Effect of eHealth on the treatment and control of type 2 diabetes*

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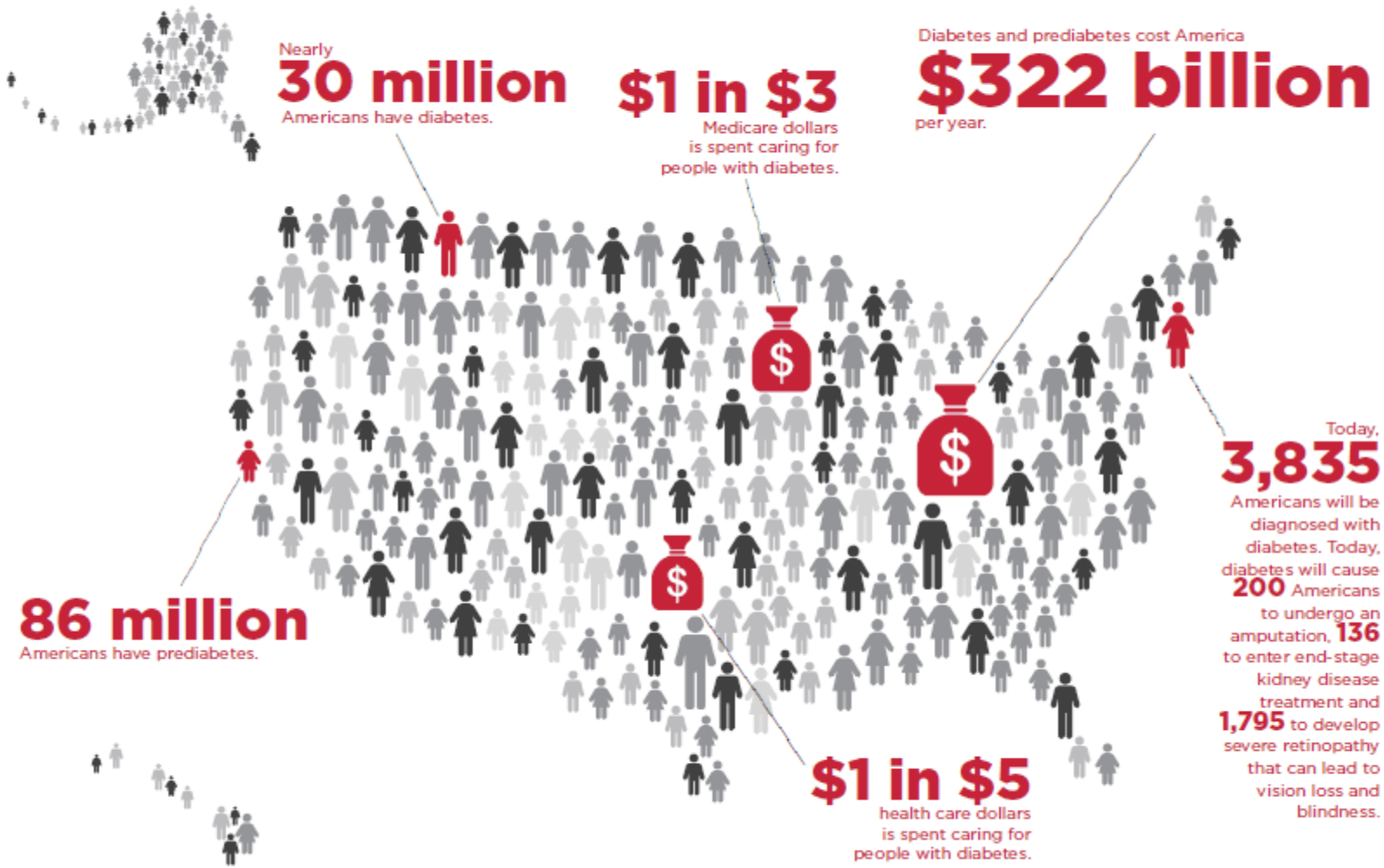
Introduction

- 29.1 million people or 9.3% of the population have diabetes in the United States (US). [1]
- Undiagnosed in the US: 8.1 million people (27.8% of people with diabetes are undiagnosed).
- The total estimated cost of diagnosed diabetes in 2012 is $245 billion, including $176 billion in direct medical costs and $69 billion in reduced productivity. [2]
- England's National Health Services (NHS) spend an estimated £14 billion pounds a year on treating diabetes and its complications.
- England's prevalence of diabetes is estimated to rise to 4 million by 2025.

1. 2014 Statistics Report | Data & Statistics | Diabetes | CDC. Available at: www.cdc.gov/diabetes/data/statistics/2014statisticsreport.htm
2. The Cost of Diabetes: American Diabetes Association. Available at: www.diabetes.org/advocacy/news-events/cost-of-diabetes.html
3. Cost of diabetes to the NHS - Diabetes.co.uk. Available at: www.diabetes.co.uk/cost-of-diabetes.htm

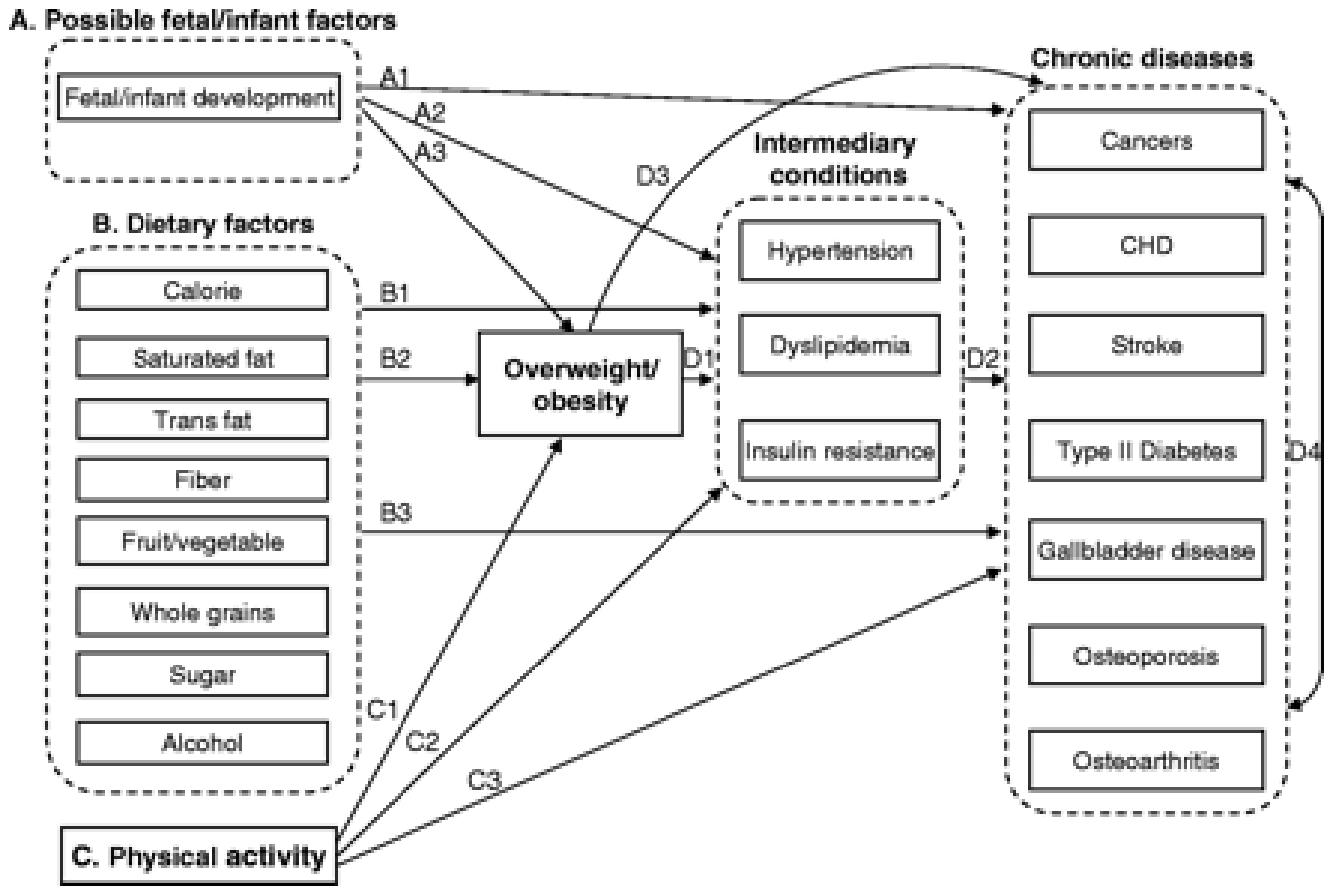
THE STAGGERING **COSTS** OF **DIABETES IN AMERICA**



Learn how to fight this costly disease at **diabetes.org/congress**

American Diabetes Association.

Etiology of Type II diabetes is multi-causal: genes and other factors



Lifestyle changes: The Diabetes Prevention Program (DPP)

- DPP (federally funded study of 3,234 people at high risk for diabetes):
  - People can delay and possibly prevent the disease by losing a small amount of weight (5 to 7 percent of total body weight) through 30 minutes of physical activity 5 days a week and healthier eating.
- People received:
  - intensive training (14 weeks) in diet, physical activity, and behavior modification
  - eating less fat and fewer calories
  - exercising for a total of 150 minutes a week
  - aimed to lose 7 percent of their body weight and maintain that loss.

DPP. Available at: https://www.niddk.nih.gov/about-niddk/research-areas/diabetes/diabetes-prevention-program-dpp/Pages/default.aspx

Best strategies for prevention and control of type II diabetes

- Antidiabetic medications, with newer anti-obesity medications and interventional bariatric procedures, have shown some promising benefits
- Diet and therapeutic lifestyle change remains the mainstay of management to improve the metabolic profile of individuals with glucose dysregulation
- New risk stratification tools to identify at-risk individuals, coupled with unselected population level intervention hold promise in future practice.

Khavandi K, Amer H, Ibrahim B, Brownrigg J. Ther Adv Chronic Dis. 2013 Sep; 4(5): 242–261. doi: 10.1177/2040622313494986. Strategies for preventing type 2 diabetes: an update for clinicians.

Current digital technologies used for prevention and control of type II diabetes

- Technologies:
  - Smartphone apps, smart scales, personal sensors, telehealth, 3D-technology, virtual reality (VR), exchanges for weight loss resistance .
  - Digital: intervention accessed and taking input from patients in the form of a computer/Web-based program or mobile phoned-based app (JMIR Res Protoc. 2015 Nov 20;4(4):e133. doi: 10.2196/resprot.4648)
- Level of evidence of Electronically Delivered, Comprehensive Interventions for Weight Loss is at best “Moderate”. [1,2]
- The reported eHealth impact on diabetes prevention and control has been inconsistent
- Long follow up for many intervention modalities are unavailable at this time
- Can we summarize this knowledge?

1. Available at: http://www.nhlbi.nih.gov/guidelines; 2. Available at: www.deloitte.com/us/top-health-care-innovations

Methods

- We used meta-analysis to identify a common effect across multiple studies of eHealth effect on estimated average glucose as expressed by HbA1c.
- Data was based on search of randomized control trials only:
- Search identified 370 articles; excluded a total of 328 articles with 23 based on title and 305 based on abstract.
- From an initial pool, reviewed the full text of 42 peer reviewed articles that fit minimal criteria for inclusion in meta-analysis.
- After discarding 23 studies with incomplete information on critical statistics, we analyzed 20 articles.

Quantitative Synthesis

- We estimate a measure of reduction in HbA1c (%) due to eHealth across 25 point estimates in 20 studies.
- We estimated effect sizes (standardized difference in means and Hedges' g) across the 25 point estimates.

Methods cont.

Quality Assessment

- The Cochrane Collaboration Risk of Bias Assessment tool was used to appraise the quality of each article by two reviewers.
- Six domains of bias (i.e., selection, performance, detection, attrition, reporting, and other) are included in the tool and scored as low, high, or unclear risk.
- Domain scores were summed to determine an overall score of low, unclear, or high risk of bias for each study
- We appraised the risk of selective reporting or publication bias by visual inspection of funnel plot symmetry.
- We further assessed the publication bias using a failsafe N test.

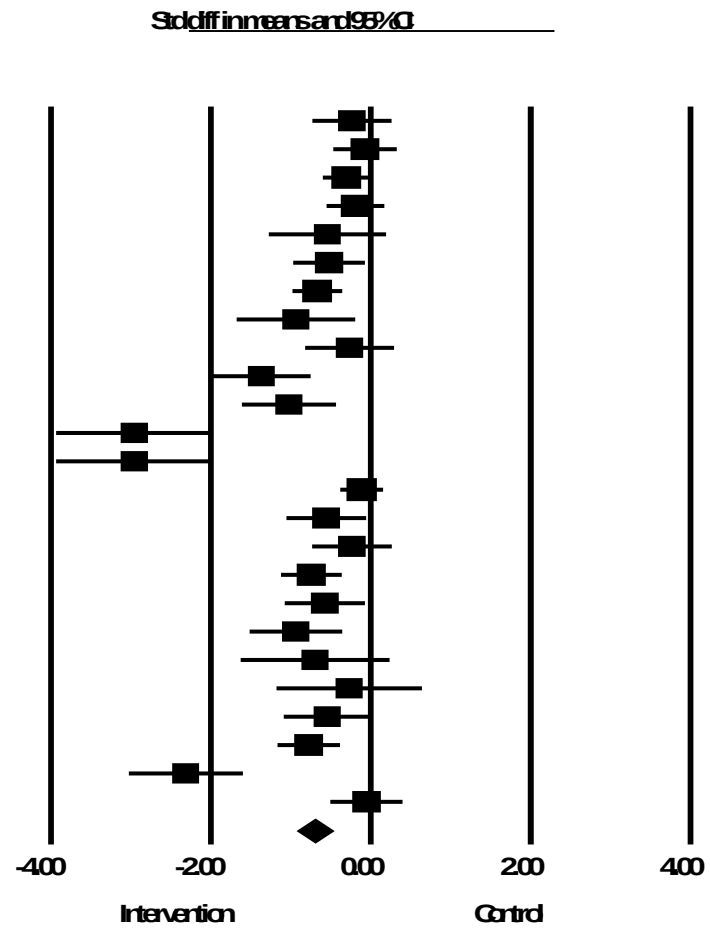
RESULTS

Effect of E-Health on Diabetes Prevention: HbA1c (%) levels by Intervention Groups						
	Treatment			Control		
	Mean (%)	SD (%)	N	Mean (%)	SD (%)	N
Bell, A.M.; 2012	8.30	1.80	31	8.10	1.60	33
Bujnowska-Fedak, M.M.; 2011	7.37	1.27	47	7.43	1.49	48
Dale, J.; 2009, 1a	8.00	1.50	78	7.90	1.10	86
Dale, J.; 2009, 2a	7.90	0.90	37	7.90	1.10	86
Faridi, Z.; 2008	6.30	0.30	15	6.80	1.00	15
Goodarzi, M.; 2012	7.02	1.02	43	7.48	1.26	38
Harno, K.; 2006	7.32	0.11	101	7.83	0.20	74
Hussein, W.I.; 2011	6.91	0.71	12	8.62	1.45	22
Kim, C.S.; 2010	7.40	0.70	47	7.60	0.80	45
Kim, H.S.; 2007, a	6.94	1.04	25	7.66	0.91	26
Kim, H.S.; 2007, b	7.04	1.39	25	7.70	0.90	26
Kim, H.S.; 2008	7.07	1.50	18	7.66	0.50	16
Kim, S. I & Kim, H.S.; 2008	6.67	0.77	18	8.19	0.54	16
Tsang, M.W.; 2001, 1a	7.55	2.20	10	7.84	2.08	10
Tsang, M.W.; 2001, 2a	8.81	1.79	9	8.40	0.98	9
Waki, K.; 2014	6.70	0.70	27	7.10	1.10	27
Yoo, H.J.; 2009	7.10	0.80	57	7.60	1.00	54
Yoon, K.H.; 2007	6.77	0.77	25	8.40	1.04	26
Zolfaghari, M.; 2012	7.96	1.75	38	8.51	1.85	39

Efffects of E-Health on Diabetes Prevention: HbA1c (%) Levels by Intervention Groups						
Study	Mean basal HbA1c (SD)- Intervention	Mean outcome HbA1c (SD)- intervention	N	Mean basal HbA1c (SD)- Control	Mean outcome HbA1c (SD)- Control	N
Bell, A.M.; 2012	9.6(1.5)	8.3(1.8)	31	9.0(0.9)	9.1(1.6)	33
Bujnowska-Fedak, M.M.; 2011	7.6(1.5)	7.4(1.3)	50	7.6(1.7)	7.3(1.5)	50
Dale, J.; 2009, 1a	8.4(1.1)	8.0(1.5)	90	8.7(1.3)	7.9(1.1)	97
Dale, J.; 2009, 2a	8.9(1.5)	7.9(0.9)	44	8.7(1.3)	7.9(1.1)	97
Faridi, Z.; 2008	6.4(0.6)	6.3(0.3)	15	6.5(0.7)	6.8(1.0)	15
Goodarzi, M.; 2012	7.9(1.2)	7.0(1.0)	43	7.8(1.2)	7.5(1.3)	38
Harno, K.; 2006	7.8(0.1)	7.3(0.1)	105	8.2(0.2)	7.8(0.2)	74
Hussein, W.I.; 2011	9.7(1.3)	6.9(0.7)	12	10.2(1.6)	8.6(1.5)	22
Kim, C.S.; 2010	9.8(1.3)	7.4(0.7)	50	9.8(1.2)	7.6(0.8)	50
Kim, H.S.; 2007, a	8.1(1.7)	6.9(1.0)	25	7.6(1.1)	7.7(0.9)	26
Kim, H.S.; 2007, b	8.1(1.7)	7.0(1.4)	25	7.6(1.1)	7.7(0.9)	26
Kim, H.S.; 2008	8.2(1.9)	7.1(1.5)	18	7.7(0.7)	7.7(0.5)	16
Kim, S. I & Kim, H.S.; 2008	8.2(1.9)	6.7(0.8)	18	7.7(0.8)	8.2(0.5)	16
Pressman, A.R.; 2014	9.4(1.7)	7.4(1.8)	118	9.2(1.5)	7.4(1.7)	107
Quinn, C.C.; 2011, 1a	9.3(1.8)	7.7(1.0)	23	9.2(1.7)	8.5(1.8)	56
Quinn, C.C.; 2011, 2a	9.0(1.8)	7.9(1.4)	22	9.2(1.7)	8.5(1.8)	56
Quinn, C.C.; 2011, 3b	9.9(2.1)	7.9(1.7)	62	9.2(1.7)	8.5(1.8)	56
Quinn, C.C.; 2014, 2a	9.9(2.0)	7.9(1.6)	37	9.9(1.8)	8.9(1.9)	29
Quinn, C.C.; 2014, 2b (45-64 yr old)	9.8(2.3)	7.9(1.9)	25	8.4(1.2)	8.1(1.5)	27
Tsang, M.W.; 2001, 1a	8.6(1.8)	7.6(2.2)	10	7.6(2.1)	8.1(2.1)	9
Tsang, M.W.; 2001, 2a	8.8(1.3)	8.8(1.8)	10	8.8(1.8)	8.4(1.0)	9
Waki, K.; 2014	7.1(1.0)	6.7(0.7)	27	7.0(0.9)	7.1(1.1)	27
Yoo, H.J.; 2009	7.6(0.9)	7.1(0.8)	57	7.4(0.9)	7.6(1.0)	54
Yoon, K.H.; 2007	8.1(1.7)	6.8(0.8)	25	7.6(1.1)	8.4(1.0)	26
Zolfaghari, M.; 2012	9.0(1.6)	8.0(1.8)	39	9.4(1.7)	8.5(1.9)	38

Effect of E-Health on Diabetes Prevention (HbA1c)

Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Bell, AM; 2012	-0.235	0.251	0.063	-0.727	0.257	-0.938	0.348
Bujnowska-Fedak, MM; 2011	-0.071	0.200	0.040	-0.463	0.321	-0.356	0.722
Dale, J; 2009 1a	-0.306	0.147	0.022	-0.594	-0.017	-2.078	0.038
Dale, J; 2009 2a	-0.192	0.182	0.033	-0.549	0.165	-1.054	0.292
Farid, Z; 2008	-0.542	0.372	0.138	-1.271	0.187	-1.457	0.145
Goodarzi, M; 2012	-0.522	0.226	0.051	-0.965	-0.078	-2.304	0.021
Harno, K; 2006	-0.669	0.156	0.024	-0.974	-0.363	-4.290	0.000
Hussein, WI.; 2011	-0.936	0.376	0.142	-1.673	-0.198	-2.486	0.013
Kim, CS; 2010	-0.266	0.281	0.079	-0.817	0.286	-0.944	0.345
Kim, HS; 2007, a	-1.368	0.311	0.097	-1.978	-0.758	-4.397	0.000
Kim, HS; 2007, b	-1.024	0.298	0.089	-1.608	-0.440	-3.437	0.001
Kim, HS; 2008	-2.958	0.497	0.247	-3.931	-1.984	-5.955	0.000
Kim, S I & Kim, HS; 2008	-2.958	0.497	0.247	-3.931	-1.984	-5.955	0.000
Pressman, AR; 2014	-0.114	0.134	0.018	-0.376	0.148	-0.854	0.393
Quim, CC; 2011 1a	-0.558	0.252	0.063	-1.051	-0.065	-2.218	0.027
Quim, CC; 2011 2a	-0.235	0.252	0.064	-0.730	0.259	-0.933	0.351
Quim, CC; 2011 3a	-0.744	0.191	0.036	-1.117	-0.370	-3.902	0.000
Quim, CC; 2014 1b	-0.575	0.253	0.064	-1.071	-0.080	-2.275	0.023
Quim, CC; 2014 2b	-0.939	0.292	0.086	-1.512	-0.366	-3.211	0.001
Tsang, MW; 2001 1a	-0.697	0.473	0.224	-1.624	0.231	-1.472	0.141
Tsang, MW; 2001 2a	-0.271	0.462	0.213	-1.175	0.634	-0.586	0.558
Waki, K; 2014	-0.542	0.277	0.077	-1.085	0.001	-1.957	0.050
Yoo, HJ; 2009	-0.775	0.197	0.039	-1.161	-0.389	-3.938	0.000
Yoon, KH; 2007	-2.314	0.362	0.131	-3.023	-1.605	-6.394	0.000
Zdfaghari, M; 2012	-0.054	0.228	0.052	-0.501	0.393	-0.237	0.813
	-0.700	0.110	0.012	-0.916	-0.485	-6.367	0.000

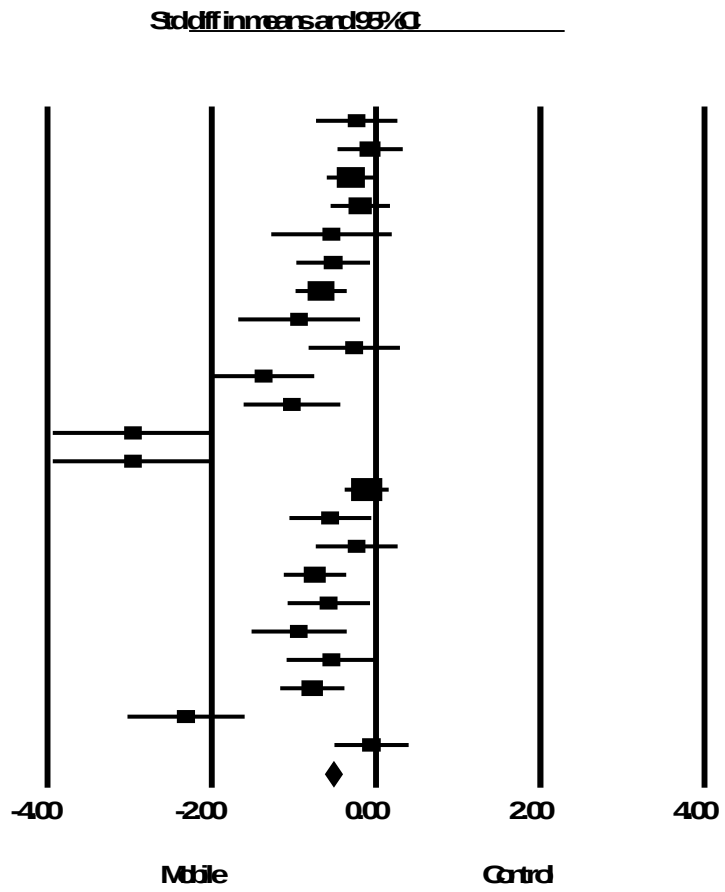


Standardized difference in means

Q-value	df (Q)	P-value	I-squared
117.970	24	0.000	79.656

Effect of E-Health (Mobile) on Diabetes Prevention (HbA1c)

Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Bell, A.M.2012	-0.235	0.251	0.063	-0.727	0.257	-0.938	0.348
Bujnowska-Fedak, M.M, 2011	-0.071	0.200	0.040	-0.463	0.321	-0.356	0.722
Dale, J.; 2009 1a	-0.306	0.147	0.022	-0.594	-0.017	-2.078	0.038
Dale, J.; 2009 2a	-0.192	0.182	0.033	-0.549	0.165	-1.054	0.292
Farid, Z; 2008	-0.542	0.372	0.138	-1.271	0.187	-1.457	0.145
Goodarzi, M; 2012	-0.522	0.226	0.051	-0.965	-0.078	-2.304	0.021
Haino, K; 2006	-0.669	0.156	0.024	-0.974	-0.363	-4.290	0.000
Hussein, W.I.; 2011	-0.936	0.376	0.142	-1.673	-0.198	-2.486	0.013
Kim, C.S; 2010	-0.266	0.281	0.079	-0.817	0.286	-0.944	0.345
Kim, H.S; 2007 a	-1.368	0.311	0.097	-1.978	-0.758	-4.397	0.000
Kim, H.S; 2007 b	-1.024	0.298	0.089	-1.608	-0.440	-3.437	0.001
Kim, H.S; 2008	-2.958	0.497	0.247	-3.931	-1.984	-5.955	0.000
Kim, S.I.&Kim, H.S; 2008	-2.958	0.497	0.247	-3.931	-1.984	-5.955	0.000
Pressman, A.R; 2014	-0.114	0.134	0.018	-0.376	0.148	-0.854	0.393
Quim, C.C; 2011 1a	-0.558	0.252	0.063	-1.051	-0.065	-2.218	0.027
Quim, C.C; 2011 2a	-0.235	0.252	0.064	-0.730	0.259	-0.933	0.351
Quim, C.C; 2011 3a	-0.744	0.191	0.036	-1.117	-0.370	-3.902	0.000
Quim, C.C; 2014 1b	-0.575	0.253	0.064	-1.071	-0.080	-2.275	0.023
Quim, C.C; 2014 2b	-0.939	0.292	0.086	-1.512	-0.366	-3.211	0.001
Waki, K; 2014	-0.542	0.277	0.077	-1.085	0.001	-1.957	0.050
Yoo, H.J; 2009	-0.775	0.197	0.039	-1.161	-0.389	-3.938	0.000
Yoon, K.H; 2007	-2.314	0.362	0.131	-3.023	-1.605	-6.394	0.000
Zdfaghari, M; 2012	-0.054	0.228	0.052	-0.501	0.393	-0.237	0.813
	-0.524	0.048	0.002	-0.617	-0.431	-11.017	0.000

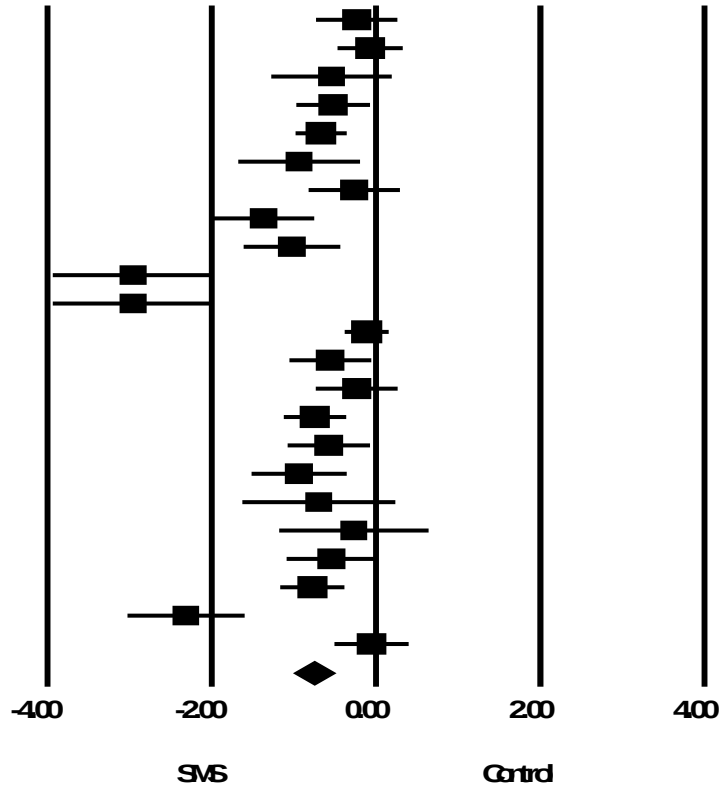


Standardized difference in means

Q-value	df (Q)	P-value	I-squared
117.536	23	0.000	81.282

Effect of E-Health (SMS) on Diabetes Prevention (HbA1c)

Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Bell, A.M; 2012	-0.235	0.251	0.063	-0.727	0.257	-0.938	0.348
Bujnowska-Fedak, M.M; 2011	-0.071	0.200	0.040	-0.463	0.321	-0.356	0.722
Fard, Z; 2008	-0.542	0.372	0.138	-1.271	0.187	-1.457	0.145
Goodarzi, M; 2012	-0.522	0.226	0.051	-0.965	-0.078	-2.304	0.021
Harno, K; 2006	-0.669	0.156	0.024	-0.974	-0.363	-4.290	0.000
Hussein, W.I.; 2011	-0.936	0.376	0.142	-1.673	-0.198	-2.486	0.013
Kim, C.S; 2010	-0.266	0.281	0.079	-0.817	0.286	-0.944	0.345
Kim, H.S; 2007a	-1.368	0.311	0.097	-1.978	-0.758	-4.397	0.000
Kim, H.S; 2007b	-1.024	0.298	0.089	-1.608	-0.440	-3.437	0.001
Kim, H.S; 2008	-2.958	0.497	0.247	-3.931	-1.984	-5.955	0.000
Kim, S.I.&Kim, H.S; 2008	-2.958	0.497	0.247	-3.931	-1.984	-5.955	0.000
Pressman, A.R; 2014	-0.114	0.134	0.018	-0.376	0.148	-0.854	0.393
Quim, C.C; 2011.1a	-0.558	0.252	0.063	-1.051	-0.065	-2.218	0.027
Quim, C.C; 2011.2a	-0.235	0.252	0.064	-0.730	0.259	-0.933	0.351
Quim, C.C; 2011.3a	-0.744	0.191	0.036	-1.117	-0.370	-3.902	0.000
Quim, C.C; 2014.1b	-0.575	0.253	0.064	-1.071	-0.080	-2.275	0.023
Quim, C.C; 2014.2b	-0.939	0.292	0.086	-1.512	-0.366	-3.211	0.001
Tsang, M.W; 2001.1a	-0.697	0.473	0.224	-1.624	0.231	-1.472	0.141
Tsang, M.W; 2001.2a	-0.271	0.462	0.213	-1.175	0.634	-0.586	0.558
Waki, K; 2014	-0.542	0.277	0.077	-1.085	0.001	-1.957	0.050
Yoo, H.J; 2009	-0.775	0.197	0.039	-1.161	-0.389	-3.938	0.000
Yoon, K.H; 2007	-2.314	0.362	0.131	-3.023	-1.605	-6.394	0.000
Zdfaghari, M; 2012	-0.054	0.228	0.052	-0.501	0.393	-0.237	0.813
	-0.757	0.122	0.015	-0.996	-0.517	-6.193	0.000

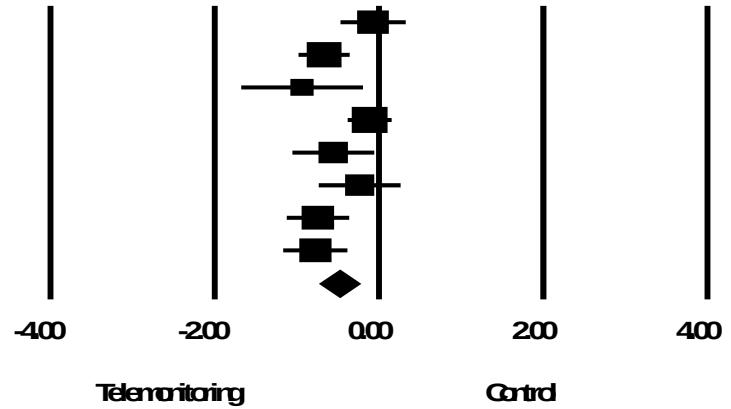


Standardized difference in means

Q-value	df (Q)	P-value	I-squared
111.423	23	0.000	80.257

Effect of E-Health (Telemonitoring) on Diabetes Prevention (HbA1c)

Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Bujnowska-Fedak, M.M; 2011	-0.071	0.200	0.040	-0.463	0.321	-0.356	0.722
Harno, K; 2006	-0.669	0.156	0.024	-0.974	-0.363	-4.290	0.000
Hussein, W.I.; 2011	-0.936	0.376	0.142	-1.673	-0.198	-2.486	0.013
Pressman, A.R; 2014	-0.114	0.134	0.018	-0.376	0.148	-0.854	0.393
Quim, C.C; 2011.1a	-0.558	0.252	0.063	-1.051	-0.065	-2.218	0.027
Quim, C.C; 2011.2a	-0.235	0.252	0.064	-0.730	0.259	-0.933	0.351
Quim, C.C; 2011.3a	-0.744	0.191	0.036	-1.117	-0.370	-3.902	0.000
Yoo, H.J; 2009	-0.775	0.197	0.039	-1.161	-0.389	-3.938	0.000
	-0.483	0.120	0.014	-0.718	-0.248	-4.026	0.000

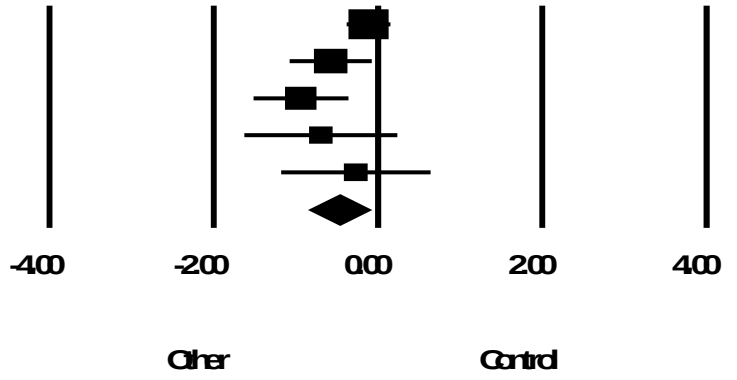


Standardized difference in means

Q-value	df (Q)	P-value	I-squared
19.545	23	0.000	64.184

Effect of E-Health (Other) on Diabetes Prevention (HbA1c)

Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Pressman, AR; 2014	-0.114	0.134	0.018	-0.376	0.148	-0.854	0.393
Quim, CC; 2014 1b	-0.575	0.253	0.064	-1.071	-0.080	-2.275	0.023
Quim, CC; 2014 2b	-0.989	0.292	0.086	-1.512	-0.366	-3.211	0.001
Tsang, MW; 2001 1a	-0.697	0.473	0.224	-1.624	0.231	-1.472	0.141
Tsang, MW; 2001 2a	-0.271	0.462	0.213	-1.175	0.634	-0.586	0.558
	-0.471	0.185	0.034	-0.834	-0.109	-2.547	0.011



Standardized difference in means

Q-value	df (Q)	P-value	I-squared
8.508	5	0.011	52.985

Result Summary

- eHealth strategies included patient engagement or clinical decision support through mobile, computer-based, e-mail and internet approaches
- We found reductions in A1C(%) due to eHealth across all 20 studies.
- Reductions in HbA1C(%) were statistically significant (p-value≤0.05) in 15 out of 25 estimates.
- A1C (%) reductions averaged -0.700 (-0,916, -0.485) with values ranging from -0.05 to a -2.96.
- We found a standardized effect size (Hedges' g) of -0.690 (-0.903, -0.478) across all studies and estimates.

Conclusion and Discussion

- Findings indicated both statistically and clinically significant effects of eHealth on diabetes prevention and control

- Implications of an average reduction of 2.1% in A1c:
  - In comparisons between metformin monotherapy and placebo (or no drug treatment), metformin reduced mean HbA1c level by 1.1%. [1]
  - In comparisons involving metformin plus another oral agent versus the other agent alone, addition of metformin reduced mean HbA1c level by 1.0%. [1]
  - In comparisons involving metformin plus insulin versus insulin alone, addition of metformin reduced mean HbA1c level by 0.8% in patients with type 2 diabetes. In patients with type 1 diabetes receiving insulin, add-on metformin therapy had no HbA1c-lowering effect.[1]
  - In comparisons between low-dose and high-dose metformin (usually 1000 vs. 2000 mg daily), HbA1c level was 0.3% lower with high-dose therapy. [1]

1. Hirst JA et al. Quantifying the effect of metformin treatment and dose on glycemic control. Diabetes Care 2012 Feb; 35:446. (http://dx.doi.org/10.2337/dc11-1465)

Conclusion and Discussion - What type of eHealth?

- All eHealth-based strategies in the meta-analysis appear to be effective, usually in combination :
  - Mobile Health (mHealth): those using cellular phones or smartphones. May include text message, apps and video via email, SMS, internet or mobile app
  - Telehealth: Way for consumers to access and increase self-care while potentially reducing office visits and travel time
  - In most studies reviewed, eHealth was an auxiliary strategy or alternative approach to deliver life style change, diet or physical activity strategies that have been show effective
  - In a few cases, eHealth was clearly meant to be the intervention, as in allowing for continued monitoring and feedback to both patient and medical providers
  - Most studies did not make this distinction clear in their hypothesis tested: was it eHealth or original life style intervention effect

Other Informatics Soluctions

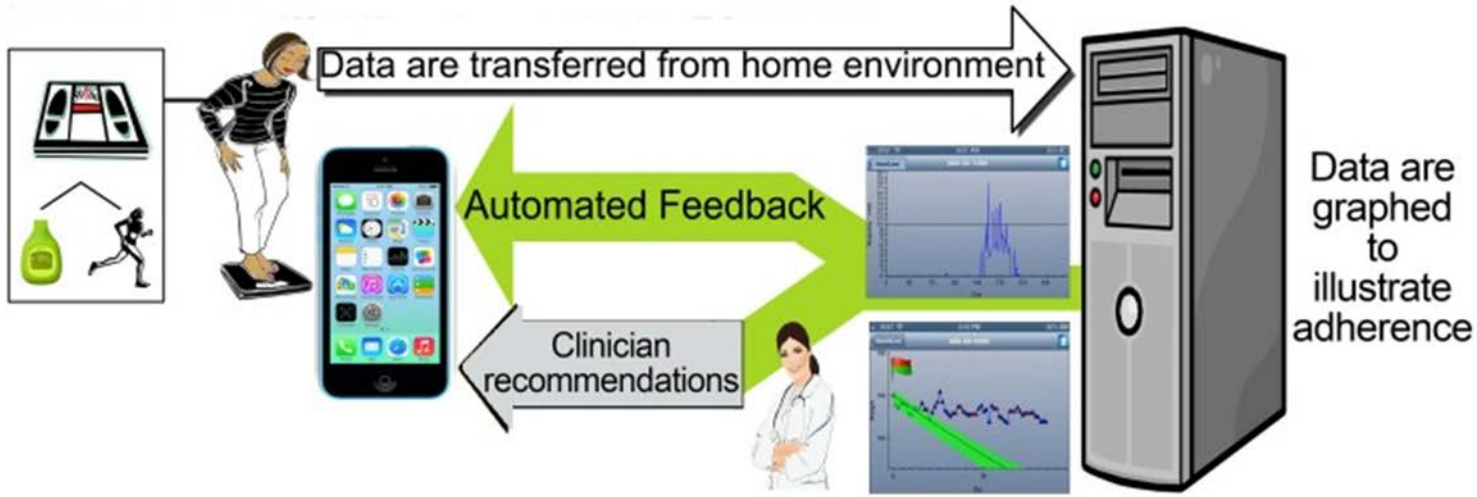
- Other eHealth-based strategies not evaluated hold promise at this time:
- Biosensors and trackers: Technology-enabled activity trackers, monitors, and sensors incorporated into clothing, accessories, and devices that allow consumers and clinicians to easily monitor health
- Virtual reality and 3-Dimensional (VR): Simulated environments that could accelerate behavior change in patients in a way that is safer, more convenient, and more accessible.

Lessons Learned

- eHealth and mHealth approaches for obesity (weight loss) and the prevention and control of diabetes have grown exponentially
- Use of computer, internet, apps, mobile phones and smartphones is nearly 100% everywhere
- Better research is needed to disentangle between effects of original interventions and contributing fraction of eHealth
- However, given the proclivity of eHealth approaches and the prevalence of mHealth in everyday life, the public health benefits of even small clinical impact may be very large (population attributable preventive fraction)

Lessons Learned

- eHealth approaches with great potential of success: one which engage patients and provide provider with critical patient care information, provides individualized treatment goals; allows for the collection of objective data from the client, as well as the input of self-reported data



Source: Smartloss: A Personalized Mobile Health Intervention for Weight Management and Health Promotion. Martin CK, Gilmore LA, Apolzan JW, Myers CA, Thomas DM, Redman LM. JMIR Mhealth Uhealth. 2016 Mar 16;4(1):e18. doi: 10.2196/mhealth.5027