

APPENDICES:

Section A.1. Results using an Alternative Definition for CW Compliance:

Below is an alternative definition to the equations provided in *Section 2.1* for measuring CW compliance. The primary difference between the formulas below and those presented in *Results* is that undertreated patients are here included in both the numerator and denominator. Similar to the primary definition, eligible patients were those age 76 and older with diabetes, and who were not taking medication to treat diabetes, were not allergic to Metformin, and had an estimated glomerular filtration rate (eGFR) greater than or equal to 30.

(1) High Life Expectancy:

CW Compliance = ratio of eligible patients with HbA1c range: $\frac{\geq 7.0\%}{All\ Values}$,

CW Non-compliance = ratio of eligible patients with HbA1c range: $\frac{< 7.0\%}{All\ Values}$

(2) Medium Life Expectancy:

CW Compliance = ratio of eligible patients with HbA1c range: $\frac{\geq 7.5\%}{All\ Values}$,

CW Non-compliance = ratio of eligible patients with HbA1c range: $\frac{< 7.5\%}{All\ Values}$

(3) Low Life Expectancy:

CW Compliance = ratio of eligible patients with HbA1c range: $\frac{\geq 8.0\%}{All\ Values}$,

CW Non-compliance = ratio of eligible patients with HbA1c range: $\frac{< 8.0\%}{All\ Values}$,

Using these definitions, the results for overall CW compliance were adjusted as follows:

CW compliance increased on average 6.7% from baseline to post-intervention. Despite the 95% CI for the 16-week CW compliance rate at baseline not overlapping with the 95% CI for the 16-week CW compliance rate post-intervention (Table A.1.1), we cautiously interpret this result as an indication of improvement in CW compliance rather than claiming statistical significance.

Figure A.1.1: CW compliance rates in four-week discrete intervals across all five practice locations. Data to the left of the first vertical dashed bar indicate baseline CW compliance rates prior to initial launch in only the Vanguard practices. Data to the right of the second vertical bar indicate CW compliance rates after activation of the nudges at all five practices.

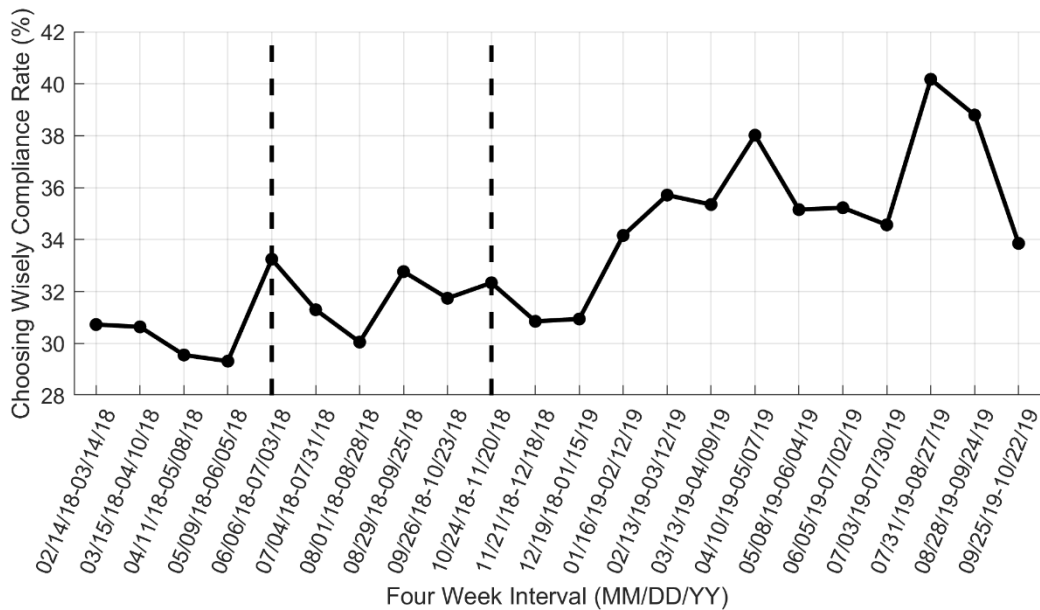


Table A.1.1: CW Compliance. (Top) CW compliance, Mean (95% CI), at baseline for each of the first four four-week intervals prior to nudge launch in the Vanguard sites, and overall baseline CW compliance rate across all 16 weeks. (Bottom) CW compliance, Mean (95% CI), in the most recent four four-week intervals after nudge deployment at all five practices, as well as the overall post-intervention CW compliance rate across all 16 weeks.

| | Dates: | Mean (95% CI): | Number of Patients: |
|-------------|-----------------------------------|-----------------------------|---------------------|
| Baseline | February 14 – March 14, 2018 | 30.7% (26.1%, 35.3%) | 384 |
| | March 15 – April 10, 2018 | 30.6% (25.9%, 35.4%) | 359 |
| | April 11 – May 8, 2018 | 29.6% (25.1%, 34.0%) | 406 |
| | May 9 – June 5, 2018 | 29.3% (24.8%, 33.9%) | 382 |
| | February 14 – June 5, 2018 | 30.1% (27.8%, 32.3%) | 1,531 |
| Most Recent | July 3 – July 30, 2019 | 34.6% (28.6%, 40.6%) | 243 |
| | July 31 – August 27, 2019 | 40.2% (33.8%, 46.5%) | 229 |
| | August 28 – September 24, 2019 | 38.8% (31.7%, 45.9%) | 183 |
| | September 25 – October 22, 2019 | 33.9% (27.2%, 40.6%) | 192 |
| | July 3 – October 22, 2019 | 36.8% (33.6%, 40.1%) | 849 |

Section A.2. CW Compliance by Individual Practice:

Using both the primary definition for CW compliance in the main text and the alternative definition in *Appendix A.1*, Figure A.2.1 shows CW compliance rates in four-week intervals stratified by practice using the main text definition for CW compliance, and Figure A.2.2 shows CW compliance rates in four-week intervals stratified by practice using the definition for CW compliance in *Appendix A.1*. In general, we observe a steady increase in CW compliance rates over time, with the exception of Pilot Site #1, which already had higher than average CW compliance rates at baseline.

Figure A.2.1: Monthly CW compliance rates stratified by practice using the definition for CW compliance in the main text. Data to the left of the first vertical dashed bar indicate baseline CW compliance rates prior to initial launch in only the Vanguard practices. Data to the right of the second vertical bar indicate CW compliance rates after activation of the nudges at all five practices.

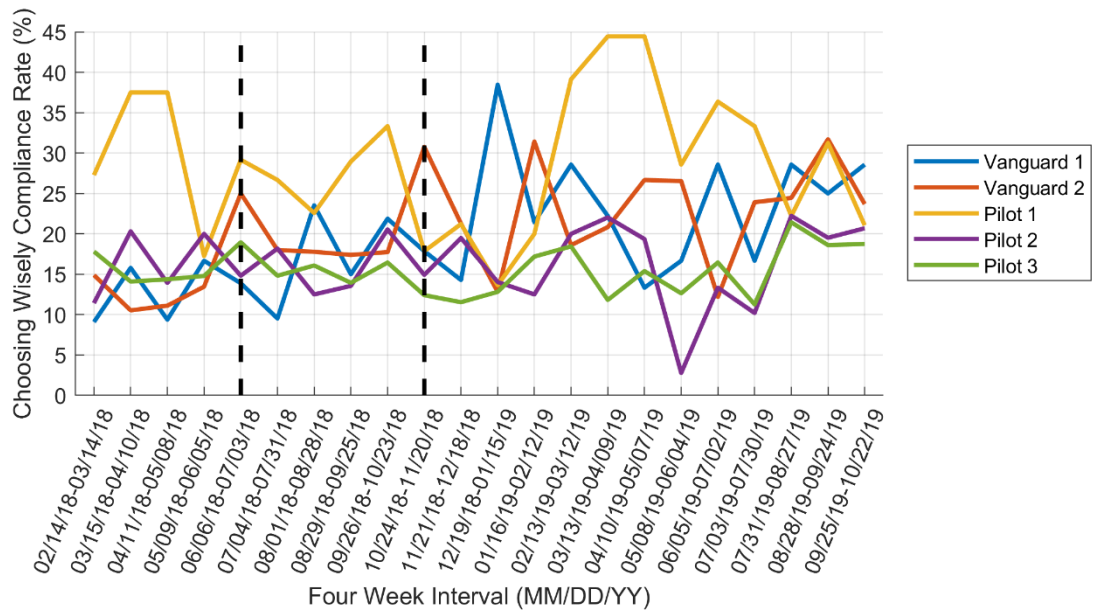
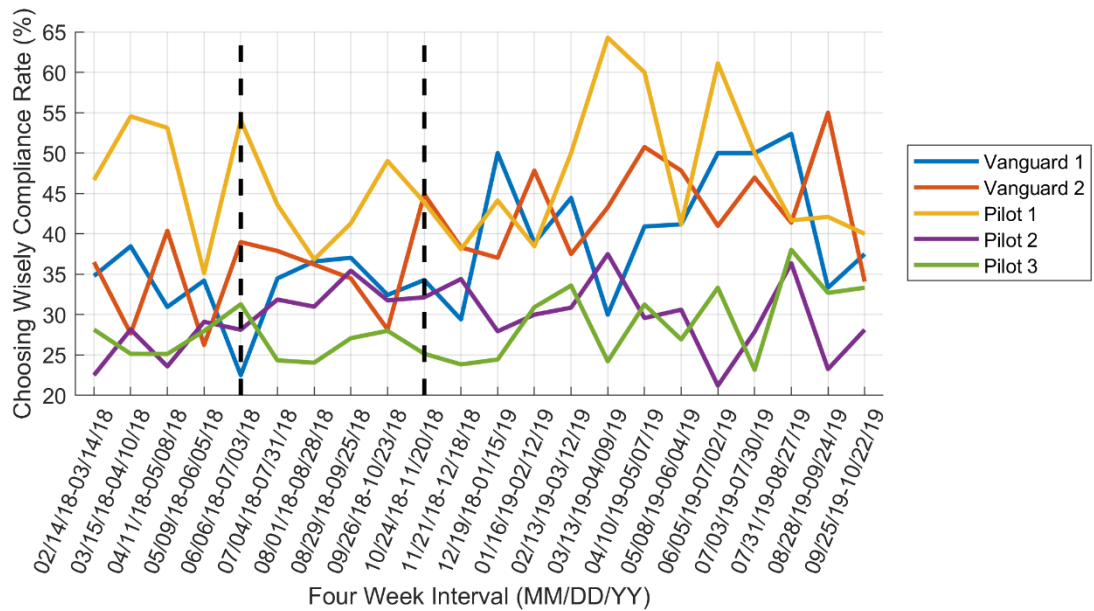


Figure A.2.2: Monthly CW compliance rates stratified by practice using the definition for CW compliance in *Appendix A.1*. Data to the left of the first vertical dashed bar indicate baseline CW compliance rates prior to initial launch in only the Vanguard practices. Data to the right of the second vertical bar indicate CW compliance rates after activation of the nudges at all five practices.




Section A.3. Images of individual BE-EHR components:
 Figure A.3.1: Tailored Advisory Nudge.

BestPractice Older Adult Guidelines Meds & Orders SmartSets

Older Adult Guidelines

Older Adult Guidelines (1)

Attention - Target A1C is Different for Patients Over 75!



Based on the patient's active problems, visit diagnoses, and age, a HIGH life expectancy has been calculated.

Guidelines for this patient:
 High life expectancy → A1C target = 7.0 - 7.5%

Patient's most recent A1C:
 HEMOGLOBIN A1C, POC (%)

| Date | Value | Status |
|------------|-------|--------|
| 04/02/2019 | 6 (A) | Final |

No results found for: HGBA1C

Tighter control can lead to dizziness, confusion, and other problems from hypoglycemia.

Consider joining your colleagues by:

- Reducing current diabetes medication

[Life Expectancy Algorithm](#)
[Choosing Wisely Guidelines](#)
[Jump to Orders](#)

Acknowledge Reason

Clinically inappropriate. Please explain | Agree with recommendation. Action taken

Accept

Figure A.3.2: Refill Protocol Nudge.

POCT HEMOGLOBIN A1C Order: 162145701


Status: Edited Result - FINAL Visible to patient: No (Not Released) Dx: Type 1 diabetes mellitus with complic...

| Ref Range & Units | 14:10 (12/14/18) | 1mo ago (10/24/18) | 1mo ago (10/23/18) | 2mo ago (9/27/18) |
|---------------------|------------------|--------------------|--------------------|-------------------|
| HEMOGLOBIN A1C, POC | 4 - 5.7 % | 3 ! | 5 | 6 ! |

Resulting Agency: NYU PERFORMED NYU PERFORMED NYU PERFORMED NYU PERFORMED

Specimen Collected: 12/14/18 14:10 Last Resulted: 12/14/18 14:10

Older Adult Guidelines



Based on the patient's active problems, visit diagnoses, and age, a HIGH life expectancy has been calculated.

Guidelines for this patient:
 High life expectancy → A1C target = 7.0 - 7.5%

Patient's most recent A1C:
 HEMOGLOBIN A1C, POC (%)

| Date | Value | Status |
|------------|-------|--------|
| 12/14/2018 | 3 (A) | Final |

No results found for: HGBA1C

Tighter control can lead to dizziness, confusion, and other problems from hypoglycemia.

Consider joining your colleagues by reducing their metformin, still the treatment of choice for older adults.

[Life Expectancy Algorithm](#)
[Choosing Wisely Guidelines](#)

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Figure A.3.3: Preference List Nudge.

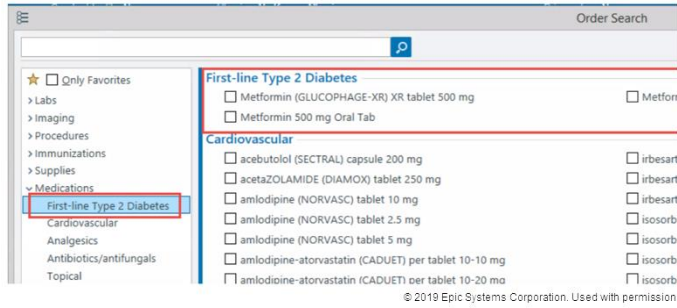
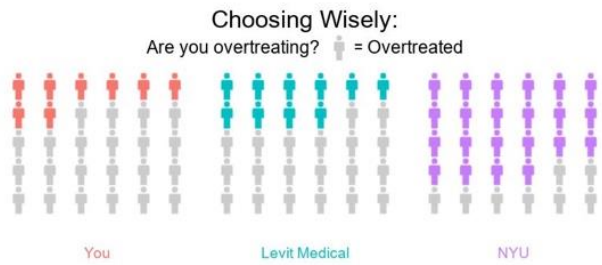
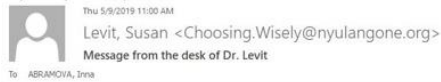


Figure A.3.4: Lab Result Nudge.



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Figure A.3.5A: Peer Comparison Nudge for provider whose CW compliance rate is low compared to peers.



You are receiving this message because you have seen a patient age 76 or older with diabetes in the last month. According to Choosing Wisely guidelines, diabetes should not be as tightly controlled in older adults. Only 8 out of 30 of your patients age 76 or older with diabetes are in their A1c target range; the rest are too tightly controlled. This compares to an average of 10 out of 30 of these patients for physicians in your practice, and an average of 22 out of 30 of these patients for physicians NYU-wide who are most successful (top 10%) at keeping their older diabetic patients' A1c within target range. If you would like more information about these patients, please reply.

Join your colleagues in Choosing Wisely by:

- Reducing prescription of diabetes medication for older patients
- Using metformin, only (if clinically appropriate)

[Choosing Wisely Guidelines](#)

Sincerely,
Dr. Susan Levit
Medical Director

Figure A.3.5B: Peer Comparison Nudge for provider whose CW compliance rate is high compared to peers.

Reply Reply All Forward
Thu 5/9/2019 11:03 AM
Levit, Susan <Choosing.Wisely@nyulangone.org>
Message from the desk of Dr. Levit
To: Pivran, Vladimir

Choosing Wisely:
Are you overtreating?  = Overtreated



You Levit Medical NYU

You are receiving this message because you have seen a patient age 76 or older with diabetes in the last month. With 5 out of 8 of these patients within their target range for A1c, you are doing as well or better than 90% of physicians in your practice (average 3 out of 8 patients in range) and NYU-wide (6 out of 8 patients in range), according to Choosing Wisely guidelines. If you would like more information about these patients, please reply.

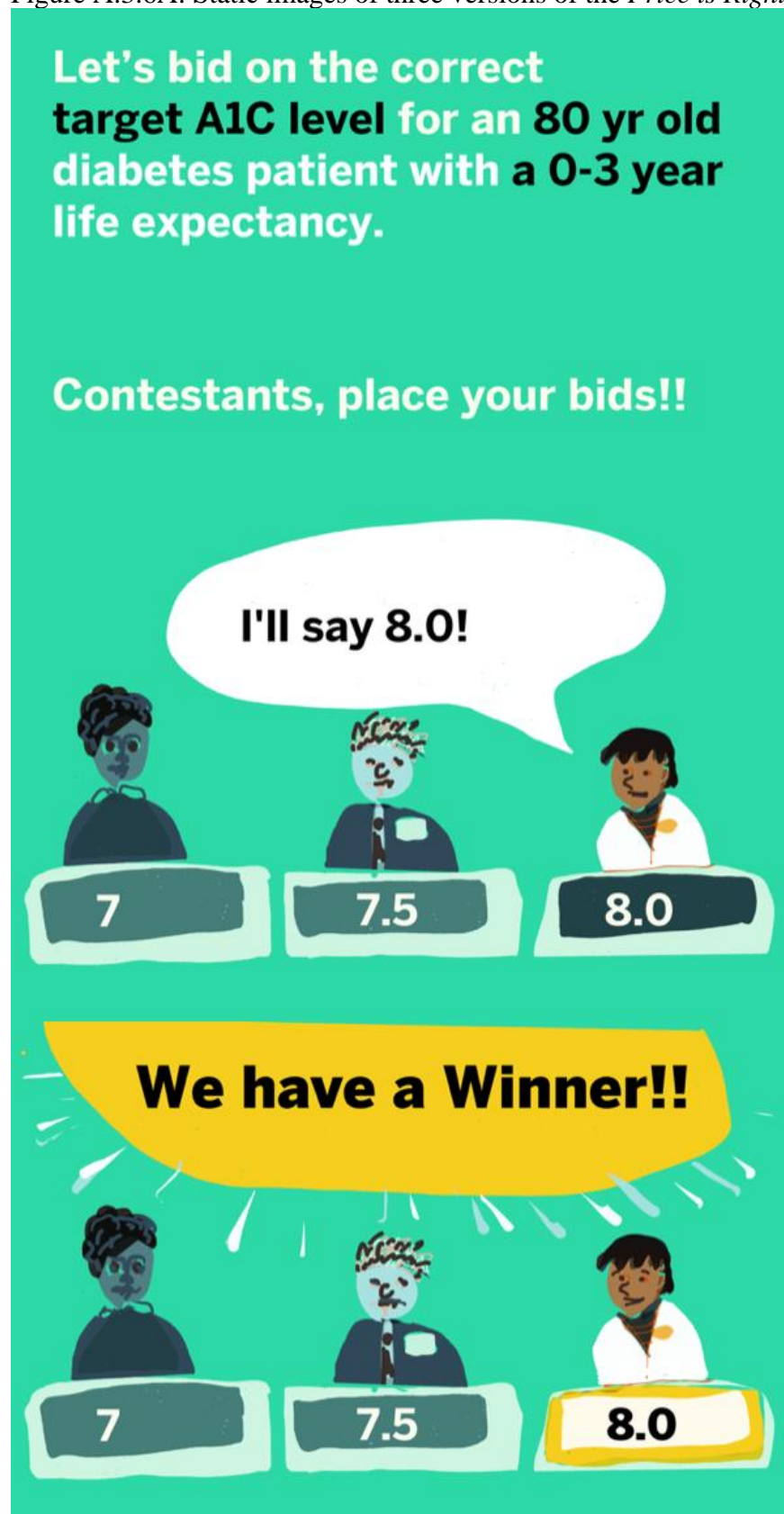
Keep Choosing Wisely by:

- Reducing prescription of diabetes medication for older patients
- Using metformin, only (if clinically appropriate)

[Choosing Wisely Guidelines](#)

Sincerely,
Dr. Susan Levit
Medical Director

Figure A.3.6A: Static images of three versions of the *Price is Right* Campaign.



Let's bid on the correct target A1C level for an 80 yr old diabetes patient with a 3-10 year life expectancy.

Contestants, place your bids!!

I'll say 7.5!



We have a Winner!!



Let's bid on the correct target A1C level for an 80 yr old diabetes patient with a 10+ year life expectancy.

Contestants, place your bids!!

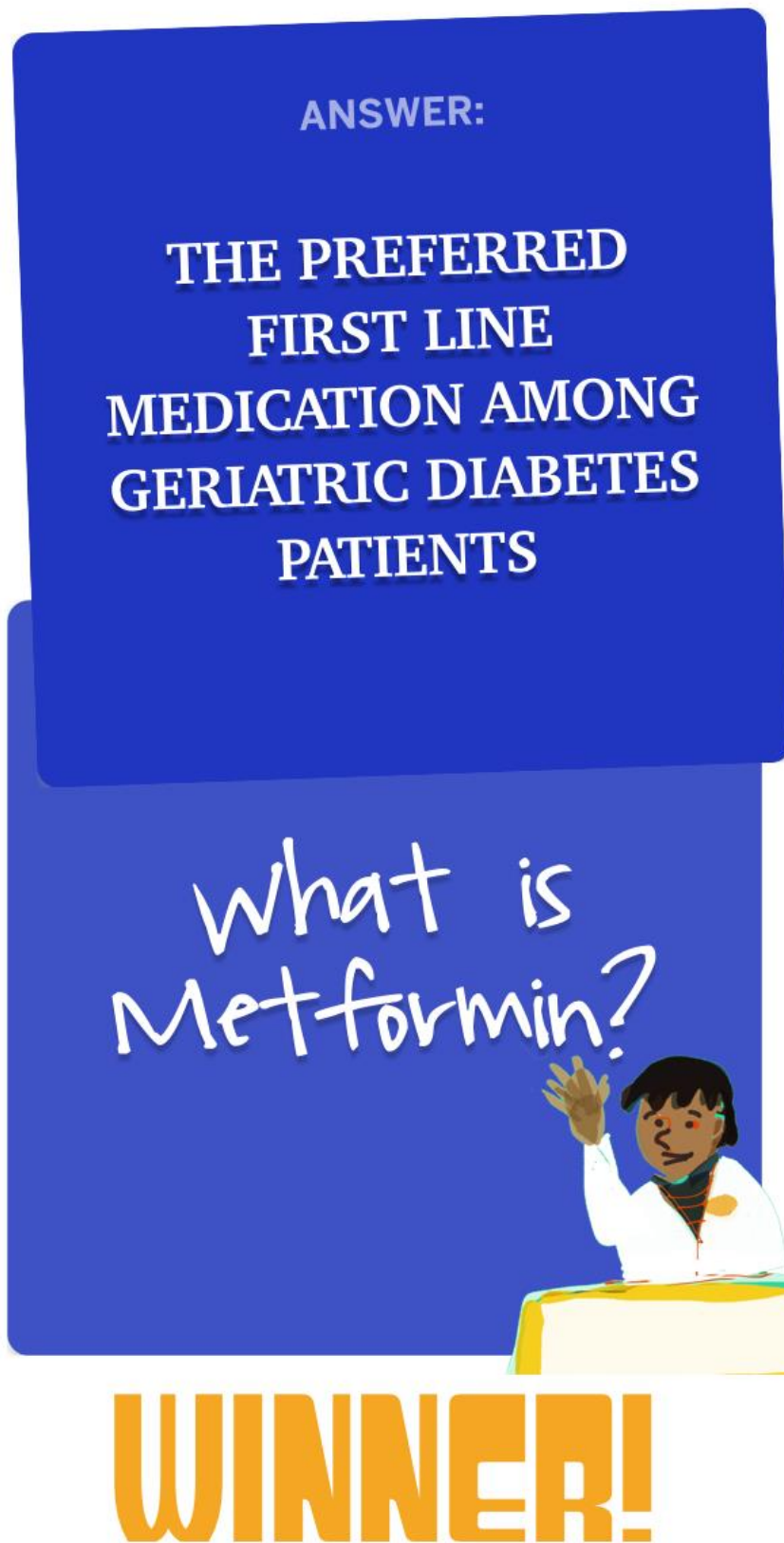
I'll say 7.0!



We have a Winner!!



Figure A.3.6B: Static images of four versions of the *Jeopardy* Campaign.



ANSWER:

TARGET A1C RANGE
FOR 80 YR OLD
WITH DIABETES AND
0-3 YEAR LIFE
EXPECTANCY

What is
8.0-9.0%?



WINNER!

ANSWER:

USING THE SAME
A1C TARGETS IN
GERIATRICS AS
YOUNGER PATIENTS
WITH DIABETES

What is
over-
treatment?



WINNER!

ANSWER:

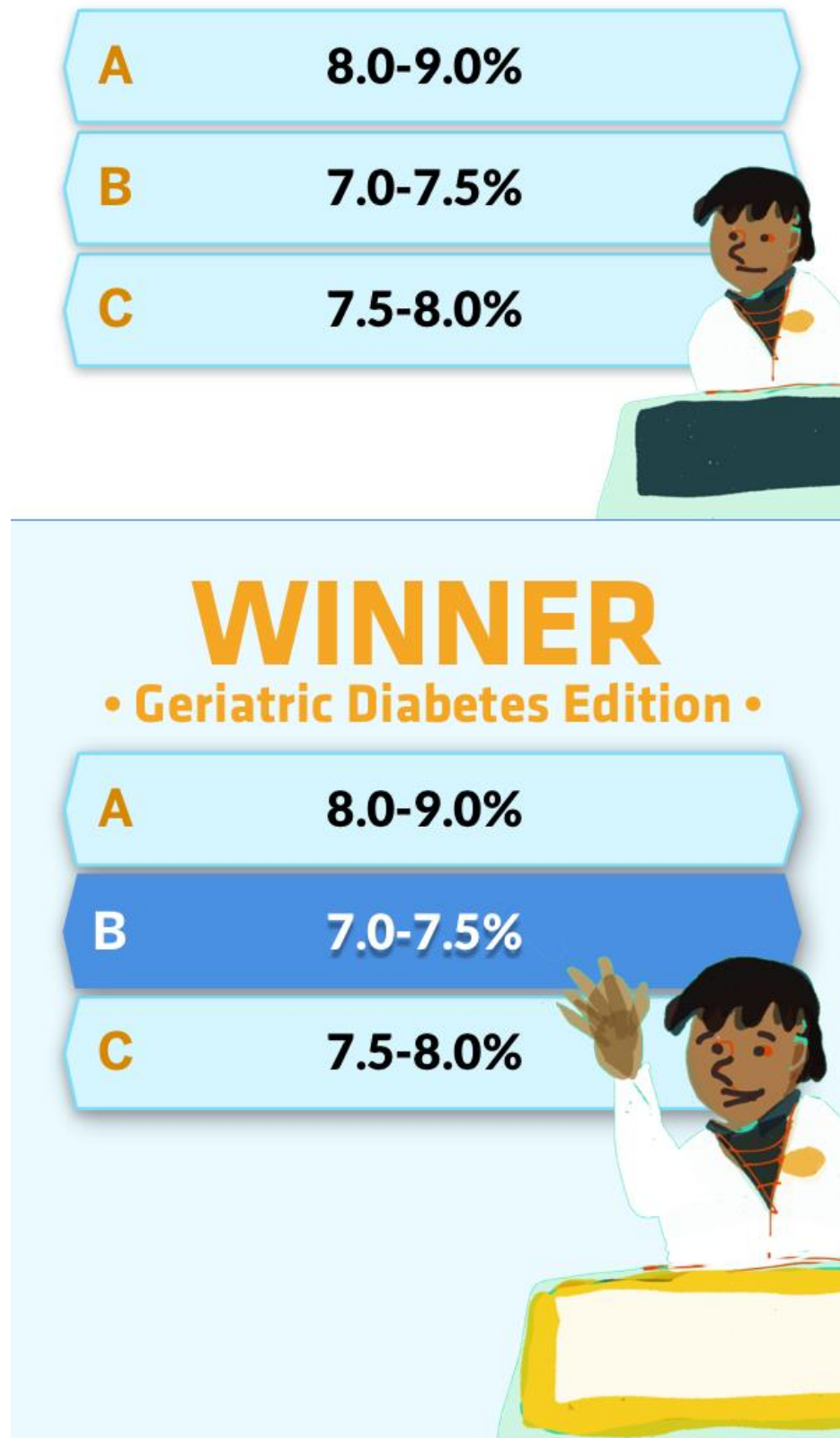
A NATIONAL
CAMPAIGN TO
REDUCE
OVERTREATMENT

What is
Choosing
Wisely?



WINNER!

Figure A.3.6C: Static images of three versions of the *Who Wants to be a Millionaire* Campaign.



A 8.0-9.0%

B 7.0-7.5%

C 7.5-8.0%



WINNER

• Geriatric Diabetes Edition •

A 8.0-9.0%

B 7.0-75%

C 7.5-8.0%



| | |
|----------|-----------------|
| A | 8.0-9.0% |
| B | 7.0-7.5% |
| C | 7.5-8.0% |



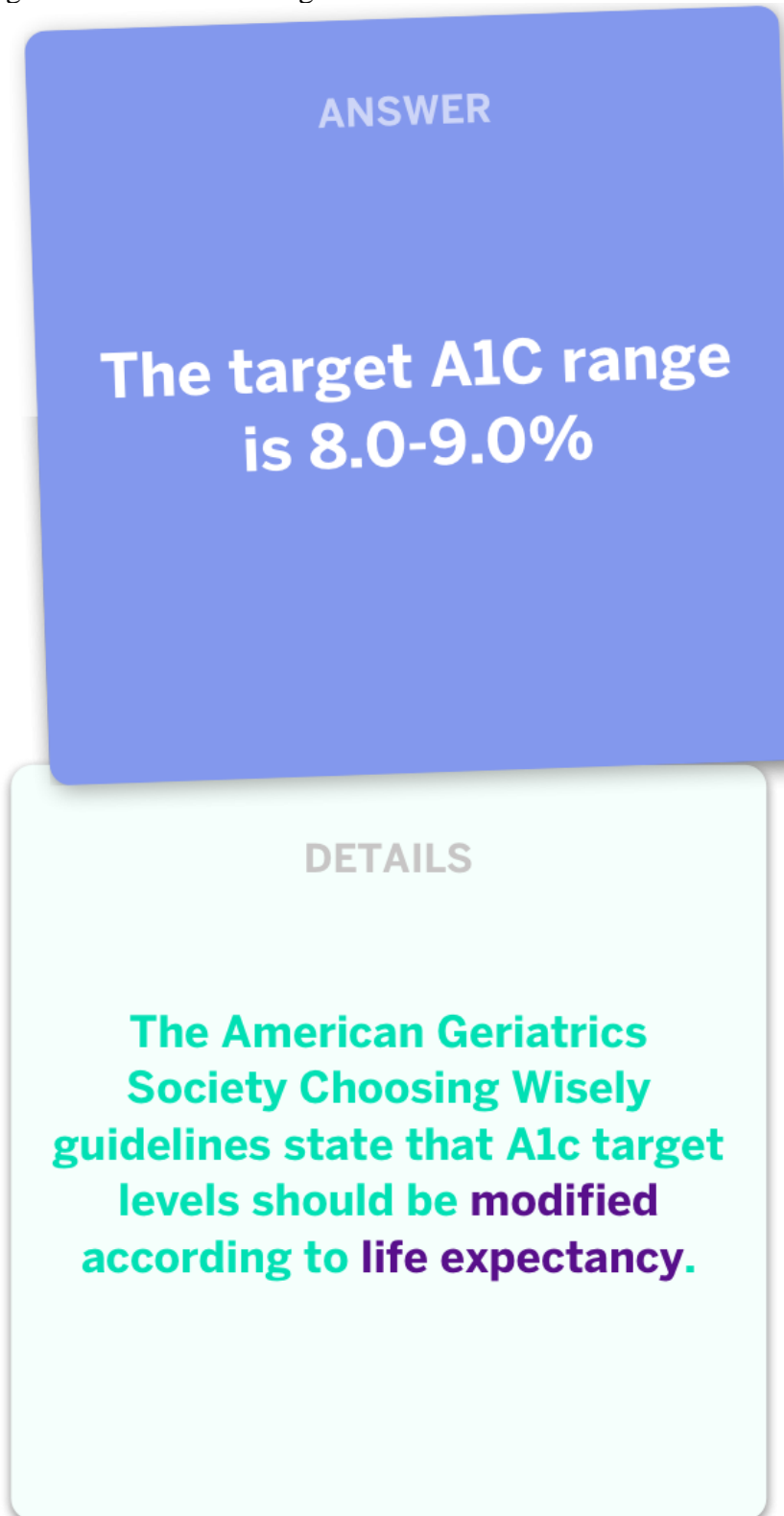
WINNER

• Geriatric Diabetes Edition •

| | |
|----------|-----------------|
| A | 8.0-9.0% |
| B | 7.0-7.5% |
| C | 7.5-8.0% |



Figure A.3.6D: Static images of three versions of the *Flashcard* Campaign.



ANSWER

Using the same A1c targets that are used for younger patients with diabetes

DETAILS

The American Geriatrics Society Choosing Wisely guidelines state that A1c target levels should be modified according to life expectancy.

ANSWER

Metformin!

DETAILS

Metformin is the recommended first line of medication even among older adults with diabetes

Section A.4. Dissemination Schedule and Frequency of Nudge #6 (Campaign):

Table A.4.1: Frequency of providers who received each of the Campaign nudges and their stratification by Campaign version and practice location.

| | Dissemination Date | 4-8-19 | 5-6-19 | 6-27-19 | 7-18-19 | 8-15-19 | 9-26-19 | 10-31-19 |
|-----------|-------------------------|------------------------|------------------|---------------------------------------|-------------------|------------------------|------------------|---------------------------------------|
| SCHEDULE | Campaign Version | <i>Price is Right™</i> | <i>Jeopardy™</i> | <i>Who Wants to Be a Millionaire™</i> | <i>Flashcards</i> | <i>Price is Right™</i> | <i>Jeopardy™</i> | <i>Who Wants to Be a Millionaire™</i> |
| FREQUENCY | # of Providers | 66 | 65 | 67 | 67 | 67 | 67 | 67 |
| VERSION | 1 | 20 | 22 | 23 | 14 | 23 | 20 | 18 |
| | 2 | 19 | 14 | 20 | 27 | 23 | 12 | 20 |
| | 3 | 27 | 14 | 24 | 26 | 21 | 16 | 29 |
| | 4 | N/A | 15 | N/A | N/A | N/A | 19 | N/A |
| LOCATION | Vanguard 1 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| | Vanguard 2 | 25 | 24 | 26 | 26 | 26 | 26 | 26 |
| | Pilot 1 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| | Pilot 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | Pilot 3 | 13 | 13 | 13 | 13 | 13 | 13 | 13 |

Section A.5. Life Expectancy Algorithm Explanation:

The algorithm below uses information, including a patient’s age, gender, and both the number and severity of comorbidities, to categorize individuals into low, medium, and high life expectancy categories. The weight assigned to each comorbidity was determined using hazard ratios that were calculated in Quan et al. 2011,³⁹ an update to the Charlson weights.³⁸ The types of comorbidities included in the algorithm and their respective weights can be found in Table 2 of Quan et al. 2011,³⁹ and are listed below for convenience:

Table A.5.1: Comorbidity weights as produced by Quan et al. 2011.³⁹

| Comorbidity: | Weight: |
|---|----------------|
| Myocardial infarction | 0 |
| Congestive heart failure | 2 |
| Peripheral vascular disease | 0 |
| Cerebrovascular disease | 0 |
| Dementia | 2 |
| Chronic pulmonary disease | 1 |
| Rheumatologic disease | 1 |
| Peptic ulcer disease | 0 |
| Mild liver disease | 2 |
| Diabetes without chronic complications | 0 |
| Diabetes with chronic complications | 1 |
| Hemiplegia or paraplegia | 2 |
| Renal disease | 1 |
| Any malignancy, including leukemia and lymphoma | 2 |
| Moderate or severe liver disease | 4 |
| Metastatic solid tumor | 6 |
| AIDS/HIV | 4 |

Using these comorbidity weights, along with the patient’s age and gender, a total score is calculated that places individuals into low, medium, and high life expectancy categories. Using research results presented by gender in Table 2 of DuGoff et al. 2014,⁴⁰ scoring thresholds were selected for the three life expectancy categories such that low life expectancy is between 0 and 3 years, medium life expectancy is greater than 3 years up to 10 years, and high life expectancy is

greater than 10 years. These life expectancy ranges were selected to align with the *Choosing Wisely* recommendations. Pseudocode for the full life expectancy algorithm is presented below:

Part I: This section of the algorithm applies an age correction

```
if age = 70-79
    age_score = 3
else if age = 80-89
    age_score = 4
else if age = 90-99
    age_score = 5
else if age = 100-109
    age_score = 6
else if age = 110-119
    age_score = 7
end
```

Part II: This section of the algorithm adds the comorbidity weights to the age scores

count_0 = number of comorbidities from the following set {myocardial infarction, peripheral vascular disease, cerebrovascular disease, peptic ulcer disease, diabetes without chronic complications}

count_1 = number of comorbidities from the following set {chronic pulmonary disease, rheumatologic disease, diabetes with chronic complications, renal disease}

count_2 = number of comorbidities from the following set {congestive heart failure, dementia, mild liver disease, hemiplegia or paraplegia, any malignancy including leukemia and lymphoma}

count_4 = number of comorbidities from the following set {moderate or severe liver disease, AIDS/HIV}

count_6 = number of comorbidities from the following set {metastatic solid tumor}

score = 0*count_0 + 1*count_1 + 2*count_2 + 4*count_4 + 6*count_6 + age_score

Part III: Finally, this section uses the total score to calculate life expectancy by gender

if Female,

 if score = 3 to 6,

 Life Expectancy -> 10+ years

 else if score = 7 to 12,

 Life Expectancy -> 3+ to 10 years

 else if score > 12,

 Life Expectancy -> 0 to 3 years

End

if Male,

 if score = 3 to 5,

 Life Expectancy -> 10+ years

 else if score = 6 to 10,

 Life Expectancy -> 3+ to 10 years

 else if score > 10,

 Life Expectancy -> 0 – 3 years

end

Section A.6. List of Abbreviations (in order of appearance in the main text):

LE = Life Expectancy

ABIM = American Board of Internal Medicine

CW = Choosing Wisely

AGS = American Geriatrics Society

BE = Behavioral Economics

EHR = Electronic Health Record

BE-EHR = Behavioral Economic Electronic Health Record

NYULH = New York University Langone Health

eGFR = estimated glomerular filtration rate

HbA1c = Hemoglobin A1c

Section A.7. Definitions of Behavioral Economics Principles:

Accountable justification: decreasing a person's intrinsic interest as a result of engaging in an activity as a means to an extrinsic goal; typically some form of acknowledgement

Affirmation: positive encouragement resulting in individuals experiencing less distress or reacting less defensively when confronted with information that contradicts their values or beliefs

Competition: individuals will work hard to achieve a goal or "win"

Defaults: options that are pre-set courses of action that take effect if nothing is specified by the decision maker;²⁸ provides individuals with a cognitive shortcut, avoiding complex decisions

Emotional appeal: the risk-as-feelings hypothesis^{A1} considers emotions as an anticipatory factor when making decisions under risk or uncertainty

Framing: Choices can be presented such that they highlight the positive or negative aspects of a decision, leading to changes in their attractiveness

Gamification: use of game elements to provide appeal, engagement, positive reinforcement, or motivation

Social norms: signals of appropriate behavior, or classifications of behavioral expectations or rules within a group of people

Suggesting alternatives: individuals are drawn towards making the simplest decision, often ignoring other cues.^{A2} Here the time and process of making complex decisions is reduced by suggesting alternatives in economic favor of the individual

Appendix-Only References:

- A1. Loewenstein GF, Weber EU, Hsee CK, Welch N. Risk as feelings. *Psychol Bull.* 2001; 127(2): 267-86.
- A2. Gigerenzer G, Gaissmaier. Heuristic decision making. *Annu Rev Psychol.* 2011; 62:451-82.
- A3. Samson A. *The Behavioral Economics Guide 2019* (with an Introduction by Uri Gneezy). 2019; Retrieved from <https://www.behavioraleconomics.com>.