

Effective Medical Writing

Pointers to getting your article published

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Writing the materials and methods

ABSTRACT

When writing scientific papers to share their research findings with their peers, it is not enough for researchers to just communicate the results of their study; it is equally important to explain the process by which they arrived at their results, so that the study can be replicated to validate the observations. The materials and methods section is used to describe the experimental design and provide sufficient details so that a competent colleague can repeat the experiment. A good materials and methods section will enable readers to evaluate the research performed and replicate the study, if necessary.

Keywords: medical writing, materials and methods, methodology

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INTRODUCTION

Science is a system of knowledge that delivers reproducible observations about the physical universe. The key term here is “reproducible”, whereby the observations or results of a scientific study are validated if they can be consistently reproduced. Understanding this as an inherent aspect of research, scientists should place a great deal of importance on the experimental design of a study. When writing papers to share their research findings with their peers, it is not enough for scientists to just communicate the results of their study; it is equally important to explain the process by which they arrived at their results.

This is usually done in the materials and methods section. The main purpose of this section is to describe the experimental design and provide sufficient details so that a competent colleague can repeat the experiment. In some journals, this section may be named subjects and methods, or simply, methods.

In this section, the author should explain clearly how the study was conducted, in order to: (1) enable readers to evaluate the research performed, and (2) permit others to

replicate the study, if necessary.

Although this section is not intended to provide a step-by-step tutorial for the reader, the author must, nonetheless, systematically state what was done, how it was done, how the data was collected, and how it was analysed.

Use questions like “what”, “how much”, “how often”, “where”, “when” and “why” to guide your explanations. Here, the author will have to tread the line between completeness (providing sufficient details to enable replication and verification of the findings) and brevity (do not describe every technical detail).

BE SYSTEMATIC

Write this section as one would carry out the study. That means arranging the experiments chronologically, or group them in logical sequence. Use sub-headings where appropriate. The order of presentation has to make the most sense to the readers (Fig. 1).

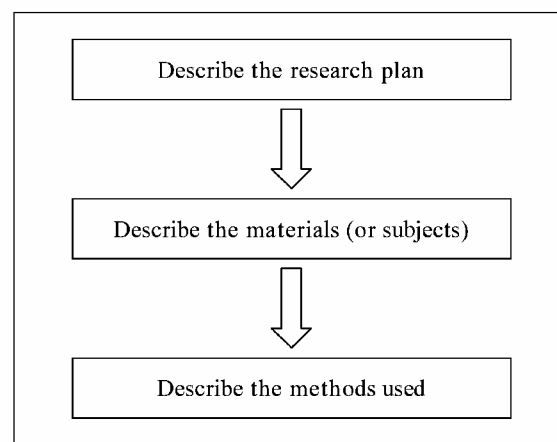


Fig. 1 The three-step process of writing the materials and methods.

Make sure to include all the items that are later presented in the Results section. In a recipe, for instance, it would be extremely incongruous to find that some items of ingredients used in the cooking methods had not been listed earlier.

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FOLLOW EACH “INSTRUCTIONS TO AUTHORS”

Since each journal has different requirements, review the journal’s Instructions to Authors or Author Guidelines before beginning to write this section. Here are some general guidelines:

- (1) For human-related studies, the first paragraph should indicate if institutional review board approval and patient informed consent were obtained. If not, it should be clear that any studies conducted were so performed for accepted clinical indications and that the studies themselves are considered acceptable and ethical for patient care.
- (2) For animal experiments, include a statement regarding approval by the institutional animal care committee or appropriate body.
- (3) Describe the experimental design if it was not a standard design readily understood or described succinctly by a standard term.
- (4) Describe clearly the number and selection of the subjects studied (patients, volunteers or experimental animals, including controls). Briefly state the population and the sampling method used.
- (5) State the inclusion and exclusion criteria for the recruitment of subjects, patients or experimental animals in the study group.
- (6) Describe how the control group was selected, and how they relate to the study group, e.g. matching by age, gender, ethnicity, clinical condition, etc.
- (7) Identify the methods, instrumentation (trade names and manufacturer’s name and location in parentheses), and procedures in sufficient detail to allow other researchers to reproduce the study.
- (8) State the manner by which the studies were evaluated: independent readings, consensus readings, blinded or unblinded to other information, time sequencing between readings of several studies of the same patient or animal to eliminate recall bias, random ordering of studies, etc. State if the study was retrospective or prospective.
- (9) Provide specific descriptions of experimental materials (Boxes 1–5) and methods. Give references to established methods and provide statements on the availability of materials. Some materials may not be commercially available; for example, materials distributed by the author or some other non-commercial source, such as a research laboratory.
- (10) Identify the equipment used (with specifications if appropriate) and the supplier(s). Describe in detail any modifications made to the equipment or any equipment that was constructed specifically for the study and, if necessary, provide illustrations or photographs of the modifications.

Box 1. Describing the materials – animals:

Animals:

- State the species or strain used, as well as the age, gender and weight.
- Describe the physiological or pathological state of the animal; e.g. pregnant, castrated, etc.
- Describe the rearing method.
- Describe the nutritional state of the animal.
- Provide the supplier’s name.

Animal diets:

- Describe the diet administered during the maintenance period.
- Describe the diet administered during the treatment period.
- Describe the constituents of the diet and their sources.

Box 2. Describing the materials – drugs:

Drugs and other interventional agents:

- Provide the generic and trade names of the drugs/agents. Provide the chemical names for non-standard drugs.
- Provide the supplier’s name.

Drug administration:

- Describe the schedule for drug administration.
- Describe the forms and doses of the drugs administered.

Box 3. Describing the materials – cultures:

Tissues and tissue cultures:

- State the sources.
- Provide details of any prior treatment or procedure administered to the tissue or culture.
- Provide the supplier’s name.

Cell lines, DNA:

- Describe in detail the types and sources used.
- Provide the supplier’s name.

Immune sera:

- Describe the source and type of the immune serum used.
- Provide the supplier’s name.

Bacterial cultures and viruses:

- Provide the standard taxonomic nomenclature.
- Describe the sources.

Culture media and buffer:

- State the components and their concentrations.

Box 4. Describing the materials – reagents:

Reagents:

- Provide detailed chemical identification of the reagents used.
- Provide the supplier’s name.

Other procedures and interventions:

- Describe any other procedures, such as surgical, that were used. Provide references for standard procedures, and detailed descriptions for non-standard procedures.

Box 5. Describing the materials – equipment

- Identify the equipment used
- Provide specific information of the equipment (trade names and manufacturer's name and location in parentheses).

Box 6. Common errors:

1. Writing this section as a set of instructions. Instead, it should just be a description of the experiments performed.
2. Mixing the results with the methods. Results should be discussed and analysed in a subsequent section, entitled "Results".
3. Omitting all explanatory information and background – save these for the discussion section.
4. Including information irrelevant to the reader, such as who fed the animals or who helped to input the data.

(11) Briefly state the statistical tests used to analyse the data. Usual, common statistical methods could be stated without providing a reference; for advanced or unusual methods, a reference or citation is required. New or substantially modified methods should be described in detail with reasons given to justify using these techniques. It is strongly

recommended that the author seeks statistical consultation before planning a study, to ensure both appropriate data collection and suitable use of statistical tests for analysis.

When describing materials, similar materials can be grouped together to save space. Materials should only be described separately if the study is very complicated and requires separate explanations. Do not describe supplies and equipment commonly found in all laboratories.

SUMMARY

Writing about how the research was conducted is just as important as doing it. Describing how the research was done is a crucial aspect of recording the scientific process by which the results were achieved. A good materials and methods section will enable readers to evaluate the research performed and provide the option to replicate the study if necessary.

Box 7. Take home points:

State:

1. What was done,
2. How it was done.
3. How data was collected, and
4. How the data was analysed.

SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME
Multiple Choice Questions (Code SMJ 2008IIA)

	True	False
Question 1. What are the reasons for clearly explaining how a scientific study was conducted?		
(a) To enable readers to evaluate the work performed.	<input type="checkbox"/>	<input type="checkbox"/>
(b) To provide a step-by-step tutorial for the readers.	<input type="checkbox"/>	<input type="checkbox"/>
(c) To permit others to replicate the study.	<input type="checkbox"/>	<input type="checkbox"/>
(d) To describe the experimental design and provide sufficient details about the study.	<input type="checkbox"/>	<input type="checkbox"/>
Question 2. The following statements regarding writing style and format are true:		
(a) Be systematic.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Follow the specific journal's Instructions to Authors.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Explain clearly how the experiment was done.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Follow a non-chronological format.	<input type="checkbox"/>	<input type="checkbox"/>
Question 3. The following are examples of the types of materials to be included in the materials and methods section:		
(a) Animals.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Drugs and other interventional agents.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Immune sera.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Results.	<input type="checkbox"/>	<input type="checkbox"/>
Question 4. The following statements about the Instructions to Authors are true:		
(a) Indicate whether or not institutional review board approval and patient informed consent were obtained for human-related studies.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Provide minute details, such as the names of the research assistants.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Describe clearly the number and selection of the subjects studied.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Identify the equipment(s) used and the supplier(s).	<input type="checkbox"/>	<input type="checkbox"/>
Question 5. Which of the following statements apply when writing the materials and methods section?		
(a) Do not write this section as a set of instructions.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Provide the background to the purpose of the study.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Describe the experiment in chronological order.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Do not include irrelevant information.	<input type="checkbox"/>	<input type="checkbox"/>

Doctor's particulars:

Name in full: _____

MCR number: _____ Specialty: _____

Email address: _____

SUBMISSION INSTRUCTIONS:

(1) Log on at the SMJ website: <http://www.sma.org.sg/cme/smj> and select the appropriate set of questions. (2) Select your answers and provide your name, email address and MCR number. Click on "Submit answers" to submit.

RESULTS:

(1) Answers will be published in the SMJ January 2009 issue. (2) The MCR numbers of successful candidates will be posted online at www.sma.org.sg/cme/smj by 15 January 2009. (3) All online submissions will receive an automatic email acknowledgment. (4) Passing mark is 60%. No mark will be deducted for incorrect answers. (5) The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council.

Deadline for submission: (November 2008 SMJ 3B CME programme): 12 noon, 25 December 2008.