

# Challenges of patient education in digital health era

*Live well with diabetes*

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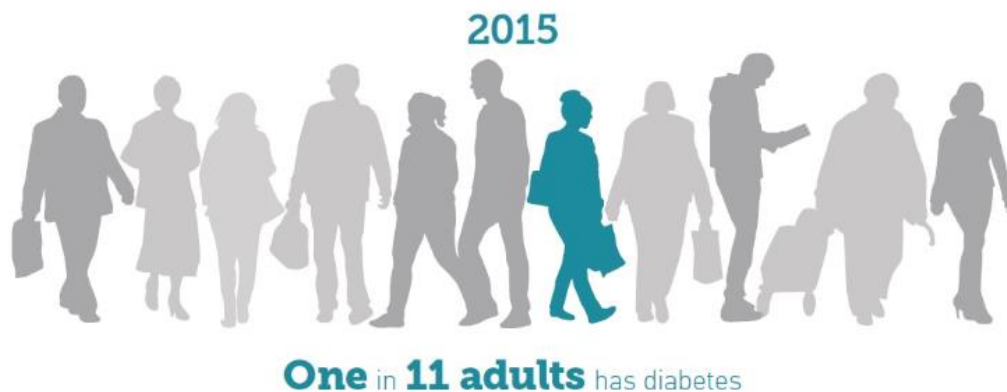
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- ***Backgrounds***
  - Importance of diabetes self-management education
  - Current challenges of diabetes education
- ***Why digital?***
- ***Diabetes education in digital era***
- ***Limitations and challenges***
- ***Suggestions for future***

# Diabetes is a complex chronic disease



- One of the top public health treats facing world
- In 2014, 387 million people had diabetes, and it will increase to 592 million by 2035



- Complex disease without proper management leads to serious complications

IDF Diabetes Atlas - Seventh Edition

# Challenges in diabetes health management

- Challenge #1: Coverage for diabetes-related medications and supplies
- Challenge #2: Medication **adherence**
- Challenge #3: **High** treatment **expenses**
- Challenge #4: No disease intervention for pre-diabetics
- Challenge #5: Complexed **self-care** during entire life
- Challenge #6: Resulting in significant morbidity, mortality, and health care resources utilization

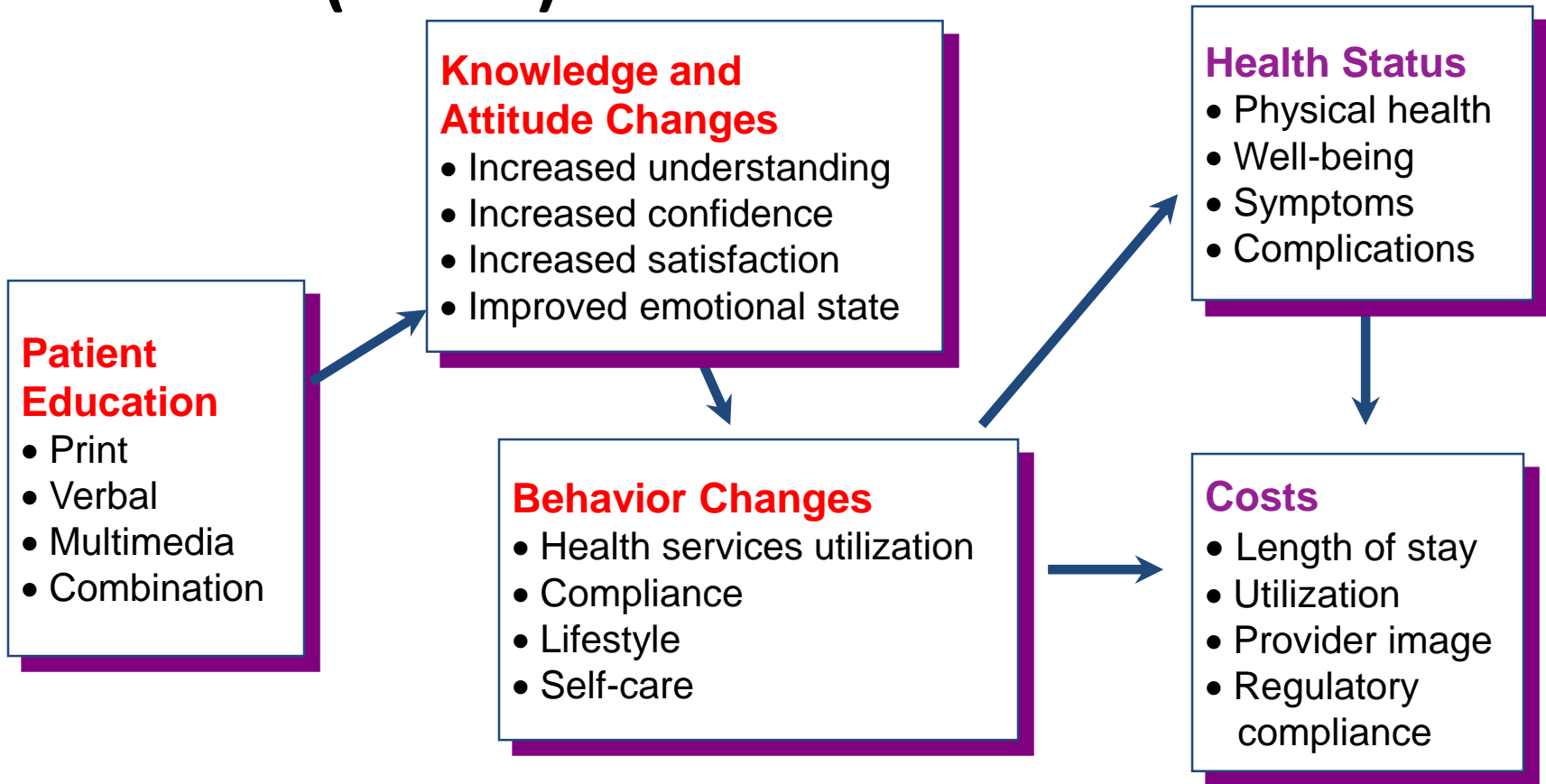
Patient and  
provider burden

Lack of data to  
inform  
therapeutic  
decision-making

Poor access to  
care

Costs

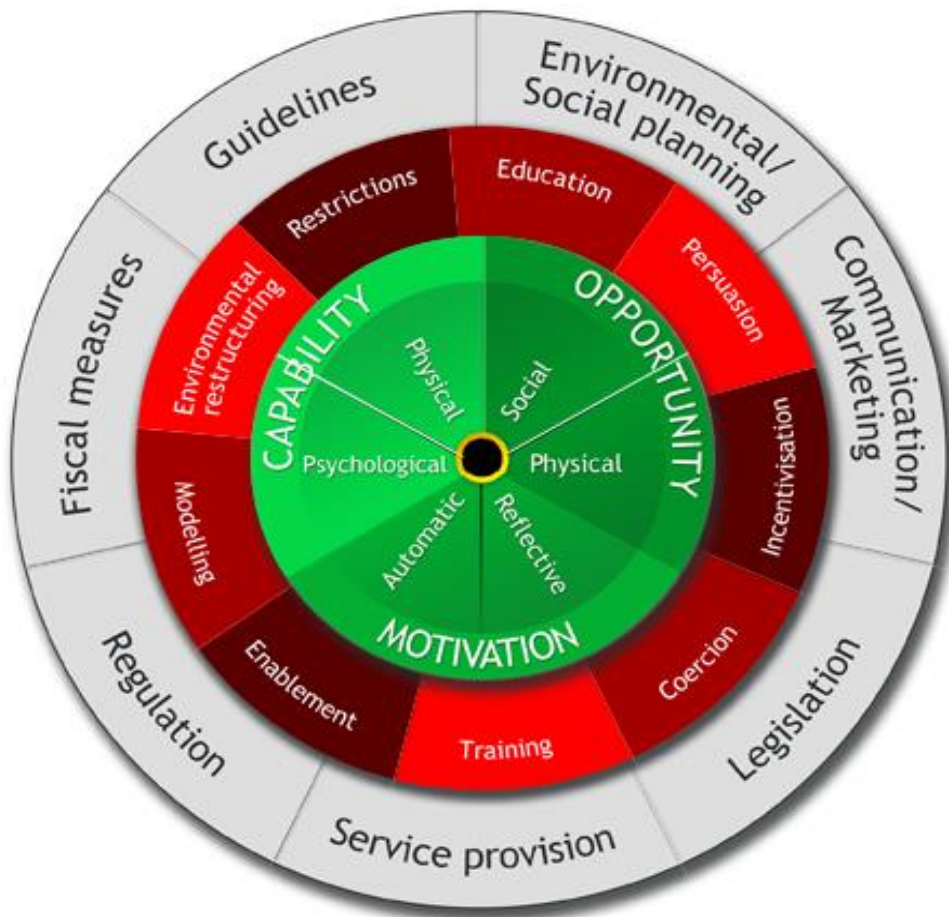
# Importance of diabetes self-management education (DSME)



Model of Patient Education Outcomes

## Background

# Behavior change and engaging the patient are critical elements of patient education



### *The behavior change wheel*

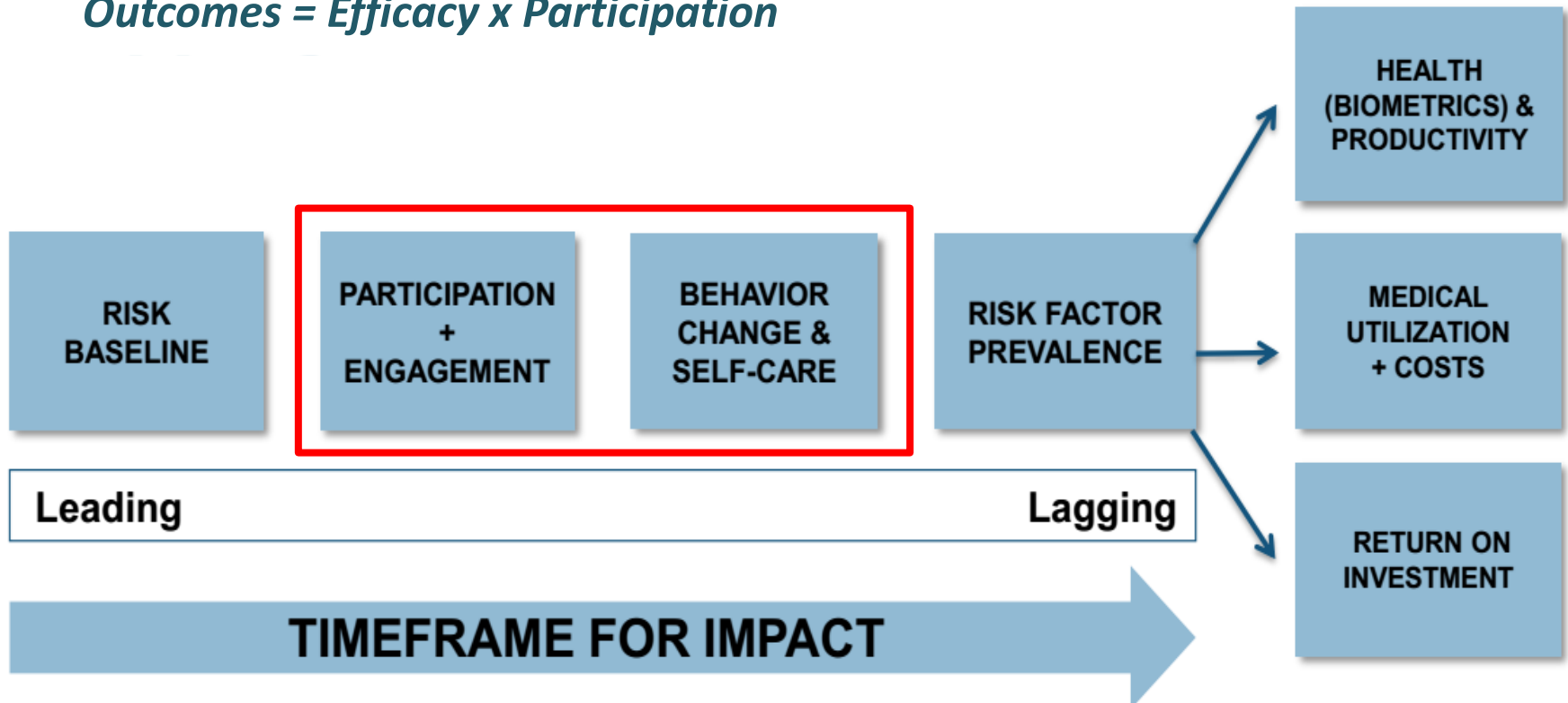
Human behavior and interaction is **very complex and requires many different perspectives and levels of inquiry** - societal, intergroup and individual - to form any sort of understanding

Michiel et al (2014) UCL for designing and evaluating behaviour change interventions.

## Background

# Engagement mapping outcomes

*Outcomes = Efficacy x Participation*



# *Challenges of diabetes education*



# 1. Patient burden

- **Geographical barriers to accessing place of patient education**
  - Patient must **travel farther to the nearest health care facility**, and have worse self-reported health status. Although 25% of the U.S. population lives in rural areas, only 10% of practicing U.S. providers reside in these areas
- **Gap between reality and education**
  - Guidelines provided by health professionals very difficult to follow / **Difficulty of applying in everyday life**
  - Diabetes also places other significant daily demands on patients, from glucose monitoring to carbohydrate counting. A study showed that people with **diabetes spend an average of 58 min/day on self-care.**
  - A study found that, if type 2 diabetes patients followed every self-care recommendation made by the American Diabetes Association (ADA), they **would have >2 hours of extra work per day.**

# Diabetes Self-management Education and Support Algorithm: Action Steps

## Four critical times to assess, provide, and adjust diabetes self-management education and support

### At diagnosis

**Annual** assessment of education, nutrition, and emotional needs

When new **complicating factors** influence self-management

When **transitions** in care occur

### Primary care provider/endocrinologist/clinical care team: areas of focus and action steps

- Answer questions and provide emotional support regarding diagnosis
- Provide overview of treatment and treatment goals
- Teach survival skills to address immediate requirements (safe use of medication, hypoglycemia treatment if needed, introduction of eating guidelines)
- Identify and discuss resources for education and ongoing support
- Make referral for DSME/S and MNT

- Assess all areas of self-management
- Review problem-solving skills
- Identify strengths and challenges of living with diabetes

- Identify presence of factors that affect diabetes self-management and attain treatment and behavioral goals
- Discuss effect of complications and successes with treatment and self-management

- Develop diabetes transition plan
- Communicate transition plan to new health care team members
- Establish DSME/S regular follow-up care

### Diabetes education: areas of focus and action steps

- Assess cultural influences, health beliefs, current knowledge, physical limitations, family support, financial status, medical history, literacy, numeracy to determine content to provide and how:
- Medications—choices, action, titration, side effects
  - Monitoring blood glucose—when to test, interpreting and using glucose pattern management for feedback
  - Physical activity—safety, short-term vs. long-term goals/recommendations
  - Preventing, detecting, and treating acute and chronic complications
  - Nutrition—food plan, planning meals, purchasing food, preparing meals, portioning food
  - Risk reduction—smoking cessation, foot care
  - Developing personal strategies to address psychosocial issues and concerns
  - Developing personal strategies to promote health and behavior change

- Review and reinforce treatment goals and self-management needs
- Emphasize preventing complications and promoting quality of life
- Discuss how to adapt diabetes treatment and self-management to new life situations and competing demands
- Support efforts to sustain initial behavior changes and cope with the ongoing burden of diabetes

- Provide support for the provision of self-care skills in an effort to delay progression of the disease and prevent new complications
- Provide/refer for emotional support for diabetes-related distress and depression
- Develop and support personal strategies for behavior change and healthy coping
- Develop personal strategies to accommodate sensory or physical limitation(s), adapting to new self-management demands, and promote health and behavior change

- Identify needed adaptations in diabetes self-management
- Provide support for independent self-management skills and self-efficacy
- Identify level of significant other involvement and facilitate education and support
- Assist with facing challenges affecting usual level of activity, ability to function, health beliefs, and feelings of well-being
- Maximize quality of life and emotional support for the patient (and family members)
- Provide education for others now involved in care
- Establish communication and follow-up plans with the provider, family, and others

# 2. Provider burden

- ***Worsening Patient-to-Provider Ratios***
  - An estimated shortage of up to 45,000 primary care providers is expected by 2020
- Diabetes educators are **challenged with identifying appropriate patient-centered educational and behavioral interventions.**
- Challenged to **support patients beyond formal training** to improve and sustain clinical and health outcomes

### 3. Economic issues

- Faced with the reality that **hospitals are cutting back or eliminating diabetes education programs**
- Patients have to receive **ongoing education**
- **Financial pressures**, reimbursement issues, poor referrals from physicians, decreased hours, issues with billing for diabetes **self-management training** and **medical nutrition therapy**, and **a need for more educators**.

### 4. Physicians vs educators

- **Should** delivery of **multidisciplinary education** for diabetes education
- Inappropriate referral system - **an improved partnership between physicians and educators** is needed for diabetes education to be sustained
- **Does not capture the full extent of patient outcomes**
  - Barriers of using patient outcomes clinically

## **5. Absence of diabetes education considering various characteristics of patient**

- **Children and adolescents with diabetes.**
- **Elderly people**
- **Low health literacy**
- **People with disabilities**

→ Customized education considering the characteristics of the subject and motivation through sustained support are needed.

**Geographical barriers**

**Gap between reality and education**

**Lack of resources: more patients than educators**

***Why digital?***

**Continuity matters**

**Cost**

**Communication**

**Need to capture comprehensive outcomes of patients**

**Variety**

## The Value Proposition

# Digital Health

Convergence of health care and technology  
: driven by the ubiquity of mobile devices and data

**H/W**



Device



Hospital



**S/W**



Data



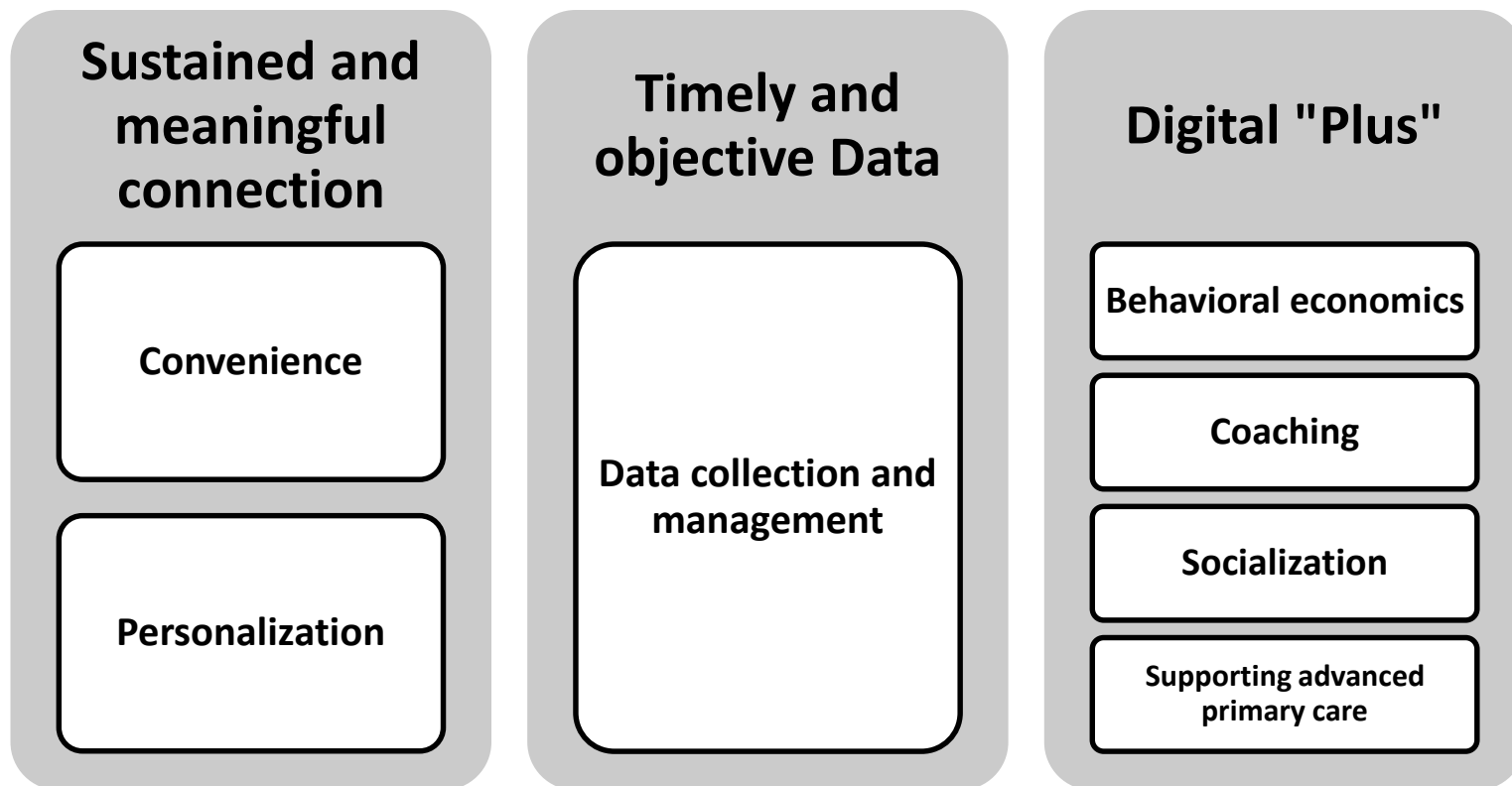
Service



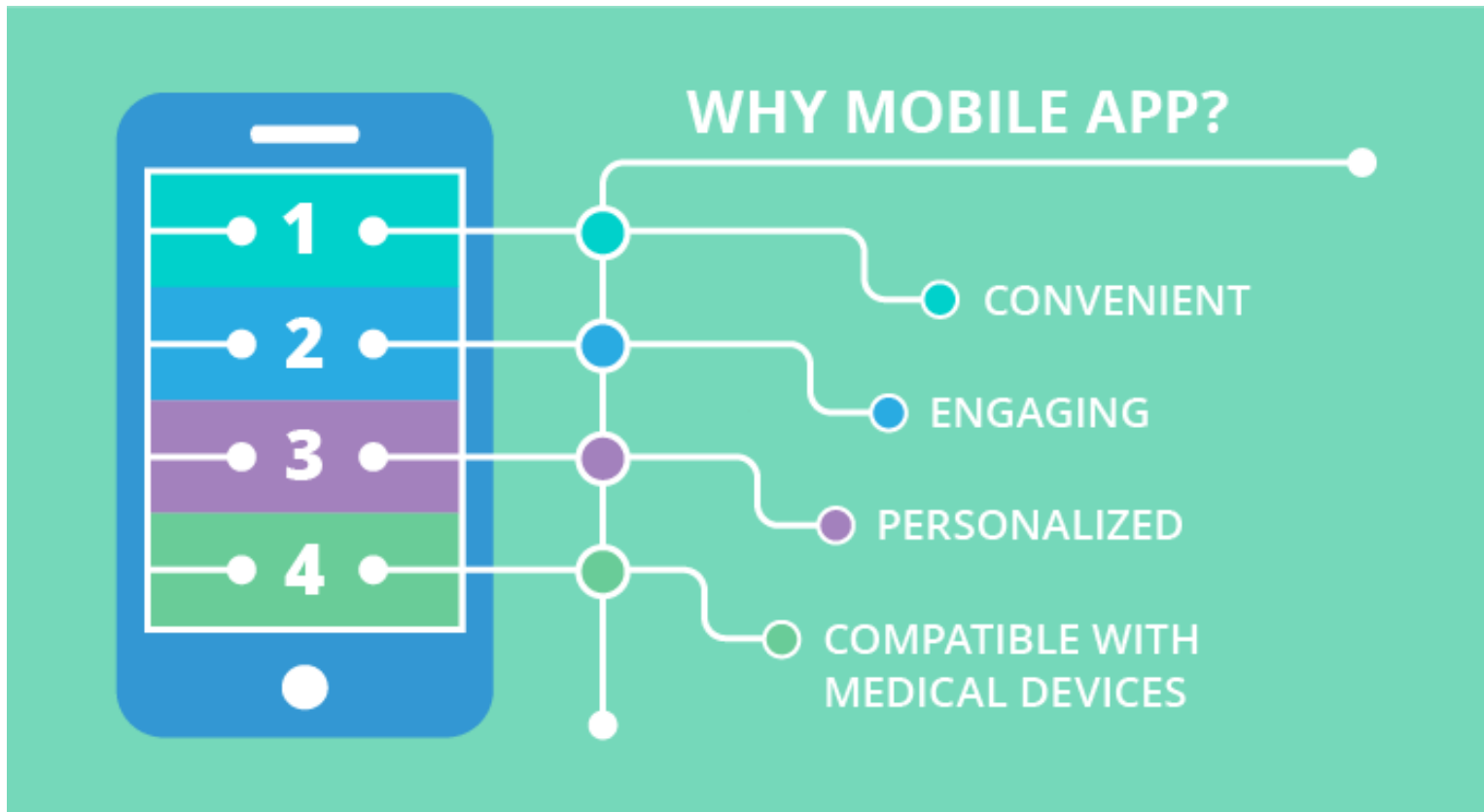
Apps



# How digital health solutions can make a difference



# Transition from face to face to digital (mobile)



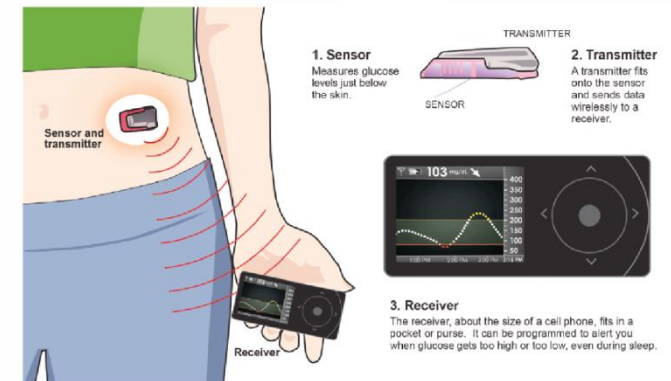
*Live with diabetes in digital era*

## Digital Health Solutions for diabetes

Digital Health Solutions	Patient burden		Provider burden		Financial effect		Improving clinical outcomes
	Reducing patient burden	Expanding geographical access	Reducing provider burden	Improving patient-to-provider ratios	Reducing economic burden	Lowering costs	
Cloud-connected glucose monitoring systems	X		X		X		X
Mobile apps							
Data management platforms	X		X				X
Telehealth services		X	X	X		X	X
Digital prevention programs					X		X
Clinically validated mobile apps		X	X		X		X
Social media	X			X			X

# Cloud-connected continuous glucose monitoring (CGM) systems

Dexcom Share, Dexcom G5, Medtronic MiniMed Connect, and Nightscout (an open-source system)



### Dexcom G5<sup>®</sup> Mobile CGM System

The Dexcom G5<sup>®</sup> Continuous Glucose Monitoring (CGM) System approved by the U.S. FDA provides real-time glucose readings for patients with type 1 or type 2 diabetes every five minutes.

# Gets more advanced, handy, interconnected

Roche Accu-Chek Connect, LifeScan VerioSync and Verio Flex, iHealth Align, LabStyle Dario, Sanofi iBGStar, Livongo for Diabetes, and Telcare



### Accu-Chek® Connect system

**Wireless** meter syncs to a smartphone app

**Automatic**—track results without logging

**Secure** online portal charts your data

**Precise** bolus calculator estimates insulin needs<sup>1</sup>

**Complete** views of your diabetes—anywhere

# Digital Health & Diabetes

## Mobile apps & wearable to support diabetes management



Diet	Physical activity	Blood glucose e-log book
Healthy out	Track 3	Diabetic
Foodily	My Fitness pal	Diabetes in check
Whole food market recipe	Moves	Diabetes companion
CarbControl	Nike + running	My sugar Junior
Lose it	Strava	Go meal
Weight watchers	UP by jawbone	Glooko
Daily burn	Endomondo	Glucose buddy
Calorie counter PRO	GymPact	DiabetesApp lite
iCookbook diabetic	FitnessFast	My net diary
Fooducate	Pacer	Glucose companion
EatLocal		
Calorie king		
HEALTHeDiabetes		
Glucose monitoring	Insulin dose calculators	Relaxation and meditation
iBGStar	Insulin calculator	Calm
Telcare	iBolus calc	Sleep cycle
	Insulin dose calculator pro	Equanimity
	Diabetes personal calculator	
Diabetes education	Rapid calc diabetes manager	Medication adherence
WebMD	PredictBGL	MyMedSchedule
Diabetes insight	EZ insulin calculator	MyMeds
Up to date	Insulin units	MedSimple
Managing type 1 Diabetes		Pillmanager
Diabetes EDC		Pill reminder
Diabetes @point of care		RxmindMe Prescription Pillboxie

# Digital Health & Diabetes

## Mobile apps

mySugr Companion(junior)  
With Gemification



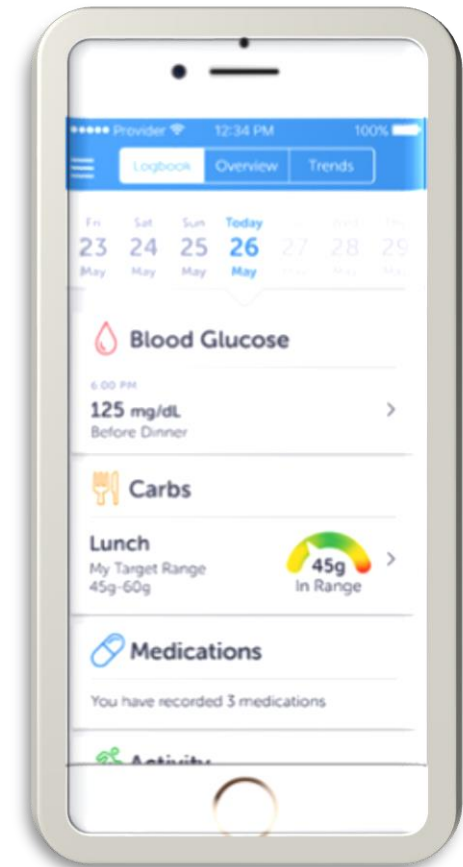
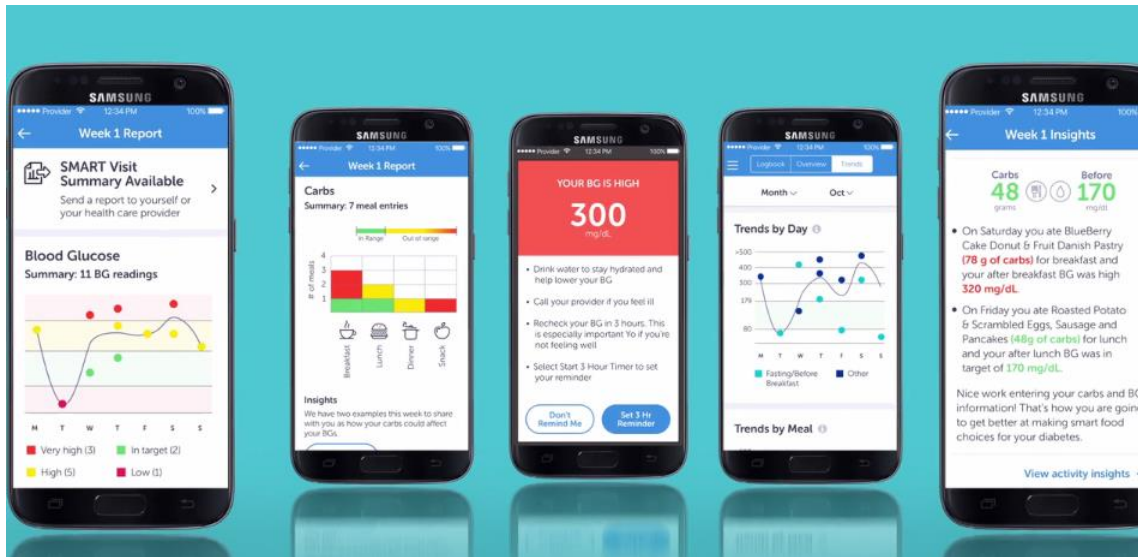
Give various missions related to diabetes management (blood glucose measurement, calorie input after meals)

Children learn how to manage diabetes through games.



## Clinically Validated Mobile Apps

WellDoc's BlueStar, the Accu-Chek Connect, Dexcom Share, Glooko Mobile App, Roche's Accu-Chek k Connect diabetes management app, ResearchKit app called GlucoSuccess



Mobile application that helps people manage Type 2 diabetes.

**Prescribed** by clinicians

**Prescription version** includes an insulin calculator.

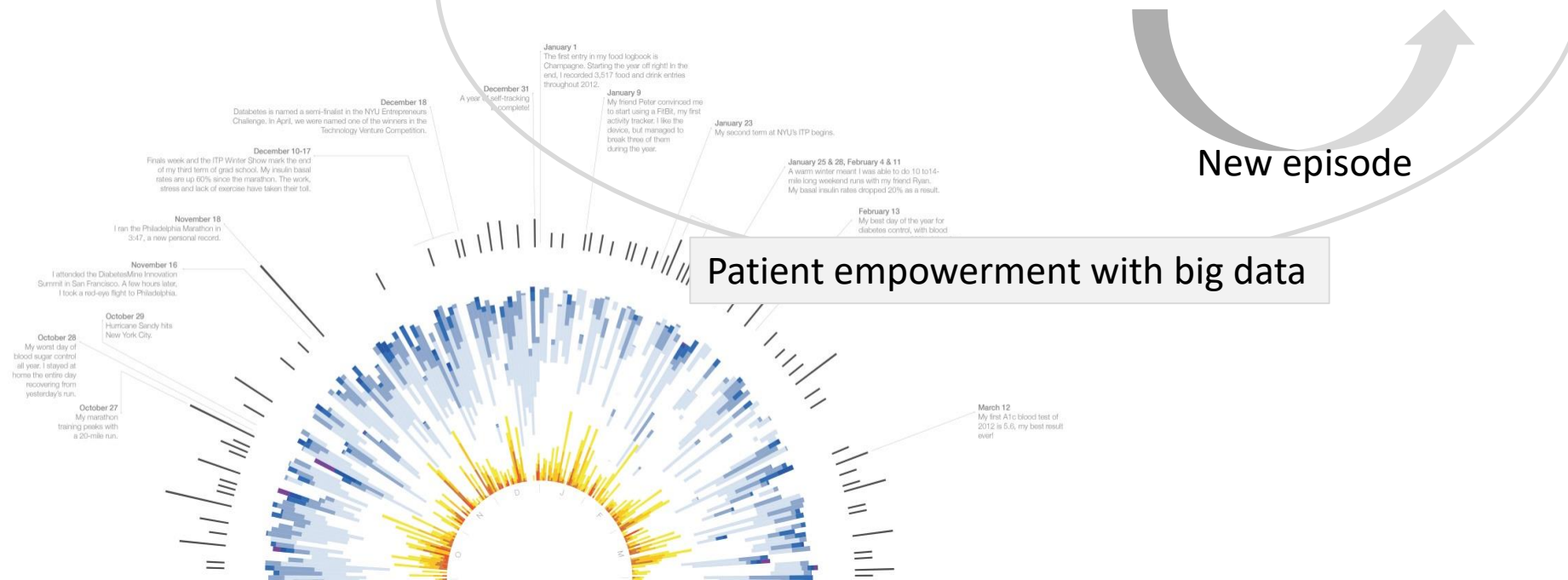
## Patients empowerment with big data

Life before diabetes

Initiative

Visit to a provider

Living with diabetes



# Data management platforms

Diasend, Glooko, and Tidepool.



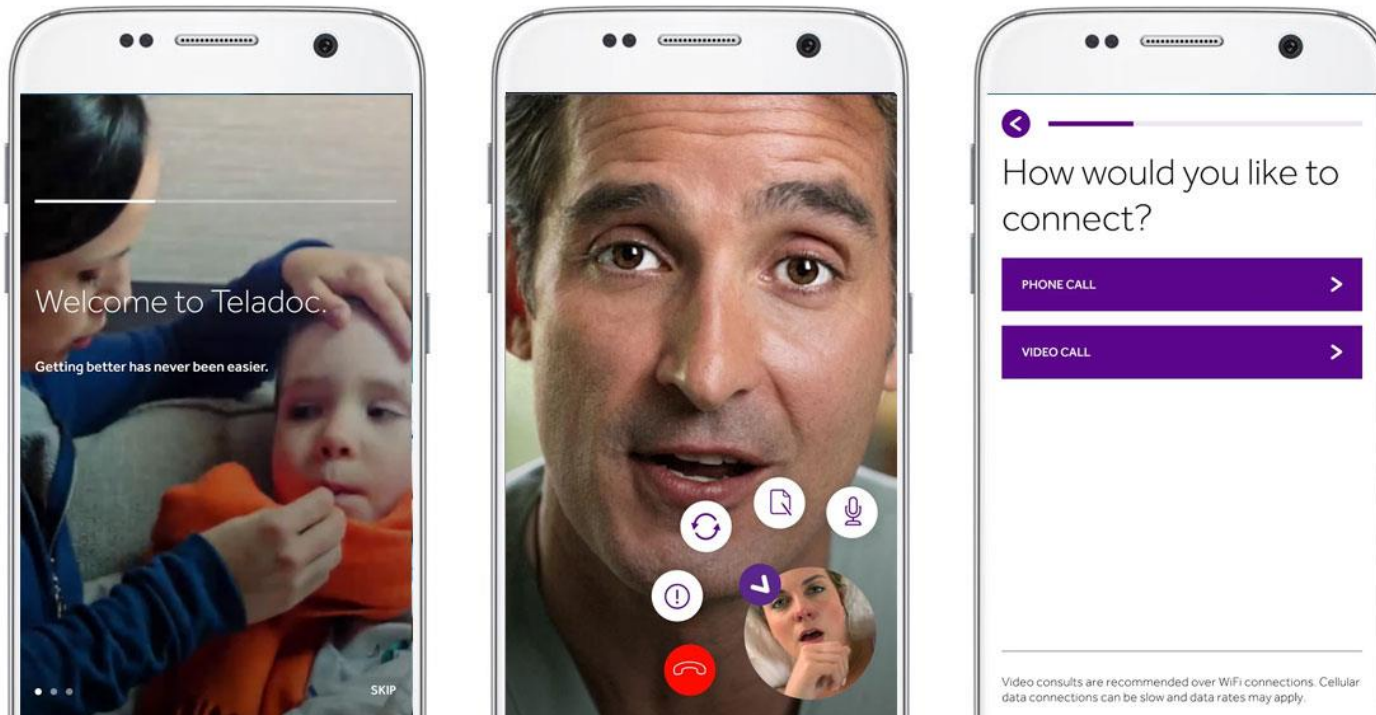
### Glooko

*The Unified Platform for Diabetes Management :*

Combination mobile app and MeterSync device wirelessly transmits data from a compatible glucometer to **the user's mobile app and to the provider care management platform**. Glooko's MeterSync is compatible with over 30 glucometers on the market.

# Telehealth services

Doctor on Demand, Teladoc, Health Tap, MDlive, American Well Corporation, and Livongo Health



### Teladoc

Teladoc is the convenient and affordable option that allows you to talk to a U.S. board-certified physician by phone or video.

## Social media

SixUntilMe and Scott's Diabetes Blog;  
online diabetes forums such as TuDiabetes, EstuDiabetes, Children with Diabetes, and Diabetes Daily;  
general social media platforms and mobile apps such as Facebook, Twitter, and Instagram;  
and information-sharing sites such as diatribe and Diabetes Mine.



Diabetes doesn't define me,  
but it helps explain me.

# Digital prevention programs: managing life

Omada Health's Prevent, Canary Health's Virtual Lifestyle Management, and Noom Health's Coach



A platform for chronic disease prevention and management

Target those with **prediabetes** and **intervene** in their health through **behavioral counseling**

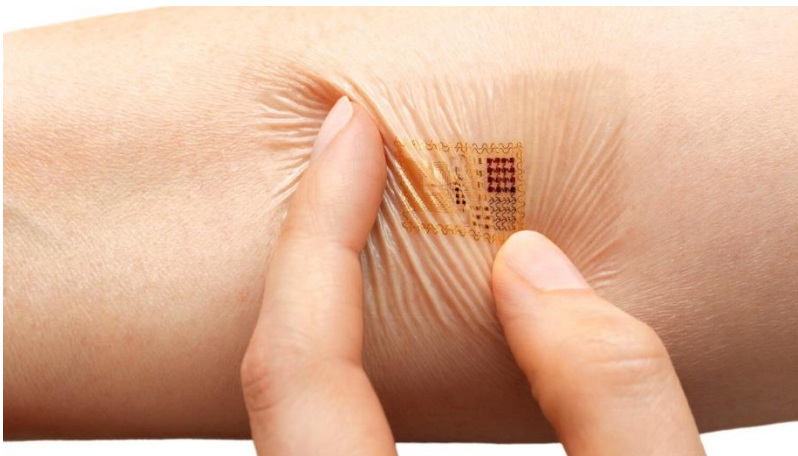
Can be **tailored** specific **population** health needs.

**Virtual** courses for disease prevention.

### Smart Contact Lens, digital tattoos



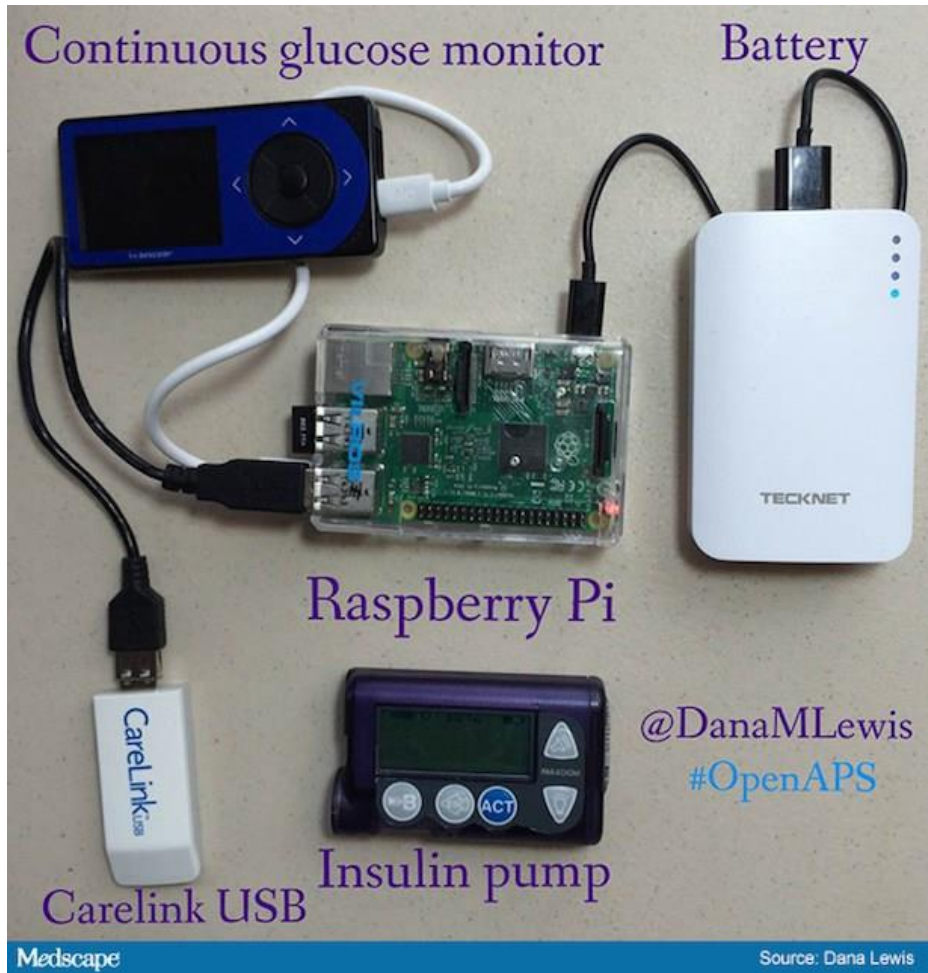
### Digital tattoos



- Pharmaceutical giant **Novartis** teamed up with Google to build this revolutionary device that promises to help patients with diabetes by measuring their **glucose levels** as well as assisting those with **eye problems**.
- The lens contains a tiny and ultra slim **microchip** that is embedded in one of its thin concave sides.
- The lens would offer an **easier** and **more comprehensive** way of monitoring the glucose levels of diabetics compared to the current techniques, which include drawing blood from the finger of the patient.

# Digital Health & Diabetes

## Artificial pancreas



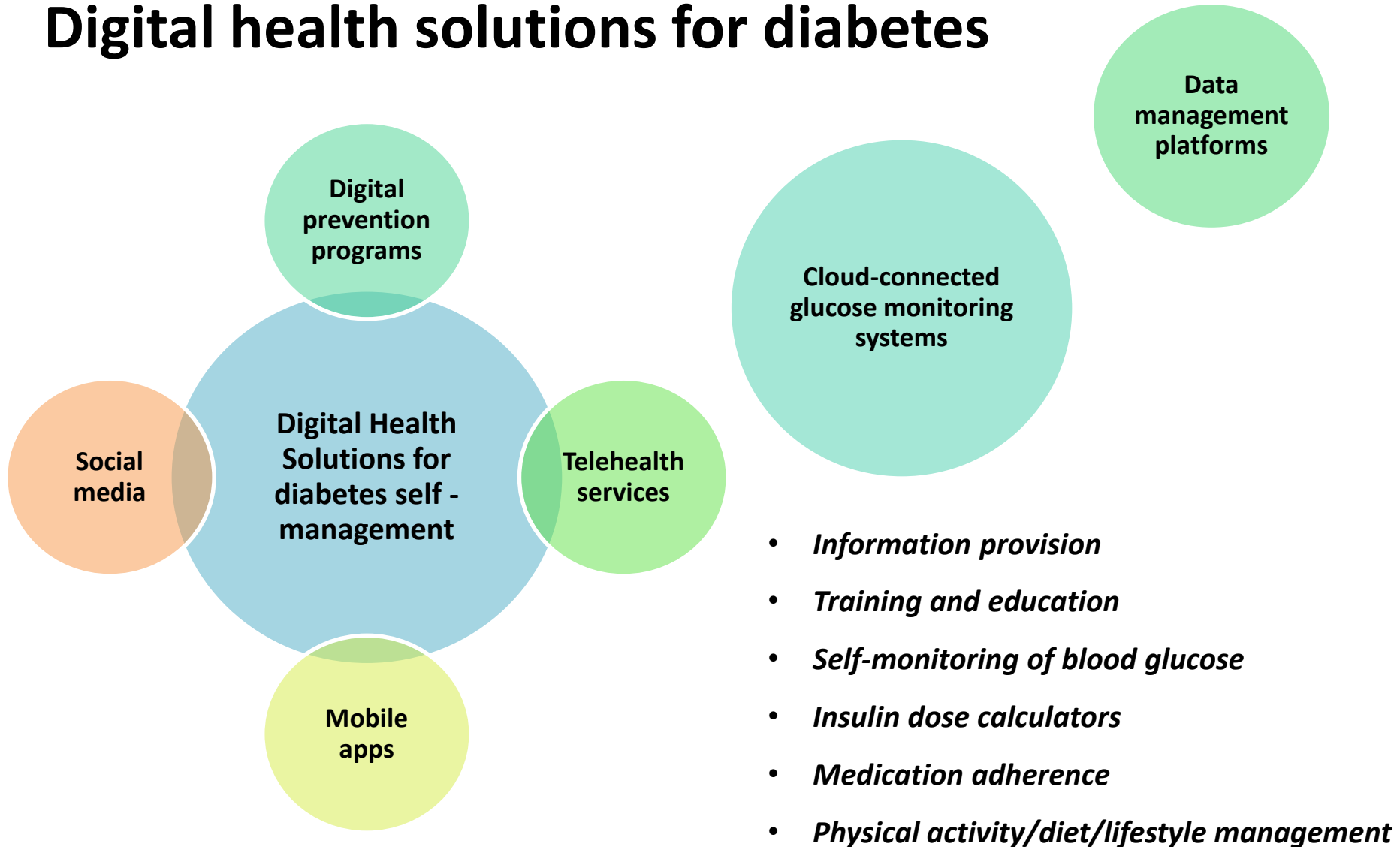
### DIY Artificial Pancreas

We believe that we can make safe and effective APS technology available more quickly, to more people, rather than just waiting for current APS efforts to complete clinical trials and be FDA-approved and commercialized through traditional processes.

#WeAreNotWaiting



# Digital health solutions for diabetes



# *Challenges of PE in digital era*

### [Lack of Scientific Evidence]

**The evidence for safety, efficacy, and cost-effectiveness of these tools are largely unknown**

*“Most of the studies were underpowered to see a meaningful and statistical difference and were of short duration.”*

Pal K, Eastwood SV, Michie S, Farmer A, Barnard ML, Peacock R, et al. Computer-based interventions to improve self-management in adults with type 2 diabetes: a systematic review and meta-analysis. *Diabetes Care*. 2014;37:1759–66. 49.

Ramachandran A, Snehalatha C, Ram J, Selvam S, Simon M, Nanditha A, et al. Effectiveness of mobile phone messaging in prevention of type 2 diabetes by lifestyle modification in men in India: a prospective, parallel-group, randomised controlled trial. *Lancet Diabetes Endocrinol*. 2013;1:191–8.

*“Source information available on the blogs or through social media that are not regulated may not be scientific and may mislead patients.”*

*“Small-sized research, inadequate methodology and selection bias can make the effect on digital based intervention weak”*

Shah, V. N., & Garg, S. K. (2015). Managing diabetes in the digital age. *Clinical Diabetes and Endocrinology*, 1(1), 16.

# Computer-Based Interventions to Improve Self-management in Adults With Type 2 Diabetes: A Systematic Review and Meta-analysis

*Diabetes Care* 2014;37:1759–1766 | DOI: 10.2337/dc13-1386

**Small beneficial effect** on blood glucose control

**Mobile phone (apps) are more effective**

No evidence of benefit for other biological, cognitive, behavioral, or emotional outcomes

Kingshuk Pal,<sup>1</sup> Sophie V. Eastwood,<sup>2</sup> Susan Michie,<sup>3</sup> Andrew Farmer,<sup>4</sup> Maria L. Barnard,<sup>5</sup> Richard Peacock,<sup>6</sup> Bindie Wood,<sup>7</sup> Phil Edwards,<sup>8</sup> and Elizabeth Murray<sup>1</sup>

## OBJECTIVE

Structured patient education programs can reduce the risk of diabetes-related complications. However, people appear to have difficulties attending face-to-face education and alternatives are needed. This review looked at the impact of computer-based diabetes self-management interventions on health status, cardiovascular risk factors, and quality of life of adults with type 2 diabetes.

## RESEARCH DESIGN AND METHODS

We searched The Cochrane Library, Medline, Embase, PsycINFO, Web of Science, and CINAHL for relevant trials from inception to November 2011. Reference lists from relevant published studies were screened and authors contacted for further information when required. Two authors independently extracted relevant data using standard data extraction templates.

## RESULTS

Sixteen randomized controlled trials with 3,578 participants met the inclusion criteria. Interventions were delivered via clinics, the Internet, and mobile phones. Computer-based diabetes self-management interventions appear to have small benefits on glycemic control: the pooled effect on HbA<sub>1c</sub> was  $-0.2\%$  ( $-2.3$  mmol/mol [95% CI  $-0.4$  to  $-0.1\%$ ]). A subgroup analysis on mobile phone-based interventions showed a larger effect: the pooled effect on HbA<sub>1c</sub> from three studies was  $-0.50\%$  ( $-5.46$  mmol/mol [95% CI  $-0.7$  to  $-0.3\%$ ]). There was no evidence of improvement in depression, quality of life, blood pressure, serum lipids, or weight. There was no evidence of significant adverse effects.

## CONCLUSIONS

Computer-based diabetes self-management interventions to manage type 2 diabetes appear to have a small beneficial effect on blood glucose control, and this effect was larger in the mobile phone subgroup. There was no evidence of benefit for other biological, cognitive, behavioral, or emotional outcomes.

Original Paper

# A Mobile Health Intervention for Self-Management and Lifestyle Change for Persons With Type 2 Diabetes, Part 2: One-Year Results From the Norwegian Randomized Controlled Trial RENEWING HEALTH

Heidi Holmen<sup>1</sup>, MSc; Astrid Torbjørnsen<sup>1</sup>, MSc; Astrid Klopst Cvancarova Småstuen<sup>1</sup>, PhD; Eirik Årsand<sup>4</sup>, PhD; Lis Ribu<sup>1</sup>,

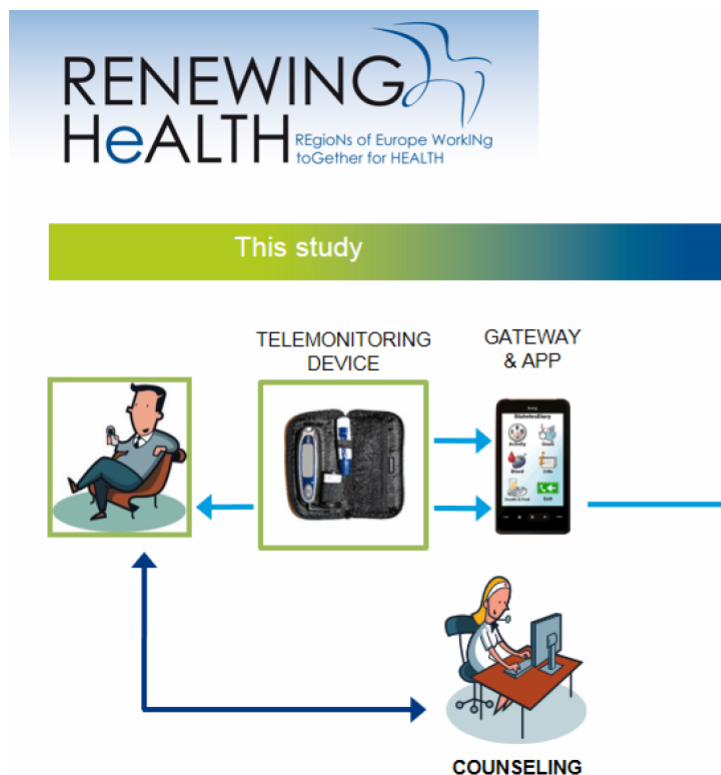
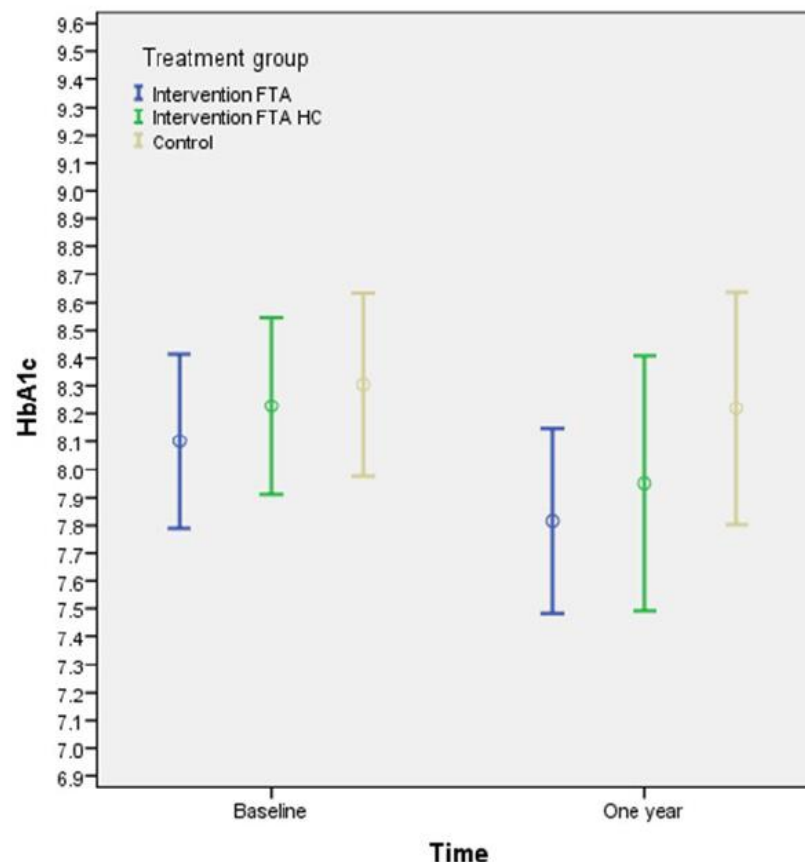


Figure 3. Mean HbA1c levels (95% CI) at baseline and 1-year follow-up (N=119). Assessed for eligibility (n = 208)



1-year follow-up  
(n = 39)

1-year follow-up  
(n = 40)

1-year follow-up  
(n = 41)

1)  
(n = 6)

### [Limited Interaction]

**The cue to action on digital health is not as strong as Face2Face education**

**Virtual environment or telecommunication on education hardly defeats FtF based education.**

*“Unlike face-to-face training, technology and virtual presences limit the learning potential due to the inability of the model to genuinely facilitate the appropriate type or quality of information that is being exchanged.”*

**It's too difficult that the digital health reacts like human.**

*“Face-to-face training adds a personal element to training as opposed to computer-based education. There is real -life interaction with responses, connections and reactions.”*

Salah Banna, 2014 september 8, [Face-to-Face Training Is Still the Better Choice Over Digital Lessons](#)

### [Digital Health Literacy]

**The current health information and app is difficult for elderly people**

*“Most available health apps does not consider people who has low literacy.”*

*“Health education is directed towards improving health literacy.*

*“Health promotion outcomes represent those personal, social and structural factors that can be modified in order to change the determinants of health.”*

Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health promotion international*, 15(3), 259-267.

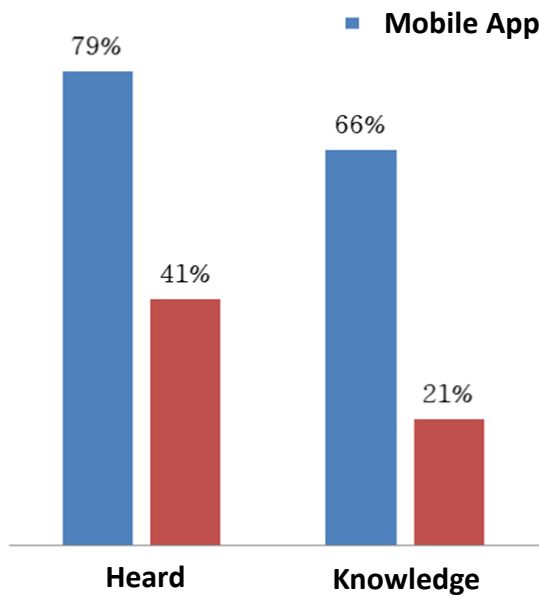
**Digital health is not unfamiliar with experienced medical professionals as well.**

*“Most of the experienced physicians are not young.”*

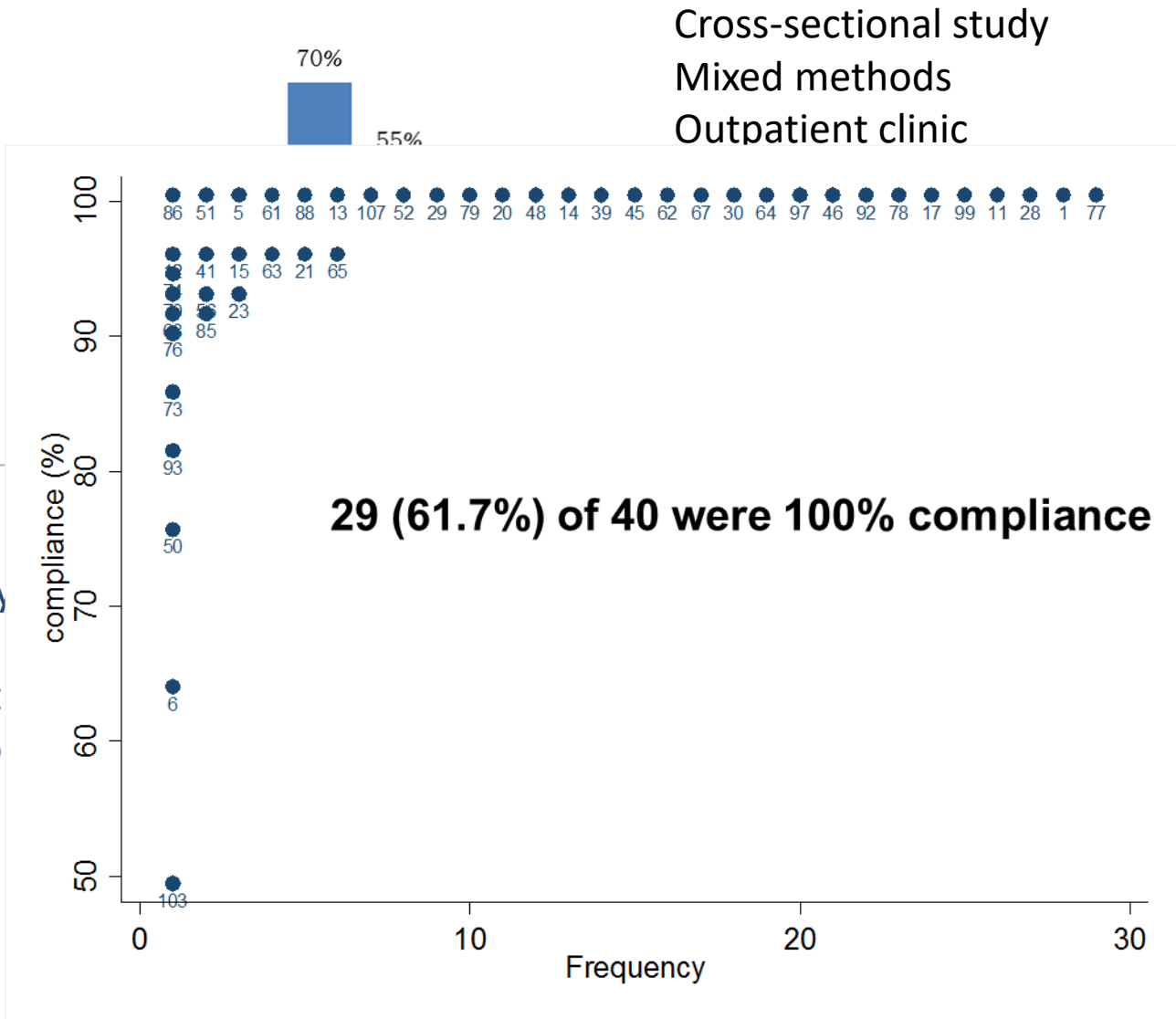
*“Lack of health informatics experts who can bridge the gulf between health and technology significantly hinders the advancement of m-Health.”*

Yu, P., Wu, M. X., Yu, H., & Xiao, G. Q. (2006, June). The challenges for the adoption of M-health. In *Service Operations and Logistics, and Informatics, 2006. SOLI'06. IEEE International Conference on*(pp. 181-186). IEEE.

# Perception, knowledge, and experience of using wearable device and application among breast cancer patients (N=100)



“Will help for healthy lifestyle”  
 “Will be helpful to exercise”  
 “More accurate than smart phone”  
 “Convenience – no need to phone”





# Limitations & Challenges

## [Access to Digital Environment and Tools]

There are people who still aren't able to take benefits of internet based services

*“Many Americans still do not have broadband at home, and some Americans have turned to mobile devices as their primary gateway to the internet, according to Pew Research Center surveys.”*

Anderson M, Horrigan J/. Smartphones may not bridge digital divide for all.: Factank News Numbers

### 13% of Americans are smartphone-only internet users

% of each group who have ...

	Broadband at home			Smartphone, but no broadband at home		
	2013	2015	CHANGE	2013	2015	CHANGE
All adults	70%	67%	-3%	8%	13%	+5%
African Americans	62	54	-8	10	19	+9
Rural residents	60	55	-5	9	15	+6
Household income < \$20K	46	41	-5	13	21	+8
\$20K-\$50K	67	63	-4	10	16	+6
\$50K-\$75K	85	80	-5	5	10	+5
Parents	77	73	-4	10	17	+7
High school degree or less	50	47	-3	11	18	+7

Source: Survey conducted June 10-July 12, 2015.

PEW RESEARCH CENTER

### Non-broadband users cite a number of reasons why they do not use high-speed connections

% of each group who cite the following as reasons for not having broadband at home

	All non-broadband users	Non-broadband users who own a smartphone
Monthly cost of home broadband subscription is too expensive	59%	59%
Have other options for internet access outside of home	46	59
Cost of computer is too expensive	45	41
Smartphone does everything online that you need to do	27	65
Service is not available or speed is unacceptable	23	27
Some other reason	25	21

Source: Survey conducted June 10-July 12, 2015.

PEW RESEARCH CENTER

### [Access to Digital Healthcare]

**Occasionally, digital health is a privilege to someone who has high-income**

*“Most payers do not cover the cost of having these devices or apps due to lack of conclusive data.”*

*“The use of apps requires the person to use an expensive smartphone and an internet data plan.”*

Anderson M, Horrigan J/. Smartphones may not bridge digital divide for all.: Factank News Numbers

**ROI (Return On Investment) is another practical issue for adopting digital health**

*“Only when the benefit can offset the cost, will the technology be widely adopted into hospital environment.”*

Yu, P., Wu, M. X., Yu, H., & Xiao, G. Q. (2006, June). The challenges for the adoption of M-health. In *Service Operations and Logistics, and Informatics, 2006. SOLI'06. IEEE International Conference on*(pp. 181-186). IEEE.

### [Information Technologies]

*“The key features for m-health applications include an integrated user interface, context switching between inter- and intra-applications, application interoperability, user defined clinical data categories, decision support, encryption, enterprise security, connectivity and centralized administration”*

Yu, P., Wu, M. X., Yu, H., & Xiao, G. Q. (2006, June). The challenges for the adoption of M-health. In *Service Operations and Logistics, and Informatics, 2006. SOLI'06. IEEE International Conference on*(pp. 181-186). IEEE.

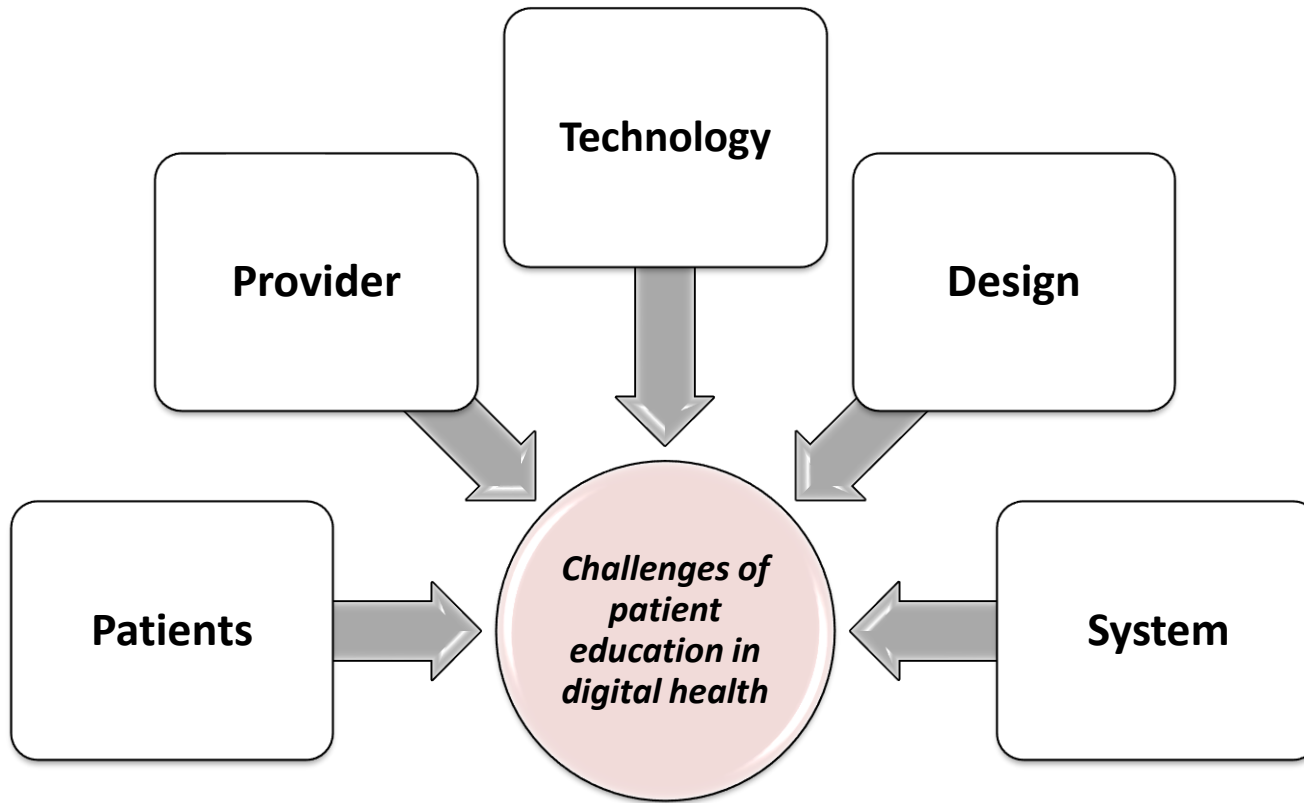
#### **Privacy and data protection**

#### **Integrated and connected apps with electronic medical records in hospital**

#### **Optimization to clinicians' workflow**

*“Interactivity is critical for physician acceptance of the solution. The success of mobile computing depends on how well the solution is integrated with mobile clinicians' workflow.”*

## Limitations & Challenges



Limited data regarding on benefits and cost effectiveness  
Access to digital health care  
Data protection & data security  
Regulation regarding digital healthcare

*Suggestions for future*

# Suggestions for future diabetes education



## Patient

- Accommodating digital health literacy



## Provider

- Practice Guidelines for future demand of diabetes educators and education
- Finding appropriate point of engagement for delivering education using Digital Health tools



## Technology

- Assuring accuracy and interactivity of digital tools



## System

- Developing and using Digital Health tools which are interoperable with electronic health record systems



## Design

- Designing educational tools with the user (patients and caregivers) in mind



## Suggestions for future diabetes education

### Patient

- Accommodating low digital health literacy
- Tailored intervention for specific population
- Context change depending on end-user
- Using AR, VR, MR tech for low literacy patients



*The example of Mixed Reality (MR)*

- Improving patient engagement due to presence



*The example of AR*

## Suggestions for future diabetes education

# Provider



- Effective training tools & guidelines for health providers
- Integration of digital health technology and provider work flow

The National Standards for Diabetes self-management education and support and Diabetes Educators Practice Guidelines offers new concepts for meeting the future demand of diabetes educators and education.

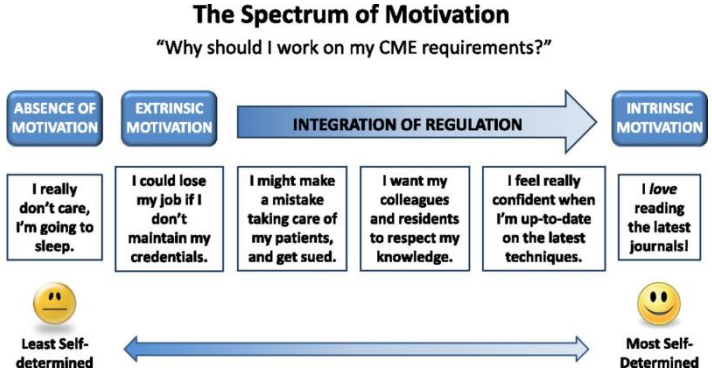
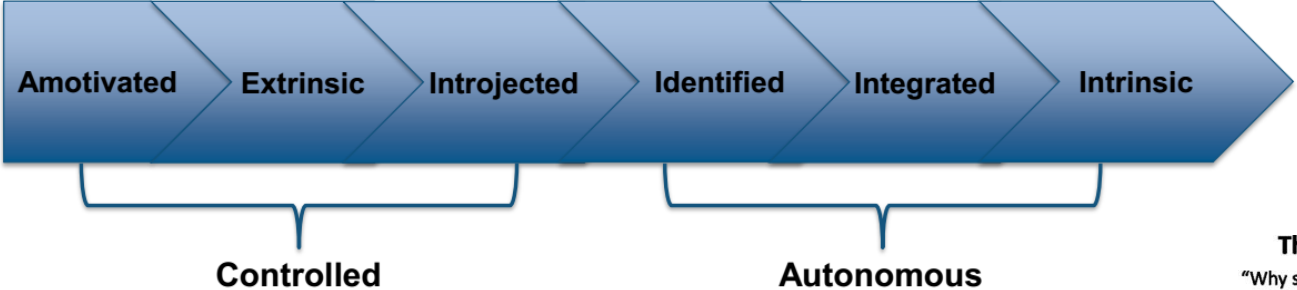


# Suggestions for future diabetes education

## Provider

- Patient education tools must be delivered at the **point of care/engagement.**

### The Spectrum of Motivational Quality



# Technology

- Improving and promoting access to digital health care

## Promoting health equity & closing the digital divide

### DIGITAL HEALTH LITERACY PROJECT

The Digital Health Literacy Project is based in Richmond, CA and brings together information and resources to address two key community health and social justice challenges: [health disparities](#) and the [digital divide](#). The project integrates ongoing local efforts to improve the health of Richmond residents while also developing and sharing best practices to guide actions in other localities.

#### Project Goals

1. Provide **online digital tools and training** to low-income individuals and families in Richmond, with a focus on helping them improve their digital literacy and use of online health information
2. Provide **high-speed wireless broadband** signal and equipment for reception to individual residences and public facilities (community centers, public housing sites, etc.)
3. Partner with community-based organizations and existing health agencies to develop a strategy to continue to **support and expand digital health literacy and broadband access** in Richmond

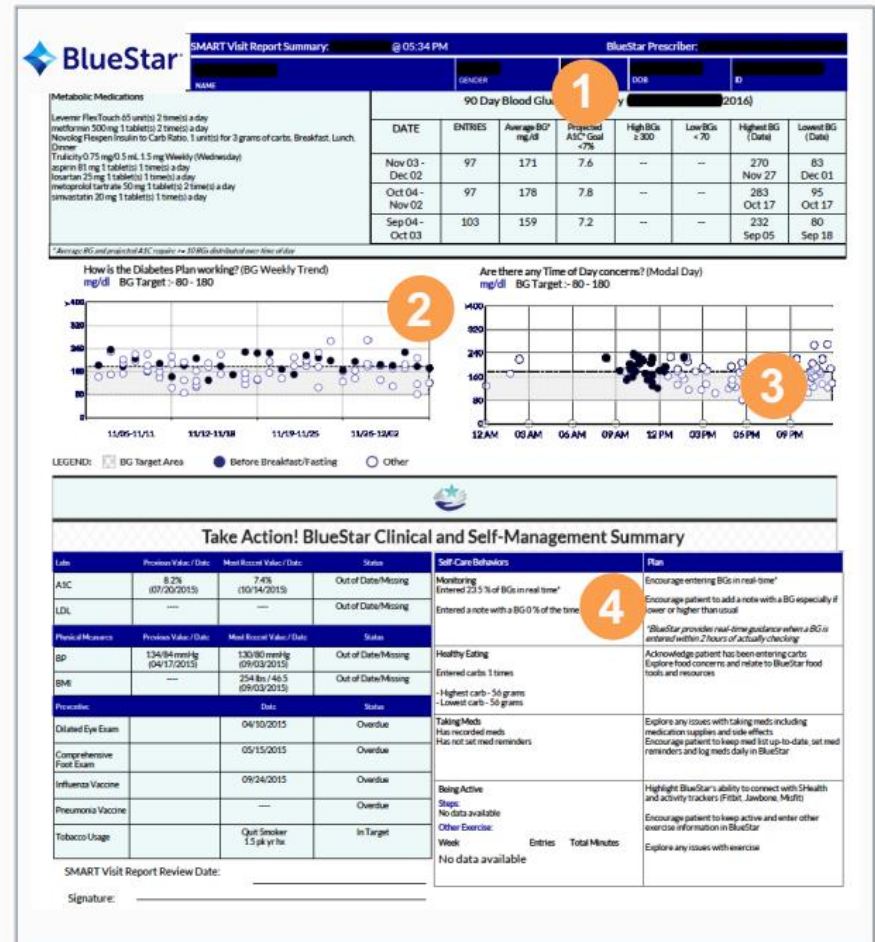
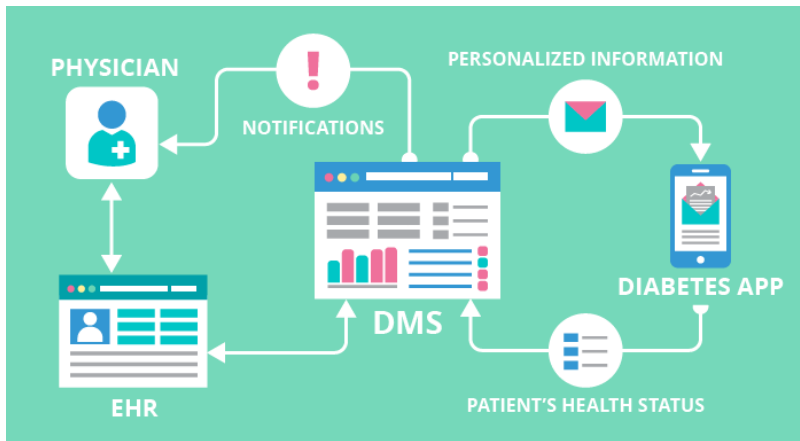
# Design

- User-centered design, service & product should be provided.
- Engaging end-users in each phase of digital health design, as well as a few techniques to facilitate better digital health design and implementation
- Customization to patient preferences and needs
- Engaged and relevant content

# Suggestions for future diabetes education

## System

- Integration of the data with clinical workflow.
- EHR-connected mHealth app.



**Thank you for  
your attention**

Any questions?

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