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Population-based Time Preferences for Future Health Outcomes

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Context. Time preference (how preference for an outcome changes depending on when the outcome occurs) affects clinical decisions, but little is known about determinants of time preferences in clinical settings. *Objectives.* To determine whether information about mean population time preferences for specific health states can be easily assessed, whether mean time preferences are constant across different diseases, and whether under certain circumstances substantial fractions of the patient population make choices that are consistent with a negative time preference. *Design.* Self-administered survey. *Setting.* Family physician waiting rooms in four states. *Patients.* A convenience sample of 169 adults. *Intervention.* Subjects were presented five clinical vignettes. For each vignette the subject chose between interventions maximizing a present and a future health outcome. The options for individual vignettes varied among the patients so that a distribution of responses was obtained across the population of patients. *Main outcome measure.* Logistic regression was used to estimate the mean preference for each vignette, which was translated into an implicit discount rate for this group of patients. *Results.* There were marked differences in time preferences for future health outcomes based on the five vignettes, ranging from a negative to a high positive (116%) discount rate. *Conclusions.* The study provides empirical evidence that time preferences for future health outcomes may vary substantially among disease conditions. This is likely because the vignettes evoked different rationales for time preferences. Time preference is a critical element in patient decision making and cost–effectiveness research, and more work is necessary to improve our understanding of patient preferences for future health outcomes. *Key words*: time factors; models, psychological; attitude to health; outcome assessment (health care).
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People make choices, and through these choices it is possible to make inferences about their preferences. Time preference is a psychological concept that describes when in time (e.g., now or in the future) one chooses to experience an event (a reward or a penalty) given a choice between the two time periods. Several studies evaluating time preferences for future health outcomes have been conducted over the past decade.[1–4]

Time preference is closely tied to the economic concept of discounting. Discounting is the quantitative process of adjusting the value of a future outcome to its present value,[5] or quantitatively adjusting for time preference. Health policy researchers frequently apply discount rates to estimates of future dollars and future health outcomes. It is common to assume that the societal discount rates for dollars and health are equal, although many researchers question this assumption.[6]

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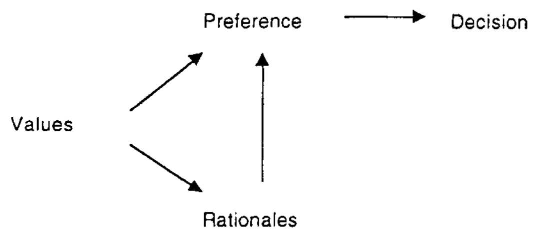

FIGURE 1. Relationships between values, rationales, and preferences.

Values, rationales, and preferences are distinct but related entities discussed in this paper (figure 1). A person's values affect the person's rationales and preferences. In the psychology literature these preferences are named time preference, risk posture, dread, etc. Any given preference (e.g., positive time preference, risk aversion, or dread) may have many rationales. For example, given that a person values money, this person may prefer a present award to one in the future. Oft-cited rationales for this time preference are the ability to spend, the ability to invest, and the fear of default.

In this paper, we take an admittedly broad look at time preference. In each vignette (see below) only one element is varied, an element related to time. Thus, we measure time preference as a final outcome, without attempting to evaluate the rationales for the preference.

Research on the time preferences for future health outcomes is limited by several factors. First, there is a strong tendency to dismiss data from individuals whose time preferences do not conform to particular properties and, in particular, individuals who have negative time preferences for health, in that they prefer a future health improvement to a present health improvement.[3,6] Second, and perhaps more important, is the emphasis in most studies on assessing the time preferences of particular individuals, as opposed to the time preferences of a particular population. Unless one is willing to make the generally indefensible assumption that all individuals in the population of interest have the same time preferences, then a particular individual patient's time preference is not directly relevant to health policy research. It is the mean time preference (or perhaps the distribution of time preferences) in the population of interest that is the relevant policy factor. In this sense, individual preferences are important only to the extent that they allow health policy researchers to make informed inferences about the population's time preferences. One solution is to use the discount rates for individuals in a study's sample to obtain an estimate of the mean discount rate in the population of interest. This is problematic using the standard gamble,[3] the time tradeoff,[7] or other time-intensive approaches to measuring individual time preferences that are difficult to administer in large random samples. In addition, these approaches are known to be subject to a variety of biases.[8] As such, it may be useful to look at other approaches to eliciting information about time preferences that are geared more toward measuring time preferences of a population and are more suitable for administration in large surveys.

Our work follows the method of Horowitz and Carson, who assessed time preferences at the group level using choices involving tradeoffs of time and money.[9] They showed how this information can be used to calculate population-based discount rates by looking at how the percentage of the population choosing the present or future alternative changes with changes in the money obtained in the future alternative. Their approach has much in common with a standard bioassay dose–response experiment.[10] Survey respondents are randomly assigned to different treatments that differ with respect to some element thought to influence what choice a respondent will make. The observed outcome, instead of being alive or dead as in the typical bioassay, is simply the alternative chosen. Thus, a discrete indicator of each subject's time preference rather than the exact time preference of each subject is obtained. From observing how the percentage choosing the situation where better health is obtained at an earlier versus later date changes with the level of the stimulus variable, it is possible to obtain information about the distribution of time preferences in the population. We set out to follow the Horowitz and Carson model[9] and evaluate population-based time preferences for health for several different clinical situations. In this regard, our study resembles work by Cropper et al., who have used the same approach to look at how population discount rates for saving lives differed over very different time horizons,[11,12] and Bosch et al., who used it to assess population utilities with the standard gamble.[13]

In the present study we investigated three questions: 1) Can information about the mean population time preferences for specific health states be easily assessed? 2) Are mean time preferences constant across different diseases? 3) Under certain circumstances do substantial fractions of the patient population make choices that are consistent with negative time preferences, in the sense of choosing options that provide for experiencing a better health state later rather sooner? The answer to the first question may provide researchers with a tool to more easily evaluate time preferences in the various populations. The latter questions address clinical and policy issues that must be surmounted in future attempts to estimate time preference rates.

Methods

Following the model by Horowitz and Carson, we developed five clinical vignettes to represent a variety of possible clinical situations: chickenpox, Parkinson's disease, a hypothetical tropical disease, migraine headache, and sterilization (i.e., the long-term complications of a sterilization procedure). Each vignette presents a situation in which the patient is asked to choose between two alternative options that result in differences between current and future health outcomes. For each vignette (except the one involving a choice of whether to expose a young child to chickenpox now) versions were developed that differed only by the level of the treatment variable. Depending on the vignette, this treatment variable involved the magnitude, the timing, or the probability of the future health outcome. Different respondents were assigned only one version, and each was asked to choose between the current option and a future option with better health. In all cases, the subject made a single decision between two choices. The University of California San Diego Human Subjects Committee approved the protocol.

The vignettes were constructed to test the assumptions that patients have positive time preferences for health outcomes (always desire to put off periods of a disease) and that these time preferences are constant across diseases. One version of each vignette along with a list of the modifications made in each version is listed in the appendix. Each vignette is described briefly here.

The chickenpox vignette consisted of only one variation of the treatment variable, whether to expose the child now to chickenpox or whether this exposure should come later. If respondents have a positive time preference, then we would expect to see all respondents picking the "expose later" option.

The structure of the Parkinson's disease vignette is similar to that of the chickenpox vignette and looks at the situation where a drug is effective for only a limited period of time. The "take the medication now" option provides the good health state immediately for a fixed period, while the "take the medication later" option provides the same health state for a fixed period starting later. The treatment variable in this vignette is the start date (i.e., 2, 4, 7, or 10 years from now) for taking the medication in the "start later" option. If respondents always desire to put off periods of a disease, all respondents should pick the "start now" option.

In the tropical disease scenario, the respondents have been exposed to a disease that will incapacitate them for a period of three months, after which time normal health will return. An injection is available that will delay but not prevent the onset of the diseases. The choice offered the respondents is to get the disease now or get the injection that will delay the onset of the disease. The treatment variable is the length of time the disease can be delayed: 6 months, 1 year, 2 years, 5 years, 10 years, or 20 years. Respondents with positive time preferences should pick the option that allows the onset of the disease to be delayed irrespective of the length of delay available.

The headache vignette offers respondents relief from migraine headaches from being able to take one of two new drugs that provide relief for different fixed periods. The "start now" option involves taking a drug that provides one year of immediate relief, while the "start later" option provides relief for 24 months. The treatment variable is the date of the start-later option: 24 months of relief in 6 months, 12 months, 18 months, 24 months, 4 years, or 7 years. The optimal choice for a respondent now depends upon the date of the start later option and the respondent's implicit discount rate.

The last of the vignettes involves sterilization and is designed to look at the time–risk tradeoff between two procedures. The first procedure is safe in the short run but poses a risk of cancer in 20 years, while the second procedure poses a 1:10,000 risk of dying in the short run but no long-term risk. The treatment variable is the long-term cancer risk in the first procedure, which is varied between 1:100 and 1:100,000.

Identical sets of 45 questionnaire packets, each consisting of an introduction, three vignettes using versions drawn using a random-numbers table, and a brief demographic questionnaire, were sent to family practice residency programs at the University of California, San Diego, the University of Kentucky–Lexington, the University of Oklahoma, and The University of Texas Medical Branch at Galveston. Literate adult patients were asked to complete a questionnaire packet while waiting to see their practitioners. To examine the reliability of the approach, the survey was replicated by giving a different group of 45 subjects from one site (San Diego) an identical set of questionnaire packets one month later. Results similar to those reported here were obtained.

The headache vignette can be used as a generalized example for the analytic plan of all vignettes. Using the individual choices each subject makes in response to the different versions, a regression equation can be developed for the migraine headache vignette using the proportion of people choosing the option of two years of relief in the future rather than one year of health immediately. A logit model, which assumes a logistic or log-logistic distribution of the implicit discount rates depending upon whether the treatment variable is entered in a linear or log form, was used for the regression in the headache vignette. (A probit model, which assumes a normal or lognormal distribution, provides nearly identical results, as expected.[10]) The treatment variable entered the regression in the form of the equilibrating discount rate (the rate at which the value of the present option and the present value of the future option are equal)[9] for each version of the vignette according to the discount-rate formula:

$$\text{Present value} = \frac{\text{Future value}}{(1 + \text{rate})^{\text{time}}}$$

For example, in the headache vignette indifference between two years of relief seven years from now and one year of relief now represents a discount rate of 10% because $1 = 2/(1 + 0.1)^7$. Those choosing one year of relief now have a discount rate larger than 10%, and those choosing two years relief seven years from now have a discount rate less than 10%. The median discount rate can be estimated from the regression results using the quotient of the intercept term and the coefficient on the treatment variable.[9]

Results

A total of 169 patients participated at the four sites. Most (n = 113, 67%) were female, and the mean age was 38 years (range 17 to 80 years). The demographic characteristics of the subjects are provided in table 1.

In responding to the chickenpox vignette (n = 51), 59%, 95% CI 49%–69%, of the subjects chose to expose the child now. By choosing to have illness now, these subjects chose future health over present health, a choice consistent with a negative time preference for health. In the Parkinson's disease vignette (n = 78) the vast majority of patients (range: 78% to 89%) chose the option for immediate relief in each scenario, a result consistent with a population made up of individuals who primarily have positive time preferences. The percentage in favor of delaying the onset in the tropical disease vignette (n = 119) does not show a monotonic relationship with respect to the possible delay period. The percentage choosing to delay the onset of the disease increased from a little over 60% at the six-month delay to almost 80% at the two-year delay. However, the percentage choosing delay fell to less than 50% at the five-year delay and continued to fall further at the ten-year delay. There was an upturn in the percentage that wanted to delay at 20 years. The results here are consistent with positive time preferences over short to moderate time periods but not over longer periods.

The observed proportions of the subjects in the headache vignette (n = 141) who chose the future health option as a function of time delay to get the two-year relief (as opposed to one-year relief) are plotted in figure 2. The estimate for the median discount rate in the headache vignette was 116%, 95% CI 41%–191%, and the log of the length-of-delay treatment variable was significant in the logistic regression at $p = 0.023$.

In the sterilization scenario, participants' (n = 99) choices were significantly influenced by the magnitude of the future risk ($p < 0.001$), with the log of the future risk providing a better fit than future risk entered linearly. The future risk had to be less than 0.000184 (current risk is fixed at 0.000100) in order to get more than 50% to pick the future-risk scenario. Given the 20-year difference between the options with the current and future risks, this implies that the participants had a median discount rate of 6.4%, 95% CI 3.0%–9.8%.

Discussion

Time preference is a critical element in many cost–effectiveness analyses, and the results of these analyses differ by how future outcomes are discounted.[14,15] Analysts argue using various theoretical models that the discount rates for health outcomes and dollars should be equal.[5,6,16] However, the validity of the assumptions underlying these models has been challenged.[6,17–19] One might not expect the time preference to be equal, since dollars and health cannot be readily exchanged for one another. Further, one can neither directly spend nor invest health, though one can both spend and invest money.

Our study provides empirical evidence that time preferences for health may vary significantly be-

Table 1 • Demographic Characteristics of the Study Population

	All Sites (n = 169)	Galveston (n = 43)	Lexington (n = 42)	Oklahoma City (n = 42)	San Diego (n = 42)
Age (mean)	38 years	40 years	37 years	34 years	42 years
Female	113 (67%)	29 (67%)	27 (64%)	34 (81%)	24 (57%)
Education > high school	112 (66%)	29 (67%)	27 (64%)	22 (52%)	34 (81%)
Student	40 (24%)	6 (14%)	8 (19%)	17 (40%)	9 (26%)
Employed	99 (59%)	29 (67%)	31 (74%)	10 (24%)	29 (69%)

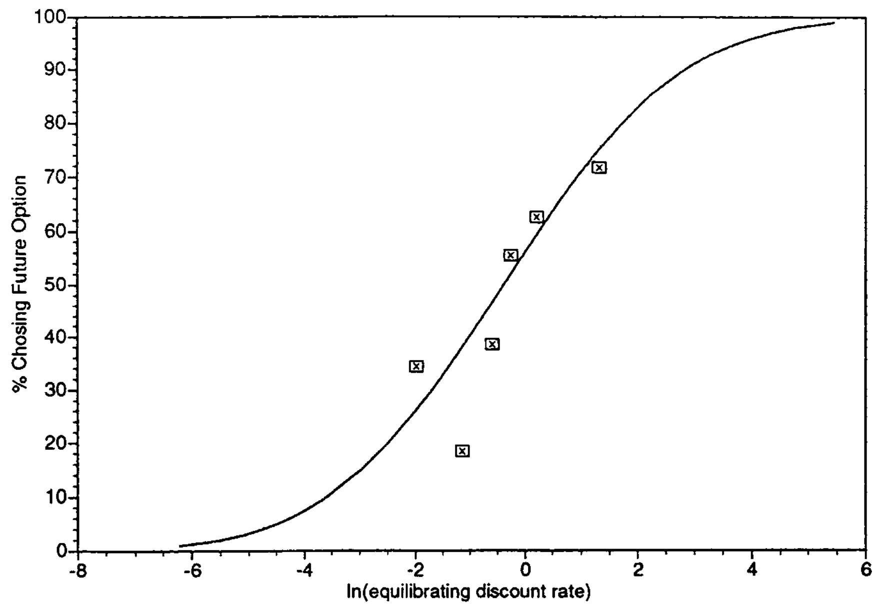

FIGURE 2. Distribution of time-preference responses for the headache vignette.

tween disease conditions. The majority of our subjects had negative time preferences in the chickenpox vignette (preferring illness now), yet a very large majority in the Parkinson's disease vignette had positive time preferences (preferring symptoms later). The tropical disease vignette suggests positive time preferences over some time periods and negative time preferences over other time periods. The responses to the headache vignette show a much larger implicit median discount rate, 116%, than do the responses to the sterilization vignette, which have a median discount rate of 3%.

Our findings are consistent with those of others, even though the methods have varied. For example, Redelmeier and Heller, using standard gamble and categorical scaling techniques, found different discount rates between different scenarios.[3] As mentioned above, they also found some patients with negative time preferences, though they eliminated these subjects from their analyses. Rose and Weeks demonstrated that discount rate varies with demographic factors,[4] a finding we supported in another report from this population.[20] Rose and Weeks also found negative time preferences to exist at times for both dollars and health.[4] Cropper et al. found that implicit discount rates appear to change over time, with short time periods being discounted more than very long ones.[11,12]

We have largely cast the results from this study in terms of time preferences and implicit discount rates, and obviously these results contradict the standard exponential discounting framework used in applied health policy research where patients are assumed to have constant time preferences for all health outcomes. There are other possible explanations for the results, some of which are suggested by patients' written responses to the vignettes and focus group discussions. For example, in the chickenpox vignette, the rationale for wanting to expose now rather than later may be largely driven by the desire to be able to schedule when the child would have chickenpox compared with when exposure occurs randomly. (The data for this study were gathered before the release of the varicella vaccine, although there was considerable mention of it in the press. The possibility of this vaccine may have biased the responses to the chickenpox vignette, but in the direction of positive time preferences by choosing to delay exposure.) The Parkinson's disease vignette corresponds most closely to the stylized health-policy example of simply delaying a better health state, and the responses we obtained to it are consistent with almost all of the population's having positive time preferences. The non-monotonic responses in the tropical disease vignette may have been driven first by a desire to optimally schedule a prolonged period of disability, then by a desire for a long delay to get this period of disability out of the way rather than to continually dread facing it over a long period, and then by a desire for an extremely long delay to entertain the possibility that a cure for the disease will be found. The different implicit discount rate distributions found in the migraine headache and sterilization vignettes may have been driven by a sense that the migraine attacks were ever-present and very disruptive, while the sterilization risks were in almost all cases perceived as low-probability risks.

However, whatever the rationale, one should not confuse the psychological rationale and the ultimate preference. One likely reason for the observed differences in the time preferences between the vignettes in the present study is that in the different vignettes different psychological rationales influenced time preferences. Our subjects responded to these different rationales by demonstrating a wide variety of time preferences for health. In their written comments they provided a variety of reasons for the preferences. This demonstrates the complexity of the phenomenon; it does not negate the variety of preferences. The majority of rationales for a monetary time preference (e.g., ability to spend, ability to invest, inflation, fear of default) all lead to positive time preferences. In contrast, in health the rationales lead to conflicting time preferences, and which rationale dominates in any situation varies. This observation supports the concept that empirical attempts to estimate time preferences should accommodate and control for factors such as uncertainty, dread aversion, etc.

Where there are large differences in time preferences in the population with respect to a particular health choice, it may be useful to look at how demographic variables correlate with different time preferences for health (e.g., Do the elderly have different time preferences for health than the young? Do people with a particular disease such as migraine headaches respond differently than those who do not?). Where there are large differences in time preferences across different types of health choices, it may be useful to look at what characteristics of those health choices may be responsible (e.g., Do procedures that have scheduling aspects differ from those that do not? Do cancer risks of mortality differ from other types of mortality risks?). While we invoked the individual perspective that is clearly relevant from a quality-of-life vantage, it may not be the relevant one in policy analysis if one believes a societal perspective is the more relevant. The vignettes could have been posed from this perspective instead, and it would be interesting to see whether different results were obtained. We are currently evaluating these questions.[20]

The recent Health and Human Services (HHS) panel directive recommends that future dollar and health outcomes be discounted at equal rates.[6] This recommendation was made despite the explicit recognition of evidence supporting differences in time preferences for future dollar and health outcomes. Our findings do not necessarily contradict the HHS panel's recommendations, since those recommendations were based on several arguments other than evidence supporting the equality of time preferences across diseases. On the other hand, should the decision be made in the future to discount future dollars and health on an empirical basis rather than at pre-ordained rates, the method used in this study may prove to be a good approach to quantifying the time preferences of populations. If our results are due to confounding variables and particular aspects of disease conditions that influence patient preferences toward options involving those diseases, then the method used here can also be used to quantify those relationships so that they can be taken account of in health policy decisions.

Conclusions

The present study provides empirical evidence that time preferences for health outcomes appear to vary substantially both among disease conditions and among people. If confirmed in further work, our results suggest that the commonly used framework for discounting health outcomes is too simplistic. Since discounting is a critical element in health policy, more work is necessary in this field with the goal of understanding the rationales for this finding and being able to more accurately model patient preferences.

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Appendix

Clinical Vignette Scenarios

1. Chickenpox

Chickenpox is characterized by 1–2 days of flu-like symptoms followed by 3–4 days of fever and a very itchy rash. Since the disease is so contagious, the child is out of school for up to a week. Chickenpox affects over 90% of all children and is generally considered to have few complications in this age group.

Your 4-year-old child has not had chickenpox. You and your spouse have. You have just learned that a child in the neighborhood has chickenpox. If you let your child play with the neighbor, your child will probably get chickenpox now. If not, your child will probably get the disease in a couple of years and will miss school.

Would you expose your child now or wait?

_______ Expose now.

_______ Wait.

Scenarios: No variants.

2. Parkinson's disease

Parkinson's disease affects the nervous system. The disease occurs primarily in older people. Patients have weakness, tremor, and they move slowly. Levodopa, a drug used to treat Parkinson's disease, is most effective in the first 5 years of treatment. Later, the drug loses its effectiveness.

Assume you are 70 years old and can expect to live another 13 years. You have Parkinson's disease. You have moderate muscle weakness. Your tremor causes your handwriting to be illegible, and you have trouble feeding yourself. The muscle slowness means you need assistance getting out of a chair at times.

You can choose to take the medicine now or in 2 years. If you choose to take the medicine now, you will be symptom-free for the next 5 years, after which time the medicine will no longer work and you will again experience the symptoms. If you choose to wait, you will have the symptoms over the next 2 years, but when you do finally start the medicine, you will be symptom-free for the following 5 years.

Which do you choose:

_______ Start 5 years of levodopa treatment now.

_______ Start 5 years of levodopa treatment in 2 years.

Scenarios: Now vs 2 years; 4 years; 7 years; 10 years.

3. Nalpak disease

Nalpak disease is an uncommon but highly contagious disease usually found in Southeast Asia. It is characterized by 3 months of tremendous weakness and fatigue along with intermittent pain. The patient cannot work. After this 3-month episode there are no further effects from the disease.

There is no treatment for Nalpak disease, but an injection (a shot) is available that postpones the symptoms for 1 year. Except for this 1-year delay in symptoms there is no difference between the symptoms of the unimmunized person and the person receiving the immunization. There is no charge for the immunization, and it is completely free of any adverse effects. However, because of severe side effects it is not possible to give the immunization more than once.

You have just returned from a trip to Southeast Asia where you were exposed to Nalpak disease. Your physician tells you will likely get the disease and has offered you the immunization.

Which course do you choose?

_______ I would receive the shot (and get the symptoms in 1 year).

_______ I would refuse the shot (and get the symptoms now).

Scenarios: Get symptoms now vs 6 months; 1 year; 2 years; 5 years; 10 years; 20 years.

4. Migraine headache

One drug for migraine headaches is given once a month and completely eliminates all headaches for the month. Without the drug a patient with severe migraines is forced to stay at home with these headaches; with the drug the patient lives a normal life. The only drawback to the drug is that it can only be administered for 12 consecutive months. After that the risk of side effects become too great.

You have severe migraine headaches lasting 1–2 days a couple of times each month. Your physician says that a new drug will be available in 6 months that will work for 24 consecutive months. You cannot take both drugs, however, and must choose between them.

What would you choose:

________ I would take the drug for 12 months *starting now*.

________ I would take the new drug for 24 months starting in 6 months.

Scenarios: 12 months of relief now vs 24 months of relief in 6 months; in 12 months; in 18 months; in 24 months; in 4 years; in 7 years.

5. Sterilization

You desire permanent sterilization, that is, you don't want to be able to have any more children. One procedure is relatively safe in the short term, but after the procedure you have a 1 in 100 risk of cancer in 20 years. The cancer is always fatal. The other procedure is more complicated to perform, and you have a 1 in 10,000 risk of dying from the procedure. On the other hand, if you survive the procedure there are no future risks.

To summarize:

	Present Risk	Risk in 20 years
Procedure A	None	1 in 100 of fatal cancer
Procedure B	1 in 10,000 of death	None

Assuming you are willing to accept the risks of at least one of the procedures, which procedure would you choose?

________ Procedure A (future risk of 1 in 100).
________ Procedure B (present risk of 1 in 10,000).

Scenarios: Present risk = 1:10,000. Future risk = 1:100; 1:1,000; 1:5,000; 1:10,000; 1:25,000; 1:50,000; 1:100,000.