNTRY	PERCENTAGE
United States	34.4%
Korea	12.9%
Canada	11.4%
Italia	9.9%
China	4.8%
Brazil	3.6%
France	3.2%
Mexico	2.9%
Spain	2.8%
United Kingdom	2.3%

Clinical Pilot

SickKids[®]

Pilot

20 adolescents aged 12-16 years
with an uncontrolled HbA1c between 8-10%

Duration of the pilot was 3 months

Pilot

20 adolescents aged 12-16 years
with an uncontrolled HbA1c between 8-10%

Duration of the pilot was 3 months

Supplied with the bant application running on an iPhone 4 and a LifeScan OneTouch UltraMini glucometer with a Bluetooth adapter

The outcome measure was
the average daily frequency of blood glucose measurement
during the pilot compared to the period three months prior



Version 2

User-centered design phase

THEME:

*Data collector vs. decision-
maker*

THEME:

Fast, discrete transactions:

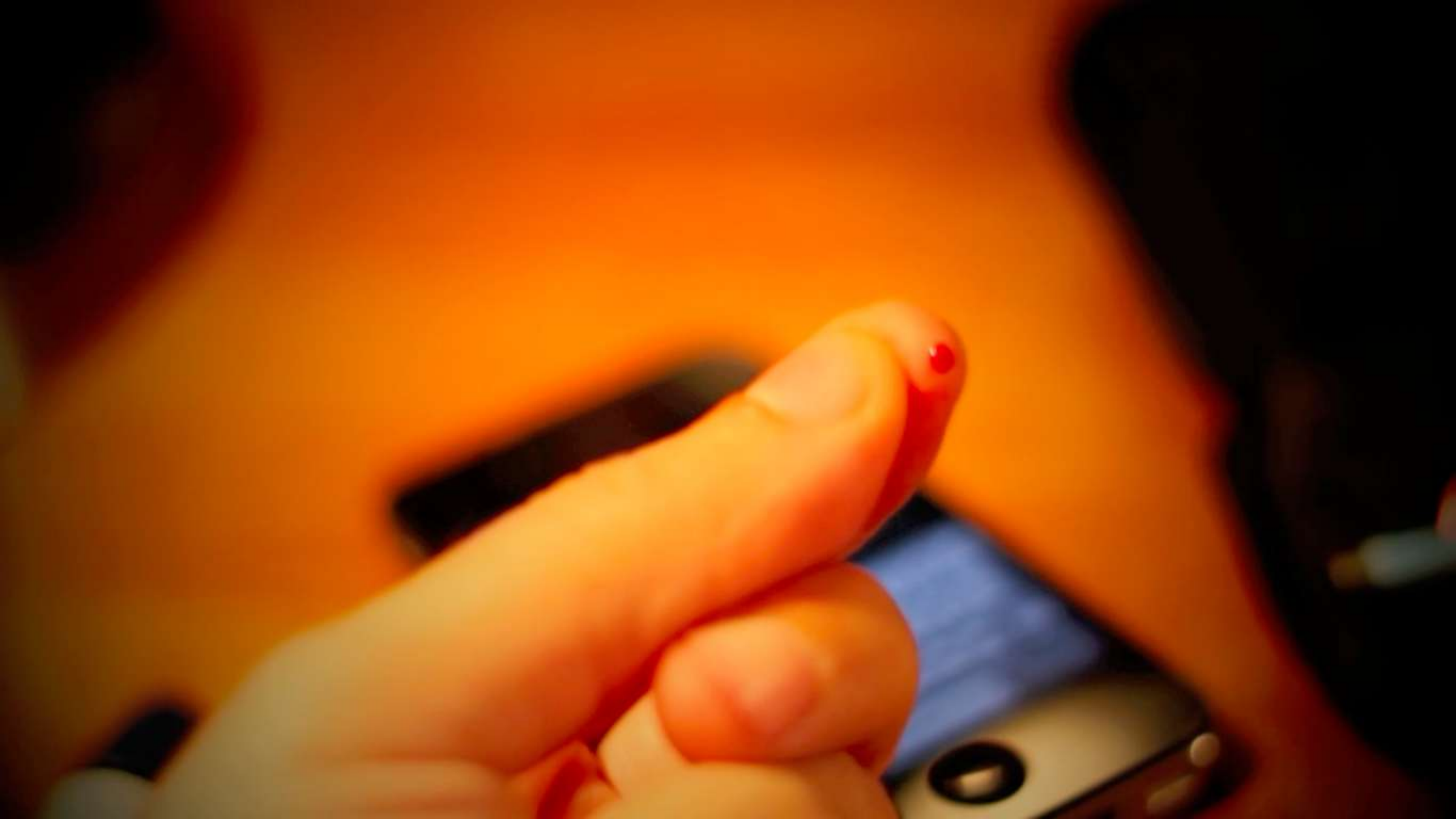
THEME:
Overcoming inertia

THEME:

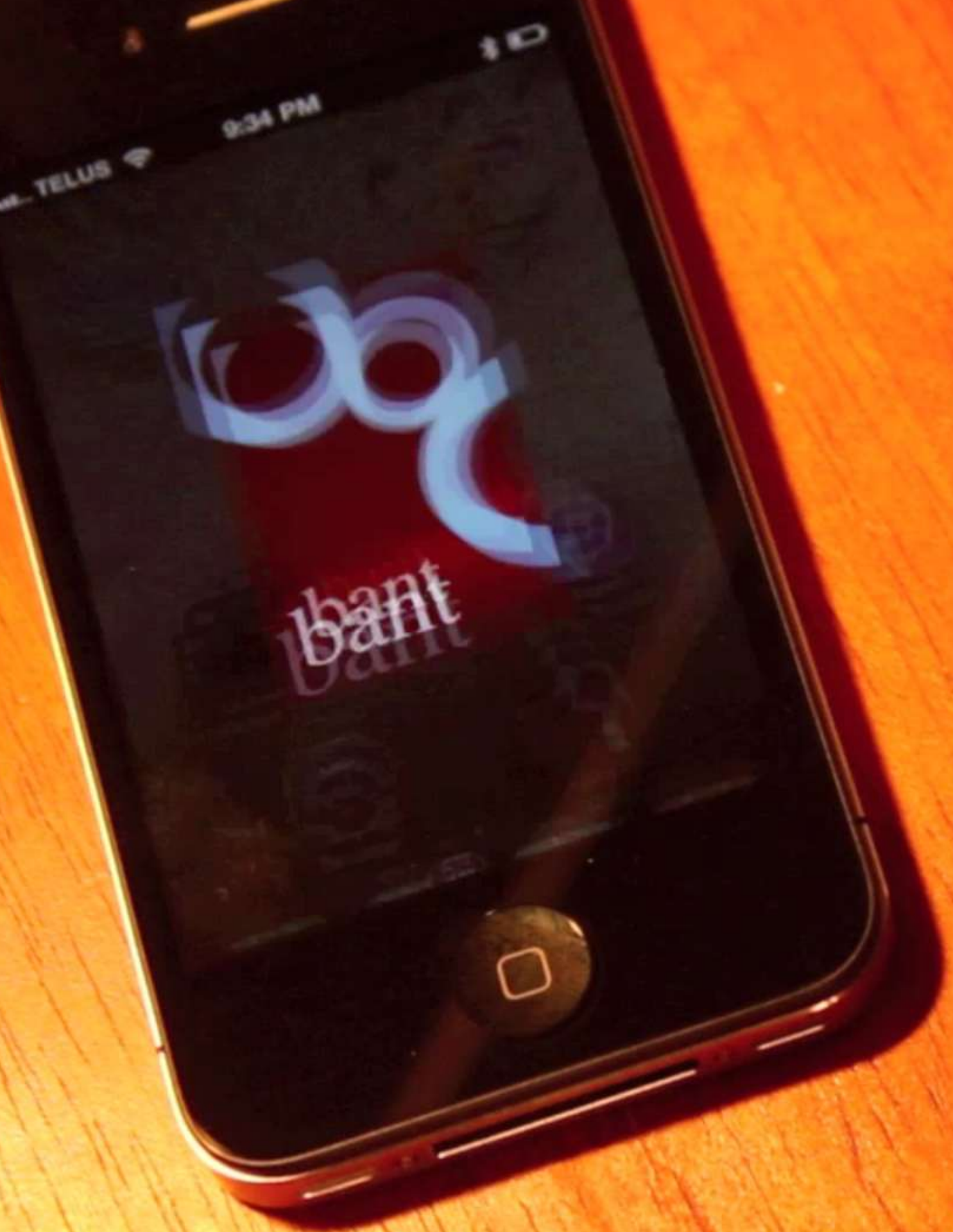
Ad hoc information sharing

















bant Book

5.1 mmol/l >

5.6 mmol/l >

5.0 mmol/l >

Readings

bant Book

Trends

Community

More

1 day ago

Light	5.1 mmol/l >
et	5.6 mmol/l >
Snack 1 reading	5.0 mmol/l >
Dinner 3 readings	5.0–5.2 mmol/l >
Bedtime 4 readings	5.2–5.6 mmol/l >

1 day ago

- Readings
- bant Book**
- Trends
- Community
- More



Loading...

#bant



Readings

Mint Book

Trends

Community

More



Community

- 

bantapptester1
20 9 mmol/l
Oh damn! A little late with my bolus tonight as I tried to work through dinner. This is where timing of insulin and food come in
- 

bantapptester3
Timestamps in Rewards feed dont update.
- 

bantapptester12
#bgnow 6.4 mmol/l
- 

bantapptester7
11.0 mmol/l Was the Second of 2 rdgs ... First one missing

Readings bant Book Trends **Community** More







OneTouch Ultra Mini
integration

both wired and wireless

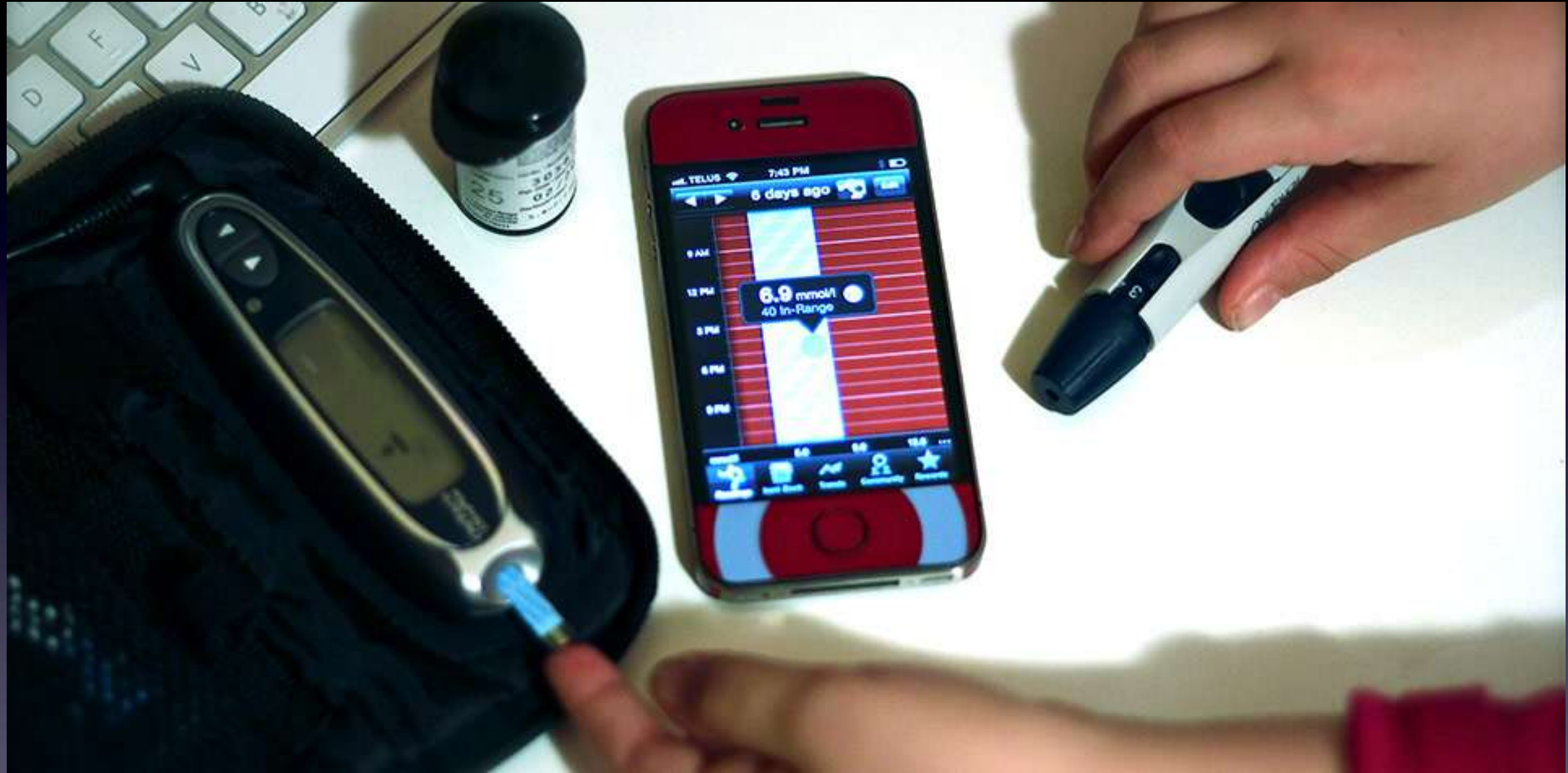
Made for
 iPod  iPhone  iPad

OneTouch Ultra integration

Bluetooth Adapter



Made for
iPod iPhone iPad



Carrier



5:59 PM



1 day ago



Edit



mmol/l

5.0

9.0

13.0

...



Readings



bant Book



Trends



Community



Rewards



bant Book

bant
Book

Today

	Overnight 1 reading	14.0 mmol/l >
	Breakfast 1 reading	11.4 mmol/l >
	Lunch 1 reading	4.0 mmol/l >
	Dinner 1 reading	3.2 mmol/l >



Readings



bant Book



Trends



Community



Rewards

7-Day

14-Day

21-Day

90-Day

bant Trends

Overnight

7 readings



14% under, 29% in, 57% over goal range

Breakfast

7 readings



14% under, 14% in, 71% over goal range

Lunch

7 readings



29% under, 14% in, 57% over goal range



Readings



bant Book



Trends



Community



Rewards

Carrier



3:53 PM



Cancel

Alert

Done

Opps! This trend is still going.
Please review your selections.



6 Low Lunch Readings

Oct 3 - Oct 7

What will you do to stop this Low trend from continuing?

Adjust basal



Adjust bolus



Change ratio



Improve carb counting

Other

Carrier

12:54 PM



Trends

Alerts (21-Day)

Lunch

6 readings



11.6 mmol/l average



3 High Lunch readings

Cause: Food

Fix: Adjust basal



Readings



bant Book



Trends



Community



More

Carrier



6:04 PM



Settings

Done

Readings Graph

Labels, Colors & Reminders >

Day starts at 6:00 AM >

Sharing

Connects with
 TELUS health space™ >





Email >


About


Feedback >

Community


 [redacted] 2h
 [redacted] received: Enjoy "Night Vision Picture and Video Spy Toolbox - Pro"! Tap link to redeem: <http://bit.ly/iITEYU>


 [redacted] 11h
 I hope we could keep the iPhone/ipod touch :(


 [redacted] 1d
 To y'all r lucky you get iPhones I got a iPod but o well it's still sick


 [redacted] 1d
 [redacted] have u been to camp huronda


Community

 [redacted] 1w
 [redacted] I might go

 [redacted] 1w
 [redacted] what thing and when

 [redacted] 1w
 Sorry meant: is anyone going :P

 [redacted] 1w
 Hey.. I'd anyone going to the diabetes day thing?

 [redacted] 1w
 [redacted] hola welcome to the knew improve future lol I'm joking
 hoya)

Criteria:

- Regular Glucose Measurements
- Participation in Communities
- Therapy Control



Readings



History



Sharing



Rewards

bant encourages
positive
health behaviours
through rewards



Reward Messages



Experience Points

2h

+100 XP for 4 readings. Sticking to it!



bant Reward

10h

Enjoy "Angry Birds Rio" !!! Tap link to redeem: <http://bit.ly/dNXYZv>



bant Reward

10h

Enjoy "Night Vision Picture and Video Spy Toolbox - Pro"! Tap link to redeem: <http://bit.ly/iITEYU>



Experience Points

1d

+70 XP for 4 readings. Sticking to it!



Readings



bant Book



Trends



Community



Rewards



bant

+100 XP for 4 readings. Sticking to it!



bant Reward

10h

Enjoy "Angry Birds Rio" !!! Tap link to redeem: <http://bit.ly/dNXYZv>



bant Reward

10h

Enjoy "Night Vision Picture and Video Spy Toolbox - Pro"! Tap link to redeem: <http://bit.ly/iITEYU>

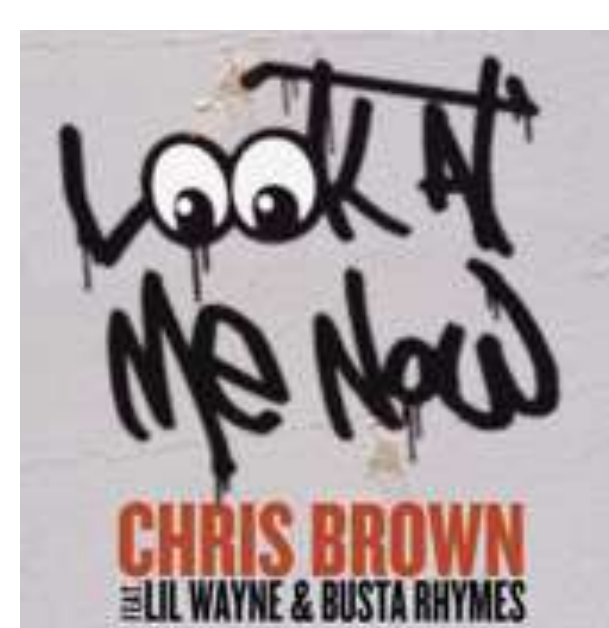


bant

Experience Points

1d

+70 XP for 4 readings. Sticking to it!



Results

 **49.6%**

Daily average frequency
of blood glucose measurement
(from 2.38 to 3.56, $p=0.006$)

Results

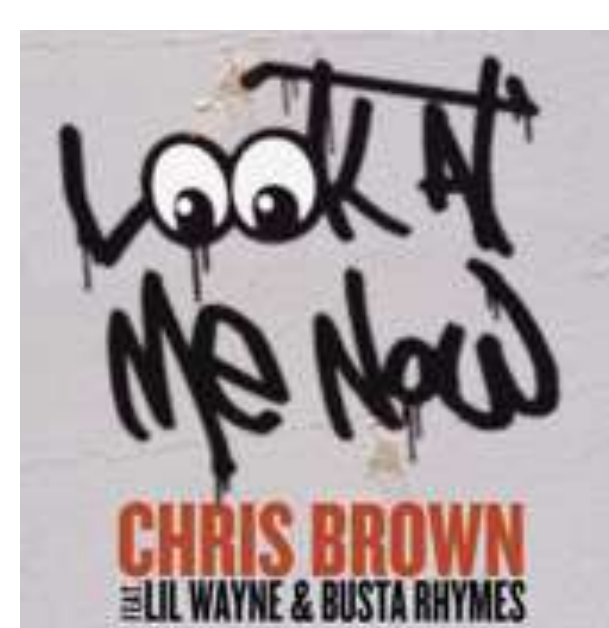
Satisfaction was high, with 87.5%
(14 of 16 subjects)
stating that they would
continue to use the system.

“... thought about trends and what to do when the alert popped up”

“... I tested more often at lunch”

“... rewards motivated me to test more”

“... she initiated more conversations about her blood sugars”













to the Dr who cures

Diabetes

Toronto Ont

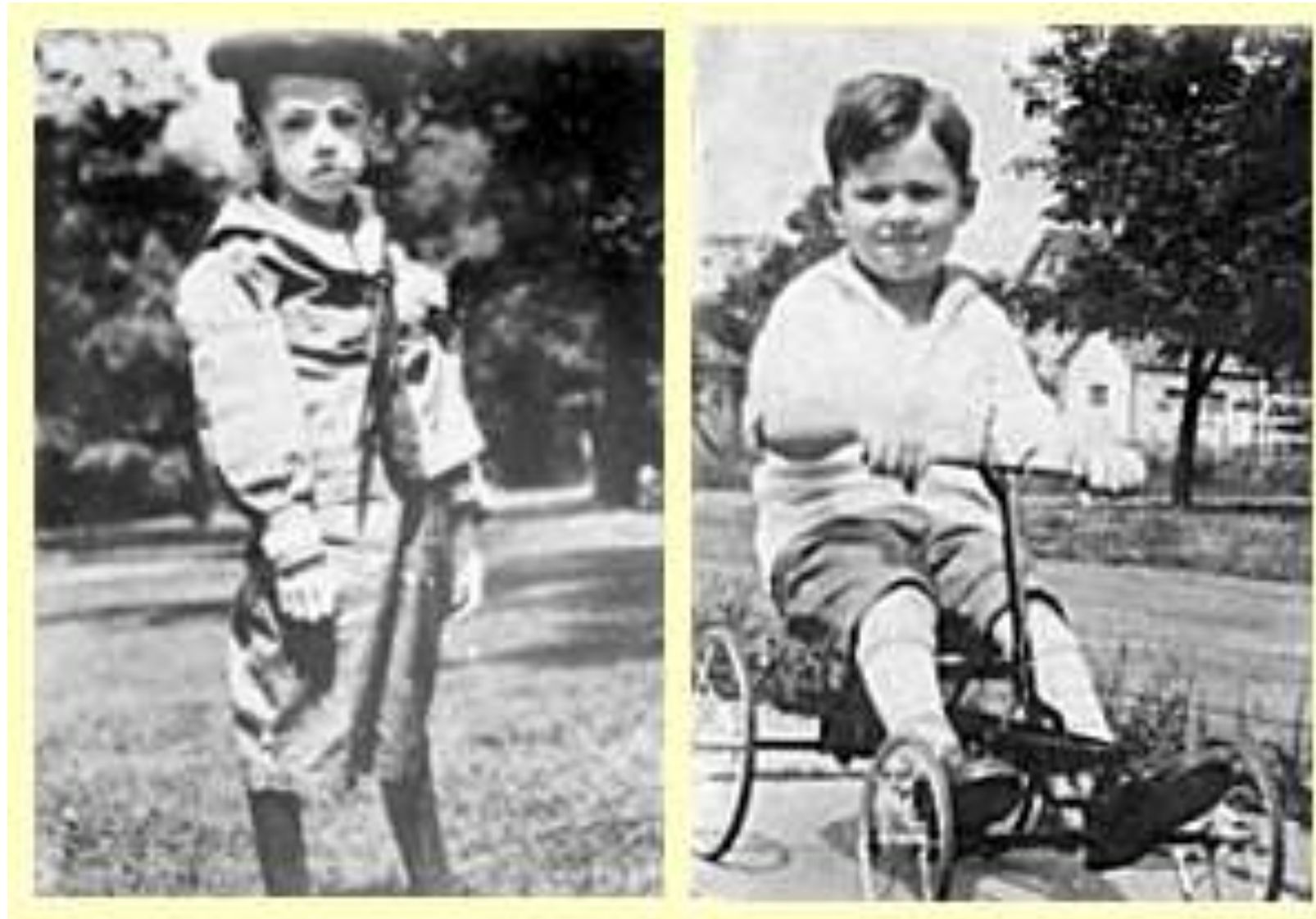




Teddy Ryder
1922

1923

DEAR DR. BANTING,
I WISH
YOU COULD COME TO
SEE ME. I AM A FAT
BOY NOW AND I FEEL
FINE. I CAN CLIMB A TREE.
MARGARET WOULD



July 1922

July 1923



bant

Conclusion

mHealth and RPM needs
rigorous, evidence-based design

passive monitoring doesn't work

“active” monitoring is required

The future of mHealth is patient-focused,
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