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Shifting medical guidelines: Compliance and spillover effects for revised antibiotic recommendations

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ABSTRACT

Rationale: Experts have recently argued that guidelines to take the full course of antibiotics are due for revision, instead recommending that patients stop when they feel better. It is unknown how communicating *revised* guidelines from medical experts about how long to take a course of antibiotics will affect beliefs, behavior, and trust in guidelines more generally. *Objective.* This study seeks to understand how revisions to long standing advice impacts the beliefs, behavior, and trust toward such guidelines from medical experts.

Method: In a pre-registered experiment, we use a national sample of UK participants ($N = 1{,}263$) to test the effects of a message that reverses the prior full-course guideline (versus a status quo message to take the full course). We also test a secondary intervention that emphasizes that medical guidance and evidence may change over time.

Results: Early stoppage messages significantly shifted personal beliefs and perceived expert consensus about early stoppage (a shift of 16%, 95% *CI:* 13.8% to 17.9%, $p < .001$) and behavioral intent (a shift of 19%, 95% *CI:* 15.3 to 21.8%, $p < .001$) in the intended direction. Yet, the new guideline also slightly decreased acceptance of uncertainty about future guidelines (a decrease of 2%, 95% *CI:* 0.2% to 3.1%, $p = .022$) and general intention to comply with other guidelines in the future (a decrease of 6%, 95% *CI:* 2.6% to 8.4%, $p < .001$); it did not affect perceptions of medical researchers' or doctors' credibility or respondents' epistemic efficacy. Prior belief about early stoppage did not moderate receptivity to messages. Notably, though, we also find receptivity to early stoppage messages was contingent on deference to experts. We find no effect of a secondary intervention that emphasizes that medical guidance and evidence may change over time. *Conclusions.* Overall, our findings suggest the (U.K.) public is likely to accept new guidelines that change long standing advice to take a full course of antibiotics. While respondents show wariness about further future revisions, these data do not show that changing guidelines undermines trust in the experts that produce them.

1. Introduction

The best medical practices and patient guidelines evolve. This simple fact raises an important question: how does the public respond to changing advice? In the case of antibiotic use, the longstanding consensus has been "always complete the full prescription, even if you feel better" (World Health Organization, 2015a). In a recent issue of the *British Medical Journal,* Llewelyn et al. (2017) argue that this medical advice is due for revision as there is little evidence demonstrating that this behaviour achieves its goal of preventing bacteria from developing resistance to antibiotics. Given the existential threat to global health posed by antibacterial resistance (World Health Organization, 2015b; The World Bank, 2016) and the possible emergence of expert dissensus (Llewelyn et al., 2017; Del Mar and Looke, 2017; NHS, 2017) about the use of antibiotics, it is essential to measure public opinion about antibiotics (and antibacterial resistance) and to examine how the public may respond to changing expert guidance.

In this study, we examine public beliefs about taking a full course of antibiotics, whether the public would accept new expert guidelines, what factors may condition their acceptance, and what effects such messages may have on behavioral intentions. Our goal here is not to advocate for or against the Llewelyn et al. (2017) position. Rather, as social scientists, our goal is to understand how the public may respond to a possible dramatic shift in official health advice.

Whereas previous studies have examined the effect of public information campaigns about antibiotic use (e.g., Huttner et al., 2010;

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McNulty et al., 2010), these campaigns have occurred amidst the prevailing elite consensus. Consistent with the call for strategic communication campaigns to reduce unnecessary antibiotic use (Review on Antimicrobial Resistance, 2016), it is important to determine whether revised guidelines from medical experts can result in appropriate mitigative behaviors (Nisbet, 2016).

Examining how the public responds to a possible change in guidance about antibiotics may inform our broader understanding of how the public responds to emerging dissensus or shifting guidelines more generally. Evolving evidence is a key facet of public health crises (Brossard et al., 2018), but its effects on the public are poorly understood. Although researchers recently have devoted more attention to understanding the implications of conflicting medical information (e.g., Han et al., 2018; Nagler, 2014; Nagler et al., 2019), much more needs to be done (Carpenter et al., 2016).

1.1. *How would the public respond to new guidelines for the use of antibiotics?*

In this study, we compare how two different messages about taking antibiotics – one that patients should complete their course no matter what, and a second message that patients should stop treatment when they feel better – affect beliefs, attitudes, and behavioral intentions. We expect the public to exhibit fairly low levels of knowledge about antibiotic use (Tamasauskiene et al., 2018). Prior work shows that individuals with less knowledge and weaker attitudes about a given issue are more receptive to new information regarding that issue (e.g., Ahluwalia, 2000). Consequently, we expect a main effect on beliefs and attitudes from messages communicating new expert health guidelines.

H1. Compared to a standard "complete the course" message, the "stop when better" message will result in greater belief and behavioral intent matching the "stop when better" recommendation.

Yet, there may be some important conditional effects based on prior attitudes (Nyhan et al., 2014). If the message contradicts respondents' prior beliefs about how staying with a course of treatment affects antibiotic resistance, then they may be less likely to accept the new guideline.

H2. Message effects will be moderated by their agreement with prior belief about best practice.

Finally, respondents who believe they personally know more about best practice in medical treatment than experts (Motta et al., 2018; Dunning, 2011) will be less influenced than those who believe that experts know more. We refer to the placement of experts' knowledge above one's own as deference to experts.

H3. Message effects will increase with deference to experts.

There may also be spill over effects of exposure to revised guidelines. Because revised guidelines by definition contradict prior consensus, exposure to these might trigger a similar set of negative psychological responses found in studies of conflicting health information (e.g., Nagler et al., 2019). Conflicting information can cause pessimism and feelings of helplessness (Lee et al., 2018; Nagler, 2014; Han et al., 2007), which may manifest in reduced perceived credibility of experts, less acceptance of uncertainty in medical guidelines, lower epistemic efficacy, and spill over effects reducing intended compliance with future guidelines in other domains.

RQ1. Does exposure to revised guidelines result in spill over effects on credibility, acceptance of uncertainty, epistemic efficacy, or general future compliance?

1.2. *Communicating contingency*

Evidence, and expert recommendations drawn from it, are subject to revision as newer data is collected. However, the potential effects of communicating this contingency, particularly in conjunction with new guidelines themselves, are unknown. There are diverging views on how this uncertainty may affect the public. On the one hand, such messaging may reduce overall trust and compliance with experts (Han et al., 2018). Statements made with confidence are more persuasive (Thomas and McFadyen, 1995), and expressing uncertainty can make experts seem less credible. Introducing uncertainty may provoke a set of negative psychological reactions known as ambiguity aversion (Camerer and Weber, 1992). Messages that emphasise the potentially temporary nature of current guidelines, therefore, may induce uncertainty or even backlash about the topic in question (Lee et al., 2018; Dixon and Clarke, 2013; Jensen and Hurley, 2012; Chang, 2013; Nagler et al., 2019) or health research and expert guidance more generally (Chang, 2015; Nagler et al., 2019). Han et al. (2018) find that uncertainty about risk and efficacy reduced vaccination intention for a hypothetical vaccine-preventable disease, and messaging about the expected nature of this uncertainty ("normalized uncertainty"), which parallels our contingency messaging, did not mitigate this outcome.

Conversely, it is possible that explicitly communicating the unsettled nature of scientific and medical knowledge may reduce resistance to new guidelines (Jensen, 2008). As Jensen points out, communicating uncertainty can help maintain the trustworthiness of scientists as a strategy for communicating their objectivity, following Popper's claim about the perpetual tentativity of scientific knowledge (1961). News coverage of medical research that includes "hedges," or details of a study's limitations, has been found to increase the credibility of both scientists and journalists (Jensen, 2008; Jensen et al., 2011). Recent work on climate research communication finds that communicating fully bounded uncertainty (i.e., sea-level rise could be between 1 and 7 ft) increases trust and message acceptance, but these gains were eliminated when acknowledging irreducible uncertainty (the unpredictable exacerbation of sea-level rise effects brought on by global warming-induced storms).

All in all, it is unclear how the specific form of uncertainty or "hedge" we employ — a message about the contingency of all scientific findings, rather than a specific result — will affect public attitudes. We assess the possibilities with a randomized addition of text to both primary messages, allowing us to explore the effects of the presence of an embedded message about scientific evidence's contingent nature.

RQ2. Does a caveat about evolving evidence affect message receptivity (factual beliefs, behavioral intent), or broader issues of credibility, general future compliance, epistemic efficacy, and acceptance of uncertainty?

RQ3. Are "evolving evidence" message effects moderated by prior belief, do they interact with the main message condition, and is there a three-way interaction among these factors?

2. Method

To measure attitudes about antibiotic use and to evaluate the effects of expert messages, we conducted an online-survey experiment in the UK ($N = 1263$) using a stratified quota sample of adults in the UK ages 16 and older. Data were collected in November 2018 through the Internet market research company, Kantar (Kantar also collected the UK data for the Special Eurobarometer 478 on Antimicrobial Resistance in September 2018). Kantar maintains a proprietary opt-in online panel. Subjects are recruited into the general panel by "traditional advertising as well as internal and external affiliate networks." For this specific survey, subjects from the panel were invited by email. Sample size was based on the size of Kantar's GB Online omnibus survey. Quotas were set for age, sex, and region (see Table A1 for demographics). Participants were compensated by Kantar. This research was approved by the institutional review board of the University of Exeter. Respondents who took part in the survey gave their consent. Hypotheses, design, and analyses were pre-registered using the Open Science Framework. Materials, analysis plan, and data available at: https://doi.org/10.17605/OSF.IO/8NFWC. The lead author affirms that the article is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally registered have been explained.

2.1. Design

Our design employed two messages about antibiotic treatment. Prior to exposure, respondents were informed that "[w]e are interested in what people think of the following message being designed to potentially disseminate in the interest of public health. Please read the message carefully and answer the questions that follow honestly." All respondents received either a message about current best practice that patients should complete their course no matter what ($n = 630$) (which serves as our baseline or reference group), or a second message that patients should stop treatment when they feel better ($n = 633$). Participants were randomly assigned to view one of the two messages. Each message included a brief description of disagreement about antibiotics in the news, followed by the randomized suggested course of action. For our indicator variable, exposure to the "stop when better" message was scored as 1, and exposure to the "complete the course" message was scored as 0.

Embedded within this experiment, we also randomized whether each message included a caveat about the contingent nature of medical guidelines (caveat $n = 633$, no caveat $n = 630$; for the indicator variable, exposure to the caveat was scored as 1). Therefore, we employed a fully crossed 2 × 2 factorial design (full course + caveat $n = 316$; full course + no caveat $n = 314$; stop when better + caveat $n = 317$; stop when better + no caveat $n = 316$).

2.2. Procedure

Participants first provided demographic information, as well as pre-treatment knowledge about and attitudes toward antibiotics, and a pre-treatment measure of deference to experts, before reading the treatment message. After considering the message, participants provided responses for outcomes variables. Finally, participants were debriefed using the NHS's discussion of the debate and current guidelines.

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

2.3. Measures

2.3.1. Outcome variables

Early stoppage beliefs were assessed using agreement with the following 7-pt Likert items: "I think that taking antibiotics for longer than necessary increases the risk of antibiotic resistance," and "I think that stopping antibiotic treatment early may encourage antibiotic resistance." Because we structure our analysis to measure the effects of the "stop when better" message relative to the standard "complete the course" message, we subtract the second measure from the first, with the resulting score ranging from −6 to 6 ($M = 0.49$, $SD = 2.41$). We then ask whether participants agree that "most experts" endorse the same statements. Again, the second item was subtracted from the first ($M = 0.41$, $SD = 2.38$). These two difference scores were averaged ($\alpha = 0.82$). Robustness checks show that the early stoppage message significantly affected each belief item, across personal and expert consensus beliefs, in the early-stoppage relevant direction.

Early stoppage behavioral intent ($M = 2.74$, $SD = 1.68$, $\alpha = 0.90$) was measured using the average of two 7-pt Likert items: "How likely or unlikely is it that you would take [would instruct family members to take] the full course of antibiotics for yourself in the future, regardless of how you are feeling at any point in the treatment?" (each reversed such that early-stoppage aligned behaviors scored higher).

A third behavioral item, *general future compliance*, was assessed independently, as robustness checks showed that the message treatment affected it in the opposite direction as the two early-stoppage-specific behavioral intent items. General future compliance ($M = 5.44$, $SD = 1.45$) was measured with the following 7-pt. Likert item: "In general, how likely or unlikely is it that you would follow the guidelines of medical researchers on other issues in the future?"

Credibility was assessed using agreement with the average of four 7-point Likert items: "Medical researchers [doctors] are trustworthy," and "medical researchers [doctors] have a high level of expertise," ($M = 5.44$, $SD = 1.10$, $\alpha = 0.90$).

Epistemic efficacy ($M = 4.27$, $SD = 1.26$, $\alpha = 0.67$) was measured using average agreement with two 7-point Likert items: "I feel confident that I can find the truth about issues in science and medicine," and "If I wanted to, I could figure out the facts behind most scientific and medical disputes," (adapted from Pingree, 2011).

Acceptance of uncertainty ($M = 4.39$, $SD = 0.83$, $\alpha = 0.39$) was measured using average agreement with four 7-point Likert items: "I am comfortable accepting uncertainty in the guidelines issued by medical institutions"; "There is no reason to follow new guidelines because they are always changing anyway" (reverse coded); "New guidelines that contradict old guidelines make me uncomfortable" (reverse coded); and "I prefer to carry out a current medical recommendation even though it may change in the future." These items draw on related research on uncertainty preferences (Carcioppolo et al., 2016; see also Han et al., 2018) but are modified to better match our research questions. The scale exhibits low reliability due to reverse-coding of two items (reversed in order to reduce acquiesence bias). Factor analysis shows the reverse-coded items form a separate subscale ($\alpha = 0.61$) from the other two items ($\alpha = 0.56$). According to our pre-registered analysis plan, we model agreement with each item separately in our robustness check. This analysis reveals that the primary driver of the results we discuss in the main text (the item most affected by the stop message) is agreement with the "I prefer to carry out a current medical recommendation even though it may change in the future" item. Full supplementary analysis is shown in the Appendix.

2.4. Pre-treatment variables

Prior belief was measured using a forced choice item asking which of the following more closely matches the participant's belief: "I think that stopping antibiotic treatment early may encourage antibiotic resistance," (mapping to the pre-existing consensus) or "I think that taking antibiotics for longer than necessary increases the risk of antibiotic resistance," (mapping to the recent counter-argument) or "I don't know." Participants then provided confidence in their belief ("Not at all," "Somewhat," "Very"). The prior belief measure used in statistical models is the resulting 6-point measure with "don't knows" ($n = 221$) excluded, where 6 = very confident that taking longer than necessary increases risk ($M = 4.02$, $SD = 1.89$). Excluding "don't knows" as per the analysis plan resulted in $n = 517$ for the *full course* message treatment and $n = 525$ for the *stop when better* message treatment. Overall, 29.93% responded that "stopping antibiotic treatment early may encourage antibiotic resistance" matched their beliefs more closely, while 52.57% responded that "taking antibiotics for longer than necessary increases the risk of antibiotic resistance" matched their beliefs more closely, and 17.50% were unsure.

Deference to experts was measured with the average of two items asking "Would you say you know more or less than medical doctors [scientists] about what's best for you when it comes to taking a prescribed course of medicine?" Responses ranged from 1 ("I know a lot less") to 6 ("I know a lot more") and were averaged together ($M = 2.32$, $SD = 1.18$, $\alpha = 0.83$), and then reversed such that more deferent scores

Table 1
Frequencies for pre-treatment variables: Concern, knowledge, and deference to experts.

	1 (Strongly disagree)	2	3	4	5	6	7 (Strongly agree)
Antibiotic resistance concern	3.96%	4.28%	5.62%	18.61%	24.94%	22.09%	20.51%
Antibiotics kill bacteria	5.23%	5.54%	7.13%	17.66%	25.02%	22.17%	17.26%
Antibiotics work on colds	33.81%	20.35%	11.56%	14.65%	10.45%	5.94%	3.25%
Antibiotics kills viruses	25.42%	13.06%	8.79%	14.65%	18.46%	13.94%	5.70%
	1 (I know a lot less)	2	3	4	5	6 (I know a lot more)	
Know more or less than medical doctors about taking a prescribed course of medicine	33.10%	25.89%	23.20%	11.56%	4.35%	1.90%	
Know more or less than scientists about taking a prescribed course of medicine	34.52%	26.13%	22.01%	11.08%	4.04%	2.22%	

were higher to aid interpretation (adapted from Motta et al., 2018).

Antibiotics knowledge was assessed by gauging agreement with the following statements about antibiotics on 7-pt. Likert scales: whether they work on most coughs and colds; can kill bacteria; or can kill viruses. In our descriptive analysis, we use the average of these 7-pt. Likert responses, with the two incorrect items (regarding viruses and coughs and colds) reversed.

Antibiotic resistance concern was measured using agreement with a single item using a 7-pt. Likert scale ($M = 5.05$, $SD = 1.57$).

3. Results

We first report descriptive results of pre-treatment knowledge and attitudes about antibiotics. Knowledge was middling, mirroring prior studies in other countries and the U.K. (e.g., André et al., 2010; Hwang et al., 2015;Special Eurobarometer 478, 2018; You et al., 2008). As Table 1 shows, 64% correctly agreed that antibiotics can kill bacteria, but 38% incorrectly agreed that they can kill viruses, and 20% incorrectly agreed that they work on most coughs and colds. Concern about antibacterial resistance was high; just over two-thirds (67.54%) agreed that they are worried about this issue (20.51% "strongly agree," 22.09% "agree," and 24.94% "somewhat agree"). A small but consequential proportion of the sample said they knew slightly more, quite a bit more, or a lot more than medical doctors (18%) and scientists (17%) about best practice with a prescribed course of medicine. Deference to experts and knowledge were correlated (Spearman's rho = 0.14, $p < .001$; or conversely, overconfidence and knowledge were inversely correlated; see Motta et al., 2018).

We tested our hypotheses using ordinary least-squares regression models for each of our outcome variables, using Stata 15. The initial models included indicator variables for both manipulations (the early-stoppage message and the caveat/"evolving evidence" message), and prior belief as a covariate (thus, models included all respondents across the four cells of the experiment, while excluding those who responded "don't know" to the prior belief measure). Subsequently, we assessed the hypothesized prior belief moderation. For comparison, we re-scaled all outcome measures to range from 0 to 1. Main effects across outcomes appear in Fig. 1. For full models, see supplementary materials. Because many of our outcome variables are correlated, we also estimated multivariate regression models as robustness tests. The results are substantively identical to the independently estimated models.

We find that messaging indicating that patients should now stop a course of antibiotics when they feel better to reduce the risk of resistance significantly increased associated factual beliefs ($b = .16$, $SE = 0.01$, $p < .001$) and behavioral intent ($b = 0.19$, $SE = 0.02$, $p < .001$). However, the early-stoppage message decreased general intention to follow new guidelines of medical researchers on other issues in the future ($b = -0.06$, $SE = 0.01$, $p < .001$), and decreased general acceptance of uncertainty in medical guidelines ($b = -0.02$, $SE = 0.01$, $p = .022$). The message did not affect epistemic efficacy or trust in medical experts. Contrary to our expectations (H2a), for no outcomes were these effects contingent on prior belief. In other words, we find that holding contrary beliefs about antibiotics prior to the experiment did not induce resistance to the new guideline. Yet, there is a significant main effect of prior belief.

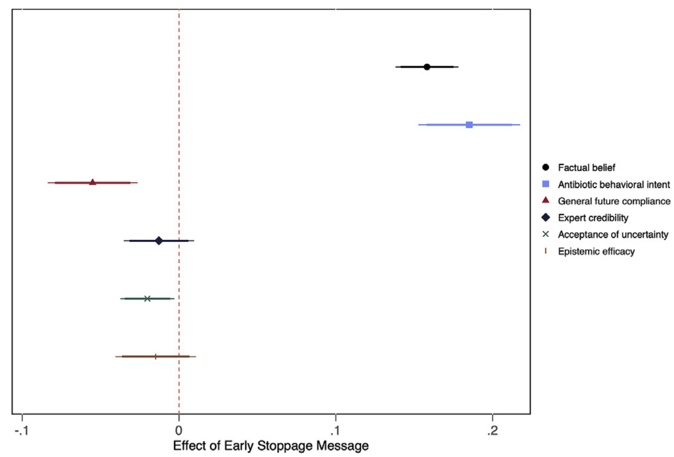

Fig. 1. Effect of early stoppage message. (*Note.* This figure reports OLS parameter estimates for multiple models. Specifically, each horizontal line reports the effect of the early stoppage message (compared to receiving the "complete the full course" message) for each outcome variable. The effect of the early stoppage message treatment is expressed as percent change in each outcome variable (with 95% confidence intervals). Each model controls for prior belief and a randomly assigned contingency message. To aid comparison, all variables are scored to range from zero to one. Factual belief and antibiotic behaviour intent scored such that early stoppage conforming outcomes receive higher values. Full model output can be found in the Supplemental Materials. $N = 1042$.).

We also find that deference to experts moderates the message's effects on factual beliefs ($b = 0.05$, $SE = 0.01$, $p < .001$), behavioral intent ($b = 0.06$, $SE = 0.01$, $p < .001$), and acceptance of uncertainty ($b = -0.02$, $SE = 0.01$, $p = .005$). The moderating effects of deference for factual beliefs and behavioral intent are depicted in Fig. 2. As Fig. 2 shows, for those who are low in deference to experts, there is very little difference in the "stop when better" and "take the full course" conditions, but for those who are higher in deference, there is a large observed difference in the outcome variables based on message treatment condition.

In addition to the primary messaging experiment, we also examined the effects of including a caveat about the contingent nature of current medical advice (RQ2 and RQ3). We found no effects of the caveat on our outcomes of interest. This null effect of the caveat message holds across multiple outcome variables – factual beliefs, behavioral intent,

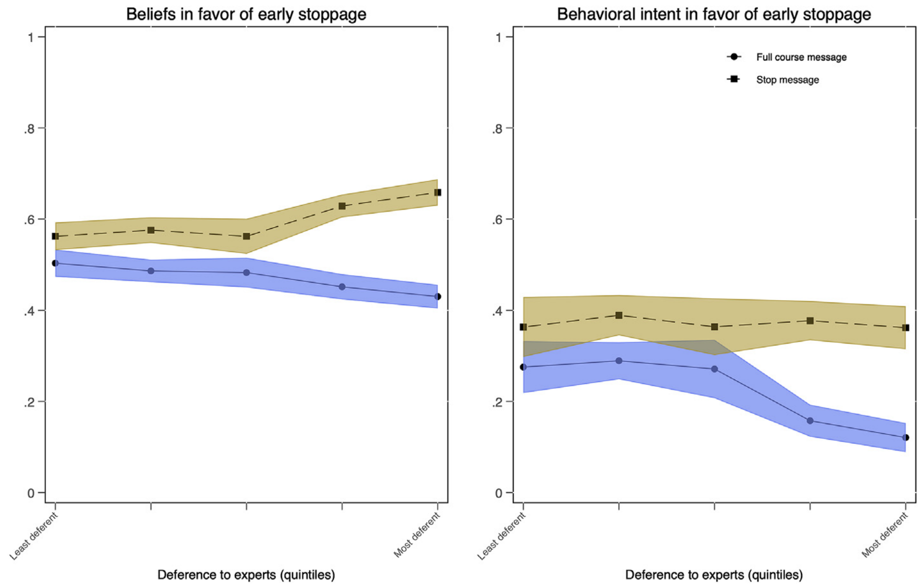

Fig. 2. Message effects on factual beliefs and behavioral intent, across deference to experts. (*Note*. Shaded areas are 95% confidence intervals. $N = 1042$.)

acceptance of uncertainty, expert credibility, general future compliance, and epistemic efficacy (RQ2). Moreover, caveat effects were not moderated by prior belief, nor by early stoppage message condition exposure, and there was no three-way interaction among these factors (RQ3). This type of contingency messaging appears to be too subtle to affect attitudes, as the manipulation check failed (t (1,261) = −0.94, p = .175). This result echoes the null effect of similar "normalized uncertainty" messaging in Han et al. (2018).

4. Discussion

As concerns about antibiotic resistance grow, some researchers have suggested patient guidelines be revised. A large portion of the UK public surveyed in our study hews closer to the stance in favour of early stoppage. In this context, our experiment finds that new guidelines have strong positive effects on beliefs about antibiotic treatment and behavioral intentions (see Fig. 1). Contrary to our expectation, prior beliefs do not condition message acceptance (see Table A4). Yet, we also found that individuals who are less deferential to experts were less likely to take up new recommendations (see Fig. 2). In addition, the new guidelines also appeared to increase general resistance to following future guidelines for other medical issues (see Fig. 1).

Llewelyn et al. (2017) write in their analysis that "[t]here are reasons to be optimistic that the public will accept that completing the course to prevent resistance is wrong if the medical profession openly acknowledges that this is so, rather than simply substituting subtle alternatives such as 'exactly as prescribed.'" While further research is needed to hone any messaging strategy, our results support this contention. Should health organizations decide to shift antibiotic guidelines, the public appears willing to follow specific guidance.

There are still a few points of concern though. While there is no negative spill over from shifting guidelines on perceptions of experts' credibility, patients' intended future compliance with other guidelines is in question. It appears that the public is willing to follow important, specific health recommendations even if they represent a shift from current practice, but at the same time expresses dissatisfaction by reporting lower intention to comply going forward, and accepts less uncertainty going forward. To avoid eroding confidence, guideline changes should be made sparingly. Further, resistance to new guidelines is strongest among members of the public who believe they know more than experts. As a result, some messages may need to be tailored to better reach this subpopulation (see e.g., MacFarlane et al., 2020).

It is also worth reflecting on the null effect of the additional text about evolving evidence. Arguably, even though this messaging failed to positively affect outcomes such as acceptance of uncertainty or perceived credibility of experts, these results can be seen as encouraging. Should these results hold, generalizing beyond the specific context we examine, they would allow public health communicators to more accurately convey the nature of their guidelines and the evidence that underpins them, without prompting negative responses to specific recommendations or expert advice more broadly. The notion of contingency inherent in medical guidelines — and how the public may react — also speaks to broader questions of science literacy. Our caveat manipulation is intended to emphasise a basic fact of the process of science: the evidence base is always evolving. We find that this messaging about process does not affect reactions to a specific guideline shift that is a direct result of this process, but further research on how best to communicate the scientific process in light of conflicts or retractions is needed (Hilgard and Jamieson, 2017; Jamieson, 2018).

Given our theory of message effects and findings, we can speculate about generalizability in terms of geographic contexts and which issues are at the heart of shifting guidelines. Based on similar levels of awareness and concern about antibiotics in other countries (André et al., 2010; Hwang et al., 2015; Special Eurobarometer 478, 2018; You et al., 2008), as well as relatively similar levels of deference to medical experts (Motta et al., 2018), it would be reasonable to expect similar uptake of revised guidelines in the U.S., the rest of Europe, and elsewhere. We may also expect the medical community to be effective in communicating revised guidelines for other low-salience issues that are unlikely to inspire backlash (e.g., the newly revised guideline to avoid daily aspirin unless prescribed [American Heart Association, 2019]). In contrast, revisions concerning more contentious issues, such as vaccine schedules, may be less accepted and subject to more pushback. We may also see less acceptance on issues for which there is already guideline-shift fatigue, such as red meat consumption (Kolata, 2019).

4.1. Limitations

There are important limitations to our study. Our design employed experimental vignettes, which limit external validity despite their established relevance in the study of strategic health communication and allowance for causal inference. Field experiments are needed to examine how such messages may persuade as they vie for attention outside a controlled setting. Likewise, our design only allowed for us to measure behavioral intention, although studies show intention is linked with observed behaviour (Webb and Sheeran, 2006).

Alternatively, it is worth reflecting on the implications of receptivity to new medical guidelines in the absence of source cues or evidence. Although respondents were informed that they were evaluating messages that may be "disseminate [d] in the interest of public health," we did not attribute the messages to any specific medical or health organization, reasoning that to do so would be unethical. Furthermore, the revised guidelines did not present specific evidence backing the shift, instead referencing expert consensus. As such, credible sources are critical in the dissemination of new health information, particularly if it contradicts prior beliefs (Bode and Vraga, 2018), and evaluating evidence is crucial in reaching informed health decisions (Verhoef et al., 2007). Arguably, that our respondents were receptive to the message without these components may suggest too much credulity on behalf of the public. Future work may seek simultaneously to examine compliance with medical experts as well as appropriate skepticism of unsupported claims by randomizing source and evidence within revised guideline messages.

5. Conclusions

Medical associations and health organizations should be aware of the influence their messaging on revised antibiotic guidelines can have going forward, as the debate about best practice continues in the face of growing concern about antibacterial resistance. The results of the current study also speak to the broader impact of shifting medical guidelines on the public. Communicating in the interest of the public health means considering not only the effects of revised guidelines on behaviours of immediate interest, where our results suggest we are more likely to see compliance, but also on downstream attitudes about expert recommendations in general. Frequent revisions may result in the slow erosion of public confidence.

Data sharing statement

All data and analysis scripts, along with materials and analysis plan, are permanently available at the site of the trial registration. https://doi.org/10.17605/OSF.IO/8NFWC.

Declarations of interest

None.

Author contributions

BL, JR, and VM conceptualized the study, BL designed the experiment, JR and VM provided feedback on the design, BL conducted the analyses, VM and JR provided feedback on the analyses, BL and JR created the figures, BL drafted the manuscript, JR and VM revised the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2020.112943.

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