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Behavioral Economics and Ambulatory Antibiotic Stewardship: A Narrative Review

Alexandra R. Richards, BA[1], **Jeffrey A. Linder, MD, MPH, FACP**[2,*]

[1]Northwestern University Feinberg School of Medicine, Chicago, IL

[2]Division of General Internal Medicine and Geriatrics, Department of Medicine, Northwestern University Feinberg School of Medicine, Chicago, IL

Abstract

Purpose: Behavioral economics recognizes that contextual, psychological, social, and emotional factors powerfully influence decision-making. Behavioral economic approaches have the potential to better understand and, through subtle environmental changes, or "nudges," improve persistent quality-of-care challenges, like ambulatory antibiotic overprescribing. Despite decades of admonitions and educational initiatives, in the United States, up to 50% of ambulatory antibiotic prescriptions remain inappropriate or not associated with a diagnosis.

Methods: We conducted a Medline search and performed a narrative review that examined the use of behavioral economics to understand the rationale for and improvement of ambulatory antibiotic prescribing.

Findings: Clinicians prescribe inappropriate antibiotics because of perceived patient demand, to maintain patient satisfaction, diagnostic uncertainty, and time pressure, among other reasons. Behavioral economics-informed approaches offer additional improvements in antibiotic prescribing than clinician education and communication training. *Pre-commitment*, in which clinicians publicize their intent to prescribe antibiotics "only when they are absolutely necessary," leverages clinicians' self-conception and a desire to act in a manner consistent with public statements. Pre-commitment was associated with a 20% absolute reduction in inappropriate antibiotic prescribing for acute respiratory infections. *Justification alerts*, in which clinicians must provide a brief text rationale for antibiotic prescribing, leverages social accountability, redefines the status quo as an active choice, and helps clinicians shift from fast to slow thinking. Justification alerts led to a decrease in absolute inappropriate antibiotic prescribing rates from 23% to 5%. *Peer comparison*, in which clinicians receive feedback to their performance compared to top performing peers, provides evidence of improved performance and leverages peoples' desire to conform to social norms and led to a decrease in absolute inappropriate antibiotic prescribing rates from 20% to 4%, a decrease that persisted 12 months after the end of the intervention. A one-

*Correspondence to: Dr. Jeffrey A. Linder, MD, MPH, FACP, Division of General Internal Medicine and Geriatrics, Northwestern University Feinberg School of Medicine, 750 N. Lake Shore Drive, 10th Floor, Chicago, IL 60611, USA, Telephone: 312-503-6407, FAX: 312-503-2755 jlinder@northwestern.edu.

time peer comparison letter from a high-profile messenger to high-antibiotic-prescribing primary care practices resulted in a 6-month, 3% decrease in antibiotic prescribing. Future directions in applying behavioral economics to inappropriate antibiotic prescribing include paying careful attention to design details; improving intervention effectiveness and durability; making harms salient; participants' involvement in intervention development (the "IKEA effect"); factoring in patient satisfaction; and patient-facing nudges about antibiotic use and care-seeking. In addition, the COVID pandemic could aid in ambulatory antibiotic prescribing improvements due to changing cognitive frames around respiratory symptom evaluation and antibiotic prescribing.

Implications: To improve ambulatory antibiotic prescribing several behavioral economics-informed approaches – especially pre-commitment, justification alerts, and peer comparison – have reduced inappropriate antibiotic prescribing to low levels.

Keywords

Antimicrobial Stewardship; Anti-Infective Agents; Economics, Behavioral; Behavioral Sciences; Ambulatory Care; Primary Health Care; Physicians, Primary Care

Introduction

Classical economic theory holds that people will seek out all applicable information and make reasoned, rational decisions that maximize their personal benefit. However, individuals seemingly do not always act rationally, often appear to act against their own interests, and are often not happy with the outcomes of their choices.[1,2] In health, despite being aware of the risks, people eat an unhealthy diet, fail to exercise, smoke, and do not get recommended preventive care. Beyond health, people also behave in ways that put their short and long-term wellbeing at risk: texting while driving, not voting, and failing to save for retirement.

Behavioral economics is a newer branch of economics that recognizes that contextual, psychological, social, and emotional factors – largely ignored by classical economics – powerfully influence decision making.[3-5] Behavioral economics may more reliably predict behavior that appears to not be in an individual's best interest.[6] To change behavior, behavioral economics often relies on "nudges," subtle changes to the environment or choice environment, intended to preserve choice but influence decision-making towards desired behavior.[2,7]

In medicine, physicians and other clinicians have a professional obligation to act in patients' best interests. However, like other professions, doctors do not always act in their patients' best interest, which may explain why seemingly fully-informed physicians continue to use low- or no-value care.[8] One critical area of such low- or no-value care is ambulatory antibiotic prescribing: despite decades of recognition, admonitions, and education, clinicians continue to prescribe antibiotics for diagnoses that will not respond to antibiotics.[9,10]

Viewing inappropriate ambulatory antibiotic prescribing as an undesirable behavior allows the application of behavioral economics and nudges to change prescriber behavior.[11-16] To make use of behavioral economics, it is important to understand the harms, reasons, and context for inappropriate antibiotic prescribing. Nudges to improve ambulatory antibiotic prescribing could address context, attitudes, cognitive frames, or social implications to make doing the right thing easy or motivating.

We conducted a literature review to describe the harms and rationales for inappropriate antibiotic prescribing and the implementation, utility, and effectiveness of applying behavioral economic principles to improve the use of ambulatory antibiotics.

Methods

For this narrative review, we searched PubMed using Medical Subject Headings in the following search: "(Economics, Behavioral[MH] OR Behavioral Sciences[MH]) AND (Antimicrobial Stewardship[MH] OR Anti-Infective Agents[MH]) AND (Ambulatory Care[MH] OR Primary Health Care[MH] OR Physicians, Primary Care[MH])." This resulted in a list of 22 articles in July 2021.

We included articles that discussed antibacterial antimicrobial stewardship in ambulatory practice and used behavioral economics or behavioral science. We excluded articles focused on antiviral or antimycobacterial stewardship. We supplemented our PubMed search with manuscripts referenced in either the identified articles ("snowballing"), those within our own bibliographies, and additional searches of the economic, psychological, and medical literature, especially to understand the rationales for inappropriate antibiotic prescribing. We considered all article types, including research articles, commentaries, review articles, editorials, and others. We included articles without restriction to time, country, or language (although all articles found and cited were in English). As behavioral economics, nudging, and ambulatory antibiotic stewardship are relatively new fields, most of the articles were published in the last 10 to 20 years.

We organized the Results and Discussion into describing the problem of inappropriate ambulatory antibiotic prescribing; harms of inappropriate ambulatory antibiotic use; and reasons for inappropriate antibiotic prescribing and how behavioral economics may help us understand inappropriate antibiotic prescribing. We conclude considering future directions about further improvement in ambulatory antibiotic prescribing and implications of the COVID pandemic. Throughout, we consider how behavioral economics may aid in understanding the problem of and solutions to inappropriate antibiotic prescribing.

Results and Discussion

Ambulatory Antibiotic Prescribing

Although antibiotic stewardship traditionally has focused on in-hospital acute care, ambulatory care accounts for over 85% of antibiotic use in humans in most countries.[17,18] In the United States, within all ambulatory care, primary care accounts for 41% of ambulatory antibiotic prescribing. In the US, the most frequently prescribed antibiotics in ambulatory settings in 2018 were penicillins and macrolides.[19]

In the United States, for acute respiratory infections, at least half of antibiotics prescribed are unnecessary.[9,20] The only common respiratory infections for which antibiotics are recommended are acute otitis media, sinusitis (a minority of cases in primary care), streptococcal pharyngitis, and pneumonia.[21-23] However, clinicians prescribe antibiotics for non-specific upper respiratory tract infections, acute bronchitis, as well as pharyngitis and sinusitis that do not meet guideline criteria for antibiotic prescribing.[24-26] Beyond acute respiratory infections, we have conducted analyses showing that up to 50% of all antibiotics prescribed in ambulatory care in the United States are either inappropriate or not associated with a diagnosis.[10,19,27]

Despite decades of admonitions and education to improve ambulatory antibiotic use, leading up to the COVID-19 pandemic in early 2020, ambulatory antibiotic prescribing had not decreased meaningfully in the United States over the prior decade and remains at about 800 prescriptions per 1000 Americans per year.[9,10,28-31] Other parts of the world have made progress. For example, England and Sweden have antibiotic prescribing rates of 607 and 325 prescriptions per 1000 population.[32-34] Belgium is seeking a 50% reduction in antibiotic use and Sweden and Norway have a goal of reducing their population antibiotic use to 250 prescriptions per 1000 population.[34,35]

Harms of Inappropriate Ambulatory Antibiotic Use

In designing behavioral economic interventions to address inappropriate antibiotic prescribing, one must consider the relative importance of these adverse effects to patients, clinicians, and other stakeholders. Inappropriate antibiotic prescribing causes adverse drug events (ADEs), is a major risk factor for *Clostridioides difficile* infection, alters the microbiome, increases the prevalence of antibiotic resistant bacteria, increases costs, and leads to future care-seeking.

Adverse drug events from antibiotics range from more minor problems like diarrhea, rashes, and vaginal yeast infections to life-threatening anaphylactic allergic reactions.[36] For children, antibiotics are one of the most common reasons for an adverse drug event-related emergency room visit.[37] Adults who receive antibiotics for non-antibiotic-appropriate respiratory diagnoses are more likely to make an emergency department visit than to have a complication prevented.[38-40]

Clostridioides difficile infection is closely associated with antibiotic use and can result in life-threatening diarrhea.[41-43] *C. difficile* infection is more common among older adults, who also have more severe disease. Although the incidence of *C. difficile* infection decreased from 2011 to 2017, the incidence of community-associated *C. difficile* infection – more likely to be related to ambulatory antibiotic prescribing – has not.[44]

Ambulatory antibiotic prescribing alters patients' microbiome for weeks to months.[45] Changes in the microbiome have been associated with obesity, diabetes, and allergic and autoimmune disease.[46-48] However, the association between childhood antibiotic use and obesity has been called into question.[49]

Antibiotic prescribing increases the prevalence of antibiotic-resistant bacteria. In the US, there are 2.8 million antibiotic-resistant infections and antibiotic resistance is related to more than 35,000 deaths.[41] Community antibiotic-resistance rates are directly proportional to community antibiotic use rates.[50,51] Antibiotic-resistant bacteria are detected within individuals for months after antibiotic exposure.[52,53] Although antibiotic-resistance looms large in the minds of researchers and policymakers, as a rationale for avoiding inappropriate prescribing, antibiotic-resistance is generally of low priority to the public, patients, and clinicians.[54-57]

Although not as great a cost as many other clinical problems, inappropriate antibiotic prescribing increases costs through unnecessary visits, antibiotic use, complications, and antibiotic resistance. Each ambulatory antibiotic prescription is probably associated with a hidden societal cost of increasing antibiotic resistance that may be between $3 and $95.[58] Collectively antibiotic resistance may cost the united states $20 billion annually with additional costs of lost productivity as high as $35 billion annually.[59]

Ambulatory antibiotic prescribing leads patients to believe in the effectiveness of antibiotics and increases future care-seeking.[60] Patients who believe in the effectiveness of antibiotics may be more likely to seek care in the future.[61] At visits, patients who want antibiotics are more likely to have received them in the past.[62] Most antibiotic stewardship interventions have been targeted at clinic visits, long after a patient has decided to seek care and may have formed expectations for care and receiving antibiotics.[63]

Reasons for Inappropriate Ambulatory Antibiotic Prescribing

Given the numerous adverse consequences associated with poor antibiotic stewardship and widespread awareness of this issue since antibiotics were first commercialized,[64] it may seem surprising that little progress has been made towards eliminating this problem. However, when one applies a behavioral economic framework to consider the social, emotional, and contextual factors that contribute to inappropriate antibiotic prescribing, the reasons for the persistence of inappropriate antibiotic prescribing become clearer.

Perceived Patient Demand—One of the greatest challenges associated with antibiotic prescription arises from perceived patient demand and/or pressure, even if the physician knows antibiotics will not help patients.[65-68] Patients may come to a clinic seeking antibiotics because clinicians had prescribed them for a similar prior situation. Patients may believe their symptoms can only be resolved with an antibiotic, or they might compare the perceived similarities between themselves and others they know who are experiencing similar symptoms, among other appeals. Attempts by clinicians to oppose these wishes have been described as “exhausting, demoralizing, and often unsuccessful.”[69] Interestingly, although clinicians cite patient demand as the number one reason for prescribing antibiotics, they are bad at identifying which patients want antibiotics.[70,71]

Maintaining Patient Satisfaction—Maintaining patient satisfaction and experience is a core tenet of the consumerist health care system in the United States.[72] Clinicians are concerned that they might receive lower patient satisfaction scores if they do not meet patients’ expectations, sometimes with an antibiotic prescription. Older studies found no association between antibiotic prescribing and patient satisfaction,[73-76] but more recent studies, particularly in telemedicine, have found high-antibiotic prescribing physicians have higher patient satisfaction ratings.[77-79]

Diagnostic Uncertainty—Similarly, diagnostic uncertainty may increase the prescription of antibiotics. Although guidelines are clear about which diagnoses should be treated with antibiotics, the nonspecific presentation of some bacterial and viral infections can make it challenging to determine the diagnosis or etiology. For example, sometimes a urinary tract diagnosis is made and prescription is given in the presence of just a few nonspecific symptoms and pyuria.[11] Clinicians often express diagnostic uncertainty for patients with cough, especially when prescribing antibiotics.[81] The distinction can be even harder to make among older adults, who are at higher risk for developing a complication with the infection or potential hospitalization.[81] Heightened concern, especially when working with older patients, might also motivate a clinician to prescribe more readily, and to use broad-spectrum agents for longer periods of time.[82] Clinicians might have "ambiguity aversion," and want to choose a perceived low known risk (prescribing antibiotic) and avoid an unknown risk (how the patient is going to do without antibiotics.[83]

Time Pressure and Decision Fatigue—Time constraints are another factor. If a clinician is behind schedule, he may believe that it would be faster to prescribe antibiotics than to try to explain why or convince a patient that they do not need them.[11,65,83] This notion is supported by a Norwegian study that found that the general practitioners with higher rates of consultations also prescribed significantly more antibiotics.[84]

Related to time constraints is decision fatigue, which refers to when a person's decision-making quality and self-regulation worsen as they become more tired.[85,86] As one example, we found that clinicians were about 5% more likely to prescribe antibiotics later in a clinic session, even for seemingly identical patients.[87]

Ease of Prescribing and Framing Effects—People are less likely to take a course of action that is more effortful or takes more cognitive energy than an alternative, easier action. Prescribing antibiotics is easy. Especially with electronic health records and the ability to quickly select a "favorite" prescription, the cognitive effort or "price" of antibiotic prescribing is low.

How actions are framed in the electronic health record influences physician behavior.[88] For example, urine cultures are ordered more frequently when they are presented as a default order with a urinalysis.[89] Making generic prescriptions the default tremendously increases their use.[90] Physicians will select more aggressive treatments – including broader-spectrum antibiotics – more often when presented individually instead of grouped with other medications.[91]

How people mentally frame problems and solutions powerfully affects behavior. If the clinician does not believe antibiotics could be harmful (i.e. does not perceive a high risk), they are significantly more likely to prescribe them.[83,84] Among Emergency Department clinicians, antibiotic prescribing rates for upper respiratory tract infections and pneumonia varied from 7% to 91%. Clinicians who framed the antibiotic prescribing decision as balancing continuing illness with possibly beneficial treatment had significantly higher antibiotic prescribing rates than those who framed the problem as balancing potentially harmful antibiotic treatment with continued illness.[93]

Related, clinicians tend to externalize the problems of antibiotic resistance and inappropriate antibiotic prescribing. Clinicians feel that they perform better than other clinicians or prescribers in other settings.[94] For example, a survey of 323 physicians demonstrated that 99% of respondents saw antibiotic resistance as a national problem, but only 63% thought it was a problem in their workspace, and thus likely do not recognize antibiotic overprescribing as a concrete problem.[95] It is challenging to get someone to change their behavior if they feel their behavior is not problematic.

People, including clinicians, are often biased towards action versus inaction.[96] In the event of a bad outcome, the cognitive and social costs are usually higher for having failed to act (avoiding inappropriate antibiotic prescribing) than for at least trying to act in patients' best interest (prescribing an unneeded antibiotic).[11,95]

Cognitive Reflectiveness—People pause and think about problems in different ways, a concept referred to as "cognitive reflection." Clinicians may have a sweet spot regarding how cognitively reflective they are about problems in general and this could translate to differences in antibiotic prescribing.

The Cognitive Reflection Test (CRT) is a psychological test that has 3 intuitive, but incorrect answers; it is thought to measure the degree to which respondents carefully consider problems. We administered the CRT to 57 clinicians and found a U-shaped relationship with clinicians at the lowest and highest CRT scores having higher antibiotic prescribing rates for respiratory infections.[96] We hypothesized that those with the lowest CRT scores tended to not consider problems carefully; those with the highest CRT scores may have overthought the clinical situation and worried about alternative diagnoses or potential complications.

Potential Solutions from Behavioral Economics

Behavioral economics interventions are generally nudges – subtle changes to the choice environment, intended to direct people to some more desirable decision – or take advantage of other psychological, emotional, or social factors. Because they are often subtle changes to the environment, behavioral economic interventions to reduce inappropriate antibiotic prescribing may be more cost-effective than educational interventions.[97] Also, despite the word "economics," behavioral economics interventions usually do not use financial incentives. Financial incentives can have a paradoxical demotivating or "undermining effect" on intrinsic motivation, especially if the financial intervention is only present temporarily.[98]

Public Commitments and Pre-Commitments—Public commitment letters and posters are interventions that utilize the profound impact of social accountability. These posters declare an intention to prescribe antibiotics only when necessary and are signed by prescribers and hung in waiting or examination rooms. Meeker and colleagues designed a randomized control trial to test this nudge, and found that public commitment letters had almost a 20% absolute risk reduction in excessive prescribing, compared to a control group ($p = 0.02$).[99] The most important aspect of the intervention might be operating in the clinicians' minds: clinicians should know that patients had been informed of their prior commitment to adhere to good antibiotic prescribing principles.

Kullgren and colleagues had 45 primary care clinicians in 6 practices pre-commit to high quality care, including avoiding prescribing unnecessary antibiotics for acute sinusitis, and delivered 1-6 months of point-of-care commitment reminders attached to a patient education handout.[100] In a stepped wedge trial, intervention clinicians also received education and patient-communication support. Compared to control clinicians, intervention clinicians did not have a significant change in their antibiotic prescribing for acute sinusitis during the intervention or in a follow-up period. Explanations for a lack of effectiveness could be that the commitments were not public or the short duration of follow-up.

Feedback and Peer Comparison—Feedback has been part of practice improvement for decades.[101] However, behavioral economics and social psychology have provided insights to improve the efficiency and effectiveness of feedback based on evidence generated from domains as varied as personal finance, voting, home energy use, and hotel towel reuse.[1,102-104] Common choices that diminish the effectiveness of feedback include showing people where they are on a bell curve, not considering the importance of the messenger, delivering feedback to the wrong recipient, ignoring emotional effects, providing too much data or an unclear message, and ignoring the power of repeated feedback.[105,106]

Hallsworth and colleagues took advantage of a one-time feedback message from a powerful messenger, the Chief Medical Officer of England, to well-targeted recipients: General Practices in the 80th percentile of antibiotic prescribing.[107] In a randomized controlled trial, compared to high-prescribing practices that did not receive any communication (n = 790 practices), practices that received feedback about their high-prescribing and a leaflet on antibiotics for use with patients (n = 791 practices with 3227 General Practitioners) prescribed 3.3% less antibiotics in the subsequent 6 months. Beyond the high-profile source of feedback, highlights of this method included its low cost, ability to scale, relative lack of barriers to implementation, and the provision of actionable means of improvement.

Meeker and colleagues, in a different cluster randomized trial from the pre-commitment, evaluated 3 interventions, one of which was a feedback intervention termed “peer comparison.”[108,109] The physicians received monthly, individualized, specific feedback via email from an identifiable, respected colleague that informed them whether a “top performer” or whether they were “not a top performer” at avoiding inappropriate antibiotic prescribing. The feedback was easily understandable and designed to be emotionally-laden: the intent was to have prescribers have a negative emotional reaction to being told they were “not a top performer” and for “top performers” to feel good about their status. This feedback also anchored the behavior among the top performers and leveraged peoples’ desire for meeting both an injunctive norm (a consensus standard) and a social norm (the action of one’s peers). In a randomized controlled trial, over 18 months, compared to control practices in which the inappropriate antibiotic prescribing rate decreased from 24% to 13%, peer comparison resulted in a reduction from 20% to 4% (difference-in-differences with control practices, −5% [95% CI, −7% to −2%]).[108] In addition, the reduction was sustained for 12 months after the feedback stopped.[109]

Justification Alerts—Meeker and colleagues also evaluated “justification alerts,” in which clinicians had to provide a brief, explicit rationale for antibiotic prescribing that was placed in the medical record.[108] Accountable justification makes prescribing a bit harder, more cognitively effortful, forced clinicians to consider injunctive norms (guidelines), and exposes one's thinking to one's peers (social accountability). Peer comparison was associated with a reduction in inappropriate antibiotic prescribing from 23% to 5% (difference-in-difference with control practices, −7% [95% CI, −9% to −3%]), but was not associated with a sustained reduction 12 months after justification alerts were stopped.[109]

Details Matter

While many behavioral economic interventions have been successful, some behavioral interventions have not been successful, which has led some commenters to conclude that "behavioral economics does not work."[110,111] However, as we have written previously, subtle differences between details of interventions matter.[112] In the example above, the commitment study by Meeker and colleages was effective,[100] but the commitment study by Kullgren and colleagues was not, perhaps because the commitment was not public and the follow-up duration was short.[108,109]

In another example, although feedback and peer comparison were used in an American[111] and a Swiss study,[113] the American study significantly decreased inappropriate antibiotic prescribing and the Swiss study did not. However, the feedback provided was very different. Whereas the feedback in the American study was simple and directed attention to the peer comparison information, the Swiss study provided much more feedback and did not highlight one message. The American study provided feedback monthly over 18 months, but the Swiss study provided feedback quarterly for 2 years. The American study focused feedback just on inappropriate prescribing, but the Swiss study included information on all antibiotic prescribing and depended on the recipient to correctly interpret the meaning of the data. The American study keyed feedback on top performing clinicians, but the Swiss study only compared prescribing to the average.

In considering nudges or behavioral economic interventions to decrease ambulatory antibiotic prescribing, it is important for researchers to be familiar with the behavioral science literature and consider consulting behavioral science expertise.[112,114]

Future Directions in Applying Behavioral Economic Principles to Ambulatory Antibiotic Stewardship

While there have been encouraging developments using behavioral economics to understand and improve health care and ambulatory antibiotic prescribing, future studies should maximize the durability, simplicity, and generalizability of interventions and take advantage of additional behavioral economic insights.

Making Harms Salient—Interventions have not generally sought to make harms salient to clinicians and patients at the time of prescribing. Whereas factors that promote ambulatory antibiotic prescribing are generally emotionally laden and immediate to the clinician and patient – belief that the patient wants antibiotics, acute symptoms, a desire to get better, fear of missing a bacterial diagnosis, and others – factors that deter antibiotic prescribing are not as immediately emotionally laden or salient – future adverse reactions and drug interactions, avoiding encouraging the development of antibiotic resistance, following guidelines, and others.[11,115]

Precommitment and other interventions mention harms to patients, precommitment may work more through patient expectation setting and encouraging clinicians to adhere to behavior they think patients now expect.[116] A future intervention might collect local data about patients who had an antibiotic adverse reaction and present this data to patients, clinicians, or both. Alternatively, a future intervention might link local antibiotic prescribing rates with local rates of antibiotic resistant organisms in a way that makes these societal harms salient to prescribers and patients before or at the time of prescribing. Making harms salient has the potential to take advantage of status quo bias (not wanting to take action that knowingly could cause harm), loss aversion (people weight losses more heavily than gains), and risk aversion.[117] However, interventions that, in effect, scare people about harms can go too far. Interventions need to avoid "the ostrich effect" in which people tend to dismiss information that they find frightening.[118]

The IKEA Effect—"The IKEA effect" in which people place more value on items or interventions they create, has been used to improve inpatient antibiotic prescribing.[119,120] Ambulatory stewardship has sought to engage clinicians and clinics to collectively improve ambulatory antibiotic prescribing,[121] but, to our knowledge, has not been used to design or implement ambulatory antibiotic stewardship interventions. Future interventions might approach a practice with a suite of ambulatory antibiotic stewardship tools from which the local practice chooses, modifies, and implements themselves.

Such home-grown interventions seeking to take care of the IKEA effect should have continuing involvement with experts in behavioral science or ambulatory antibiotic stewardship. Clinicians' stated and true preferences could be different. Also, clinicians often have a preference to select interventions that are convenient and easy-to-use rather than interventions that are effective.[114]

Factoring in Patient Satisfaction—As noted above, clinicians frequently cite maintaining patient satisfaction as their number one rationale for why they prescribe antibiotics and some studies have shown an association between antibiotic prescribing and patient satisfaction.[120] Future nudge interventions might provide feedback about both antibiotic prescribing and patient satisfaction. "Top Performers" would have low inappropriate antibiotic prescribing and high patient satisfaction. With two main pieces of data, a prescribing/satisfaction report will be more complicated than a single datum report about antibiotic prescribing, which raises concerns about the ease of interpretability. Providing too much information could strain prescribers' limited attention,[119] but has the potential to alter care in two important domains.

Patient-Facing Nudges about Antibiotic Use and Care-Seeking—Many efforts to decrease ambulatory antibiotic prescribing have focused on prescribers at the time of the prescribing decision, but behavioral economics nudges have not focused on patients or patients' decision to seek care. Because ambulatory antibiotic use is not distributed evenly among patients,[120] it makes sense to focus nudges on high-utilizing patients (analogous to how peer comparison might focus on high-prescribers). One could imagine a letter or feedback nudge targeted at high-utilizing patients (say, those that used 3 or more antibiotic prescriptions per year in the absence of an alternative explanation like chronic lung disease), exposing that their behavior is outside of social norms ("You use more antibiotics than 80% of patients like you…"), to see if that altered future behavior. As one example, a letter could nudge patients to consider that their repeated antibiotic use could be an indicator of an alternative diagnosis or condition ("Your repeated symptoms could be due to a different problem, like allergies…").[63]

To prevent inappropriate antibiotic prescribing at an in-person visit, nudges might prevent the visit in the first place.[63,115] Patients with respiratory symptoms might be defaulted into a pre-visit, online triage, or be set up with online monitoring in lieu of an in-person visit. Only patients that met specific symptom severity or duration criteria would advance to an online or in-person visit.

COVID-19 and Antibiotic Stewardship

The COVID-19 pandemic has probably resulted in a dramatic decrease in ambulatory antibiotic prescribing in 2020 and 2021. For example, the 10 most prescribed outpatient antibiotics in the United States had decreases of 13% to 49% in fills in April 2020 compared to August 2014 to March 2020.[122] Using the same data source, others at the Centers for Disease Control and Prevention found a 33% decrease in antibiotic prescribing through May 2020.[123] Using a different prescribing data source, other investigators found that Amoxicillin and Azithromycin had weekly prescribing decreases of 20% to 64% from mid-March to the end of April 2020.[124] The decrease in antibiotic prescribing is probably a result of a combination of decreased infection with non-COVID respiratory viruses,[125] changes in care seeking,[126] a recognition that antibiotics are not effective for COVID-19, and patients and clinicians being more concerned about the diagnostic possibility of COVID-19 and not focused on inappropriate symptom treatment.

Previously, an ambulatory visit for respiratory symptoms was presumed by some to be an antagonistic interaction – or at least one of misunderstanding – in which the patient was seeking a magic cure to get better and clinicians were charged with convincing patients they did not need antibiotics (or even that they were harmful). Patients and clinicians may now be thinking about respiratory symptoms in a completely different way: the overriding concern is that the patient has COVID, obtaining testing, and the implications of the diagnosis for living arrangements, work, other social interactions, and the ongoing spread of COVID to others.

Because the dominant paradigm in ambulatory care underlies most of the research we cite in this paper – patients are seeking relief or treatment and clinicians are acquiescing or trying to balance not prescribing antibiotics with maintaining safety – has been, in some ways, broken, could the COVID pandemic be an opportunity to break with the past? Just as clinicians with different cognitive frames have different antibiotic prescribing rates,[92] different or altered patient cognitive frames could impact a consideration of or desire for antibiotics. Future interventions could take advantage of patients' seeming interest in knowing what virus they have to, in effect, change the subject from antibiotic prescribing.

Alternatively, future interventions might generalize patients' seeming understanding that "antibiotics don't work for COVID" to other viral respiratory infections.

Going forward, it will be important to continue to measure ambulatory visits and ambulatory antibiotic prescribing to see if the decreases of 2020 persist. Behavioral economics provides opportunities to leverage dramatic shifts in care and behavior to change future behavior.

Conclusion

Behavioral economics recognizes that people alter their choices depending on the context, as well as psychological, social, and emotional factors surrounding that choice. Nudging clinicians has been effective in reducing inappropriate antibiotic prescribing to very low levels, especially using pre-commitment, justification alerts, and peer comparison. However, future directions might employ additional behavioral economic insights to reduce inappropriate ambulatory antibiotic prescribing, like the IKEA effect, factoring in patient-satisfaction, and patient-facing nudges. In addition, behavioral economic-informed interventions might take advantage of the altered cognitive frames regarding antibiotic prescribing in the wake of the COVID pandemic.

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