Effective Use of Tables and Figures in Abstracts, Presentations, and Papers

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In some situations, tables, graphs, and figures can present certain types of information (including complicated relationships and sequences of events) more clearly and in less space than the same information would require in sentence form. However, do not use tables, graphs, and figures for small amounts of data that could be conveyed clearly and succinctly in a sentence. Also, do not reiterate in sentences the data that are shown in a table, graph, or figure: the point of creating a table or graph or figure is to eliminate that type of sentence from your manuscript. In building a data table you must balance the necessity that the table be *complete* with the equally important necessity that it not be too complex. Sometimes it is helpful to break a large table into several smaller ones to allow the reader to identify important information easily, but, conversely, it is a common mistake of novice authors to split up into several tables data that belong in one table. In almost all cases, only one table or graph or figure should be included in an abstract, and then only if it can convey essential information in less space and in a more easily interpretable way than the sentence form. For a poster, in almost all instances you should use only one typeface and one font in a table, graph, or figure. In general, do not use bold, italics, or color unless you are presenting a great deal of data and you need to highlight certain data values and you are certain that using bold, italics, or color will improve readability, which is rare. Do not include identical information in a table and a graph/figure. In reporting a clinical trial you will need to include a patient flow chart that identifies the number of patients initially screened for the study, the number of patients who were excluded (and why) after initial screening or in the final analysis, and how many patients entered, exited early, and completed each arm of the study. A treatment protocol should also be described with a flow chart. In preparing a graph the most common error is to include a line that suggests an unsubstantiated extrapolation between or beyond the data points. In selecting the graph's axes, avoid truncating, enlarging, or compressing the axes in ways that might make the graph confusing or misleading. To prepare clear, accurate, easily interpretable tables, graphs, and figures, rely on the rules described in authoritative guides such as the Council of Science Editors' *Scientific Style and Format* and the American Medical Association's *Manual of Style*. *Key words: research; respiratory care; publications; tables and charts; medical illustration; manuscripts, medical; exhibits; communication; conferences and congresses.* [Respir Care 2004;49(10):1233–1237.

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Introduction

Illustrations, including graphs and figures, are often convenient and helpful to present and clarify information. They should not simply be a repetition of data in the text or a table. If information can be conveyed clearly and succinctly without use of a figure or graph, then no illustration is necessary. However, their proper use can illustrate complicated relationships more clearly and in less space than can the written word. This article describes some "dos and don'ts" for appropriate use of illustrations in abstracts, posters, and papers.

Data tables are very important in that they can be used to organize much of the information collected in a research effort. These "raw" data allow the reader to rapidly identify what information is available and quickly see where important results are located. Data tables should be complete but must not be too complex. Sometimes it is helpful to break a large table into several smaller ones to allow the reader to identify important information easily.

Care must be exercised when using a table or a figure in an abstract. In an abstract, space is at a premium, so the illustration or table needs to be small, but if you reduce the size too much, you will make the table or figure difficult to read. Carefully select only the most important data for tables and figures that you intend to place in an abstract. The table or figure should take up no more than one third of the space of the abstract space. Some journals allow for additional space for figures to accompany an abstract. Knowing the requirements of the particular venue will allow optimum use of space. Usually only one (table or figure) should be included in an abstract. A table or figure should be included only if it can more succinctly supply essential information than can a written description.

Figure 1 demonstrates an appropriate use of a data table in an abstract. The attractive things about this table and abstract are: the authors use only one table; the table takes up about one third of the total abstract space; and the typeface and font size are consistent between text and table. The amount of data presented is large, but it all seems appropriate, judging from the study design. The table illustrates how many data can be clearly conveyed in a small space. Raw numbers, percentages, and statistical significance (p values) are all included. The table makes it easier to understand the results, and its placement within the abstract is esthetically pleasing, so the table enhances the abstract. Presenting the table's data in sentences would have taken much more space, so this is an excellent example of the efficiency that can be achieved by using a carefully constructed table in an abstract.

Figure 2 is an example of how small mistakes in constructing a table can have a large impact on readability, usefulness, and attractiveness. The table in Figure 2 has unnecessary font and typeface changes: different sizes of normal, bold, and italics are used to no benefit and obvious detriment. The author's intent was presumably to distinguish the row headings and to highlight certain data, but the different type sizes and bold and italics decreased the table's readability and attractiveness. Changes in font or typeface should be used only when they improve readability, which is rare. Note also that the table in Figure 2 gives no indication of statistical significance (p values), raising the question of whether any of the information presented is important.

Another important function of illustrations and tables is to detail complex events. Figure 3 shows a table that de-

FACTORS ASSOCIATED WITH MECHANICAL VENTILATION IN A PEDIATRIC POPULATION.

Introduction: Mechanical ventilation (MV) is commonly employed in support of pediatric ICU (PICU) patients who exhibit respiratory dysfunction. Many RC departments employ protocols to reduce the incidence or duration of MV in this population. Scant empirical information exist which identify various baseline factors that are associated with MV in this population. As a result, few protocols account for contributory factors in the development of treatment protocols. The purpose of this study is to examine factors associated with pediatric MV. **Methods:** 1979 PICU admissions were included in this retrospective, case-control study. Co-morbidities such as age, prior ICU admission, operative status, and diagnosis, as well as, worst perturbed physiologic parameter during first 24 hours following admission were captured for each of the 1979 patients. Cases were identified as those patients who required MV at anytime during their PICU admission. Once patients were appropriately identified (case/control), the comordities and physiologic derangements were examined using bivariate analysis to identify those factors that were associated with the need for MV. **Results:** The result are shown in table 1 below:

Parameter	Cases (n=754)	Controls (n=1225)	p-value
Age	5.4 ± 5.8	6.9 ± 6.1	<0.001
BP systolic (highest)	118 ± 23	122 ± 19	<0.001
Heart Rate (highest)	153 ± 29	142 ± 29	<0.001
pH (highest)	7.42 ± 0.09	7.37 ± 0.16	<0.001
Previous ICU	162/754 (27%)	115/1225 (9%)	<0.001
Cardiac arrest	16/754 (2%)	11/1225 (1%)	0.023
Cardiac arrythmias	109/754 (14%)	91/1225 (7%)	<0.001
Meningitis	29/754 (4%)	22/1225 (2%)	0.005
Pneumonia	163/754 (22%)	104/1225 (8%)	<0.001
Sepsis	331/754 (44%)	377/1225 (31%)	<0.001

Conclusions: Our study demonstrates that a variety of factors, present or immediately following PICU admission, are associated with the need for MV in our pediatric population. The importance of these and other factors in predicting the need for or duration of MV in a PICU population must be further delineated. Identification of contributory factors associated with MV, as identified in this study, may further aid practitioners in the development of treatment protocols that target MV support and duration.

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Fig. 1. Example of appropriate use of a data table in an abstract, to present the important results of a retrospective study. The results are entirely presented in the table. (The authors' identities have been removed and the abstract is presented only for illustration, not endorsement or rebuttal of its content.)

	# Patients *Seen* by CM	Clinic Visits 12 mos Prior to CM	Clinic Visits After CM	ER Visits 12 mos Prior to CM	ER Visits After CM
1st Quarter	15	50	26	24	0
2nd Quarter	15	28	10	20	0
Totals	*30*	*78*	*36*	*42*	*0*
Control Group Data					
1st Quarter	15	47	48	20	24
2nd Quarter	15	41	54	16	13
Totals	30	88	102	36	37

Fig. 2. This table illustrates several errors in formatting, including detrimental changes in typeface and not providing p values (see text).

Ventilator Management Summary

Day	Ventilator Parameters						pH	P_{aCO2}	P_{aO2}/F_{iO2}
	Mode	$Peak_{awy}$/PEEP	Freq	I:E	PS	V_E (L/Min)			
#22	PCV	40/14	10	1:1		7.6	7.14	71	255
	PSV	40/14			26	13.2	7.21	53	140
#23	PSV	40/14			26	16.6	7.42	46	131
	BiLevel	30/12	6	1:1	25	12.0	7.35	56	176
#25	BiLevel	28/10	6	1:1	25	13.0	7.44	51	260
#30	BiLevel	24/10	6	1:1	18	10.8	7.34	45	271
#31	BiLevel	20/10	6	1:1	18	13.6	7.38	37	330
#32	PSV	18/10			8	15.4	7.50	30	234
#34	PSV	14/5			9	16.1	7.45	31	328

Fig. 3. A table showing the events of a case report.

tails the timeline of key events in a case report. The table format makes it easy to understand the chronology of changes in the measured variables. A sentence-style description of that data would not be nearly as easy to follow.

Some tables use lines or boxes, whereas others use white space, to separate columns. Lines require additional space, but in some cases they improve readability. Consider whether lines are needed or if, instead, space is at a higher premium. The rules for the use of tables and graphs in abstracts (Table 1) are different from the rules for their insertion in a full report published in a journal, where space is less limited.

In contrast to abstracts, in a full manuscript in a journal, multiple illustrations should be used and can be expanded. Tables, graphs, and figures can be used to summarize experiments, describe the inclusion criteria, give background information, and present results. Tables should include all potentially important information; however, a table can be made too complex, so in some cases you should separate the data into separate, smaller tables to improve readability. Two basic rules: do not include identical information in a table and a graph; and don't repeat the information from a table or graph in the text. Let the illustration speak for itself. Some sentences may need to mention data that appear in a table or graph (eg, "We were surprised that 81% of these patients had sepsis"), but sentences should not merely reiterate the data (eg, "Figure 1 shows that 47% of patients had COPD, 21% had ARDS, and 81% had sepsis.) The point of creating a table or graph is to eliminate that type of sentence from your manuscript. Each

Table 1. Rules for Tables and Figures in Abstracts

Use a table or figure only if it helps you convey the meaning more clearly or in less space
In the table or figure present only important information
The table or figure should take up less than one third of the abstract space
Include a table only if you can use the same font size as the abstract text (or maybe just a little smaller!)
Do not present the same information in both a table and a figure, and do not present the same data in both the text and the table or figure
Consider whether the use of lines in a table improves readability enough to justify the space the lines consume

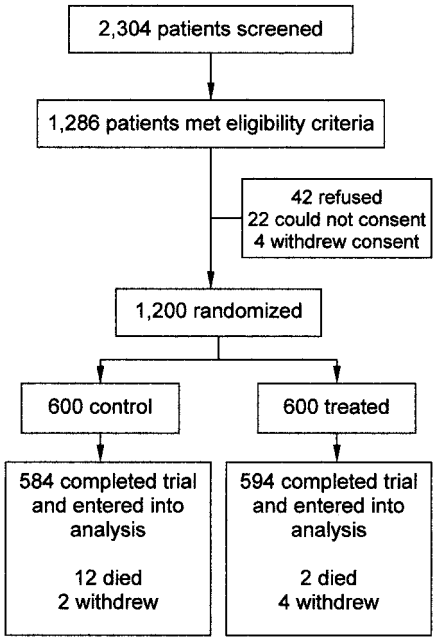

Fig. 4. Example of a clinical trial patient flow chart. Many journals require such a chart for a paper to be considered for publication.

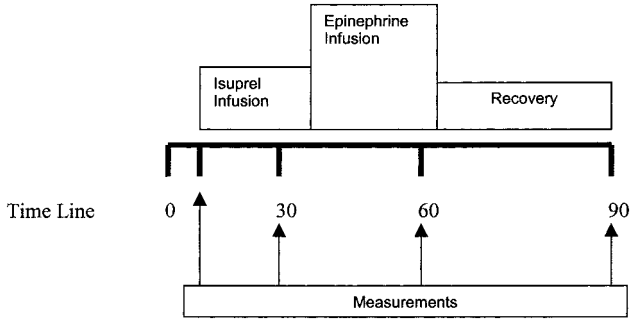

Fig. 5. A complicated treatment protocol can be clearly expressed as a time-line diagram.

illustration should have a clear, unique purpose and the text should only *refer* to the illustration—not repeat it. In a journal manuscript, where there is more space, certain tables and graphs might be enhanced by careful use of different fonts, used to draw attention to specific areas or information within a table. However, typesetting and journal policies may limit the font choices.

Poster presentations are more akin to manuscripts, and multiple illustrations may help the viewer quickly understand the experiment, results, and conclusions. Large tables should be avoided if possible, but if a large table is needed, it may be good to use bold font or italics to draw the reader's attention to the important data or areas of the table. The typeface should be clearly printed and the font size must be large enough to easily read from a distance of $\geq$ 4 feet. Colored text may be used,

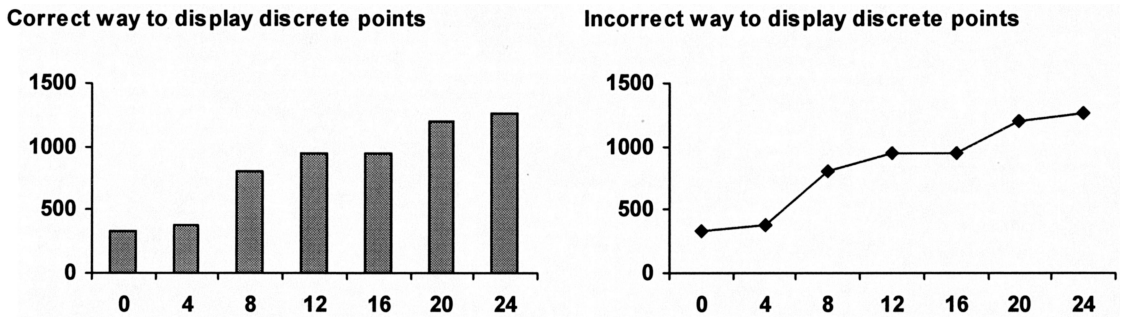

Fig. 6. Discrete points should not be connected with a line.

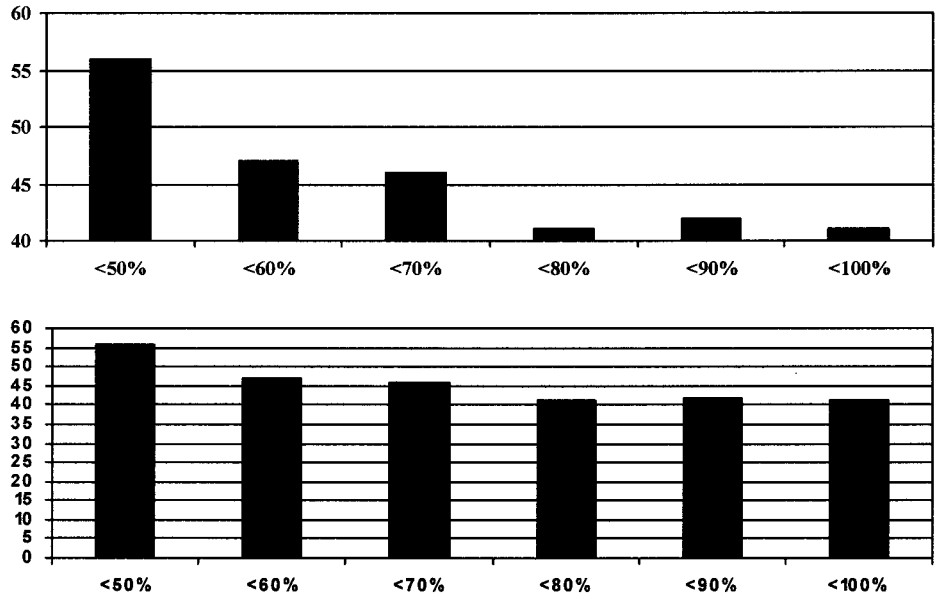

Fig. 7. Improper axis starting points and/or scale can give a misleading appearance that differences are statistically significant. The truncated ordinal axis (ie, zero–40 is missing) in the upper graph makes the differences appear large, whereas in the lower panel the ordinate values begin at zero and the graph is vertically compressed, which visually suggests that the differences are smaller.

but only for emphasis and with caution, as color may detract from the poster's esthetics. Graphs should be simple to view and interpret. For a poster presentation you may want to use color in your graph to help the viewer interpret it, but if you use color, remember that you will probably have to rework the figure into black-and-white when you submit your manuscript to a scientific journal, because it is unlikely that a scientific journal will publish the figure in color (printing in color is expensive and most journals only publish color figures if the paper is very important and the color is important to the illustration). Make sure the typeface and font are large enough for easy reading.

Patient Flow Chart

A relatively new requirement in reporting clinical trials is a patient flow chart, which shows the number of patients who were eligible for a clinical trial, the number of patients selected and excluded (and the reasons why) after initial screening or in the final analysis, the number of patients who withdrew early from the study, and the number who finished the study. This type of chart makes it easy to see how many patients were disqualified and why, and to guess how the exclusions might have influenced the outcome. Figure 4 shows an example of that type of patient flow chart. In that example, of the 2,304 patients screened for this trial, 1,200 were randomized to one or the other study group, and 1,178 completed the trial and were entered into the final analysis. This is a concise way of describing the patient makeup of the study and is much clearer than a sentence-form description would be.

A flow chart can also be used to clarify a complicated treatment protocol. This can be useful for presenting an experimental design or for clinical care, such as in describing a patient-driven protocol. Figure 5 shows how a com-

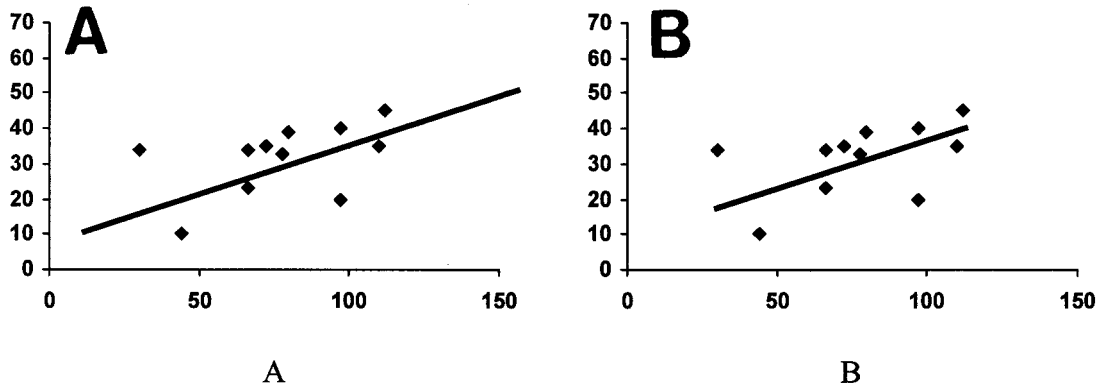

Fig. 8. Lines that extend beyond the actual values observed (unsubstantiated extrapolation) can lead to unsubstantiated conclusions. The regression line in graph A suggests a linear relationship at values greater than 120 and less than 25, but there are no data points in these areas, so no conclusions can be drawn about values in those areas of the graph. Graph B shows the regression line terminating in the proper places: at the ends of the data values. This is one example of how lines in graphs can be misleading.

plicated experimental treatment protocol can be simply represented as a diagram.

Graphs to Represent Data

Graphs are one of the best ways to display data, but there are several common mistakes that many authors make and that editors sometimes overlook. These are more of style than content. The first error is connecting discrete points with a continuous line. For instance, if vital capacity was measured every 4 hours with a group of patients, it is not correct to connect those distinct points, because the implication of the connecting line is that it represents continuous data, whereas in fact no one knows what the vital capacity values may have been between the measurements. Figure 6 illustrates how discrete measurements should and should not be illustrated. The points can be connected if they represent measurements of an individual patient at different times. Used that way, the line simply makes identification of the second measurement with the same subject more clearly and does not suggest continuous measurements.

A graph's axes can affect the reader's visual analysis and enhance or degrade the reader's understanding of the significance of the data. Expressing small changes as percentage change from baseline can make insignificant changes appear important. All statistics should be performed on the actual values: not percentages. Truncating, enlarging, or compressing axes can also make a graph potentially confusing or misleading. Sometimes axes are truncated or compressed to conserve space, but sometimes it is done to increase the likelihood of acceptance of the abstract or paper. Figures 7 and 8 illustrate these issues. Extending a regression line beyond the data points inaccurately suggests that conclusions can be drawn about expected values on the graph in areas where there are no data points.

Summary

Tables, graphs, and illustrations should be carefully considered so that they enhance rather than confuse the reader's understanding of the research. Since abstracts are limited in size, only one table or figure should be used, and it must make more efficient use of space than is required in a manuscript. Posters and papers can include more illustrations but be careful to prevent redundancy. Large data tables can be broken up into multiple tables to improve readability. Avoid making graphs that may mislead the casual reader into thinking that a nonsignificant difference is a significant difference.

To learn more about tables, figures, and graphs, I recommend the book *Scientific Style and Format*,[1] by the Council of Biology Editors (now the Council of Science Editors) and the American Medical Association's *Manual of Style*,[2] which describe how to organize the data, units of measure, alignment and positioning of data, format, numbering, captioning, axis labels, and production and reproduction of bar graphs, decision trees, digital images, flow charts, logarithmic scales, pie charts, scatter plots, and scattergrams. The *Manual of Style* also addresses whether specific data are better presented in a table or a figure.

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