Collective wisdom and decision making in Surgical Oncology. A review paper for the EJSO

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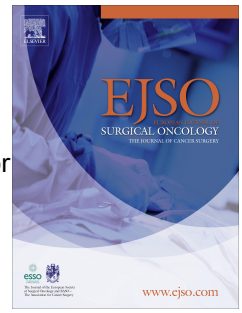

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Collective wisdom and decision making in Surgical Oncology.

A review paper for the EJSO

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Abstract

Aim: To describe systems for capturing and optimising collective knowledge and insight in areas of complexity and uncertainty in surgical oncology, with particular reference to the Delphi process and related systems.

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Methods:

Internet search engines (Google, Google Scholar) and four databases (SCOPUS, PubMed, Medline and Embase) were searched to find English language articles on the use of The Delphi Process and related systems in surgical oncology, using a variety of search terms.

Findings:

There are a number of established systems for co-opting group knowledge and facilitating collective decision-making. These find applications in commerce, industry, government and defence. They have also been applied to problems in surgical oncology, for example using the Delphi process to optimise the management of colorectal cancers and metastases.

Conclusions: Collective decision making tools find practical applications in the allocation of resources and in clinical decision making in fields of surgical oncology practice where there is a wide range of evidence and expert opinion. Such methodologies set new standards for the collating of professional expertise and for the writing of “best clinical practice” guidelines in the cancer subspecialities.

Introduction

There are many areas of uncertainty in clinical and oncological practice. The breadth and extent of the published literature in any one subject area is now huge, and accruing at an enormous rate. The "cloud" experience of huge numbers of individual clinicians treating individual patients with their infinite variety of presentations and responses to treatment across the world often goes uncaptured and unrecorded. There is no prospect of any one person collating, analysing and distilling this mass of published and unpublished knowledge in a realistic time frame, even with the help of modern search engines.

Digital technologies and the opening up of the Internet have driven forward the science of understanding mass behaviours, and have provided means for the efficient dissemination and collation of responses and opinions from large numbers of people. We see these processes in daily use in dissemination by scientific search engines such as SCOPUS, Google Scholar and Web of Science, and in communal interactive systems such as Facebook, Twitter and MySpace.

Individual genius, insight and intellectual courage drives human society forward in many ways, as illustrated by the work of Galileo, Newton, Einstein and Darwin. However, many challenges in medicine and public health require a collective approach. They need systems which tap into many different sources of wisdom and experience if resources are to be allocated most efficiently, and if clinical outcomes are to be optimised on an individual and a population basis.

In recent times, we have seen a major shift in medical decision making from the "wise individual" to the multidisciplinary team. Our horizons have risen from the local and parochial to the regional, national and supranational. The Internet has brought worldwide and near instantaneous visibility to the key literature and as email has radically simplified cross border communications. Internet development has also brought a whole new thinking and language of terminologies which recognises "the wisdom of crowds" and which captures this collective knowledge through processes such as "crowdsourcing", and "collaborative filtering". Perhaps the best known of these techniques in Medicine is the Delphi process. This has already found a number

of practical applications in surgical oncology. It is a substantial advance over simple questionnaire based surveys

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Methods

Four databases (SCOPUS, PubMed, Medline and Embase) were searched using a variety of terms to find English language articles pertaining to collective knowledge systems such as the Delphi System in general and in respect of surgical oncology in particular.

Keywords included “Crowdsourcing”, “the wisdom of crowds”, ‘Delphi System’, ‘Delphi Method’ and ‘Delphi Method in Surgical Oncology’.

No Cochrane reviews were found on this topic. The search identified that there were no prospective randomised controlled or systematic reviews, one observational study and three studies involving the Delphi technique and oncology.

The Delphi system

The Delphi System is an approach used to gain consensus among a panel of nominated voting experts. It was originally developed in the 1950s by the Research and Development Corporation, RAND, for forecasting future warfare after World War II (**1, 2)**. In 1959, Helmer and Rescher published a paper describing a tool for pooling the predictions of a panel of experts for questions that could not be answered as yet by exact science (**3**).

In addressing major organisational problems, group decision-making is open to bias from single experts and ‘follow thy leader’ tendencies. There is often a reluctance to abandon previously stated opinions and groups may be subject to a variety of pressures. The Delphi System offers anonymity, and asynchronicity in time and place, thus allowing individual beliefs to be expressed independently in contributing to the conclusions of the whole group.

The Delphi System has been widely applied outside healthcare in strategic military and political planning and in business decision making (**4-7**). However, there is as yet

no level 1 evidence to prove the value of the process as an alternative to group discussion for clinical decision-making.

The Delphi system lends itself to a range of applications in cancer management, both in the allocation of resources and in interpreting a complex clinical evidence base, so as to aid multidisciplinary decision making across diverse disciplines. Professional guidance to interpreting the literature using the Delphi technique may also assist clinical MDT decision making and hence optimise practice in a rapidly changing practice and technical environment.

Components of the Delphi Process

The Delphi system is a structured process with four core principles of anonymity, asynchronicity, controlled feedback and statistical analysis. A question or problem is identified and defined by the leading body. An extensive factual information search should take place and evidence-based statements provided to potential members of the panel. The panel should be experts in their field and be adept at structural, critical analysis of information. Debriefing sessions can be used to ensure panel experts are aware of the educational resources**.** Information is provided as a list of statements for submission to the Delphi experts.

A group moderator is then nominated. The moderator does not vote but provides information, delegates tasks, submits statements to the panel, collects response, analyses data, submits the response for further panel scrutiny in repeated rounds and collaborates the result for presentation to the panel.

A series of voting rounds take place which may be separated in time and place, and which may be conducted through a variety of media, including email. Early voting rounds help to define study objectives. Subsequent rounds rank these objectives in order of importance and develop criteria for further consideration, which are then ranked. The process identifies areas where there are differences in opinion or agreement, which may or may not lead to a consensus view on each of the questions posed.

The four key principles of the Delphi System:

Anonymity: This ensures that the personalities and status of the voting experts cannot influence group behaviour. Opinions perceived as unpopular or maverick can be freely expressed. Experts may change their opinions without pressure to match preconceived expectations.

Asynchronicity: This allows the process to move forward without depending upon participants being together in time and place. This allows time for reflection and for geographically widely dispersed experts to contribute effectively.

Controlled feedback: This allows the results of each subsequent round formulate the next, under direction of the moderator.

Statistical output; The Delphi process produces quantitative results from the qualitative beliefs of the panel. The Delphi group can then assign a level of confidence in the results and gauge satisfaction with the outcome.

The Delphi rounds

The facilitator submits a questionnaire or list of factual statements to the Delphi experts. The experts respond anonymously. A list of goals and criteria are developed from the result analysis of this questionnaire and processed by the facilitator to formulate a second questionnaire, which goes to a second voting round. The results are analysed and criteria developed for ranking in order of importance by the Delphi panel.

In the third Delphi round, the ranked criteria are analysed and weighted again. The unimportant are discarded and the moderately important may be rephrased and resubmitted, new criteria for panel response may be developed. The revised list of weighted criteria is submitted to the panel and for further ranking. The Delphi process can run to numerous rounds, but to avoid panel fatigue it has been recommended that 4 rounds are optimal. The panel rank the criteria for the final time in the consensus round.

In the consensus round, the results are processed by the facilitator and presented to the group. Criteria are ranked and recommendations for practice are made. A consensus may or may not be secured on each question posed.

Examples of the Delphi process in surgical oncology in practice

Colorectal Cancer Management (Europe)

The International Conference on 'Multidisciplinary Rectal Cancer Treatment: Looking for a European Consensus" (EURECA-CC2) provides an example of the Delphi process in action. The Conference was organised in Italy and endorsed by the European Society of Medical Oncology (ESMO), European Society of Surgical Oncology (ESSO), and the European Society of Therapeutic Radiation Oncology (ESTRO), and 34 specialists with a range of expertise were invited to form the Panel. The Delphi document was available to all Committee members as a web-based document customized for the consensus process. Eight chapters were identified: epidemiology, diagnostics, pathology, surgery, radiotherapy and chemotherapy, treatment toxicity and quality of life, follow-up, and research questions. For each chapter, and a series of statements were developed. Each member commented and voted three times.

The votes were anonymous and rounds one and two were asynchronous, with three weeks available for voting. Statements upon which an agreement was not reached after voting round 1 (24th September to 20th October) and voting round 2 (10th November to 1st December) were openly debated during the Consensus Conference in Perugia in Italy from 11th – 13th December 2008. A hand-held televoting system collected the opinions of both the Committee members and the audience after each debate.

A final voting round took place by email after the conference between 20th January and 10th February 2009. There were 207 voted sentences. Of these, 86% achieved large consensus, 13% achieved moderate consensus, and only 3 resulted in minimum consensus. The results were summarised and published (**8**).

Hepatic resection for metastatic colorectal cancer (Canada)

The Candian Hepatico-Pancreatico-Biliary (HPB) Society nominated a Delphi panel of experts to provide quality of care guidelines for the management of patients undergoing hepatic resection for metastatic colorectal cancer (Ref). The CHPBS group of 16 experts included two medical oncologists, one anaesthetist, one hepatologist, one pathologist, one palliative care physicians and nine surgeons. A literature search produced a list of evidence-based statements as possible quality indicators. The voting took place by post.

In each Delphi round, each statement was scored on a 5-point Likert scale as follows: (1) do not include, (2) little reason to include, (3) could include, (4) should include, (5) must include. Replies were anonymous and asynchronous. The response was compiled as an Excel spreadsheet and those statements with a mean score of >4 were kept as quality indicators. Those with an average score of >3 but <4 were re-sent to participants to score again with any new statements developed from round 1. Statements scoring <3 were discarded. The process was repeated for the final round 3, with participants being asked to add a weighting score to the established quality indicators. A 100% response was received for all rounds. The panel identified 18 quality indicators for care of the patient undergoing hepatic resection from metastatic colorectal cancer.

These indicators included items of structure and organisation, including hospital volumes, the establishment of HPB MDTs, equipment and review systems; process and service targets for specialist referral, investigation and treatment; and outcome indicators (**9**).

The Research Agenda of the American Society of Colon and Rectal Surgeons

The Delphi method can be extended to the polling of the entire membership of a specialist Society, as illustrated by the following exercise conducted by the American Society of Colon and Rectal Surgeons (ASCRS) to reach a consensus on the research questions of highest importance in terms of clinical care.

A modified Delphi process was used. 203 responding members in Round 1 submitted 746 questions. These were reduced to 105 questions encompassing 21 topics in

colorectal surgical practice. In Rounds 2 and 3, 399 and 360 respondents, respectively, further prioritised and refined the list of questions. The final 20 items included 14 questions related to colorectal cancer, and six on benign disease topics, which were scored and tabulated.

The authors reported that the research agenda produced by this study reflects the clinical issues of greatest importance to the ASCRS members, and would help direct future research (**10**).

Modifications of the Delphi Process:

Oncosurge

In 2005, an international panel of HPB surgeons set out to create a therapeutic decision model identifying appropriate procedure sequences for the management of colorectal metastases. The RAND Corporation/University of California, Los Angeles Appropriateness Method (RAM) was used to assess strategies of resection, local ablation and chemotherapy. After a comprehensive literature review, an expert panel rated the appropriateness of each treatment option for a total of 1,872 ratings decisions in 252 cases. A decision model was constructed, consensus measured and results validated using 48 virtual cases, and 34 real cases with known outcomes. The group described its methodology as follows:

“The RAM methodology is a modified Delphi process which invites experts to apply their judgments on the appropriateness of treatments for an average patient within each category, treated by the average provider in the average hospital. The term "average" is clearly defined. “Appropriateness” describes the relative weight of the benefits and risks of a medical procedure, such that a procedure is "appropriate" when the expected benefits outweigh the possible negative consequences by a sufficient margin. The definition of a "sufficient margin" recognises the subjectivity of the expectations and risk perceptions of the individual patient, and their clinician(s) (**11**). Therefore, to be of clinical use, the decision model must rank and stratify benefit/risk and benefits ratios for each treatment strategy in each clinical presentation. A procedure is judged to be "uncertain" when benefits and risks are similar, or if there is disagreement within the expert panel”.

In this study, the appropriateness of different treatments was scored on a scale of 1 (highly inappropriate) to 9 (clearly appropriate) against each clinical presentation. For the purpose of analysis, ratings from 1-3 for any given treatment were considered inappropriate, 4 to 6 represented uncertainty, and 7 to 9 indicated appropriateness. The group rating was taken as the median judgment of the panelists. Uncertainty could indicate that the experts were uncertain, or that there was disagreement among the experts, which would indicate a need for further clinical research. Bimodal disagreement (1 to 3 v 7 to 9) led to a discussion preceding the second round of ratings.

An international panel of 16 oncologists, surgeons and radiologists with wide experience in the diagnosis and treatment of liver metastases were provided with a systematic review of the indications for surgical resection of colorectal liver metastases prepared by two of the authors of this study and funded by the British Cancer Research Campaign (now CRUK). Each model patient was assigned to one indication, but considered for each possible treatment.

A preliminary panel meeting established three treatment groups for consideration: liver resection, local ablation, and chemotherapy. For each treatment segment, all relevant possible patient characteristics were included in the list of indications.

A second meeting reviewed the results of the first round of ratings, and modifications were made to the list of treatment options and indications. Panelists then privately rated each of the three treatment groups separately. The strategies that emerged from the second round of ratings were incorporated into a decision matrix in the form of a computer program, the OncoSurge decision model. Validation of the model by the expert panel was accomplished using 48 representative virtual theoretical cases using the real decision characteristics identified by the appropriateness analysis. These 48 cases were created specifically to ensure that the expert panel had considered the full range of all potential clinical presentations, making the validation process span the full range of potential patients. The validation process using the 48 virtual theoretical cases was reinforced by the panelists using 34 real cases from their panelists' own clinical practices with known outcomes.

Overall consensus rates for a series of statements ranged from 93.4 to 99.1%. For example, absolute contraindications to liver resection were judged to be unresectable extrahepatic disease, more than 70% liver involvement, liver failure, and lack of surgically fitness. Recommendations were also made in respect of factors which did not influence treatment strategy; indications for immediate resection and after chemotherapy, and in respect of surgery in relation to other ablation techniques.

The model identified criteria for resectability for individual patients; made recommendations for optimal treatment strategies; and provided opportunities for medical education.

The authors concluded that the OncoSurge decision model for colorectal liver metastases combines the best available scientific evidence with the collective judgment of worldwide experts. It allows a clinician to optimise treatment in the context of local skills, resources for each patient. The methodology can be applied efficiently across health care systems worldwide, to decision making in multimodality therapy for other cancers, such as rectal cancer or adjuvant therapy for breast, lung, and pancreatic cancer (**12**).

Development of quality indicators for patients undergoing colorectal cancer surgery.

McGory et al reported using a modification of the RAND/UCLA Appropriateness Methodology to update National Cancer Institute-sponsored consensus panel guidelines for colorectal cancer surgery from 2000. They used structured interviews with experienced colorectal cancer surgeons and systematic reviews of the literature to identify candidate quality indicators addressing perioperative care for patients undergoing surgery for colorectal cancer. A panel of 14 colorectal surgeons, general surgeons, and surgical oncologists then evaluated and formally rated the indicators using the modified Delphi method.142 candidate indicators were identified in six broad domains: privileging (which addresses surgical credentials), preoperative evaluation, patient-provider discussions, medication use, intraoperative care, and postoperative management. The expert panel rated 92 indicators as valid, which address all domains of perioperative care and which could be used as quality performance measures and for quality-improvement programs (**13**).

The Delphi approach to attain consensus in methodology of local regional therapy for peritoneal surface malignancy

At the Fifth International Workshop on Peritoneal Surface Malignancy (PSM) in Milan, December 2006, the Delphi process was used to seek a consensus on technical aspects of cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC). Topics discussed included pre-operative workup; eligibility to CRS + HIPEC; intra-operative staging system; technical aspects of surgery; residual disease classification systems; HIPEC: nomenclature and modalities; drugs, carrier solution and optimal temperature; morbidity grading systems. Conflicting points were voted upon in two rounds by an international panel in local-regional therapy.

Peritoneal surface malignancies (PSM) have been traditionally regarded as uniformly terminal conditions. The combination of cyto-reductive surgery and perioperative intraperitoneal chemotherapy has changed PSM management from palliation to possible cure. Due to the inherent differences in biological and clinical behavior, the optimal adaptation of comprehensive treatment to each PSM is still a matter of debate. A session of "The Fifth International Workshop on Peritoneal Surface Malignancy" (Milan, Italy, December 4-6, 2006) was committed to reach a consensus pertaining to conceptual and technical aspects of the loco-regional treatment of each PSM. The consensus developing process was based on principles of the Delphi method. A total of 103 international experts from 17 countries were included in six Working Groups for each of the following PSM: peritoneal mesothelioma, abdominal sarcomatosis, carcinomatosis of gastric, colo-rectal, appendiceal, and ovarian origin. The respective working groups wrote evidence reports. The main conflicting points regarding preoperative evaluation, patient eligibility, combined treatment methodology, postoperative follow-up and future investigational perspectives were listed as multiple-choice questions. 160 Conflicting Points were identified. A consensus of more than 50% of voters favoring one option was reached in 143 of these (**14, 15**).

Other Oncological Applications of the Delphi process

The Delphi process has been used on an occasional basis to identify priorities in cancer nursing service provision and cancer educational priorities for GPs (**16**). Hall et al reported the use of the Delphi method to prioritise funding decisions at the

National Cancer Institute (**17**), while Brook et al reported its use in assessing medical technologies (**18**).

Other Collective Knowledge Systems

The Internet is driving new commercial systems to capture the power of collective intelligence embodied in the conscious and subconscious choices and preferences that individuals make whenever they use the Web. While we are a long way from capturing the collective decision making of clinicians and MDTs on a case-by-case basis and hence from learning how to optimise individual cancer outcomes, we can at least start to see how this might be possible in a wired and networked world.

The *wisdom of crowds* is a concept which describes the aggregation of information in groups, resulting in decisions that may be better than could have been made by any single member of the group. The most meaningful outputs are derived from groups and "crowds" where there is diversity of opinion; independence of opinion; decentralisation and specialisation; and a method of aggregating the collective judgements into a collective decision (**19**). Groups and crowds are also capable of irrational behaviour and of collective failures of intelligence and common sense, where the groups are too homogeneous, centralised, bureaucratised or divided. *Crowdsourcing* is the study of information inherent in the actions of large numbers of independently acting individuals, leading to measurable collective outputs (for example in marketing or politics).

Discussion

Collective decision-making systems have various advantages over the committee work and open group discussions in decision-making and strategic planning. However, they must be applied and interpreted with care, as they have a number of vulnerabilities, according to the composition of the expert voting panel, and the reliability of the evidence base upon which each expert's opinion is based.

Limitations of Collective Decision Making System

The Delphi model and related systems have a number of practical limitations. They require a considerable amount of organisation to produce recommendations that are a snapshot of knowledge and opinion at one point in time. Given the rapid rate of

change of knowledge and the increase in available information, they can become rapidly outdated unless mechanisms are in place to revisit and reappraise the decisions.

The quality of any consensus achieved is determined by the quality of the information available to the panel. In many subject areas, there is a “perceived wisdom” which may or may not reflect ground truth or a correct reading of the entirety of the literature. While in theory all evidence must be made available to support the decision making process, in practice no one expert is likely to be able to afford all of the time needed to rehearse all of the literature or to modify all personal prejudices.

The process may also be biased by the selection of panel members themselves. The panel will be a “coalition of the willing”, and is more likely to reflect cooperating opinion than adversarial opinion. The panel may suffer from illusory expertise: some of the experts’ knowledge may be confined to a narrow field. The experts may be designated from a small collective of colleagues or an imbalance of subspecialities, thus inherently biasing the interpretation of the available data in the context of their own experience. Hence, the larger and wider the panel of decision makers, the more truly representative is the output likely to be.

The Delphi process has other potential sources of bias. The participants may vote or score a statement or opinion without being fully informed, because the information provided to them, or the range of questions posed, reflects the prejudices of the originating group or organisation. They are also vulnerable to the subjectivity of the moderators and facilitators. Thus, the revised criteria can be resubmitted to the panel in a way to promote a desired direction. Format bias in a questionnaire may produce the same result. The questionnaire may be ambiguous and although ambiguous statements should be discounted, they may be included in results data depending upon the scrutiny of the monitor and facilitator (20).

Fortunately, the Internet and modern communication systems come to our assistance here. There is no reason why large numbers of individuals, such as the entire membership of a subspeciality association, or the subscribers of a journal, should not

be open to canvassing quickly and cost effectively, and their views readily collated in a Delphi type process on one or more subject areas.

The conduct of a Delphi process may be of interest and may reflect a very accurate reading of the available evidence base, but there is as yet no obligation on any individual or group to act upon the product. Moreover, the passage of time will negate much of the value of the process, unless there is a built in review and reiteration process at regular intervals, which has not as yet been reported in surgical oncology subject areas.

Conclusions

In conclusion, the Delphi process and related group decision making systems provide a meritorious and democratic means by which a large number of individuals can express a collective opinion on a wide range of topics and issues on any one subject area. These processes represent a generational shift from decision making by individuals and committees to anonymous and democratic collaborative working and combining of expertise, where all contributors have a voice and a “secret ballot”.

The enabling technologies for collective decision making are now well established. Among other applications, they suggest a route to a much more robust format for Guidelines to “best clinical practice” in various of the cancer subspecialities, such as are published from time to time in the EJSO and elsewhere. We commend a trial of expert panel voting systems in preparing the next generation of such guidelines and in other areas of uncertainty as to future directions for research, resource allocation and technology implementation in surgical oncology.

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