

# How to Write an Effective Discussion

Dean R Hess PhD RRT FAARC

## Introduction

### Elements to Include in the Discussion

State the Major Findings of the Study

Explain the Meaning of the Findings and Why the Findings Are Important

Relate the Findings to Those of Similar Studies

Consider Alternative Explanations of the Findings

State the Clinical Relevance of the Findings

Acknowledge the Study's Limitations

Make Suggestions for Further Research

Give the "Take-Home Message" in the Form of a Conclusion

### Things to Avoid When Writing the Discussion

Overinterpretation of the Results

Unwarranted Speculation

Inflating the Importance of the Findings

Tangential Issues

The "Bully Pulpit"

Conclusions That Are Not Supported by the Data

### Summary

**Explaining the meaning of the results to the reader is the purpose of the discussion section of a research paper. There are elements of the discussion that should be included and other things that should be avoided. Always write the discussion for the reader; remember that the focus should be to help the reader understand the study and that the highlight should be on the study data. Key words: publishing; writing; manuscripts, medical; communication.** [Respir Care 2004;49(10):1238–1241. © 2004 Daedalus Enterprises]

## Introduction

You have carefully written the hypothesis. You have designed the study and collected the data. You have con-

ducted the statistical analysis and grouped the summary results into table and graphs. But what does it mean? Explaining the meaning of the results to the reader is the purpose of the discussion section. Although the discussion comes at the end of the paper, you should be thinking about what you will write in the discussion section from the moment that the study is conceived. Questions that you will develop in the discussion should be considered from

---

Dean R Hess PhD RRT FAARC is affiliated with the Department of Respiratory Care, Massachusetts General Hospital, and Harvard Medical School, Boston, Massachusetts.

Dean R Hess PhD RRT FAARC presented a version of this article at the RESPIRATORY CARE Journal symposium, "Anatomy of a Research Paper: Science Writing 101," at the 48th International Respiratory Congress, held October 5–8, 2002, in Tampa, Florida.

---

Correspondence: Dean R Hess PhD RRT FAARC, Respiratory Care, Ellison 401, Massachusetts General Hospital, 55 Fruit Street, Boston MA 02114. E-mail: dhess@partners.org.

Table 1. Elements to Include in the Discussion

State the study's major findings
Explain the meaning and importance of the findings
Relate the findings to those of similar studies
Consider alternative explanations of the findings
State the clinical relevance of the findings
Acknowledge the study's limitations
Make suggestions for further research

Table 2. Things to Avoid in the Discussion

Overrepresentation of the results
Unwarranted speculation
Inflation of the importance of the findings
Tangential issues
The "bully pulpit"
Conclusions that are not supported by the data
Inclusion of the "take-home message"; save this for the conclusions section

the study's outset. Why is the study important? How does this study relate to previous studies? What are the limitations of the study design? There are elements of the discussion that should be included and other things that should be avoided (Tables 1 and 2). Most important, always write the discussion for the reader; the discussion is not a forum for you to impress others with your knowledge of the subject. You should be trying to convince the reader of the merits of the study results.

**Elements to Include in the Discussion**

**State the Major Findings of the Study**

The discussion should begin with a statement of the major findings of the study. This should be the very first paragraph in the discussion. It should be a direct, declarative, and succinct proclamation of the study results. However, it should not include data or reference to the study design. Several examples illustrate the point. In a paper by Anton et al<sup>1</sup> the discussion begins with the sentence, "Our results confirm that these nasal and full-face masks are similarly efficient over 15 min of NPPV with COPD patients recovering from acute hypercapnic respiratory failure." This clearly states the most important finding of that study. Fluck et al<sup>2</sup> began the discussion section of their paper with the sentence, "Our findings suggest that ambient light has no statistically significant effect on S<sub>pO<sub>2</sub></sub> readings and that ambient light's effect on S<sub>pO<sub>2</sub></sub> is clinically unimportant." That is a good example of a direct, declarative, and succinct proclamation of the study results.

**Explain the Meaning of the Findings and Why the Findings Are Important**

No one has thought as long and as hard about your study as you have. As the person who conceived, designed, and conducted the study, the meaning of the results and their importance seem obvious to you. However, they might not be so clear for the person reading your paper for the first time. One of the purposes of the discussion is to explain the meaning of the findings and why they are important, without appearing arrogant, condescending, or patronizing. After reading the discussion section, you want the reader to think, "That makes perfect sense. Why hadn't I thought of that?" Even if your study findings are provocative, you do not want to force the reader to go through the paper multiple times to figure out what it means; most readers will not go to that effort and your findings will be overlooked, disregarded, and forgotten.

**Relate the Findings to Those of Similar Studies**

No study is so novel and with such a restricted focus that it has no relation to other previously published papers. The discussion section should relate your study findings to those of other studies. Questions raised by previous studies may have served as the motivation for your study. The findings of other studies may support your findings, which strengthens the importance of your study results. Stoller et al<sup>3</sup> discussed their study results in the context of a previous study by others: "Our finding that changing in-line suction catheters less frequently is associated with lower cost and no higher incidence of VAP replicates the findings of a randomized controlled trial conducted by Kollef et al, upon which our amended policy was based." It is also important to point out how your study differs from other similar studies. An example can again be drawn from Stoller et al:<sup>3</sup> "Certainly, differences in the specific criteria used to define VAP could contribute to the rate differences between the present study and that of Kollef et al. For example, comparison of the criteria for nosocomial pneumonia in our study with the criteria used by Kollef et al shows similar component features but different rating schemes to establish the diagnosis."

**Consider Alternative Explanations of the Findings**

Despite efforts to remain objective and to maintain equipoise, it is easy to consider only those explanations that fit your bias. It is important to remember that the purpose of research is to *discover* and not to *prove*. It is easy to fall into the trap of designing the study to prove your bias rather than to discover the truth. When writing the discussion section, it is important to carefully consider all pos-

sible explanations for the study results, rather than just those that fit your biases.

### State the Clinical Relevance of the Findings

The reason we conduct studies is usually to improve the care of our patients. Thus it is important to cast the findings of your study in the context of clinical practice. For which patients do the results apply and for which do they not apply? Experimental studies conducted in the laboratory usually do not involve human subjects, but the results may have clinical implications, which should be stated. A paper by Swart et al<sup>4</sup> gives an example of a laboratory study, the clinical relevance of which is overtly stated: “The clinically important measurements, for both screening and monitoring, are predominantly FEV<sub>1</sub> and FVC, and the Spirospec and Masterlab 4.0 showed excellent correlation ( $r = 0.99$ ) and very good limits of agreement for FEV<sub>1</sub> and FVC. For FEV<sub>1</sub> and FVC the Spirospec and the Masterlab 4.0 could be used interchangeably.”<sup>4</sup>

### Acknowledge the Study’s Limitations

All studies have limitations. Unfortunately, the limitations of some studies are fatal flaws that preclude publication. However, even the best studies in the most prestigious journals have limitations. It is far better for you to identify and acknowledge your study’s limitations than to have them pointed out by a peer-reviewer or a reader (in a letter to the editor after publication). Fluck et al<sup>2</sup> acknowledged a limitation of their study and used it to make a suggestion for further research: “We used only healthy white subjects, to minimize confounding variables. Future research should include testing subjects with darker skin and subjects whose oxygen saturation is below normal (< 95%).”

### Make Suggestions for Further Research

Although a study may answer important questions, other questions related to the subject may remain unanswered. Moreover, some unanswered questions may become more focused because of your study. You should make suggestions for further study in the discussion section. Laboratory experimental studies typically lead to suggestions for follow-up clinical studies with human subjects. An example comes from a laboratory study of oscillating positive expiratory pressure (OPEP) devices by Volsko et al,<sup>5</sup> who wrote, “One subject that remains to be explored is how to determine at the bedside whether a patient can perform OPEP and, if so, which device to select.”

### Give the “Take-Home Message” in the Form of a Conclusion

What is the “take-home message”? What do you want the reader to remember from your study? The take-home

message should be the first sentence of your conclusions section. In some journals the conclusions section is a paragraph or subsection at the end of the discussion, whereas other journals (*RESPIRATORY CARE*, for instance) require a separate conclusions section. The conclusions section may also provide suggestions for practice change, if appropriate. An example of a well-written conclusion comes from a study by Apostolopoulou et al,<sup>6</sup> who wrote: “VAP is a common infection and certain interventions might affect the incidence of VAP. ICU clinicians should be aware of the risk factors for VAP, which could prove useful in identifying patients at high risk for VAP and modifying patient care to minimize the risk of VAP, such as avoiding unnecessary bronchoscopy or modulating enteral feeding.”

### Things to Avoid When Writing the Discussion

#### Overinterpretation of the Results

It is easy to inflate the interpretation of the results. Be careful that your interpretation of the results does not go beyond what is supported by the data. The data are the data: nothing more, nothing less.

#### Unwarranted Speculation

There is little room for speculation in the discussion. The discussion should remain focused on the your data and the patients and/or devices in your study. If the subjects in your study had asthma, it is usually not appropriate to speculate about how your findings might apply to other patient populations. If your study used volume-controlled ventilation, it may not be appropriate to speculate about how the findings might apply to pressure-controlled ventilation. If you feel compelled to speculate, be certain that you clearly identify your comments as speculation: “We speculate that. . . .”

#### Inflating the Importance of the Findings

After all of the hard work that goes into a study, it is easy to attribute unwarranted importance to study findings. We all want our study to make an important contribution that will be cited for generations to come. However, unwarranted inflation of the importance of the study results will disgust reviewers and readers. A measure of humility goes a long way.

#### Tangential Issues

It is important to remain focused on the hypothesis and study results. Injecting tangential issues into the discussion section distracts and confuses the reader. Tangential issues

run the risk of diluting and confounding the real message of the study.

### The “Bully Pulpit”

Do not use the discussion section to criticize other studies. Although you should contrast your findings to other published studies, this should be done professionally. Do not use the discussion to attack other investigators. Moreover, never preach to the reader.

### Conclusions That Are Not Supported by the Data

The hypothesis → study → data → conclusions should be a tight package. Avoid the temptation to allow your biases to enter into the conclusions.

### Summary

The discussion section gives you an opportunity to explain the meaning of your results. When writing the discussion, remember that the focus should be to help the

reader understand the study and that the highlight should be on the study data.

### REFERENCES

1. Anton A, Tarrega J, Giner J, Guell R, Sanchis J. Acute physiologic effects of nasal and full-face masks during noninvasive positive-pressure ventilation in patients with acute exacerbations of chronic obstructive pulmonary disease. *Respir Care* 2003; 48(10):922–925.
2. Fluck RR Jr, Schroeder C, Frani G, Kropf B, Engbretson B. Does ambient light affect the accuracy of pulse oximetry? *Respir Care* 2003;48(7):677–680.
3. Stoller JK, Orens DK, Fatica C, Elliott M, Kester L, Woods J, et al. Weekly versus daily changes of in-line suction catheters: impact on rates of ventilator-associated pneumonia and associated costs. *Respir Care* 2003;48(5):494–499.
4. Swart F, Schuurmans MM, Heydenreich JC, Pieper CH, Bolliger CT. Comparison of a new desktop spirometer (Spirospec) with a laboratory spirometer in a respiratory out-patient clinic. *Respir Care* 2003;48(6):591–595.
5. Volsko TA, DiFiore JM, Chatburn RL. Performance comparison of two oscillating positive expiratory pressure devices: Acapella versus Flutter. *Respir Care* 2003;48(2):124–130.
6. Apostolopoulou E, Bakakos P, Katostaras T, Gregorakos L. Incidence and risk factors for ventilator-associated pneumonia in 4 multidisciplinary intensive care units in Athens, Greece. *Respir Care* 2003;48(7):681–688.