Scalable Prevention of Chronic Disease

An Actuate Program in Development

Actuate | December 2020

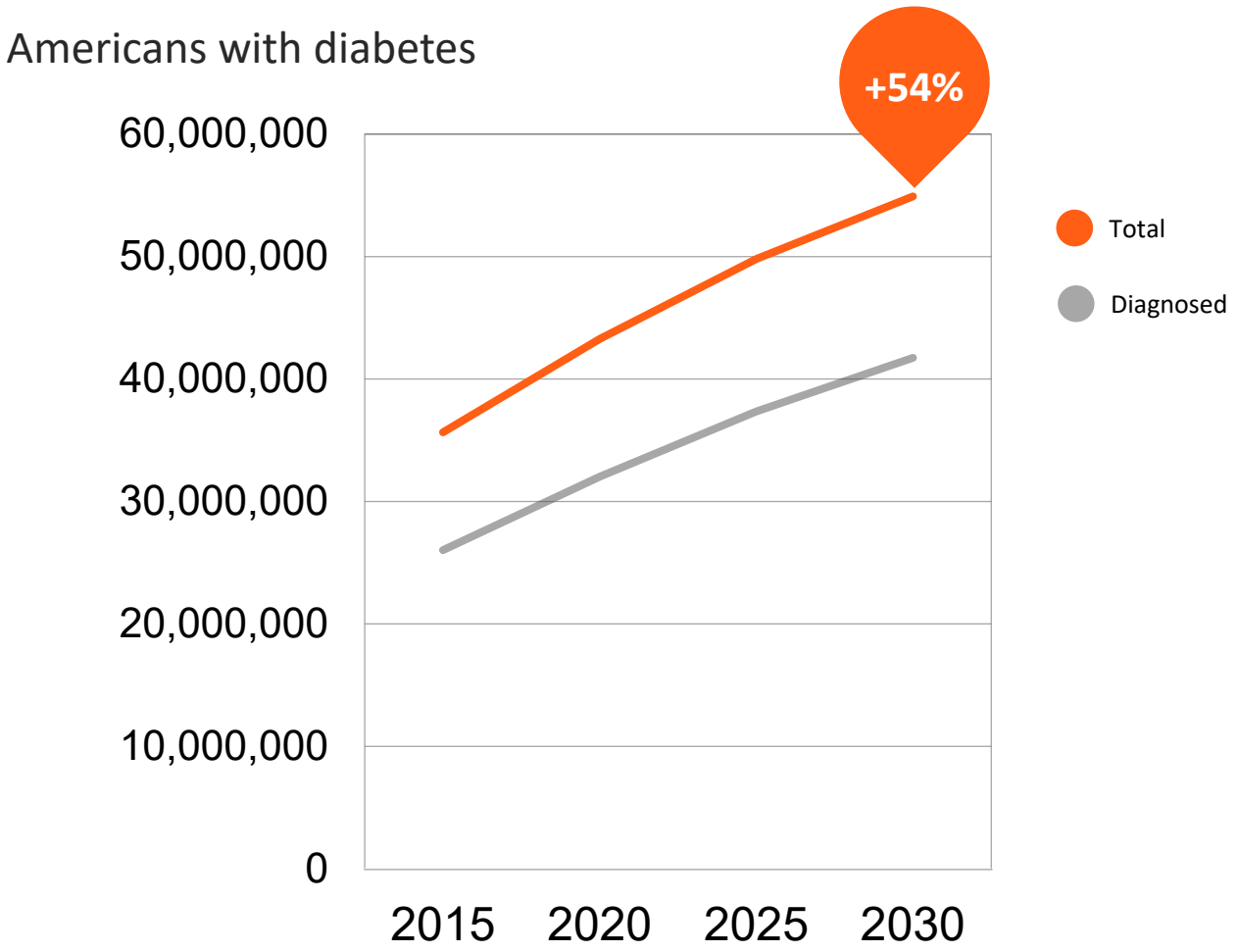
We aim to turn the tide of chronic disease

Preventable chronic disease

- Leading cause of healthcare spending in the US (75%)
- Leading cause of US deaths (7 of 10)
- Leading contributor to cost growth
- 1 in 3 people are at risk

Hypertension is the most common chronic disease

Diabetes is the fastest growing chronic disease



+108,000,000 Americans projected to have prediabetes in 2030

Raghupathi W, Raghupathi V. An Empirical Study of Chronic Diseases in the United States: A Visual Analytics Approach. Int J Environ Res Public Health. 2018;15(3):431. Published 2018 Mar 1. doi:10.3390/ijerph15030431
Rwolet et al, 2016 Population Health Management. Diabetes 2030: insights from yesterday, today and the future trends. Feb. 1, 2017
Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Dennison C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. Hypertension. 2018;71(19):e13–115.

Today’s solutions are limited

We know what works

Almost two decades ago, the Diabetes Prevention Program (DPP) showed that the transition from prediabetes to diabetes was reduced by 58% for those who received lifestyle coaching

Similar healthy habits also underpin prevention for hypertension and other diseases

Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002;346(6):393-403. doi:10.1056/NEJMoa012512

But many millions who are at risk are not benefiting

24%

Only 24% of those with hypertension have their blood pressure under control

1%

1% of those at risk of diabetes are in an evidence-based prevention program

Why?

"National Diabetes Statistics Report 2020; Estimates of Diabetes and Its Burden in the US." National Diabetes Statistics Report, Center for Disease Control and Prevention (CDC), 2020, www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.Pdf.
Shea, Pat. (2019, June 27). "Scaling and Sustaining the National Diabetes Prevention Program" [Webinar]. National Association of Chronic Disease Directors. https://coveragetoolkit.org/wp-content/uploads/2019/07/6.27.19-Case-for-Coverage-webinar-slides_FINAL-v2.pdf

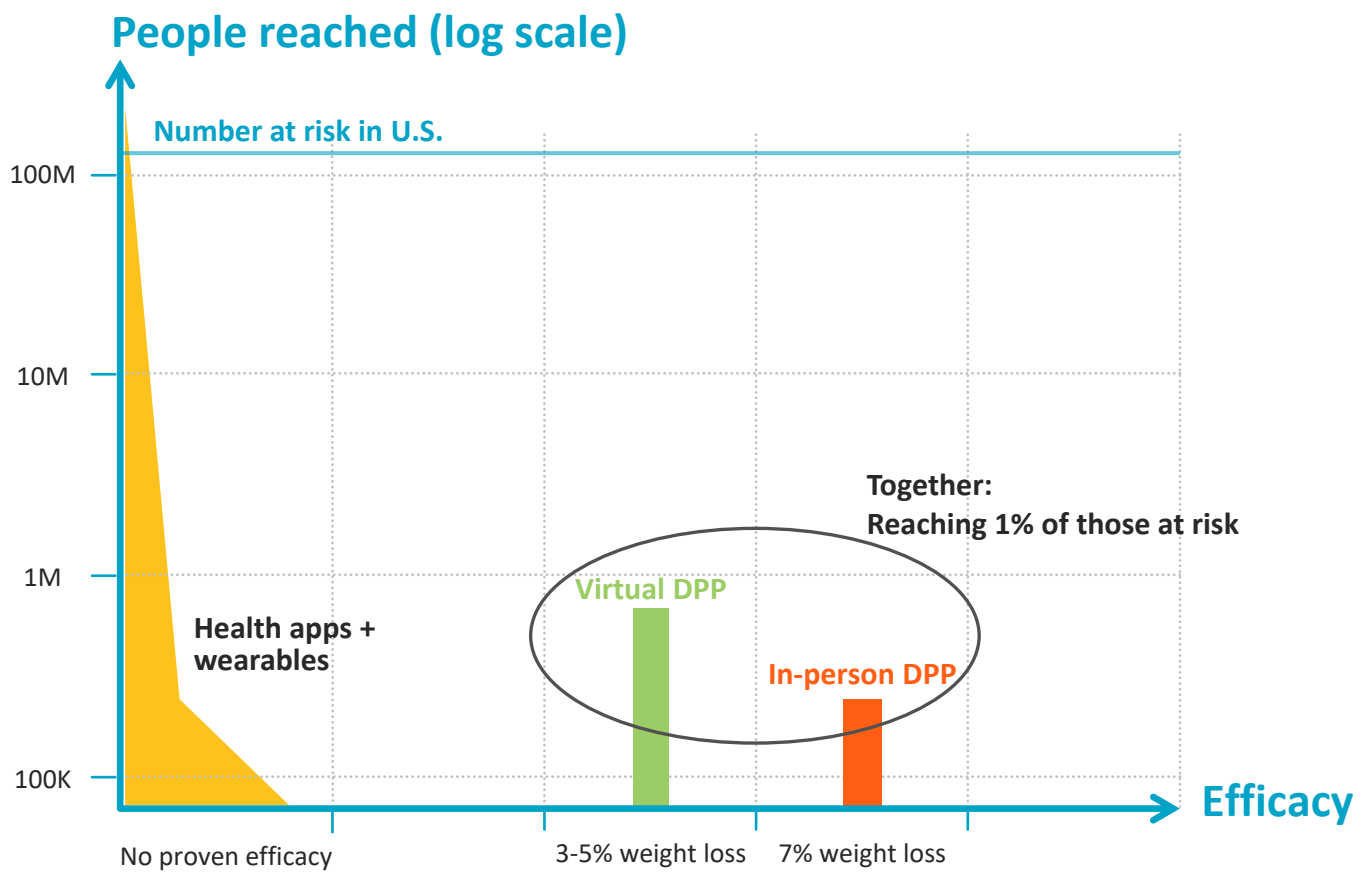
Today's solutions have fundamental limits

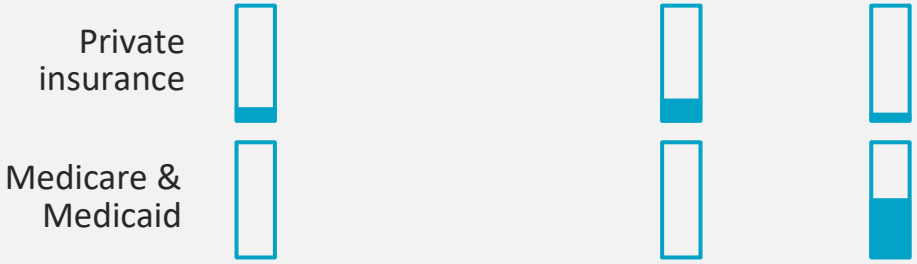
Diabetes Prevention Program (DPP)
- In-person coaching
- Limiter: labor cost limits adoption

Virtual DPP
- Video coaching, customer support
- Limiter: lower labor cost reduces efficacy

Health apps & wearables
- Sensors, reminders, diaries, networking
- Limiter: inadequate for disease prevention without personal coaching

See appendix for details



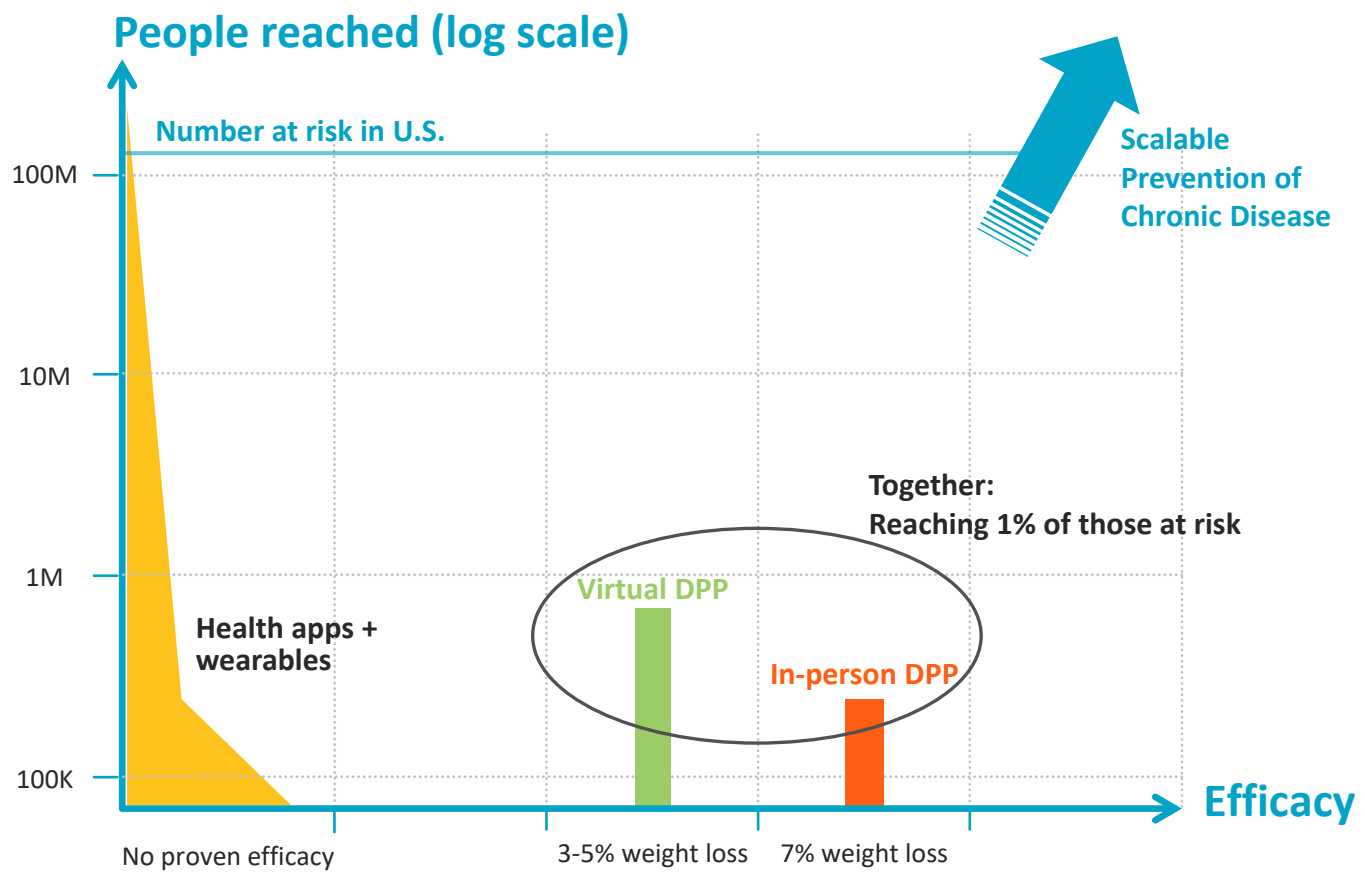


Prevention is stuck in a holding pattern

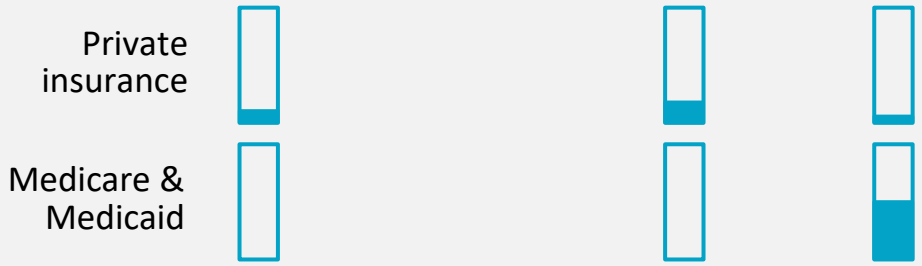
An opportunity to break out

Ultra-low-cost, highly effective behavior change

- Real-time, continuous monitoring
- Coaching and incentives at the right moment
- Combined: low cost to enable scale and potential for better-than-DPP efficacy



Efficacious, inexpensive prevention could make full insurance coverage viable

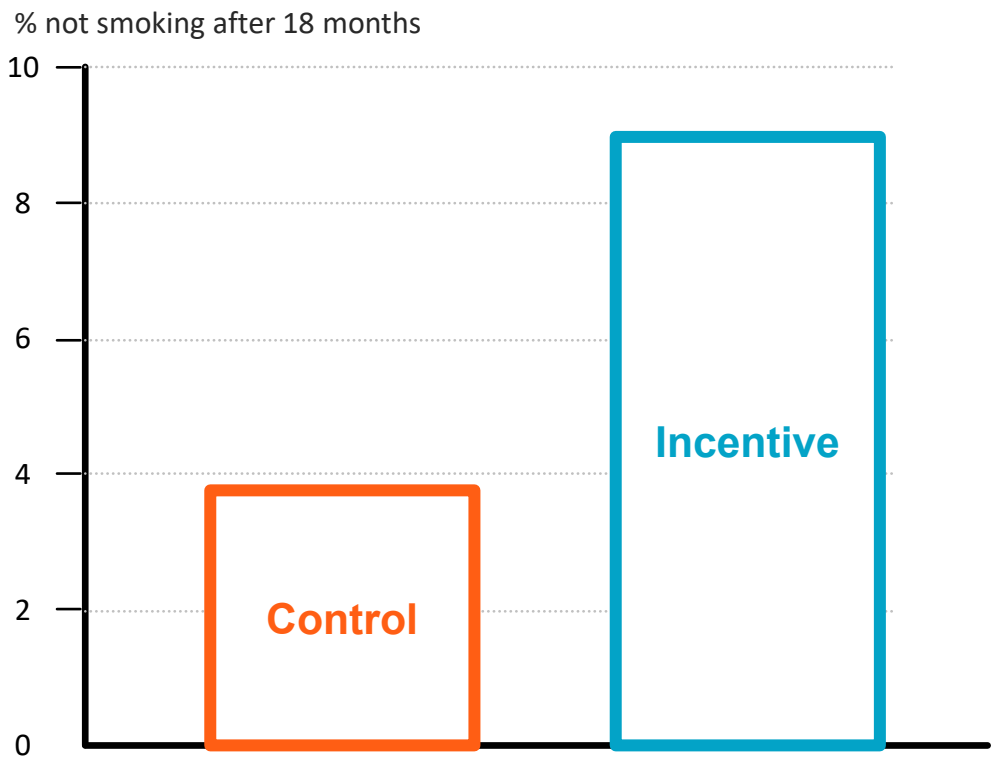


AI-powered research opens the door

Effective incentives

Emerging research

Cash incentives of only 20% of the cost of a pack-a-day habit doubled the number of smokers who quit



Volpp, K.G., Troxel, A.B., Pauly, M.V., Glick, H.A., Puig, A., Asch, D.A., Galvin, R., Zhu, J., Wan, F., DeGuzman, J. and Corbett, E., 2009. A randomized, controlled trial of financial incentives for smoking cessation. New England Journal of Medicine, 360(7), pp.699-709.

Implications for prevention

The Diabetes Prevention Program did not incentivize participants' behavior

Adding incentives to DPP-type coaching could significantly boost outcomes

New methods can rapidly develop personalized, optimized incentives with the potential to be even more effective

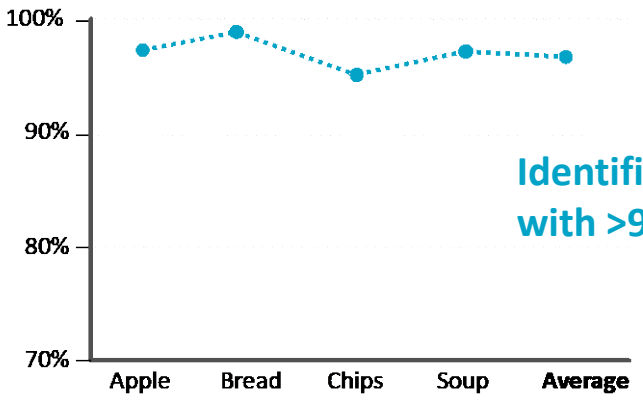
Research needed to test and build models for:

- Financial and non-financial incentives
- Different incentives for different good behaviors
- Optimal times and circumstances to offer incentive for behavior change
- Frequency of incentives
- Continuous refresh to keep high engagement

Sensing behavior

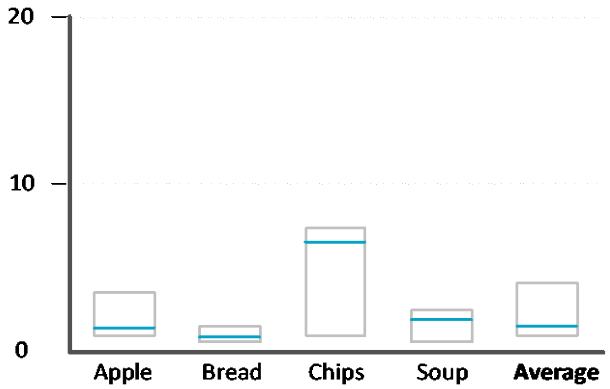
Emerging research

A collection of small commodity sensors identifies which food type is consumed and estimates calories



Identified food type with >90% accuracy

Estimated calories with <10 calories error



Implications for prevention

Inspires the possibility of completely passive food intake measurement via smartphone

Research needed to make this approach practical for everyday use:

- Adapt approach to microphones and accelerometers in smartphones and smartwatches
- Train machine learning models to recognize a wide range of foods

S. Zhang et al. "Estimating Caloric Intake in Bedridden Hospital Patients with Audio and Neck-worn Sensors." The Third IEEE/ACM International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE 2018).

Behavior from language

Emerging research

Linguistic analysis of Facebook posts predicts depression better than standard psychological survey

Eichstaedt, Johannes C., et al. "Facebook language predicts depression in medical records." Proceedings of the National Academy of Sciences 115.44 (2018): 11203-11208.

Implications for prevention

Linguistic correlates for everyday activities are much easier than for a complex condition like depression

Research needed to use linguistic analysis for food intake, physical activity, and other prevention-related behaviors

- Securely analyze multiple forms of personal communications (texts, tweets, social media postings)
- Train machine learning models to recognize changes in individual behavior

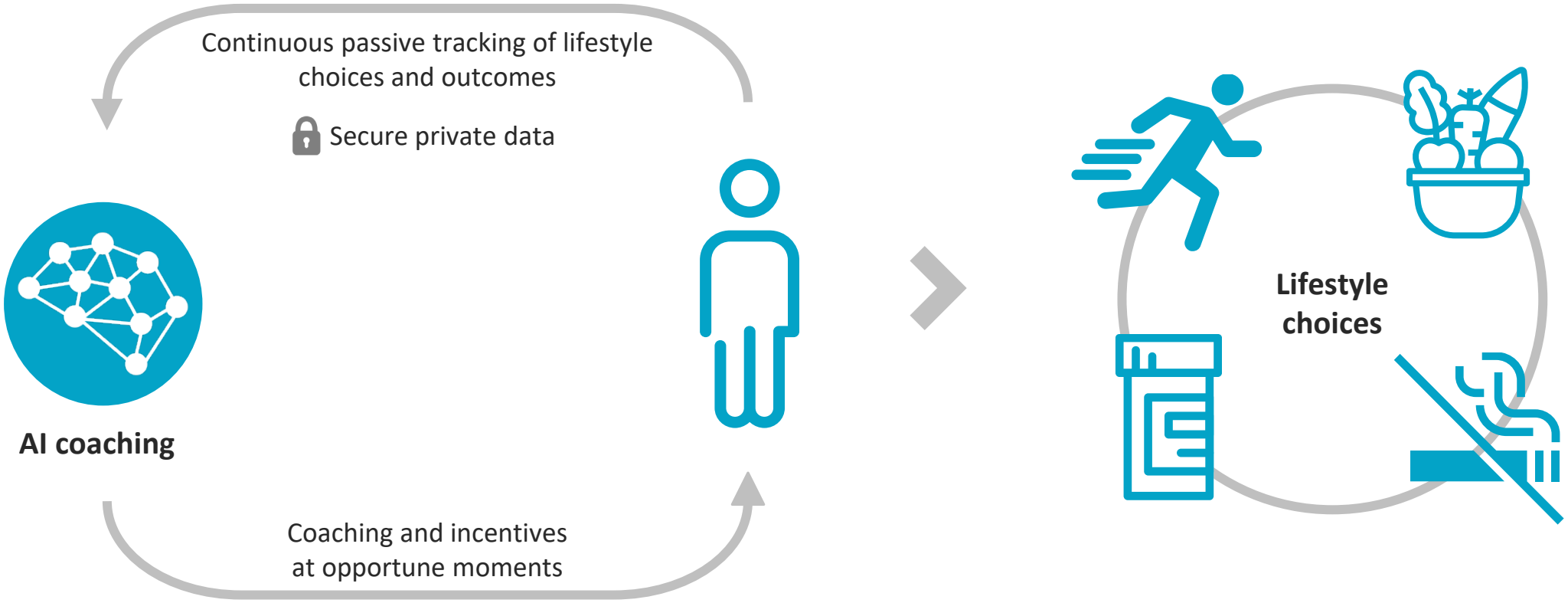
Additional research results

Requirement	New research results
Symptom and biomarker sensing	• Optical sensors used to measure blood glucose and blood pressure correlates via smartphone and smartwatch • VO2 and high-resolution cardio sensing coming to smartwatches
Behaviors	• Accelerometer and gyroscope-based activity recognition and intensity measurement via smartphone
Incentivization	• Incentives can improve outcomes 2x for behavior adherence for vaccination • Automated and personalized incentives can improve outcomes 6x in advertising

Banerjee, A.V., Duflo, E., Glennerster R. & Kothari, D. (2010). Improving immunisation coverage in rual India: Clustered randomised controlled evaluation of immunisation campaigns with and without incentives. British Medical Journal 340. doi:10.1136/bmj.c2220.
Chen, R., Chu, T., Liu, K., Liu, J. and Chen, Y., 2015. Inferring human activity in mobile devices by computing multiple contexts. Sensors, 15(9), pp.21219-21238.
Chunara, R. B. (2013). Assessing the online social environment for surveillance of obesity prevalence. PloS one 8(4).
Yan, J. L. (2009). How much can behavioral targeting help online advertising? In Proceedings of the 18th international conference on World wide web (pp. pp. 261-270). ACM.

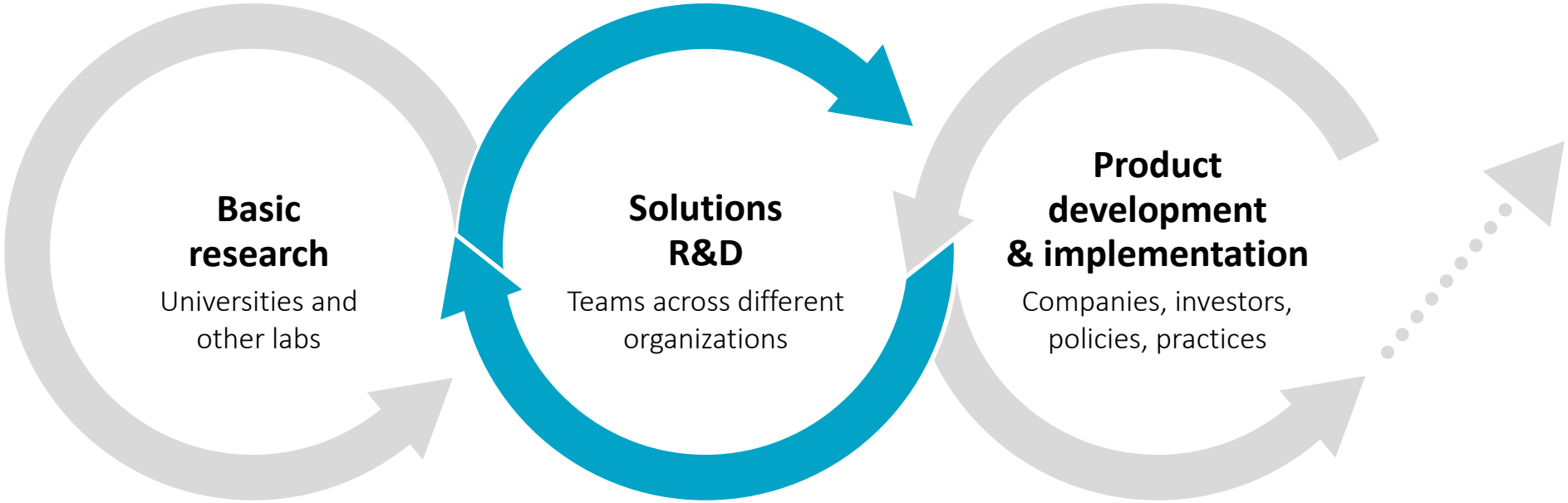
Actuate’s Scalable Prevention program

Integrating these disparate research elements can start a new generation of behavioral health



This challenge requires solutions R&D

Existing approaches will not turn the tide of chronic disease



- Essential ingredients but…
- Not applied to behavioral health
- Not integrated into practical solutions
- No clinical proof

- Missing

- Companies/investors pursue proven approaches with limited R&D and time horizons
- Business models for tech solutions address profitable niches without solving the societal chronic disease problem — it's bigger than one company

Scalable Prevention of Chronic Disease

Program objective

Research and demonstrate
unprecedented prevention efficacy
with **ultra-low-cost tools**
that can reach more than 100,000,000 people

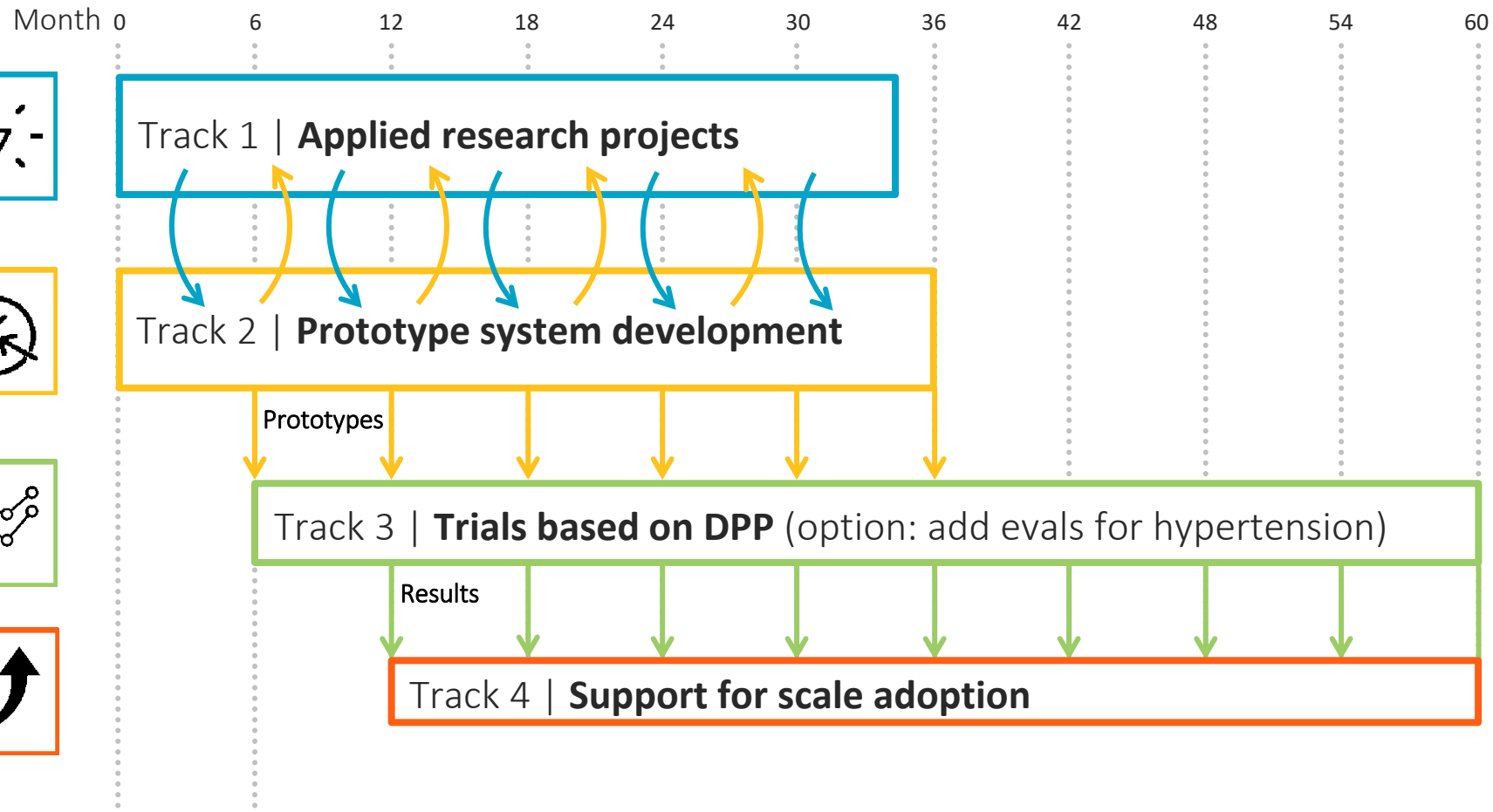
Program plan

Apply research to prevention
Passive sensing of behaviors
Measurement of symptoms
Automated design of coaching/incentives

Develop prototypes
Build automated systems that successfully coach users

Conduct trials
Long-term effectiveness study via clinical trials

Catalyze full-scale adoption
Activate payers, providers, and companies to scale results to 100,000,000 people

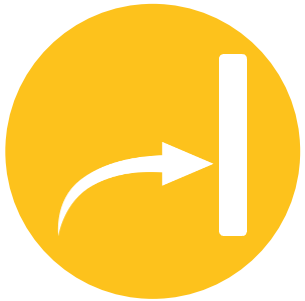


Program milestones

Scalable Prevention of Chronic Disease

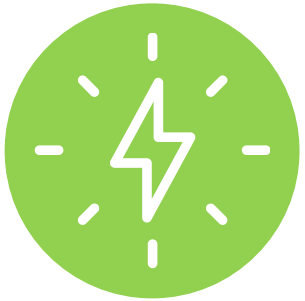
A dangerous problem

Preventable chronic disease is consuming health and healthcare



Limited solutions today

We know what works but are reaching only a tiny fraction of those in need



New research

Artificial intelligence + applied behavioral science can unlock extraordinary new possibilities

A program to change what's possible

Research and demonstrate unprecedented efficacy with tools that can reach 100,000,000 people

Thank you

Appendix

The Diabetes Prevention Program

Diabetes Prevention Program (DPP) lifestyle coaching

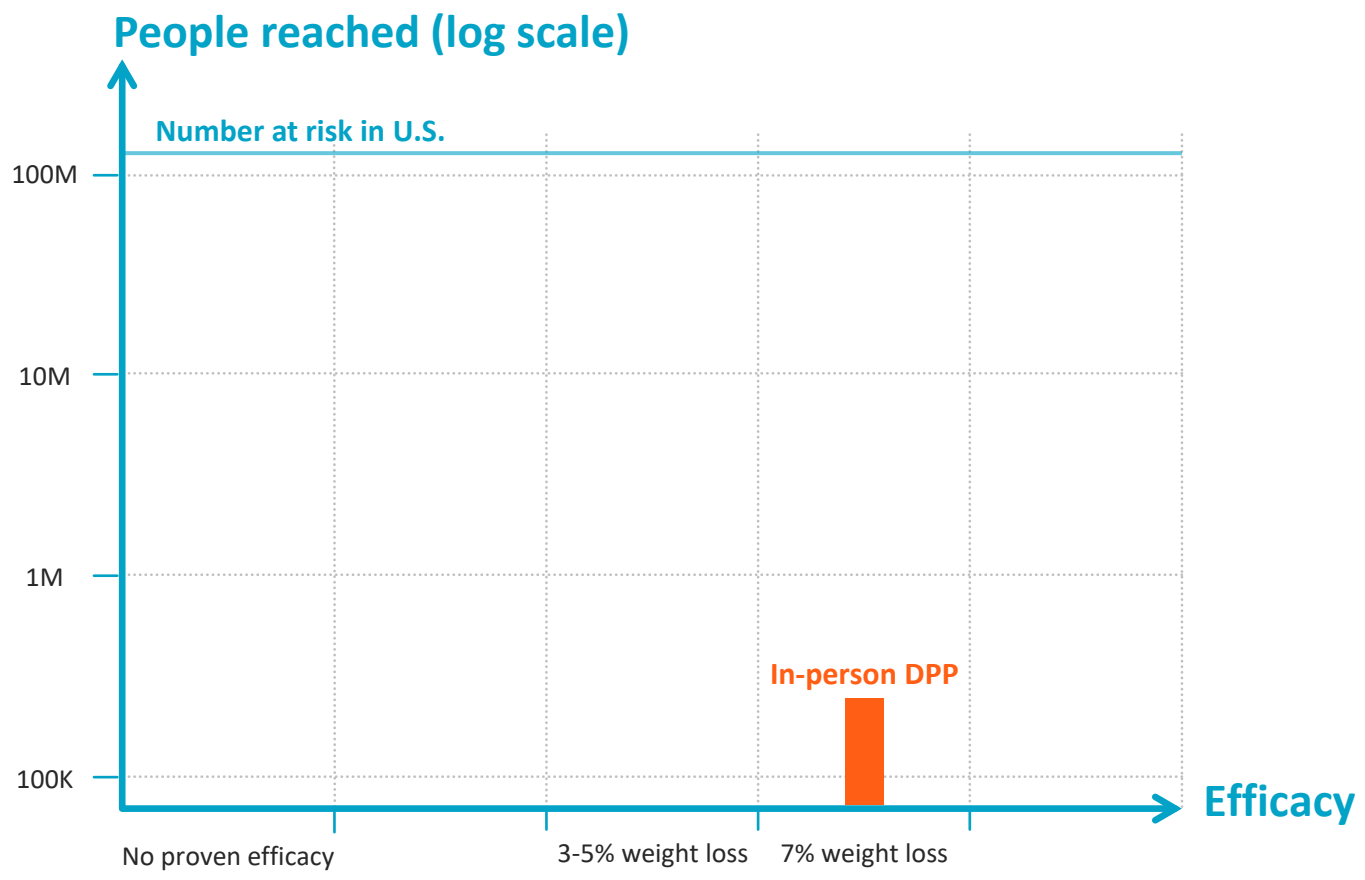
- In-person individual and group coaching at a cost of $5,500/person over 10 years (2020 dollars)

Lifestyle coaching is the most efficacious prevention to date

- 58% reduction in diabetes risk
- 2x better outcomes vs. metformin

Hard to scale

- 2010: CDC introduces national DPP
- 2019: 373,000 out of 100,000,000 enrolled



Fundamental limit:

Labor costs

Private insurance

Medicare & Medicaid

Limited coverage

Medicare coverage
Medicaid in 11 states

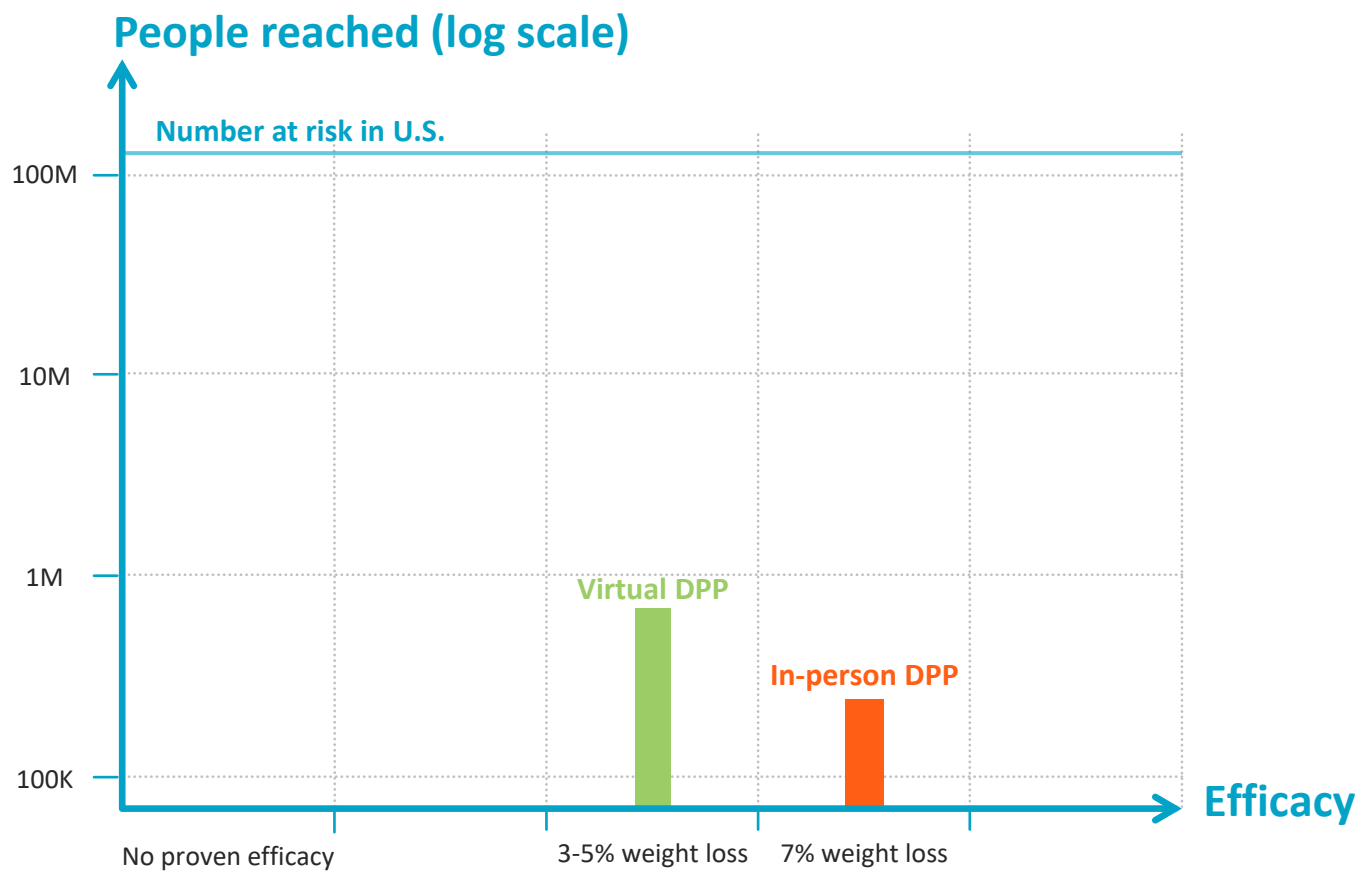
Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002;346(6):393-403. doi:10.1056/NEJMoa012512
National Diabetes Prevention Program Coverage Toolkit. (29 July 2019). States Where the National DPP is a Medicaid Covered Benefit 2019. Retrieved from: https://coveragetoolkit.org/medicaid-agencies/medicaid-coverage-2/
Shea, Pat. (2019, June 27). "Scaling and Sustaining the National Diabetes Prevention Program" [Webinar]. National Association of Chronic Disease Directors. https://coveragetoolkit.org/wp-content/uploads/2019/07/6.27.19-Case-for-Coverage-webinar-slides_FINAL-v2.pdf
The 10-Year Cost-Effectiveness of Lifestyle Intervention or Metformin for Diabetes Prevention. The Diabetes Prevention Program Research Group. Diabetes Care Apr 2012, 35 (4) 723-730; DOI: 10.2337/dc11-1468

Virtual DPP (vDPP)

Less coaching, remote labor
- Individual and group coaching by video, online courses, customer support

Somewhat better reach via lower cost
- Two biggest players report 817,000 users combined

Lower efficacy
- 50% less weight loss after 3 years vs. DPP
- Adherence rates less than 50% of DPP
- Few RCTs; no data on long-term efficacy



Fundamental limit:

Lower labor costs reduce efficacy

Cohan, Peter. "Wrong, Cramer! Livongo Rival Omada Health's Physera Buy Aims At $200B Opportunity." Forbes, Forbes Magazine, 19 July 2020, www.forbes.com/sites/petercohan/2020/07/18/wrong-cramer-livongo-rival-omada-healths-physera-buy-aims-at-200b-opportunity/?sh=fd7a2787fc6f.
"Livongo Reports Third Quarter 2020 Financial Results." Yahoo!, Yahoo!, 28 Oct. 2020, www.yahoo.com/lifestyle/livongo-reports-third-quarter-2020-200500898.html.
"PRESS RELEASE: Omada Digital Diabetes Prevention Program Shows Sustained HbA1c Reduction and Weight Loss in Randomized Control Trial." Press | Omada Health, 3 Nov. 2020, www-omadahealth-com.cdn.ampproject.org/c/s/www.omadahealth.com/press/press-release-omada-digital-diabetes-prevention-program-shows-sustained-hba1c-reduction-and-weight-loss-in-randomized-control-trial?hs_amp=true.
Sepah, S Cameron et al. "Engagement and outcomes in a digital Diabetes Prevention Program: 3-year update." BMJ open diabetes research & care vol. 5,1 e000422. 7 Sep. 2017, doi:10.1136/bmjdrc-2017-000422

Health apps and wearables

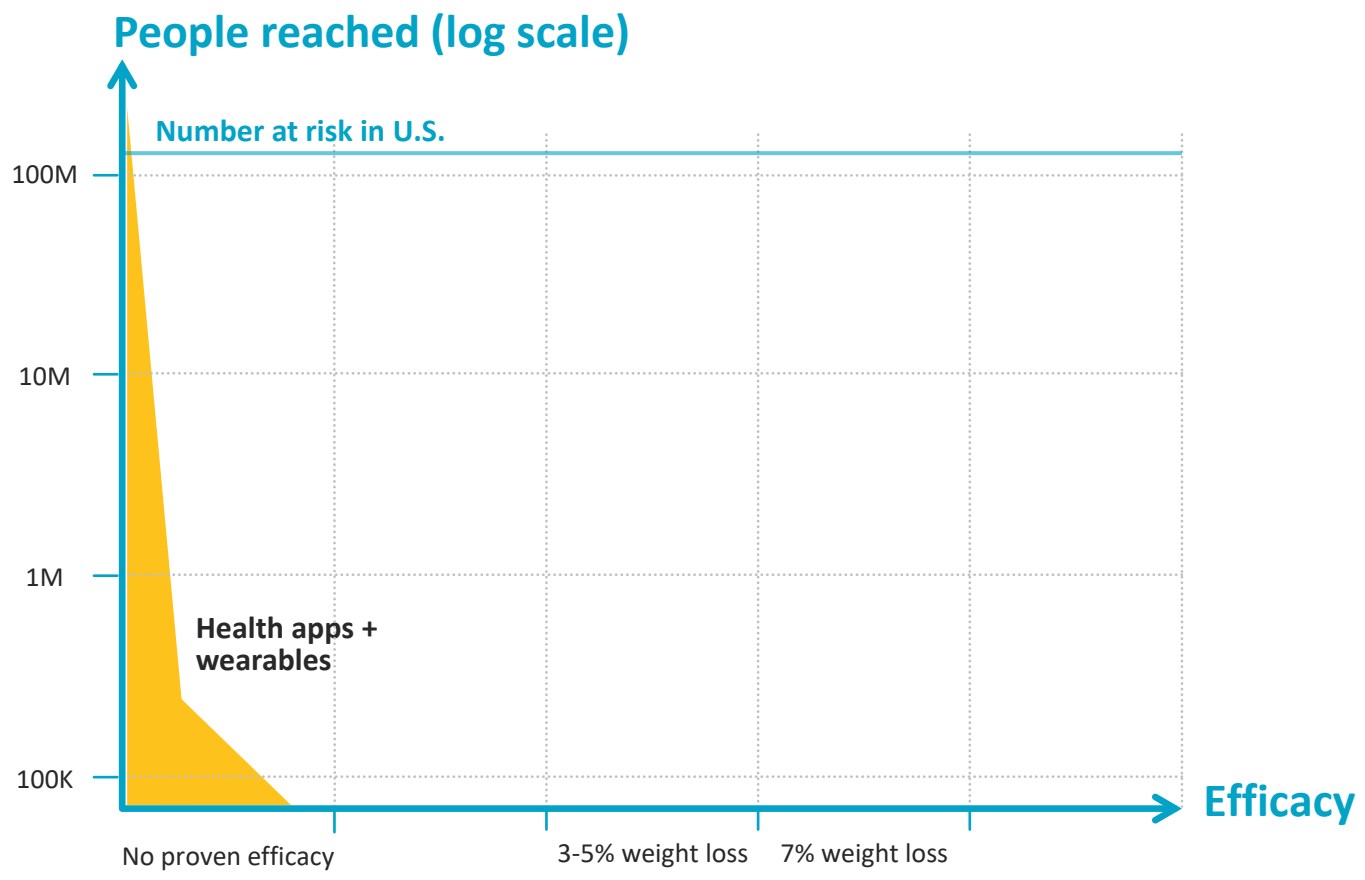
Apps and wearables
- Sensors for activity tracking
- Reminders, activity & food diaries
- Social networking

Unprecedented reach
- No labor -> inexpensive
- 318,000 apps available
- Up to 150M downloads

No proven efficacy
- Very few RCTs; no long-term studies
- Wearables + DPP-like counseling 40% worse than counseling alone

Fundamental limit:

Without personalized coaching, inadequate for disease prevention



Private insurance		Limited coverage
Medicare & Medicaid		No coverage

IQVIA Institute for Human Data Science. The Growing Value of Digital Health. Nov 2017. Available at: http://www.iqvia.com/institute/reports/thegrowing-value-of-digital-health. Accessed September 15, 2020.
Jakicic, J. M. (2016). Monitoring and Feedback for Long-Term Weight Loss. jamanetwork.com/journals/jama/fullarticle/2553448: JAMA, American Medical Association.
Under Armour. (2020). 2019 Annual Report. Retrieved from https://about.underarmour.com/investor-relations/financials/annual-reports