Behavioural Economics – Evidence for Chronic Disease Prevention?

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Outline

• Brief Introduction to the problem
• Introduction to theory on traditional and behavioural economic incentives in influencing health behavior
• Evidence
• A few of my Singapore studies
• Concluding Comments
Behavioral Drivers of Chronic Diseases

• Over the past few decades, developed countries have undergone a major economic transition
  – Dramatic changes in dietary patterns, with greater reliance on pre-packaged and highly processed foods
  – More sedentary lifestyle

• Mechanization and Westernization

• Enter rising rates of chronic disease

• Rising GDP and rising rates of NCDs go hand in hand
  • Interestingly, so does rising life expectancy
Example: Diabetes

Over 350 million with diabetes worldwide

- **US:**
  - Prevalence is 8.3%
  - Pre-diabetes prevalence is 35%

- **China:**
  - Prevalence is 11.6%
  - Pre-diabetes prevalence is 50%

- **Singapore:**
  - Prevalence is 12%

- **Vietnam:**
  - Prevalence is 6%
  - Doubled in last decade

- **China and India combine for 163 million cases**

- **Who’s getting it?**
How does one prevent NCD’s

• Eat a healthy diet
• Exercise
• Don’t smoke
• Don’t drink too much
• Take meds as prescribed
• Maintain a healthy weight

• Few can pull it off.

• Can economics help?
Traditional Economics

- Assumes individuals are rational and maximize utility subject to constraints (e.g., budget, time, genetics).
  - They are forward-looking and make decisions by weighing the long term benefits and costs of all possible alternatives
- Decision rule for optimal amount of an activity
  - Marginal benefit = Marginal cost
- Predictions
  - As the cost (including opportunity cost) [benefits] of engaging in healthy activities increases, individuals will participate in fewer [more] healthy activities
- The model is highly predictive
Incentives in Traditional Economics

- Theory suggests that economic incentives can be used to ‘turn back the clock’
- Aim is to alter either marginal benefits (carrot) or marginal costs (stick)
- Size matters
- How and when incentives are delivered are less important
- No role for habit formation
- Could be cost-effective or even cost-saving (although that’s a high bar)
Behavioral Economist’s View

• They don’t believe that individuals can maximize their utility
• Recognize that people often make systematic errors in their decision making that lead to suboptimal choices
• Substantial evidence to support this hypothesis
  • More so for food than for PA
• Implications:
  – If people’s choices around health behaviors (and the consequences of those choices) are not optimal from the individual perspective, suggests a role for third parties to guide people in helping themselves
  – And not just to save money
Where Do People Get it Wrong?

- **Present-bias**
  - Putting too much weight on the present and too little on the future
  - Termed hyperbolic discounting
- **Salience effects**
  - More salient factors weigh more heavily on decisions
  - Advertising plays a significant role in what is salient
- **Time-inconsistency**
  - Preference at one point in time is inconsistent with preference at another point in time
  - Generates regret
Where Do People Get it Wrong? (cont.)

• Probabilistic assessment bias
  – People are very bad at understanding probabilities
  – Tend to overestimate probability of unlikely events and underestimate probability of likely events

• Framing effects
  – Choices people make are influenced by the way information is presented or ‘framed’
    • Think 50% off

• Loss aversion
  – People value losses more than gains of equal magnitude
Applying Economics to Correct These Biases

• Even for non-utility maximizing decisions, traditional incentives will still influence behaviors

• Target areas where people routinely make mistakes

• Behavioral economists believe the structure, design, framing, and timing of incentives matter, in addition to the size of the incentive
Types of Incentives/Disincentives

- **Rewards (carrots)**
  - Cash payments
  - Lotteries – exploit probabilistic assessment bias
  - Non-cash rewards (voucher, gifts, coupons, free foods)
    - Address salience and presence-bias
    - Better than cash?

- **Penalties (sticks)**
  - Experience rating
  - Deposit contracts (a pre-commitment device to address time inconsistency)
    - Theory says these should work better due to loss aversion

- **Value based pricing**
  - Reducing copayments for high value services
Evidence – Review of Literature

• RCTs and quasi-experimental studies
• Published during 1993-2013 (past 20 years)
• Evaluated incentive effects on consumer side, not on supply side
  • Many studies show docs will work for pay
• Focused on health behaviors (e.g. physical activity, diet, medication adherence, preventive services)
Identified 52 Studies for Review

<table>
<thead>
<tr>
<th></th>
<th>Gym attendance</th>
<th>Physical activity</th>
<th>Weight loss</th>
<th>Healthy food uptake</th>
<th>Medical services uptake</th>
<th>Medication adherence</th>
<th>Blood glucose</th>
</tr>
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<tbody>
<tr>
<td>Direct cash payments</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Voucher/gift card</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Foods and other rewards</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Deposit contract</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Lottery</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Lower copay</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>Framing</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>5</td>
<td>-</td>
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</tr>
</tbody>
</table>
Evidence on Cash Incentives

• Strongest evidence for one time activities or when frequent, salient, and/or tied to performance
  • So better for physical activity than for weight

• Long-term evidence for any health behavior/outcome is thin (few studies) but not compelling
Evidence on Deposit Contracts/Lotteries

- Deposit contracts generally not effective for physical activity or weight loss, even in the short run
- Lottery incentives show some short-term effects
- Combination of deposit contracts and financial rewards (e.g. lottery, matching) show some short-term effects, but long-term evidence is limited
Evidence on Reduced Copays

• Effectiveness:
  – Lower copays increase medication adherence although effects are modest

• Cost implications:
  – Claim is that lower copay interventions are cost neutral but evidence is limited.
Evidence on Habit Formation

- Literature finds little evidence of incentives on habit formation
- Suggests that incentives that work would need to be sustained
- Could still be cost-effective or even cost saving
  - But the latter is a tough sell
Evidence for Other Types of Incentives

• Framing strategies are effective in promoting initial physical activities and healthy food choices.
  – But effect sizes are small in most cases

• Non-cash rewards (gift cards, vouchers, free foods) are generally effective to induce simple one-off activities (e.g., getting immunized, signing up for something) but less so for repeated activities

• No evidence of sustained behaviour changes for these approaches
Are incentives counter productive?

• Deci and Ryan suggest this is possible
  • If they reduce intrinsic motivation

• Many have hypothesized such an effect for health behaviors

• No evidence to support it
Overall Conclusion From Review

- Many studies show some indication of behavior change in the short term
- More so for process than outcome measures
- Little evidence of long term results or cost-effectiveness
- But the literature is thin
- More research is needed!
Introduction to a few of my Singapore studies
A Cluster Randomized Controlled Trial of an Incentive-based Outdoor Physical Activity Program

Overview

- **The research question:** *Can we develop a strategy to increase physical activity and outdoor time among Singapore youth?*
  - Singaporean kids are inactive and myopic

- **Strategy:** Combine incentives for walking (as measured via pedometers) with structured weekend outdoor programs
  - Incentive – $30 “Toys R Us” gift card if a child logs 8,000 steps per day on at least half the days of a month
  - A structured weekend outdoor program in parks

- Tested via randomized control trial (RCT)
- Primary outcome – 6 minute walk test
- Secondary – pedometer (sealed in control)
Results

Changes in Physical Activity as measured by Pedometer Steps at follow-up controlling for age, gender and ethnicity

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Intervention Group</th>
<th>Intervention effect</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=89)</td>
<td>(n=145)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedometer steps, mean ± SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entire week</td>
<td>7767 ± 382</td>
<td>8660 ± 567</td>
<td>958**</td>
<td>0.010</td>
</tr>
<tr>
<td>Weekdays</td>
<td>7826 ± 299</td>
<td>8646 ± 447</td>
<td>848**</td>
<td>0.041</td>
</tr>
<tr>
<td>Weekends</td>
<td>7684 ± 664</td>
<td>8779 ± 885</td>
<td>1239**</td>
<td>0.018</td>
</tr>
<tr>
<td>% of Children who attained at least 8000 steps daily</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entire week</td>
<td>1.9 ± 0.6</td>
<td>24.0 ± 7.5</td>
<td>15.72***</td>
<td>0.001</td>
</tr>
<tr>
<td>Weekdays</td>
<td>8.4 ± 7.8</td>
<td>33.0 ± 17.8</td>
<td>5.87***</td>
<td>0.006</td>
</tr>
<tr>
<td>Weekends</td>
<td>12.6 ±20.8</td>
<td>50.0 ± 35.5</td>
<td>29.32***</td>
<td>0.003</td>
</tr>
</tbody>
</table>

*p<0.10   **p<0.05   ***p<0.01

a 89 control participants wore sealed pedometers at follow-up.
There were 3 different trajectory classes: the first group increased activity but was not sustained; the second group met the target step levels while the third group well surpassed the step goals.
Total Weekend Step Trajectories Over 36 Weeks – Incentive arm (N=136)

Incentives for kids are promising
A Randomized Trial of economic Incentives to Promote Walking Among Full-time Employees – TRIPPA Study (Overview and Interim Results)

PRINCIPAL INVESTIGATOR:
DR. ERIC A FINKELSTEIN, Associate Director & Associate Professor, Health Services & Systems Research Program, Duke-NUS

COLLABORATORS:
DR. ROBERT SLOAN, Former Centre Head, Physical Activity Centre for Excellence, Health Promotion Board, Singapore
DR. BENJAMIN A HAALAND, Assistant Professor, Office of Clinical Sciences, Duke-NUS
Study Objective

- Use a randomized controlled trial (RCT) to test whether incentives plus Fitbit Zip pedometer or pedometer only can motivate full-time employees to walk more (6-month assessment) and sustain increases post-incentives (12-month assessment)

- Flexible walking “program” where participants can choose intensity/duration

- Incentives tied to steps logged via wireless Fitbit Zip pedometers

- Conducted by Health Services and Systems Research at Duke-NUS Graduate Medical School (PI – Eric A Finkelstein) with funding from Ministry of Health and support from Health Promotion Board
Incentive Schemes Vary Depending on Study Group

All enrolled participants *randomly* allocated to one of four study groups-

1. **Cash Incentive Group** – Receive Fitbit Zip pedometer and earn cash incentives of up to $30 per week for 6 months for meeting physical activity goals.

2. **Charity Incentive Group** – Same as above, except that incentives will be donated to a charity of the participant’s choice.

3. **Program (Fitbit) Only Group** – Receive Fitbit Zip pedometer and earn $4 a week for 6 months. No physical activity goal.

4. **Control Group** – Earn $4 a week for 6 months. No physical activity goals, and do not receive pedometer.
Step Goals and Incentives

- Participants in the Cash and Charity Incentive groups earn incentives if they meet step goals as follows:

<table>
<thead>
<tr>
<th>Step Target / Week</th>
<th>Incentives / Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;= 50,000 Steps</td>
<td>S$15</td>
</tr>
<tr>
<td>&gt;= 70,000 Steps</td>
<td>S$30</td>
</tr>
</tbody>
</table>

- 70,000 steps per week is equivalent to the Health Promotion Board’s (HPB) guidelines for physical activity

- Note – incentives could have been implemented in many ways
Outcome Measures

• Activity levels, weight, blood pressure and heart rate are measured at the baseline, 6-, and 12-month assessments
  – *Primary outcome measure* – Physical activity levels measured via accelerometer worn for 1 week at each assessment
    • No more 6 min walk test
  – *Secondary outcome measures* – Body Mass Index (BMI), Blood Pressure, Heart Rate, steps as measured via the Fitbit Zip

• For those not in the control arm, Fitbit Zip data is also available throughout the intervention period
  – These data are the focus of this presentation (non-blinded)

• Physical activity and health outcomes will be analyzed for the entire study sample (*800 participants*) upon completion of the trial.
Study Group Allocation

• To date, 697 enrolled participants were randomly allocated to one of the four study groups as shown below:

<table>
<thead>
<tr>
<th>Study Group</th>
<th># of Enrolled Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Incentive Group</td>
<td>175</td>
</tr>
<tr>
<td>Charity Incentive Group</td>
<td>167</td>
</tr>
<tr>
<td>Program Only Group</td>
<td>177</td>
</tr>
<tr>
<td>Control Group</td>
<td>178</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>697</strong></td>
</tr>
</tbody>
</table>

• Recruitment for up to 100 additional participants is on-going
Incentive Payouts

- Average weekly earnings per participant in Cash group: $23.00
- Average weekly earnings per participant in Charity group: $14.00

- Might this approach be cost-effective?

- Do greater steps translate into improved health outcomes?
  - Perhaps depends on how they are getting them.
TRIPPA Online System

• In addition to extensive Fitbit website (fitbit.com), TRIPPA Online system allows participants to view steps walked every week, incentives earned, and upcoming study sessions
• Worksites can view aggregate step data of participating employees (no information on individual employees is shared)
• Charities can view how much money has been raised by participants (participant names are anonymized, but can be made visible with permission)
TRIPPA System for Participants

Welcome Ms Aarti Sahaaranam

24025
Total amount of steps taken since the start of this week

$0.00
Total amount of money you have earned since the start of this week

Weekly Payment
$30.00 - 75,000 steps

Weekly exercise tip
Listening to music while running will make the workout seem easier!

Events

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Title</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 Oct 2012</td>
<td>13:00</td>
<td>Team meeting/ISAT feedback</td>
<td>AF</td>
</tr>
<tr>
<td>24 Apr 2013</td>
<td>09:00</td>
<td>Random assessment</td>
<td></td>
</tr>
<tr>
<td>30 Apr 2013</td>
<td>08:00</td>
<td>Program starts</td>
<td></td>
</tr>
<tr>
<td>06 May 2013</td>
<td>09:00</td>
<td>New Court Timestamps</td>
<td></td>
</tr>
<tr>
<td>09 May 2013</td>
<td>08:00</td>
<td>Open street survey</td>
<td></td>
</tr>
<tr>
<td>17 May 2013</td>
<td>09:00</td>
<td>New Court Timestamps</td>
<td></td>
</tr>
<tr>
<td>25 May 2013</td>
<td>09:00</td>
<td>New Court Timestamps</td>
<td></td>
</tr>
<tr>
<td>10 Jun 2013</td>
<td>09:00</td>
<td>Baseline Assessment</td>
<td></td>
</tr>
<tr>
<td>20 May 2013</td>
<td>09:00</td>
<td>Total Seguro</td>
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</table>

Financial History

<table>
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<tr>
<th>Date</th>
<th>Description</th>
<th>Earned/Paid</th>
<th>Paid</th>
<th>Balance</th>
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<tr>
<td>30 May 2013</td>
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<td>$0.00</td>
<td>$90.00</td>
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<td>26 Jul 2013</td>
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<td>$30.00</td>
<td>$0.00</td>
<td>$120.00</td>
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<tr>
<td>10 Aug 2013</td>
<td>Incentive payment</td>
<td>$30.00</td>
<td>$0.00</td>
<td>$150.00</td>
</tr>
<tr>
<td>22 Aug 2013</td>
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<td>$30.00</td>
<td>$0.00</td>
<td>$180.00</td>
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<tr>
<td>05 Sep 2013</td>
<td>Incentive payment</td>
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<td>$0.00</td>
<td>$210.00</td>
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<tr>
<td>15 Sep 2013</td>
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<td>$0.00</td>
<td>$240.00</td>
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<td>05 Oct 2013</td>
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<td>$0.00</td>
<td>$270.00</td>
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<td>$0.00</td>
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<td>$360.00</td>
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<td>Incentive payment</td>
<td>$30.00</td>
<td>$0.00</td>
<td>$390.00</td>
</tr>
</tbody>
</table>

Step History

Weekly Number of Steps

Step History

1168012
Total steps to date
TRIPPA System for Worksites

Welcome

88090848
Total steps logged to date

Average daily steps among employees by work

- Charity
- Program
- Cash
TRIPPA System for Charities

Singapore Cancer Society

- Wildlife Reserves Singapore Conservation Fund
- Garden City Fund
- The Straits Times School Pocket Money Fund
- Riding for the Disabled Association of Singapore
- Breast Cancer Foundation
- Club Rainbow
- Asian Women’s Welfare Association
- Centre for Fathering
- Yellow Ribbon Project Fund
- Singapore Red Cross
- Singapore Cancer Society
- Children’s Charities Association of Singapore
- Thye Hua Kwan Moral Society

$5580.00
Total raised for charity

Donations

<table>
<thead>
<tr>
<th>Name</th>
<th>Worksite/Company</th>
<th>Total Amount Donated</th>
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<tr>
<td>Anonymous</td>
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<td>$500.00</td>
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<tr>
<td>Anonymous</td>
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<td>Anonymous</td>
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<tr>
<td>Anonymous</td>
<td></td>
<td>$15.00</td>
</tr>
</tbody>
</table>
A Randomized Incentive-Based Weight Loss Trial in Singapore – TRIO Study (Overview and Interim Results)

**Principal Investigator:**
DR. ERIC A FINKELSTEIN, Associate Director & Associate Professor, Health Services & Systems Research Program, Duke-NUS

**Collaborators:**
DR. THAM KWANG WEI, Consultant, Dept of Endocrinology, SGH
DR. BENJAMIN A HAALAND, Assistant Professor, Office of Clinical Sciences, Duke-NUS
Study Objective

*Use a Randomized Controlled Trial (RCT) to test the extent to which traditional or behavioral economic incentives, when combined with an existing evidence-based weight loss program, improve weight loss and weight loss maintenance.*

**Strategy:** Incorporate economic incentives into existing evidence-based weight loss program from the SGH Life Centre
Study Design

- Randomize overweight participants into one of two arms (control and incentive)
- All participants receive a 16 week intensive weight loss program adapted from the Diabetes Prevention Program for use in Singapore
- Those randomized to incentive arm receive traditional (cash) or lottery incentives for meeting weight loss and step goals
  - Theory says incentives will work but lotteries work better
  - We let them choose
- All participants pay a fee to access the program
  - Addresses loss aversion
  - Minimizes 3rd party costs
**Study Design: Incentive Payouts**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Timing</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight-loss goal (1kg)</td>
<td>Weeks 1, 2, 3, 4, 5, 6, 7, 8</td>
<td>$20 sub-total: $200</td>
</tr>
<tr>
<td>Monthly pedometer goals (10k steps on 20 days/mo)</td>
<td>Months 1-8</td>
<td>$20 sub-total: $160</td>
</tr>
<tr>
<td>4-mo weight loss goal (5% WL)</td>
<td>Month 4</td>
<td>$100</td>
</tr>
<tr>
<td>8-mo weight loss goal (8% WL)</td>
<td>Month 8</td>
<td>$100</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>Total:</strong></td>
<td><strong>$560</strong></td>
</tr>
</tbody>
</table>

- **Participant pay-in:**
  - $235 for Program
  - $165 for access to the Incentive programs

- **Maximum Incentive payout:**
  - $560 per participant

- If choose lottery *Amount* is a lottery ticket with a 10% chance of winning 10x the amount and a 90% chance of winning $0

- No incentives beyond month 8 (maintenance period)
Outcome Measures

• Weight is officially measured at baseline, months 4, 8, and 12
  – Primary outcome measure – Weight loss at month 12
  – Secondary outcome measure – Weight loss at months 4 and 8

• Hypothesis is that incentive program will increase weight loss at all time points through month 12 and at a reasonable cost per additional kg lost
# Response to Screening Survey

<table>
<thead>
<tr>
<th>Screener Outcome</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Screeners Completed</td>
<td>572</td>
<td>100%</td>
</tr>
<tr>
<td>Eligible</td>
<td>186</td>
<td>32.5%</td>
</tr>
<tr>
<td>Eligible with Doctor’s Consent</td>
<td>48</td>
<td>8.4%</td>
</tr>
<tr>
<td>Ineligible</td>
<td>338</td>
<td>59.1%</td>
</tr>
<tr>
<td>Total Enrolled (target is 188)</td>
<td>133</td>
<td>23.3% of those screened</td>
</tr>
</tbody>
</table>
Study Arm Allocation

• All 133 enrolled participants to date:

<table>
<thead>
<tr>
<th>Study Arm</th>
<th># of Enrolled Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm 1 - Control</td>
<td>47</td>
</tr>
<tr>
<td>Arm 2 - Incentive</td>
<td>86*</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
</tr>
</tbody>
</table>

• Recruitment for 55 additional participants is on-going
Is this just an academic exercise?
Wearable technology revolution

• The digital health device retail market totals almost $400 million annually
• This will be a billion dollar industry shortly
• Personal health devices such as Fitbits, Jawbones and Nike FuelBands are increasingly popular
• These technologies will be increasingly combined with incentives/disincentives to internalize external costs of poor health behaviors.
• Vitality Health is leading the way to leveraging eHealth technology and incentives
• Others are following suit
Vitality

- Vitality customers can earn “points” by doing a health review, fitness assessment, joining and attending a gym and monitoring health with a fitness device
- Points can be used to receive discounted health insurance, vouchers and rewards, such as movie tickets
  - **Up to 15% discount on new insurance plans**
  - Discounts and rewards depend on number of Vitality points and status
  - Year-to-year health insurance discounts require participants to maintain health lifestyle
Looking Ahead

• Future will see rising rate of NCDs, rising costs, and rising life expectancy

• Renewed emphasis on individual responsibility and accountability at provider level (Think ACOs)
  – Pay for performance will happen at both levels

• Increased reliance on technology and cost shifting via carrots and sticks
Concluding Comments

• My own views:
  – Behavioral change is really hard
  – So far there are no magic bullets (or pills)
  – Incentives have a role but research has yet to identify best practices for sustainable, cost-effective programs
  – They won’t work for most but will work great for some
  – Best chances for physical activity
  – I would focus on kids
  – Key is low-cost, sustainable, and demand-driven interventions
  – More research is needed, especially in terms of how best to leverage new technology
Thank You

Partner in Academic Medicine

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