SPECIAL CONTRIBUTIONS

Research Ethics: Ethical Issues of Data Reporting and the Quest for Authenticity

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Abstract. The search for truth and its unbiased reporting are ultimate goals of conducting scientific research. Ideally, the reporting of research data ought to be an objective task. In practice, however, it is fraught with numerous statistical and ethical pitfalls, seldom addressed in formal emergency medicine training. The lure of academic celebrity and related influences may persuade researchers to report results in ways that make data appear more interesting, or worthy of publication. Several examples of potentially misleading data reporting are illustrated, including using inappropriate statistical tests, neglecting negative results, omitting missing data points, failing to report actual numbers of eligible subjects, using inappropriate graph labels or terminology, data dredging, and others. Although potentially inaccurate or inflated methods of data reporting may not constitute overt scientific misconduct, the intentional misrepresentation of data is a form of fraud or deception. Publicly funded academic inquiry is a privilege and honor enjoyed by a trusted few. Regardless of outcome, every effort should be made to report data in the most scientifically accurate method. To this end, the Society for Academic Emergency Medicine Code of Conduct and American College of Emergency Physicians Code of Ethics provide important guidance toward the accurate, compassionate, competent, impartial, and honest conduct of scientific research. Accuracy and authenticity in data reporting are first and foremost a matter of individual integrity, and are crucial to the preservation of academic credibility, the protection of future patients, and the public's trust in the medical research enterprise. **Key words:** ethics; research; data reporting; authenticity. ACADEMIC EMERGENCY MEDICINE 2000; 7:691–694

CASE PRESENTATION

Dr. A. wanted desperately to get an abstract accepted for presentation at an upcoming research meeting. His angst was amplified by his need for one more publication in order to reach his quota for possible promotion, not to mention the exotic venue and the recognition he would receive in his institution's newsletter. Due to time constraints, his submission to the local institutional review board (IRB) was written somewhat haphazardly and submitted very late. Although IRB approval was granted, there was too little time to allow adequate data collection. Two days before the abstract submission deadline, as computer keyboards in emergency medicine offices nationwide clattered away, he and his colleagues felt pressured to present the data in the best light possible. Because the results appeared more favorable with a one-tailed test, he reported these results rather than the more appropriate two-tailed test. He performed as many statistical tests as his computer program would allow, and then reported only those that were most significant. Because one of the statistical tests approached statistical significance, he surmised that with larger numbers, statistical significance would be reached, and so reported a trend toward statistical significance, in the absence of a rational power analysis. To further camouflage his small numbers of subjects, he reported percentages, omitted raw numbers, and adjusted the graph axes to magnify small differences between groups.

MOTIVATION TO CONDUCT SCIENTIFIC RESEARCH

There are numerous factors that may motivate academicians to conduct scientific research. Perhaps the most laudable motivation is the desire to bring to light information that will contribute to the body

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of medical knowledge and ultimately benefit patient care in a meaningful way. However, all researchers experience external forces that promote or prevent the promulgation of quality research. Several examples of these external motivational forces may include:

1. Departmental publishing requirements.
2. Requirements for promotion.
3. Competitive pressures.
4. Institutional, regional, and national recognition.
5. Financial remuneration.
6. Media publicity.

The elimination of external forces in academic centers is unrealistic. Rather, individual researchers must strive to remain cognizant of these biases, and attempt to minimize their influence on the pursuit of truth. The validity and intellectual honesty of conducting and reporting analysis are critical, since the ramifications of published data, accurate or misleading, may have consequences for years to come. Any misrepresentation, whether overtly fraudulent, or merely inflated, may carry both short-term and long-term ramifications, and may adversely affect the integrity of the academic enterprise, and potentially even the well-being of future patients.

Ethical Issues of Data Reporting

Although many consider the reporting of research data to be a purely objective task, the availability of numerous statistical analysis techniques and reporting techniques presents numerous options, some of which are more scientifically valid and ethical than others.

External forces may negatively impact the honest and accurate reporting of research data. Researchers may wish to present their work in the most favorable light to improve chances of acceptance for publication or presentation. Although all of the following examples may not necessarily be immoral or unethical, a few potential examples of inaccurately reporting data may include:

1. *Failing to include number of eligible participants*. For example, if a large number of eligible participants refused consent, or were not included for other reasons, failure to report this may falsely mislead the reader to believe that study participants are representative of the entire body of eligible participants.
2. *Inaccurate reporting of missing data points*. For example, in a study with a large number of participants, but high fractions with missing data points, the reporting of data could be manipulated to camouflage missing data points.
3. *Failing to report all pertinent data*. Some researchers purposely neglect to report sections of data that are inconsistent, or unexplainable, with other results. This unscientific selection of data points is misleading.
4. *Failing to report negative results*. Although positive results appear more interesting, and may carry increased probability of acceptance for publication, negative results are scientifically as important to report. A failure to demonstrate a statistically significant difference between groups is *not* a failure to demonstrate meaningful results. Demonstration of negative results may be valuable to the medical community, and may obviate the need for additional financial or time investments from other researchers. Particularly in this era of cost containment, the demonstration of a lack of benefit of a new therapy may be valuable.
5. *Allowing research sponsors to influence reporting of results*. For example, pharmaceutical sponsors may pressure researchers to report only results favorable to their product or may prohibit presentation or publication of the results altogether.
6. *Inappropriate graph labels*. For example, showing only a fraction of the y-axis scale, or unclear axis labeling, may magnify small differences between data points.
7. *Reporting percentages rather than actual numbers*. Although this may be appropriate in some cases, if the intent is to deceive, it represents inaccurate and perhaps unethical reporting.
8. *Reporting results of inappropriately applied statistical tests*. For example, several statistical tests may be applied to the same data set, and the researcher may elect to report only the test that yielded the most favorable results, rather than determining a priori the most appropriate statistical tests to use.
9. *Reporting differences, when statistical significance is not reached*. For example, although the p-value is not significant, some researchers report a "trend" toward significance. This is inaccurate, as, per convention, unless otherwise stated, a p-value ≥ 0.05 is accepted as not significant; that is, a difference was not found. Some authors suggest that reporting confidence intervals is a superior method of reporting, because of improved informational content, in a more explicit and precise format.[1,2]
10. *Reporting no difference, when power is inadequate*. If the study sample size is too small, a type II error may be committed. Although power of 0.8 is acceptable by convention, this allows a 20% chance of incorrectly accepting the null hypothesis. In some cases, researchers should consider being more fastidious, and strive for a power of 0.9 or higher. In any case, alpha and beta should be considered prior to beginning the study and a deter-

mination should be made of what type I or type II errors are acceptable.

11. *Data "dredging."* Although for some studies, multiple looks at the data may be appropriate, merely performing multiple tests to search for significant associations can be misleading and statistically inaccurate. If multiple comparisons are used, correction should be performed, using a test such as the Bonferroni or Scheffe methods.[3]

12. *Splitting data into multiple publications*. Related data from a single study are usually most powerful when presented in a single publication, although this may not always be feasible, especially in abstracts. Splitting data into multiple publications, merely for the purpose of increased number of publications, is unethical and should be avoided.

13. *Inappropriate use of terminology without precise definitions*. For example, words such as "rarely" and "commonly" may have differing implied meanings to researchers and readers. If only 48% of patients had a given outcome, it is probably misleading to report this occurred "rarely."

14. *Reporting conclusions that are not supported by data*. Opinion or conjecture should not be presented as research findings.

15. *Ignoring citations or prior work that challenge stated conclusions or call current findings into question*. Rather than considering disparate citations as a threat, they may be used as important components of discussion.

16. *Inflation of research results for the media*. Although media coverage of significant research is important, the quest for a pithy soundbite ought not supersede the duty to accurately portray findings in the most intellectually honest way.

Many researchers claim to conduct scientifically accurate and honest research, but may fail to realize that such exaggerations and errors as listed above may in fact constitute an element of scientific misconduct.[4–7] Although the methods of designing the research study, obtaining institutional approval, obtaining informed consent, and appropriate study methods are all crucial to the performance of scientifically accurate and ethically legitimate research, the honest and accurate reporting of data is also an essential component.[8,9] In fact, scientific fraud, in any form, sows seeds of myth that may plague future generations of clinicians and researchers, and may take decades to debunk. Thus, we sin twice; against our divinity within and the honored profession without.

Reviewers, editors, and publishers involved in the peer-review and publication processes share the burden of responsibility for the dissemination of accurate, relevant research data. Recognition of potential inaccurate data reporting methods is an important part of the peer-review process.

Duty to Society

In addition to the self-motivating elements that drive researchers to pursue meaningful academic inquiry, a societal duty to conduct and report research accurately must be recognized. Unambiguous public funding (such as National Institutes of Health or Centers for Disease Control and Prevention grants) creates an obvious public duty to embrace rigorous integrity in the conduct of medical research. Additionally, other more camouflaged public funding, such as government support of medical education, graduate medical education, hospital support, and government-funded medical insurance, must also be recognized. These multivalent contributions from the public purse provide an optimal environment for researchers, which in turn creates a social contract, an onus that researchers have to steward hospital, laboratory, and patient resources wisely. The accurate and honest reporting of research results is an important element of fulfilling this social contract.

The Quest for Authenticity

Authenticity and honesty are crucial toward preserving individual integrity, as well as that of the entire scientific enterprise. The true scientist revels in the pursuit of truth and knowledge. The internal satisfaction derived from accurate and significant scientific findings (including negative studies) should transcend potential disappointments, such as lack of media coverage, rejection by certain publications, or lack of approval from colleagues. In fact, the importance of many scientific discoveries initially went unrecognized. A sincere researcher realizes that the quality of work is more important than the quantity of publications and presentations, which may not accurately reflect the significance of the research findings.

Although external forces can have far-reaching effects on actions involving data reporting, it is the internalization of those external influences that allows these phenomena to occur. Similarly, the resolution of these issues must also come from within, from the quest for scientific authenticity.

Several steps may be taken toward ensuring the scientifically and ethically most valid reporting methods. One method is the advance determination of the most appropriate statistical and reporting techniques. Some advocate that a research paper can be written in large part *prior* to data collection, with only specific numbers missing, to be filled in after data collection. A carefully formulated research question and study design enables the investigator to establish scientifically valid statistical analysis, possible results, and conclusions, prior to the potential influence of external

forces on reporting methodology. The Society for Academic Emergency Medicine Code of Conduct[10] and American College of Emergency Physicians Code of Ethics[11] provide important guidance toward the accurate, compassionate, competent, impartial, and honest conducting and reporting of research results.

Researchers not only should take care to avoid every aspect of scientific misconduct in research, but should take responsibility for mentoring young investigators regarding appropriate scientific conduct, and for reporting and investigating alleged scientific misconduct.[12] Researchers should be aware of and support institutional compliance programs that help to promote accurate and honest research.[13]

CONCLUSIONS

An academic inquiry is a privilege and an honor, to be guarded like a sacred trust. The influence of data reporting on current and future generations must never be underestimated. Although all researchers experience both internal and external forces that may influence the conduct of scientific research, every attempt should be made to recognize such forces, and resist their influence. Researchers should avoid conducting empty research unlikely to result in meaningful knowledge, and consider potentially better application of time and resources to other academic or personal endeavors. The reporting of data should be done with honesty and integrity, and every effort should be made to report data in the scientifically most accurate method. Only conclusions that are supported by accurate data should be stated, in efforts to preserve the integrity of medical research, to protect future patients, and the public's trust in the research establishment.

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