Journal of Pharmaceutical Health Services Research, 2023, **14**, 35–41
https://doi.org/10.1093/jphsr/rmac056
Advance access publication 6 January 2023
Research Paper

JPHSR Journal of Pharmaceutical Health Services Research

OXFORD

Japanese pharmacists' information strategy using behavioural economics: provision of numerical information with 'peak-end rule' improves willingness to take a hypothetical medication

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Abstract

Objectives Low medication adherence is considered a cause of exacerbated diseases and greater economic losses. Hence, information strategies that improve patients' willingness to take medications have received considerable attention. Newer information strategies that utilise the 'peak-end rule' proposed in behavioural economics were investigated in this study to advance strategy development.

Methods An online scenario survey was conducted among adults aged 20–79 years in Japan. One of four medication counselling videos on a hypothetical hypertension drug narrated by a pharmacist was viewed by the respondents and their willingness to take the medication was evaluated. The four scenarios differed according to the presence or absence of risk probability and the order in which risk and benefit were provided.

Key findings The responses of 383 participants were analysed and the results revealed that providing risk probability increased their willingness to take medication (3%), whereas the estimated risk probability by the participants was 28.7% on an average when no numerical probability was provided. Moreover, when risk probability was provided in a benefit/risk order, the willingness to take medication increased than in the risk/benefit order.

Conclusions The participants' willingness to take medication improved when the pharmacists provided risk probability; this helped participants comprehend that the risk probability was lesser than their assumptions. Moreover, the participants' attention to the numeric information in medication counselling can be elicited by the peak-end rule. The findings from the hypothetical scenarios employed in this study merit further testing in real-life situations for clinical application.

Keywords : Health services research; pharmaceutical HSR

Introduction

Low medication adherence is considered a cause of exacerbated diseases, increased healthcare costs, and an increased mortality rate.[1–3] Approximately 50% of patients do not take their prescribed medications as instructed by healthcare professionals.[4] In the United States (USA), the annual economic losses due to non-adherence ranged from $5271 to $52 341 per person.[5] In asymptomatic chronic diseases, for example, 83.7% of medication non-adherence was reported in patients with uncontrolled hypertension.[6] Furthermore, lower success rates in hypertension treatment have been attributed to low medication adherence among Asians when compared to other countries.[7] Hence, information strategies to improve patients' willingness to take medication are topics of considerable interest.[8]

Several information strategies have recently been developed for healthcare personnel to provide effective medication counselling.[9, 10] When the likelihood of medication-related adverse events (risks) is verbally described (e.g. 'rarely'), patients tend to believe that the risk is actually higher.[11] In contrast, specifying the actual risk probability reduces the patients' risk evaluation of the medication,[12] and increases their willingness to take the medication.[13, 14] Hence, patients' perception that the provided risk probability is lesser than expected, improves their willingness to take the medication.

However, the appropriate time to provide risk probabilities has rarely been examined. In behavioural economics, experience evaluation is strongly influenced by its most intense part and at the end, and is known as the peak-end rule.[15–17] For example, an inexpensive reward followed by a luxurious reward is positively evaluated than vice versa.[15] Therefore, more attention is paid to the peak experience that occurs at the end of an event. Moreover, increased willingness to take medication when risk probability is provided has been

Received: 5 November 2022 Accepted: 24 November 2022

reported,[13, 14] suggesting that risk probability is an important factor (peak) that gains the patient's attention. Therefore, if the risk probability is provided at the end of the medication counselling, it may gain more attention, and willingness to take medication may further increase than with conventional methods alone.

The order effect of medication counselling has rarely been reported. A scenario study in the USA on physicians' medication counselling reported that the benefits of medication were highly valued when the risks were conveyed after the benefits than vice versa.[18] However, the order effect on the willingness to take medication has not been verified. More than 70% of outpatients in Japan are provided prescription drugs and medication counselling by pharmacists at community pharmacies.[19] Therefore, the order effect of medication counselling by community pharmacists on patients' willingness to take the medication needs to be determined.

The effect of risk probability provision and its order effect on willingness to take medication was investigated in this study. The following hypotheses, numbered 1–3, were tested using a hypothetical hypertension medication counselling scenario.

(1) The willingness to take medication increases with the provision of risk probabilities during medication counselling than without provision.
(2) An order effect on the willingness to take medication is observed in medication counselling with risk probability (risk information after the benefit improves the willingness to take medication than vice versa).
(3) No order effect on the willingness to take medication is observed in medication counselling with no risk probability.

Methods

Participants

An online survey of Japanese adults aged 20–79 years was conducted by the marketing research firm Rakuten Insight (Tokyo, Japan). The number of responses was adjusted to match Japanese demographics (age and sex ratio).[20]

Procedure for the online survey

The online survey was conducted from 13 May 2021 to 17 May 2021. Participants used personal computers (PC) or smartphones/tablets to complete the survey. The respondents were queried on the following at the beginning of the survey: whether they were healthcare providers, their current health status (seven-item method), and whether they had a history of hypertension. Respondents were subsequently provided with preliminary information and were instructed to move to a quiet environment and enable audio output from their devices, before viewing the medication counselling videos. The video was played once at the respondent's discretion, and after the video ended, participants responded on their willingness to take medication, safety evaluation and risk estimation. Finally, a screening question ('What disease was this medication for?') was answered by the participants. Data from respondents who did not correctly answer the question were not recorded.

Scenarios

A medication counselling scenario regarding a hypothetical hypertension medication 'Normo Tablets' was presented to respondents via video in this study. Respondents watched the videos and answered the questionnaire via their personal computers or smartphones/tablets.

Prior information

Prior information on hypertension was provided to the respondents before they viewed the scenario: 'Imagine that you have been diagnosed with hypertension in the hospital. The doctor has prescribed the medication to treat high blood pressure. You bring the prescription to the community pharmacy, where the pharmacist explains the medication. Hypertension must be treated because it can cause serious illnesses like heart disease and stroke'.

Medication counselling scenarios

Four different scenarios were created for this study (RB0, BR0, RB1, BR1) with assigned risk probabilities (no: 0 and yes: 1) and provision order (risk/benefit: RB and benefit/risk: BR). A general description, benefits, and risks of 'Normo Tablets' were included in each scenario (Table 1). One scenario was randomly assigned to each respondent. Random allocation of scenarios was conducted by Rakuten Insight's web system while using age and gender as stratification variables. For example, based on the Japanese population distribution, the allocation of each scenario type was predetermined such that half of them would be given to female participants, and about 10% to those in their 20s. When a certain gender and age segment reached the maximum capacity, the call for responses was closed. Participants were not informed that there were multiple scenarios.

Medication counselling videos

In the survey videos, the medication counselling scenarios were read aloud by the pharmacist while the respective

Table 1 Medication counselling scenarios

General explanation
Your doctor has prescribed a medicine called Normo Tablet 10 mg for you today. Take one tablet once a day, after breakfast, with normal water or lukewarm water. If you forget to take it, you may not get the expected effect. If you miss a dose, you do not have to take it that day, but you should take it at the usual time the next day. Do not stop taking it at your own discretion.
Benefit
Normo tablet is the most commonly used drug for the treatment of hypertension. This medicine lowers blood pressure by widening the vessels. By keeping the blood pressure normal, this medicine can reduce the risk of heart attack or stroke.
Risk
There are several side effects of Normo tablets that you should be aware of. [The total probability of all side effects is about 3%.] Feeling more tired after taking this medicine is a sign of a particular side effect. [The probability of this particular side effect is less than 1%.]

The texts in [] were removed for scenarios without numerical information.

documents were displayed on-screen (Figure 1). Regardless of the scenario, the total length of the videos was fixed at 2 m 24 s. At the beginning of the video, a confirmation sound was played, and respondents were asked to control their devices' volume. The video player was adjusted to prevent repeated replays or rewinds. The scenarios with risk probability included two sentences: 'The total probability of all side effects is about 3%' and 'The probability of this particular side effect is less than 1%'. The former phrase provides respondents with the total probability of side effects (3%), whereas the latter phrase provides the probability of a particular side effect (1%) associated with an initial symptom of experiencing fatigue easily. Risk probabilities were not included in the medication counselling document, they were only provided as an audio recording. Since this was not applicable for RB0 and BR0, the period when the two sentences were read was silent and the respondents were informed of the same.

Outcome measures

The proportion of respondents who indicated a certain degree of willingness to take medication (medication willingness rate) was the primary outcome of this study. The question 'Would you be willing to take this medication?' was answered on a seven-point Likert scale (one = not at all and seven = definitely) by the respondents. Respondents who indicated the top three items on the scale (five = slightly, six = moderately and seven = definitely) were classified as a having certain degree of willingness, and the rest, as having the sunwillingness to take medication. In addition, the safety evaluation of the medication as a secondary outcome was examined. The question 'Do you think this medication is safe?' was answered on a seven-point Likert scale by the respondents. Additionally, respondents were queried, 'What percentage do you think side effects will occur when you take this medication?' A response between 0% and 100% (risk estimation) was received. To demonstrate the validity of the conditions for providing risk probabilities, respondents who answered incorrectly (>3%) in BR1 and RB1 were excluded from the analysis.

Ethical considerations

Before the survey, an online informational sheet that specified the survey procedures and assured the confidentiality of individual responses was read, and voluntary participation was confirmed by all participants. Written informed consent was not provided in this study. Data collected from the survey were anonymised and kept confidential as per Rakuten Insight's privacy policy. This study has been approved by The Medical Research Ethics Review Committee for Human Subjects at [blinded for review] University (Approval number: Human Medical Ethics – xxx).

Data analyses

First, the proportion of the respondents who indicated their willingness to take the medication (medication willingness rate) in the four medication counselling scenarios and 95% confidence intervals (CIs) of medication willingness rates for each scenario were calculated for comparative analysis. Normal approximation was used to calculate the CIs. Second, a logistic regression analysis was conducted using the overall group to test hypothesis 1. In this analysis, the coefficients of the predictor variable (providing risk probability and respondents' demographics) on the objective variable (medication willingness rate) were estimated. Third, logistic regression analyses were conducted using the group provided with risk probability (BR1/RB1) and the group not provided with risk probability (BR0/RB0) to test hypotheses 2 and 3. In addition, a two-way ANOVA was conducted with safety evaluation as the dependent variable, and risk probability and information order as independent variables (generalised η^2 was used as the effect size) to analyse the secondary outcome. Finally, the mean and CI of the risk estimations were calculated for BR0 and RB0.

Results

Demographics of the respondents

Among the data of 500 individuals supplied by Rakuten Insight, 383 were included and a total of 117 respondents, including 47 healthcare providers and 70 participants who responded ambiguously to risk estimates in BR1 and RB1 were excluded from the study. The mean age of the analysed respondents was 51.4 years (SD = 15.8), and 49.9% were female. Detailed participant demographics are presented in Table 2. The sample sizes for each scenario were 117, 115, 73 and 78 for RB0, BR0, RB1 and BR1, respectively.

Comparison of willingness to take medication by scenario

The medication willingness rates for the four scenarios are presented in Figure 2. Medication willingness rates between

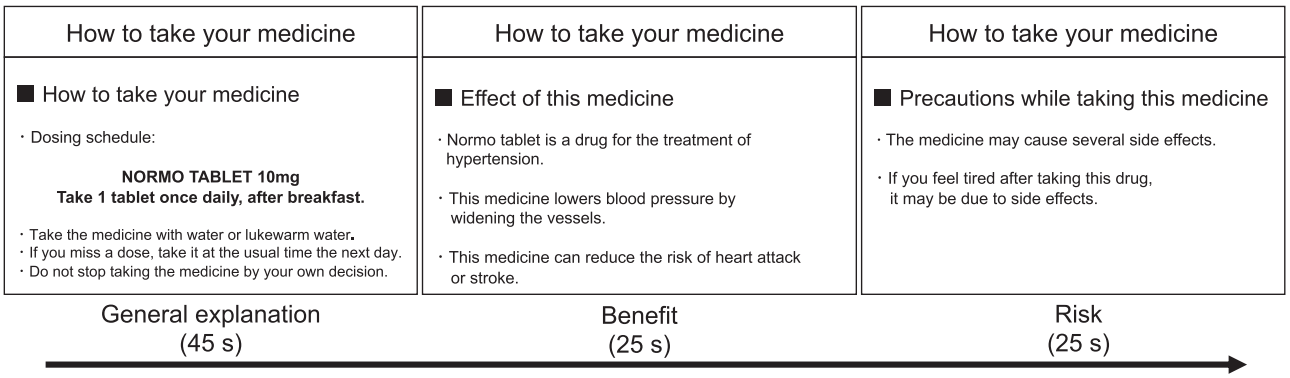

Figure 1 Medication counselling video (BR0, BR1).

Table 2 Demographic characteristics of respondents (n = 383)

Demographics	Frequency	Percentage
Age		
20–30 years	45	11.7
31–40 years	54	14.1
41–50 years	74	19.3
51–60 years	67	17.5
61–70 years	72	18.8
71–79 years	71	18.5
Sex		
Male	192	50.1
Female	191	49.9
Health status		
1 Very poor	7	1.8
2	12	3.1
3	65	17.0
4	32	8.4
5	105	27.4
6	128	33.4
7 Excellent	34	8.9
Hypertension		
Hypertensive	89	23.2
Non-hypertensive	294	76.8

information orders were similar in the group not provided with risk probability: 24.8% (CI: 17.0–36.2) for RB0 and 29.6% (CI: 21.2–37.9) for BR0. Conversely, approximately a 20% difference between information orders was observed in the group provided with risk probability: 27.4% (CI: 17.2–37.6) for RB1 and 47.4% (CI: 36.4–58.5) for BR1.

Hypothesis testing by the binomial logistic regression model

The results of the analyses of hypotheses 1–3 using the binomial logistic regression model are presented in Table 3. First, for hypothesis 1, the medication willingness rate increased on providing risk probability (β = .46, $P < 0.05$) and with a history of hypertension (β = 0.69, $P < 0.05$). Next, for hypothesis 2 (the group provided risk probability), the rates increased in the benefit/risk order (β = 0.91, $P < 0.05$) than in the risk/benefit order. Finally, for hypothesis 3 (the group not provided risk probability), no significant coefficient was observed in information order, and the willingness rate increased with a history of hypertension (β = 1.10, $P < 0.05$).

Analysis of secondary outcomes

First, in a two-way ANOVA applying safety evaluation as the dependent variable, only the main effect of risk probability was significant (F [1, 379] = 8.77, $P < 0.01$, $\eta^2 = 0.02$) and the order effect of information and the interaction effects were not significant. The mean safety evaluation for each scenario was 4.2 (SD = 1.0), 4.3 (SD = 1.1), 4.5 (SD = 0.99) and 4.7 (SD = 0.94) for RB0, BR0, RB1 and BR1, respectively. Second, the mean (CI) risk estimation for the group not provided risk probability was 28.7% (CI: 25.8–31.6), including 28.5% (CI: 24.4–32.6) for BR0 and 28.9% (CI: 24.8–33.0) for RB0.

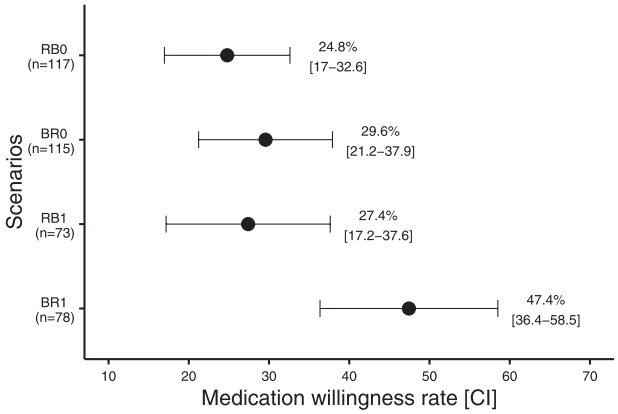

Figure 2 Medication willingness rate in the scenarios. The four scenarios differ in numerical risk probabilities (no: 0 and yes: 1) and provision order (risk/benefit: RB; benefit/risk: BR).

Discussion

In this study, hypotheses 1–3 were tested to determine whether providing risk probability and information order (the peak-end rule), using hypothetical medication counselling videos, improved participants' willingness to take medication and the results were supported by these hypotheses.

First, the medication willingness rate in the overall group (Table 3) was increased on providing risk probability, suggesting an improved willingness to take medication. This result was consistent with those in previously reported studies.[13, 14] Furthermore, increased safety evaluation on providing risk probability was observed in the analysis of secondary outcomes. Conversely, the probability was estimated to be 28.7% on average by the group with no numerical probability (BR0/RB0), implying that the risk probability in the scenario (1%/3%) was lesser than the respondents' assumptions, which may have increased their willingness to take medication. However, a low willingness rate, similar to when the risk probability was not provided (RB0, BR0), was observed when the risk information preceded the benefit (RB1) (Figure 2). Therefore, hypothesis 1 is partially supported. Hence, information order may moderate the effect of risk probability on willingness to take medication. Additionally, the 28.7% risk probability estimated by the group not provided with probabilities was notably above the general drug safety regulations. This result may be an important finding concerning risk assessment among people without medical expertise. However, the participants' subjective expected probability of side effects would depend on the type of medicine and the side effects, which would require further investigation.

Numerical-based risk communications to enable patients can make therapeutical decisions based on accurate information have been recommended by the Journal of the Royal Statistical Society and the British Medical Journal.[21, 22] In the European Union (EU), risk probabilities have been included in consumer medication information.[23] However, in Japan, numerical risk probabilities are rarely included in drug package inserts. Therefore, drug package inserts that describe the probability of adverse events, or at least include information about the low probability, are desirable.

Second, in the analysis for the group provided risk probability, the increase of willingness rate in the information order

Table 3 Logistic regression analysis for testing the hypotheses

Predictor	β	SEβ	Odds ratio	95% CI	
				Lower	Upper
Testing hypothesis 1 using Overall group (n = 383)					
Numeric	0.46*	0.23	1.59	1.02	2.49
Age	0.00	0.01	1.00	0.98	1.01
Female	0.27	0.23	1.30	0.83	2.04
Health state	−0.13	0.08	0.88	0.75	1.03
Hypertension	0.69*	0.29	2.00	1.14	3.50
Testing hypothesis 2 using the group with numerical risk probabilities (n = 151)					
Benefit/risk	0.91*	0.35	2.47	1.24	4.95
Age	−0.01	0.01	0.99	0.97	1.02
Female	−0.10	0.35	0.91	0.45	1.81
Health state	−0.06	0.12	0.95	0.75	1.19
Hypertension	0.24	0.44	1.27	0.53	3.03
Testing hypothesis 3 using the group without numerical risk probabilities (n = 232)					
Benefit/risk	0.10	0.31	1.10	0.60	2.03
Age	0.00	0.01	1.00	0.98	1.02
Female	0.61	0.32	1.85	0.99	3.46
Health state	−0.18	0.11	0.83	0.67	1.04
Hypertension	1.10*	0.39	3.00	1.39	6.45

*$P < 0.05$.

of benefit/risk when compared with risk/benefit was noticed (Table 3). This result was consistent with that reported in previous studies,[18] indicating that hypothesis 2 was supported. Therefore, the effect of the peak-end rule, wherein the risk probability is considered to be at its 'peak', was observed in this study. The peak-end rule is a cognitive bias caused by a difference in the order of experience, derived from the empirical perception that future gains are expected for improving events than for events worsening over time.[24] This bias has been observed in primates closely related to humans and may be an adaptive strategy acquired before humans evolved from apes.[25] The influence of individual attributes such as cultural differences, educational background, and health literacy have no effect on information strategy using the peak-end rule. Therefore, this method can be applied to a wider population in various clinical settings.

Information strategy using the peak-end rule proposed in this study can be regarded as a behavioural economics method based on libertarian paternalism (nudge). 'Any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives' is known as a 'nudge'.[26] Nudging may involve the concern of violating patients' free will; however, its use in medical settings has been encouraged upon sufficient ethical justification.[27–29] Therefore, nudging based on the peak-end rule, if used to increase patients' attention to risk probability and support evidence-based decision-making, would be ethically justified.

However, in the secondary outcome analysis, the scenarios' order effect on safety evaluation was not significant, suggesting that the peak-end rule does not apply in safety evaluation. Regardless of the information order, attention is paid only to the risk information when participants consider a drug's safety. The differences in the nature of patients' safety evaluation of medications and their willingness to take medications and the extent to which each may contribute to medication adherence needs further research.

Third, in the analysis of the group not provided risk probability, the information order did not affect the willingness rate (Table 3); thus, hypothesis 3 is supported by confirming that the peak-end rule does not apply when risk probability is not provided. The delivery of a smaller risk probability than the participants' assumptions would have been a rewarding experience for the participants, and the peak-end rule would have then been applied.

Some of the limitations of this study are discussed as follows. First, the participants were recruited via the internet and unconfident personal computer or smartphone users may have been excluded. Participants from a wide age range, including young people, were assumed to be patients who have visited a pharmacy. Thus, information strategies for patients in their old age who have been treating hypertension for many years would differ from the scenario developed in this study. Second, the monologue-style scenario created in this study mirrors Japanese pharmacy practices. Therefore, further verification, preferably including a dialogue-style scenario, would be required before generalising this strategy across cultures. Third, the influence of individual characteristics on the information strategy was not considered. Future studies should include a measurement of patients' numerical skills since this is closely related to their understanding of risk probability.[12, 13] Fourth, the extent to which risk probabilities were distinctive in the participants' experiences was not determined in this study. In the future, it may be necessary to conduct in-laboratory experiments (e.g. eye tracking and physiological response) to see if a response can be considered peak when the risk probability is presented. Fifth, the essential outcome in this study was medication adherence (medication compliance

and number of remaining medications). This study determined only a temporary willingness to take medication after a short counselling session. Furthermore, risk perception of side effects is only one of the many factors that influence adherence. Therefore, further studies are necessary to determine the contribution of short-term improvement in willingness to take medication on long-term medication adherence, in comparison with other factors.

Conclusion

Risk probability provision with the peak-end rule is an effective information strategy to increase participants' willingness to take medication. This helps patients understand that the likelihood of an adverse event is lesser than their assumption. Furthermore, risk probability is influenced by the peak-end rule and greater patient attention is attracted when it is provided at the end of medication counselling. It is suggested that the findings of this study, which employed hypothetical scenarios, merit further investigation in real-life situations for clinical application.

Acknowledgements

We wish to thank Yasutaka Kato and Nao Sekine for their contribution and help in developing the medication counselling scenarios.

Author contributions

A.Y., S.O. and D.K. conceptualised the study; A.Y. planned the protocol with the support of N.H. and S.O.; N.H. was the narrator of the scenarios; S.O. contributed substantially to the data interpretation; N.H., S.O., S.O. and D.K. evaluated the manuscript drafted by A.Y. and provided critical feedback. The final manuscript was read and approved by all authors. The corresponding author, as guarantor, takes full responsibility for the final article, has access to all data, and makes the final decision to publish or not. The corresponding author certifies that all authors listed meet the criteria for authorship and that no other authors who meet the criteria have been omitted.

Ethical considerations

This study has been approved by The Medical Research Ethics Review Committee for Human Subjects at Josai University (Approval number: Human Medical Ethics – 2021-06).

Funding

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of Interest

The authors declare that there are no conflicts of interest.

Data Access Statement

The authors listed had complete access to the study data. Access to the survey respondence data supplied by the marketing research firm Rakuten Insight, excluding the privacy information of the respondents (e.g. names, residents, Email addresses) includes browsing and processing of the data, which is ongoing.

Data Availability Statement

All materials supporting the findings in this study are available from the corresponding author upon reasonable request.

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