Challenges of patient education in digital health era

Live well with diabetes

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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
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

http://www.hopkinsmedicine.org/gim/core_resources/Patient%20Handouts/index.html
Importance of diabetes self-management education (DSME)

Knowledge and Attitude Changes
- Increased understanding
- Increased confidence
- Increased satisfaction
- Improved emotional state

Behavior Changes
- Health services utilization
- Compliance
- Lifestyle
- Self-care

Health Status
- Physical health
- Well-being
- Symptoms
- Complications

Costs
- Length of stay
- Utilization
- Provider image
- Regulatory compliance

Model of Patient Education Outcomes
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.

Engagement mapping outcomes

Outcomes = Efficacy x Participation

Background

RISK BASELINE

PARTICIPATION + ENGAGEMENT

BEHAVIOR CHANGE & SELF-CARE

RISK FACTOR PREVALENCE

HEALTH (BIOMETRICS) & PRODUCTIVITY

MEDICAL UTILIZATION + COSTS

RETURN ON INVESTMENT

Leading

Lagging

TIMEFRAME FOR IMPACT
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

<table>
<thead>
<tr>
<th>At diagnosis</th>
<th>Annual assessment of education, nutrition, and emotional needs</th>
<th>When new complicating factors influence self-management</th>
<th>When transitions in care occur</th>
</tr>
</thead>
</table>
| - 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 |

### Primary care provider/endocrinologist/clinical care team: 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 adaptions 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

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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

Varun Iyengar et al., Challenges in Diabetes Care: Can Digital Health Help Address Them?, American Diabetes Association, 2016 Nov, (3) 34 : 133-141
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.

Varun Iyengar et al., Challenges in Diabetes Care: Can Digital Health Help Address Them?, *American Diabetes Association*, 2016 Nov, (3) 34 : 133-141
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.
Why digital?

- Geographical barriers
- Gap between reality and education
- Lack of resources: more patients than educators
- Continuity matters
- Cost
- Communication
- Variety

Need to capture comprehensive outcomes of patients
The Value Proposition

Digital Health

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

- Connected devices gathering data
- Making those data useful by software and apps
- Using technology to improve the outcomes of a chronic disease by the emergence of new care models

Digital health can equip
- providers with better information
- make patients' lives simpler
- offer payers lower costs and better results
How digital health solutions can make a difference

Sustained and meaningful connection
- Convenience
- Personalization

Timely and objective Data
- Data collection and management

Digital "Plus"
- Behavioral economics
- Coaching
- Socialization
- Supporting advanced primary care

The Value Proposition

Jeremy Nobel, MD, MPH, Digital diabetes solutions in Action: An opportunity study, Northeast Business Group on Health Solutions Center, April, 2017
Transition from face to face to digital (mobile)

 WHY MOBILE APP?

1. CONVENIENT
2. ENGAGING
3. PERSONALIZED
4. COMPATIBLE WITH MEDICAL DEVICES
Live with diabetes in digital era
# Digital Health Solutions for diabetes

<table>
<thead>
<tr>
<th>Digital Health Solutions</th>
<th>Patient burden</th>
<th>Provider burden</th>
<th>Financial effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reducing patient burden</td>
<td>Expanding geographical access</td>
<td>Reducing provider burden</td>
</tr>
<tr>
<td>Cloud-connected glucose monitoring systems</td>
<td>X</td>
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<tr>
<td>Mobile apps</td>
<td>X</td>
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<td>Data management platforms</td>
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<td>Telehealth services</td>
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<td>Digital prevention programs</td>
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<tr>
<td>Clinically validated mobile apps</td>
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<tr>
<td>Social media</td>
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</table>

Varun Iyengar, Challenges in Diabetes Care: Can Digital Health Help Address Them?, American Diabetes Association, 2016 Nov, (3) 34: 133-141
Digital Health & Diabetes

Cloud-connected continuous glucose monitoring (CGM) systems

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

Dexcom G5® Mobile CGM System
The Dexcom G5® Continuous Glucose Monitoring (CGM) System approved the U.S. FDA provides real-time glucose readings for patients with type 1 or type 2 diabetes every five minutes.
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
- **Complete** views of your diabetes—anywhere
Digital Health & Diabetes

Mobile apps & wearable to support diabetes management

<table>
<thead>
<tr>
<th>Diet</th>
<th>Physical activity</th>
<th>Blood glucose e-log book</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy out</td>
<td>Track 3</td>
<td>Diabetic</td>
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<tr>
<td>Foodily</td>
<td>My Fitness pal</td>
<td>Diabetes in check</td>
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<tr>
<td>Whole food market recipe</td>
<td>Moves</td>
<td>Diabetes companion</td>
</tr>
<tr>
<td>CarbControl</td>
<td>Nike + running</td>
<td>My sugar Junior</td>
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<tr>
<td>Lose it</td>
<td>Strava</td>
<td>Go meal</td>
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<tr>
<td>Weight watchers</td>
<td>UP by jawbone</td>
<td>Glooko</td>
</tr>
<tr>
<td>Daily burn</td>
<td>Endomondo</td>
<td>Glucose buddy</td>
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<tr>
<td>Calorie counter PRO</td>
<td>GymPact</td>
<td>DiabetesApp lite</td>
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<td>iCookbook diabetic</td>
<td>FitnessFast</td>
<td>My net diary</td>
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<td>Fooducate</td>
<td>Pacer</td>
<td>Glucose companion</td>
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<td>EatLocal</td>
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<td>Calorie king</td>
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<td>HEALTHtheDiabetes</td>
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<td>Glucose monitoring</td>
<td>Insulin dose calculators</td>
<td>Relaxation and meditation</td>
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<td>iBGStar</td>
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<td>iBolus calc</td>
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<td>Equanimity</td>
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<td></td>
<td>Diabetes personal calculator</td>
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<tr>
<td>Diabetes education</td>
<td>Rapid calc diabetes manager</td>
<td>Medication adherence</td>
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<td>WebMD</td>
<td>PredictBGL</td>
<td>MyMedSchedule</td>
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<td>Diabetes insight</td>
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<td>Up to date</td>
<td>Insulin units</td>
<td>MedSimple</td>
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<td>Managing type 1 Diabetes</td>
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<td>PillManager</td>
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<td>Diabetes EDC</td>
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<td>Diabetes @point of care</td>
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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 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**
- Healthy self

**Initiative**
- Health incident

**Visit to a provider**
- Encounter
- Diagnosis
- Treatment
- Follow up

**Living with diabetes**
- New episode

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Digital Health & 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.
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.

https://labiotech.eu/contact-lens-glucose-diabetes/
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

- Digital prevention programs
- Cloud-connected glucose monitoring systems
- Telehealth services
- Data management platforms
- Social media
- Mobile apps

- Information provision
- Training and education
- Self-monitoring of blood glucose
- Insulin dose calculators
- Medication adherence
- Physical activity/diet/lifestyle management

Varun Iyengar, Challenges in Diabetes Care: Can Digital Health Help Address Them?, American Diabetes Association, 2016 Nov, (3) 34: 133-141
Challenges of PE in digital era
Limitations & Challenges

[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.”


“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”

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

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 HbA1c 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 HbA1c 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.
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

Figure 3. Mean HbA1c levels (95% CI) at baseline and 1-year follow-up (N=119).
Limitations & Challenges

[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.”


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.”

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

Cross-sectional study
Mixed methods
Outpatient clinic

"Will help for healthy lifestyle"
"Will be helpful to exercise regularly"
"More accurate than smartphone"
"Convenience – no need to have smartphone"

"Not sure about accuracy"
"Afraid of losing it"
"Not stylish"
"Easy to forget wearing"
"Feel more stressful to do exercise"
"Might need to pay more for data"
"Not sure about data security"

29 (61.7%) of 40 were 100% compliance
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

<table>
<thead>
<tr>
<th>13% of Americans are smartphone-only internet users</th>
<th>Non-broadband users cite a number of reasons why they do not use high-speed connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of each group who have ...</td>
<td>% of each group who cite the following as reasons for not having broadband at home</td>
</tr>
<tr>
<td>Broadband at home</td>
<td>All non-broadband users</td>
</tr>
<tr>
<td>All adults</td>
<td>70%</td>
</tr>
<tr>
<td>African Americans</td>
<td>62%</td>
</tr>
<tr>
<td>Rural residents</td>
<td>60%</td>
</tr>
<tr>
<td>Household income &lt; $20K</td>
<td>46%</td>
</tr>
<tr>
<td>$20K–$50K</td>
<td>67%</td>
</tr>
<tr>
<td>$50K–$75K</td>
<td>85%</td>
</tr>
<tr>
<td>Parents</td>
<td>77%</td>
</tr>
<tr>
<td>High school degree or less</td>
<td>50%</td>
</tr>
</tbody>
</table>

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

PEW RESEARCH CENTER
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.”

Limitations & Challenges

[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”


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

Challenges of patient education in digital health

Limited data regarding 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)

The example of AR

- Improving patient engagement due to presence
Provider

• Effective training tools & guidelines for health providers

• Integration of digital health technology and provider workflow

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

- Amotivated
- Extrinsic
- Introjected
- Identified
- Integrated
- Intrinsic

Controlled

Autonomous

The Spectrum of Motivation
“Why should I work on my CME requirements?”

- Absence of motivation
  - I really don’t care, I’m going to sleep.
- Extrinsic motivation
  - I could lose my job if I don’t maintain my credentials.
- Integration of regulation
  - I might make a mistake taking care of my patients, and get sued.
- Intrinsic motivation
  - I want my colleagues and residents to respect my knowledge.
  - I feel really confident when I’m up-to-date on the latest techniques.

Least Self-Determined

Most Self-Determined
Technology

• Improving and promoting access to digital health care

Promoting health equity & closing the digital divide

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.

http://www.digitalhealthliteracy.org/
Suggestions for future diabetes education

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

Baker T, Gustafson D, Shah D. How can research keep up with eHealth? Ten strategies increasing the timeliness and usefulness of eHealth research. JMIR. 2014; 16(2)
Suggestions for future diabetes education

System

• Integration of the data with clinical workflow.

• EHR-connected mHealth app.

https://www.scnsoft.com/blog/revolving-diabetes-management-caregiverconnected-mhealth-app
Thank you for your attention

Any questions?

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