Making Numbers Meaningful: Goal-directed communication with numbers

Jessica S Ancker, MPH, PhD
Weill Cornell Medical College

Brian J Zikmund-Fisher, PhD
University of Michigan

Poll questions for workshop participants

Which seems worse?

a. A risk of 0.1%

b. A risk of 1 in 1000

Poll questions for workshop participants

Which seems worse?

a. A disease affecting 100 of every 100,000 people

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Which pill would you prefer?

a. One with rare side effects

b. One with a 2% chance of side effects

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Which surgery would you choose?

a. One with a 90% chance of succeeding
b. One with a 10% chance of failing

Poll questions for workshop participants

Which lab finding would make you more worried?

a.

Test	Your Result	Standard Range	Units
Platelet Count (PLT)	135	150-400	$x10^9/L$

b.

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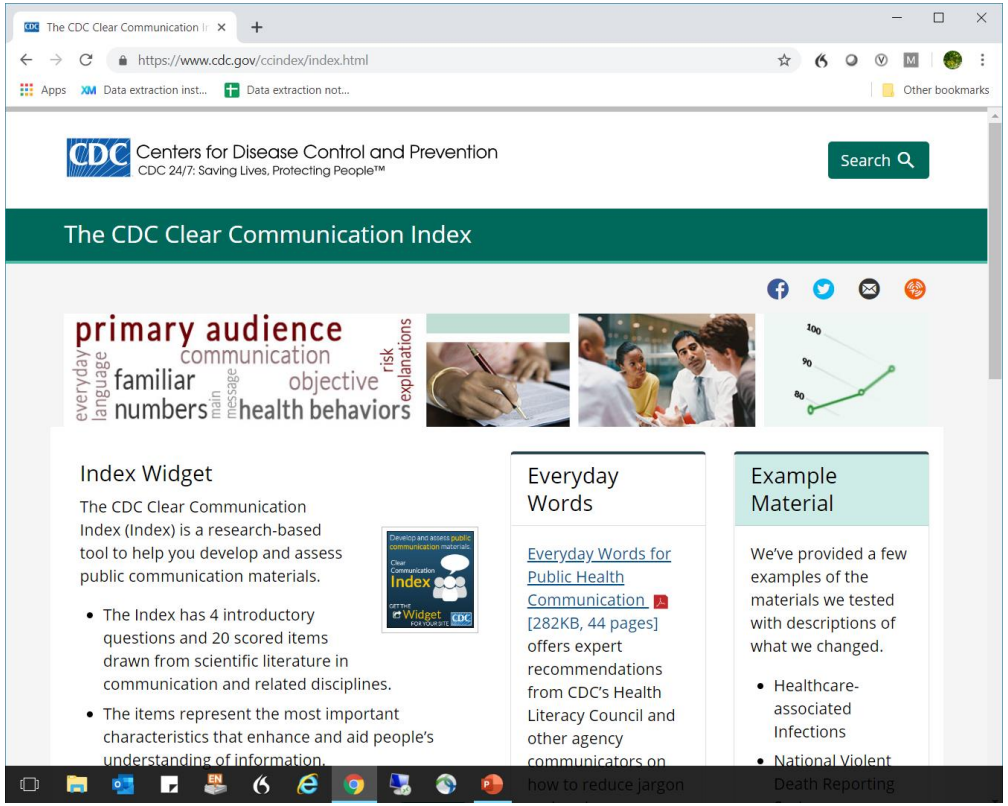
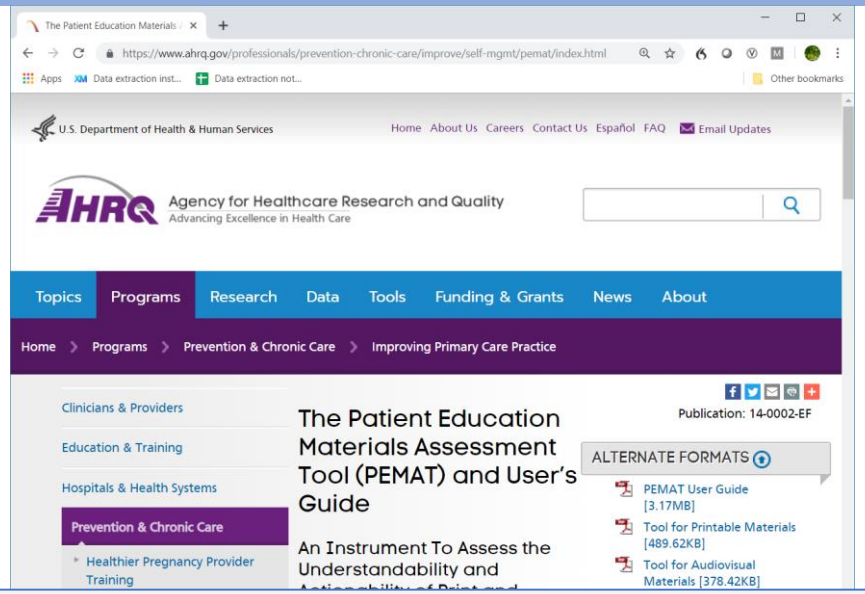
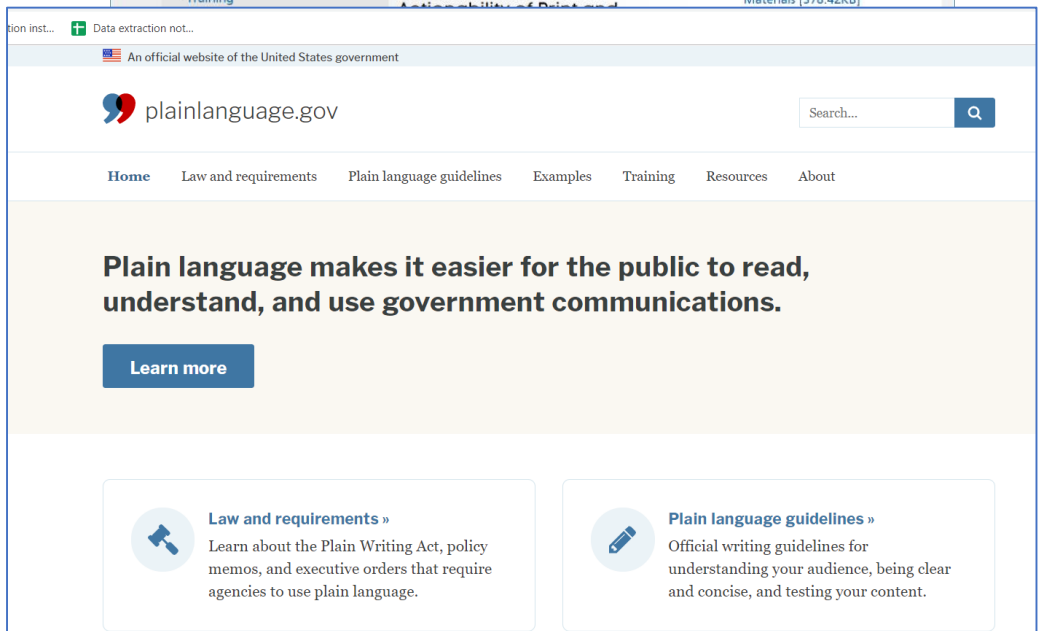
b.

If you want to access the evidence about how to write clearly, you have lots of resources

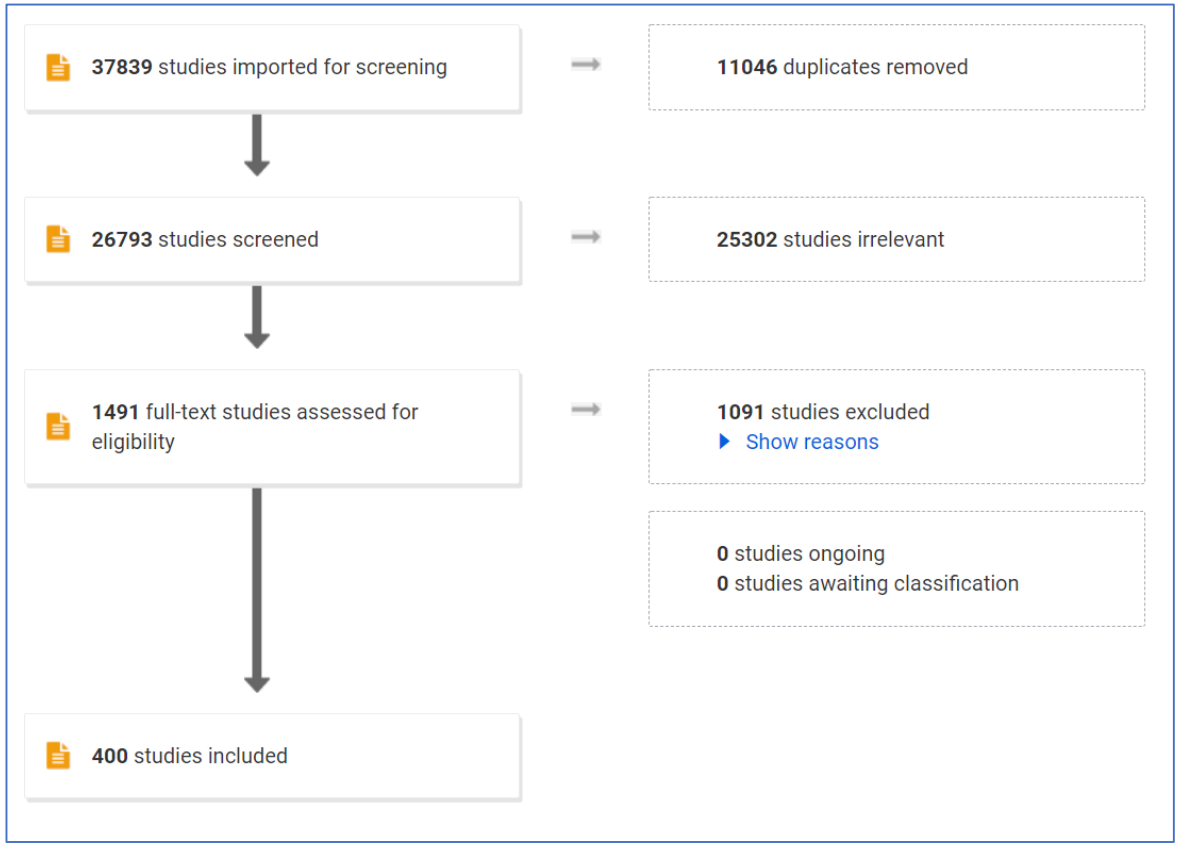






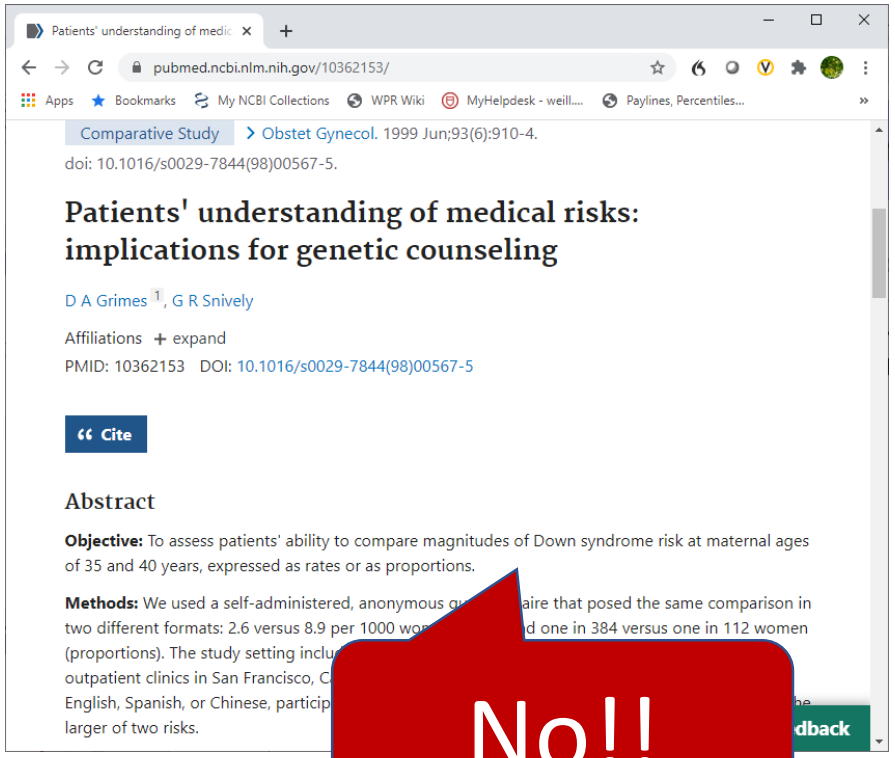
But there's nothing comparable for numbers

We are a multidisciplinary team of researchers addressing this gap by synthesizing the vast research literature on communicating numbers

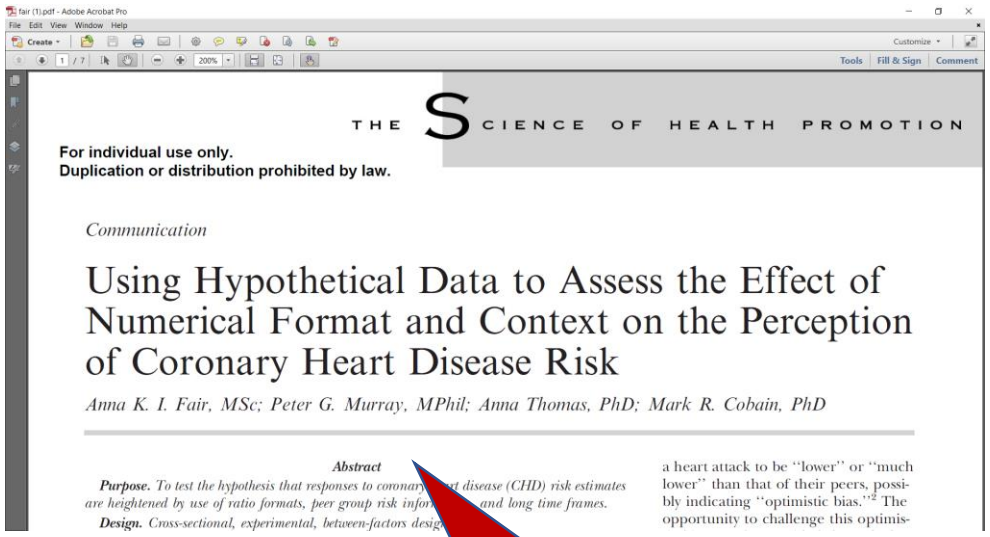


But we kept finding research that celebrated and opposed the same thing!

Research question: Should we describe a risk as a 1 in X chance?



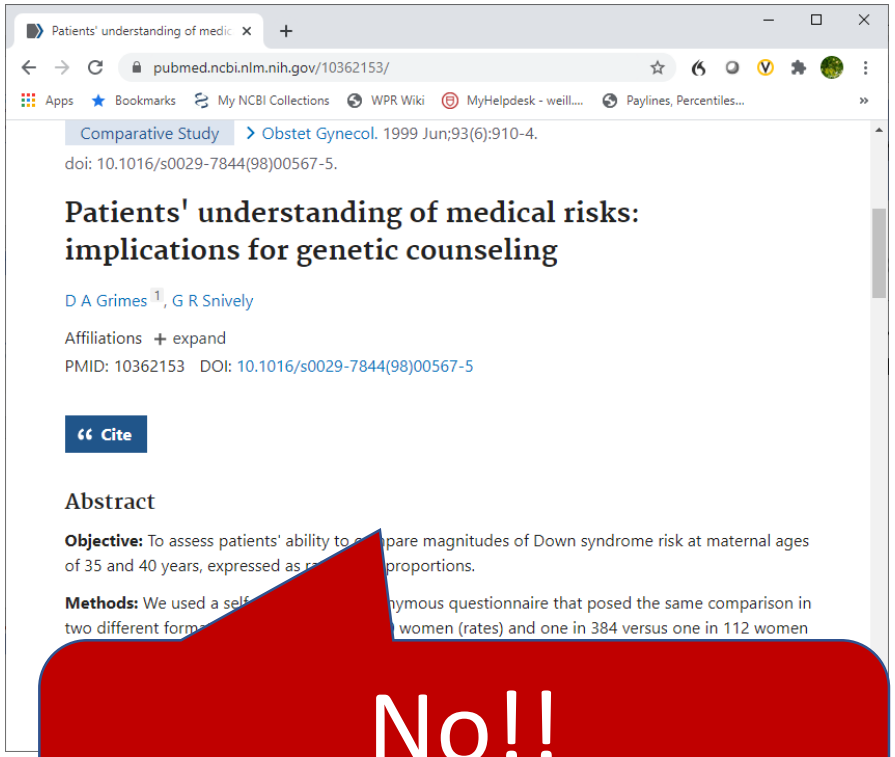
No!!



Yes!!

A key concept that helped make sense of these contradictions was the **goal of the communication**

Research question: Should we describe a risk as a 1 in X chance?



Patients' understanding of medic

pubmed.ncbi.nlm.nih.gov/10362153/

Apps Bookmarks My NCBI Collections WPR Wiki MyHelpdesk - weill.... Paylines, Percentiles...

Comparative Study Obstet Gynecol. 1999 Jun;93(6):910-4.

doi: 10.1016/s0029-7844(98)00567-5.

Patients' understanding of medical risks: implications for genetic counseling

D A Grimes [1], G R Snively

Affiliations + expand

PMID: 10362153 DOI: 10.1016/s0029-7844(98)00567-5

Cite

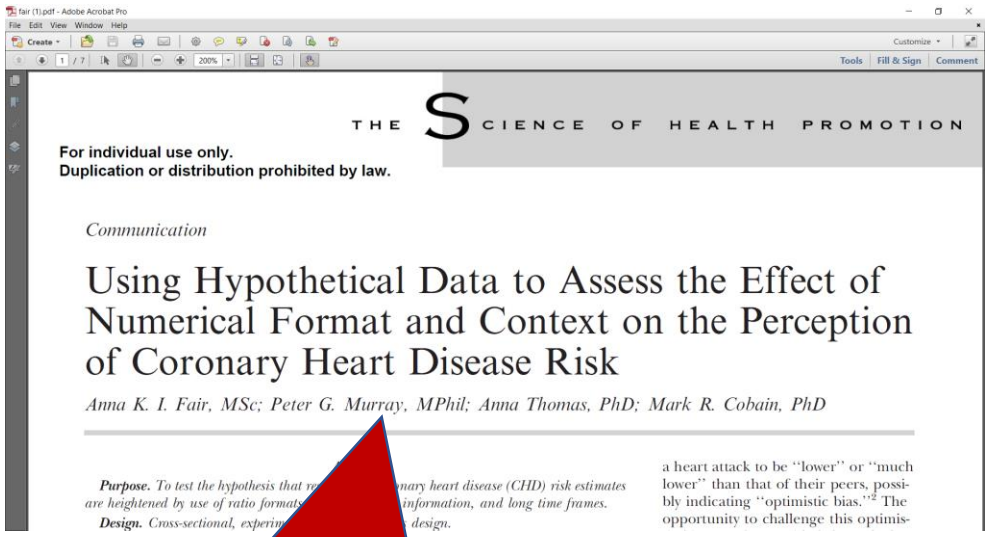
Abstract

Objective: To assess patients' ability to [illegible]pare magnitudes of Down syndrome risk at maternal ages of 35 and 40 years, expressed as r[illegible] proportions.

Methods: We used a self[illegible]nymous questionnaire that posed the same comparison in two different forma[illegible] women (rates) and one in 384 versus one in 112 women

No!!

If you want your reader to be able to compare 2 risks and tell which is bigger



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Communication

Using Hypothetical Data to Assess the Effect of Numerical Format and Context on the Perception of Coronary Heart Disease Risk

Anna K. I. Fair, MSc; Peter G. Murray, MPhil; Anna Thomas, PhD; Mark R. Cobain, PhD

Purpose. *To test the hypothesis that r[illegible]nary heart disease (CHD) risk estimates are heightened by use of ratio format[illegible] information, and long time frames.*

Design. *Cross-sectional, experim[illegible] design.*

a heart attack to be "lower" or "much lower" than that of their peers, possibly indicating "optimistic bias."[2] The opportunity to challenge this optimis-

Yes!!

If you want your reader to feel *more concerned* about a risk

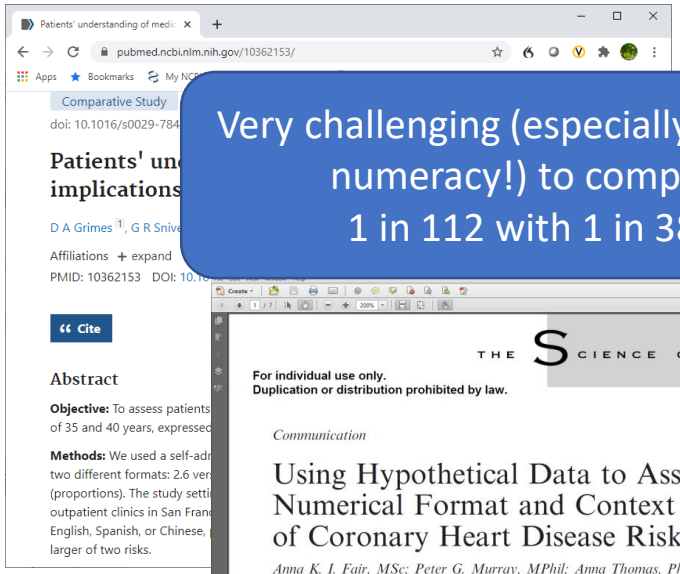
There are **multiple possible outcomes** we might want from our number communication

- We might want people to be able to…
  - Remember the number
  - Have a feeling about how large or small the number is
  - Feel good or bad about that number
  - Be able to categorize the number (high, medium, low...)
  - Be able to compare numbers (above/below, similar/different)
  - Be motivated by the numbers to act (or not act)

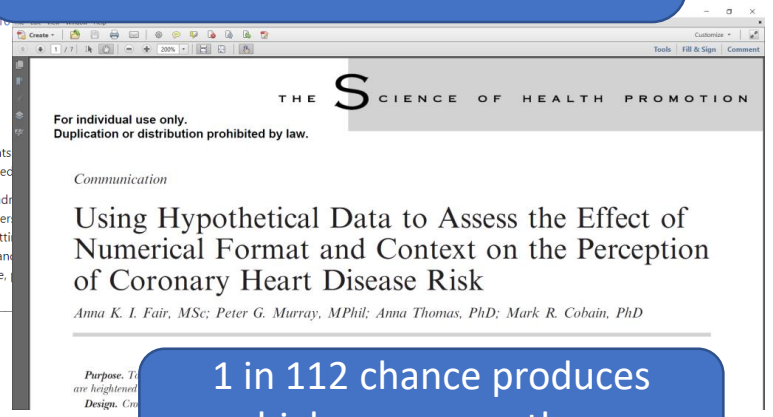
Our Advice:
First: identify the goal of your communication.
Then: select numbers to match.

- Some of the most common goals:
  - To inform
  - To persuade or motivate behavior change

- Other goals may include:
  - To increase credibility of the information
  - To increase engagement with the information
  - To make the information memorable



Very challenging (especially with low numeracy!) to compare
1 in 112 with 1 in 384



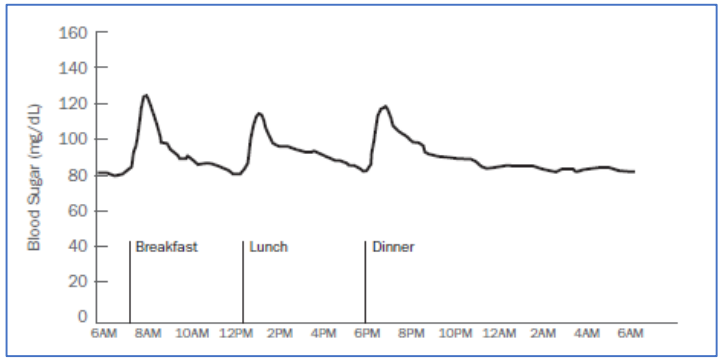
1 in 112 chance produces higher concern than 0.8% chance

The type of data matters, too

We may want to discuss:

- One data point at one time
- A comparison between 2 data points
- A trend over time
- …

Among smokers, the risk is 20%
Among non-smokers, the risk is 4%



So we are coming up with guidance that looks a bit like this

Type of data	Goal				
	To raise or lower concern	To promote behavior change	To facilitate comparison	To make memorable	....etc.
Single data point					
Two data points					
Trend					
... etc					

Some examples based on your earlier answers

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b.

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Which seems worse?

a. A risk of 0.1%
b. A risk of 1 in 1000

Risks shown as 1 in X are more concerning and lead to stronger behavioral intentions than risks shown as % or as X*N in N

Which seems worse?

a. A disease affecting 100 of every 100,000 people
b. A disease affecting 1 of every 1000 people

Psychologically:

0.1% < 1 in 1000

and

100 in 100,000 < 1 in 1000

What is your goal? To increase concern? Or to reduce it?

Poll questions for workshop participants

Which pill would you prefer?

a. One with rare side effects
b. One with a 2% chance of side effects

Risks described as “rare” are more concerning than risks described as having a 1% chance or less

Risks described as “common” are more concerning than risks described as having 20% chance

Psychologically:

“rare” > 1% chance

“common” > 20%

What is your goal? To increase concern? Or to reduce it?

Poll questions for workshop participants

Options described in the positive frame (chance of success) appear more appealing than options described in the negative frame (chance of failing)

Which surgery would you choose?

a. One with a 90% chance of succeeding
b. One with a 10% chance of failing

People with low numeracy are more strongly affected than people with high numeracy

Psychologically:

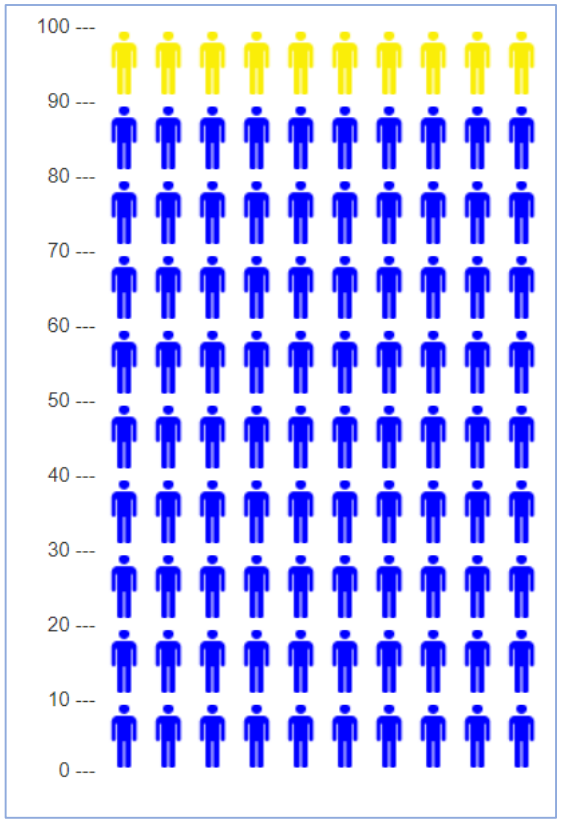
90% chance of success > 10% chance of failure

What is your goal? To promote one of the options? Or to provide a balance?

The evidence suggests

Framing both ways also helps balance perceptions

- The surgery has a 90% chance of succeeding and a 10% chance of failing



Which surgery would you choose?

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b. One with a 10% chance of failing

To provide balance, adding an icon array helps draw attention to both the 10% and the 90%

Poll questions for workshop participants

Visualizing a value in context of its range as well as meaningful categories helps readers place the number in context

What is your goal? To raise concern about out-of-range values? Or lower concern about borderline values?

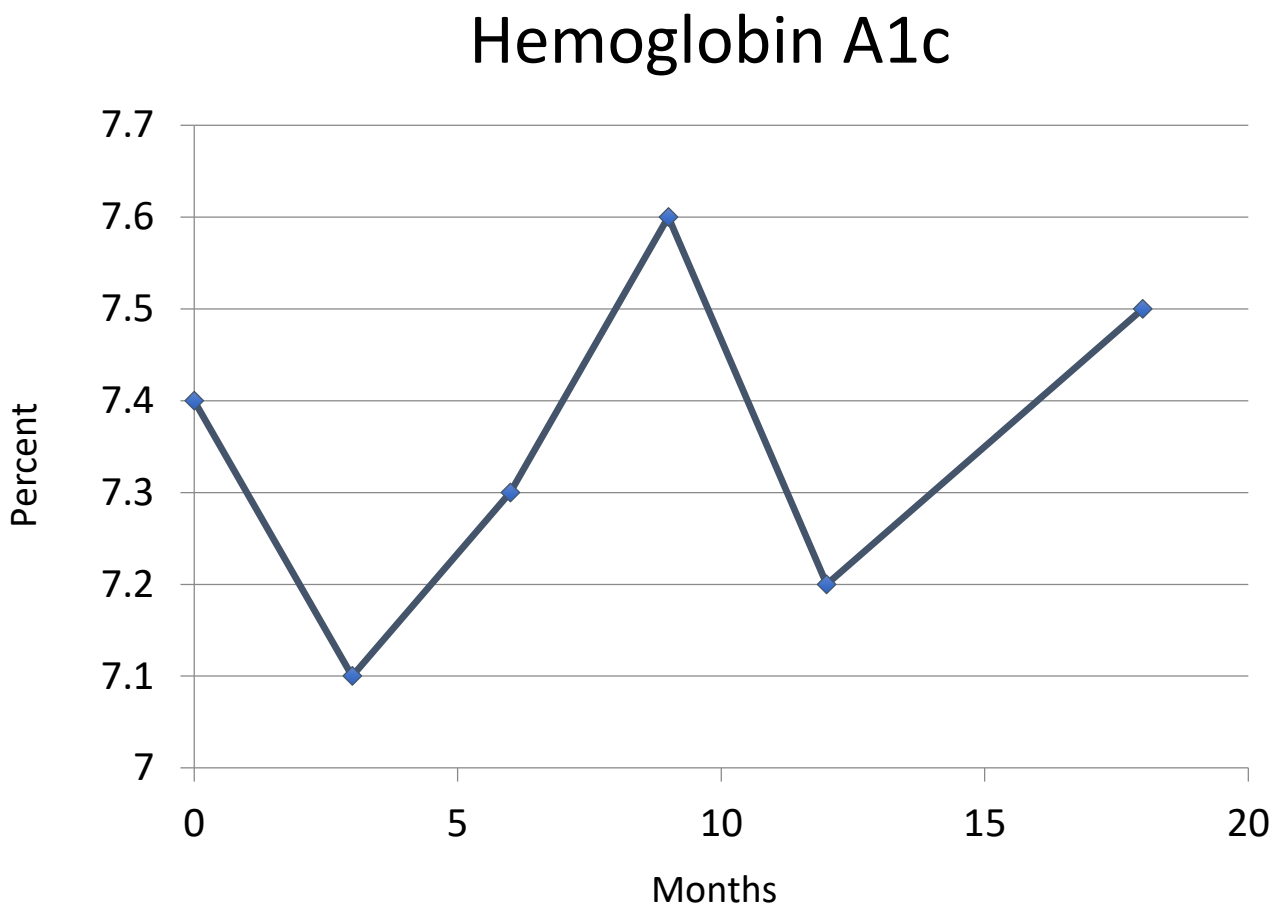
Which lab finding would make you more worried?

a.

Test	Your Result	Standard Range	Units
Platelet Count (PLT)	135	150-400	x10^9/L

b.

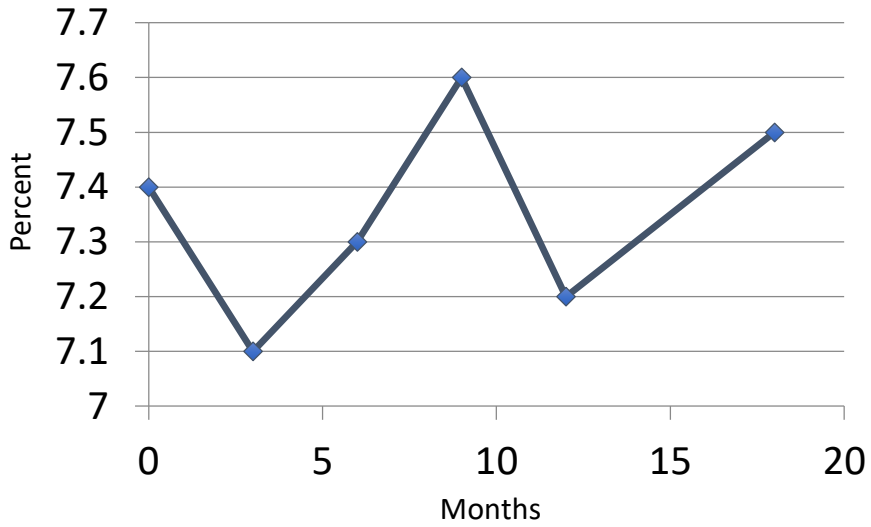
What do you take away from this graphic?



Central Message:

Varies

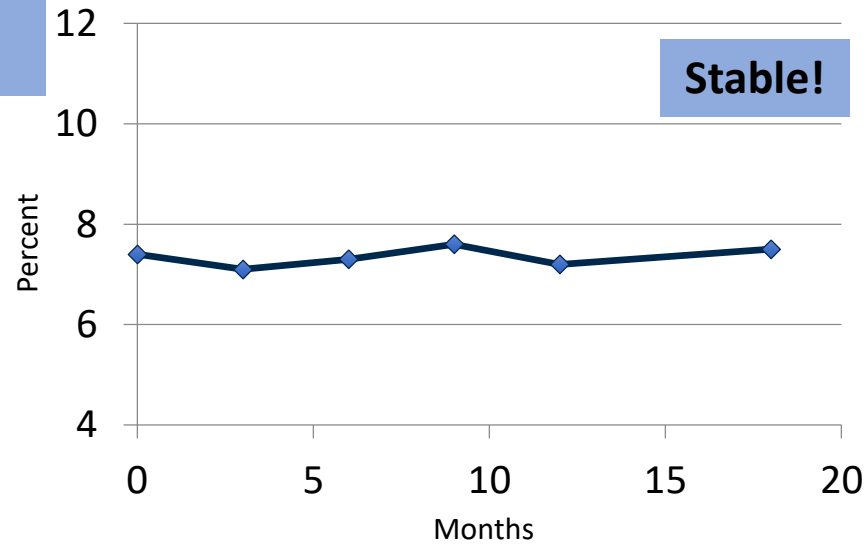
Varies!



Scaled to **data** variations

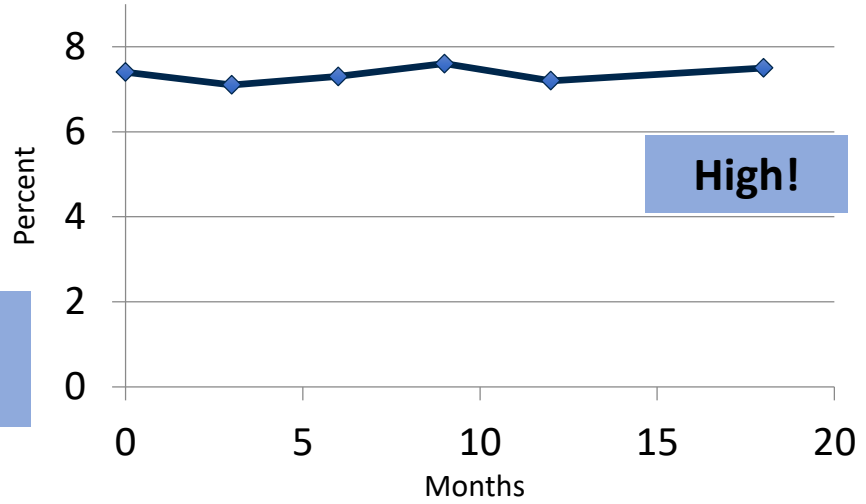
?

Scaled to **population** variations



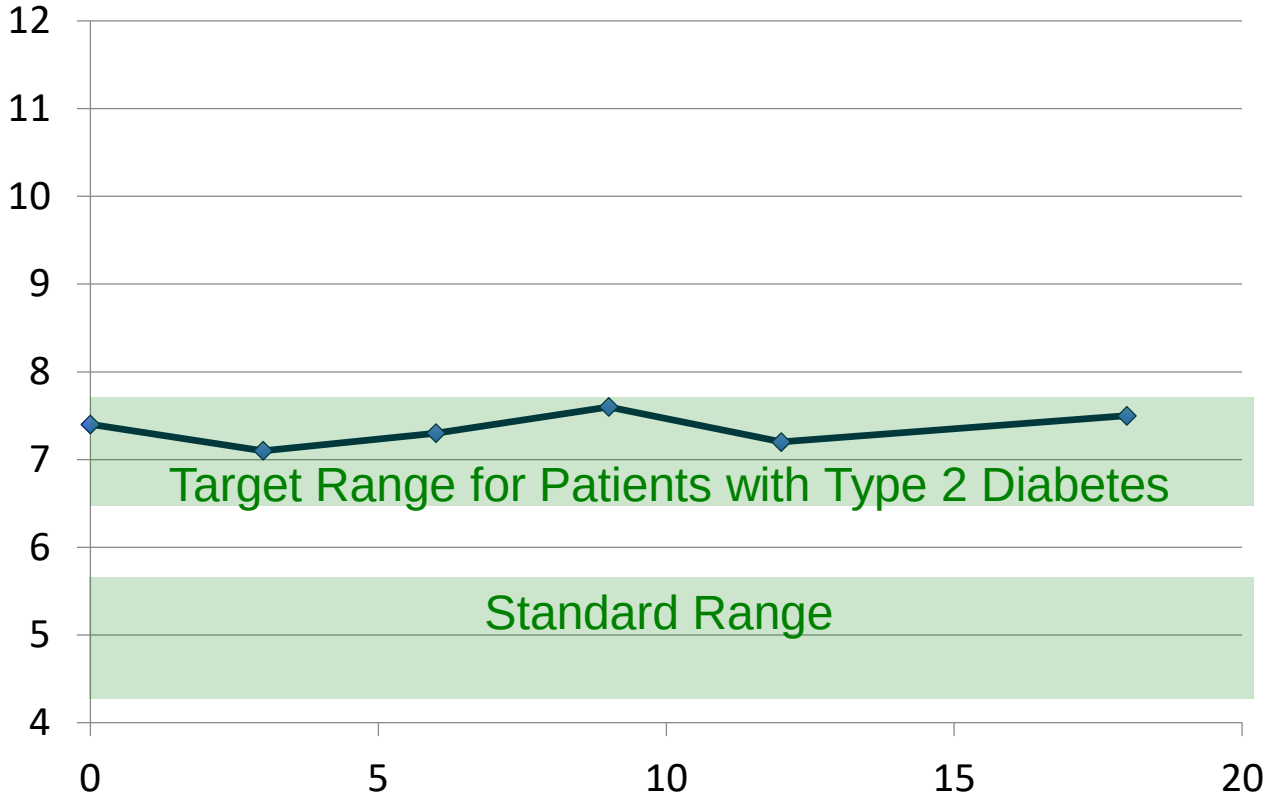
Stable!

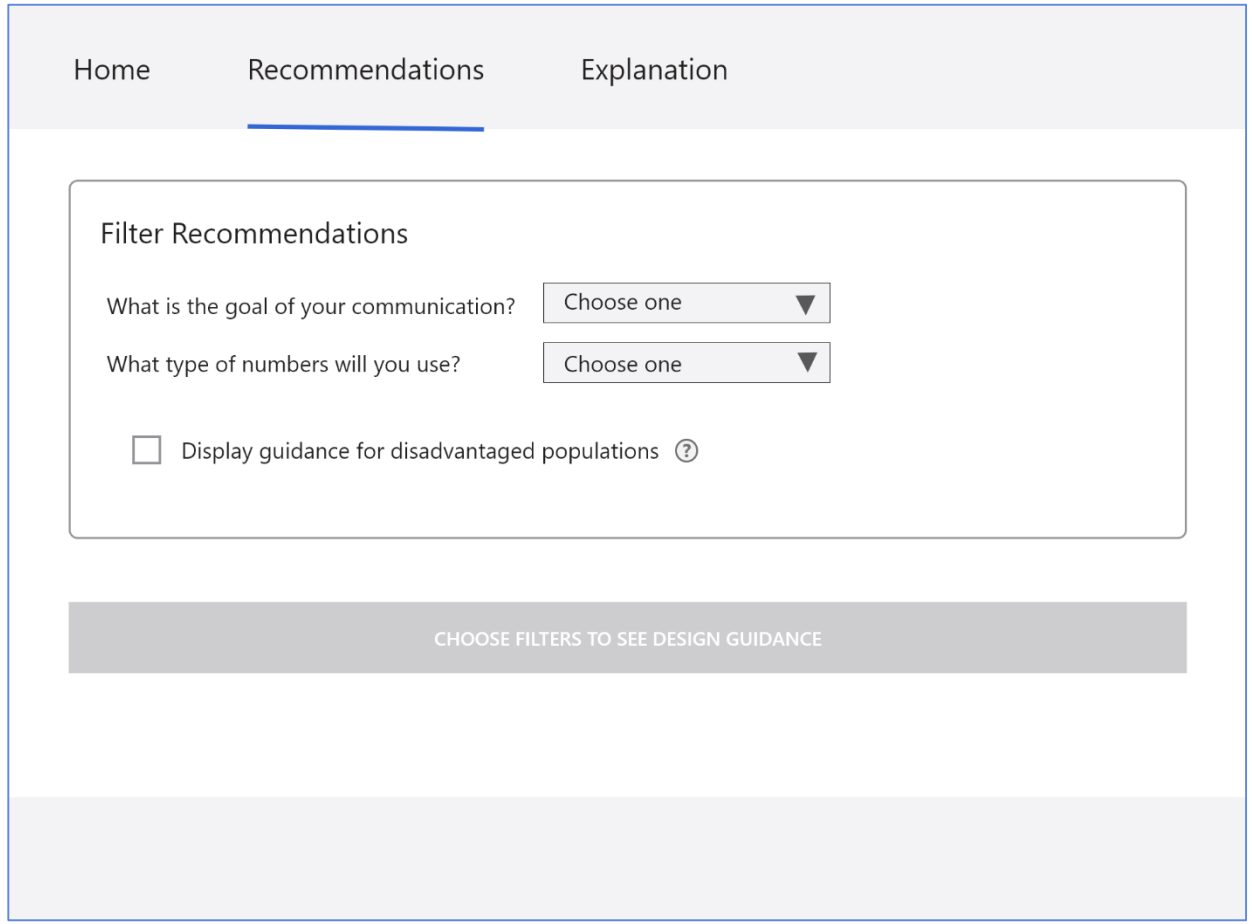
Scaled to **zero**

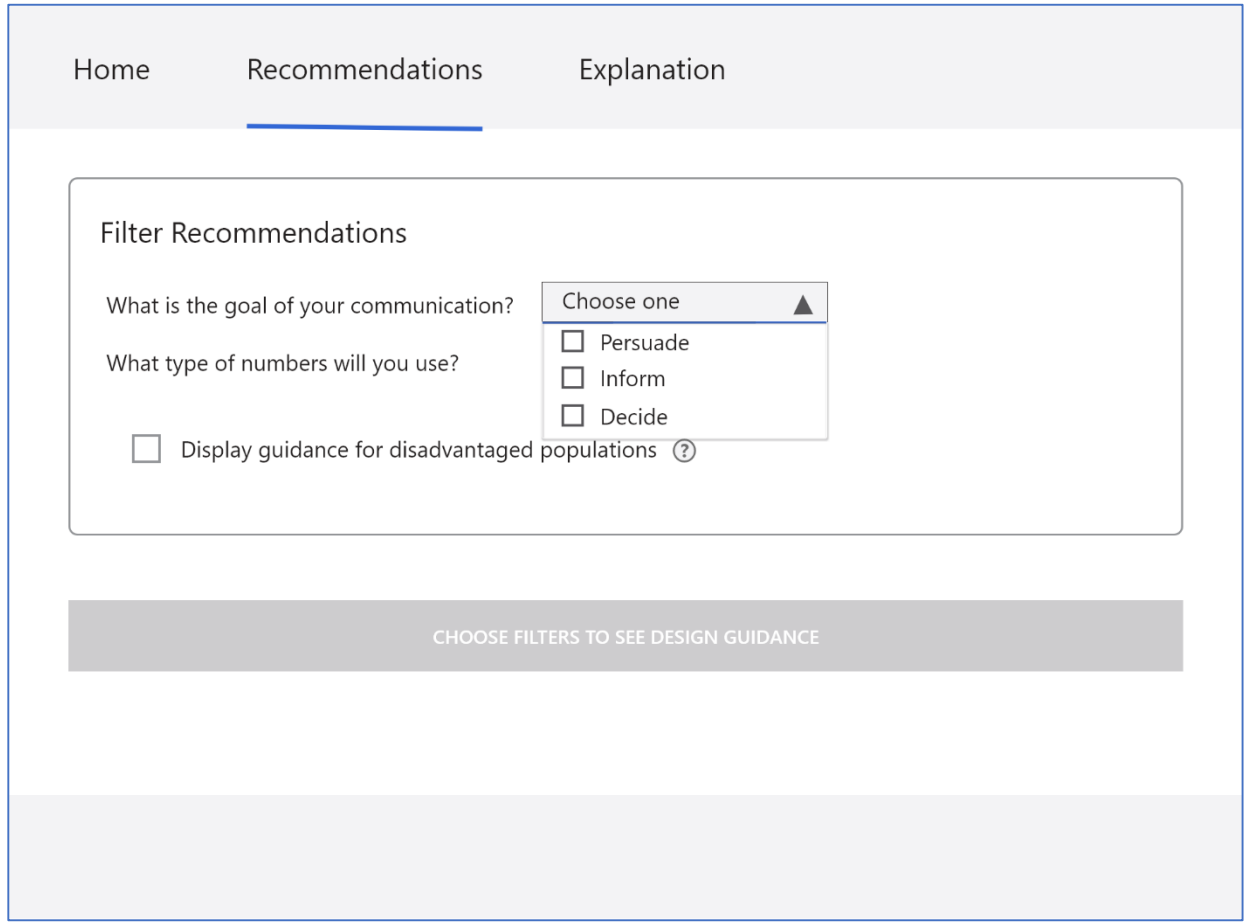


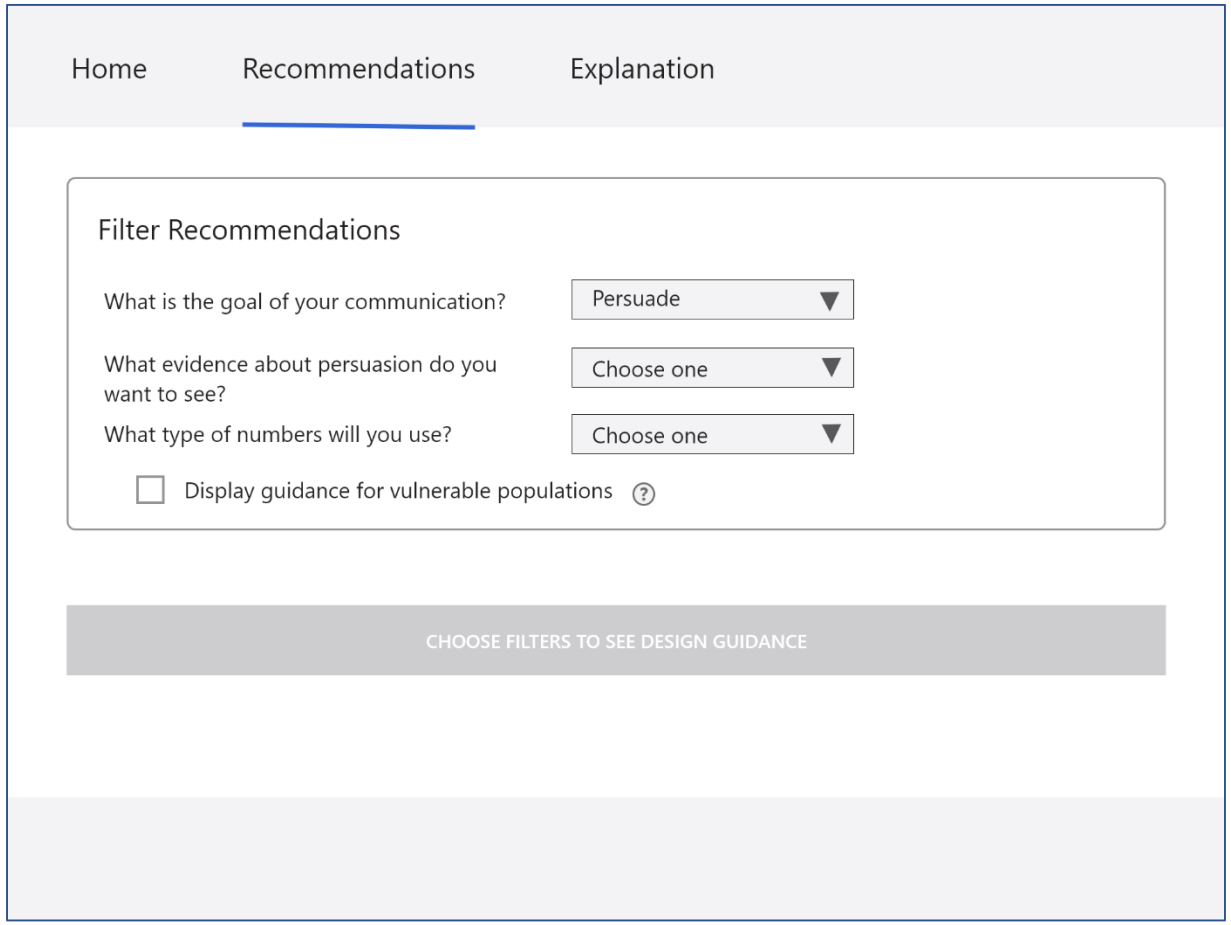
High!

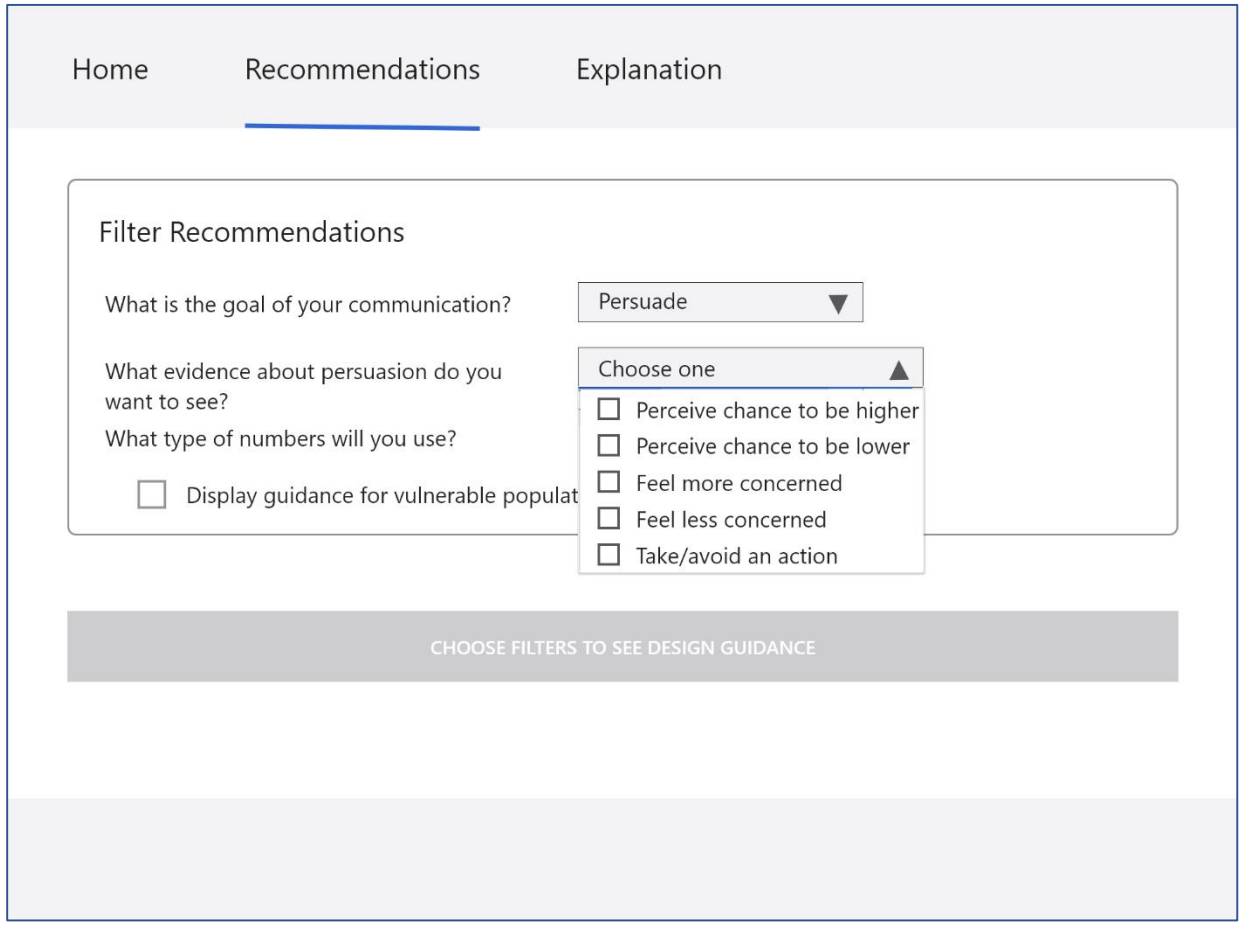
Good or Bad?

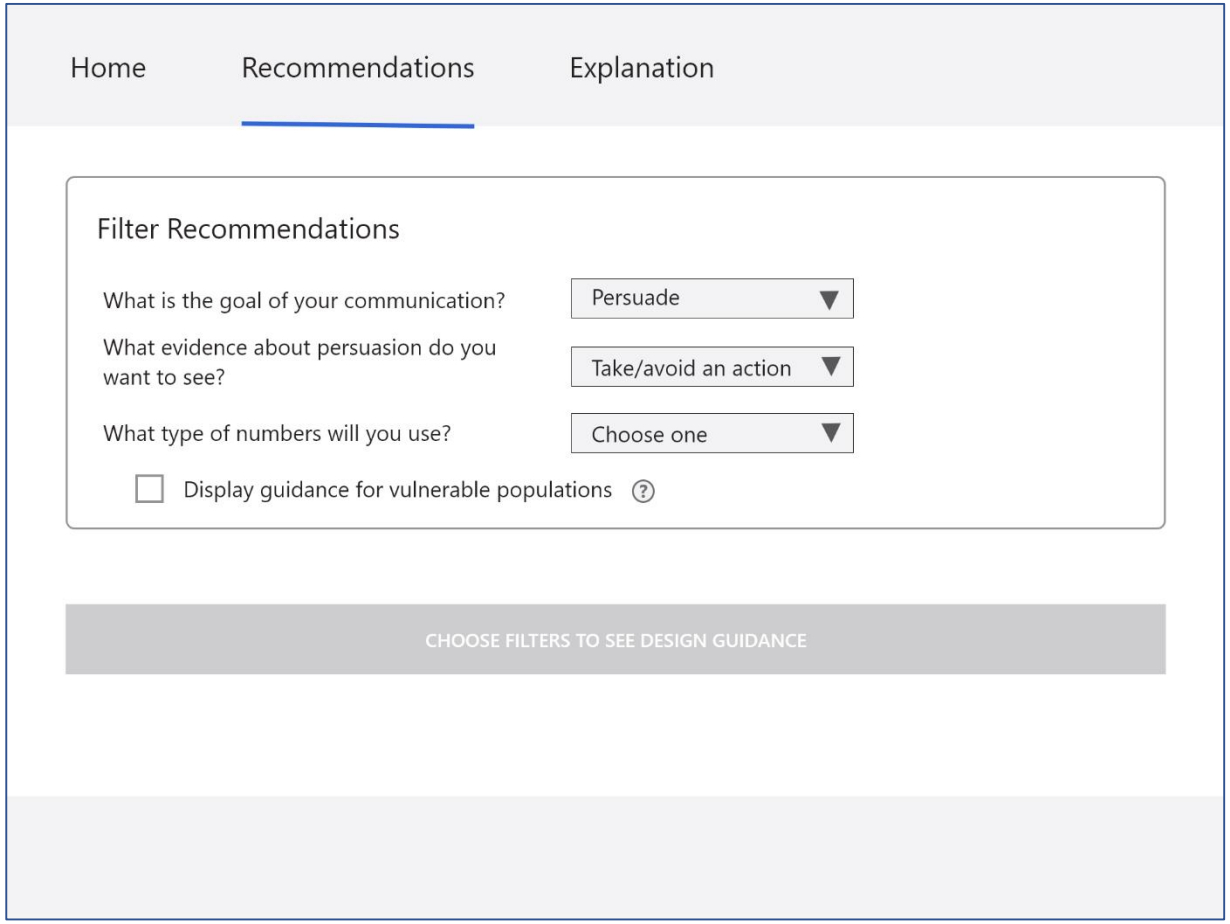

12
11
10
9
8
7
6
5
4
0
5
10
15
20
Target Range for Patients with Type 2 Diabetes
Standard Range


Home
Recommendations
Explanation
Filter Recommendations
What is the goal of your communication?
Choose one
What type of numbers will you use?
Choose one
Display guidance for disadvantaged populations
CHOOSE FILTERS TO SEE DESIGN GUIDANCE


Home
Recommendations
Explanation
Filter Recommendations
What is the goal of your communication?
Choose one
Persuade
Inform
Decide
What type of numbers will you use?
Display guidance for disadvantaged populations
CHOOSE FILTERS TO SEE DESIGN GUIDANCE


Home
Recommendations
Explanation
Filter Recommendations
What is the goal of your communication?
Persuade
What evidence about persuasion do you want to see?
Choose one
What type of numbers will you use?
Choose one
Display guidance for vulnerable populations
CHOOSE FILTERS TO SEE DESIGN GUIDANCE


Home
Recommendations
Explanation
Filter Recommendations
What is the goal of your communication?
Persuade
What evidence about persuasion do you want to see?
Choose one
Perceive chance to be higher
Perceive chance to be lower
Feel more concerned
Feel less concerned
Take/avoid an action
What type of numbers will you use?
Display guidance for vulnerable populat
CHOOSE FILTERS TO SEE DESIGN GUIDANCE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What is the goal of your communication?
Persuade
What evidence about persuasion do you want to see?
Take/avoid an action
What type of numbers will you use?
Choose one
Display guidance for vulnerable populations
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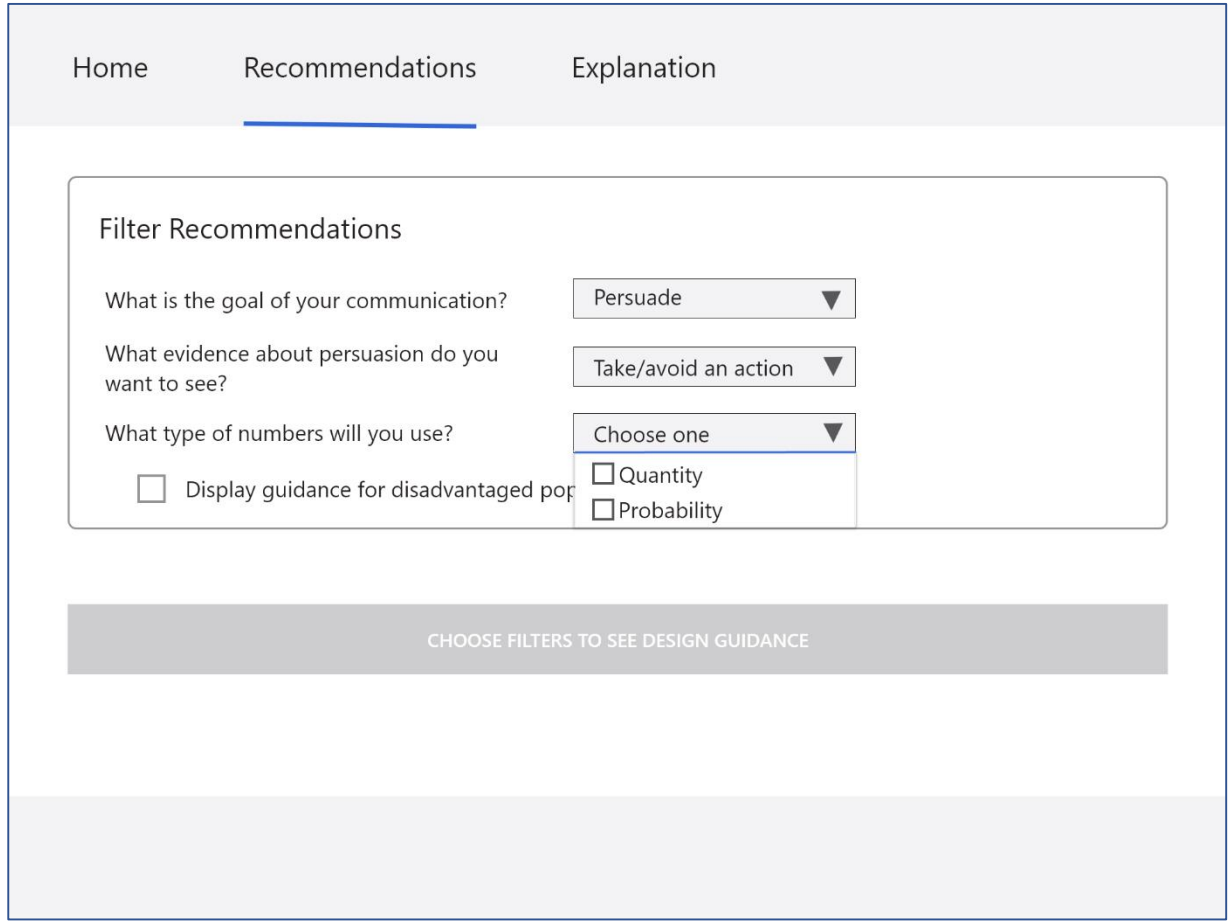
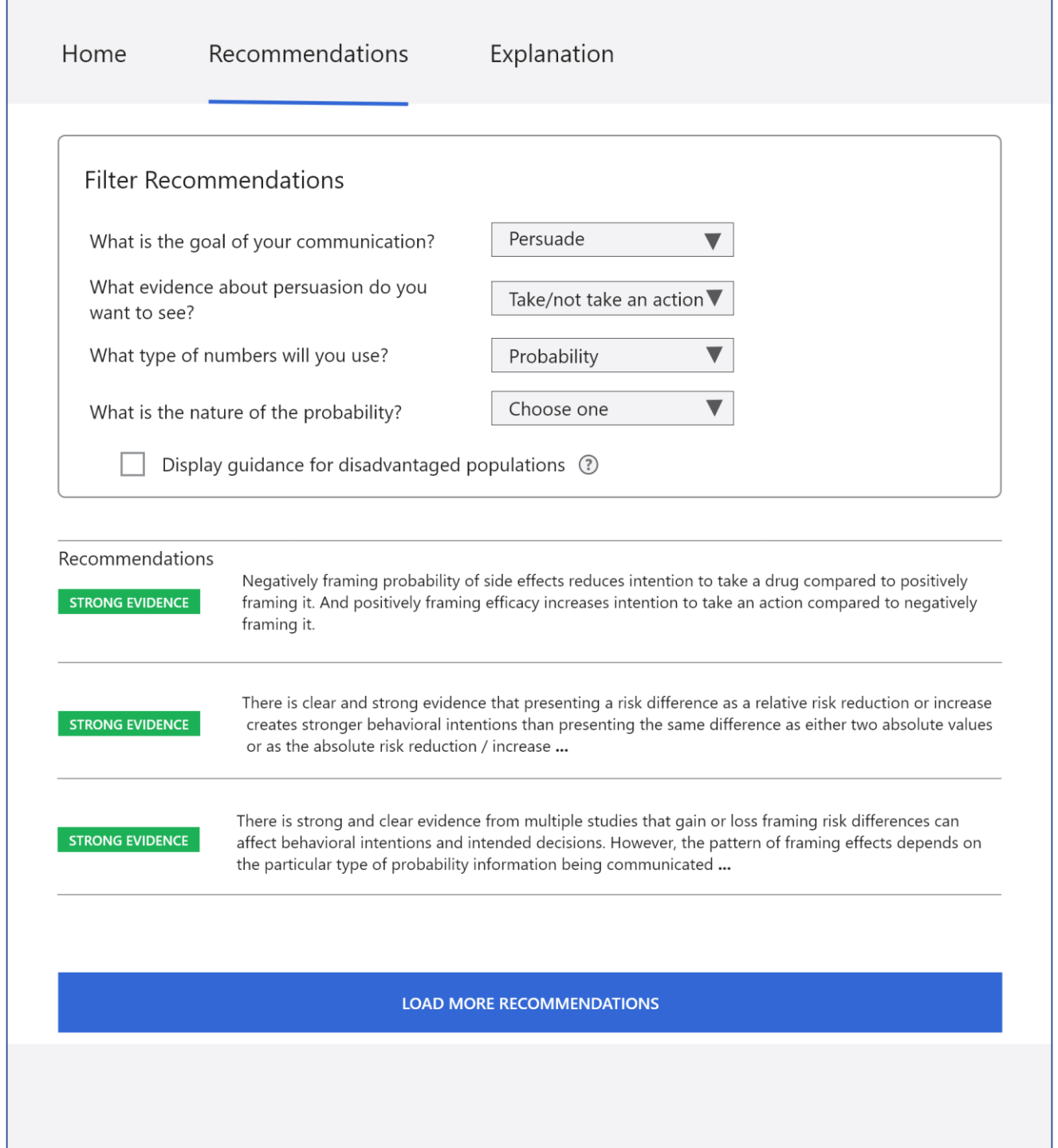
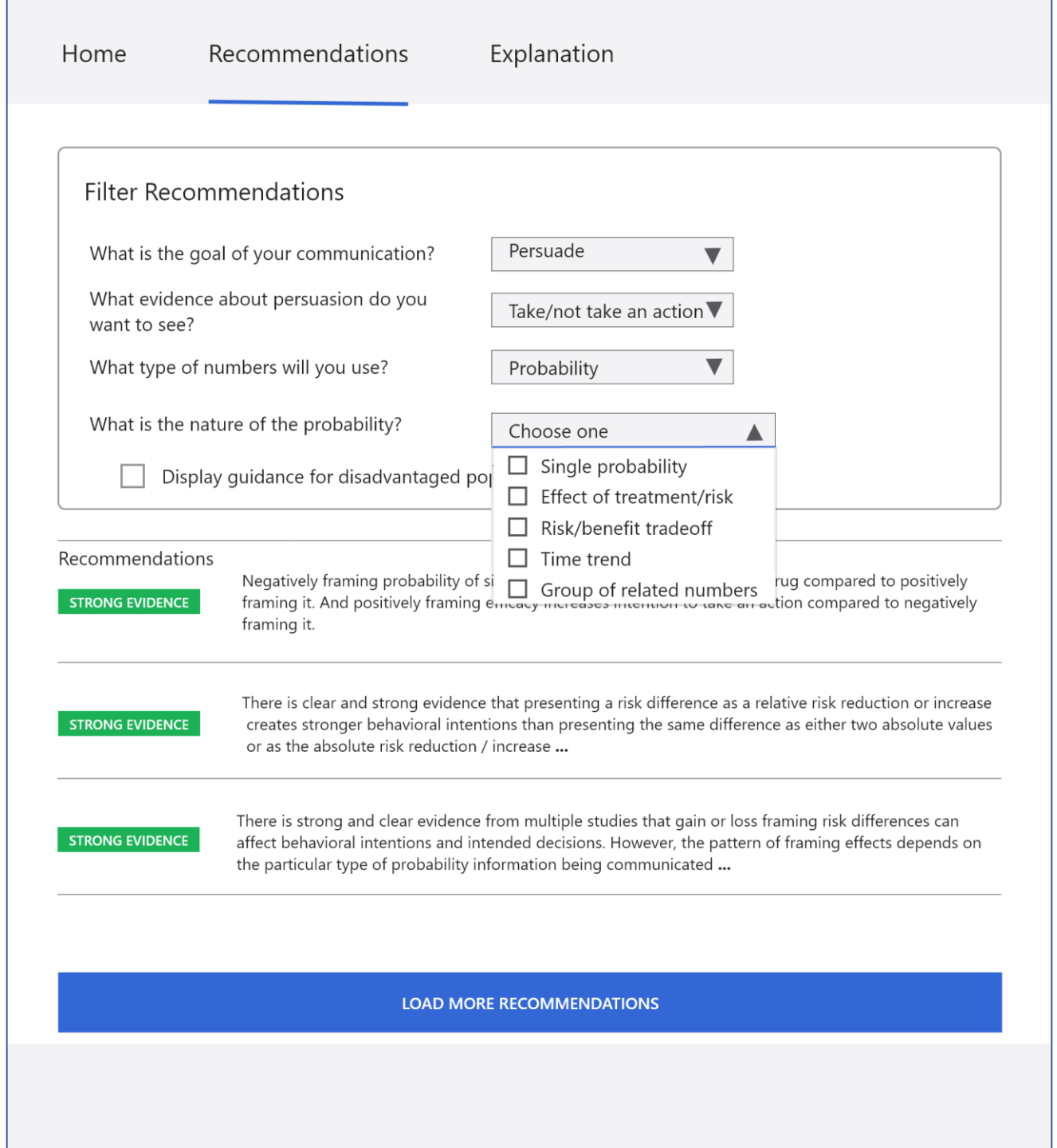

Home
Recommendations
Explanation
Filter Recommendations
What is the goal of your communication?
Persuade
What evidence about persuasion do you want to see?
Take/avoid an action
What type of numbers will you use?
Choose one
Quantity
Probability
Display guidance for disadvantaged pop
CHOOSE FILTERS TO SEE DESIGN GUIDANCE


Home
Recommendations
Explanation
Filter Recommendations
What is the goal of your communication?
Persuade
What evidence about persuasion do you want to see?
Take/not take an action
What type of numbers will you use?
Probability
What is the nature of the probability?
Choose one
Display guidance for disadvantaged populations
Recommendations
STRONG EVIDENCE
Negatively framing probability of side effects reduces intention to take a drug compared to positively framing it. And positively framing efficacy increases intention to take an action compared to negatively framing it.
STRONG EVIDENCE
There is clear and strong evidence that presenting a risk difference as a relative risk reduction or increase creates stronger behavioral intentions than presenting the same difference as either two absolute values or as the absolute risk reduction / increase ...
STRONG EVIDENCE
There is strong and clear evidence from multiple studies that gain or loss framing risk differences can affect behavioral intentions and intended decisions. However, the pattern of framing effects depends on the particular type of probability information being communicated ...
LOAD MORE RECOMMENDATIONS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Explanation
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What is the goal of your communication?
Persuade
What evidence about persuasion do you want to see?
Take/not take an action
What type of numbers will you use?
Probability
What is the nature of the probability?
Choose one
Single probability
Effect of treatment/risk
Risk/benefit tradeoff
Time trend
Group of related numbers
Display guidance for disadvantaged po
Recommendations
STRONG EVIDENCE
framing it.
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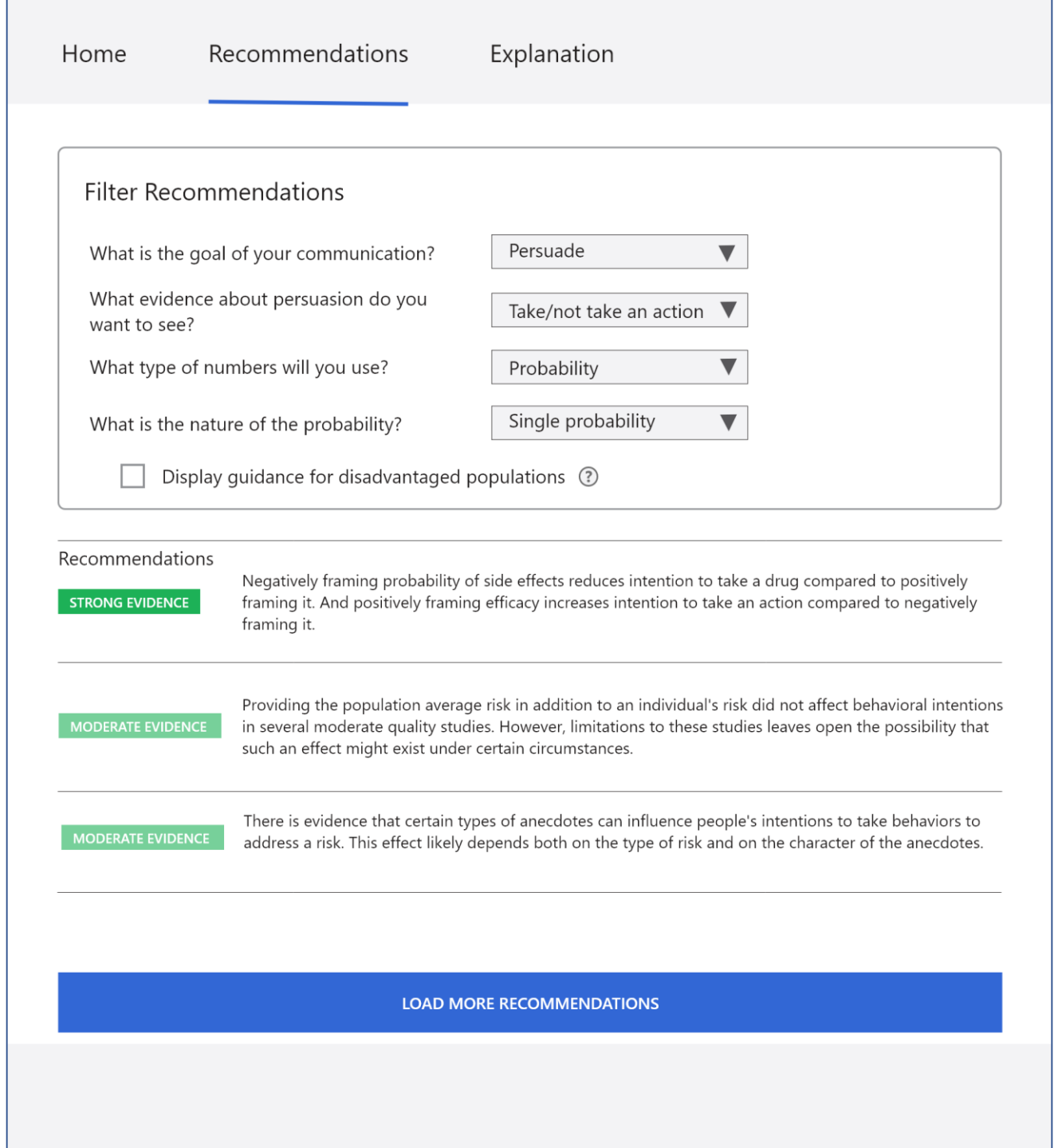
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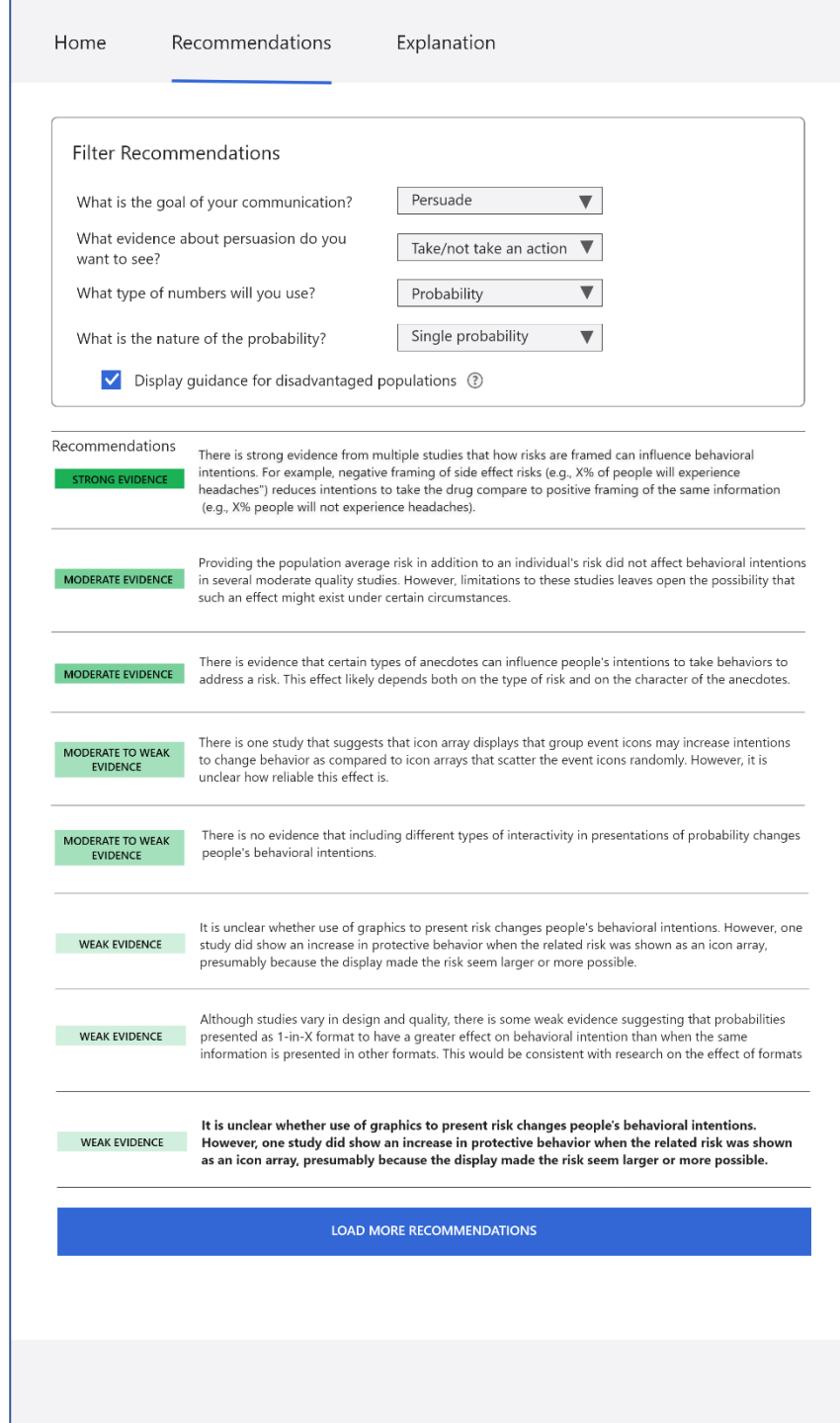
Probability
What is the nature of the probability?
Single probability
Display guidance for disadvantaged populations
Recommendations
STRONG EVIDENCE
Negatively framing probability of side effects reduces intention to take a drug compared to positively framing it. And positively framing efficacy increases intention to take an action compared to negatively framing it.
MODERATE EVIDENCE
Providing the population average risk in addition to an individual's risk did not affect behavioral intentions in several moderate quality studies. However, limitations to these studies leaves open the possibility that such an effect might exist under certain circumstances.
MODERATE EVIDENCE
There is evidence that certain types of anecdotes can influence people's intentions to take behaviors to address a risk. This effect likely depends both on the type of risk and on the character of the anecdotes.
LOAD MORE RECOMMENDATIONS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Single probability
Display guidance for disadvantaged populations
Recommendations
STRONG EVIDENCE
There is strong evidence from multiple studies that how risks are framed can influence behavioral intentions. For example, negative framing of side effect risks (e.g., X% of people will experience headaches") reduces intentions to take the drug compare to positive framing of the same information (e.g., X% people will not experience headaches).
MODERATE EVIDENCE
Providing the population average risk in addition to an individual's risk did not affect behavioral intentions in several moderate quality studies. However, limitations to these studies leaves open the possibility that such an effect might exist under certain circumstances.
MODERATE EVIDENCE
There is evidence that certain types of anecdotes can influence people's intentions to take behaviors to address a risk. This effect likely depends both on the type of risk and on the character of the anecdotes.
MODERATE TO WEAK EVIDENCE
There is one study that suggests that icon array displays that group event icons may increase intentions to change behavior as compared to icon arrays that scatter the event icons randomly. However, it is unclear how reliable this effect is.
MODERATE TO WEAK EVIDENCE
There is no evidence that including different types of interactivity in presentations of probability changes people's behavioral intentions.
WEAK EVIDENCE
It is unclear whether use of graphics to present risk changes people's behavioral intentions. However, one study did show an increase in protective behavior when the related risk was shown as an icon array, presumably because the display made the risk seem larger or more possible.
WEAK EVIDENCE
Although studies vary in design and quality, there is some weak evidence suggesting that probabilities presented as 1-in-X format to have a greater effect on behavioral intention than when the same information is presented in other formats. This would be consistent with research on the effect of formats
WEAK EVIDENCE
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LOAD MORE RECOMMENDATIONS

Choosing goals is hard

- We often want people to remember
  - AND to have their feelings changed
  - AND to be motivated
  - AND…
- But, there is often a tension between informing and persuading
  - Number communications that support careful analytical thought tend to be different than those that support emotional motivation

Your audience will only remember **ONE** thing

- Sad fact: Your audience will only remember **ONE** thing from your number, table, or graphic.
  - Yes, really. ONE.

- But, **your choice of numerical formats dictates what outcome will be most salient to your audience**
  - In other words, you can choose what that one takeaway message is

Take-home points

1. Clarify the **most important goal** of your communication
   - What must the audience think, feel, or do immediately on receiving your numerical message?

2. Select number **formats that support the primary goal**
   - Even if that means other goals may be undermined

Questions?

Jessica S Ancker, MPH, PhD
Weill Cornell Medical College

Brian J Zikmund-Fisher, PhD
University of Michigan