Contingent Valuation Method (CVM)

- Diener A, O'Brien B, Gafni A (1998) Health care contingent valuation studies: a review and classification of the literature. *Health Econ.*, 7: 313-326. https://doi.org/10.1002/(SICI)1099-1050(199806)7:4<313::AID-HEC350>3.0.CO;2-B
- Carson RT (1999). Contingent Valuation: A User's Guide. *Environmental Science & Technology*, 34: 1413-1418.
- Klose T (1999) The contingent valuation method in health care. *Health Policy*. 47(2) :97-123. https://doi.org/10.1016/s0168-8510(99)00010-x
- Developed in environmental economics
- Also applied in behavioral economics
- Application to public health is increasing
- Basic concepts
  - Evaluate everything in terms of money
    - WTA (willingness to accept): How much do you need to accept intervention
    - WTP (willingness to pay): How much do you pay to prevent intervenion
  - Enable total benefit (or loss) calculation as sum of WTA/WTP

Please image the following scenario

- A remote governmental land provides important habitat for several wild species. The management agency must decide whether to issue a lease for mining or not, so that comparison of mining value and wildlife habitat value is needed. Few people visit there because of remote location. Non-use values are the largest component of the value for preserving the site.
  - Direct comparison of economic benefit from mining and ecological (species diversity) benefit is impossible.
  - Summing up the travel costs by visitors will underestimate the benefits of preserving the site.
  - Contingent valuation method (CVM, including contingent choice) is applicable.

The steps of CVM

- Define the valuation problem: What services are valued? Who is the relevant population?
  - The remote site with potential mining resources
  - Wildlife habitat
  - All the citizens of the nation (in this example, USA)
- Make preliminary decisions about the survey: How to conduct survey? To whom?
  - In-person interview: Effective for complex questions, but expensive and taking long periods for data collection
  - Mail: Sometimes also expensive, but shorter periods are needed
  - Phone: Not expensive, shorter periods, difficult to ask questions
- Actual survey design: Begins with initial interviews and/or focus group discussion (questions including general information for the people and the site to know whether they are familiar with the site and its wildlife), then more detailed and specific issues including knowledge about mining, the site characteristics and uniqueness of species or potential substitute site are given or questioned, followed by different approaches to valuation question and payment method → makes the hypothetical scenario, valuation question, then pretests
- Actual survey implementation: Sample selection (ideally at random from relevant population), repeat-mails/phones and reminder to increase the response rate
- Final step: Compile, statistically analyze and report the results. Evaluation of non-response bias should be done in several ways.
- Estimated WTA/WTP per capita or per household (simple average or applying Weibull distribution) may be extrapolated to whole relevant population. If WTP per capita is $0.10, total benefits to all US citizens are $26 million.

Exxon Valdez oil spill example, 1989

https://darrp.noaa.gov/oil-spills/exxon-valdez

- On March 24, 1989 the oil tanker Exxon Valdez ran aground in Prince William Sound, Alaska, spilling 11 million gallons of oil. The ecologically sensitive location, season of the year, and large scale of this spill resulted in one of the largest environmental disasters in U.S. history.
- Exxon settled in 1991 with funds disbursed in three discrete parts: criminal plea agreement ($25 million), criminal restitution ($100 million), and **civil settlement ($900 million)** ← **using CVM**.
- For the sample from the whole USA, questionnaire survey was conducted, and the WTA per household was estimated as $30, multiplied by the total numbers of household in USA, resulted in $2.8 billion → through the negotiation between Exxon and Federal Government and Alaska State Government, compensation for the US citizens was set at $1 billion → $900 million paid.

Valdez principle

https://changeoracle.com/2015/03/02/valdez-principles-ceres-principles/

- 1. Protection of the biosphere: ‘We will minimize and strive to eliminate the release of any pollutant that may cause environmental damage to air, water, or earth or its inhabitants. We will safeguard habitats in rivers, lakes, wetlands, coastal zones and oceans and will minimize contributing to the greenhouse effect, depletion of the ozone layer, acid rain or smog.
- 2. Sustainable use of natural resources: ‘We will make sustainable use of renewable natural resources, such as water, soils and forest. We will conserve non-renewable natural resources through efficient use and careful planning. We will protect wildlife habitats, open spaces and wilderness, while preserving biodiversity.
- 3. Reduction and disposal of waste: ‘We will minimize the creation of waste, especially hazardous waste, and wherever possible recycle materials. We will dispose of all wastes through safe and responsible methods.
- 4. Wise use of energy: ‘We will make every effort to use environmentally safe and sustainable energy sources to meet our needs. We will invest in improved energy efficiency and conservation in our operations. We will maximize the energy efficiency of products we produce and sell.
- 5. Risk reduction: ‘We will minimize the environmental health and safety risks to our employees and the communities in which we operate by employing safe technologies and operating procedures and by being constantly prepared for emergencies.
- 6. Marketing safe products and services: ‘We will sell products or services that minimize adverse environmental impacts and that are safe as consumers commonly use them. We will inform consumers of the environmental impacts of our products or services.
- 7. Damage compensation: ‘We will take responsibility for any harm we cause to the environment by making every effort to fully restore the environment and to compensate those persons who are adversely affected.
- 8. Disclosure: ‘We will disclose to our employees and to the public incidents relating to our operations that cause environmental harm or pose health or safety hazards. We will disclose potential environmental, health or safety hazards posed by our operations, and we will not take any action against employees who report any conditions that create a danger to the environment or pose health or safety hazards.
- 9. Environmental directors and managers: ‘We will continue to improve management resources to implement the CERES principles. This includes monitoring and reporting our implementation efforts, and sustaining a process to ensure that the board of directors and chief executive officer are kept informed of and are fully responsible for all environmental matters. We will establish a committee of the board of directors with responsibility for environmental affairs. At least one member of the board of directors will be a person qualified to represent environmental interests to come before the company.
- 10. Assessment and audit: ‘We will conduct and make public an annual self-evaluation of our progress in implementing these principles and in complying with applicable laws and regulations throughout our worldwide operations. We will work towards the timely creation of independent environmental audit procedures which we will complete annually and make available to the public.’

FAO's survey guide for developing countries
https://www.fao.org/4/x8955e/x8955e00.htm

- Formally, WTP is defined as the amount that must be taken away from the person's income while keeping his utility constant:
  $V(y - WTP, p, q1; Z) = V(y, p, q0; Z)$
  where V denotes the indirect utility function, y is income, p is a vector of prices faced by the individual, and q0 and q1 are the alternative levels of the good or quality indexes (with $q1 > q0$, indicating that q1 refers to improved environmental quality).
- Willingness to accept for a good is defined as the amount of money that must be given to an individual experiencing a deterioration in environmental quality to keep one's utility constant:
  $V(y + WTA, p, q0; Z) = V(y, p, q1; Z)$

CVM in health care (Klose T, 1999)

https://doi.org/10.1016/s0168-8510(99)00010-x

- CVM is to determine monetary valuations of effects of health technologies.
- Comprehensive review of CVM in the health care literature until 1998
- Methodological / conceptual issues, WTP as measure of benefits vs other measures used in medical technology assessment.
- When performing CVM using original data and meeting qualitative criteria.
- Theoretically valid, several indications of convergent validity.
- No results on criterion validity and only a few on reliability.
- Different elicitation formats were compared (Table 1).
  - Direct questions were seen problematic.
  - First bids used in bidding games influenced the monetary valuation significantly (starting point bias).
  - The range of bids of payment cards also affected the valuation (range bias).
  - No strategic bias.
- The influence of different states of valuation (ex-ante, ex-post) and of payment methods, as well as the possible aggregation of the results of decomposed scenarios rather than more complex holistic scenarios, were rarely investigated.
- Further methodological analysis and testing seems to be necessary before CVM may be used in health care decision making.
- Important research topics are the connection of assessment of different elicitation methods and criterion validity as well as tests on reliability according to methodological issues. Concerning conceptual issues, the analysis of the influence of different states of evaluation and of the status of the respondents as diseased or non-diseased, as well as the aggregation of results of decomposed scenarios, proved to be topics of further research.

Table 1. Elicitation methods among studies (Klover T, 1999)

Elicitation method	Problems of methods expected	Evidence of problems
Direct question	Problems of non-response and protest answers exist, more difficult to answer	Strong evidence
Bidding game	Problem of starting point bias exists	Strong evidence
Payment cards / interval checklist	Problem of range bias exists	Rarely investigated, some evidence
TIOLI (take-it-or-leave-it-offer) method	Problem of “yea-saying” behavior exists	Once investigated, some evidence

- TIOLI: Closest to real market decisions of individuals. The individuals are asked whether they are willing to pay one bid. This bid is varied in the sample. The distribution of WTP in the sample can be derived from the yes/no answers and mean or median WTP are estimated using logit or probit regressions or non-parametric methods.
  → Discrete Choice Experiments (DCE)

Starting point bias in bidding game

- Gustavsson A, Jönsson L, McShane R, Boada M, Wimo A, Zbrozek AS (2010) Willingness-to-pay for reductions in care need: estimating the value of informal care in Alzheimer's disease. *Int J Geriatr Psychiatry*, 25(6): 622-32. https://doi.org/10.1002/gps.2385

A two-part elicitation method was used similar to the methods used by Kartman et al. (Kartman et al., 1996). First in the dichotomous choice part, the carer was asked whether he or she was willing to pay X for the proposed scenario, where X was an initial amount in local currency which was randomly varied across carer subgroups. If the response was yes, the carer was asked to state whether he or she was probably or definitely sure of this positive response. Thereafter, a bidding game followed in which the bid was increased successively until the carer was no longer willing to pay the latest bid (or until the bid was equal to the assumed maximum bid). If the initial bid was rejected, no follow-up question on certainty was asked, but the bid was decreased until the carer was willing to pay the latest bid (or until the bid was equal to zero). Carers were also asked to say why they accepted or rejected the initial bid in order to exclude protest answers.

The carers were randomly stratified into five subgroups of similar size, differing only in the initial bids used for the dichotomous choice question.

Table 1 Bidding game schedule for a 1 h reduction and each country

Starting bid for	UK (GBP)	Spain (Euro)	Sweden (SEK)	US (USD)
	7	9	100	11
Subgroup 1	14	18	200	22
	25	35	400	44
	50	60	700	80
Subgroup 2	70	90	1000	110
	90	110	1300	140
	110	140	1600	180
Subgroup 3	140	170	2000	220
	200	260	3000	330
	270	350	4000	440
Subgroup 4	340	430	5000	550
	440	560	6500	700
	540	690	8000	900
Subgroup 5	680	860	10 000	1100

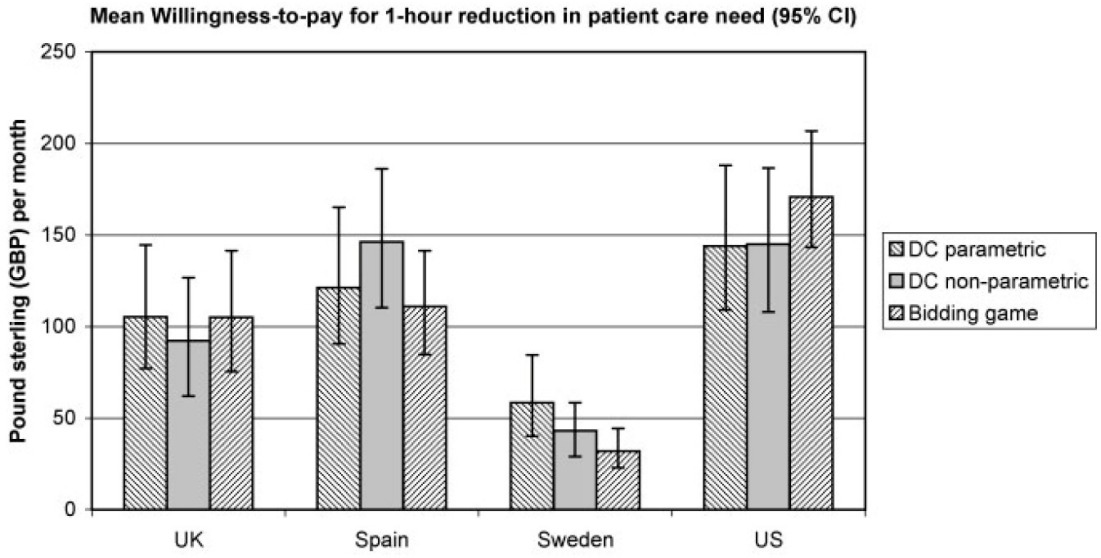

Figure 1 Mean WTP estimates for 1 h reduction in patient care need by country and estimation method (95% bootstrapped CI).

Table 2. Validity and reliability of CVM

Methodological issue	Criteria tested in studies	Evidence
Theoretical / internal validity	Positive influence of health gain and income on WTP	Strongly indicated
Convergent validity	Correlation with other monetary and non-monetary measures of health benefits	Indicated to some but not all studies
Criterion validity	Stated WTP reflects real market behavior	Not directly investigated
Test-retest reliability	Reproducibility	Rarely investigated, mediocre correlations

Table 3. Conceptual issues

Conceptual issue	Examined in studies	Findings and comments
WTP-WTA disparity	Once (until 1998)	No disparity found, although expected (Martín-Fernández et al., 2021 proved)
Payment methods	Rarely	Payment methods can influence the WTP
State of evaluation	Rarely	State of evaluation can influence WTP, no assessment of conversion of ex-post (after everything fiixed) into ex-ante (insurance-based) values (until 1998)
Subadditivity in decomposed scenarios	Rarely	Subadditivity occurs, aggregation of WTPs from decomposed scenarios was not assessed (until 1998)

CVM used in COVID-19 vaccination

- Merga BT, Ayana GM, Negash B, Alemu A, Abdurke M, Abdu A, Balis B, Bekana M, Fekadu G, Raru TB (2022) Health-care Workers' Willingness to Pay for COVID-19 Vaccines in Eastern Ethiopia: Using Contingent Valuation Method. *Clinicoecon Outcomes Res*. 14: 395-404. https://doi.org/10.2147/CEOR.S361199
- **Background**: Health-care workers (HCWs) are among the highest risk groups for COVID-19 infection. The vaccine is found to be vital for HCWs, their household contacts, and their patients to protect against COVID-19 infection and maintain the safety of health systems. The actual willingness to pay for COVID-19 vaccination and associated factors remain uncertain among health-care workers in Ethiopia.
- **Methods**: Institution-based cross-sectional study was conducted among 403 randomly selected health-care workers working in health facilities in eastern Ethiopia from February 3 to March 20, 2021. Pretested structured questionnaire was used to collect data. Binary logistic regression analysis was fitted to test the associations between outcome and explanatory variables.
- **Results**: The magnitude of willingness to pay for a COVID-19 vaccine was 42.8%. The median amounts of money respondents willing to pay was 400 ETB (US$ 10.04). Sex (male, AOR = 2.33; 95% CI: 1.39, 3.93), monthly income (>7000 ETB, AOR = 1.22; 95% CI: 1.11, 2.51), affordability (AOR = 1.99; 95% CI: 1.18, 3.35), fear of side effects (AOR = 3.75; 95% CI: 2.13, 6.60), support vaccinations (AOR = 2.97; 95% CI: 1.65, 5.35), the likelihood of getting COVID-19 infection (AOR = 2.11; 95% CI: 1.26, 3.52) were independent determinants of WTP for a COVID-19 vaccine.
- **Conclusion**: Health-care workers' willingness to pay for COVID-19 vaccination was found to be low. Detailed health education and training about COVID-19 vaccines are required regarding their side effects, and efficacy to make an informed decision to enhance the willingness to pay for the vaccine. Moreover, the government should consider providing COVID vaccines free of charge for low-income groups and at an affordable price for those who could pay.

WTA-WTP gap in health care

- Martín-Fernández J, López-Nicolás Á, Oliva-Moreno J, Medina-Palomino H, Polentinos-Castro E, Ariza-Cardiel G (2021) Risk aversion, trust in institutions and contingent valuation of healthcare services: trying to explain the WTA-WTP gap in the Dutch population. *Cost Eff Resour Alloc*. 19(1): 27. https://doi.org/10.1186/s12962-021-00281-9
- **Background**: The preferences of citizens are a basic element to incorporate into the decision-making process when planning health policies. CVM is common to calculate the value for citizens that new technologies, interventions, and the provision of services or policies have. However, choosing the correct CV tool may not be a neutral decision. This work aims to assess the substitution of a healthcare service by comparing valuation differences between WTP for the maintenance of the service vs the WTA for its substitution, both of which are related to subject characteristics, with a particular focus on trust in institutions and risk aversion.
- **Methods**: To study Dutch population preferences when physician assistants replace anaesthesiologists. Differences between the distributions of WTA and WTP were compared through full decomposition methods, and conditional quantile regression was performed.
- **Results**: 2/3 expressed null values for WTA and WTP. 1/3 reported WTA > WTP, which increased further with lower income and the possible presence of a strategic bias. In contrast, being more than 65 years old, having trust in government, and preferring anaesthesiologists decreased the WTA-WTP difference. Risk aversion had no clear association with the WTA-WTP gap.
- **Conclusions**: Known differences between the perceived value of health services from the perspective of gains and losses could be related to people's characteristics. Trust in government but not aversion to risk was related to the WTA-WTP differences. Identifying a profile of citizens who are averse to losing health services should be considered when designing and implementing health services or interventions or making disinvestment decisions.

Discrete Choice Experiments

- https://thedecisionlab.com/reference-guide/statistics/discrete-choice-experiment
  - Participants choose between a finite number of options with different attributes, helping researchers analyze preferences and trade-offs without asking participants directly.
  - Participants are typically presented with a series of hypothetical scenarios and are asked to rank their preferences or select their top choice.
  - Widely used in fields like marketing, health economics, transportation, and policy-making to predict consumer preferences, optimize product offerings, or design policies that reflect public priorities
- Common process
  - **Attributes and levels**: Each option is broken down into shared features (attributes, such as price, travel time, or side effects) that vary across specific values (levels, such as $10, $25, or $50).
  - **Choice sets**: Respondents view several scenarios (often 5 to 10 tasks) side by side, each showing two or more options with different combinations of attribute levels, plus sometimes an "opt-out" or status quo choice.
  - **Statistical modeling**: Researchers analyze patterns across all choices—commonly using multinomial, conditional, or mixed logit models grounded in random utility theory—to estimate the relative importance of each attribute and calculate willingness to pay (WTP) or trade-offs.
- Szinay D, Cameron R, Naughton F, Whitty J, Brown J, Jones A (2021) Understanding Uptake of Digital Health Products: Methodology Tutorial for a Discrete Choice Experiment Using the Bayesian Efficient Design. *J Med Internet Res*, 23(10): e32365 https://www.jmir.org/2021/10/e32365

Motivations of health volunteer

- Liu Z, Sato N, Shimamura Y (2023) Exploring Preferences of Health Volunteers for Reward Packages in Indonesia: A Case Study using a Discrete Choice Experiment. *Kokuminkeizaizasshi (Japanese)*, 227(4): 107-119. https://doi.org/10.24546/0100482444
  - DCE in 3 districts of Sleman Regency, Special Region of Yogyakarta
  - The preferences of medical volunteers (*kader*) regarding compensation (combination of monthly salary, transportation fee, certificates, right to be leader, bonus) for their activities were examined.
  - Altruism was assessed by dictator game (*kader* as sender within 120,000 IDR)
    - V1 (receiver randomly chosen from whole Indonesia, don't know each other), V2 (receiver randomly chosen from the same community of sender, don't know each other), V3 (same community, sender doesn't know receiver, but receiver knows sender) were compared
    - N=311, average amounts of sending were 45,871 (V1), 54,839 (V2), 58,682 (V3)
    - The *kaders* sent larger amount than 60,000 were high-altruistic, others low-altruistic
  - Regardless of their level of altruism, *kaders* prefer to receive both monetary and non-monetary rewards.
  - The *kaders* with low altruism prefer monthly income (monetary rewards) more than those with high altruism, while *kaders* with high altruism prefer activity certificates (non-monetary and social rewards) more than those with low altruism.
  - The activity certificates issued by the village office are equivalent in value to a monthly income of approximately 40,000 IDR for *kadels* with low altruism, whereas for *kadels* with high altruism, they are equivalent to a monthly income of approximately 80,000 IDR.

Health workers' preference using DCE

- Gadsden T, Sujarwoto S, Purwaningtyas N, Maharani A, Tampubolon G, Oceandy D, et al. (2022) Understanding community health worker employment preferences in Malang district, Indonesia, using a discrete choice experiment. *BMJ Global Health*, 7: e008936 https://doi.org/10.1136/bmjgh-2022-008936
- Efendi F, Chen CM, Nursalam N, Andriyani NW, Kurniati A, Nancarrow SA (2016) How to attract health students to remote areas in Indonesia: a discrete choice experiment. *Int J Health Plann Manage*, 31(4): 430-445. https://doi.org/10.1002/hpm.2289
- Agarwal S, Abuya T, Kintu R, Mwanga D, Obadha M, Pandya S, Warren CE (2021) Understanding community health worker incentive preferences in Uganda using a discrete choice experiment. *J Glob Health*, 11: 07005. https://doi.org/10.7189/jogh.11.07005