Cognitive Bias in Postoperative Opioid-Prescribing Practice
A Novel Effect

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Background: Given that excess opioid prescriptions contribute to the US opioid epidemic and there are few national opioid-prescribing guidelines for the management of acute pain, it is pertinent to determine whether prescribers can sufficiently assess their own prescribing practice. We investigated podiatric surgeons' ability to evaluate whether their own opioid-prescribing practice is less than, near, or above that of an "average" prescriber.

Methods: We administered a scenario-based, voluntary, anonymous, online questionnaire consisting of five surgery-based scenarios commonly performed by podiatric surgeons. Respondents were asked the quantity of opioids they would prescribe at the time of surgery. Respondents were also asked to rate their prescribing practice compared with the average (median) podiatric surgeon. We compared self-reported behavior to self-reported perception ("I prescribe less than average," "I prescribed about average," and "I prescribe more than average"). Analysis of variance was used for univariate analysis among the three groups. We used linear regression to adjust for confounders. Data restriction was used to account for restrictive state laws.

Results: One hundred fifteen podiatric surgeons completed the survey in April 2020. Less than half of the time, respondents accurately identified their own category. Consequently, there were no statistically significant differences among podiatric surgeons who reported that they "prescribe less," "prescribe about average," and "prescribe more." Paradoxically, there was a flip in scenario 5: respondents who reported they "prescribe more" actually prescribed the least and respondents who believed they "prescribe less" actually prescribed the most.

Conclusions: Cognitive bias, in the form of a novel effect, occurs in postoperative opioid-prescribing practice; in the absence of procedure-specific guidelines or an objective standard, podiatric surgeons, more often than not, were unaware of how their own opioid-prescribing practice measured up to that of other podiatric surgeons. (J Am Podiatr Med Assoc 113(3), 2023)

Of the 70,630 drug overdose deaths in the United States in 2019, 70.6% involved opioids, the procurement of which can be directly and indirectly traced to prescribing practices[1]; in the same year, 37.5% of opioid misusers obtained them from prescriptions or stole them from physicians.[1,2] A further 50.8% of opioid misusers last obtained opioids from a friend or relative, a problematic reflection of the commonly known opioid reservoir maintained by variable prescription rates and, notably, excessive postoperative prescription.[2-4] Importantly, prescribing standards can lessen excessive prescription, and national standards for opioid prescribing in chronic pain are available, but postoperative opioid-prescribing standards are not well elucidated for common podiatric procedures.[5,6] Postoperative

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opioid prescription after foot and ankle surgery in particular has been noted to be both excessive and variable[7,8]; Brooks et al[7,9] were the first to demonstrate that clinically meaningful opioid-prescribing variation exists on the national level among podiatric surgeons at the National Scientific Conference of the American Podiatric Medical Association (APMA) in 2020.

Central to the reduction of postoperative opioid prescribing in podiatric medicine is the dearth of prescribing data and standards; whereas in other fields prescriber awareness of opioid consumption and prescribing trends has been shown to reduce postoperative opioid prescription, podiatric surgeons have comparably very few data with which to become aware.[10,11] Reduction efforts necessarily then depend on assessment of postoperative podiatric opioid-prescribing practices and provider awareness in the status quo such that standardization and educational interventions may later be introduced.[12,13] Previous exploration into postoperative prescribing has indicated that rather than instantiating blanket prescription standards, procedure-specific opioid-prescribing standards should be pursued, but spillover reduction in opioid prescription may be observed for nonstandardized procedures given evidence-based potential for spillover into other realms as well. [12,13] An assessment of podiatric surgeons' awareness of postoperative opioid prescription trends has not been previously studied.

In the absence of prescribing standards and data, variation in postoperative opioid prescription by podiatric surgeons may be attributed to subsequent reliance on individual factors such as experience and education; it remains unknown the role of cognitive bias regarding postoperative opioid-prescribing practice, although cognitive bias has been explored in other various prescribing contexts.[7,14-17] For example, cognitive bias in the Dunning-Kruger effect occurs in one's estimation of their own competence, which may not be indicative of their actual competence. The present study, to our knowledge, is the first to explore the possibility of cognitive bias in opioid-prescribing practice. We assessed for cognitive bias in podiatric surgeons' perceptions of their postoperative opioid-prescribing habits relative to average podiatric prescribing trends in the United States and hypothesized that cognitive bias would result in most podiatric surgeons being unable to correctly identify their own postoperative opioid-prescribing habits as above, below, or near the national average.

Methods

Research Design

We received exempt status from the Committee for the Protection of Human Subjects at Dartmouth College (Hanover, New Hampshire) for an open, voluntary, anonymous, five-scenario, online questionnaire distributed on the internet via Qualtrics (Qualtrics, Seattle, Washington), an online survey platform that uses panel-based sampling to reach specific demographic groups. Content validity was established through an extensive review of the literature in September 2019 and by the members of the 2019–2020 Clinical Practice Advisory Committee of the APMA, who served as content experts. Respondents received no incentive for survey completion and could use a back button to revisit their answers. No personal or identifiable information was stored. We completed the pilot study in 2020. Given the amount of data collected and the extent of the a priori analytic plan, we decided a posteriori to break the original study into separate publications. This study adhered to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES), located in Appendix 1. The five scenarios are described in Appendix 2.

Sample, Data Collection Process, and Questionnaire

The target population was practicing podiatric surgeons in the United States. We recruited practicing podiatric surgeons through e-mail invitation from the APMA's membership list, which consisted of approximately 8,736 members who fit the eligibility criteria. Retired podiatric surgeons, podiatric surgeons who no longer perform surgery, current fellows, and residents were excluded. Survey respondents who did not complete the demographics section, which was at the end of the questionnaire, were also excluded from analysis. Respondents who skipped or did not answer certain scenarios were still included as long as they answered at least 3 scenarios and the demographics section.

The survey took an estimated 10 to 15 min to complete. There were 120 questions in the survey; however, we used conditional branching, which resulted in no more than 60 questions generating for respondents who opted to prescribe no more than one opioid per scenario. Two survey invitations were sent out via e-mail to the APMA's membership list during the data collection period, which occurred during

April 2020. The consent statement (Appendix 3), which was provided at the beginning of the survey, asked participants to respond to the questionnaire only once. Respondents were presented with five different scenarios, each with a different but common limb preservation surgery performed by podiatric surgeons. For each scenario, respondents were asked to complete a fill-in-the-blank response for the number of opioid pills (dosage units) prescribed at the time of surgery. Demographic data were also collected, and in the demographics section, respondents were asked to rate their own opioid-prescribing practice (self-perception); to capture this, we asked respondents to compare their opioid-prescribing practice with that of the average podiatric surgeon practicing in the United States by rating their prescribing practice as "more than," "less than," or "about average" compared with the average podiatric surgeon.

Statistical Analysis

We analyzed the data using R version 4.0.3 (R Foundation for Statistical Computing, Vienna, Austria). Completed surveys were analyzed at a predefined $\alpha \leq .05$ for statistical significance. Unweighted responses were analyzed. Analysis of variance was used for the self-perception univariate analysis. To adjust for confounding in the analysis stage and given the exploratory nature of the study, we decided a posteriori to adjust for all basic demographics, which served as explanatory variables in the linear regression model. We decided a priori to have "prescribes about average" be the referent group. All of the assumptions for linear regression were met. We also completed a second data-restricted analysis of variance as well as linear regression models by eliminating respondents practicing in states that have opioid-prescribing laws for acute pain that are stricter than 7 days to account for these laws.

Variables of Interest

Number of pills prescribed (opioid dosage units) at the time of surgery was the dependent variable for the linear regression models. We also aimed for a descriptive breakdown of self-reported opioid dosage units prescribed at the time of surgery. We decided a priori to have three self-reported opioid groups: "below average," "average," and "above average." Note that these three groups do not represent self-perception but rather self-reported opioid quantities. We established a priori that below average represented greater than 20% below the national median, average represented the national median and 20% below and above it, and above average represented greater than 20% above the national median.

Results

Descriptive Results

The survey was sent to 8,763 APMA members who met the inclusion criteria. There was a completion rate (defined as completing at least 3 of 5 scenarios and the demographics section at the end of the questionnaire) of 89.84% (115 of 128). The final sample included 115 podiatric surgeons who completed 100% of the survey, resulting in an overall response rate of 1.32% (115 of 8,736). Without adjusting for other variables, most of those who identified as "prescribes less" and "prescribes more" prescribed that way in only two of five scenarios. Respondents who identified as "prescribes average" actually prescribed average in only three of five scenarios. Most of the time, respondents' self-perception did not align with their self-reported opioid dosage units prescribed at the time of surgery (Table 1). The demographic characteristics of the respondents are provided in Table 2.

Univariate Analyses

There was no statistical significance noted in the complete sample (Table 3). Once we restricted the data by removing respondents who practiced in states with strict opioid-prescribing laws for acute pain, which we defined as limiting opioid prescriptions for less than 7 days, there was still no statistically significant difference by self-perception (Table 4).

Regression Analysis

Adjusting for age, sex, practice environment, practice location, board certification, practice region, and practicing since pain was included as the fifth vital sign, there was no statistically significant different among respondents who reported that they "prescribe more" compared with those who reported that they "prescribe less" or "prescribe average" (Table 5). After restricting the data by removing respondents who practiced in states with strict laws for opioid prescribing for acute pain, there was still no statistically significant difference by self-perception (Table 6). Although not statistically significant, in scenarios 2, 4, and 5, podiatric surgeons who reported that they "prescribe more" actually prescribed less than the "prescribes

Table 1. American Podiatric Surgeons' Self-Perceived Opioid-Prescribing Practice Compared with the "Average Podiatrist" versus the National Median

Scenario	Self-perception: "I prescribe. . ."	Self-Reported Reality (%)[a]		
		Less than Average (>20% Below Median)	Average (Median ± 20%)	More than Average (>20% Above Median)
Scenario 1	Less than average	5	12	7
Median = 20[b]	Average	15	20	29
	More than average	2	2	7
Scenario 2	Less than average	7	13	9
Median = 20[b]	Average	15	20	28
	More than average	4	2	2
Scenario 3	Less than average	17	13	1
Median = 28[b]	Average	23	33	6
	More than average	1	6	0
Scenario 4	Less than average	16	14	0
Median = 28[b]	Average	21	31	8
	More than average	3	6	1
Scenario 5	Less than average	5	8	17
Median = 24[b]	Average	13	25	22
	More than average	3	2	5

[a]Values are rounded to the nearest percentage.
[b]Median number of opioid dosage units prescribed.

average" group. Furthermore, in scenario 5, podiatric surgeons who reported that they "prescribe more" actually prescribed less than those who reported that they "prescribe less." Which, in turn, means that in scenario 5, podiatric surgeons who reported that they "prescribe less" actually prescribed more than those who reported that they "prescribe more"; this occurred in both the full data and the restricted data analyses.

Discussion

Summary of Findings

In this nationwide cross-sectional study of 115 podiatric surgeons, most respondents' self-reported opioid-prescribing practice did not align with their own self-perception of it, even when the data were restricted by removing states with strict prescribing laws. Those who believed that they prescribed less than average did not always prescribe less, and those who believed that they prescribed more than average typically prescribed less than average. Furthermore, in scenario 5 there was a paradoxical flip, where those who believed that they prescribe less actually prescribed the most and those who believed that they prescribe more actually prescribed the least. Despite all of the explanatory variables being included in the regression models, there still was no statistically significant difference in self-perception. The lack of statistically significant differences between self-perception groups suggests that self-perception and actual prescribing practice do not necessarily align.

The national median quantity of opioids prescribed by this study's sample was almost identical to that in a similar study by Brooks et al[7] (n = 860), suggesting that despite the relatively low study sample size (n = 115), the national median that was used to determine the "average" in the descriptive results was reasonable.

A Novel Effect

A true Dunning-Kruger effect is seen when a person with less experience overestimates their abilities and at the same time an experienced person underestimates their own abilities.[18] For example, a recent study tested participants on item recognition and asked them how they thought they performed relative to the others.[19] The resulting answers showed that those in the bottom 25th percentile overestimated their abilities and those in the top 75th percentile ranked themselves lower than they were.[19] Thus, as participants became more qualified, their confidence in themselves dropped, whereas the less qualified participants displayed high confidence levels.[19] A somewhat similar observation was noted in this cross-sectional study; however, the effect that we describe is not a true Dunning-Kruger effect because competence was

Table 2. Demographic Characteristics of the 115 Survey Respondents

Characteristic	Respondents (No. [%])
Sex	
Female	28 (24)
Male	86 (75)
Unknown	1 (1)
Board certification	
Yes	76 (66)
No	38 (33)
Unknown	1 (1)
Primary practice region	
Northeast	25 (22)
Midwest	29 (25)
South	34 (30)
West	20 (17)
Unknown	7 (6)
Practice location	
Urban	30 (26)
Suburban	63 (55)
Rural	20 (17)
Unknown	2 (2)
Practice environment	
Academic	4 (3)
Solo private practice	34 (30)
Group practice	
2–4 physicians	31 (27)
≥5 physicians	22 (19)
Federal services	8 (7)
Hospital/health system	15 (13)
Unknown	1 (1)

not assessed. In this study, cognitive bias occurred when prescribers could not accurately determine how their prescribing practices compared with those of their peers or "the average podiatric surgeon," with some prescribers who believed that they prescribe less when in reality they actually prescribe well above the national median; these podiatric surgeons overestimate their own abilities or at least fail to understand what "the average podiatric surgeon" actually prescribes. Cognitive bias also occurred when prescribers who believed that they prescribed more actually prescribed less. Given the context of the climate of the current opioid epidemic, which has led to many prescribers attempting to reduce excess opioid prescriptions, understanding the impact of this novel effect may be key to stemming the overprescription of postoperative opioids.[20,21]

Table 3. Analysis of Variance Results for Self-perception of Opioid-Prescribing Practice

Scenario No.	*P* Value
1	.70
2	.814
3	.40
4	.164
5	.84

Table 4. Analysis of Variance Results for Self-perception of Opioid-Prescribing Practice with Data Restricted by State Laws

Scenario No.	*P* Value
1	.697
2	.849
3	.395
4	.148
5	.840

Similar Observations in Other Specialties

Few studies exist on the variation of opioid prescriptions among podiatric surgeons; however, there have been variations noted in other specialties.[22] A study published in 2018 noted that "a subset of 10% of orthopedic surgeons prescribed more than one third of the total narcotic medications" in their field.[22] This same study also found that there was a variation in opioid prescriptions not only by region but even by state, finding that there was a "nearly 4-day difference in narcotics prescription duration by orthopedic surgeons in New York compared to those in Vermont."[22] Another study found that between 2013 and 2016, orthopedic surgeons who were male, lived in the South, and had an osteopathic degree prescribed significantly more than other orthopedic peers.[23] Although these studies did not directly suggest that the Dunning-Kruger effect or another effect related to cognitive bias when it came to opioid prescriptions, cognitive bias may explain a portion of the variation.

In 2020, Ahmed and Walsh[24] published a study of general surgery trainees, who were asked how many cholecystectomies they had performed and whether they would be comfortable performing one. Of the 24 surgeons who had performed two or fewer procedures, 16 stated that they would be "somewhat comfortable" performing one independently, and two said that they would be "very comfortable."[24] This high confidence level in the face of blatant inexperience may suggest cognitive bias.[24] Furthermore, a study published by Titan et al[25] showed that when given guidelines for opioid prescriptions after surgeries performed by general surgeons, the quantity of opioids prescribed decreased significantly, yet 91.4% of patients still reported

Table 5. Linear Regression Models for Self-perception of Opioid Dosage Units Prescribed at the Time of Surgery[a]

Predictor	Estimate	95% CI	*P* Value
	Scenario 1		
(Intercept)	23.96	19.63 to 28.29	<.001[b]
I prescribe less than average	–2.56	–10.77 to 5.65	.531
I prescribe more than average	2.24	–8.54 to 13.01	.676
	Scenario 2		
(Intercept)	22.5	19.53 to 25.47	<.001[b]
I prescribe less than average	–1.13	–6.38 to 4.13	.669
I prescribe more than average	–2.5	–11.66 to 6.66	
	Scenario 3		
(Intercept)	26.6	24.11 to 29.10	<.001[b]
I prescribe less than average	–2.83	–7.13 to 1.46	.193
I prescribe more than average	0.4	–7.35 to 8.14	.919
	Scenario 4		
(Intercept)	27.81	24.90 to 30.73	<.001[b]
I prescribe less than average	–4.81	–9.90 to 0.27	.063
I prescribe more than average	–0.1	–7.88 to 7.68	.98
	Scenario 5		
(Intercept)	23.44	20.26 to 26.63	<.001[b]
I prescribe less than average	1.33	–4.18 to 6.84	.63
I prescribe more than average	–0.94	–9.36 to 7.47	.823

[a]The models are also adjusted for age, sex, practice environment, practice location, board certification, and practice region.
[b]Statistically significant.

alleviation of pain. Given that in 2015, 12.8% of patients who were prescribed opioids misused or abused them at some point,[21] the 91.4% of patients whose pain was alleviated may be even higher because the study could not adjust for drug-seeking behavior, which commonly leads patients to deny alleviation of pain.[21] So, if the goal of opioid prescription is to alleviate pain, and some surgeons are regularly prescribing much more than necessary to reach this goal, we are left again questioning whether this widespread overprescribing may be partly due to this novel effect.

Table 6. Linear Regression Models for Self-perception of Opioid Dosage Units Prescribed at the Time of Surgery with Podiatric Surgeons Practicing in States with Strict Opioid Laws (<7 Days) Removed[a]

Predictor	Estimate	95% CI	*P* Value
	Scenario 1		
(Intercept)	24.12	19.65 to 28.59	<.001[b]
I prescribe less than average	–2.72	–11.08 to 5.64	.514
I prescribe more than average	2.08	–8.86 to 13.02	.702
	Scenario 2		
(Intercept)	22.34	19.24 to 25.45	<.001[b]
I prescribe less than average	–0.97	–6.34 to 4.40	.719
I prescribe more than average	–2.34	–11.65 to 6.96	.615
	Scenario 3		
(Intercept)	26.68	24.10 to 29.27	<.001[b]
I prescribe less than average	–2.91	–7.28 to 1.46	.188
I prescribe more than average	0.32	–7.52 to 8.15	.936
	Scenario 4		
(Intercept)	28	25.05 to 30.95	<.001[b]
I prescribe less than average	–5	–10.12 to 0.12	.055
I prescribe more than average	–0.29	–8.10 to 7.53	.942
	Scenario 5		
(Intercept)	23.44	20.26 to 26.63	<.001[b]
I prescribe less than average	1.33	–4.18 to 6.84	.63
I prescribe more than average	–0.94	–9.36 to 7.47	.823

[a]The models are also adjusted for age, sex, practice environment, practice location, board certification, and practice region.
[b]Statistically significant.

A Path Forward

Recognizing cognitive bias is essential to improving patient care through behavioral change on the part of physicians. As Mariam Ramani suggested in 2020 after observing large variability between residents' capability and their observed competence, assessments that are "completed by a variety of faculty, peers, patients, and staff" should hold more weight than a resident's self-evaluation.[26] The article goes on to mention that "self-doubt is a critical step" when it comes to improved performance.[26] Because physicians are always improving and "practicing" their craft as new evidence comes to light,[27] this advice should be taken to heart.[26] The same principle applies to postoperative opioid-prescribing habits. Empowering prescribers with a way to accurately measure their own prescribing habits is one of the benefits of guidelines for postoperative prescribing practice, which would serve as an appropriate range of opioid dosage units to allow for patient-centric and procedure-focused care.

Limitations

There are a few limitations of the presented study. Although social desirability bias is a form of cognitive bias, it is difficult to parse from the novel effect that we described. One of the limitations was the low response rate. The 1.3% response rate (n = 115) limits generalization of the findings to all of the podiatric surgeons practicing in the United States. However, this response rate may provide sufficient power for the analysis to suggest any statistical significance in the analyses. Furthermore, there may be a discrepancy between what respondents said they would do and what they actually do. The interpretation of the presented scenarios may also depend on the individual respondents. To mitigate this potential limitation, we had tested the survey questions before its dissemination and followed the CHERRIES checklist. Although we attempt to capture the represented population via the APMA, its membership may not accurately serve as a proxy for the entire podiatric surgeon population in the United States. In addition, the scenarios presented in this study were primarily limb salvage surgeries; it is unknown whether other surgeries, such as elective foot and ankle surgeries, would yield similar results. Although there are several inherent limitations, this study was the first attempt to investigate the impact of self-perception on opioid-prescribing behavior among podiatric physicians and surgeons in the United States.

Conclusions

Cognitive bias, in the form of a novel effect, occurs in postoperative opioid-prescribing practice; in the absence of procedure-specific guidelines or an objective standard, podiatric surgeons, more often than not, were unaware of how their own opioid-prescribing practice measured up to that of other podiatric surgeons. We believe that this novel effect is a clinically meaningful phenomenon that needs to be accounted for by the stakeholders of the US opioid epidemic. This effect may explain a portion of the variation seen in opioid-prescribing practice. Furthermore, if prescribers cannot identify how their prescribing practice stacks up, there may be a need for national guidelines and/or further opioid education. Additional research is warranted to determine the extent and impact of cognitive bias on postoperative prescribing practices in podiatric medicine and other surgical specialties.

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Disclaimer: The contents do not represent the views of the US Department of Veterans Affairs or the US Government.
Note: The first author and corresponding author, when first planning this project, were inspired by Saint Leo (patron of their undergraduate university, Saint Leo University); these two authors prefer to call this novel effect the "Saint Leo Effect."

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APPENDIX

Appendix 1. Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

Checklist Item	Explanation	Page No.
Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	2
IRB approval	Mention whether the study has been approved by an IRB.	2
Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	2, appendix 3
Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	2
Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	2–3
Open survey versus closed survey	An "open survey" is a survey open for each visitor to a site, and a closed survey is open only to a sample that the investigator knows (password-protected survey).	2
Contact mode	Indicate whether the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	2–3
Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers) or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix.	2–3
Web/e-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	NA (Qualtrics)
Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could preselect the sample or influence the results. For example, a survey about vaccination on an anti-immunization Web site will have different results from a Web survey conducted on a government Web site.	2
Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	2
Incentives	Were any incentives offered (eg, monetary, prizes, or nonmonetary incentives such as an offer to provide the survey results)?	2
Time/date	In what timeframe were the data collected?	3
Randomization of items or questionnaires	To prevent biases, items can be randomized or alternated.	NA
Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions.	NA
No. of items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	2
No. of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	NA
Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes," how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a nonresponse option such as "not applicable" or "rather not say," and selection of one response option should be enforced.	NA (Qualtrics)
Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step that displays a summary of the responses and asks the respondents if they are correct).	2

Appendix 1. continued

Checklist Item	Explanation	Page No.
Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available based on IP addresses or cookies or both.	NA (Qualtrics)
View rate (ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary.	NA (Qualtrics)
Participation rate (ratio of unique visitors who agreed to participate/ unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a box), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	NA (Qualtrics)
Completion rate (ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is relevant only if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that "completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate.")	3
Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	NA
IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	NA
Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	NA
Registration	In "closed" (nonopen) surveys, users need to log in first, and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	NA (open survey)
Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires that terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	2–3
Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cutoff point, and describe how this point was determined.	NA
Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the nonrepresentative sample; if so, please describe the methods.	3–5

Abbreviations: IRB, institutional review board; NA, not applicable.

This checklist has been modified from Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res 6: e34, 2004 [erratum in J Med Internet Res 14: e8, 2012]. Article available at https://www.jmir.org/2004/3/e34/; erratum available at https://www.jmir.org/2012/1/e8/. Copyright © Gunther Eysenbach. Originally published in the *Journal of Medical Internet* Research, September 29, 2004, and January 4, 2012, respectively. [Mismatch].

Appendix 2. Patient Scenarios

Patient 1

A 56-year-old woman with a history of poorly controlled type 2 diabetes mellitus (hemoglobin A_{1c} level, 10.5%), hypertension, and a body mass index of 35 presents for a neuropathic ulceration of the left second toe due to clawing of the digit. The patient is unsure of when it began but noticed stains on her carpet when she went barefoot. The left second digit is rigidly contracted. The ulceration is purulent and probes deep to bone. Radiographic findings are consistent with osteomyelitis. The patient denies pain and use of opioids.

Operation: left second toe partial amputation

Patient 2

A 67-year-old man with a history of poorly controlled type 2 diabetes mellitus (hemoglobin A_{1c} level, 9.5%), hypertension, hyperlipidemia, and chronic kidney disease stage 2 presents for chronic sub–fifth metatarsophalangeal joint plantar neuropathic ulceration. The ulceration began almost 1 year ago and has been worsening during the past few weeks. Previously, the patient had been following up at a wound care center for serial debridement but stopped going because his ulceration never hurt him. He now reports 2 of 10 pain. You note fluctuance on examination, and plain film radiographs are concerning for soft-tissue emphysema and osteomyelitis of the fifth metatarsal head as well as the base of the fifth proximal phalanx. His 1-month-old noninvasive vascular studies were unremarkable. The patient has palpable dorsalis pedis/posterior tibial pulses. He denies previous opioid use and has been taking over-the-counter ibuprofen for pain.

Operation: right lateral forefoot incision and drainage with a partial fifth-ray amputation

Patient 3

A 57-year-old man with a history of poorly controlled type 2 diabetes mellitus (hemoglobin A_{1c} level, 12.7%), chronic kidney disease stage 1, and a previous left partial first-ray amputation presents with a chronic left second sub–metatarsophalangeal joint wound that probes to bone. The ulceration is red, hot, swollen, and warm with purulence. The patient reports no pain. Protective sensation is absent plantarly and diminished elsewhere to the level of the ankle joint. Radiographs reveal underlying osteomyelitis of the second metatarsal head and proximal shaft. Palpable dorsalis pedis/posterior tibial pulses are present bilaterally. Vascular laboratory studies suggest good healing potential. The patient reports never taking opioids.

Operation: left transmetatarsal amputation with a percutaneous tendo-Achilles lengthening

Patient 4

A 55-year-old nondiabetic man with a history of cauda equina complicated by paraplegia presents with a chronic right heel pressure ulcer that probes to bone. The ulceration began more than a year ago. There is evidence of osteomyelitis of the right calcaneus on radiographs and magnetic resonance images. The patient had previously undergone 6 weeks of intravenous antibiotic drug therapy. The wound has continued to worsen despite multiple attempts at o-loading. Palpable pedal pulses are found bilaterally. The patient has chronic pain due to his spinal cord injury and regularly takes hydrocodone 10 mg.

Operation: right partial calcanectomy

Patient 5

A 62-year-old man with a history of poorly controlled type 2 diabetes mellitus (hemoglobin A_{1c}, 9.5%), low back pain, hypertension, hyperlipidemia, peripheral artery disease, and Charcot's neuroarthropathy is referred to you for foot pain. The patient has bounding pedal pulses and reports 4 of 10 pain. A magnetic resonance image reveals a deep abscess secondary to his Charcot. You perform an incision and drainage of the deep abscess. After completing the incision and drainage, the resulting wound is too large for primary closure; even after the use of negative pressure wound vacuum-assisted closure therapy, which improved the wound depth, the wound remains open. The patient reports daily use of hydrocodone 5 mg for his low back pain.

Operation: debridement and application of a split-thickness skin graft to right plantar midfoot

Appendix 3. Consent Statement

Postoperative Narcotic Prescribing Practices in Podiatric Limb Salvage Surgery Hello! We are interested in understanding the postoperative prescribing practices of podiatrists following limb salvage surgeries. We are inviting you to participate in this questionnaire-based research study because of your expertise and experience as a podiatrist practicing in the United States. This questionnaire contains five hypothetical patient scenarios based on an aggregate of patients seen by podiatrists. Participation is voluntary and we appreciate your input. Please review the entire form before agreeing to participate if you choose to do so. This study is being conducted by: Brandon Brooks, DPM; Co-Primary Investigator, Dartmouth College, Geisel School of Medicine. Kristina Wol, PHD MPH; Co-Primary Investigator, Dartmouth College, Geisel School of Medicine Please ask any questions you have now. If you have questions later, you may contact Brandon Brooks, DPM, at brandon.m.brooks.gr@dartmouth.edu or Kristina Wol, PhD, at Kristina.b.wol@dartmouth.edu. Procedures: If you agree to be in this study, please answer questions to the best of your ability. If a question is not completely applicable to you, you may either skip the question or answer “what you would have done” in that situation. Please only take the survey once. This questionnaire should take approximately 10 to 15 minutes of your time. Confidentiality and Anonymity: Your responses and information collected via the questionnaire will be maintained confidentially. The results of this study will be kept private and only reported in aggregate. Identifying information will not be used in any presentation or paper written about this project. Research records will be stored securely and only the co-primary investigators will have access to the raw data. Voluntary Nature of the Study: Participation in this study is voluntary. If you decide to participate, you are free to not answer any question or to withdraw at any time. If you decide not to participate, we appreciate your time and consideration. Statement of Consent: I have read the above information and agree to take part in the study.

Yes

No