

What is a Delphi process?

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- A Delphi process is a **group facilitation technique**, which is an iterative multistage process, designed to transform the opinion of individual experts into **group consensus** in situations where information is scant and a level of uncertainty exists, requiring expert judgement.
- The classic Delphi process comprises **multiple rounds**, with questionnaires for each round being developed based on the input of the preceding round. This allows experts to review and adjust their opinion in light of the group response and, therefore, move towards a convergent viewpoint.
- In a classic Delphi process, **experts remain anonymous** to each other, with question rounds being managed and analysed by a facilitator.
- Classic Delphi processes have **advantages over other group consensus techniques** because experts are not brought together at the same time and in the same place, overcoming the practical difficulties of geography and diary clashes, while also removing some of the dynamics issues common in group meetings.
- **Various modifications** of the Delphi process exist; one common modification replaces the third round of questions with a face-to-face expert meeting.
- Factors important for the success of a Delphi process are the clear definition of the project objectives and measures of consensus, the selection of appropriate experts, a **clear briefing** and good starting material, and **well-designed questionnaires** that build on each other through effective analysis.
- Delphi processes have been applied to a **range of healthcare questions**, as diverse as establishing best practice commissioning and estimating disease prevalence.

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Introduction

In the 8th century BC, the rich, poor, Greek and foreign all flocked to consult the famous oracle at Delphi.¹ The oracle, Pythia, was said to be able to channel the spirit of the gods, seeing into the future to foretell of success or disaster and, more importantly, providing insight that could inform the actions of those consulting her.²

It is not surprising, therefore, that when searching for an approach to improve expert prediction in policy decision-making in the 1950s, the RAND corporation thought back to the oracle and developed what is known as the Delphi process.

So, what is a Delphi process? The following definitions capture the different aspects of this process:

- 'A group facilitation technique, which is an iterative multistage process, designed to transform opinion into group consensus'³
- 'A relatively strongly structured group communication process, in which matters, on which naturally unsure and incomplete knowledge is available, are judged upon by experts.'^{2,4}

Together, these definitions illustrate the Delphi process as a technique that:

- involves group working
- Requires expert judgement and insight
- Is valuable when robust data are lacking
- Occurs in rounds
- Focuses on creating a convergence of viewpoints.

This title describes the key features of the Delphi process, offering insights on its use and illustrating how it has been employed in different areas of healthcare.

Overview of the Delphi process

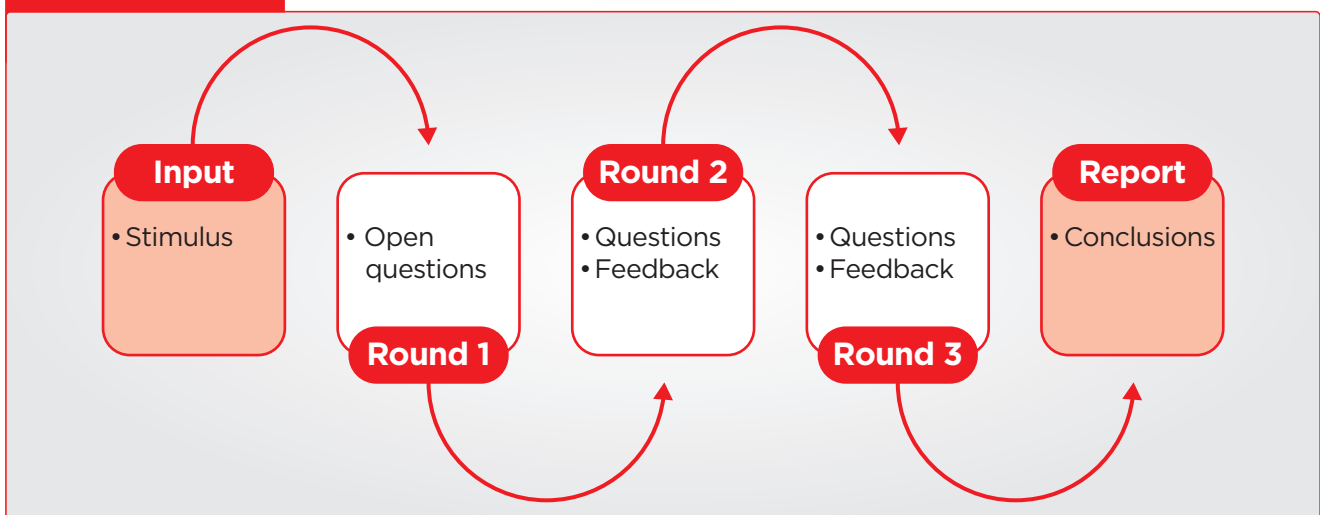
The Delphi process comprises separate rounds, with the questionnaire for each round being derived from the responses to the preceding one.⁵ Round 1 questions tend to be open and aimed at capturing broad opinions and viewpoints. Subsequent rounds of questions tend to be more focused and structured as they build on the responses to the previous rounds and aim to focus ideas and concepts into summary statements on which consensus can be achieved. Rounds can continue until consensus is reached, although such an open-ended approach is rarely possible in a real-world setting. Three rounds of questions, as shown in Figure 1, are deemed to be sufficient to achieve consensus in most situations.⁶

The example Delphi process shown in Figure 1 also has an input step before Round 1. This input step allows expert respondents to be briefed on both the Delphi process methodology and the objectives of the Delphi project; it also provides any information that may be relevant to the issue being considered such as systemic literature review findings.

Another important part of the Delphi process is the production of a final report, identifying key conclusions on areas of consensus and also characterising the areas where consensus was not reached.

As well as the classic Delphi approach shown in Figure 1, various modifications are used. One common modified Delphi process adds a face-to-face meeting in place of the final round of questions. This final consensus meeting brings the experts together to allow

Figure 1. Delphi process schematic showing a three-round process



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discussion of the findings, with a focus on areas where consensus was not reached.⁷ Other modified Delphi processes have used voting methods, such as key pads, to gather feedback synchronously from a group of experts at a face-to-face or virtual meeting.⁸

With this overview of the Delphi process in mind, it is worth highlighting some of the key characteristics and benefits of the Delphi approach, which explain why it has become a popular technique.

The Delphi process: characteristics and benefits

As described above, the Delphi technique is an iterative process, used to gain insight from experts on issues on which their judgement is important. It also has a number of other characteristics, which make it a robust method for achieving consensus (see Box 1). First, in the classic Delphi process, the expert respondents remain anonymous, never meet and simply share their views via a Delphi facilitator through the scheduled rounds. This has a number of benefits, both practical and methodological (see Box 2). Practically, experts never need to be brought together at the same time and in the same place, allowing engagement with a geographically diverse expert group and avoiding diary conflicts, as well as saving time and cost.⁹ This also gives experts time to reflect on their answers and to complete them at a time when it is convenient for them.

Methodologically, anonymity also removes issues of social bias; that is, experts can answer more honestly, without pressure from peers or more senior colleagues, and the impact of individuals who may dominate in group meetings is removed.⁸

When is a Delphi process appropriate?

A range of different techniques is available to poll opinions and gather insights from experts; so, when is it appropriate to use a Delphi process rather than any other technique? Obviously, there is general acceptance that gaining insight and opinions from more than one expert is desired when dealing with topics on which information is scant, a level of uncertainty exists and expert judgement is required. Under such

- Anonymous
- Iterative, based on a series of 'rounds'
- Based on opinions of a group of experts
- Focused on answering questions that need judgemental decision-making
- Asynchronous – does not demand experts to be available at the same time in the same place
- Moderated by a facilitator

Box 1. Characteristics of a Delphi process

- Not constrained by geographic distribution of experts
- Anonymity reduces social bias of responses
- Participants do not need to know each other
- Participants have time to review and consider their answers
- Participants can complete the rounds when convenient for them
- Group 'discussion' is recorded
- Proven effective in a wide range of fields and situations
- Well accepted as a credible technique for gaining consensus
- Flexible process, allowing adaptation to address a broad range of complex problems in a wide variety of fields

Box 2. Benefits of the Delphi technique⁹

circumstances, two possible approaches can be taken: (1) questioning experts individually and aggregating their responses mathematically, or (2) creating a group interaction where experts work together to produce an answer to the question, an example of the old adage of 'two heads being better than one'. This latter approach is known as behavioural aggregation, with the Delphi process being one of a range of possible techniques.¹⁰ Other examples of group behavioural aggregation approaches are listed in Table 1.

One reason why the Delphi process is widely used in healthcare and health economics, is that it is recognised by the National Institute for Health and Care Excellence as a formal consensus method, along with the nominal group technique, appropriate for identifying areas where agreement on best practice is lacking.¹²

When selecting a Delphi process over other consensus methods, it is important to consider the constraints of time, expert

Table 1. Alternative techniques for developing group consensus

Technique	Description
Nominal group technique ⁵	A structured group meeting format, where experts interact in a strictly controlled way. The meeting starts with individuals working in silence to capture ideas in writing. Ideas are shared and discussed in a restricted manner followed by voting and ranking to determine ideas on which the group concur
The Sheffield Elicitation Framework (SHELF) ¹¹	A formal elicitation process to capture expert knowledge about one or more uncertain quantities in the form of a probability distribution. This face-to-face method uses a facilitator to elicit information from either individuals or a group of up to five experts. The framework provides detailed guidance and software to support the final production of an elicited probability distribution

availability and location, size of the sample group and budget. If time is short, then alternative methods may be more appropriate than a Delphi process, for which a minimum of 45 days should be allowed for completion.⁵ Similarly, if group size is very small and experts are located in close proximity, then a face-to-face approach may be more practical.

The Delphi process key success factors

A number of factors impact the success of a Delphi process: the Delphi ‘team’, definition of objectives and outcomes, selection of experts, format of the questionnaire, input material, questionnaire design and analysis of each round of answers and the final report. Each of those is discussed in more detail below.

The Delphi team

Delphi processes usually involve some key stakeholders, in addition to the expert panel whose judgement is being elicited; namely, the decision-makers (or steering committee) and the management or facilitator group.^{2,5} The ‘decision-makers’ are essentially the group driving the process and needing the answer to the question under scrutiny. They are responsible for defining the scope and remit of the Delphi process and work with the facilitator to approve questionnaires and support the selection of experts. The facilitators work with the decision-makers to realise and run the Delphi process, guiding it from their position of expertise, and

managing all the practical elements such as distribution of questionnaires and moderation of the rounds.⁵

Setting clear objectives and defining measures of consensus

A Delphi process needs to start with a clear definition of the questions or problems to be addressed by the experts. To do this, it is helpful to consider the reasons for running the process and to categorically determine the outcome (or outcomes) wanted from the process. Communicating this effectively to the experts is essential, as it helps engage them actively in the process and lets them understand where they are trying to get to as a group.

Establishing what is meant by consensus and how it will be measured as part of the process is also important. A common approach is to set a threshold for consensus based on the percentage of respondents whose votes fall within a certain number of categories on a Likert scale; for example, consensus would be achieved if 70% of experts agreed or strongly agreed with a statement based on a four-point Likert scale.⁶ Alternatively, it may be more appropriate and reliable to measure the stability of experts’ responses in successive rounds of the questionnaire, as this can reveal movement in opinions.

The case examples, shown later, provide some insight into the different approaches to consensus which may be relevant to specific situations.

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Selecting experts

The Delphi process is about eliciting the judgement of experts to gain consensus on a subject that they have insight into. It is, therefore, important to define who qualifies as an 'expert' for the problem under consideration. The best way to do this is to establish a set of expert criteria that can be scored to identify the most appropriate experts. The following broad criteria can be used as a starting point to assess an individual's suitability as an expert:

- Knowledge and practical engagement with the issue under investigation: do they know enough about the ins and outs of the subject to allow them to contribute with insight and authority?
- Capacity and willingness to contribute: does the question matter to them and are they able to engage effectively in the discussion?
- Assurance that they have sufficient time available: do they have enough total time available to commit to a Delphi process?
- Timelines fit with personal or work priorities: does the schedule for the Delphi rounds broadly fit with the time they have available and not correspond to sabbaticals or holidays?
- Good written communication skills: can they express themselves effectively in written English in a coherent and concise way?
- Knowledge and skill level need not necessarily be accompanied by a formal academic qualification: for example, the views of expert patients who live with a chronic condition may be more appropriate in some instances than just the views of their doctors, especially when considering quality of life questions.⁹

How many experts does it take to complete a Delphi?

Once the expert criteria have been established, the next question is how many experts are needed for the Delphi process. No overall agreement regarding optimum expert sample size can be found in the literature and no criteria are available on which sample size can be judged. Published papers use Delphi groups that include from five experts upwards, with many studies having between ten and 100 experts.⁹

Evidence suggests that reliable outcomes can be achieved from small numbers of experts, providing they have homogenous levels of training and knowledge, assessed through strict inclusion criteria.⁹ However, good evidence is available to suggest that heterogeneity of panels improves decision-making and this would be especially true if the issue in question impacts a large number of different stakeholders – all of whom should be represented in the expert group.⁷

Dropout from the expert group during a Delphi process can occur. It may, therefore, be advantageous to make allowance for this and include a larger sample than needed.

Assessing usual response rates to surveys on similar topics can help guide this calculation.⁹

The appropriate group size will also be determined by the way that consensus will be measured – if statistical power is needed, then a larger expert group may be needed.

Optimising the format

The format of a classic Delphi process, where experts engage remotely with a series of questionnaires, lends itself to online survey methods. Various proprietary online survey tools, such as SurveyMonkey®, are available and can be employed in a cost-effective and efficient way to run surveys; however, these may have limitations on question format and layout, which could restrict the way in which questions are asked. In addition, some evidence suggests that lower response rates are found with internet-based questionnaires.⁷ Some pros and cons of basic online and paper-based surveys are shown in Table 2.

When selecting the format for the questionnaire, the attitude (and technical capability) of the experts, the time scale involved and the format of questions that will be employed (for example, rating or multiple-choice) should be considered. Most importantly, the questionnaire should allow the experts to add detailed comments and additional notes to illustrate and expand their answers. The easier the questionnaire is to complete, the better quality of responses.

Identifying the starting point and input required

As shown in Figure 1, an input step is the starting point for any Delphi process. The

Table 2. Pros and cons of different questionnaire delivery formats

Proprietary online survey tools	
Pros	Cons
<ul style="list-style-type: none"> • Fast delivery • Inbuilt respondent tracking and automated reminders • Results automatically collated and some analysis usually provided • Ability to set rules for questions (eg, a question about the proportion of patients receiving different treatment options must add up to 100%) 	<ul style="list-style-type: none"> • Some institutional firewalls block invitations emailed from survey websites • Limited formats for question styles can result in extended questions which lengthen and complicate questionnaires • The standardised format and structure can be dull to complete and lead to confusion and ‘loss of place’ • Experts must be online to complete the survey
Paper-based (either electronic or hardcopy)	
Pros	Cons
<ul style="list-style-type: none"> • Fast delivery if emailed • Greater control over layout and presentation • Better user understanding of length of questionnaire and orientation within it 	<ul style="list-style-type: none"> • Manual tracking of users is more time-consuming to administer • If completed by hand, writing can be difficult to read/illegible • Manual collation of data required; therefore, more time-consuming

input step can be thought of in two parts – one focused on contracting and briefing and the other focused on providing relevant background information.

For contracting, it is important to explain the rationale for the Delphi approach and the outcomes sought; a description of the Delphi process and how the experts should engage with it should be provided; the time schedule for the separate rounds of questions and the estimated time needed to complete each round should be outlined.

The need for additional background information varies with the objectives of the Delphi process; for example, a Delphi process aimed at identifying expert opinion on the prevalence of a specific disease in both the general population and specific population subgroups may include a systematic review of the literature on disease prevalence as an input, allowing the experts to consider their opinion in the context of the wider, published evidence base.

Questionnaires and analysis

The questionnaire in each round of a Delphi process builds on the preceding one and each round, therefore, tends to have certain

distinct characteristics. Because of this interdependency, it is also more practical to discuss the questions and analysis together.

Round 1

Questionnaire development

Round 1 is the first set of questions that the experts will receive and usually consists of broad and open-ended questions that require fulsome, written answers. As an example, a Delphi process might be trying to establish the most appropriate clinical interventions for the treatment of patients with a rare disease for which no formal management guidelines exist; in such cases, broad, open questions could be used in the first round to gather information about the treatments the experts use in patients with this disease.

Although Round 1 involves open questions in the majority of cases, it is acceptable to use a structured questionnaire based on an extensive review of the literature if the basic information concerning the target issue is available.⁶ If, for example, a Delphi process aims to understand clinical management decisions such as the likely treatments a subgroup of patients with severe psoriasis who have comorbid diabetes and

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hypertension will receive, it would be appropriate to structure questions around the treatment options available for all patients with severe psoriasis as a starting point.

When using structured questions in Round 1, it is important, however, to provide respondents with an opportunity to add additional comments and narratives, as this helps provide context for their decision-making and judgements that can aid analysis and feed into the Round 2 questionnaire.

Questionnaire analysis

Round 1 responses are collated by the facilitator and analysed. The nature of the analysis can vary, depending on the starting point. For open-ended questions, responses are analysed, evaluated and clustered into themes that are prioritised according to the number of experts who have identified them.² These themes are used to develop the Round 2 questionnaire.

Round 2

Round 2 presents the data collated from the responses to Round 1 with any accompanying narrative. In Round 2, experts may reconsider their individual opinion in light of the opinion collected from the group as a whole. To aid this reflection, it is helpful to provide some statistics, such as indicators of central tendency; that is, the mean, median and mode and the standard deviations or interquartile ranges that can be linked to questions.⁶

In Round 2, experts are usually asked to rate their level of agreement or disagreement with the collated responses, generally by using Likert-type scales.⁶

Responses from Round 2 are collated and by this stage, areas of consensus should be building.

Round 3

Round 3 presents the data collected from Round 2, again with an accompanying narrative. Areas of consensus should be reported and where no consensus has been achieved, the responses should be represented for further consideration, as previously. The focus of Round 3 is on identifying the specific reasons for consensus not being achieved, so it is important to

Example 1. An expert Delphi consensus on the prevalence of dementia in the UK¹³

Aim: The aim was to estimate the prevalence of dementia within the UK to support effective policy-making.

Approach: The Delphi panel comprised ten senior academics with relevant expertise and experience. Experts were provided with a systematic review of relevant research on prevalence to support their decision-making. The experts were then asked to make their own prevalence estimates for different types of dementia in different populations; for example, for different gender and age groups or for people living in care homes. Responses were summarised as mean prevalence estimates and returned to the experts for review. Experts could adjust their original responses in light of the responses from the group as a whole. The levels of agreement between participants in the first and second rounds were assessed using a statistical device, known as intraclass correlation coefficient, within age groups. Mean prevalence and standard deviation were calculated for each age and gender group.

Conclusions: The authors concluded that they had successfully generated expert consensus estimates of dementia prevalence based on a systematic review of the whole relevant research evidence base, which was more robust than other estimates. This provided more precise and more extensive information about the effects of age and gender on disease prevalence and insights into the distribution of patients within the community.

Example 2. Disentangling rhetoric and reality: an international Delphi study of factors and processes that facilitate the successful implementation of decisions to decommission healthcare services¹⁴

Aim: The aim was to establish international expert opinion on best practice in decommissioning healthcare services and identify the factors and processes that facilitate the successful implementation of decommissioning projects.

Approach: A panel of 30 international experts in decommissioning theory and practice was convened for a three-round Delphi process. The experts were asked to consider, define and rate factors that shape the process and outcomes of decommissioning programmes and to provide examples of best practice in decommissioning. Open comments were extracted, coded and then grouped into key concepts. Round 1 asked for open responses under some key headings; for example, factors that positively shape the process of decommissioning. Round 2 asked experts to rate statements derived from Round 1 using four-point Likert scales. Threshold levels of consensus were set by measuring percentage responses and categorised as high, medium, low or none. Factors that achieved low or no consensus were then used to drive Round 3.

Conclusions: The Delphi process identified strong agreement on three considerations that should inform decommissioning decisions; namely, quality and patient safety, clinical effectiveness and cost-effectiveness. In addition, high consensus was found on a number of key factors that shaped decommissioning and three best practice decommissioning approaches. Interestingly, the process revealed that what the experts *thought* should drive decommissioning was very different from the factors that were most influential in practice.

capture comments and explanation on this from the experts.⁶

In a modified Delphi process, where Round 3 is a meeting, the same conventions apply but effective facilitation of the meeting is needed to manage any possible group

dynamic issues such as dominant or unresponsive participants.

Final report

It is always appropriate to write up the results and, at the very minimum, share these with the Delphi team (that is, the expert group and decision-makers),⁵ and in many circumstances, it is also appropriate to publish the findings. For effective assessment of the quality of the Delphi process and data, it is important to include details of the elements of the process, including objectives and definition of consensus, selection criteria for experts, number of experts, number of rounds plus response rates for each round, details of a meeting (if one was held), results of each round and final conclusions, plus a copy of the questionnaires in an appendix.⁷

Examples of Delphi processes

So far, the focus of this title has been on the methodology and process. This section provides some examples of the ways in which Delphi processes have been used in practice in three distinct situations:

- Example 1 shows a two-round classic Delphi process being used to estimate disease prevalence based on input from a systematic review.¹³
- Example 2 shows a three-round Delphi process being used, without major input, to capture and define best practice in decommissioning healthcare services.¹⁴
- Example 3 shows a modified Delphi process, combining a written round with a face-to-face meeting and using patient case histories as input to elicit information about treatment recommendations for a rare disease.¹⁵

Conclusions

Since the Delphi technique was introduced some sixty years ago, it has become a valuable evaluative tool for group decision-making and has been applied to a wide range of problems. Its popularity resides in two characteristics, which appear to be contrary – namely, first, its flexibility and applicability to a wide range of situations and, second, its rigour in addressing some of the issues common in group decision-making.

Example 3. Enzyme replacement therapy and/or haematopoietic stem cell transplantation at diagnosis in patients with mucopolysaccharidosis type I: results of a European consensus procedure¹⁵

Aim: Mucopolysaccharidosis type I (MPS I) is a rare, lysosomal storage disorder presenting with a broad clinical spectrum and causing progressive multi-organ dysfunction. The aim of the Delphi process was to gain consensus among European experts on the optimum use of the two available treatment options: enzyme replacement therapy and haematopoietic stem cell transplantation (HSCT).

Approach: The Delphi panel was formed of 15 clinical experts. In Round 1, they were presented with 15 patient case histories and asked to identify whether each of the patients was suitable for HSCT or not and include reasons for their decision. At a subsequent face-to-face meeting, the cases were presented again, in a different order, to check for intra-observer reproducibility. The experts then used their collated statements from Round 1 with a set of statements about treatment options, compiled by the planning team based on both personal experience and a literature review, as a starting point for a moderated discussion.

Conclusions: For four of the Round 1 case histories, there was complete disagreement on treatment approach between the experts. The subsequent discussion at the face-to-face meeting revealed and explained the underlying drivers influencing treatment decisions. The outcome from the meeting was a series of consensus statements and a joint formulation of the rationale for these statements that could support clinicians in decision-making in this rare disorder.

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