

What to expect when meeting a statistician

BY G CZANNER

There are a growing number of statisticians working closely with ophthalmologists. They have different training but they are driven by the same goal: to perform high quality evidence based clinical research [1,2]. In a perfect world we would simply conduct clinical studies on all patients and observe differences between the treatment groups, with the conclusion that the observed differences are due to treatment. However, due to ethical reasons, we can only conduct a study on a sample of patients, which brings uncertainty into clinical research. In particular, we need to decide if the variability observed is due to true differences between treatments or simply due to sampling chance. This is one of the questions that can be answered by statistics and was well characterised by my statistics consulting teacher Allan Sampson (University of Pittsburgh): "Statistics is the language of science; in the omnipresence of randomness, statistics provides the context and framework for the understanding and interpretation of data."

Statisticians and statistical consultants

A statistician is a person who can perform analyses, give consultations, teach and perform research to invent new statistical methods. A statistical methodological advisor or consultant provides methodological and statistical advice and guidance to clinicians interested in making decisions regarding the design of studies, the collection and analysis of data, and the presentation and dissemination of research findings [3]. Trained in both statistics and communication skills, advisors can work in academia, industry or the public sector.

When is the best time to seek statistical advice?

An honest answer is to seek statistical advice before beginning the research. To quote statistician Ronald Fisher:

"To consult the statistician after an experiment is finished is often merely to ask him to conduct a postmortem examination. He can perhaps say what the experiment died of." [4]

Skills and education

Statistical consultants have postgraduate training in statistics (MSc or PhD), as well as relevant practical experience, which may be formally recognised via a statistical society (e.g. CStat is a chartered statistician recognition given by the Royal Statistical Society and currently re-evaluated every five years). Advisors may also have significant education and experience in the particular field in which they work (e.g. medicine, neuroscience, economics, manufacturing). Some universities offer specific graduate programs in fields such as biostatistics, psychological methods, or methodology and statistics for the medical, behavioural and social sciences.

Where do we find statisticians?

Statisticians work in universities, in industry, consultancy or as self-employed free-lance consultants. Some universities offer in-house statistical advice for researchers from within the university, or they may have an established self-financed consultancy centre. Statistical advisors are also consulted by public administration, where they may be involved at all levels of governance. In the legal system, statistical consultants may be called upon as expert witnesses, in particular in cases that involve statistical considerations.

What type of questions will a statistician ask?

Typically, a statistician will want to know what type of advice is needed, the research questions, the resources for statistical work and current progress with data collection or analysis. Professional statisticians and consultancies will ask the client to fill in a questionnaire or they will fill it in at the first meeting with the client.

The typical questions are:

- What are your research questions?
- Have you already collected the data?
- If you have already collected the data, what is the study type (e.g. retrospective observational or case / control study)?
- What is the study population (e.g. age range, control groups, inclusion / exclusion criteria)?
- What are the outcome measures (primary and secondary outcomes, including the type of data that are being collected, for example binary, categorical, continuous, time to event)?
- What is your funding?

What range of tasks can a statistician do?

The type of tasks that a statistician can do vary depending on funding and on the specifics of the project. A statistician can simply give advice or can also do the analyses. The statistician may just do a single consultation at one point during the study (called cross-sectional consulting), they may repeatedly give advice or do some analyses throughout the duration of the study (called longitudinal consulting) [3]. Typically, a statistician can provide advice or assistance with:

- Formulation of the hypotheses. A research aim needs to be formulated into testable hypotheses. This usually starts with a discussion of what the primary and secondary outcomes need to be.
- Choice of study design and research study (e.g. case-control study).
- Determination of an adequate sampling procedure for your study, survey or experiment.
- Randomisation for randomised clinical trials.
- Determination of sample size calculations (i.e. number of patients in each treatment group).
- Choice or construction of measurement instruments.
- Data analysis methods (e.g. t-test,

analysis of variance, logistic regression, etc.) so that the research questions can be answered adequately.

- Systematic review and meta-analysis.
- Statistical advice or participation in a grant proposal. It is necessary to address all of the above areas in a grant proposal. The statistician can give advice, write the grant proposal section and estimate the funding needed to do any data analysis work.
- Supervision of data collection to ensure elements of the population are being sampled correctly.
- Presentation of results, help with write-up of statistical results for manuscripts, professional conferences and slide presentations.

- Presenting your collected data (e.g. advice on best plots).

Simple vs. advanced statistical methods

Sometimes only advice is sought from a statistician with the understanding that the clinician will do the analyses. In such cases, the statistician needs to know the clinician's level of understanding of research methods and statistics. If their understanding is small then the statistician should suggest both a simpler statistical method and more advanced methods.

Defining the statistical hypothesis

A statistical consultant will help to clarify

substantive research questions and to translate them into methodological and statistical procedures. In some cases, this may also entail profound ethical considerations [3].

References

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TAKE HOME MESSAGE

- It is important to think about study design and data analysis methods at a very early stage of clinical research, and it is crucial to have discussion with a statistician who can help to formulate the hypotheses.
- Statistics contains a very large number of methods and tools; and often statisticians specialise in some areas, while striving to have good knowledge and experience in common data analysis methods.
- Good communication and trust between statistician and ophthalmologist is one of the most important keys for successful clinical research.



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