

Supplemental Material

This supplemental material provides additional details surrounding each of the major sections of an original research article with the intention of demystifying the purpose of and approach to the writing of each section. Original research articles are structured using the standardized format that is often referred to by its acronym, IMRaD.¹⁻⁵ IMRaD identifies the primary sections of the body of each manuscript: introduction, methods, results, and discussion. The title and the abstract are tacked onto the beginning of the manuscript's body. The conclusion is tacked onto the end.

The Title

The title should be descriptive, informative, and attractive to the target audience.^{1,4-9} It needs to be clear and unambiguous, taking care to identify the population, the problem that is being investigated, and the study type.^{6,7,10} For example:

- Behavior and adoptability of hoarded cats admitted to an animal shelter¹¹
- Outbreak management of multidrug-resistant *Bordetella bronchiseptica* in 16 shelter-housed cats¹²
- Effect of a provincial feline onychectomy ban on cat intake and euthanasia in a British Columbia animal shelter system¹³
- Fecal viral DNA shedding following clinical panleukopenia virus infection in shelter kittens: a prospective, observational study¹⁴
- Descriptive epidemiology and test characteristics of cats diagnosed with *Microsporum canis* dermatophytosis in a Northwestern US animal shelter¹⁵

- 25 • Zoonotic and Non-Zoonotic Intestinal Parasites in Shelter Dogs at Admission and Before
26 Discharge¹⁶
- 27 • An Opportunity to Increase Access to Pyometra Treatment¹⁷
28

29 **Keywords**

30 Select keywords that you have not incorporated in the title to further enhance visibility through
31 search engines.² Consider aligning yours with those that colleagues within the same discipline
32 have chosen to describe similar content areas. For example, keywords for Jacobson et al's
33 *Behavior and adoptability of hoarded cats admitted to an animal shelter* include animal
34 hoarding, behavior, adoptability, adoption return, shelter, and food anxiety.¹¹

35

36 When selecting from medical keywords, draw upon Medical Subject Headings (MeSH).^{4,18,19}
37 MeSH is essentially a thesaurus that retrieves keywords from among a standardized set. Because
38 these words are used for indexing and cataloguing, they should make it easier for others to find
39 your article once published.

40

41 **Abstract**

42 Second to the title, the abstract is typically the most accessible part of your manuscript and is
43 what readers will use to determine whether to dive deeper.^{1,2,4-6,20} Abstracts may be structured or
44 unstructured, depending upon journal submission guidelines.¹ Irrespective of formatting, all
45 abstracts highlight the rationale for the study, identify the author's objectives and research
46 questions, outline the basic methodology of the study, disclose key findings, and mirror the

47 conclusions that are outlined in the manuscript.^{1,2,6} Think of the abstract as a CliffsNotes version
48 that distills the contents of the paper into one short summary that simultaneously answers who,
49 what, when, where, why, and how. The abstract is by intent stand-alone and provides the most
50 crucial details of the study that you want readers to absorb.^{1,21} Refer to each journal's submission
51 guidelines for criteria on how to structure your abstract in alignment with their preferences.

52

53 **Building the Introduction**

54 The introduction of a scientific manuscript focuses on the preliminary question, "what?"
55 followed by the clarifier, "why?", as in:^{1,2,6}

- 56 • What is topic x ?
- 57 • What is and is not currently known about topic x ?
- 58 • What is the significance of topic x with respect to this population of patients?
- 59 • What does this article set out to contribute with respect to topic x ?
- 60 • Why should clinicians or the public at large improve their understanding of topic x ?
- 61 • What is your approach to topic x and why is this approach novel?
- 62 • What are your objectives and/or research questions?
- 63 • What is your hypothesis?

64

65 The introduction is all about making your case for why you studied what you did.⁵ You must
66 provide justification for your investigation. Make it explicit to readers which gap in the current
67 knowledge base you are seeking to fill.^{2,18,20,22} Implement the funnel analogy or the three-
68 paragraph template to explain your rationale.

69

70 A funnel is by design widest at the top, then narrows down. A figurative funnel in scientific
71 writing implies that the author starts the introduction broadly by capturing what is known about
72 the presenting problem.^{4,5} The introduction then funnels into something unknown and ends with
73 the question that the author is seeking to answer.^{4,5}

74

75 The three-paragraph template suggests building three different consecutive structural roles into
76 the introduction: significance, critical information gap, and hypothesis.²³ The first paragraph
77 identifies the problem and why it is important to study.^{6,23} The second paragraph clarifies that
78 there is a knowledge gap which precludes comprehensive understanding of the stated
79 problem.^{6,23} The third paragraph details your research questions, objectives, and/or hypothesis
80 along with a broad overview of your approach.^{6,23} Details specific to methodology or other study
81 instruments will be reserved for the next section of the paper, methods.

82

83 **Delineating the Methods**

84 The methods section of a scientific manuscript focuses on the question, “how?”, as in, how did
85 you perform the study so that any reader could replicate it.^{2,5,6,20,22,24} Steps should be described
86 sequentially, in the past tense, including how sample size was determined, how data was
87 collected and analyzed, how often, from whom, by whom, and using what safety
88 mechanisms.^{1,6,20} Safety mechanisms include how informed consent was obtained in those
89 studies that require it.⁶ The methods section must also take care to incorporate statements of
90 approval, if appropriate, from the Institutional Review Board²⁵ for studies involving human

91 subjects, the Institutional Animal Care and Use Committee (IACUC) for studies involving non-
92 human animal subjects, or other ethical review board.^{2,6,18,20,22}

93

94 The methods section must be complete, yet concise. If validated methodology has been utilized,
95 then reference such methods to avoid unnecessary detail. Report any modifications to
96 procedures.² To further condense the methods, many journals allow an appendix or other form of
97 supplemental material.^{1,6} This allows readers to access design blueprints or survey templates if
98 their interest in reviewing such tools has been piqued.

99

100 **Disclosing the Results**

101 The results section of a scientific manuscript focuses on the question, “what?”, as in “what were
102 the findings?”.^{4,6} It should be concise and easy to follow. Findings are reported without
103 interpretation⁵, including those results that negate your hypothesis.²⁶ Not all data must be
104 presented; only relevant data that relates to the study’s objective.⁶ Positive, negative, or
105 unexpected outcomes should be reported in an easy-to-understand format. Readability is key so
106 that readers do not become lost in a sea of data.^{4,6} Present results that relate to the entire
107 population first before presenting results for subgroups.¹ Provide graphical aids when
108 representation of data can be both visually clear and self-explanatory.⁴ Tables typically
109 demonstrate specific data points whereas figures display trends.¹ Label headers and axes clearly.¹
110 Titles of tables and figures should be stand-alone with all the essential information to understand
111 the content. Photographs may also be featured, particularly in case reports that evaluate clinical

112 outcomes. Revisit journal submission guidelines to determine if images will be published in
113 color. If not, make use of images that are compatible with grayscale printing.

114

115 **Initiating Discussion**

116 The discussion section of a scientific manuscript focuses on the question, “so what?”⁶ There is an
117 inherent tendency to repeat the results or rehash introductory content here.¹⁸ Both are erroneous
118 approaches to scientific writing. The discussion section is intended to build upon the frame of the
119 manuscript which has already been established.¹⁸ Readers do not need to be reminded of the
120 results; they do need to be informed what to do with them.^{18,27} This is your opportunity to
121 interpret your findings and compare them against other published works.^{2,22,28} Expand upon the
122 significance of your results. Explain what can and cannot be inferred.^{20,22} Reference related
123 research as needed to back up assertions.¹ Identify gaps in knowledge, limitations, or weaknesses
124 of your study.^{1,20} Consider sample size, demographics of the sample population, and
125 methodology.² If there were deviations from the protocol, explain why and what might have been
126 done in retrospect to navigate any missteps. Be critical when it is indicated and do not overstate
127 your findings.¹⁸ Walk the reader through future developments that you might pursue based upon
128 the new knowledge base that you have established.¹ Walk the reader through what is still
129 unknown and why.

130

131 **Concluding the Manuscript**

132 The conclusion of a scientific manuscript is your final opportunity to emphasize key
133 takeaways.¹⁸ New information should not appear here, and no references should be cited.^{4,18}

134 Emphasize how your research will influence current practice.^{2,20} Incorporate any
135 recommendations that have arisen from the investigation.^{2,20}

136

137 **The Order in Which to Write**

138 Writing a manuscript based on original research lends itself to dividing the work into discrete
139 tasks. Which tasks come first in some ways stem from the logical chronology of each
140 investigation. For example, the introduction can be more-or-less written before the study has
141 concluded, and the methods can be mostly written before the results are complete. The abstract is
142 typically the last piece that is written.^{2,6} A mistake that novices often make is penning this section
143 first. By the time the article has undergone multiple revisions, the original abstract rarely
144 matches and in fact may even contradict the conclusions reported in the body of the manuscript.

145

146 **Common Challenges that May Be Encountered Along the Way**

147 The introduction often runs the risk of either being too broad or too extensive. It can be
148 challenging to find that balance of diving deep enough into literature review without
149 unintentionally penning a separate review article. Restrict the introduction to two to five
150 paragraphs of direct relevance to your study, and structure it in such a way that the reader is led
151 to the explicit rationale as to why this study is warranted.⁵

152

153 The materials and methods section often runs the risk of being incomplete or out of order.⁵ Key
154 details that are pertinent to the study may be inadvertently left out.⁵ Is the study design clear? Is

155 the process of sample collection obvious? Are the analytical methods used apparent? Is the study
156 population sufficiently defined? Ask colleagues who are not involved in the study to review this
157 component. Ask them to verbally recreate your methodology, then actively listen to unearth
158 where there are gaps in information.

159

160 The results section is often the most intimidating for authors, perhaps because it can be
161 challenging to report statistical analysis without infusing key inferences that belong in the
162 discussion. Moreover, at times the results do not match the methods or methods are reported in
163 the results.⁵ Neither creates a cohesive picture of the data that the study yielded. To mitigate this
164 risk of an incomplete portrait, review the methods and results sections in parallel. Go back and
165 forth between them to be sure that they are in harmony. There should be a result for every
166 method and vice versa.⁵ A third challenge associated with the results section is redundancy.⁵
167 Authors often repeat data more than once, by summarizing in text data that have already been
168 presented in a figure or table format.⁵ In fact, figures and tables are intended to replace data
169 summaries, rather than replicate them. Use of figures and tables should be intentional and
170 improve readability rather than lengthen the process by which a reader is led through the results.
171 Strategically place figures and tables where visual representation of data is advantageous.

172

173 The discussion section often runs the risk of becoming a repeat of the introduction and/or the
174 results. The main message of the study becomes lost through unnecessary repetition.⁵ The reader
175 does not need to be walked through the rationale of the study again. What the reader benefits
176 most from here is an understanding of 1) if the research question has been answered sufficiently,

177 2) where the study's results fit in the context of the literature, and 3) how the results can be
178 applied to present day situations.⁵

179

180 A second challenge associated with the discussion section is that limitations are not addressed.⁵

181 Some authors may fear that if they acknowledge the study's limitations, then the study is

182 invalidated. The reality is that limitations do not negate the value of scientific inquiry; they open

183 the door to next steps and new chapters of research that can be learned from past errors or

184 oversights. Take note of these limitations and consider how these will inform the next scientist.

185 Studies are imperfect. Highlight the imperfections so that you can report objectively about what

186 you might have done differently, were you to repeat the study. Science is about process rather

187 than perfection and if subsequent research is to build upon yours, then you need to be very clear

188 about your own journey, including those areas that may have consciously or unconsciously

189 influenced study outcomes.

190

191 **A Word or Two about References**

192 References are an essential part of contributing to scientific literature because they are how

193 authors acknowledge sources and ensure that others who have been referred to are appropriately

194 credited for their work.²⁹ Original research articles represent advancements of previously laid

195 ideas, which provide context for the study, its justification, methodology, and interpretations.²⁹ If

196 references are inaccurate or lack credibility, then "the resulting argument and conclusions may be

197 akin to a thread hanging from a poorly woven garment - 1 small tug and the entire piece begins

198 to unravel."³⁰

199

200 Common types of errors involving references include: ³⁰

- 201 • Inadvertent errors of omission due to lack of familiarity with current literature
- 202 • “daisy chaining,” citing an author who is not the primary source of information
- 203 • Citing another author’s introduction
- 204 • Citing speculation as fact
- 205 • Inaccurately paraphrasing, thus changing the interpretation of an original source

206

207 To mitigate the chance of making one or more of these errors, be accountable for your work and
208 check the accuracy of all citations.⁵ Avoid carrying citations from others’ work forward unless
209 you have done due diligence and fact-checked them.⁵ Prioritize peer-reviewed sources.⁵

210 Recognize that non-peer-reviewed sources can include anecdotes, which may or may not be
211 accepted as truth.⁵

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213

214 **References**

215

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