Abstract. The goal of medical research is the acquisition and application of new knowledge for the benefit of individual patients and society as a whole. Achieving this goal requires excellence in scientific methodology, honesty in data collection and interpretation, and realistic assessment of the implications of the findings. Underlying all steps in the acquisition of new knowledge is the absolute need for application of the highest ethical standards for research. Occasionally, ethical principles of research are breached because of lack of understanding or the carelessness of researchers. However, researchers have the obligation to know and apply basic principles of research ethics in order to avoid, prevent, or recognize deviations from ethical scientific behavior. When intentional violations of the principles of ethical research occur, the impact to the scientific and lay community can be profound. Misconduct can be prevented if the ethical principles of research are understood and consistently applied. This paper describes the sources and detection of misconduct in the production of science in order to provide emergency researchers with the knowledge needed to prevent misconduct from occurring at all. Key words: scientific misconduct; research misconduct; scientific fraud. ACAD EMERGENCY MEDICINE 1999; 6:840–848

Emergency medicine researchers are involved in a variety of basic science and clinical research efforts designed to assist in the diagnosis and management of the acutely ill or injured. The ultimate goal of our research is the application of newly acquired knowledge for the benefit of our patients and our community. Valid scientific investigation requires pure and appropriate experimental design, objective and accurate data collection and analysis, and honest and complete scientific reporting. Our research findings have profound implications on our practice and our patients; honesty in the research process is therefore essential. When intentional violations of the principles of ethical research occur, the scientific community, our specialty, and our institutions are placed at risk of irretrievable loss of credibility, and our patients are placed at risk of increased harm and suffering. This paper describes the occurrence, detection, and prevention of misconduct in the production of science, and offers an overview of the process of investigating allegations of scientific misconduct.

The National Commission on Research Integrity (NCRI) defines research misconduct as “significant misbehavior that appropriates the intellectual property or contributions of others, that intentionally impedes the progress of research, or that risks corrupting the scientific record or compromising the integrity of scientific practices. . . .” In its definition, the NCRI has avoided the use of the term “research fraud” and instead uses “research misconduct.” Fraud is only one type of misconduct; the Commission identifies several other culpable activities. Examples include misappropriation, misrepresentation, and interferences as defined in Table 1. The Commission also states that any obstruction of the investigation of an allegation of misconduct, or noncompliance with federal research regulations also constitutes scientific misconduct. Unavoidable errors in the research process or differences in interpreting scientific data are not scientific misconduct.

The NCRI does not discuss the gradation of seriousness of research offenses; it recommends an even distribution of sanctions against those who engage in any type of scientific misconduct, “based on the extent of misconduct established.” Practically, however, the scientific community does differentiate the seriousness of an act of research misconduct, and bases this assessment on the intent of the individual committing the offense. For example, ignorance, negligence, or overwork may result in carelessness in data collection or inter-
sources of error and misconduct in research. Honest errors are unavoidable, and beyond the control or knowledge of the investigator. An example is the error in data analysis when patients give inaccurate information to the unsuspecting investigator. Since the investigator is unaware of this inaccuracy, he or she is not responsible for this type of error. Careless errors are culpable actions; the investigator has some awareness of engaging in questionable activities. Careless errors include “sloppiness, laziness, and the tendency to take unjustified shortcuts.”

For example, an investigator may search for all previous work on a specific research question using only basic searching of MEDLINE. However, this retrieves only 30–60% of published randomized clinical trials in certain areas of medicine. With 40–70% of available trials unreviewed, the researcher may make unjustified assumptions concerning the current state of knowledge on the research topic. Errors due to neglect of pertinent information, or conscious disregard for known methods of data evaluation and retrieval, are careless and preventable.

Scientific misconduct is intentional deception. Some examples include sloppy or selective data analysis and reporting, data manipulation, honorary or “gift” authorships, plagiarism, lack of input into papers that bear your name, failure to critically evaluate manuscripts or grants that you have been asked to review, misdirection or misuse of research funds, or the use of methods that do not conform to those accepted by the research community. Research fraud is the most serious type of scientific misconduct, and is deliberate falsification and fabrication.

The cases in Table 2 illustrate many types of scientific misconduct. Although scientists are reluctant to believe that misconduct occurs, these cases show that it can happen at premier institutions, in laboratories of renowned researchers, and involve researchers with outstanding credentials and impeccable reputations.

Each step of a research study is susceptible to both error and misconduct. Before a study begins, its pre-enrollment stages must be thoroughly completed. This includes demonstration of compliance with federal, state, or institutional rules and regulations concerning the conduct of research, such as obtaining approval from the institutional review board (IRB) or animal care and research committee. For human studies, prospective informed consent.

<table>
<thead>
<tr>
<th>TABLE 1. HHS Definitions of Misconduct*</th>
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<tr>
<td><strong>Research misconduct:</strong></td>
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<td><strong>Examples</strong></td>
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<tr>
<td>Misappropriation:</td>
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<tr>
<td>Misrepresentation:</td>
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<tr>
<td>Interference:</td>
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<tr>
<td>Other forms of professional misconduct</td>
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<tr>
<td>Obstruction of investigations of research misconduct:</td>
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<td>Noncompliance with research regulations:</td>
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<tr>
<th>Accusation</th>
<th>Case</th>
<th>Circumstance</th>
<th>Outcome</th>
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<tr>
<td><strong>Data fabrication</strong></td>
<td>Soman, Yale. 1979–1980&lt;sup&gt;29&lt;/sup&gt;</td>
<td>Published a report based on nonexistent data; falsified results in three others. Discarded data for several other studies. Plagiarized an article his mentor had been asked to review.</td>
<td>Prolonged internal and external investigations eventually found Soman guilty of misconduct. Twelve papers eventually retracted. The whistle-blower was poorly treated throughout the investigation, and eventually left research.</td>
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<td>Slutsky, UC San Diego, 1983&lt;sup&gt;11,30&lt;/sup&gt;</td>
<td>Published 12 studies based on nonexistent data: another 48 were questionable.</td>
<td>Fifteen papers retracted from eight journals. Resigned his appointment.</td>
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<td>Breuning, U. Pittsburgh, 1988&lt;sup&gt;21&lt;/sup&gt;</td>
<td>Fabricated and falsified data in clinical trials of drug treatments for hyperactive institutionalized children.</td>
<td>During an institutional investigation, Breuning admitted his guilt and was eventually dismissed from his position. Indicted on two counts of submitting false statements to the government and one count of obstructing the investigation of an allegation of misconduct. Suspended from practice for five years, ordered into rehabilitation and community service, and required to pay back his salary to U. Pittsburgh.</td>
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<td><strong>Data falsification</strong></td>
<td>Darsee, Harvard Medical School, 1981&lt;sup&gt;12&lt;/sup&gt;</td>
<td>Mislabeled lab data from a cardiology study to suggest the data had been collected over several days instead of several hours.</td>
<td>Event was witnessed. Darsee denied wrongdoing, and was allowed to continue with his work. Subsequent investigations indicated Darsee had fabricated data in work from three institutions. Several papers retracted. Darsee's case prompted the development of a formal policy at Emory to deal with allegations of misconduct; Harvard also refined their standing procedures.</td>
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<td>Summerlin, Sloan-Kettering Cancer Institute, 1974&lt;sup&gt;44&lt;/sup&gt;</td>
<td>When his research came under criticism, he falsified results of skin transplants in mice by coloring some animals with a felt-tipped pen.</td>
<td>Event was witnessed and immediately reported. Summerlin admitted his guilt, and was dismissed from his position.</td>
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<td><strong>Data manipulation</strong></td>
<td>Imanishi-Kari and Baltimore, MIT, 1986&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Accuracy of published study questioned by a post-graduate student, who stated that the results failed to support the conclusions of the study.</td>
<td>Forensic analysis conducted of the data. Multiple internal and external investigations with different conclusions. Grants withdrawn, papers retracted. Baltimore pressured to resign from presidency of Rockefeller University. Case recently re-investigated (1996). Appeals Board exonerated Baltimore and Imanishi-Kari.</td>
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<td>Needleman, U. Pittsburgh, 1991&lt;sup&gt;29&lt;/sup&gt;</td>
<td>Accused by the lead industry of data manipulation in his work, which suggested that low-level lead exposures were responsible for neurobehavioral defects in children.</td>
<td>Several investigators had reached similar conclusions and had replicated Needleman's work. The Office of Scientific Integrity (OSI) investigation finds no misconduct. Needleman's reputation suffers; frequent mention of investigation when subsequent research is published.</td>
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<td><strong>Protocol violations</strong></td>
<td>Poisson and Fischer, St. Luc Hospital, Montreal; National Surgical Adjuvant Breast Project (NSABP), 1990–1993&lt;sup&gt;35&lt;/sup&gt;</td>
<td>Falsified enrollment criteria of some study patients in a clinical trial comparing breast cancer therapies. Failed to obtain required prospective informed consent in a third of enrolled patients.</td>
<td>National Surgical Adjuvant Breast Project (NSABP) aware of fraudulent data in 1990; no public disclosure until 1993. Federal investigation revealed protocol violations, data mismanagement, and fabrication by Fischer (project PI) who was relieved of his role in the study. Poisson was suspended and barred from receiving public funds for research for eight years.</td>
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<td>Tseng, Massachusetts Eye and Ear Infirmary, 1988&lt;sup&gt;15&lt;/sup&gt;</td>
<td>Accused of using invalid methods in a clinical trial of vitamin A eye ointment. Frequently changed enrollment criteria and dose of agent. Enrolled 250 patients despite approval to enroll only 50. Concerns over conflict of interest; Tseng and his supervisors owned stock in the pharmaceutical company sponsoring the study.</td>
<td>Multiple internal and external investigations. Harvard reevaluated its policies dealing with misconduct and conflict of interest.</td>
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<sup>*For complete reference citations, see the reference list.</sup>
sent from potential subjects is usually required. If this is required and not obtained, the investigator is guilty of scientific misconduct.1

Once the study begins, enrollment criteria and predetermined randomization must be adhered to. When these criteria are inconsistently applied, not only are the study results in question, but the whole research program may be jeopardized.4 Blinded studies must remain blinded to the investigators and collected data should be analyzed only at scheduled points; only data and safety monitoring boards may be unblinded and find it necessary to perform unscheduled analyses for the safety of patients. Stopping a trial prior to the total planned enrollment, unless recommended by the data and safety monitoring board, may constitute misconduct and leave the results suspect.5

Once the study has been completed, misconduct can occur in the analysis and presentation of the data. Fraudulent data manipulation may include data fabrication, data falsification, data dredging, or data deletion. Misconduct in data analysis may also include performing a variety of statistical tests and only presenting those that show statistical significance.

CAUSES FOR MISCONDUCT

Although the reasons for engaging in research misconduct are complex, most perpetrators of scientific misconduct attribute their behavior to the fierce competition of the research world.6 The “publish or perish” mentality present in most academic settings tends to place a greater emphasis on the quantity rather than the quality of published research. There is also competition for priority in research findings. Not only is it important to publish novel research, it is essential to publish it first.7 This may result in lack of attention to detail, shortcuts in the protocol or presentation, or intentional omission of key methodologic steps to make it impossible for others to duplicate research findings.8

Researchers, especially those who are also clinicians, have great demands on their time, and may be too busy to pay attention to minor details of the research process or to adequately supervise research technicians and students. Noted investigators frequently are popular mentors. They may agree to supervise too many novice researchers or have inadequate resources to maintain a close and critical eye on all that goes on within their research purview. Admiration and respect for a mentor can provoke student researchers to manipulate data or the analysis of data to produce the results they believe their mentor is expecting. Finally, the pressure on a researcher to produce important findings is compounded by the desire to achieve fame and establish credibility and a reputation as an expert in a specific scientific area.

THE IMPACT OF SCIENTIFIC MISCONDUCT

Regardless of the cause, scientific misconduct has far-reaching consequences. Patients can be harmed when clinicians alter their clinical practice based on a fraudulent paper in the literature.9 The impact on the research enterprise and other researchers can also be immense. Most research is based on previous findings. If new hypotheses are developed from fraudulent findings, inappropriate trials of investigation will be followed, thus wasting time, effort, and money.10 If fraudulent research is the basis for subsequent funding, other researchers who are competing for scarce research money lose out. Co-investigators may be unjustly accused of misconduct because of guilt by association, and their subsequent research may be viewed skeptically.11 Student researchers who learn bad habits, who witness misconduct that is not reported, or who fail to learn research ethics can be hurt by scientific misconduct and unknowingly perpetuate it. When the media reports a scientific crime, the credibility of the research community is lessened. Every act of scientific misconduct degrades the morale of other scientists, taints the reputation of the researchers, and destroys public trust in the research enterprise.

DETECTING AND REPORTING SCIENTIFIC MISCONDUCT

The traditional methods to protect against and detect scientific misconduct have been peer review and replication of research results. However, the changing climate of biomedical research has made these methods impractical or ineffective.11

Peer review relies on the careful critique of submitted grants, manuscripts, or research proposals by experts in particular research areas. Often, these reviewers are volunteers with other full-time obligations. Their expertise and research interests may put them in competition with the submitting author. Reviewers may be unable or unwilling to examine the rationale, methods, and data analysis with sufficient detail needed to detect falsification or fabrication. Their effort may be limited by lack of time, resources, or enthusiasm or by an unconscious bias against the submitting author’s potential success.12

The replication of research findings is costly in terms of time and money, and rarely results in publishable material. Currently, replication of research is done primarily to expand upon or modify the original methods to answer a different re-
TABLE 3. General Principles of the “Whistle-blower’s Bill of Rights”

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<th>Principle</th>
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<td>Whistle-blowers</td>
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<td>· Are free to disclose information that supports the belief that misconduct has occurred.</td>
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<tr>
<td>Institutions have a duty to</td>
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<tr>
<td>· Not tolerate or engage in retaliation against good-faith whistle-blowers.</td>
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<tr>
<td>· Provide procedures for examining and resolving complaints, disputes, and allegations of misconduct.</td>
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<td>· Follow procedures in an unbiased fashion.</td>
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<tr>
<td>· Elicit and evaluate fully and objectively information about the concerns raised by whistle-blowers.</td>
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<tr>
<td>· Expediately handle cases involving alleged research misconduct.</td>
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<tr>
<td>· Credit promptly (in public or private as appropriate) those whose allegations are substantiated.</td>
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search question or meet a separate research need. If an experiment is replicated, incorrect results may be discovered, but it is not possible to determine whether these inaccuracies result from a flawed study or from fraudulent data.11 The usefulness of replication in detecting scientific misconduct is therefore quite limited.

Although detection of scientific misconduct is not an easy task, there are signs that should raise suspicions. Extreme productivity, especially out of proportion to the level of training and experience of the investigator, is highly suspicious. This is illustrated by the case of Robert Slutsky, whose curriculum vitae listed 137 publications produced mostly during seven years of postgraduate training in three different medical specialties.11 Slutsky’s misconduct ranged from carelessness to fraud. He reported methods and procedures inaccurately, presented some of his previously published data as if they were new, and reported measures, experiments, and statistical analyses that were never actually performed. Many of his research advisors, colleagues, and co-investigators had questions about the accuracy and quality of his work, but they failed to report their concerns to his department and institution. When Slutsky applied for a faculty appointment after his final fellowship, his letters of recommendation contained questions about his extreme research productivity at such an early point in his career, and suggested carelessness in some of his research techniques. These concerns were never pursued by the search committee reviewing his credentials. Of Slutsky’s 137 publications, 12 were eventually identified as fraudulent, and 48 were judged to be questionable.

Complicated research protocols or very predict-
He was eager to succeed, and as a result, modified the protocol by enrolling many more patients than he had approval for, and varying the doses of medication used. When it was apparent that the drug was not effective, Dr. Tseng minimized the negative results while he sold his rights to the formula and his stock in the company that produced the ointment. Although financial benefit may not have been the reason for his culpable actions, it is likely that his special interest in success clouded his judgment during the enrollment stages of the clinical trial.

It may not be possible or desirable to eliminate all research circumstances in which a real or perceived conflict of interest arises. Many lifesaving drugs and devices have been developed through collaborative efforts of researchers and industry, and it is unlikely that all worthy future research efforts can be funded by neutral agencies. The relationship between researchers and industry has the desirable effect of providing necessary resources to enhance our ability to effectively treat patients. In other circumstances, it may be desirable but impossible to reduce real or perceived conflicts of interest. Intellectual conflicts of interest will never be reduced if scientific reputation, gratification, publication, and promotion and tenure decisions appear to depend on the reporting of possibilities, publication, and promotion and tenure and career advancements may be put on hold, pending the outcome of a long, tedious, and expensive investigation.

Errors in judgment, differences in opinion regarding the interpretation and meaning of data, or the desire to investigate the possibility of misconduct are insufficient reasons to accuse an investigator of research misconduct. This is illustrated by the case of David Needleman, a pediatrician and psychiatrist, whose research suggested that low levels of lead exposure resulted in neurobehavioral deficits in children. He was accused of scientific misconduct by investigators who were sponsored by the lead industry. It was ultimately determined that their concerns had to do with differences in the interpretation of his data, rather than any particular act of misconduct. An accusation of misconduct must be based on specific actions that can be investigated. “Sometimes it is necessary to explain to an informant about the question of intent, the separation of fraud from error, and the necessity of finding solid information and being able to come up with specific charges to take action on a request for an investigation.”

THE INVESTIGATION OF AN ALLEGATION OF RESEARCH MISCONDUCT

As the federal government evolves its system for investigation of accusations of misconduct, it has called for institutions to develop clearly written policies and procedures for conducting fair and thorough investigations. The process must be balanced and allow a serious consideration of the accusation while simultaneously protecting the whistle-blower and the alleged perpetrator. Key elements in policies dealing with allegations of research misconduct are described in Table 4. The Association of American Medical Colleges has described a process for the evaluation of an allegation of misconduct. This process has been adopted by many institutions.

Most institutions have designated a high-level official as the individual to whom allegations of misconduct should be made. Once an allegation of misconduct has been made, a preliminary inquiry is usually initiated by a standing institutional committee to determine whether a formal investigation is warranted. If it is determined that the
allegation does not merit further evaluation, a written report is produced, documenting the information that led to this conclusion. If the allegation requires in-depth investigation, a formal process is begun to collect and thoroughly examine information pertinent to the allegation of misconduct. The details of the planned investigative process are then communicated to the alleged perpetrator.

Most institutions convene a special committee to formally investigate allegations of misconduct. Members of this committee must have no bias or conflict of commitment or interest with the investigator or the research under investigation. The committee may ask the investigator to supply research material pertaining to the allegation (such as lab books, raw data, and publications of the research results). Interviews with research collaborators and coauthors may be conducted to determine the events surrounding the allegations. The individual under investigation should be given access to all information collected by the investigative committee, and provided with adequate time to develop a formal response.

Once the investigative committee has made a decision about the allegation, a preliminary report is prepared detailing the rationale for the decision. Usually the investigator is allowed time to appeal this decision before the report is finalized. The investigative committee may make recommendations to the institutional administrators regarding the ultimate disposition of the case. Disciplinary action may follow, based on the institutional policy for academic misconduct.

If an investigator is found guilty of misconduct, the institution may require that co-investigators, co-authors, and funding agencies be notified. Retractions or correction of any erroneous publications resulting from flawed studies may also be required. Investigators may be censured, placed on probation or suspended, denied faculty reappointment, or fired. In addition to these punitive measures against the investigator, the institution itself is obligated to look at how and why the misconduct occurred, and take steps to prevent similar problems in the future. If the guilty investigator has been involved with government-funded research, active research funding may be terminated, and the investigator may be barred from future funding. The investigator may also be prohibited from serving on research study sections or other government research committees.

Recently, several court cases involving scientific misconduct have been brought under the False Claims Act, which includes a provision for designating part of the award and/or penalty to the whistle-blower, to encourage the reporting of suspected misconduct. Supporters of this use of the False Claims Act believe that institutions will be forced to provide more ethical oversight of the research process. Detractors point out that institutions are severely penalized by this action even when they have conducted a thorough and fair investigation of reported misconduct. In fact, data from their own investigation could be used against them in a court of law; the thoroughness of future investigations might therefore be jeopardized.

### Preventing Research Misconduct

When scientific misconduct occurs, the research community has the obligation of exposing the event, and dealing with it fairly. The scientific community has an even larger responsibility to prevent misconduct from occurring at all. Education, communication, supervision, and responsible mentorship are key in this effort. Scientific integrity and research ethics should be taught during all phases of research education. In the education of medical students, residents, and fellows, formal and informal teaching of research ethics should be included in any curriculum. In addition to defining what research misconduct is, we should also teach our students research professionalism and what constitutes ethical research practices. Our educational message must be clear, and we cannot rely on role modeling alone to instill ethical behavior in junior researchers.

We must also teach our students practical applications of the concepts of ethical research. We should emphasize the importance of accurate data recording and analysis, the responsibilities of being a co-investigator, the need for meticulous adherence to the established protocol, and the value of honest intellectual discussion and questioning of the research findings. The misrepresentation of data or research productivity must be labeled as fraud; we should encourage high-quality research, instead of large quantities.

We must also inform our research colleagues of existing sanctions of law or institutional policy on perpetrators of scientific misconduct. The submission of false information in an application for a federal grant is a felony, punishable with a fine up to $10,000 and/or imprisonment for up to ten years.
In addition, existing grants and contracts may be suspended, terminated, or withheld for this offense. Institutions that receive NIH funds are required to define research misconduct and establish methods to investigate allegations of misconduct. These institutional policies are frequently published in faculty handbooks, but are infrequently read. 

Increased research supervision by mentors and supervisors for investigators at all levels will reduce the likelihood of the occurrence of misconduct. Established investigators must pass on ethical research traditions and values, including respect for primary data, the responsibility to present negative findings, and the importance of retaining original data and biological samples. The importance of data quality must also be instilled in junior researchers. Data quality includes "those characteristics of a research project such as data capture, traceable calibration of equipment, recording and retention of data, examination of statistical validity, and independent tracing of data from summaries contained in draft reports to the original data in laboratory records and computers." With increased supervision, the premature independence of novice researchers will be avoided.

Supervision by research mentors should be an active and interactive process. This allows the mentor to point out errors in concept or practice during the research process. Frequent research meetings should be held to discuss progress and problems. Controlling the size of a research team will make any aberrant behavior easier to detect, and peer pressure from close associates may prevent misconduct. When discrepancies are noted in data collection or analysis, early investigation should occur. Additional supervision of the research process can be provided by a departmental research committee. A review by this group of all manuscripts or grant applications before submission to journals or funding agencies will provide a critical appraisal of the feasibility and likelihood of the reported data, given the local research environment.

Retention of raw data for at least five years after its publication will allow re-examination of the results, should questions or allegations of misconduct arise. The inability to produce original data during an investigation of misconduct may lead to the presumption that the data never existed.

The development of guidelines on appropriate research behavior will avoid misunderstandings by investigators and by others who may believe misconduct is occurring. The consequences of inappropriate actions or inappropriate accusations should also be specified in these documents. Departments, as well as institutions, should develop a specific procedure to deal with allegations of misconduct. The procedure must include protection for whistleblowers, who are often junior researchers or research assistants, and who by reporting their suspicions, risk losing their jobs and careers. Protection must also be provided to the alleged perpetrator, who runs the risk of substantial damage to his or her career, when questions of inappropriate scientific behavior arise.

Professional organizations have a role in preventing scientific misconduct. These organizations are responsible to their membership, to the research community, to the general public, and to individual investigators to set standards of responsible conduct of biomedical research. The standards should be clearly articulated and disseminated within the organizations' codes of ethics. These statements can serve as a framework against which questionable activities can be measured. The ethical framework advanced by an organization must deal with many issues that are related to scientific misconduct. These include conflict of interest, responsible mentorship, responsible authorship, peer review, humane treatment of animals, and compliance with regulations for human subjects research.

**CONCLUSION**

Scientific misconduct is a serious event that has a broad impact on the investigator, his or her associates, patients, and society as a whole. Often misconduct occurs because of lack of understanding or carelessness on the part of the investigator. Occasionally, the investigator clearly intends to deceive.

Several specific behaviors suggest that misconduct has occurred, and should alert observers to begin investigation. Misconduct can often be prevented if young investigators are taught research ethics and are carefully supervised by co-workers and mentors. If misconduct is suspected, a non-threatening procedure for reporting and investigating the allegation should be available at the departmental, institutional, and federal levels. Several such policies have been advanced and successfully applied; they can serve as the basis for development of guidelines for other institutions.

**References**


4. Robinson A. Science and scandal: what can be done about