Evidence-Based Nudges for Better Patient Outcomes

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Overview

No matter how effective a medication, protective a vaccine, or beneficial a lifestyle modification, clinicians must recommend them and patients must engage with them to achieve improvements in health. Our decisions and behaviors are heavily influenced by the environment in which they occur. For example, small changes to the way choices are presented and information is framed within the electronic health record (EHR) can lead to significant differences in the way clinicians order tests and treatments. Social networks and norms influence how individuals eat and exercise. In many cases, these influences go unnoticed or are not given much thought. A concerted effort can help develop systematic approaches to designing interventions that better align our decisions and behaviors with long-term goals.
Patient engagement landscape

The concepts of remote monitoring, telemedicine, and, as noted by The New England Journal of Medicine, automated hovering have been around for a while now. In the United States, health care funding promotes a reactive, visit-based model in which patients are seen when they become sick, usually during hospitalizations and outpatient visits. The care model fails not only because it is costly and often fails to prevent disease, but also because individual behaviors account for so much of health outcomes. Even patients with chronic illnesses may only spend a few hours a year with a doctor or nurse, but they spend 5,000 waking hours a year determining whether to take prescribed drugs or obey other medical advice, deciding what to eat and drink, whether to smoke, and other things that can have a huge effect on their health.

Meanwhile, clinicians are being asked to do more with less time. They often run behind schedule and suffer from decision fatigue. As noted by The Journal of the American Medical Association, a cumulative burden of making choices leads to worse decisions over time, and even the most knowledgeable and well-resourced doctors deliver care with gaps, such as overusing surveillance imaging in a cancer patient, failing to prescribe statins to a patient who meets the criteria, or prescribing an expensive medication when a less expensive alternative is accessible. Usually, these differences emerge not from a lack of judgement, experience, or poor intentions, but rather because doing it right all of the time is difficult, and practice environment design unwittingly makes guideline-concordant treatment harder — or at least not as easy as it should be. This is where nudges come into play.

Enabling personalized and measurable engagements through the Nudge Framework

True patient engagement should have observable performance metrics that can be measured over time. In general, this is still a concern. However, data being collected continues to demonstrate that patient engagement can be highly beneficial when performed in a coordinated manner. With the advent of devices to track activity, heart rate, and much more, the rise of AI to predict health issues from that flood of data, automation to “hover” over patients and so on, healthcare is on the cusp of putting patients where they belong — at the center of their own health (with some assistance).

It is possible to provide amazing care to any individual but it can come at a significant cost. Concierge care for all? Sure, but at what cost and who will pay that price? This is where advances in technology and “automated hovering” will play an increasingly important role. Programs such as Heart Safe Motherhood have been shown to reduce automated hovering costs significantly and reduce readmissions while not increasing clinician workloads.

Nudge Framework

The Nuffield Council of Bioethics has created an intervention ladder that helps to balance the impact of interventions with their ethical considerations. It can be adapted to form a nudge intervention ladder. As one moves up the ladder, nudges become both more paternalistic and more effective.
Guide choice through default options: This is often the most effective option where making cancer screening the path of least resistance is implemented. Defaults are already in place in other industries. Companies like Netflix and Amazon do this already by playing the next episode in the series. You have to explicitly make a choice to exit out.

Enable choice: This approach increases the options made available and simultaneously makes it more convenient to complete the cancer screening. Approaches could include easy and immediate scheduling or other such approaches.

Prompt implementation intention: This asks the individual to pre-commit to completing the cancer screening in a timely manner. This approach could include selecting a particular date or even committing to a pledge.

Frame information: This approach delivers feedback in a manner that motivates completing cancer screening. This could be either by delivering peer comparisons to indicate when one is an outlier to the norm, or by increasing transparency on the costs of tests and treatments.

Provide Information: This is often only slightly better than doing nothing. The presumption is that simply providing information will cause someone to act in their best interest, such as offering education on the benefits of cancer screening or quitting smoking.

Do nothing: An example being to simply monitor cancer screening rates. This doesn’t provide much value except to establish a baseline. Most reports might fall into this category, i.e. there is rarely a “so what” question being answered by the report.
While it might be tempting to jump directly to the top of the ladder, it is important to remember that, the higher on the ladder, implementing those nudges requires access to more data from other systems, in addition to EHR data, or in the context of clinicians, access to the EHR. Each of those are possible but the implementation and on-the-ground effort will be non-trivial.

Examples of patient nudges

- In a randomized trial with overweight and obese adults from 40 US states, the study used a behaviorally designed gamification intervention with competition to significantly increase physical activity during a 6-month period with sustained effects in the 3 months after the intervention stopped. Participants in the competition arm walked about 100 miles more than control during the study.

- In a randomized trial of elderly patients that recently had a heart attack or other ischemic event, the study used loss-framed financial incentives and personalized goal-setting to increase physical activity during a 4-month intervention (1368 steps per day more than control) with sustained effects in the 2 month follow-up period (1154 steps per day more than control).

- In a randomized trial of adolescents and young adults with type 1 diabetes, the study used loss-framed financial incentives to significantly increase glucometer adherence from 19% in control to 50% in the intervention group.

Examples of clinician nudges

- In a randomized trial of primary care physicians, the trial used peer comparison feedback on clinician performance with automated patients lists to triple the prescribing of statin medications for patients that were at high-risk of cardiovascular events. This led to the health system’s wide adoption of these types of nudges for statin prescribing.

- In a randomized trial of radiation oncologists, the trial used nudges in the electronic health record to reduce the rate of unnecessary imaging in palliative cancer patients from 68% to 32%. This saved more than 3,000 unnecessary imaging tests per year.

- In a study of primary care practices, the study used nudges in the electronic health record to increase influenza vaccination rates by 9.5 percentage points. Across the entire health system, this led to 5000 more patients being vaccinated.

Behavioral phenotyping

Digital health tools such as apps and devices continue to show rapid growth and adoption. Many digital programs focus on changing behavior. For example, health systems focus on wellness programs such as vaccinations and cancer screenings. Employers offer workplace wellness programs that focus on weight loss and increased physical activity. Health plans offer programs targeted at diet and medication adherence. These programs, however, continue to struggle with adoption and even more importantly, ongoing engagement. One possible cause is that programs are designed with a one-size-fits-all approach. But we know that individual personalities, motivations, and values are different and must be considered as part of the program design and targeting. In other industries, companies like Netflix and Amazon evaluate prior use / purchases and offer tailored suggestions. It is important that health care learn from these successes and try to personalize care.
So how would behavioral phenotyping work? The general approach would be to:

- **Collect data:** collect information on individual specific attributes such as behaviors, preferences, and experiences. Some of this data might exist within EHRs. Others could be derived from external sources of data. Some of the data can be collected over time by asking patients to respond to surveys and so on.

- **Develop phenotypes:** once this data is available, multiple techniques can be applied to extract phenotypes. The goal here should be to **derive a small but manageable set of phenotypes** that can be explained in plain English. There are several statistical tools that can also **aid in this process**.

- **Tailor the experience:** test out multiple experiences and see what works best.

**Design considerations (AI/ML)**

As you can imagine, AI/ML techniques can play a powerful role in identifying phenotypes and targeting. Combining machine learning methods with behavioral nudges to identify behavioral phenotypes, studies have developed, refined, and validated **machine-learning models to predict oncology patients at high-risk of mortality**.

Additional studies have **delivered machine-learning mortality estimates with behavioral nudges to clinicians during patient clinic visits to increase documentation of advance care planning**. There are many opportunities to improve the delivery and implementation design to encourage advanced care planning.

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**The Nudge Framework in action**

**Case example: The STEP UP trial**

**Challenge**

Nearly 80% of US adults are insufficiently active. While gamification is offered through workplace wellness programs across the United States, most workplace wellness programs and digital health applications have failed to appropriately leverage principles from theories of health behavior — possibly a major reason why recent evaluations suggest there has been little effect from them on health behaviors.

**Design**

This study recruited overweight and obese adults from across 40 states in the US. The interventions were all behaviorally designed gamification interventions with three social incentives. The interventions lasted for six months and then were turned off but participants continued to be monitored for three more months to study the sustainability/ongoing engagement of the interventions.
The competitive arm did the best overall (1000 more steps per day) during the course of the intervention and was also the one that showed the most sustained impact (approx 600 more steps daily) even *after* the intervention was stopped. This indicated that the intervention could be successful in creating a new healthy habit. However, the trial wanted to learn more about the characteristics of the individuals (phenotypes) in each of those cases.

Based on participant data, shown below, the study identified three distinct phenotypes.

**Extroverted & motivated**
This was the largest sub-group. They tended to be more open and extroverted and had higher exercise self-efficacy. They responded best to competition but *did not* maintain activity when the incentives were removed.
Motivating this group

- May need different incentive to tap into intrinsic motivation.
- Long-term/recurring incentive and reminder structures may be necessary.

Results for extroverted and motivated participants

Results for less active and less social participants

Motivating this group
- Most to gain with low baseline activity and less experience with wearables.
- Less socially connected, so there's potential to benefit from social incentives offered via remote gamified platform.
- Sustained activity increase suggests successful habit formation.

Less motivated & at-risk
This final category exhibited higher neuroticism and were less extroverted. They were also more health risk-taking and had lower social support. This group did not seem to benefit from any of the interventions.

Less active and less social
These individuals had the least prior wearable use, lowest initial baseline of steps, and lower exercise self-efficacy. They also exhibited less social risk-taking and had lower social support. This group was the “ideal” group in that they had sustained increase in step count in all intervention groups.
Results for less motivated and at-risk participants

![Graph showing change in daily steps]

**Motivating this group**
- Consider behavioral and psychological traits in risk factor assessment.
  - Personality profile of high neuroticism, low extroversion, low conscientiousness/ grit.
  - Poor health behaviors and more health related risk-taking.
  - Low social support.
- May benefit from more intensive and longitudinal in-person support.
- Health coaches.
- Community health workers.
- Behavioral health resources.

In summary, while digital programs often fail over time, it is possible to understand patient phenotypes that can inform design of programs that can in turn be targeted to achieve the best possible outcomes.

**Case example: flu vaccinations**

**Challenge**
This quote from the CDC says it all, “We estimate, overall, there were 490,600 hospitalizations and 34,200 deaths during the 2018-2019 season.” As any medical professional will tell you, the lack of uptake of vaccinations is disturbing. The intent here was to figure out ways to stem this tide.

**Design**
The goal with this study was to try and recruit up to 150,000 patients across Penn Medicine and Geisinger and an additional 800,000 individuals from Walmart Pharmacy. For the Penn and Geisinger cases, upcoming appointments were known whereas in the Walmart Pharmacy context, there was no equivalent. Two reminder texts were sent 72 hours and 24 hours prior to a patient’s appointment. The first message encouraged patients to request a flu shot at their upcoming appointment to protect the health of themselves and their families, and the second reminded patients that a flu shot had been reserved for their appointment. Interestingly, across the board, roughly a third of the messages tested significantly increased flu shot uptake.

**Results**
In top-performing intervention, the use of the word “reserved” increased uptake by 5%. The exact same language could not be used in the Walmart context since they could not guarantee availability, so they modified the language with an equivalent term, “waiting for you,” with similar results.

This intervention literally cost less than ten cents per patient. Applying these learnings in the COVID context could save a lot of lives.
In more conservative terms, the researchers are optimistic that what they’ve learned about the flu vaccination uptake will help with COVID vaccination uptakes as well.

**Implementation considerations in clinical contexts**

Most behavioral interventions currently designed are one-size-fits-all, which assumes that a single intervention will work for people in very different ways. Personalization doesn’t have to come at the expense of scalability. Here are best practices for implementing behavioral nudges in a clinical context:

**SMS as the preferred channel of communication:**
The ubiquity of text messaging / SMS is well known. This approach has been tested by us in various conditions, ages, ethnicities, and literacy levels, and has shown to be consistently an effective medium as long as the messages are well designed and not too frequent.

**A consistent experience:**
Clinicians enroll patients into the program, otherwise the patients can be confused by a sudden SMS from an unfamiliar third-party.

**Embedded enrollment:**
To simplify the clinician’s workflow, enable enrollment from within the electronic health record (EHR). Patients should either be enrolled by clinicians from within the EHR or automatically enrolled into a program, based on test results. This eliminates barriers around education, new system logins, and makes for rapid uptake and enrollment into a program.

**A complete patient experience:**
In cases of exceptions or escalations, there needs to be a clinical operations backend to connect with patients. Personnel can call patients who escalate to identify if they need to be brought into the ED or not. The language of symptom questions should be very targeted so that escalations are also specific and actionable.

**Case example: SMS remote monitoring**

**Challenge**
In early March of 2020, when the U.S. began to take the threat of this pandemic seriously, a small team began to brainstorm ideas of how this challenge could be addressed. At this point, the biggest concern was hospitals becoming overwhelmed with patients. Each patient requiring hospitalization, there might be 25 or more patients who would not be sick enough to require hospitalization, but who could worsen quickly or be worried they might.

**Design**
Researchers developed a Short Message Service (SMS)-based automated remote monitoring program, called “COVID Watch,” for patients with presumed or confirmed Covid-19 infection. The texting program, which triggers calls from telemedicine clinicians when needed, was designed to supplement existing lines of care. This approach is called “**automated hovering**.”
The study focused on developing a strategy to watch over patients with confirmed or presumed COVID-19 at home, as well as dyspnea (difficulty breathing) as the primary symptom to track. While there were other symptoms of COVID, none of the others was felt to be as **clinically critical**.

As the paper published later details, the study tried to solve for three goals simultaneously:

1. Support a heterogeneous population of patients infected with Covid-19 who were remaining at home.
2. Identify and expedite the care of infected patients whose conditions were worsening.
3. Reduce health care personnel burden at a time when clinicians were being diverted to other tasks.

**COVID Watch patient flow**

Source: The authors
NEJM Catalyst (catalyst.nejm.org) © Massachusetts medical society
Sample SMS exchange of a clinical escalation

How are you feeling compared to 12 hours ago? Reply A, B, C.
A) Better
B) Same
C) Worse

Is it harder than usual for you to breathe? Reply Y or N.

Thank you. We have notified our care team. A Penn Medicine clinical will call you soon. Our goal is to reach you within an hour.

If you feel this is an emergency, please call 911.

Results
The program has served over 18,000 patients, to date. As you can see from the graph below, the acceptance rate is extremely high (98+%).

COVID Watch program results

Patient Funnel

<table>
<thead>
<tr>
<th>Invited</th>
<th>Enrolled</th>
<th>Escalated</th>
</tr>
</thead>
<tbody>
<tr>
<td>18,641</td>
<td>18,287</td>
<td>3,041</td>
</tr>
</tbody>
</table>

Source: The authors
NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society
**Case example: operationalizing equity through vaccine clinics**

**Challenge**
Black Americans are at greater risk of contracting COVID-19, and twice as likely to become hospitalized with COVID than their white counterparts. Thus far, they are also statistically under-vaccinated for COVID-19, largely due to both difficulty in accessing the shots and an underlying mistrust of the larger health care industry.

**Design**
Setting up a clinic that promotes accessibility while also using commonly used channels such as SMS and voice was an innovation with the primary goal being one of minimal to zero wait times and no technology requirements on the patient population. This meant that individuals would be able to register, pick an appointment, provide as much information as possible upfront and all they needed to do was show up. There was no need for email addresses, QR codes, lengthy web forms etc. All that information was captured via SMS and IVR.

**Results**
The results, published in The New England Journal of Medicine, speak for the effort. Aggregate NPS score was 90+.

**Clinic 1 at the Church of Christian Compassion on 2/13/2021**

**Highlights:**
- Vaccinations done: 550.
- Wait time for the vaccination: Less than 1 minute.

**Clinic 2 at the Francis Myers Recreation Center on 2/27/2021**

**Highlights:**
- This was a fully inbound process, i.e. individuals texted READY to a number or called the same number to trigger an IVR flow.
- Vaccinations done: 765.
- Wait time for the vaccination: Still less than 1 minute.
- Walk-ins: The program offset no-shows with planned walk-ins.

There are additional stories about more clinics and increased scale, however, the key point of this case is to highlight that patient engagement is not hard. You have to:
- Make an intentional effort.
- Offer patients multiple channels to engage with you.
- Make sure the effort is on you, not the patient.
- Use technology to simplify things.
- Integrate the best you can but if not possible, start simple.
Conclusion

Key information and important choices are constantly being presented in health care. Yet often, these frames or default options are selected haphazardly without attention to shared goals of overcoming common barriers to patients taking action. Incremental changes in how you message interventions both for patients and clinicians can go a long way. To recap, three best practices are foundational to the efficacy of nudges:

- Clearly identify patient needs and barriers to care — meet the patient where they are, rather than requiring them to come to the clinician.
- Understand communication preferences across patient population groups and test your communication messages by offering multiple engagement paths for patients.
- Embed the patient experience within the clinician workflow, optimizing for a quality patient experience that incorporates activities into clinical workflows.

Opportunities for effective nudges abound in health care because choice architectures guide our behavior whether we know it or not. As more health care decisions are made within digital environments, where they can be witnessed and their context can easily be reshaped, most health systems would be well served by insourcing nudge expertise.