Sociedade Brasileira de Geriatria e Gerontologia

ALMA

GeronLab Laboratório de Pesquisa em Envelhecimento Humano

PUC

TECNOLOGIA E DOENÇAS CRÔNICAS

VIRGÍLIO GARCIA MOREIRA MD MSC PHD

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4 Bilhões de Usuários

140 milhões de usuários – 9h/dia conectados

13 mil apps mhealth apple store (Strickland, 2012)

44 milhões de downloads (Rasking, 2012)

2



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Review

Nursing Ethics
1–16
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Ethical issues related to the use of gerontechnology in older people care: A scoping review

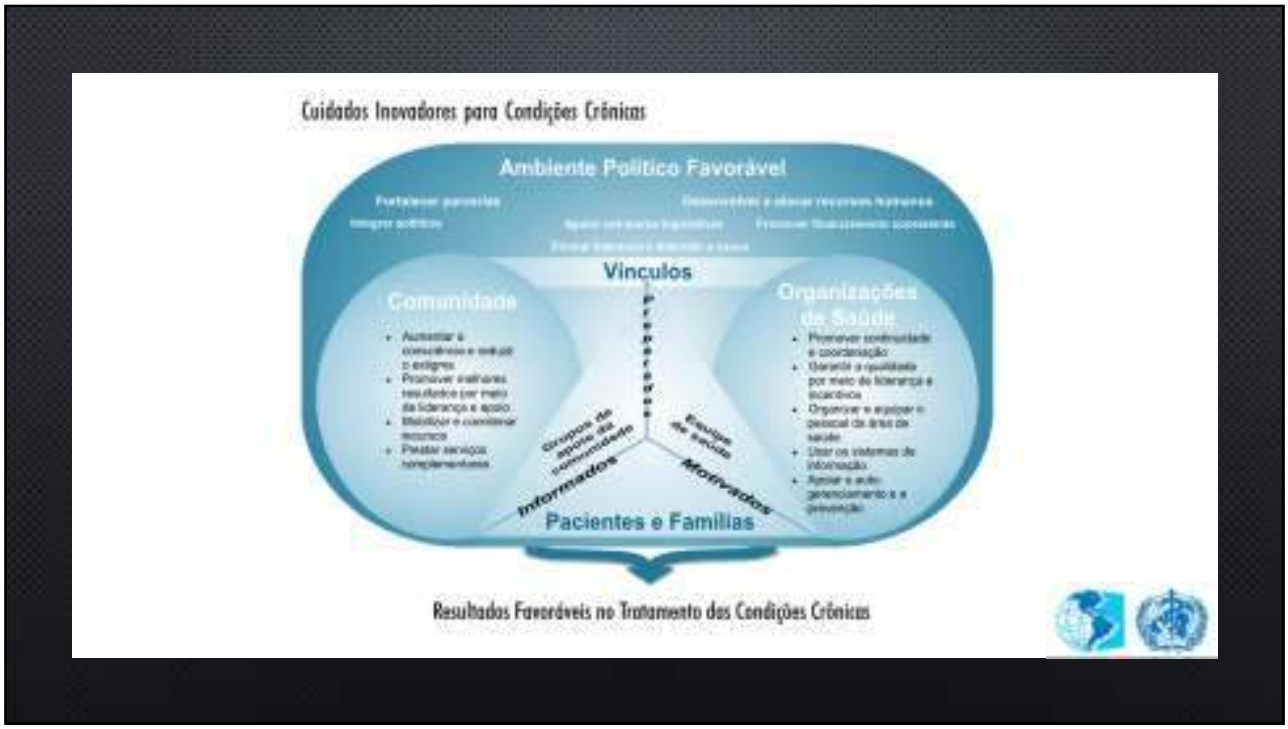
Suvi Sundgren and Minna Stolt
University of Turku, Finland

Riitta Suhonen
University of Turku, Finland; Turku University Hospital, Finland; City of Turku, Welfare Division, Finland

Abstract
Background: Demographic trends indicate growth of population aged 65 and older in Western countries. One of the greatest challenges is to provide high-quality care for all. Technological solutions designed for older people, gerontechnology, can somewhat balance the gap between resources and the increasing demand of healthcare services. However, there are also ethical issues in the use of gerontechnology that need to be pointed out.
Purpose: To describe what ethical issues are related to the use of gerontechnology in the care of community-dwelling older people.
Methods: A scoping review was performed to identify and analyse studies concerning ethical issues when using gerontechnology in the home care of older people. The literature search was limited to studies published after 1990 and addressed to the electronic databases CINAHL, PubMed, Cochrane, Medic, IEEE Explore and Web of Science. The search was performed in July–August 2018. Data from empirical studies were analysed using thematic analysis.
Ethical considerations: This scoping review was conducted in accordance with good scientific practice. The work of other researchers was respected and cited appropriately.
Results: A total of 17 studies were identified. Two main themes were found. 'Balancing between the benefits of using gerontechnology and the basic rights of older people', consisted of the subthemes safety, privacy and autonomy. The other main theme, 'Gerontechnology as a risk of insecurity for older people', included the subthemes fear of losing human contact and concern and fear. Surveillance and monitoring technologies were mainly studied.
Conclusion: These results suggest that there may be ethical issues related to the use of gerontechnology and they must therefore be taken into consideration when implementing technology in the care of community-dwelling older people.

Keywords
Technology, older people, ethics, home care, scoping review

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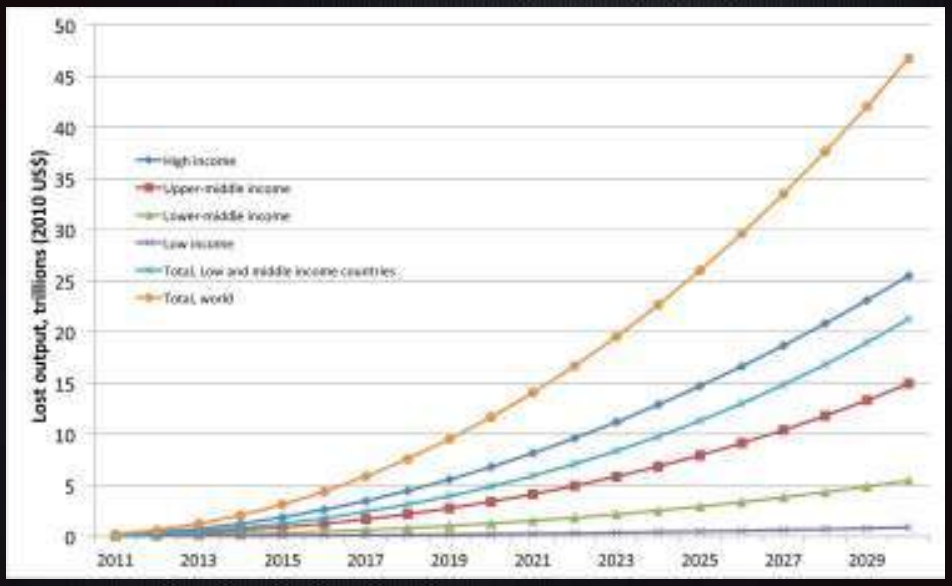

Cuidados Inovadores para Condições Crônicas
Ambiente Político Favorável
Vínculos
Comunidade
Organizações de Saúde
Informados
Motivados
Pacientes e Famílias
Resultados Favoráveis no Tratamento das Condições Crônicas

5


The Global Economic Burden of Non-communicable Diseases
WORLD ECONOMIC FORUM
COMMITTED TO IMPROVING THE STATE OF THE WORLD
Gross
GDP
Product
Domestic
A report by the World Economic Forum and the Harvard School of Public Health
September 2011
HARVARD School of Public Health

6

Figure 4: Output losses will speed up over time
(Breakdown of NCD cost by disease, based on EPIC model)



Harvard, Health SOP. The Global Economic Burden of Non-communicable Diseases. World Economic Forum. 2011 Sep. 64: 1–80.

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Figure 1. High cost of NCDs to economies, health systems, households and individuals

Economies	Health systems	Households and individuals
• Reduced labour supply • Reduced labour outputs (e.g. cost of absenteeism) • Additional cost to employers (e.g. insurance) • Lower returns on human capital investments • Lower tax revenues • Increased public health and social welfare expenditures	• Increased consumption of NCD-related health care services • High medical treatment costs (per episode and over time) • Demand for more effective treatments (e.g. cost of technology and innovation) • Health system adaptation (e.g. organization, service delivery, financing) and adaptation costs	• Reduced well-being • Increased disabilities • Premature deaths • Household income decrease, loss or improverishment • Higher health expenditures, including catastrophic spending • Savings and assets loss • Reduced opportunities

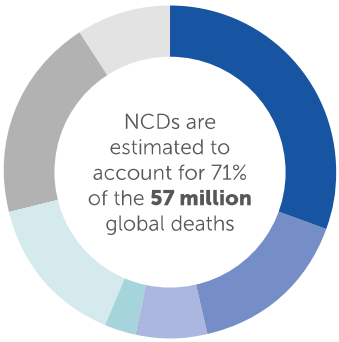
Country productivity and competitiveness | **Fiscal pressures** | **Health outcomes** | **Poverty, inequality and opportunity loss**

Source: Nokolic IA, Stanciole AE, Zaydman M. Chronic emergency: why NDCs matter. Health, Nutrition and Population Discussion Paper. Washington (DC): World Bank; 2011.

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FIGURE 1: **GLOBAL MORTALITY (% OF TOTAL DEATHS), ALL AGES, BOTH SEXES, 2016**

- 31% Cardiovascular diseases
- 16% Cancers
- 7% Chronic respiratory diseases
- 3% Diabetes
- 15% Other NCDs
- 20% Communicable, maternal, perinatal and nutritional conditions
- 9% Injuries



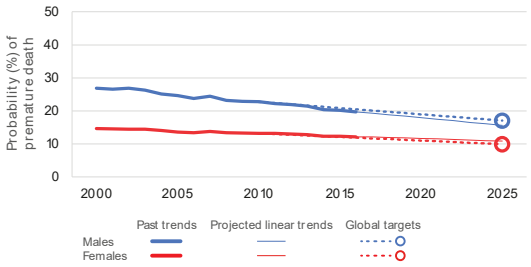
World Health Organization

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ARGENTINA

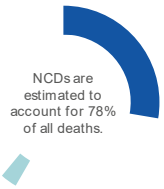
2016 TOTAL POPULATION: 43 847 000
2016 TOTAL DEATHS: 328 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 28% Cardiovascular diseases
- 20% Cancers
- 10% Chronic respiratory diseases
- 3% Diabetes
- 17% Other NCDs
- 16% Communicable, maternal, perinatal and nutritional conditions
- 6% Injuries



37 500 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

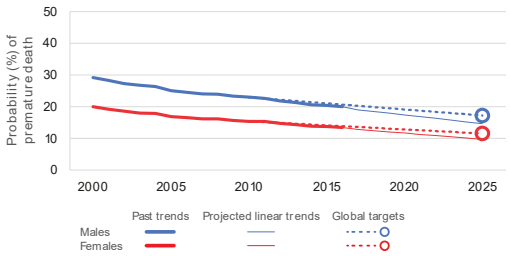
World Health Organization

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BRAZIL

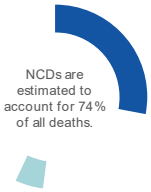
2016 TOTAL POPULATION: 207 700 000
2016 TOTAL DEATHS: 1 320 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 28% Cardiovascular diseases
- 18% Cancers
- 6% Chronic respiratory diseases
- 5% Diabetes
- 17% Other NCDs
- 14% Communicable, maternal, perinatal and nutritional conditions
- 12% Injuries



188 000 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

World Health Organization

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		NATIONAL TARGET SET		DATA YEAR	MALES	FEMALES	TOTAL
MORTALITY							
	Premature mortality from NCDs	✓	Total NCD deaths	2016	516 800	458 500	975 400
			Risk of premature death between 30-70 years (%)	2016	20	13	17
	Suicide mortality	-	Suicide mortality rate (per 100 000 population)	2016	-	-	6
RISK FACTORS							
	Harmful use of alcohol	✓	Total alcohol per capita consumption, adults aged 15+ (litres of pure alcohol)	2016	13	2	8
	Physical inactivity	✓	Physical inactivity, adults aged 18+ (%)	2016	40	53	47
	Salt/Sodium intake	✓	Mean population salt intake, adults aged 20+ (g/day)	2010	11	10	10
	Tobacco use	✓	Current tobacco smoking, adults aged 15+ (%)	2016	18	10	14
	Raised blood pressure	X	Raised blood pressure, adults aged 18+ (%)	2015	26	20	23
	Diabetes	X	Raised blood glucose, adults aged 18+ (%)	2014	7	9	8
	Obesity	✓	Obesity, adults aged 18+ (%)	2016	19	26	22
			Obesity, adolescents aged 10-19 (%)	2016	10	8	9
	Ambient air pollution	-	Exceedance of WHO guidelines level for annual PM2.5 concentration (by a multiple of)	2016	-	-	1
	Household air pollution	-	Population with primary reliance on polluting fuels and technologies (%)	2016	-	-	<5

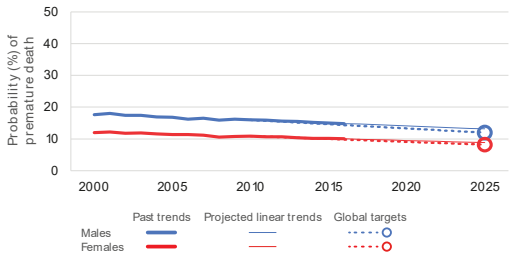
World Health Organization

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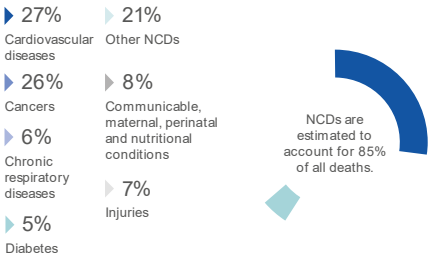
CHILE

2016 TOTAL POPULATION: 17 910 000
2016 TOTAL DEATHS: 110 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY



19 100 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

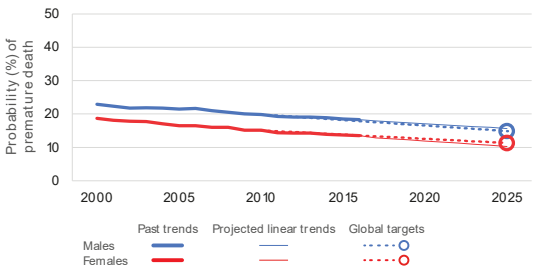
World Health Organization

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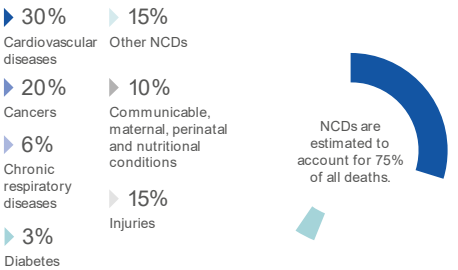
COLOMBIA

2016 TOTAL POPULATION: 48 653 000
2016 TOTAL DEATHS: 282 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY



700 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

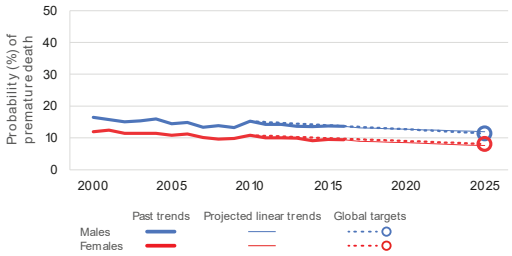
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COSTA RICA

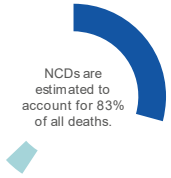
2016 TOTAL POPULATION: 4 857 000
2016 TOTAL DEATHS: 25 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 29% Cardiovascular diseases
- 20% Other NCDs
- 23% Cancers
- 6% Communicable, maternal, perinatal and nutritional conditions
- 7% Chronic respiratory diseases
- 10% Injuries
- 4% Diabetes



16 000 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

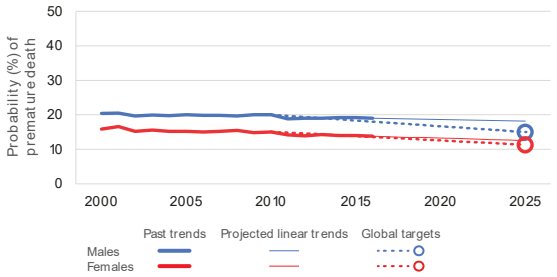
World Health Organization

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CUBA

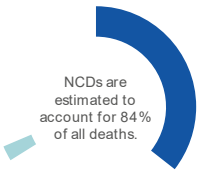
2016 TOTAL POPULATION: 11 476 000
2016 TOTAL DEATHS: 98 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 36% Cardiovascular diseases
- 15% Other NCDs
- 25% Cancers
- 8% Communicable, maternal, perinatal and nutritional conditions
- 6% Chronic respiratory diseases
- 8% Injuries
- 2% Diabetes



4 400 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

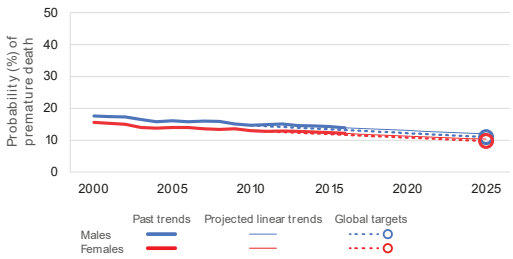
World Health Organization

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ECUADOR

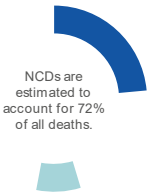
2016 TOTAL POPULATION: 16 385 000
2016 TOTAL DEATHS: 84 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 24% Cardiovascular diseases
- 19% Other NCDs
- 17% Cancers
- 15% Communicable, maternal, perinatal and nutritional conditions
- 5% Chronic respiratory diseases
- 13% Injuries
- 8% Diabetes



113 800 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

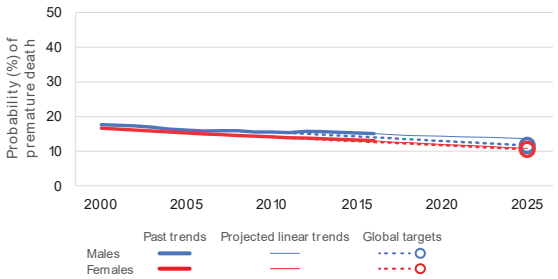
World Health Organization

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EL SALVADOR

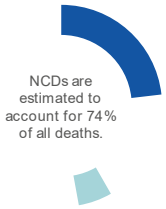
2016 TOTAL POPULATION: 6 345 000
2016 TOTAL DEATHS: 42 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)*



PROPORTIONAL MORTALITY*

- 23% Cardiovascular diseases
- 27% Other NCDs
- 16% Cancers
- 11% Communicable, maternal, perinatal and nutritional conditions
- 3% Chronic respiratory diseases
- 15% Injuries
- 5% Diabetes



2 700 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

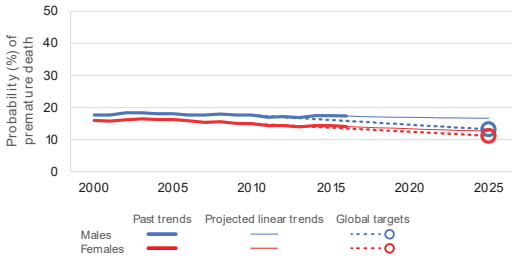
World Health Organization

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MEXICO

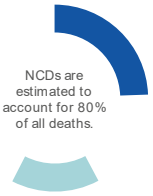
2016 TOTAL POPULATION: 127 500 000
2016 TOTAL DEATHS: 653 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 24% Cardiovascular diseases
- 22% Other NCDs
- 12% Cancers
- 10% Communicable, maternal, perinatal and nutritional conditions
- 6% Chronic respiratory diseases
- 10% Injuries
- 15% Diabetes



97 400 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

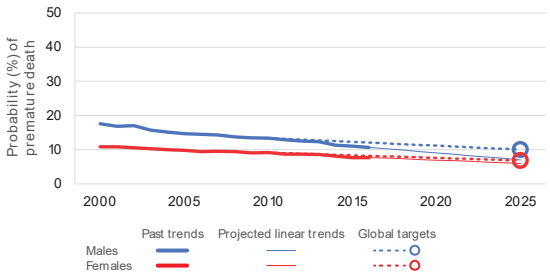
World Health Organization

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NORWAY

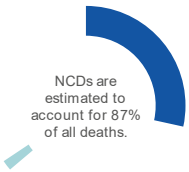
2016 TOTAL POPULATION: 5 255 000
2016 TOTAL DEATHS: 41 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 28% Cardiovascular diseases
- 22% Other NCDs
- 28% Cancers
- 7% Communicable, maternal, perinatal and nutritional conditions
- 8% Chronic respiratory diseases
- 6% Injuries
- 2% Diabetes



4 000 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

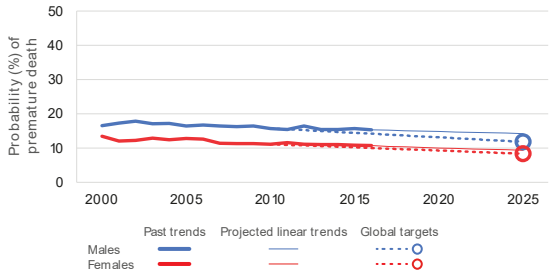
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PANAMA

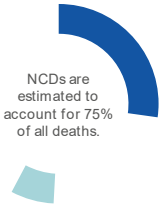
2016 TOTAL POPULATION: 4 034 000
2016 TOTAL DEATHS: 20 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 27% Cardiovascular diseases
- 17% Other NCDs
- 17% Cancers
- 16% Communicable, maternal, perinatal and nutritional conditions
- 6% Chronic respiratory diseases
- 10% Injuries
- 7% Diabetes



5 100 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

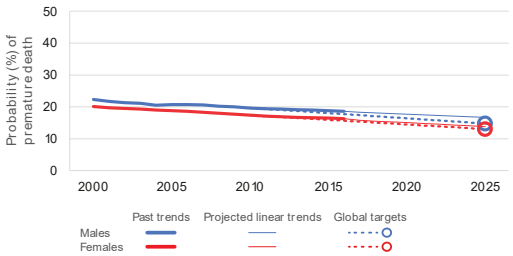
World Health Organization

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PARAGUAY

2016 TOTAL POPULATION: 6 725 000
2016 TOTAL DEATHS: 36 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)*



PROPORTIONAL MORTALITY*

- 29% Cardiovascular diseases
- 20% Other NCDs
- 16% Cancers
- 14% Communicable, maternal, perinatal and nutritional conditions
- 3% Chronic respiratory diseases
- 12% Injuries
- 7% Diabetes



19 400 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

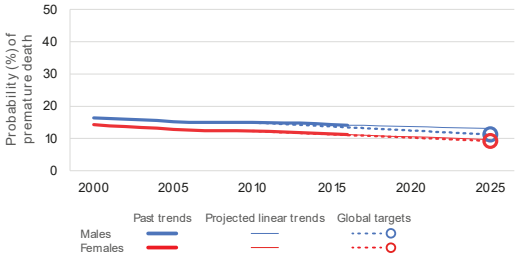
World Health Organization

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PERU

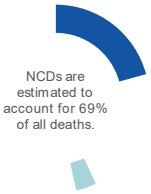
2016 TOTAL POPULATION: 31 774 000
2016 TOTAL DEATHS: 172 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)*



PROPORTIONAL MORTALITY*

- 21% Cardiovascular diseases
- 23% Other NCDs
- 17% Cancers
- 20% Communicable, maternal, perinatal and nutritional conditions
- 6% Chronic respiratory diseases
- 10% Injuries
- 4% Diabetes



89 900 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO "BEST BUYS"

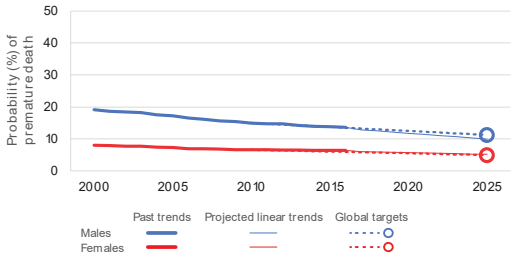
World Health Organization

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SPAIN

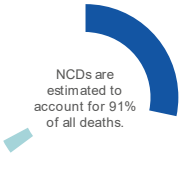
2016 TOTAL POPULATION: 46 348 000
2016 TOTAL DEATHS: 418 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



PROPORTIONAL MORTALITY

- 28% Cardiovascular diseases
- 24% Other NCDs
- 26% Cancers
- 5% Communicable, maternal, perinatal and nutritional conditions
- 10% Chronic respiratory diseases
- 3% Injuries
- 2% Diabetes



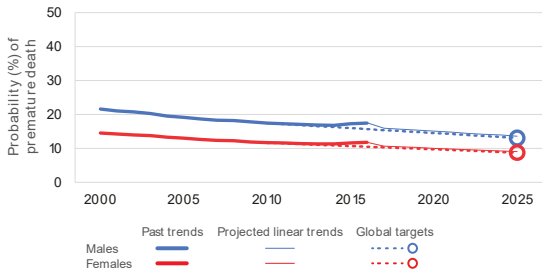
193 000 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO "BEST BUYS"

24

UNITED STATES OF AMERICA

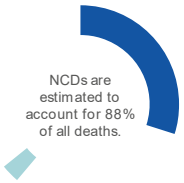
2016 TOTAL POPULATION: 322 200 000
2016 TOTAL DEATHS: 2 802 000

RISK OF PREMATURE DEATH DUE TO NCDS (%)



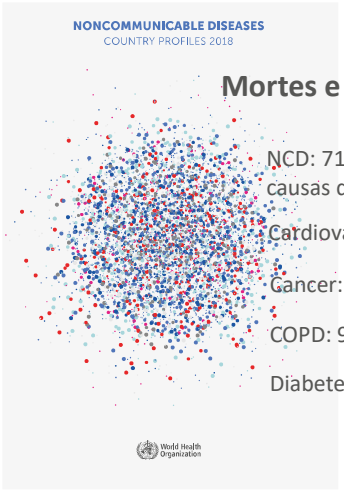
PROPORTIONAL MORTALITY

- 30% Cardiovascular diseases
- 24% Other NCDs
- 22% Cancers
- 5% Communicable, maternal, perinatal and nutritional conditions
- 9% Chronic respiratory diseases
- 7% Injuries
- 3% Diabetes



563 600 LIVES CAN BE SAVED BY 2025 BY IMPLEMENTING ALL OF THE WHO " BEST BUYS"

25



Mortes e Doenças Crônicas no Mundo

NCD: 71% (41 millhões) de 57 milhões de causas de morte em todo o mundo.

Cardiovascular: 44%

Cancer: 22%

COPD: 9%

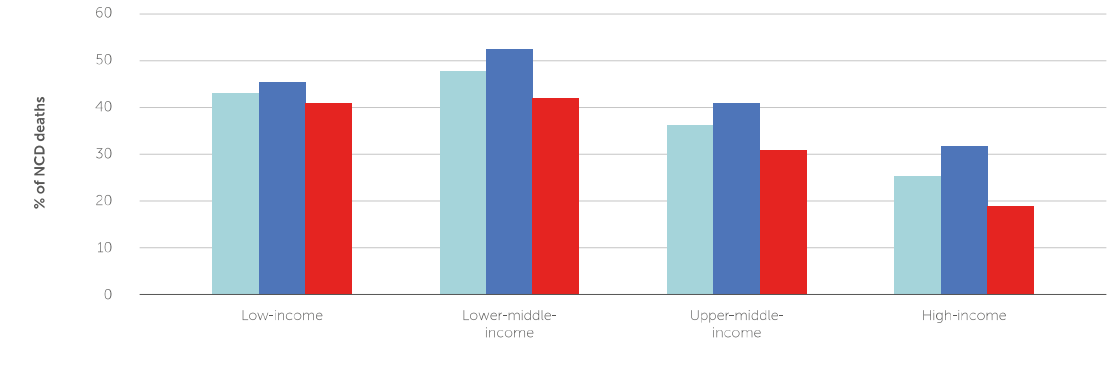
Diabetes: 4%

World Health Organization

Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000–2016. Geneva: World Health Organization; 2018.

26

FIGURE 2: **PROPORTION OF NCD DEATHS OCCURRING AMONG THOSE AGED 30 - 69 YEARS, BY INCOME GROUP, 2016**



27



28

TABLE 1: **NONCOMMUNICABLE DISEASE "BEST BUYS"**

Risk factor/ disease to be addressed	Intervention	Detailed description
Reduce Tobacco use	Tax	Increase excise taxes and prices on tobacco products
	Packaging	Implement plain/standardized packaging and/or large graphic health warnings on all tobacco packages
	Advertising, promotion and sponsorship	Enact and enforce comprehensive bans on tobacco advertising, promotion and sponsorship
	Smoke-free public places	Eliminate exposure to second-hand tobacco smoke in all indoor workplaces, public places, and public transport
	Educate	Implement effective mass media campaigns that educate the public about the harms of smoking/tobacco use and second-hand smoke

World Health Organization

Tackling NCDs "Best buys" and other recommended interventions for the prevention and control of noncommunicable diseases. Geneva: World Health Organization; 2017.

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Reduce harmful use of alcohol	Tax	Increase excise taxes on alcoholic beverages
	Advertising	Enact and enforce bans or comprehensive restrictions on exposure to alcohol advertising (across multiple types of media)
	Availability	Enact and enforce restrictions on the physical availability of retailed alcohol (via reduced hours of sale)
Reduce unhealthy diet	Reformulate food	Reduce salt intake through the reformulation of food products to contain less salt and the setting of target levels for the amount of salt in foods and meals
	Supportive environments	Reduce salt intake through the establishment of a supportive environment in public institutions such as hospitals, schools, workplaces and nursing homes, to enable lower sodium options to be provided
	Educate	Reduce salt intake through a behaviour change communication and mass media campaign
	Packaging	Reduce salt intake through the implementation of front-of-pack labelling
Reduce physical inactivity	Educate	Implement community-wide public education and awareness campaigns for physical activity which includes a mass media campaign combined with other community-based education, motivational and environmental programmes aimed at supporting behavioural change of physical activity levels

World Health Organization

Tackling NCDs "Best buys" and other recommended interventions for the prevention and control of noncommunicable diseases. Geneva: World Health Organization; 2017.

30

Manage cardiovascular disease and diabetes	Drug therapy and counselling	Drug therapy (including glycaemic control for diabetes mellitus and control of hypertension using a total risk[2] approach) and counselling to individuals who have had a heart attack or stroke and to persons with high risk (≥ 30%) of a fatal and non-fatal cardiovascular event in the next 10 years
Manage cancer	Vaccinate	Vaccination against human papillomavirus (2 doses) of 9-13 year old girls
	Screening	Prevention of cervical cancer by screening women aged 30–49, either through: • Visual inspection with acetic acid, linked with timely treatment of precancerous lesions; • Pap smear (cervical cytology) every 3–5 years, linked with timely treatment of precancerous lesions; or • Human papillomavirus test every 5 years linked with timely treatment of precancerous lesions

World Health Organization

Tackling NCDs "Best buys" and other recommended interventions for the prevention and control of noncommunicable diseases. Geneva: World Health Organization; 2017.

31



Abordagem dos idosos: 5 a 10% dos idosos consomem 60 a 70% dos recursos destinados a esta faixa etária

Mendes, EV, 2009

Guerra et al, 2007

32


100%
EVOLUTION
78%
STATUS

33


Health
Fall Detection
vital signs tracking
Medication Management
PERS
Telehealth
Wellness
Smart home
Wearables
End Of Life Planning
Social & Communication
Cognitive Care
For Senior Living Communities
Caregiving
For Healthcare Providers
Independence
Transportation
ADL
Finance
Sensory Aids
Mobility Aids
For Home Care Agencies
Home Care
Legacy
2019
Gerontechnology
Market Landscape
TheGerontechnologist.com

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JOURNAL OF MEDICAL INTERNET RESEARCH Gammon et al

Original Paper

The Chronic Care Model and Technological Research and Innovation: A Scoping Review at the Crossroads

Deede Gammon[1,2], Psych, PhD; Gro Karine Rosvold Berntsen[1,3], MD, PhD; Absera Teshome Koricho[2], Mphil, MSc; Karin Sygna[2], MPH; Cornelia Ruland[2], RN, PhD

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[2]Center for Shared Decision Making and Collaborative Care Research, Oslo University Hospital, Oslo, Norway
[3]The National Research Center in Complementary and Alternative Medicine, University of Tromsø, Tromsø, Norway

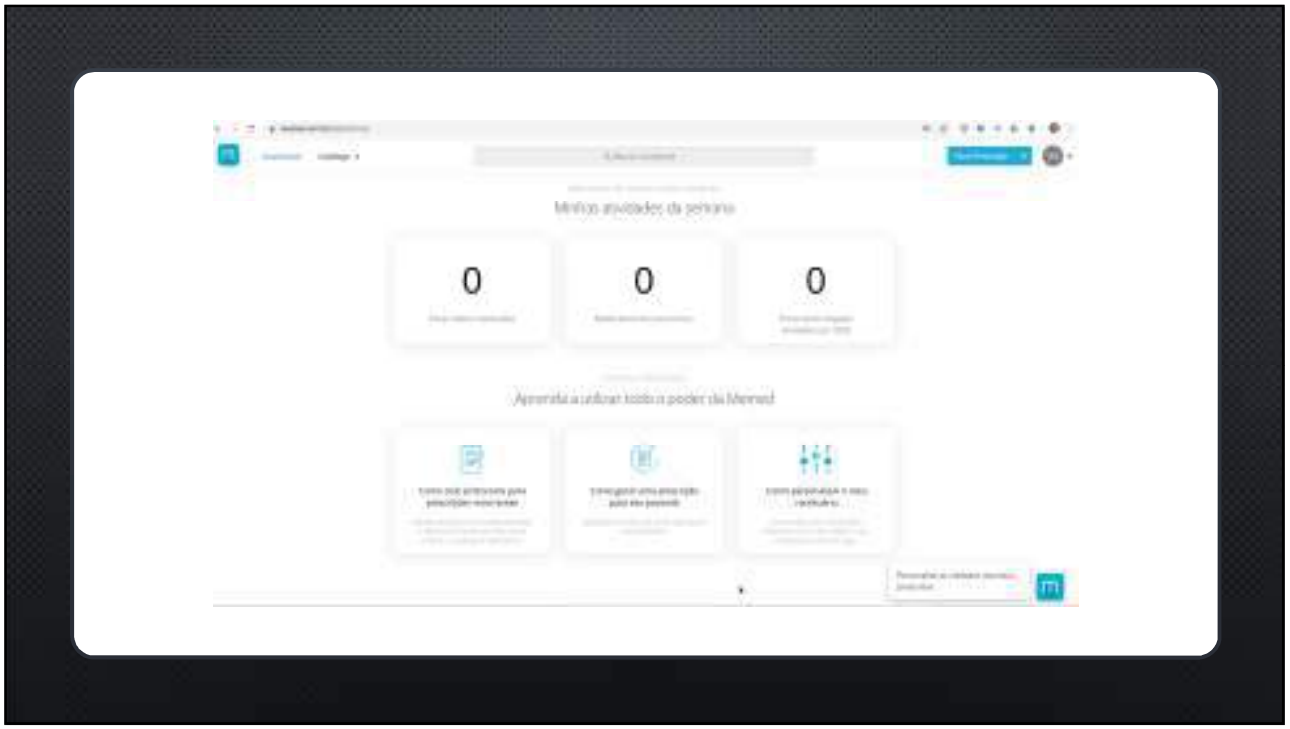
35

MANEJO DE DOENÇAS CRÔNICAS

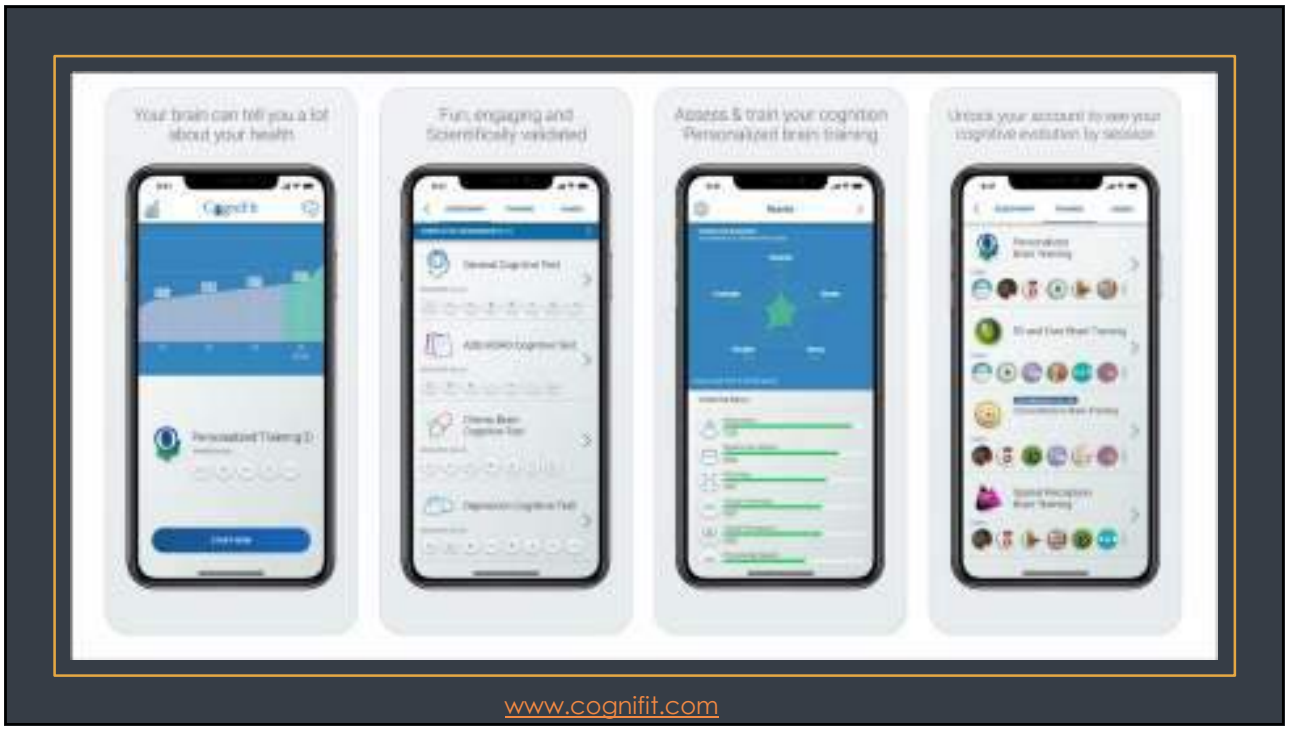
- HIPERTENSÃO ARTERIAL SISTÊMICA
- DOENÇA CORONARIANA
- DISLIPIDEMIA
- DIABETES
- SEDENTARISMO
- TABAGISMO
- ABUSO DO ÀLCOOL



36


0
0
0

37


Your brain can tell you a lot about your health
Fun, engaging and Scientifically validated
Assess & train your cognition Personalized brain training
Unlock your account to see your cognitive evolution by session
www.cognifit.com

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REVIEW

Technology in Parkinson's Disease: Challenges and Opportunities

Espay AJ, Bonato P, Nahab FB, et al. Technology in Parkinson's disease: Challenges and opportunities. *Mov Disord* 2016; 31: 1272-1282.

39

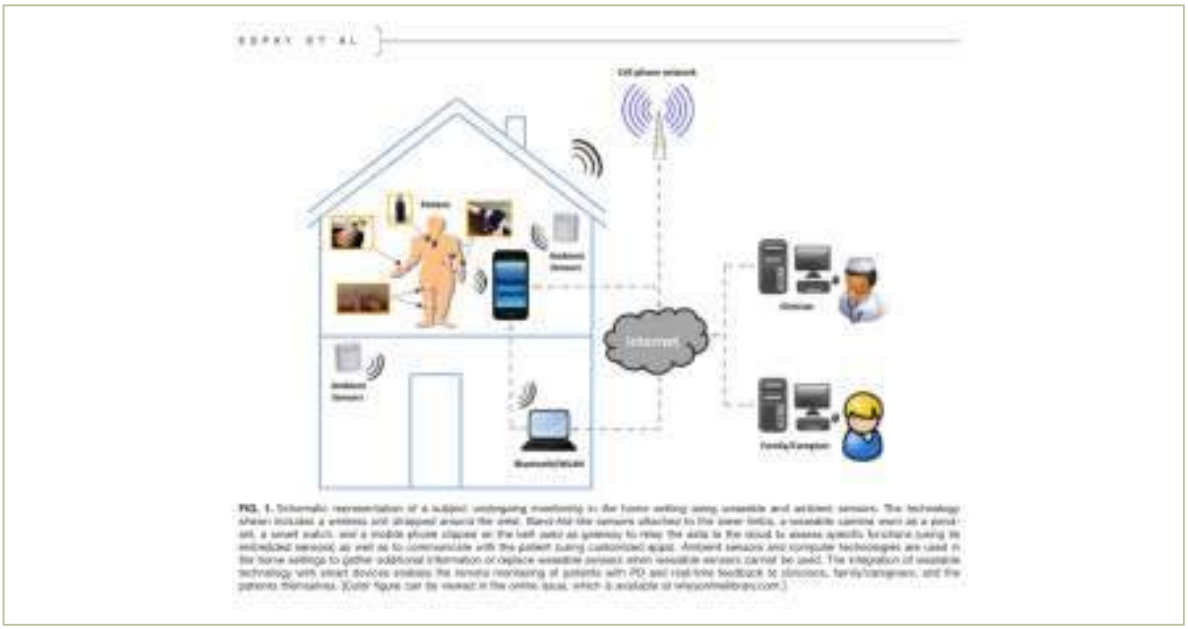
TABLE 1. Examples of available and needed technologies relevant to the diagnosis and clinical management of patients with Parkinson's disease

Clinical problem	Available/needed technologies	Clinical objective
Improving diagnosis	Needed: sensors for prodromal features (e.g., constipation, REM sleep behavior, anosmia); blood sensors for biomarkers (α-synuclein, proteinomics, etc.)	Enable population screening for PD, including the earliest possible (prodromal) stages
Monitoring response to therapy and motor complications (motor fluctuations, dyskinesia)	Available: accelerometers, gyroscopes, magnetometers, electrogoniometers, surface EMG sensors Needed: small patches onto the skin or other sensors that improve patient adherence	Collect ecologically valid data of motor fluctuations, falls, freezing of gait episodes Implement sensor-based closed-loop technologies capable of delivering treatments (eg, infusion pump)
Monitoring nonmotor symptoms and progression	Available (but requiring improvements): sweat sensors, skin conductance sensors, heart rate sensors, blood pressure sensors	Collect ecologically valid data of nonmotor symptoms and progression
Improving medical treatment	Available (but requiring improvements): oral capsules, subcutaneous and gastrointestinal infusion pumps	Implement adjustable extended-release drug formulations, smart (self-adjusting) levodopa delivery infusion systems
Enhancing surgical treatment	Available (but requiring improvements): STN DBS, GPi DBS, Vim thalamus DBS	Implement closed-loop STN and GPi DBS (variable stimulation based on local field potentials)
Improving rehabilitation interventions	Available: accelerometers, gyroscopes, magnetometers, electrogoniometers, surface EMG sensors, pulse oximetry sensors, respiratory rate sensors, blood pressure sensors	Implement closed-loop cueing and feedback systems validated for home use

DBS, deep brain stimulation; EMG, electromyography; GPi, globus pallidus pars interna; PD, Parkinson's disease; REM, rapid eye movement; STN, subthalamic nucleus; Vim, ventrointermedial nucleus.

Espay AJ, Bonato P, Nahab FB, et al. Technology in Parkinson's disease: Challenges and opportunities. *Mov Disord* 2016; 31: 1272-1282.

40

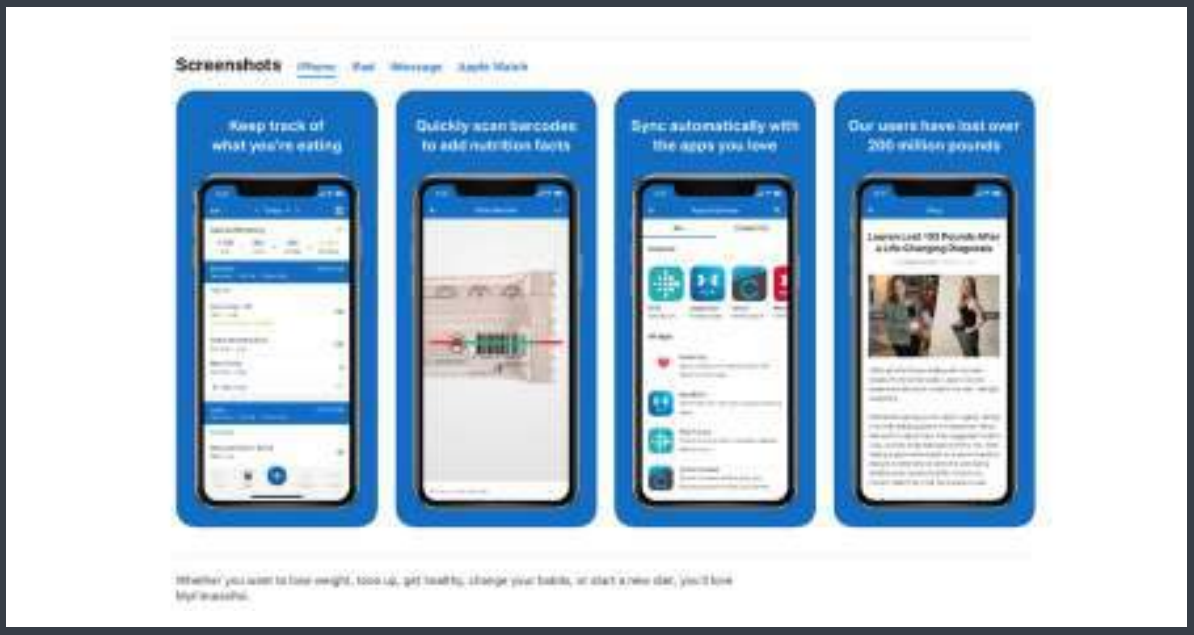


Espay AJ, Bonato P, Nahab FB, et al. Technology in Parkinson's disease: Challenges and opportunities. *Mov Disord* 2016; 31: 1272-1282.

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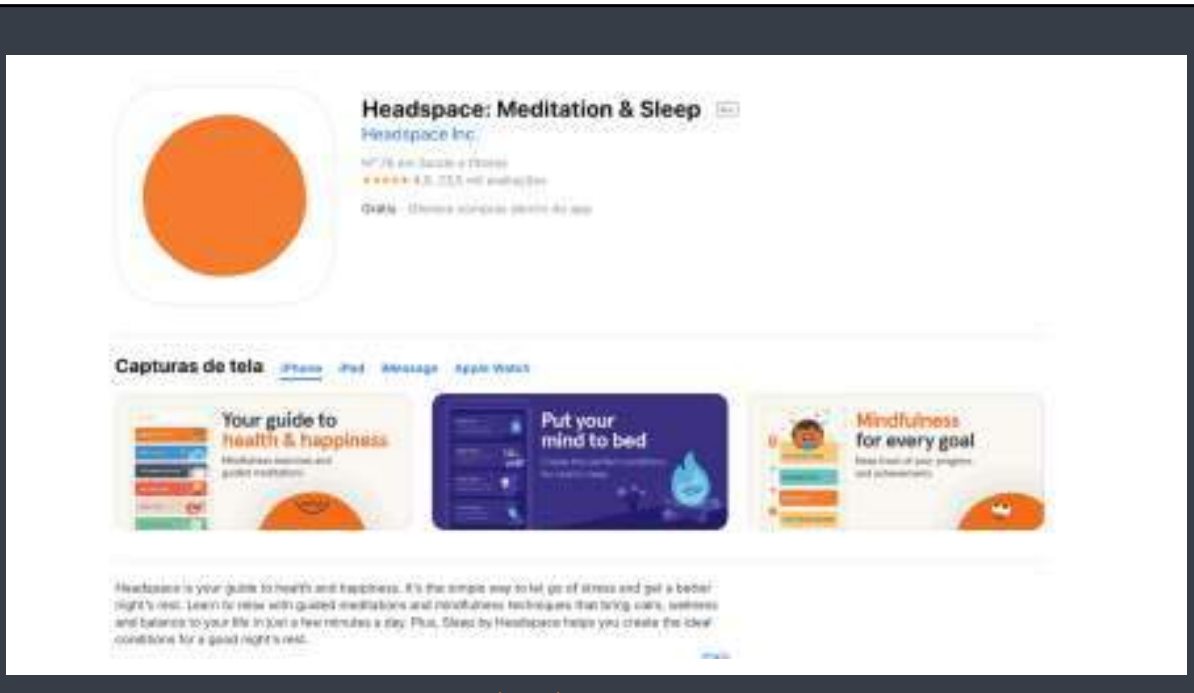


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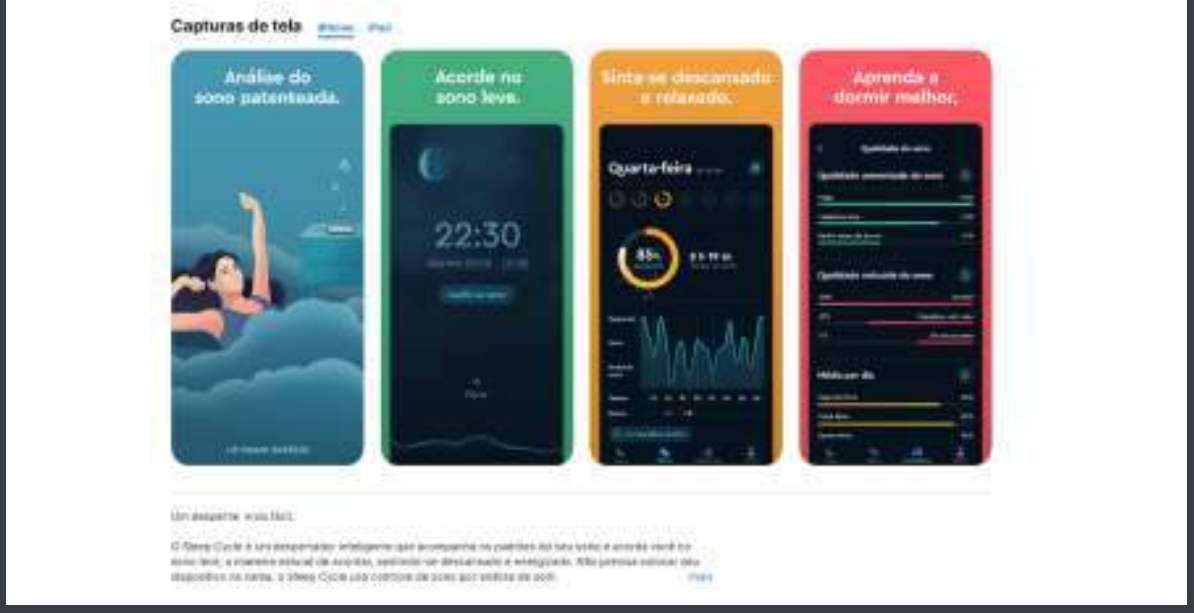
www.myfitnesspal.com

43



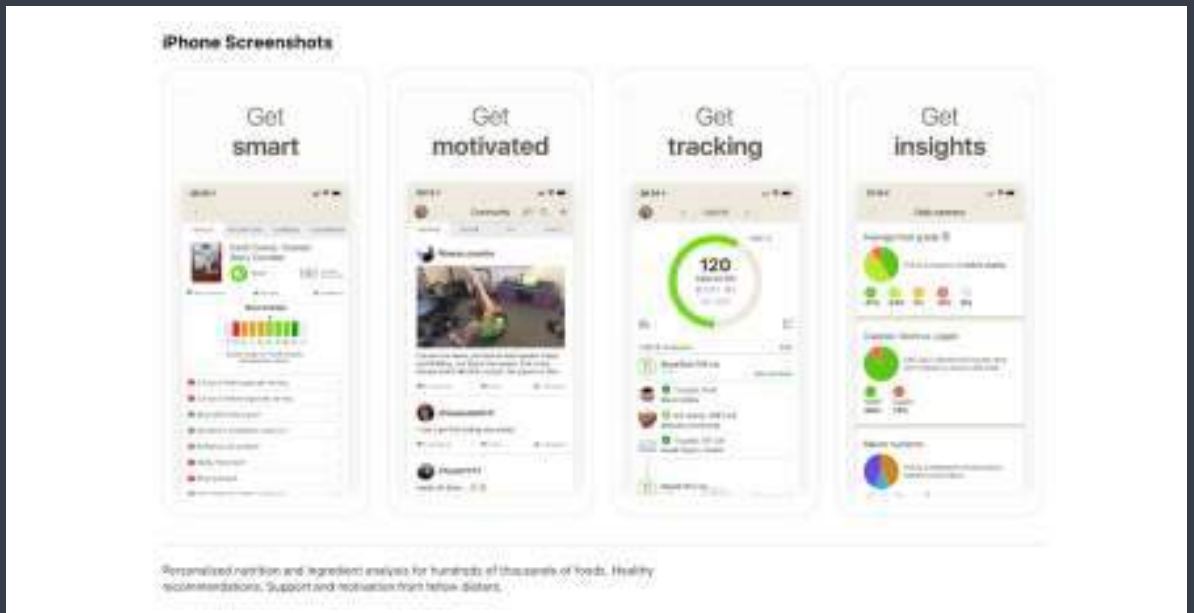
www.headspace.com

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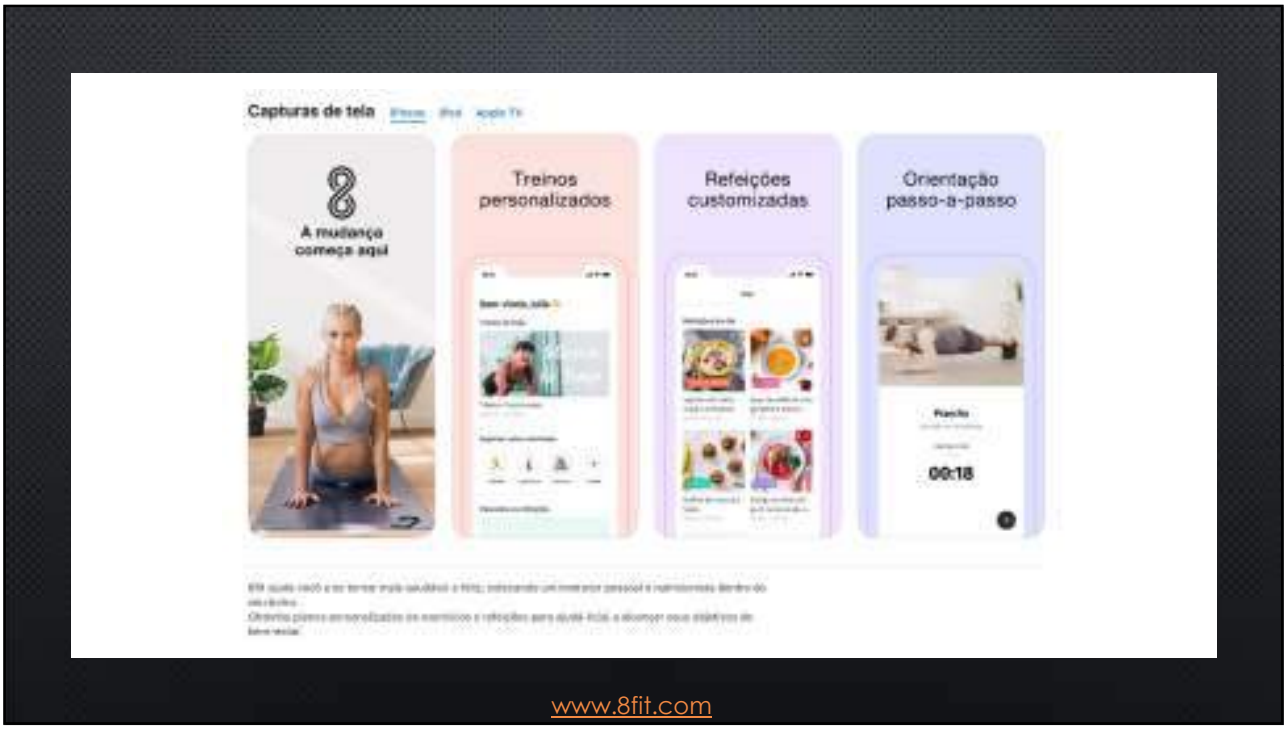
www.sleepcycle.com

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www.fooducate.com

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www.8fit.com

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App Gero360

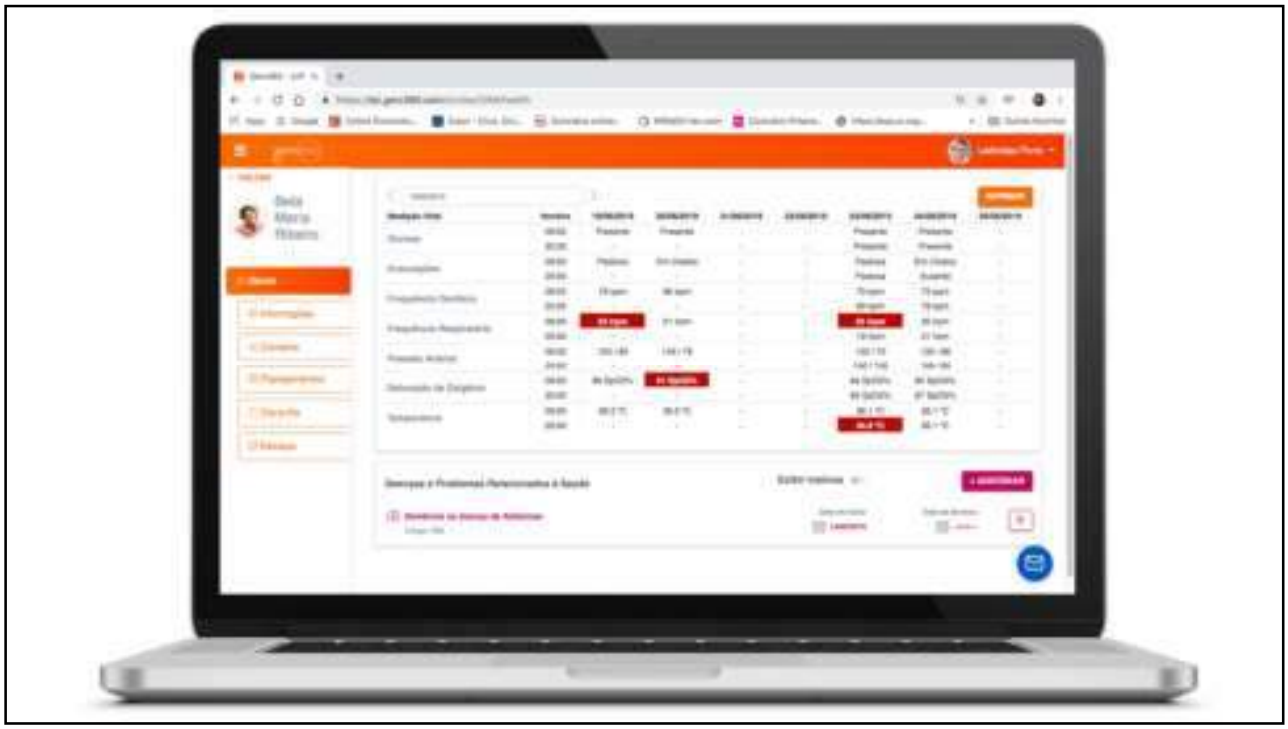
Agenda completa de cuidados, permite planejar, registrar e monitorar itens críticos da rotina do idoso:

- Medicamentos
- Sinais vitais
- Compromissos (de saúde ou sociais)

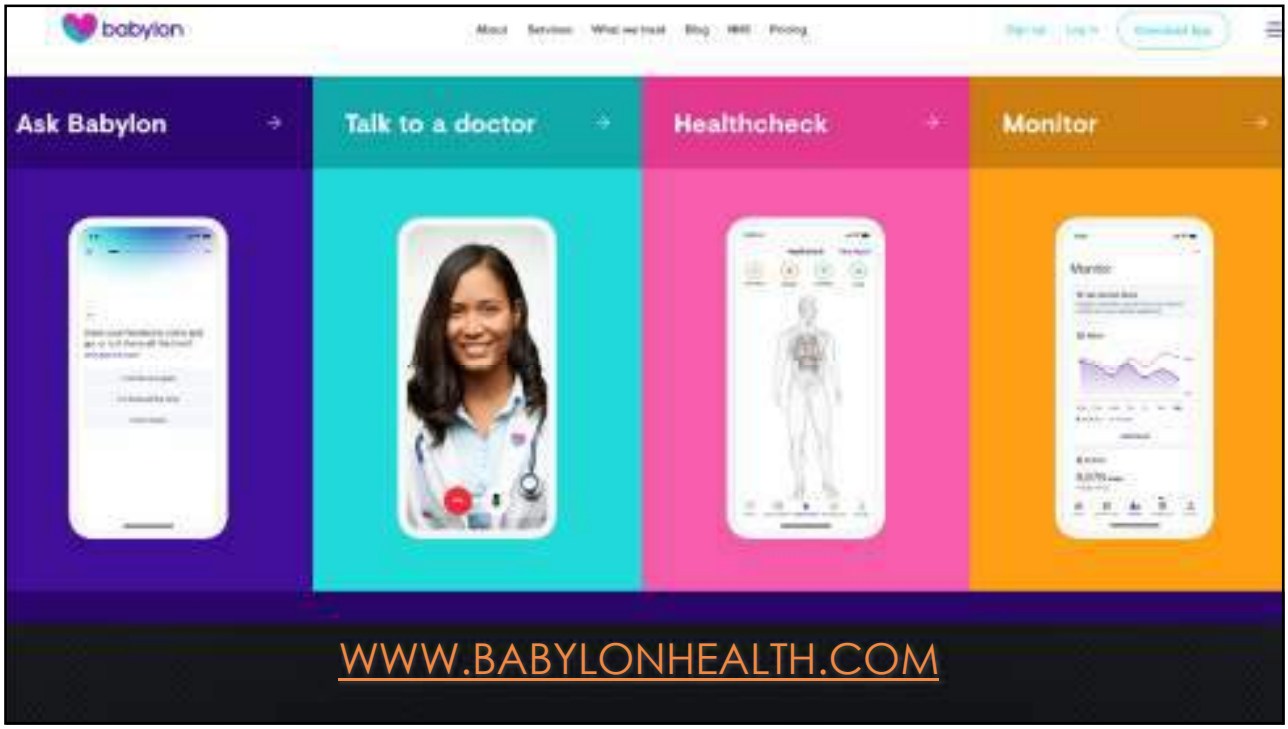
Orienta quem executa as tarefas no dia-a-dia.

Alerta quem precisa ser informado em situações inseperadas.

48



49


babylon
Ask Babylon
Talk to a doctor
Healthcheck
Monitor
WWW.BABYLONHEALTH.COM

50

CHI 2011 • Session: Rehabilitation May 7–12, 2011 • Vancouver, BC, Canada

How to Evaluate Technologies for Health Behavior Change in HCI Research

Predrag Klasnja[1], Sunny Consolvo[3], & Wanda Pratt[1,2]

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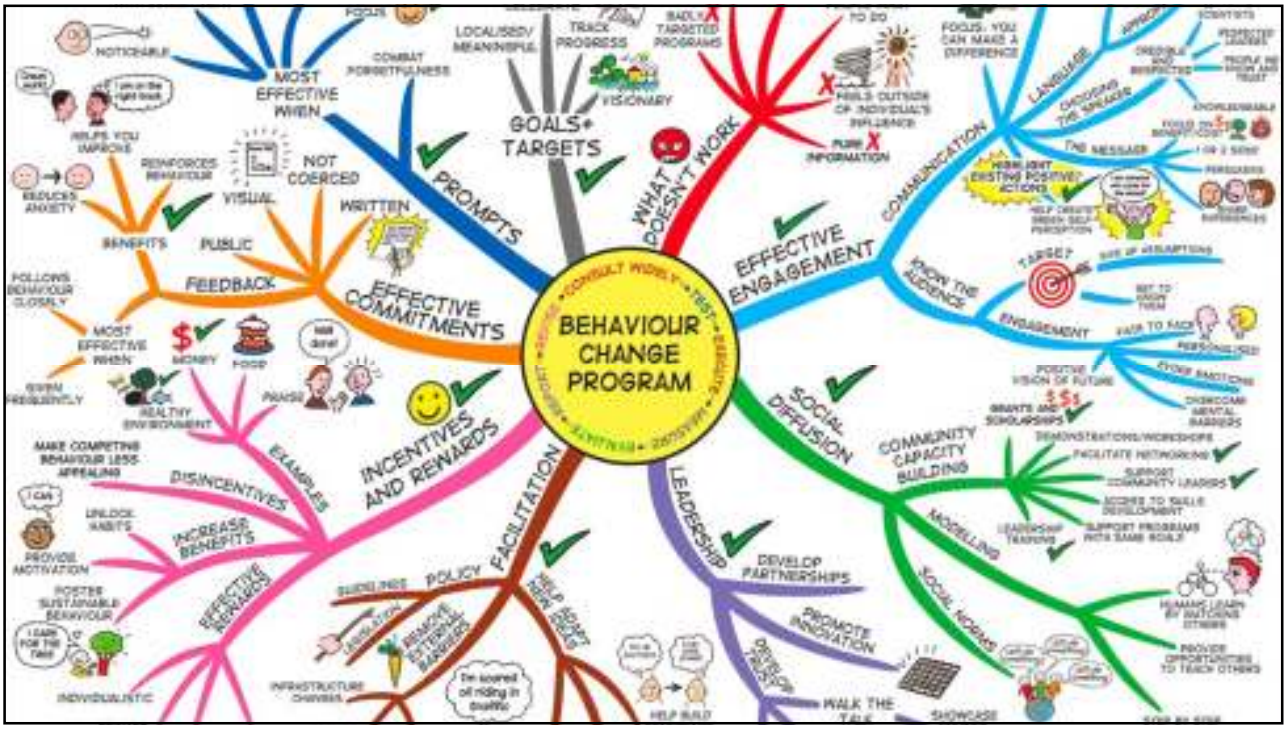
[3]Intel Labs Seattle
Seattle, WA 98105, USA
sunny.consolvo@intel.com

ABSTRACT

New technologies for encouraging physical activity, healthy diet, and other types of health behavior change now frequently appear in the HCI literature. Yet, how such technologies should be evaluated within the context of HCI research remains unclear. In this paper, we argue that the obvious answer to this question—that evaluations should assess whether a technology brought about the intended change in behavior—is too limited. We propose that demonstrating behavior change is often infeasible as well as unnecessary for a meaningful contribution to HCI research, especially when in the early stages of design or when evaluating novel technologies. As an alternative, we suggest that HCI contributions should focus on efficacy evaluations that are tailored to the specific behavior-change intervention strategies (e.g., self-monitoring, conditioning) embodied in the system and studies that help gain a deep understanding of people's experiences with the technology.

This work has the potential to make a meaningful impact on society. The prevalence of chronic diseases such as diabetes, obesity, and coronary heart disease continue to rise and are now responsible for over 70% of U.S. healthcare expenditures [20]. Some of the most important risk factors for these conditions are behavioral, including smoking, physical inactivity, excessive food intake, and diets heavy in trans fats. A successful change in these behaviors is a fundamental aspect of both prevention and effective management of chronic conditions, as well as an important contributor to health and wellbeing more broadly. Due to their low cost, high penetration, and integration in people's everyday lives, technologies such as mobile phones, web applications, and social networking tools hold great promise for supporting individuals as they strive to adopt and sustain health-promoting behaviors. HCI research can significantly contribute to the design of innovative and effective tools that help people in these efforts.

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Preventive Medicine

Review

A meta-analysis of computer-tailored interventions for health behavior change

Paul Krebs, James O. Prochaska, Joseph S. Rossi

ARTICLE INFO

ABSTRACT

Krebs P, Prochaska JO and Rossi JS. A meta-analysis of computer-tailored interventions for health behavior change. *Prev Med* 2010; 51: 214-221.

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Ontario
Health Quality Ontario
Qualité des services de santé Ontario

Health Technologies for the Improvement of Chronic Disease Management: A Review of the Medical Advisory Secretariat Evidence-Based Analyses Between 2006 and 2011

M Nikitovic and S Brener

Nikitovic M and Brener S. Health technologies for the improvement of chronic disease management: a review of the Medical Advisory Secretariat evidence-based analyses between 2006 and 2011. Ont Health Technol Assess Ser 2013; 13: 1-87. 2013/11/15.

54

Table 1: Included Evidence-Based Analyses

Year; Volume (Number)	Title
Type 2 Diabetes	
2009;9(22)	Bariatric Surgery for People With Diabetes and Morbid Obesity: An Evidence-Based Analysis (7)
Coronary Artery Disease	
2010;10(17)	Primary Angioplasty and Thrombolysis for the Treatment of Acute ST-Segment Elevated Myocardial Infarction: An Evidence Update (8)
Atrial Fibrillation	
2006;6(7)	Ablation for Atrial Fibrillation: An Evidence-Based Analysis (9)
Chronic Obstructive Pulmonary Disease	
2012;12(3)	Influenza and Pneumococcal Vaccinations for Patients With Chronic Obstructive Pulmonary Disease (COPD): An Evidence-Based Review (10)
2012;12(4)	Smoking Cessation for Patients With Chronic Obstructive Pulmonary Disease (COPD): An Evidence-Based Analysis (11)
2012;12(8)	Noninvasive Positive Pressure Ventilation for Acute Respiratory Failure Patients With Chronic Obstructive Pulmonary Disease (COPD): An Evidence-Based Analysis (12)
Congestive Heart Failure	
2005;5(14)	Implantable Cardioverter Defibrillators—Prophylactic Use: An Evidence-Based Analysis (13)
Stroke	
2011;11(6)	Constraint-Induced Movement Therapy for Rehabilitation of Arm Dysfunction After Stroke in Adults: An Evidence-Based Analysis (14)
Chronic Wounds	
2009;9(2)	Pressure Ulcer Prevention: An Evidence-Based Analysis (15)
2010;10(23)	Negative Pressure Wound Therapy: An Evidence-Update (16)
Other	
2013;in press (17)	Photoselective Vaporization for the Treatment of Benign Prostatic Hyperplasia

Nikitovic M and Brener S. Health technologies for the improvement of chronic disease management: a review of the Medical Advisory Secretariat evidence-based analyses between 2006 and 2011. Ont Health Technol Assess Ser 2013; 13: 1-87. 2013/11/15.

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DIABETES



Watch Monitor Glucose



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Review Article

Technology in the Management of Diabetes Mellitus

Ranjit Unnikrishnan, Nitika Sharma, Viswanathan Mohan, Harish Ranjani
Dr. Mohan's Diabetes Specialities Centre and Madras Diabetes Research Foundation, Chennai, Tamil Nadu, India

Abstract

The explosive increase in the prevalence of diabetes mellitus in resource-strapped regions of the world demands innovative solutions in healthcare. Advances in information technology, diagnostics and food technology have the potential to make diagnosis and treatment of diabetes simpler, cost-effective and patient-friendly. Newer methods of glucose testing such as the ambulatory glucose profile promise to make clinical decision-making easier and more robust. More advanced modes of insulin delivery are likely to help larger proportions of patients achieve their glycaemic goals with minimal risk of hypoglycaemia. Use of telemedicine and electronic medical records represents a significant advance in improving delivery of diabetes care and monitoring its outcomes. Efforts are also on to harness the wide penetrance of mobile phones in spreading awareness about diabetes and its prevention as well as in screening for retinopathy. Advances in technology also promise to favourably alter the food habits of the population, with the advent of the novel high-fibre white rice being a case in point. This narrative review aims to discuss some of the ways in which emerging technologies are making diabetes monitoring and treatment easier, more effective and pleasant for the patient.

Keywords: Ambulatory glucose profile, diabetes, electronic medical record, food technology, mobile health, smartphone funds photography, technology, telemedicine

Unnikrishnan R, Sharma N, Mohan V, Ranjani H. Technology in the management of diabetes mellitus. J Diabetol 2018;9:3-11.

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Learning objectives of the review

- To describe different glucose monitoring systems and their usefulness in promoting optimal glycaemic control
- To assess and compare different types of insulin delivery devices
- To recognise the role of electronic health (e-health) and mHealth in managing diabetes mellitus
- To define the role of food technology in the management of diabetes.

Unnikrishnan R, Sharma N, Mohan V, Ranjani H. Technology in the management of diabetes mellitus. J Diabetol 2018;9:3-11.

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Table 1: Invasive blood glucose monitors

Glucometers brand name	Company	How it works	Advantages	Disadvantage
iBG star	Sanofi Aventis and AgaMatrix	Meter can be integrated into iPhone or iTouch	Integrated with smartphone	Only integrated with iPhone/iTouch; requires a blood sample
Telcare	Telcare Inc.	Uses third generation cellular service to communicate with smartphone apps and its own web-based software; gives feedback to user with every BG reading; can reorder supplies through meter	Easy to send data to logs and clinicians, gives feedback to user with every BG, easy to reorder supplies	Requires a blood sample
Freestyle InsuLinx	Abbott	Meter with bolus calculator within	No need to calculate bolus dose	Requires a blood sample
One Touch Verio IQ	Lifescan	Meter with pattern recognition capabilities. Also has a rechargeable battery	Prompts user when patterns of hypoglycaemia or hyperglycaemia occur, so medication adjustments can be made	Requires a blood sample

BG: Blood glucose

Table 2: Non-invasive blood glucose monitors

Glucometers brand name	Company	How it works	Comments
GlucoTrack[11]	Integrity Applications	Uses ultrasound, conductivity, and heat capacity in an ear clip sensor to check BG's	Non-invasive and accurate
Near infrared optical spectroscopy	Inlight Solutions	Uses near infrared optical spectroscopy and multivariate analysis to measure glucose through the skin	Non-invasive, under development
LighTouch Technology	LighTouch	Light of a specific color is projected into the user's fingertip and the different colored light that is reprojected from the fingertip is measured	Non-invasive, under development
Contact lens CGM	University of Washington	Contact lens with additional enhancements, including an antenna, measures glucose concentrations in tears and sends the signal to a receiver	Non-invasive, under development

CGM: Continuous glucose monitoring, BG: Blood glucose

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Name of the App	Comments
Fooducate	Helps in weight loss, educates about pros and cons of various foods, and helps to monitor carbs, colorings, mood, hunger, sleep, and exercise
Glooko	Tracks medicine usage, carb counts, and lifestyle info. Integrates data from most CGM, BG meter, insulin pumps, and fitness trackers
Health2sync	Enables us to invite friends or family as a partner on this app for added support and motivation. The app lets us see all our vital stats at a glance within the dashboard or look more deeply at individual metrics like blood pressure, weight, and BG
Dr. Mohan's Diabetes App	Offers online lifestyle coaching program, a 16-week curriculum, to be viewed like a reality-based TV show that helps to cope with the behavioral and emotional aspects of managing diabetes; 2-min videos on different aspects of diabetes explained by country's top diabetes consultant, facilitates patients to monitor vital information such as glucose and HbA1c levels, diet, physical activity steps, and weight

HbA1c: Glycated hemoglobin, BG: Blood glucose

Unnikrishnan R, Sharma N, Mohan V, Ranjani H. Technology in the management of diabetes mellitus. J Diabetol 2018;9:3-11.

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Diabetes Care Volume 42, Supplement 1, January 2019 S71

Check for updates

7. Diabetes Technology: *Standards of Medical Care in Diabetes—2019*

American Diabetes Association

Diabetes Care 2019;42(Suppl. 1):S71–S80 | https://doi.org/10.2337/dc19-S007

The American Diabetes Association (ADA) "Standards of Medical Care in Diabetes" includes ADA's current clinical practice recommendations and is intended to provide the components of diabetes care, general treatment goals and guidelines, and tools to evaluate quality of care. Members of the ADA Professional Practice Committee, a multidisciplinary expert committee, are responsible for updating the Standards of Care annually, or more frequently as warranted. For a detailed description of ADA standards, statements, and reports, as well as the evidence-grading system for ADA's clinical practice recommendations, please refer to the Standards of Care Introduction. Readers who wish to comment on the Standards of Care are invited to do so at professional.diabetes.org/SOC.

62

Diabetologia (2019) 62:877–887
https://doi.org/10.1007/s00125-019-4864-7

REVIEW

Digital health technology and mobile devices for the management of diabetes mellitus: state of the art

Rongzi Shan [1,2] · Sudipa Sarkar [1,3] · Seth S. Martin [1,4]

Received: 25 January 2019 / Accepted: 13 March 2019 / Published online: 8 April 2019
© Springer-Verlag GmbH Germany, part of Springer Nature 2019

Abstract
Diabetes mellitus is a disease that can be difficult to manage and requires high levels of health literacy and numeracy, self-monitoring and frequent contact with clinicians. If not optimally controlled, diabetes can lead to kidney failure, blindness and cardiovascular complications, which, in turn, contribute to increasing healthcare costs. Although not yet widely used, mobile health (mHealth) tools have enhanced diabetes management and prevention and are likely to play an increasing role with the growth of smartphone ownership and medical device innovations. Recent mHealth interventions targeting type 1 and type 2 diabetes are diverse in their goals and components, and include insulin management applications, wearable blood glucose meters, automated text messages, health diaries and virtual health coaching. In this paper, we review the modalities and components of various impactful interventions for insulin management, diabetes education, self-management and prevention. More work is needed to investigate how individual demographic, socioeconomic, behavioural and clinical characteristics influence patient engagement and the efficacy of mHealth tools for diabetes.

Keywords Diabetes · Digital health · Glucose monitoring · HbA_{1c} · mHealth · Precision medicine · Review · Self-monitoring · Smartphones · Wearables

Insulin Management

Diabetes Education

Wearable

Self-Management

Shan R, Sarkar S and Martin SS. Digital health technology and mobile devices for the management of diabetes mellitus: state of the art. *Diabetologia* 2019; 62: 877-887.

63

Table 1 mHealth interventions for insulin management

Study, setting	Sample characteristics	Modality	Components of intervention	Clinical outcomes
Charpentier et al, 2011 [8] TeleDiab 1 Study, Diabeo (Voluntis) Multicentre RCT: 17 hospitals in France	T1DM adults, on basal-bolus insulin regimen. Age: 33.8 ± 12.9 years. Baseline HbA_{1c}: 9.07 ± 1.07% (76 ± 11.7 mmol/mol) *n* = 59 Diabeo + teleconsultation *n* = 60 Diabeo alone *n* = 60 Paper SMBG log-book and usual care	Mobile app, telephone calls	Insulin bolus calculator: based on SMBG, carbohydrate counts and physical activity. Suggests adjustments for insulin/carbohydrate ratio and basal insulin dose if SMBG off-target. Teleconsultations with physicians: every 2 weeks for SMBG log-book review, insulin-dose adjustments and motivational support.	Diabeo only group had 0.67% (7.3 mmol/mol) greater reduction in HbA_{1c} at 6 months than control ($p < 0.001$). Diabeo + teleconsultation had 0.91% (9.9 mmol/mol) greater HbA_{1c} reduction at 6 months ($p < 0.001$). No difference in frequency of hypoglycaemic episodes between groups.
Rossi et al, 2010 [9] Diabetes Interactive Diary (DID; Meteda) Multicentre RCT: Italy, England, Spain	T1DM adults, on any insulin regimen except for soluble regular or NPH insulin, no previous education on carbohydrate counting. Age: 35.4 ± 9.5 years in DID group, 36.1 ± 9.4 years in control group. Baseline HbA_{1c}: 8.2 ± 0.8% (66 ± 8.7 mmol/mol) in DID group, 8.4 ± 0.7% (68 ± 7.7 mmol/mol) in control group *n* = 67 DID intervention *n* = 63 Usual care	Mobile app, SMS	Insulin bolus calculator: based on SMBG, carbohydrate counts, physical activity, and insulin/carbohydrate ratio. Recommends daily carbohydrate intake. Suggests basal insulin dose adjustments. SMS communication with physicians: recorded data are regularly sent to physicians; therapeutic recommendations are texted to patients.	No difference in HbA_{1c} reduction; both groups reduced HbA_{1c} by −0.5% (5.5 mmol/mol) at 3 months, maintained at 6 months. DID group had significantly improved diabetes-related quality-of-life scores.
Rossi et al, 2013 [10] DID (Meteda) Multicentre RCT: Italy	T1DM adults, on 1 daily dose insulin glargine + 3 doses insulin glulisine, no previous education on carbohydrate counting. Age: 38.4 ± 10.3 years in DID group, 34.3 ± 10.0 years in control group. Baseline HbA_{1c}: 8.4 ± 0.1% (68 ± 1.1 mmol/mol) in DID group, 8.5 ± 0.1% (69 ± 1.1 mmol/mol) in control group *n* = 63 DID intervention *n* = 64 Usual care	Mobile app, SMS	Same as above	No difference in HbA_{1c} reduction; both groups reduced HbA_{1c} by −0.50% (5.5 mmol/mol) at 6 months. DID group had 86% lower incidence rate of moderate–severe hypoglycaemic episodes and improved quality-of-life scores.
Levy et al, 2015 [12] Mobile Insulin Titration Intervention (MITI) Single-centre RCT: USA	Low-income T2DM patients taking insulin glargine in a clinic primarily serving uninsured or Medicaid patients. Age: 46.70 ± 10.25 years. Baseline HbA_{1c}: 11.72 ± 1.83% (104 ± 20.0 mmol/mol) *n* = 33 MITI *n* = 28 Usual care	SMS, telephone calls	Glucose monitoring: patients received texts requesting their fasting SMBG values. Remote management: the clinic's diabetes nurse educator reviewed the SMBG responses for alarm values, consulted titration algorithm and called patient to adjust insulin dose if needed.	Percentage of patients who achieved optimal insulin glargine dose within 12 weeks was higher in the MITI arm (88%) than in the usual care arm (37%; $p < 0.001$).
Bolinder et al, 2016 [16] FreeStyle Libre (Abbott) Multicentre RCT: Sweden, Austria, Germany, Spain, Netherlands	T1DM adults, well controlled on insulin therapy. Age: 42 years (IQR 33–51) in intervention group, 45 years (IQR 33–57) in control group. Baseline HbA_{1c}: 6.7 ± 0.5% (50 ± 5.5 mmol/mol) in intervention group, 6.7 ± 0.6% (50 ± 6.6 mmol/mol) in control group *n* = 119 Flash glucose monitoring *n* = 120 Usual care with finger-stick SMBG	Flash glucose testing	Glucose monitoring: interstitial glucose concentrations captured on a skin-worn sensor; scanning with reader device displays current glucose level and 8 h trends. Data can be uploaded from the reader to device software to generate reports. Patients otherwise managed diabetes according to usual care.	Time in hypoglycaemia (<3.9 mmol/l) decreased by 1.24 h/day more in the intervention than control group at 6 months ($p < 0.0001$). No difference in 6-month HbA_{1c} reduction between groups. Treatment satisfaction favoured intervention.
Haak et al, 2017 [17] FreeStyle Libre (Abbott) Multicentre RCT: France, Germany, UK	T2DM adults on insulin therapy. Age: 59.0 ± 9.9 years in intervention group, 59.5 ± 11.0 in control group. Baseline HbA_{1c}: 8.74 ± 0.97% (72 ± 10.6 mmol/mol) in intervention group, 8.88 ± 1.04 (74 ± 11.3 mmol/mol) in control group *n* = 149 Flash glucose monitoring *n* = 75 Usual care with finger-stick SMBG	Flash glucose testing	Same as above.	Time in hypoglycaemia (<3.9 mmol/l) decreased by 0.47 h/day more in intervention than control at 6 months ($p = 0.0096$). No difference in 6 month HbA_{1c} change between groups. Treatment satisfaction favoured intervention.

T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus

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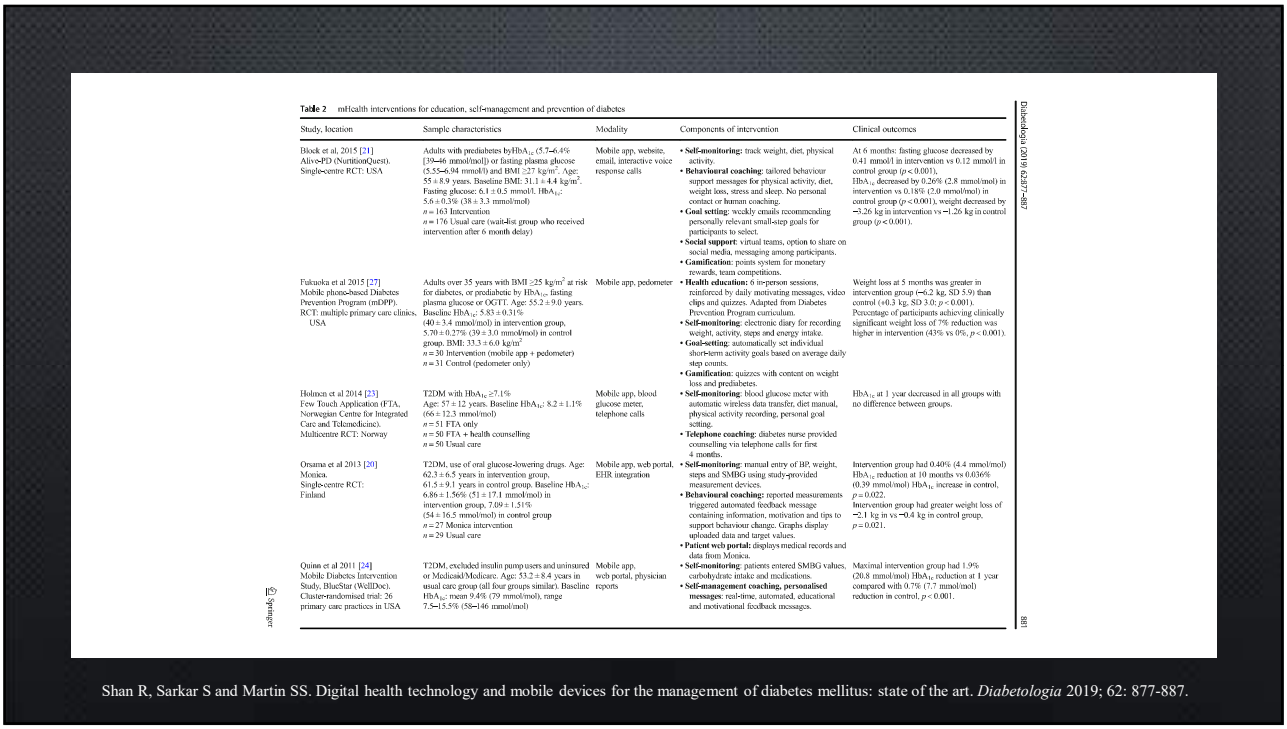


Table 2 mHealth interventions for education, self-management and prevention of diabetes

Study, location	Sample characteristics	Modality	Components of intervention	Clinical outcomes
Block et al, 2015 [21] Alive-PD (NutritionQuest). Single-centre RCT: USA	Adults with prediabetes by HbA_{1c} (5.7–6.4% [39–46 mmol/mol]) or fasting plasma glucose (5.55–6.94 mmol/l) and BMI ≥27 kg/m². Age: 55 ± 8.9 years. Baseline BMI: 31.1 ± 4.4 kg/m². Fasting glucose: 6.1 ± 0.5 mmol/l, HbA_{1c}: 5.6 ± 0.3% (38 ± 3.3 mmol/mol) *n* = 163 Intervention *n* = 176 Usual care (wait-list group who received intervention after 6 month delay)	Mobile app, website, email, interactive voice response calls	• **Self-monitoring:** track weight, diet, physical activity. • **Behavioural coaching**: tailored behaviour support messages for physical activity, diet, weight loss, stress and sleep. No personal contact or human coaching. • **Goal setting**: weekly emails recommending personally relevant small-step goals for participants to select. • **Social support**: virtual teams, option to share on social media, messaging among participants. • **Gamification:** points system for monetary rewards, team competitions.	At 6 months: fasting glucose decreased by 0.41 mmol/l in intervention vs 0.12 mmol/l in control group ($p < 0.001$), HbA_{1c} decreased by 0.26% (2.8 mmol/mol) in intervention vs 0.18% (2.0 mmol/mol) in control group ($p < 0.001$), weight decreased by −3.26 kg in intervention vs −1.26 kg in control group ($p < 0.001$).
Fukuoka et al 2015 [27] Mobile phone-based Diabetes Prevention Program (mDPP). RCT: multiple primary care clinics, USA	Adults over 35 years with BMI ≥25 kg/m² at risk for diabetes, or prediabetic by HbA_{1c}, fasting plasma glucose or OGTT. Age: 55.2 ± 9.0 years. Baseline HbA_{1c}: 5.83 ± 0.31% (40 ± 3.4 mmol/mol) in intervention group, 5.70 ± 0.27% (39 ± 3.0 mmol/mol) in control group. BMI: 33.3 ± 6.0 kg/m² *n* = 30 Intervention (mobile app + pedometer) *n* = 31 Control (pedometer only)	Mobile app, pedometer	• **Health education:** 6 in-person sessions, reinforced by daily motivating messages, video clips and quizzes. Adapted from Diabetes Prevention Program curriculum. • **Self-monitoring**: electronic diary for recording weight, activity, steps and energy intake. • **Goal-setting**: automatically set individual short-term activity goals based on average daily step counts. • **Gamification**: quizzes with content on weight loss and prediabetes.	Weight loss at 5 months was greater in intervention group (−6.2 kg, SD 5.9) than control (+0.3 kg, SD 3.0; $p < 0.001$). Percentage of participants achieving clinically significant weight loss of 7% reduction was higher in intervention (43% vs 0%, $p < 0.001$).
Holman et al 2014 [23] Few Touch Application (FTA, Norwegian Centre for Integrated Care and Telemedicine). Multicentre RCT: Norway	T2DM with HbA_{1c} ≥7.1% Age: 57 ± 12 years. Baseline HbA_{1c}: 8.2 ± 1.1% (66 ± 12.3 mmol/mol) *n* = 51 FTA only *n* = 50 FTA + health counselling *n* = 50 Usual care	Mobile app, blood glucose meter, telephone calls	• **Self-monitoring**: blood glucose meter with automatic wireless data transfer, diet manual, physical activity recording, personal goal setting. • **Telephone coaching**: diabetes nurse provided counselling via telephone calls for first 4 months.	HbA_{1c} at 1 year decreased in all groups with no difference between groups.
Orsama et al 2013 [20] Monica. Single-centre RCT: Finland	T2DM, use of oral glucose-lowering drugs. Age: 62.3 ± 6.5 years in intervention group, 61.5 ± 9.1 years in control group. Baseline HbA_{1c}: 6.86 ± 1.56% (51 ± 17.1 mmol/mol) in intervention group, 7.09 ± 1.51% (54 ± 16.5 mmol/mol) in control group *n* = 27 Monica intervention *n* = 29 Usual care	Mobile app, web portal, EHR integration	• **Self-monitoring**: manual entry of BP, weight, steps and SMBG using study-provided measurement devices. • **Behavioural coaching:** reported measurements triggered automated feedback message containing information, motivation and tips to support behaviour change. Graphs display uploaded data and target values. • **Patient web portal:** displays medical records and data from Monica.	Intervention group had 0.40% (4.4 mmol/mol) HbA_{1c} reduction at 10 months vs 0.036% (0.39 mmol/mol) HbA_{1c} increase in control, $p = 0.022$. Intervention group had greater weight loss of −2.1 kg in vs −0.4 kg in control group, $p = 0.021$.
Quinn et al 2011 [24] Mobile Diabetes Intervention Study, BlueStar (WellDoc). Cluster-randomised trial: 26 primary care practices in USA	T2DM, excluded insulin pump users and uninsured or Medicaid/Medicare. Age: 53.2 ± 8.4 years in usual care group (all four groups similar). Baseline HbA_{1c}: mean 9.4% (79 mmol/mol), range 7.5–15.5% (58–146 mmol/mol)	Mobile app, web portal, physician reports	• **Self-monitoring**: patients entered SMBG values, carbohydrate intake and medications. • **Self-management coaching, personalised messages**: real-time, automated, educational and motivational feedback messages.	Maximal intervention group had 1.9% (20.8 mmol/mol) HbA_{1c} reduction at 1 year compared with 0.7% (7.7 mmol/mol) reduction in control, $p < 0.001$.

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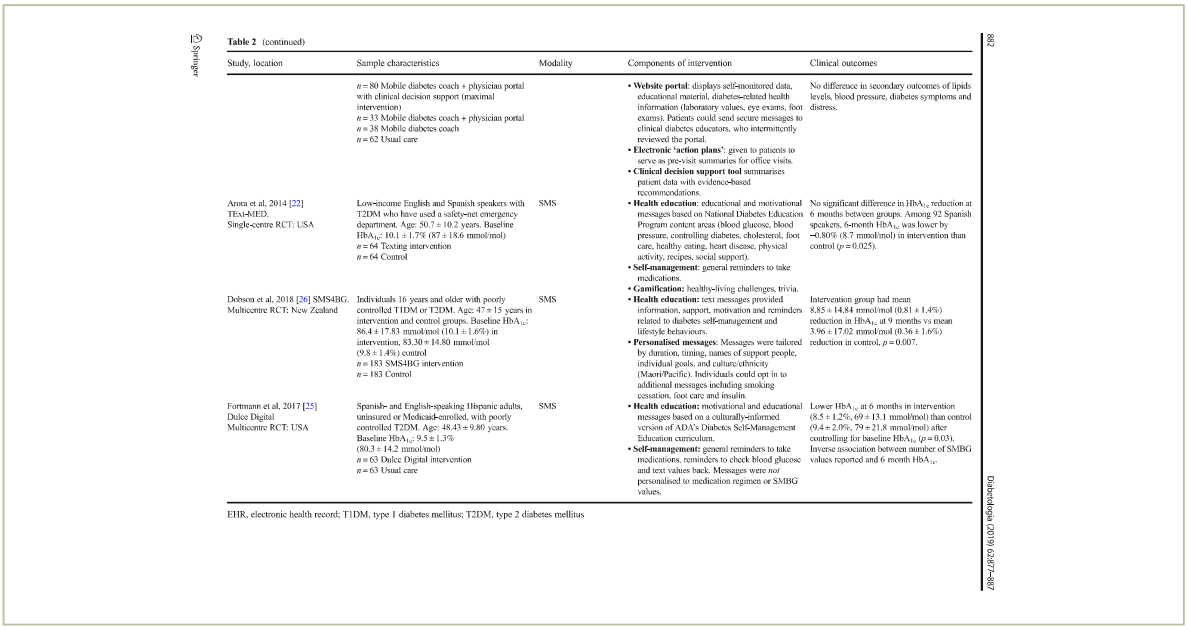


Table 2 (continued)

Study, location	Sample characteristics	Modality	Components of intervention	Clinical outcomes
	n = 80 Mobile diabetes coach + physician portal with clinical decision support (maximal intervention) *n* = 33 Mobile diabetes coach + physician portal *n* = 38 Mobile diabetes coach *n* = 62 Usual care		• **Website portal**: displays self-monitored data, educational material, diabetes-related health information (laboratory values, eye exams, foot exams). Patients could send secure messages to clinical diabetes educators, who intermittently reviewed the portal. • **Electronic 'action plans'**: given to patients to serve as pre-visit summaries for office visits. • **Clinical decision support tool** summarises patient data with evidence-based recommendations.	No difference in secondary outcomes of lipids levels, blood pressure, diabetes symptoms and distress.
Arora et al, 2014 [22] TExT-MED. Single-centre RCT: USA	Low-income English and Spanish speakers with T2DM who have used a safety-net emergency department. Age: 50.7 ± 10.2 years. Baseline HbA_{1c}: 10.1 ± 1.7% (87 ± 18.6 mmol/mol) *n* = 64 Texting intervention *n* = 64 Control	SMS	• **Health education**: educational and motivational messages based on National Diabetes Education Program content areas (blood glucose, blood pressure, controlling diabetes, cholesterol, foot care, healthy eating, heart disease, physical activity, recipes, social support). • **Self-management**: general reminders to take medications. • **Gamification:** healthy-living challenges, trivia.	No significant difference in HbA_{1c} reduction at 6 months between groups. Among 92 Spanish speakers, 6-month HbA_{1c} was lower by −0.80% (8.7 mmol/mol) in intervention than control ($p = 0.025$).
Dobson et al, 2018 [26] SMS4BG. Multicentre RCT: New Zealand	Individuals 16 years and older with poorly controlled T1DM or T2DM. Age: 47 ± 15 years in intervention and control groups. Baseline HbA_{1c}: 86.4 ± 17.83 mmol/mol (10.1 ± 1.6%) in intervention, 83.30 ± 14.80 mmol/mol (9.8 ± 1.4%) control *n* = 183 SMS4BG intervention *n* = 183 Control	SMS	• **Health education:** text messages provided information, support, motivation and reminders related to diabetes self-management and lifestyle behaviours. • **Personalised messages**: Messages were tailored by duration, timing, names of support people, individual goals, and culture/ethnicity (Maori/Pacific). Individuals could opt in to additional messages including smoking cessation, foot care and insulin.	Intervention group had mean 8.85 ± 14.84 mmol/mol (0.81 ± 1.4%) reduction in HbA_{1c} at 9 months vs mean 3.96 ± 17.02 mmol/mol (0.36 ± 1.6%) reduction in control, $p = 0.007$.
Fortmann et al, 2017 [25] Dulce Digital Multicentre RCT: USA	Spanish- and English-speaking Hispanic adults, uninsured or Medicaid-enrolled, with poorly controlled T2DM. Age: 48.43 ± 9.80 years. Baseline HbA_{1c}: 9.5 ± 1.3% (80.3 ± 14.2 mmol/mol) *n* = 63 Dulce Digital intervention *n* = 63 Usual care	SMS	• **Health education:** motivational and educational messages based on a culturally-informed version of ADA's Diabetes Self-Management Education curriculum. • **Self-management:** general reminders to take medications, reminders to check blood glucose and text values back. Messages were *not* personalised to medication regimen or SMBG values.	Lower HbA_{1c} at 6 months in intervention (8.5 ± 1.2%, 69 ± 13.1 mmol/mol) than control (9.4 ± 2.0%, 79 ± 21.8 mmol/mol) after controlling for baseline HbA_{1c} ($p = 0.03$). Inverse association between number of SMBG values reported and 6 month HbA_{1c}.

EHR, electronic health record; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus

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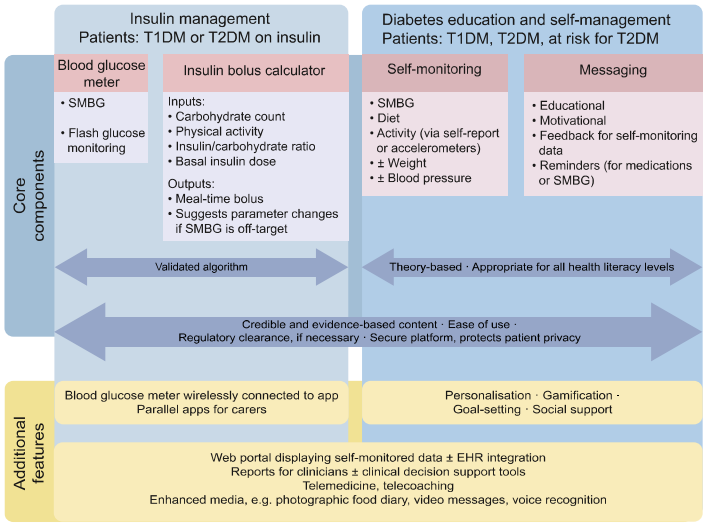


Fig. 1 Summary of key components and features of mHealth interventions for diabetes. EHR, electronic health record; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus. This figure is available as a downloadable slide

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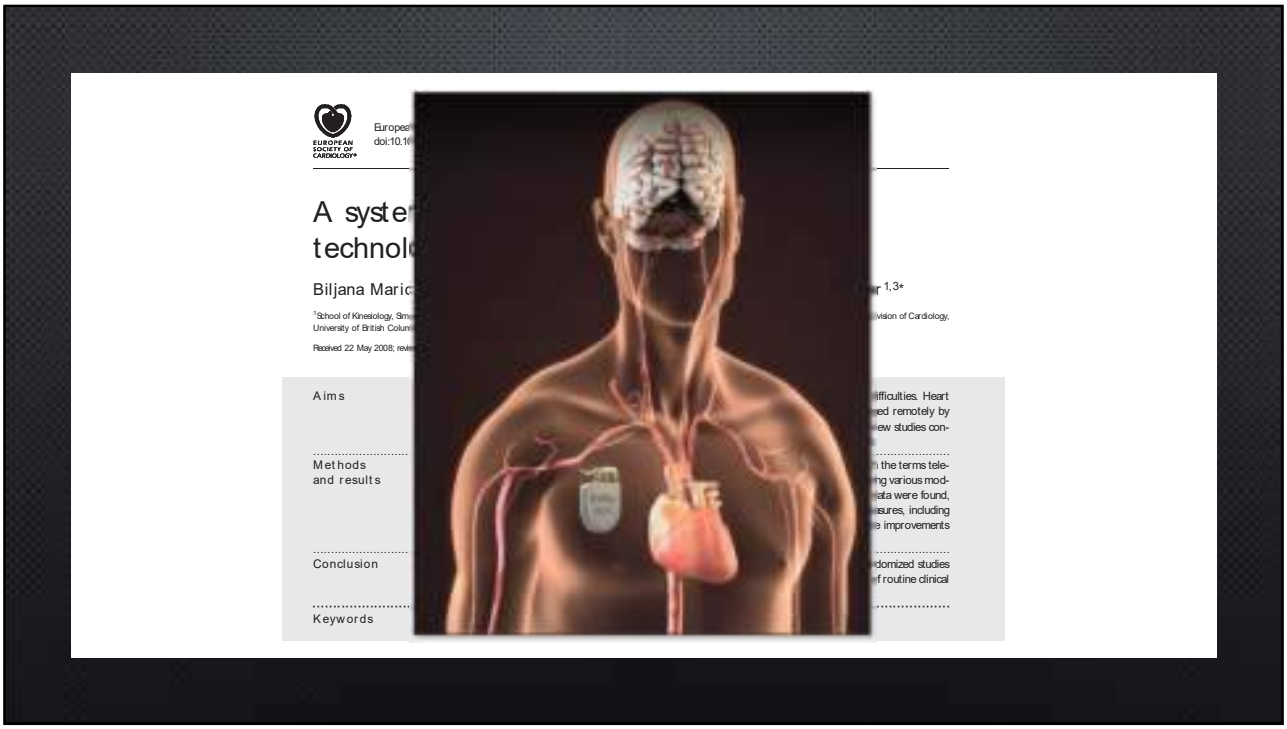
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Summary

- mHealth interventions for diabetes are heterogeneous and clinical effects are generally modest
- Barriers to adoption include cost, sustainability and integration with healthcare systems
- mHealth has particular potential to expand access to healthcare in underserved populations and to deliver precision medicine
- More work is needed to assess which features promote clinical efficacy and patient engagement
- Future work in diabetes should focus on medication adherence and lifestyle modifications
- Closed-loop systems may replace the need for insulin management mHealth tools

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JOURNAL OF MEDICAL INTERNET RESEARCH

Original Paper

Perceptions and Experiences of Heart Failure Patients and Clinicians on the Use of Mobile Phone-Based Telemonitoring

Emily Seto[1,2], PhD, PEng; Kevin J Leonard[1,2], PhD, MBA; Joseph A Cafazzo[1,2,3], PhD, PEng; Jan Barnsley[2], PhD; Caterina Masino[1], MA; Heather J Ross[4,5], MD, MHSc, FRCPC

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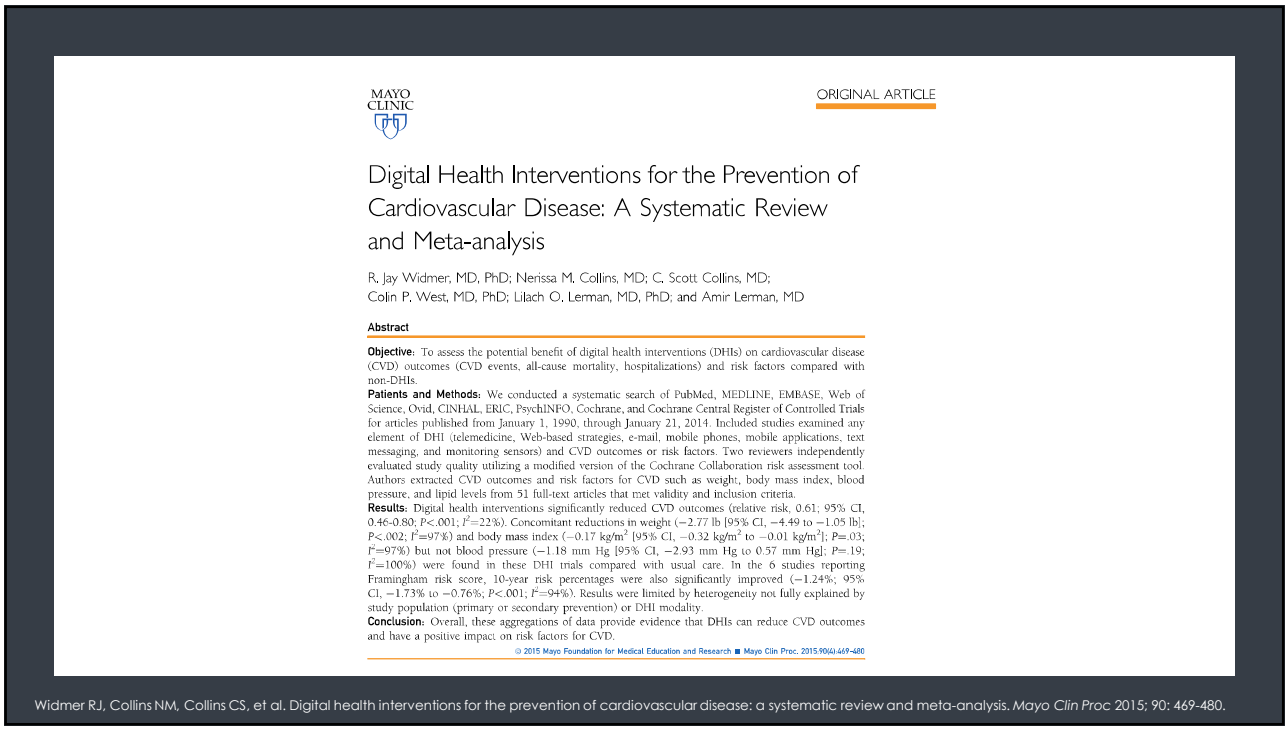
International Journal of Medical Informatics

Barriers to technology use among older heart failure individuals in managing their symptoms after hospital discharge

Highlights

- Technology may assist older individuals with heart failure to manage their condition and engage in self-care.
- Barriers to the use of technology is identified among older patients with heart failure and the informal caregivers.
- Patients were willing to engage in heart failure self-care, but they often relied on their caregivers who were more willing to ask questions.
- Technology tools may assist heart failure self-care, but they must be tailored for use among older individuals.

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MAYO CLINIC

ORIGINAL ARTICLE

Digital Health Interventions for the Prevention of Cardiovascular Disease: A Systematic Review and Meta-analysis

R. Jay Widmer, MD, PhD; Nerissa M. Collins, MD; C. Scott Collins, MD; Colin P. West, MD, PhD; Lilach O. Lerman, MD, PhD; and Amir Lerman, MD

Abstract

Objective: To assess the potential benefit of digital health interventions (DHIs) on cardiovascular disease (CVD) outcomes (CVD events, all-cause mortality, hospitalizations) and risk factors compared with non-DHIs.

Patients and Methods: We conducted a systematic search of PubMed, MEDLINE, EMBASE, Web of Science, Ovid, CINHAL, ERIC, PsychINFO, Cochrane, and Cochrane Central Register of Controlled Trials for articles published from January 1, 1990, through January 21, 2014. Included studies examined any element of DHI (telemedicine, Web-based strategies, e-mail, mobile phones, mobile applications, text messaging, and monitoring sensors) and CVD outcomes or risk factors. Two reviewers independently evaluated study quality utilizing a modified version of the Cochrane Collaboration risk assessment tool. Authors extracted CVD outcomes and risk factors for CVD such as weight, body mass index, blood pressure, and lipid levels from 51 full-text articles that met validity and inclusion criteria.

Results: Digital health interventions significantly reduced CVD outcomes (relative risk, 0.61; 95% CI, 0.46-0.80; $P<.001$; $I^2=22\%$). Concomitant reductions in weight (−2.77 lb [95% CI, −4.49 to −1.05 lb]; $P<.002$; $I^2=97\%$) and body mass index (−0.17 kg/m^2 [95% CI, −0.32 kg/m^2 to −0.01 kg/m^2]; $P=.03$; $I^2=97\%$) but not blood pressure (−1.18 mm Hg [95% CI, −2.93 mm Hg to 0.57 mm Hg]; $P=.19$; $I^2=100\%$) were found in these DHI trials compared with usual care. In the 6 studies reporting Framingham risk score, 10-year risk percentages were also significantly improved (−1.24%; 95% CI, −1.73% to −0.76%; $P<.001$; $I^2=94\%$). Results were limited by heterogeneity not fully explained by study population (primary or secondary prevention) or DHI modality.

Conclusion: Overall, these aggregations of data provide evidence that DHIs can reduce CVD outcomes and have a positive impact on risk factors for CVD.

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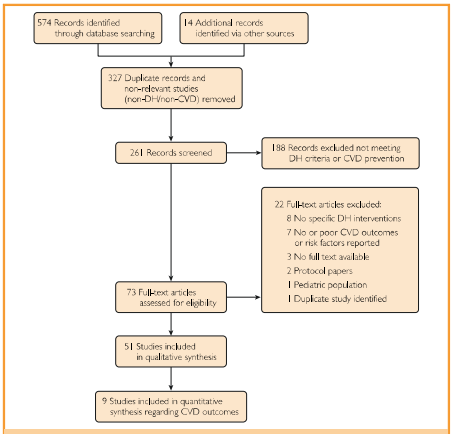


FIGURE 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) schematic for study selection. CVD = cardiovascular disease; DH = digital health.

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TABLE. Summary of 9 Randomized Controlled Trials Reporting Cardiovascular Disease Outcomes With Digital Health Interventions

Reference	Study duration (mo)	No. of patients: Total	No. of patients: DHI	Study population	DHI	Findings
Appel et al[20] 2011	24	415	139	Primary prevention, hypertension	Web-based	Larger, health care site obesity intervention delivered remotely or in person significantly reduced weight (−4.6 kg and −5.1 kg, respectively) vs controls. No impact on CVD events, rehospitalizations, or all-cause mortality
Blasco et al[21] 2012	12	203	102	Secondary prevention	SMS text, smartphone	Health care secondary prevention trial showing improved secondary prevention outcomes (repeated CVD events, rehospitalizations, or all-cause mortality; RR, 1.4; 95% CI, 1.1-1.7) with telemonitoring and SMS text
Dendale et al[22] 2012	6	160	80	Secondary prevention, heart failure	Telephone, data monitoring	Health care–delivered telemonitoring service in patients with heart failure significantly reduced all-cause mortality ($P=.01$) but did not reduce hospitalizations per patient (0.24 vs 0.42; $P=.06$)
Frederix et al[23] 2015	4.5	90	40	Secondary prevention	E-mail, SMS text, data monitoring	Body sensor data monitoring in patients undergoing cardiac rehabilitation improved exercise capacity (2688±220.33 mL/min vs 2485.89±385.64 mL/min, $P=.014$) and number of rehospitalizations
Green et al[24] 2012	12	778	520	Primary prevention	Telephone, Web-based	In hypertensive patients assigned to usual care vs a Web-based or telephone-based intervention, those who used the Web-based platform had a greater percentage of achieving target BP (55% vs 39%; 95% CI, 49%-62%; $P<.001$). Increased adverse events occurred in intervention group
Reid et al[25] 2012	12	223	115	Secondary prevention	Web-based	Internet-based data monitoring for physical activity in post-MI patients revealed significant improvements in physical activity and QOL compared with usual care. The intervention had a small, nonsignificant effect on hard CVD outcomes
Scherr et al[26] 2009	6	120	54	Secondary prevention, heart failure	Telephone, SMS text, data monitoring	Data monitoring in patients with recent decompensated heart failure yielded a high attrition rate but a 50% reduction in CVD end points and hospitalizations with a mean improvement in NYHA class by one category in the treatment group
Southard et al[27] 2003	6	104	53	Secondary prevention	Web-based	Internet-based secondary prevention tool reduced CVD end points (15.7% vs 4.6%) and provided a significant cost savings. The intervention group had a more robust weight loss (−3.68 lb vs 0.47 lb; $P=.003$), with no other surrogate markers of CVD achieving statistical significance
Vernooij et al[28] 2012	12	330	164	Secondary prevention	Web-based	Clinic-based online risk factor improvement tool significantly reduced Framingham risk scores (−14%; 95% CI, −25% to −2%) after 12 mo in patients randomized to the intervention. No significant reduction in CVD events, death, and hospitalizations in the DHI group

BP = blood pressure; CVD = cardiovascular disease; DHI = digital health intervention; MI = myocardial infarction; NYHA = New York Heart Association; QOL = quality of life; RR = relative risk; SMS = short message service.

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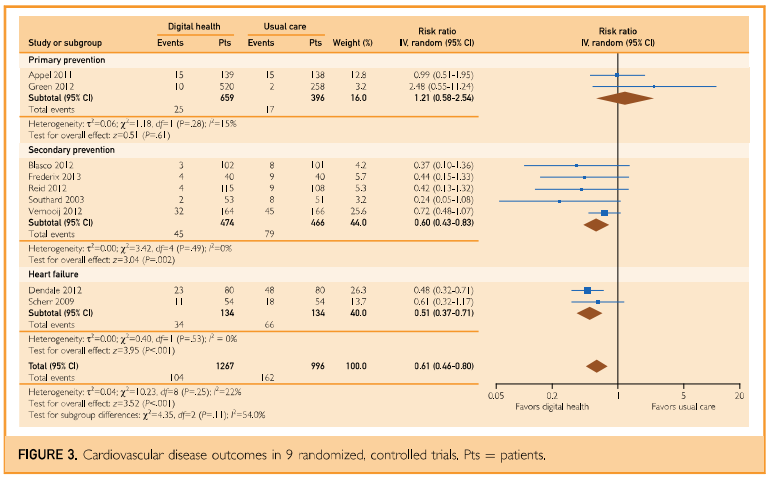


FIGURE 3. Cardiovascular disease outcomes in 9 randomized, controlled trials. Pts = patients.

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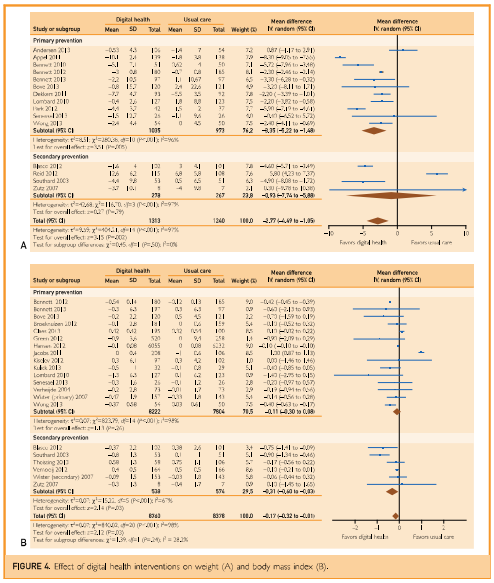


FIGURE 4. Effect of digital health interventions on weight (A) and body mass index (B).

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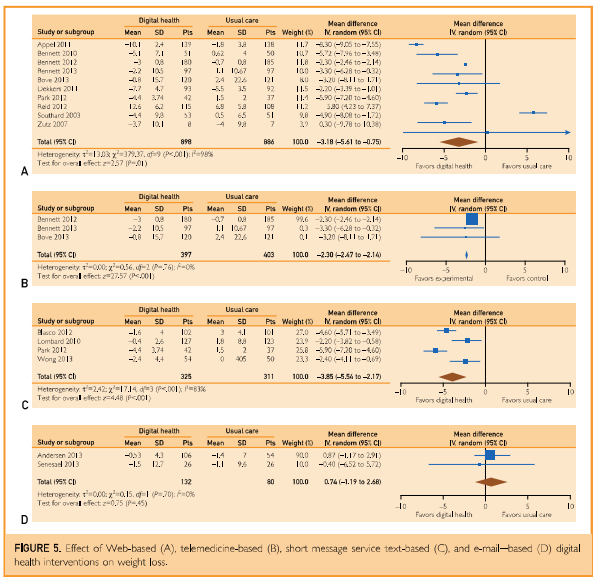


FIGURE 5. Effect of Web-based (A), telemedicine-based (B), short message service text-based (C), and e-mail–based (D) digital health interventions on weight loss.

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AGING SOCIETY AND GERONTECHNOLOGY: A SOLUTION FOR AN INDEPENDENT LIVING?

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Abstract: Recent studies report that the majority of older adults wish to live in their own homes, for as long as possible. This creates a growing interest in technologies to enable older people to remain living independently at home. The purpose of this article is to provide a narrative review of current technology appropriate for older adults' home use. The key research questions were as follow: 1- What is the evidence demonstrating that gerontechnologies are effective in enabling independent living? 2- What are devices designed specifically for frail elderly persons ? Several publications were identified about devices targeting social isolation (videophonic communication, affective orthotic devices or companion-type robots, personal emergency response systems [security]), autonomy loss (technologies for maintenance of autonomy in the activities of daily living) and cognitive disorders (cognitive orthotics, wandering management systems, telemonitoring). Very few articles dealt specifically with the frail older person. In particular, there was extremely limited evidence on use and efficacy of these devices within this population. There is a need to obtain a consensus on definition of the technologies, and also to revisit work strategies and develop innovative business models. To meet this goal, we need to create a network of technological companies, aging services organizations, end-users, academics, and government representatives to explore the real needs of the frail older population and to develop and validate new devices promoting aging at home.

Key words: Frailty, elderly, technologies, home, review, disability, evaluation.

Piau A, Campo E, Rumeau P, et al. Aging society and gerontechnology: a solution for an independent living? *J Nutr Health Aging* 2014; 18: 97-112.

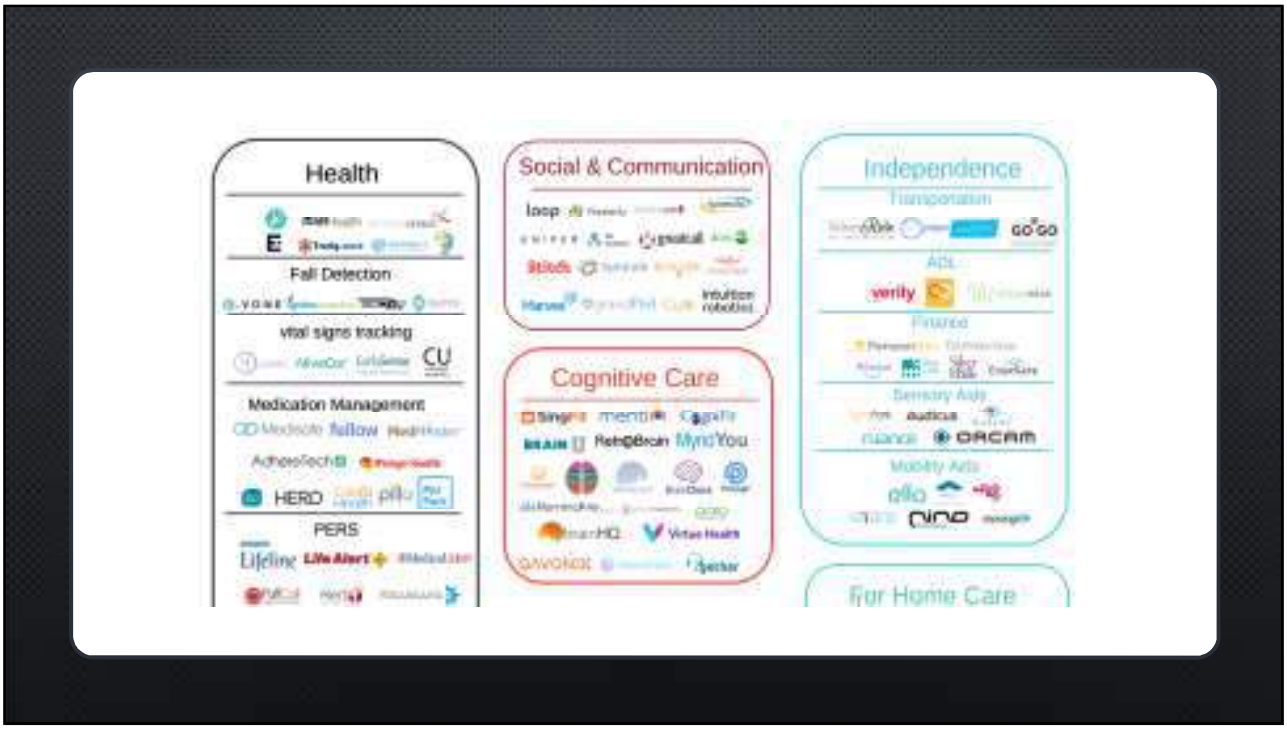
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CONCLUSÕES

- BENEFÍCIOS PARA:
  - DESFECHOS CARDIOVASCULARES
  - MUDANÇA DE ESTILO DE VIDA



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Health
Fall Detection
vital signs tracking
Medication Management
PERS
Social & Communication
Cognitive Care
Independence
Transportation
ADL
Finance
Sensory Aids
Mobility Aids
For Home Care