Manual for
Research and Publication Ethics
in Science and Engineering

Authors: Eun Seong Hwang, Eun Hee Cho, Young-Mog Kim, Kibeom Park, Wha-Chul Son,
Tae-Woong Yoon, Jeong Mook Lim

Title: Manual for research and publication ethics in science and engineering

Published by Korean Federation of Science and Technology Societies, Seoul, Korea (http://kofst.or.kr/).
Printed and bound in Korea on January 22, 2016

National Library of Korea Cataloging In Publication (CIP)

Manual for Research and Publication Ethics in Science and Engineering / Eun Seong Hwang,
Eun Hee Cho, Young-Mog Kim, Kibeom Park, Wha-Chul Son, Tae-Woong Yoon, Jeong Mook Lim
[Authors]. -- Seoul: Korean Federation of Science and Technology Societies, 2016
p. ; cm

ISBN 978-89-5938-345-0 93190 : Not for sale

Science and engineering
Ethics
Research and development

195.94-KDC6
174.95-DDC23 CIP2016000472

http://dx.doi.org/10.6087/manual_ethics_2016_01

Amount of print copies: 1,000

This book was supported by the Korean Government (2015).

This book is printed on acid-free paper.

Manual for Research and Publication Ethics in Science and Engineering

Eun Seong Hwang, Eun Hee Cho, Young-Mog Kim, Kibeom Park,
Wha-Chul Son, Tae-Woong Yoon, Jeong Mook Lim

KOFST
THE KOREAN FEDERATION OF SCIENCE AND TECHNOLOGY SOCIETIES

AIMS & SCOPE, TARGETED READERS, LIMITATIONS, AND USE

Aims & scope

This manual covers a wide range of issues regarding research and publication ethics in science and engineering, and written to raise South Korea and other Asian countries' standards of research and publication ethics in the sciences up to the international level.

Targeted readers

This manual is for anyone interested in scientific research or journal editing: in other words, researchers or students in the sciences, journal editors, editorial staff members, publishers, manuscript editors, statistical editors, peer reviewers, employees of journal publishing houses, librarians, etc. Authors or journalists who write professionally on scientific topics or members of the public who are interested in research and publication ethics are well suited to join the audience as well. But, this manual is also helpful to the students who are performing scientific researches and writing research articles.

Level of content

This manual will be most helpful to scientific researchers, managers of journals, and the readers of those journals. In order to fully understand the contents, one must have at least submitted or evaluated a research paper, or must be currently involved in journal-related work. But, this manual is also helpful to scientists and students at any level once they are performing researches and writing research articles.

Limitations

This book addresses the international standards of ethics and the level of ethics of ordinary South Korean researchers and citizens as of 2014. Because ethics may evolve over time, it would be hasty to conclude that the contents of this manual will forever indicate the correct standard. As time passes, more appropriate standards of ethics may be proposed for certain circumstances.

Use

Anyone may use the contents of this manual for research purposes by disclosing sources according to the Creative Commons Attribution License. This manual may be especially useful in workshops for editors, manuscript editors, and journal article reviewers and contributors. When citing parts of this manual, we recommend citing the original works listed in the reference section.

Expected time for comprehension

At least one hour; at most 96 hours

CONFLICT OF INTEREST AND DISCLAIMER

Conflict of interest

The authors have no conflict of interest with any of the agencies discussed in this manual.

Disclaimer

- **Liability**
  Neither the publisher nor the authors will be legally liable for the material presented here. In addition, they cannot guarantee the accuracy, completeness, or usefulness of the information provided.

- **Privacy/confidentiality policy**
  Personal information is protected by the Privacy Protection Act of the South Korean government, and no personal information shall be collected. Using personal information for commercial or criminal purposes is prohibited.

- **Endorsement**
  This manual does not endorse any products. The opinions written here shall not be used for the advertisement or endorsement of products.

- **Accuracy of information**
  Because information evolves continuously, this manual does not guarantee the accuracy of information.

- **Disclaimer**
  Neither the publisher nor the authors will be legally liable for any of the contents, so readers must keep this premise in mind when reading this manual.

- **Advertisement**
  This manual does not handle advertisements for commercial enterprises.

PREFACE

Manual for research and publication ethics in science and engineering

With the development of world class research infrastructure in East Asian countries such as Japan, Korea, China and Taiwan, high quality research is conducted, producing internationally-recognized findings. In other Asian countries, science and technology are also undergoing rapid development, and research outcomes are being actively discussed domestically. The dissemination of results is central to research, and scientists are seeking to have their work read and cited as widely as possible, usually through internationally acclaimed scientific journals. Editors of domestic academic journals have also been making efforts to internationalize their journals to publicize their papers and researchers to an international audience. International exposure increases the number of citations of a researcher's work. At the same time, however, research is also open to greater scrutiny, and flaws in the research process are more widely open to criticism. While most flaws are unintentional, in some cases, deliberate breaches of scientific integrity have been identified. A researcher's advancement in science is not achieved solely through publication of a large body of work in internationally recognized journals. A scientist needs to adopt good research practices. Conducting and publishing research with integrity is key to the genuine advancement of science, of an individual, a country, and humanity.

Recently, the demand for guidelines on research and publication ethics has increased in Korean academic society. Research and publication ethics has always been considered an area that researchers learned from experience or through one-on-one interactions with mentors. However, most researchers now think there should be formal instruction of the common guidelines for research practices. The authors share this view and have noted in their teaching experience that a decent number of scientists think they have not received the necessary exposure to ethics and research guidance, and thus had insufficient time to fully embrace research integrity. It also appears that unlike in the past, different fields of research allow varying practices, resulting in confusion in establishing standards and values of research integrity that are important to science.

We believe such a phenomenon rings true in other Asian countries as well. In light of this situation, we, the authors, have published a research and publication ethics manual in Korean and distributed the book and its PDF file to universities and research institutions nationwide. The publication was immediately received with an enthusiastic welcome from the Korean

academic society and has since become a companion for scholars devoted to conducting research with high integrity. The purpose of translating this manual into English is to reach other Asian researchers to assist in establishing and promoting appropriate standards of research ethics in the broader Asian scientific community.

This manual presents guidelines for good research practices for scholars in most fields of science and engineering. The following aspects of research and publication ethics are discussed:

- Key principles for ethical conduct and standards in research;
- Research misconduct and inappropriate research practices;
- Ethical guidelines for editors to follow during the publication process, including: writing, submission, editing, and reviewing stages;
- Instructions on the use of CrossCheck to screen for plagiarism;
- Guidelines for institutions on handling cases of research misconduct;
- Instructions for identifying and resolving conflicts of interest;
- Ethical principles and practical guidelines for studying human and animal subjects; and
- Concepts of research integrity and guidelines for its practice in laboratories.

This manual is also intended to be a:

- Reference for researchers to ensure integrity while undertaking research and writing papers;
- Reference for universities, institutions, and academic societies when addressing ethical issues related to their members' research and as guidelines for practicing good research standards; and
- Textbook or basic reference material for a class on research ethics for science and engineering students.

It is our great pleasure to provide readers of this manual with up-to-date international standards on research and publication ethics.

Eun Seong Hwang, Ph.D.
Chair, Committee for Publication Ethics, Korean Council of Science Editors

MAIN PURPOSES OF THE MANUAL

Purpose of publication

- This manual provides a reference for individual researchers to prevent any violation of research ethics should the need to make an ethical decision arise while researching or writing a research report.
- This manual can help an institution's Research Integrity Committee or Investigation Committee, journal editors, members of a publication committee or research ethics committee, etc. make decisions or follow-up measures for actual cases that impinge upon research and publication ethics.
- This manual provides the basic materials needed for developing a program on research misconduct prevention and research ethics education.

The design of the manual

- This manual explains in detail the "Guidelines to Research Ethics" of the Ministry of Education and "The Basic Principles of Research Ethics Regulations" of the Ministry of Science, ICT & Future Planning to help researchers and staff.
- Since basic principles and procedures are already handled in "The Understanding and Practice of Research Ethics" of the Ministry of Science and Technology or under each institution's code of research ethics, this manual has strived to promote the understanding of research ethics standards.
- In addition, this manual has gone beyond merely suggesting standards regarding research ethics—it has introduced issues to review before making a judgment on research misconduct, the basic virtues any researcher should have internalized before practicing research ethics, and actual factors needed to secure research integrity, along with real-life cases.
- Chapter 2 handles the guidelines researchers and agencies should refer to when making a decision on research misconduct and inappropriate research practices.
- Chapter 3 lays down guidelines for the publication of journals or research papers.
- Chapter 4 features the investigation and procedures for handling research misconduct.
- Chapter 5 presents guidelines on precautions and solutions regarding conflicts of interest that may arise during research.
- Chapter 6 deals with bioethics needed for research targeting humans and animals and the basic issues and procedures to keep in mind for conducting proper research.
- Chapter 7 explains the background of concepts and principles that may not be directly relevant but are nevertheless needed for the establishment of research ethics. Through this chapter, the authors of the manual hope to help researchers internalize research integrity and also help them learn research ethics.

INTRODUCTION TO AUTHORS

Authors

Eun Seong Hwang | Chair of the Committee on Publication ethics, Korean Council of Science Editors; Department of Life Science, University of Seoul, Seoul, Korea (eshwang@uos.ac.kr)
http://orcid.org/0000-0001-8580-8444

Eun Hee Cho | Vice-chair of the Committee on Publication ethics, Korean Council of Science Editors; Department of Biology Education, Chosun University, Gwangju, Korea (ehcho@chosun.ac.kr)

Young-Mog Kim | Member of the Committee on Publication ethics, Korean Council of Science Editors; Department of Food Science & Technology, Pukyong National University, Busan, Korea (ymkim@pknu.ac.kr)

Kibeom Park | Member of the Committee on Publication ethics, Korean Council of Science Editors; Division for Innovation Policy Research, Science & Technology Policy Institute, Sejong-Si, Korea (soli@stepi.re.kr)

Wha-Chul Son | Member of the Committee on Publication ethics, Korean Council of Science Editors; Global Leadership School (Philosophy), Handong Global University, Pohang, Korea (phtechhd@gmail.com)

Tae-Woong Yoon | Member of the Committee on Publication ethics, Korean Council of Science Editors; School of Electrical Engineering, Korea University, Seoul, Korea (yoon.tw@gmail.com)

Jeong Mook Lim | Member of the Committee on Publication ethics, Korean Council of Science Editors; Department of Agricultural Biotechnology, Seoul National University, Seoul, Korea (limjm@snu.ac.kr)

Translators

Yunhee Whang and Jocelyn Graf | Compecs Inc., Seoul, Korea

Manuscript Editors

Hye-Min Cho and Hee-Kyung Chung | Infolumi, Seongnam, Korea

Layout Editor

Kyoung-Mi Jung | Academya, Anyang, Korea

CONTENTS

CONTENTS

1

Research Ethics in Science and Engineering

I. Scope of Research Ethics

1. General guidelines for scientific research

In modern society, science is no longer practiced within the ivory tower only for the pure joy of discovering the truth. More and more academic scientists are receiving payment or financial assistance as a reward for their research. Some scientists are becoming wealthy from the monetary value of their intellectual property. In other words, research not only promotes the prestige of scientists for their academic achievement, but has also become an important source of financial gain. This has resulted in increasing pressure on scientists to achieve significant research accomplishments. The rapidly increasing number of scientists has also resulted in growing competition for research ideas and funding. Meanwhile, research that had never been imagined in the past, such as human genome project, is now pursued. Furthermore, because research is being conducted by teams of scientists, from a few to dozens under one head scientist, it has become more important than ever to closely supervise the research.

These changes have occurred as the result of an increase in the number of scientists and the expansion of the scope of research fields. In the past, there were fewer scientists than now; these scientists followed purely conventional ways of practicing scientific research, but now these norms are being replaced for practical reasons and convenience. Consequently, there is a growing need to emphasize the general principles and standards of research ethics.

Considering these contexts, scientists should fully understand and practice the "Principles for ethical conduct in research" proposed by David B. Resnik and considered as essential in the science and engineering fields internationally. In 1998, Resnik first proposed 12 principles for ethical conduct. Later, in 2009, the 12 principles were republished after modifications were made according to the current ethical issues of that time. In the principles published in 2009, issues of intellectual property, respect for colleagues and test subjects, and resource management were emphasized. While principles of ethical conduct based on research integrity were emphasized in the 1998 version, principles based on respect for scientists and resources were emphasized in the 2009 version. Rather than disregarding the principles of 1998 as history, both sets of principles should be understood and implemented. Accordingly, the principles of both 1998 and 2009 are introduced below.

Principles for ethical conduct in research, 1998 [1]

① **Honesty**: Scientists should not fabricate, falsify, or misrepresent data or results. They should be objective, unbiased, and truthful in all aspects of the research process.

② **Carefulness**: Scientists should avoid errors in research, especially in presenting results. They should minimize experimental, methodological, and human errors and avoid self-deception, bias, and conflicts of interest.

③ **Openness**: Scientists should share data, results, methods, ideas, techniques, and tools. They should allow other scientists to review their work and be open to criticism and new ideas.

④ **Freedom**: Scientists should be free to conduct research on any problem or hypothesis. They should be allowed to pursue new ideas and criticize old ones.

⑤ **Credit**: Credit should be given where credit is due but not where it is not due… Responsibility and credit should be viewed as two sides of the same coin; a person should be given credit for a piece of research only if they can take responsibility for it (Kennedy 1985).[2]

⑥ **Education:** Scientists should educate prospective scientists and insure that they learn how to conduct good science. Scientists should educate and inform the public about science.

⑦ **Social responsibility**: Scientists should avoid causing harm to society and they should attempt to produce social benefits… Scientists have an obligation to conduct socially valuable research, to participate in public debates, to give expert testimony (if asked), to help make science policy, and to debunk junk science.

⑧ **Legality**: In the process of research, scientists should obey the laws pertaining to their work… Laws pertain to many different aspects of research, including the use of hazardous and controlled substances, the use of human and animal subjects, the disposal of wastes, hiring practices, the appropriation of funds, and copyrights and patents (PSRCR 1992).[3]

⑨ **Opportunity**: Scientists should not be unfairly denied the opportunity to use scientific resources or advances in the scientific profession… Scientists should not discriminate against colleagues or prospective colleagues on the basis of race, sex, national origin, nationality, age, or other characteristics not directly related to scientific competence (Merton 1973).[4]

---

[1] Resnik DB. The ethics of science: an introduction. London: Routledge; 1998. p. 48-65. This section is a direct quote from the book, and all citations within it are as cited in Resnick's text.
[2] Kennedy D. On academic authorship. Stanford, CA: Stanford University Press; 1985.
[3] Panel on Scientific Responsibility and the Conduct of Research (PSRCR). Responsible science. Vol. 1. Washington, DC: National Academy Press; 1992.
[4] Merton RK. The sociology of science: theoretical and empirical investigations. Chicago: University of Chicago Press; 1973.

⑩ **Mutual respect**: Scientists should treat colleagues with respect… The principle implies that scientists should not harm one another, either physically or psychologically, that they should respect personal privacy, that they should not tamper with each other's experiments or results, and so forth.

⑪ **Efficiency**: Scientists should use resources efficiently… Research that could probably be reported in one paper is sometimes divided up into three, four, or five papers. Additionally, scientists also sometimes use the same results for several different papers simply by making some minor changes in writing or presentation. Both of these practices can be regarded as unethical because they waste the scientific community's resources (Huth 1986).[5]

⑫ **Respect for subjects**: Scientists should not violate rights or dignity when using human subjects in experiments. Scientists should treat non-human, animal subjects with appropriate respect and care when using them in experiments.

Guidelines for ethical research conduct, 2009[6]

① **Honesty**: Honestly report data, results, methods and procedures, publication status, research contributions, and potential conflicts of interest. Do not fabricate, falsify, or misrepresent data in scientific communications, including grant proposals, reports, and publications (Pellegrino 1992, Resnik 1996a.b).

② **Objectivity**: Strive for objectivity in experimental design, data analysis, data interpretation, peer review, personnel decisions, grant writing, expert testimony, and other aspects of research where objectivity is expected or required.

③ **Openness**: Share data, results, ideas, tools, materials, and resources. Be open to criticism and new ideas.

④ **Confidentiality**: Protect confidential communications, such as papers or grants submitted for publication, personnel records, business or military secrets, and records that identify individual research subjects and patients.

---

[5] Huth EJ. Irresponsible authorship and wasteful publication. Ann Intern Med 1986;104:257-9.
[6] Shamoo AE, Resnik DB. Responsible conduct of research. New York: Oxford; 2009. p. 28. Printed with permission from David B. Resnik.

⑤ **Carefulness**: Avoid careless errors and negligence; carefully and critically examine your own work and the work of your peers. Keep good records of research activities, such as data collection, research design, consent forms, and correspondence with agencies or journals. Maintain and improve your own professional competence and expertise through lifelong education and learning; take steps to promote competence in science as a whole.

⑥ **Confidentiality**: Protect confidential communications, such as papers or grants submitted for publication, personnel records, business or military secrets, and records that identify individual research subjects and patients.

⑦ **Carefulness**: Avoid careless errors and negligence; carefully and critically examine your own work and the work of your peers. Keep good records of research activities, such as data collection, research design, consent forms, and correspondence with agencies or journals. Maintain and improve your own professional competence and expertise through lifelong education and learning; take steps to promote competence in science as a whole.

⑧ **Respect for colleagues**: Respect colleagues, students, and subordinates. Do not harm colleagues; treat them fairly. Do not discriminate against colleagues on the basis of sex, race, ethnicity, religion, or other characteristics not related to scientific qualifications. Help to educate, train, mentor, and advise the next generation of scientists.

⑨ **Respect for intellectual property**: Honor patents, copyrights, and other forms of intellectual property. Do not use unpublished data, methods, or results without permission. Give credit where credit it is due. Do not plagiarize.

⑩ **Respect for the law**: Understand and comply with relevant laws and institutional policies.

⑪ **Respect for research subjects**: Show proper respect and care for animals when using them in research. Do not conduct unnecessary or poorly designed animal experiments. When conducting research on human subjects, minimize harms and risks and maximize benefits; respect human dignity, privacy, and autonomy; take special precautions with vulnerable populations; and distribute fairly the benefits and burdens of research.

⑫ **Stewardship**: Make good use of human, financial, and technological resources. Take care of materials, tools, samples, and research sites.

⑬ **Social responsibility**: Promote good social consequences and prevent bad ones through research, consulting, expert testimony, public education, and advocacy.

⑭ **Freedom**: Research institutions and governments should not interfere with freedom of thought and inquiry.

2. Research integrity: The most important value in scientific research

When conducting research, scientists must exhibit a more professional mindset toward achieving excellence rather than simply complying with the basic principles of research ethics under a passive mindset. In other words, scientists must strive for research integrity. Research integrity does not simply mean integrity of research data. Research integrity is a comprehensive term including the scientist's diligence and honesty, and it must be implemented throughout the entire research process. "Integrity in Scientific Research,"[7] published by the US National Academy of Sciences, defines research integrity (individual level) as follows:

> For the individual scientist, integrity embodies above all a commitment to intellectual honesty and personal responsibility for one's actions and to a range of practices that characterize the responsible conduct of research, including
>
> - intellectual honesty in proposing, performing, and reporting research;
> - accuracy in representing contributions to research proposals and reports;
> - fairness in peer review;
> - collegiality in scientific interactions, including communications and sharing of resources;
> - transparency in conflicts of interest or potential conflicts of interest;
> - protection of human subjects in the conduct of research;
> - humane care of animals in the conduct of research; and
> - adherence to the mutual responsibilities between investigators and their research teams.

[7] Committee on Assessing Integrity in Research Environments, National Research Council, Institute of Medicine. Integrity in scientific research: creating an environment that promotes responsible conduct [Internet]. Washington, DC: National Academies Press; 2002. Box 1, Integrity in research (individual level); [cited 2015 Dec 15]; p. 5. Available from: http://www.ncbi.nlm.nih.gov/books/NBK208712/pdf/Bookshelf_NBK208712.pdf

II. Characteristics of Research in Science and Engineering

In comparison to research in the humanities and the social sciences, research in science and engineering has the following characteristics:

1. Collaborative research

When a number of scientists conduct research as a team, conflicts may arise during the research process or while publishing the research results. These conflicts often lead to research misconduct and result in the loss of research integrity. Accordingly, the principal investigator has the very important role of supervising the entire research process. At times, the principal investigator may initiate research misconduct, as seen in Woo Suk Hwang's 2005 stem cell research misconduct case. On the other hand, because the majority of research in science and engineering is conducted in a collaborative manner, many, including the principal investigator are listed as authors of the research paper published in a journal. This is different from research practices in the humanities, in that in the humanities, especially in literature, history, and philosophy, a student generally becomes the sole author of the research paper because it is generally believed that the development of thinking in writing is extremely important in the production of a research paper, and so including the academic advisor as an author of a paper that is based on the student's writing is deemed inappropriate.

2. Laboratory research

Scientists conduct experiments and spend the majority of their day within the restricted space of the laboratory. This may promote the development of intellectually valuable relationships among scientists; however, it can also result in serious conflicts due to limitations of space or stress from interpersonal relationships. The lead scientist must be aware of such possibilities and manage the lab environment accordingly.

3. Diversity in experimental results

Various experiments and methods of measurement are used in science and engineering research. Failure to understand the principles and usage of the equipment may cause errors during the interpretation of the results. Additionally, equipment malfunction may result in data

distortion. The lead researcher and the other researchers must be mindful of such possibilities and ensure that data is managed accurately and meticulously.

4. Keeping lab notebooks

In contrast to humanities and social sciences research, where there is a narrower range of types of experiments and research methods and where ongoing follow-up is not required, research in science and engineering requires a lab notebook for recording the details of the experiment. Keeping a lab notebook is crucial not only for data management, but also as the researcher's proof of participation in performing the experiment.

5. Data processing

Various types of equipment and methods are used in science and engineering research. The resulting raw data can also be presented in many forms such as numbers, photographs, and plots. Scientists collect and process the data appropriately to present them in a clear, persuasive format; however, distortion of the truth may result, whether it is intentional (data fabrication and exaggeration) or unintentional (error).

6. Large scale research expenditure

For humanities and social sciences research, research expenditures are generally limited to the labor costs for a couple of researchers and some research expenses. In contrast, research in science and engineering requires greater labor costs as well as materials and equipment and activity expenses. This results in a higher probability of misuse of research funds. Therefore, the principal investigator's responsibility in managing research funds is extremely important.

7. Conflict in the research results

The results of science and engineering research are not only published as a paper, but often result in acquisition of a patent or transfer of technology, both having monetary value. Because a number of scientists are involved in the research, conflicts may arise in determining the order of scientists as authors and whether their names will be registered or not. An even greater conflict may result when money is involved, as in the case of acquisition of patents or transfer of technology. Such conflicts often result in permanently hostile relationships and may even divide

scientists into different social groups. If this keeps up, scientists will be heading in a negative direction that will not advance the cause of scientific research and development.

8. Research on living subjects

Research in science, engineering, and social sciences sometimes involves humans as test subjects. In the past, research subjects have been known to receive unethical or unfair treatment and in some cases, damage to their health. Today, direct harm to test subjects has decreased. Instead, scientists face new problems, such as leakage of personal information. For this reason, research using human subjects is thoroughly regulated under the Institutional Review Board (IRB) of the researcher's institution. Research using animals is under the supervision of the Institutional Animal Care and Use Committee. It is important for scientists to show respect for research subjects, whether humans or animals, and to make sure they are not unnecessarily abused or harmed.

In comparison to research in the humanities and social sciences, these characteristics represent the complexity of research in science and engineering. The cause of such complexity lies in the fact that research misconduct results from the problems that arise from various experiments and the participation of many scientists, as well as the impact, both direct and indirect, on human life.

III. Issues of Research Ethics in Science and Engineering in Korea

It is uncertain how much research misconduct occurs in Korea, for the number of cases of suspected misconduct has not been properly counted, and there are no institutions responsible for such a function. According to Korean Ministry of Education data, 169 cases of research misconduct have reportedly occurred in 35 universities in Korea from 2008 to 2012,[8] which translates to one case per university each year. However, it is estimated that the actual number of cases is much greater.

According to Ministry of Education data, plagiarism (60%) tops the list of types of research misconduct, followed by unethical assignment of authorship (20%), redundant publication (11%), ghostwriting (6%), and forgery (4%). Meanwhile, according to the results of an online questionnaire "Research ethics, how far have we come?" conducted by the Center for Research Ethics Information and the Biological Research Information Center (BRIC)[9] in January 2013, 42% of Korean researchers were concerned about the issue of research ethics. For the scientists, the main concerns were, in order of importance, (1) copyright of the author (41%), (2) data processing (20%), (3) record keeping (13%), and (4) bioethics (9%).[10] There is a high probability that the majority of the respondents were young researchers of science and engineering representing life sciences, for BRIC is a community through which graduate students in the field of biological science and young scholars share information. Consequently, the results of this questionnaire can be viewed as reflecting the characteristics of research ethics of science and engineering. In a general sense, publication ethics-related issues such as plagiarism and inappropriate authorship is one of the major challenges in research ethics that Korean scientists are faced with regardless of discipline.

The following are unethical practices which occur frequently in Korea. Because Korean academia is especially susceptible to such practices, science and engineering researchers in Korea must be extra vigilant to prevent even the appearance of research misconduct.

---

[8] Jang YJ. Dishonorable acts account for 86% of violations of university research ethics during the past 5 years. Share Channel News [Internet]. 2013 Oct 31 [cited 2015 Dec 15]. Available from: http://www.e-nanoom.com/news/articleView.html? idxno=620

[9] Biological Research Information Center. A non-profit Korean web community designed to provide information on biological research. Young scientists majoring in the field of biology frequently join the site.

[10] Center for Research Ethics Information/Biological Research Information Center. Research ethics, how far have we come? SciON, 2013.1.23-30 [Internet]. Pohang: BRIC; 2013 [cited 2015 Dec 15]. Available from: http://bric.postech.ac.kr/scion/ survey/result.php?PID=236&STA=1

1. Problems in research paper publication

Duplicate publication and exaggeration of accomplishments | Redundant publication, which duplicates the work of previous similar research is one of the most frequent cases of unethical practice in Korea.

Inappropriate authorship | The common practice of listing of people who had not actually contributed to the research as authors started to decrease in 2006 after unethical authorship was included in the governmental guideline as one of research misconduct. However, with the increasing emphasis on one's research accomplishments in today's society, to include people who do not deserve to be granted proper authorship of a paper seems to be on the rise among medical professionals, businessmen, and government officials who are pursuing scholarly title for the sake of their job. In contrast, graduate students or postdoctoral researchers, who should receive appropriate recognition for their contributions, are being sacrificed due to unethical authorship. In addition to the cases mentioned above, occasionally the principal investigator's misjudgment may threaten the authors' rights.[11]

Media manipulation | After the incident involving scientist Woo Suk Hwang,[12] the number of cases are decreasing in which research results that have not yet received scientific verification from peer review are presented through a press conference or newspaper article by scientists seeking fame or profit, but such cases have not completely disappeared.

2. Problems during the research process

Data integrity is at the core of research integrity. To achieve data integrity, scientists must be cautious at all stages of the experiment and investigation. Not only must the research plan be thoroughly designed in the initial stage, but data must be properly recorded and stored before, during, and after the experiment. However, the importance of taking such prudent measures is

---

[11] Kim HM. Ewha Womans University, "controversies of Nature article author" seem to continue. The Kyunghyang News [Internet]. 2012 Jul 23 [cited 2015 Dec 15], It has not been clearly stated in http://news.khan.co.kr/kh_news/ kh an_art_view.html?artid=201207231815381&code=940202, but it has been reported that there are possibilities the student has been unjustly denied authorship. Meanwhile, on the same day, *The Korea Times* has reported that Ewha Womans University has decided the students deserve rights of co-authorship and has requested that the *Nature* journal make the corresponding modifications. Park MS. Ewha Womans University, "Nature acknowledges the co-authorship of graduate student in Professor Nam Goo-hyun's paper." The Korea Times [Internet]. 2012 Jul 23 [cited 2015 Dec 15]. Available from: http://news.hankooki.com/lpage/society/201207/h2012072323161321950.htm

[12] Kim DR. Hwang Woo Suk puts media manipulation before research. Oh My News [Internet]. 2006 Sep 27 [cited 2015 Dec 15]. Available from: http://www.ohmynews.com/NWS_Web/View/at_pg.aspx?CNTN_CD=A0000303778. The article points out that the cloned cow Yeongrong-i announced by researcher Woo Suk Hwang in the press has not actually been published as a paper.

often not much emphasized during research mentoring or education.

Fabrication of data | Even after the disclosure of Woo Suk Hwang's fabrication of data in his retracted *Science* papers in 2005, research papers involving intentional deception continue to be discovered. Prominent examples are fabrication of data in *Nature Chemical Biology* by professor Kim of KAIST in 2006[13] and in the works of professor Kang of Seoul National University in 2012.[14] Meanwhile, papers are often withdrawn due to the discovery of inadvertent mistakes, negligence, and self-deception. In the case of unintentional errors where the errors occurred during the data processing and proposal stage, the authors themselves generally announce their errors and retract the paper and therefore are not severely criticized; however, such cases still have a ripple effect in the scientific world due to the confusion caused by the distorted data.

Insufficient research record keeping | It is extremely important to preserve the raw data from an experiment and maintain detailed records of all the research. Even today, however, good record keeping and management by the scientists are still lacking. One of the allegations of research misconduct frequently reported to committees on research integrity is submitting the research of others, particularly the study results of a contract research service, as their own graduate thesis. Scientists must keep accurate records of their data and maintain proper research notebooks to be ready to prove their research results as their own.

3. Laboratory life and collaborative research activity

Conflicts in the laboratory | Various problems are likely to occur when a number of people work together in a laboratory or office for an extended period of time. A prime example is conflict among laboratory members. According to a 2006 survey of graduate students studying life sciences, half of the active biology laboratories in Korea struggle with conflicts that negatively affect their research.[15]

Poor mentoring | The relationship between the mentor and the mentee is very important in research. Mentors can greatly impact the mentee not only during the research process, but also after the research is completed. However, although quite rare, there have been cases in Korea in

[13] Dolgin E. Korean scientist fired for fraud. The Scientist [Internet]. 2008 Mar 3 [cited 2015 Dec 15]. Available from: http://www.the-scientist.com/?articles.view/articleNo/26181/title/Korean-researcher-fired-for-fraud

[14] Stokes TL. Korean stem cell investigation expands to another researcher, and more papers. Retraction Watch [Internet]. 2012 Jun 8 [cited 2015 Dec 15]. Available from: http://retractionwatch.com/2012/06/08/ korean-stem-cell-investigation- expands-to-another-researcher-and-more-papers/

[15] University of Seoul. 47th evaluation of academic advisor/research director by graduate students/researchers studying science. SciON, 2006.11.21-11.30 [Internet]. Pohang: BRIC; 2006 [cited 2015 Dec 15]. Available from: http://bric.postech.ac.kr/scion/survey/result.php?STA=1&PID=169

which the mentors abuse their power not as an advisor, but as an authority figure. In such situations, mentees are generally forced to yield to the mentors. Sometimes the mentee then seeks revenge against the mentor by engaging in acts of research misconduct. Therefore, the academic advisor or the principal investigator must acknowledge the graduate students or the scientists not as workers to be exploited, but as the future generation of scientists and treat them with respect and with appropriate guidance. Meanwhile, the research institution must continually ensure that the mentor provides proper mentoring, guarantees a safe laboratory environment, and protects whistleblowers.

4. Ethics of research on living subjects

Initial review | Research on living subjects must undergo review by the IRB and the IACUC and approval must be received before research begins. However, many scientists are not clear on which experiments must undergo initial review as research on living subjects, and on whether their methods are ethically acceptable.

Informed consent | Before using humans as test subjects, informed consent from the human subjects must be obtained appropriately. Informed consent signifies that adequate information was provided to the subjects and that consent was voluntarily given. This also includes developing appropriate research procedures.

IV. Policy and the Current State of Research Ethics in Korea

1. Progress of research ethics policy

Systematic discussion regarding research ethics and verification of research integrity began after the stem cell research fabrication incident in 2005. An investigation committee was formed and carried out an investigation of the duplicitous research of Dr. Hwang, but there was much confusion during the process regarding the investigating body, the principles and procedure of investigation, and how to proceed after the investigation. Consequently, the need for a governmental research ethics system was proposed. The previous Ministry of Science and Technology had taken the lead by establishing guidelines for research ethics and integrity, and promulgating, in February of 2007, the "Guidelines for Assurance of Research Ethics" as article 236 in the Ministry of Science and Technology. This remains the foundation of research ethics in Korea.

Subsequently, articles concerning research ethics were added to the Framework Act on Science and Technology regarding government-sponsored research and development projects and to the Academic Promotion Act regarding academic research. Additionally, a regulatory system was established as required by the enforcement decrees, regulations of the Ministry of Sciences, ICT, and Future Planning, and regulations of the Ministry of Education.

In addition to establishing the Guidelines for Ensuring Research Ethics, the previous Ministry of Science and Technology also focused on establishing guidelines for writing lab notebooks and on amending regulations regarding co-management of nationally sponsored research and development projects. The previous Ministry of Education [16] and the National Research Foundation of Korea [17] promoted activities to increase awareness and education of research ethics by proposing and encouraging the establishment of a research ethics code, case studies, and research ethics activities in academic societies. Focusing on the need for ethics concerning biomedical research on human subjects and embryo research, the Ministry of Health and Welfare initiated an amendment to the Bioethics and Safety Act and enhancement of responsibilities of the National Bioethics Committee. The Ministry of Culture amended the copyright law and strengthened their system of managing copyrighted materials.

---

16 Ministry of Education (MOE) [Internet]. Sejong: MOE; [cited 2015 Dec 15]. Available from: http://english.moe.go.kr/enMain.do

17 The National Research Foundation of Korea (NRF) [Internet]. Daejeon: NRF; [cited 2015 Dec 15]. Available from: http://www.nrf.re.kr/nrf_eng_cms/

When the Ministry of Education and the Ministry of Science and Technology were consolidated in 2008, the administrative department of research ethics was established. Subsequently, a basic scheme of research ethics was formulated, followed by a more comprehensive policy such as raising awareness of research ethics, establishing guidelines for plagiarism and duplicate publication, and establishing a Center for Research Ethics Information Center (http://www.cre.or.kr/). Currently, matters concerning research ethics are administered by the Academic Promotion Division of the Ministry of Education. Support programs for research ethics activities are continuously promoted through periodic surveys and fora on the national and institutional status of research ethics implementation and practice.

2. Current status of implementation of institutional internal evaluation systems

Government guidelines require that along with basic principles and procedures of verification of research integrity, organizations of government-funded research and development projects must implement self-regulation with regard to research ethics. According to 2010 figures, over 80% of Korean four-year universities and over 90% of government-funded research institutions have established their own verification system such as regulations on research ethics and research integrity committees (Table 1).

Table 1. Status of establishment of internal research ethics valuation system per time period [18]

Period of enactment	University	Academic society	Government-funded research institution
Before 2007	19 (10.6%)	82 (18.1%)	20 (55.6%)
2007	80 (44.4%)	190 (41.9%)	8 (22.2%)
2008	59 (32.8%)	137 (30.2%)	5 (13.9%)
After 2009	22 (12.2%)	45 (9.9%)	3 (8.3%)
Total	180 (100%)	454 (100%)	36 (100%)
Not yet enacted	35	16	4

Through such activities, cases of research misconduct have been identified each year. In universities, the number of research misconduct cases officially handled by the Investigation Committee was 18 in 2007, 32 in 2008, and 48 in 2009 and 2010 together. [19]

[18] Lee WY. Investigation and analysis study of current status of research ethics activity. Daejeon: National Research Foundation of Korea; 2011. p. 22.
[19] *ibid*. p. 38.

Government guidelines only apply to government-funded research and development projects; however, the institutional research ethics evaluation system developed by each research institution applies to all research conducted by its members, including student graduate theses.

3. Trends in science and technology

Beginning with the stem cell research fabrication incident, and following the government's systematization efforts, the science and technology professional associations have also begun to show interest in the professional and social responsibility of scientists and engineers. Together with the Korean Academy of Science and Technology, the National Academy of Engineering, and the Korean National Commission for UNESCO, the Korean Federation of Science and Technology Societies proposed the Scientists and Engineers Code of Ethics in 2007. Since the code of ethics and establishment of regulations were first systemized in 2008, almost all academic societies have come to uphold regulations regarding research ethics.

In addition, with the initiatives of the Korean Association of Medical Journal Editors (KAMJE, http://kamje.or.kr), the interest in publication ethics has heightened among academic journals, which has led to the establishment of the Korean Council of Science Editors (KCSE, http://www.kcse.org). Since these two organizations regularly offer publication ethics training programs targeting the editors of academic journals, good research practice is expected to spread among academic journals published in Korea.

References

Center for Research Ethics Information/Biological Research Information Center. Research ethics, how far have we come? SciON, 2013.1.23-30 [Internet]. Pohang: BRIC; 2013 [cited 2015 Dec 15]. Available from: http://bric.postech.ac.kr/scion/survey/result.php?PID=236&STA=1

Committee on Assessing Integrity in Research Environments, National Research Council, Institute of Medicine. Integrity in scientific research: creating an environment that promotes responsible conduct [Internet]. Washington, DC: National Academies Press; 2002. Box 1, Integrity in research (individual level); [cited 2015 Dec 15]; p. 5. Available from: http://www.ncbi.nlm.nih.gov/books/NBK208712/pdf/Bookshelf_NBK208712.pdf

Dolgin E. Korean scientist fired for fraud. The Scientist [Internet]. 2008 Mar 3 [cited 2015 Dec 15]. Available from: http://www.the-scientist.com/?articles.view/articleNo/26181/title/Korean-researcher-fired-for-fraud

Huth EJ. Irresponsible authorship and wasteful publication. Ann Intern Med 1986;104:257-9.

Jang YJ. Dishonorable acts account for 86% of violations of university research ethics during the past 5 years. Share Channel News [Internet]. 2013 Oct 31 [cited 2015 Dec 15]. Available from: http://www.e-nanoom.com/news/articleView.html?idxno=620

Kennedy D. On academic authorship. Stanford, CA: Stanford University Press; 1985.

Kim DR. Hwang Woo Suk puts media manipulation before research. Oh My News [Internet]. 2006 Sep 27 [cited 2015 Dec 15]. Available from: http://www.ohmynews.com/NWS_Web/View/ at_pg.aspx?CNTN_CD=A0000303778

Kim HM. Ewha Woman's University, "controversies of Nature article author" seem to continue. The Kyunghyang News [Internet]. 2012 Jul 23 [cited 2015 Dec 15]. Available from:http://news.khan.co.kr/kh_news/khan_art_view.html?artid=201207231815381&code=940202

Lee WY. Investigation and analysis study of current status of research ethics activity. Daejeon: National Research Foundation of Korea; 2011.

Merton RK. The sociology of science: theoretical and empirical investigations. Chicago: University of Chicago Press; 1973.

Ministry of Education (MOE) [Internet]. Sejong: MOE; [cited 2015 Dec 15]. Available from: http://english.moe.go.kr/enMain.do

The National Research Foundation of Korea (NRF) [Internet]. Daejeon: NRF; [cited 2015 Dec 15]. Available from: http://www.nrf.re.kr/nrf_eng_cms/

Panel on Scientific Responsibility and the Conduct of Research (PSRCR). Responsible science. Vol. 1. Washington, DC: National Academy Press; 1992.

Park MS. Ewha Woman's University, "Nature acknowledges the co-authorship of graduate student in Professor Nam Goo-hyun's paper." The Korea Times [Internet]. 2012 Jul 23 [cited 2015 Dec 15]. Available from: http://news.hankooki.com/lpage/society/201207/ h201207232316132195 0.htm

Resnik DB. The ethics of science: an introduction. London: Routledge; 1998.

Shamoo AE, Resnik DB. Responsible conduct of research. New York: Oxford; 2009.

Stokes TL. Korean stem cell investigation expands to another researcher, and more papers. Retraction Watch [Internet]. 2012 Jun 8 [cited 2015 Dec 15]. Available from: http://retractionwatch.com /2012/06/08/korean-stem-cell-investigation-expands-to-another-researcher-and-more-papers/

University of Seoul. 47th evaluation of academic advisor/research director by graduate students/ researchers studying science. SciON, 2006.11.21-11.30 [Internet]. Pohang: BRIC; 2006 [cited 2015 Dec 15]. Available from: http://bric.postech.ac.kr/scion/survey/result.php?STA =1&PID=169

2

Research Misconduct and Inappropriate Research Practices

I. Scope and Meaning of Research Misconduct

1. Scope

According to the Guidelines for Assurance of Research Ethics[1] of the Ministry of Education and the Rules for Research Ethics Assurance and Prevention of Scientific Misconduct[2] of the Ministry of Science, ICT, and Future Planning, the types of research misconduct include "fabrication," "falsification," "plagiarism," "unjustified authorship," and "other acts that deviate from the acceptable range in each academic field," as well as "intentional intervention in investigation of suspected acts of one's own or others' misconduct, or acts of harming a whistleblower."

"Fabrication, falsification, and plagiarism" are acts of research misconduct as defined by the United States Federal Guidelines and universally characterized as the most basic acts of misconduct. In Korea, the act of "unjustified authorship" was also included in this list in order to abolish such acts through strict regulations, for it has been the most prevalent type of misconduct in Korea.

"Acts that deviate from the acceptable range in an academic field" and "research through other unjustified means" have a comprehensive meaning that can regulate acts of research misconduct on their own. These actions have been added to the definition to deal with cases where acts of misconduct are difficult to define precisely or to address new and ambiguous forms of misconduct that may occur in the future.

"Plagiarism" is clearly a representative act of research misconduct, while "self-plagiarism" and "duplicate publication" are not usually included in the acts of research misconduct. Some countries, however, include them in the acts of research misconduct, and in the case of Korea, a public hearing occurred in June 2015 on whether we should define "self-plagiarism" and "duplicate publications" as acts of research misconduct, and consequently, such activities are expected to be included in the acts of research misconduct soon. Even nowadays, duplicate publication is regarded as a highly inappropriate act and is subject to a severe level of disciplinary measures.[3]

---

[1] Ministry of Education, Science and Technology Instructions, No. 260. Guidelines for Assurance of Research Ethics (enacted Aug. 1, 2012, revised section).

[2] Ministry of Science, ICT and Future Planning Ordinance, No. 6. Rules Regarding Management of National Research and Development Projects (enacted Aug. 5, 2013).

[3] On June 26, 2009, the National Research Foundation of Korea took measures to restrict researchers who had engaged in duplicate publication as well as data duplication from participating in any national research and development projects (Park GH. Paper plagiarism. 2: Extracted from national project plan of professor Kim Cheol-ho of Sungkyunkwan University. Seoul News [Internet]. 2009 Jun 27 [cited 2015 Dec 15]. Available from: http://www.seoul. co.kr/news/newsView.php?id= 20090627008018).

2. Intent of the regulation of research misconduct

It is important to know why research misconduct is a significant issue in science. "Fabrication" and "falsification" distort the truth and deliver inaccurate information to other researchers; accordingly, other researchers may be greatly wronged, and advancement of the development of science might also be hindered. "Plagiarism" does not distort the data, but instead, overstates the researcher's accomplishment by using the stolen work of others. "Unjustified authorship" also misrepresents the work of researchers.

The fundamental problem of research misconduct is that such action destroys the trust and sense of team spirit among fellow researchers. Misconduct in research threatens to undermine the foundation of science since the advance in science is based on the trust among the members of the science community. Misconduct in research undermines the foundation of science, which is based on the "integrity of scientists." "Acts that deviate from the acceptable scope in each academic field" may be determined by how greatly they damage the trust and sense of team spirit among fellow researchers.

Research misconduct is different from "unintentional or accidental distortion and irregularities," in that the misconduct is deliberate. The intentional aspect of the misconduct is the reason why the guidelines of the Ministry of Education accentuate the disciplinary measures for research misconduct; in fact, the majority of institutions impose disciplinary measures according to the degree of research misconduct.[4]

[4] For example, Seoul National University has expelled Professor Woo Suk Hwang, who fabricated his stem cell research paper in 2006 and has dismissed a person who engaged in other research misconduct from the College of Veterinary Medicine in 2012 (Cho WI. Dismissal of professor Kang Soo-kyung of Seoul National University engaged in fabrication of 17 articles. Hankooki.com [Internet]. 2013 Mar 8 [cited 2015 Dec 15]. Available from: http://news.hankooki.com/lpage/society/ 201303/h2013030821055721950.htm).

II. Fabrication and Falsification of Data

1. Fabrication of data

Fabrication is the act of inventing data or results without actually measuring them or acquiring them through investigation. The following case of inserting arbitrary numbers despite the absence of measurement at the 1 hour and 3 hour points in time is an example of fabrication of data.

Original data

Repetitions	Measured values		
	1 hour	3 hours	5 hours
#1	Not measured	Not measured	17
#2	Not measured	Not measured	20

Fabrication of data at 1 and 3 hours ➔

Data published

Repetitions	Measured values		
	1 hour	3 hours	5 hours
#1	4	10	17
#2	6	11	20

Fig. 1. Example of data fabrication.

Other examples of data fabrication are: (1) not measuring the control group and just assigning arbitrary numbers to the control group after the experiment, (2) entering similar numbers to retain statistical significance, and (3) using data or images from other past research of their own or of others and presenting them as newly discovered data.

2. Falsification of data

Data falsification is manipulating research materials, equipment, or procedures, or changing or omitting data without reasonable justification such that the results are not accurately reflected. The following example is a representative case of data falsification in which the numbers at the 3 hour point in time have been changed so that the data is arranged in a linear growth pattern.

Other broadly similar examples of data falsification include: (1) unjustified modifications to the data records in lab notes, (2) reporting fraudulent details of experimental procedures, materials, and figures in research proposals and articles, and (3) dishonest presentation of the study content in an abstract for an academic presentation.

Original data

Repetitions	Measured values		
	1 hour	3 hours	5 hours
#1	5	3	17
#2	7	2	20

Falsification of data at 3 hours

Data published

Repetitions	Measured values		
	1 hour	3 hours	5 hours
#1	5	10	17
#2	7	11	20

Fig. 2. Example of data falsification.

In terms of usage, there is no need to distinguish between data 'fabrication' and data 'falsification'; they are the same, in that they present nonexistent data as true.

III. Plagiarism

1. Definition of plagiarism

Dictionaries define plagiarism as "copying words or ideas of another person and presenting them as one's own original work." Plagiarism includes the following two acts: "taking" the work of another person and adding onto one's work, and "deceiving the public" by presenting these results as if they are one's own independent work.

Meanwhile, the Guidelines for Research Ethics of the Korean Association of Academic Societies define plagiarism as, "**copying or paraphrasing the entire text or parts of others' work without giving appropriate credit**"; however, this is an extremely ambiguous definition of plagiarism, for it can be assumed that reusing another person's work is acceptable if appropriate credit is given. In fact, the majority of cases where the work of others is copied verbatim with credit given should be considered acts of plagiarism.

Using more than one sentence word-for-word from another person's work is generally considered unacceptable, and even a single sentence must be cited to disclose that it is not the author's own work. This is the agreement of the editors of the World Association of Medical Editors (WAME), who have broad experience in editing international academic journals.[5] Thus this should be accepted as the international standard and appropriate practice in the academic world.

Unintentional or accidental plagiarism is still considered plagiarism | Often, students who have poor writing ability and who do not know proper citation practices engage in plagiarism. Even scholars who have experience with writing papers make the mistake of incorporating information or ideas they gained from other sources and failing to properly acknowledge the original sources of their writing. Whether unintentional or accidental, such cases cannot avoid being labeled as plagiarism.

Copyright infringement | Plagiarizing another person's work can be considered an act of copyright infringement. Even when the text that is plagiarized is not very long, if the plagiarized section includes the important parts of the author's work that reflects his or her creative efforts, it is

[5] On the web forum of the World Association of Medical Editors (WAME) on November 18, 2006, when Mary Ellen Kerans (coordinator, Mediterranean Editors & Translators) noted that "medical journal editors are indeed highly tolerant of one-sentence copying, provided the reference is given. Nevertheless, one-sentence copying creates problems in writing cohesion, and is to be avoided," Diana Mason (Editor-in-Chief, *American Journal of Nursing*) remarked, "I do agree with Mary Ellen." and other editors also mentioned their agreement (WAME-Listserve [discussion list on the Internet]. World Association of Medical Editors; 2006 Nov 18 [cited 2015 Dec 15]. Available from: http://www.wame.org/ appropriate-use-of-of-other-authors2019-sentences).

likely to be adjudicated not only as plagiarism but also as copyright infringement. Serious consequences follow a conviction of copyright infringement; in most cases, reparations to be paid to the copyright holder is much higher than any financial benefit obtained from the act of plagiarism, and in some serious cases, a jail sentence may be imposed.[6]

Case of copyright infringement without plagiarism | Reusing and citing images from the work of others may not be considered plagiarism when the researcher provides appropriate citations. However, the researcher must receive permission to use the illustrative material from the publisher who possesses the copyright to the paper, image, or book. For instructions on the correct use of illustrative material, refer to section E, 'Plagiarism of Data' of this manual.

Case of plagiarism without copyright infringement | Copyrights are only valid during the lifetime of the author and 50 years after the death of the author; after this period, the work belongs in the public domain. Using works in the public domain does not fall under copyright infringement; it is considered publicly available information. However, the issue of plagiarism may still be raised because the majority of scientific papers remain as theories and not as widely accepted knowledge even after the death of the author. Furthermore, even if a theory becomes accepted knowledge, passing off someone else's expression or idea as one's creative work falls under plagiarism.[7]

2. Types of plagiarism

1) Idea plagiarism

Using the opinion, research idea, method, or system of analysis, or the organization of the paper and its results without appropriate credit is a form of idea plagiarism. Idea plagiarism often occurs among researchers writing a paper for the first time, during the process of writing the introduction. When the researcher develops ideas proposed in another paper while explaining the background information of his research topic in the introduction, if he does not cite the original sources, readers may mistake the argument as that of the researcher, which then results in idea plagiarism.

A more serious form of idea plagiarism is the act of taking the hypothesis or the main idea from the work of another person and presenting the paper as if he or she is the first person to come up

[6] The case can be confirmed in the following article (Jeong JY. Court orders "50 million won compensation for substitution of authors of paper". Segye News [Internet]. 2008 Aug 13 [cited 2015 Dec 15]. Available from: http://www. segye.com/content/html/2008/08/13/20080813002762.html).

[7] Lee IJ. Research misconduct. In: Hwang ES, Song SS, Lee IJ, Park K, Sohn WC. Understanding and practice of research ethics. Daejeon: National Research Foundation of Korea; 2011. p. 96.

with it. Such a paper is generally rejected for publication for the reason that reviewers do not find "creativity or novelty" of discovery in the paper. However, if the reviewers are not aware of the existing paper, it may still be published without the plagiarism detected; such a case would raise the issue of idea plagiarism.

Another frequently occurring form of idea plagiarism is taking credit for the ideas picked up from academic conference or personal communication. In this case, a phrase such as "John F Weinberg, personal communication" must be inserted in the pertinent place in the paper to give credit for the idea of another person.

Reviewers may receive ideas helpful to their own research through reviewing papers or research proposals of others. However, it is inappropriate for the reviewer to cite such material in his or her paper; to avoid conflict of interest, they must not administer the review of submitted papers relevant to their own research. If the reviewer learns an idea from reviewing and wants to use it, the proper way to do it while sustaining trust among researchers is to cite the idea after the research under review is published.

2) Text plagiarism

A. Duplication (verbatim plagiarism; copying)

1 **Senescence suppressors: their practical importance in replicative lifespan extension in stem cells** Cell. Mol. Life Sci. (2014) 71:4207–4219

Late passage MSCs express smaller amounts of homing receptors [8, 9] dropping down the efficacy of therapy.

Replicative senescence becomes more problematic when cell therapy is considered for aged individuals for whom the practice would be in greater demand. BMSCs from older human donors have a lower growth rate and capacity as well as decreased potential for differentiation [10–13]. The decreased proliferation is due to an increase in gate-keeping tumor suppressor activity and likely functions in reducing the incidence of cancer in aging tissues, but it also causes a decrease in regenerative capacity [14, 15]. This would certainly impose a limitation on the applicability of stem cell therapy in aged donors.

Replicative senescence may simply be viewed as an outcome of the chronic activation of DNA damage response triggered from short and deformed telomeres. p53-Rb and p53-Rb2 (probably functions more importantly than p53-Rb in human MSC), gate-keeping tumor suppressor pathways, play central roles in senescence imposition by linking damage sensing and execution of cell cycle arrest [17–19]. DNA damage is exacerbated by reactive oxygen species (ROS), and ROS-mediated single-strand breaks in telomeres have been shown to cause earlier imposition of senescence [16]. ROS are produced at a high level by damaged mitochondria, causing even higher levels of damage [20]. Thus, the cellular ROS level increases

2 **Determinants of Stem Cell Life Span** An imaginary paper

This number of cells is reached after 27 doublings from a single cell, which consumes a large portion of the proliferative potential. Even if the population does not reach the end of its life span, many cells in the late passage population show slow proliferation and express a senescence phenotype

Replicative senescence becomes more problematic when cell therapy is considered for aged individuals for whom the practice would be in greater demand. BMSCs from older human donors have a lower growth rate and capacity, as well as decreased potential for differentiation (7-9). The decreased proliferation is due to an increase in gate-keeping tumor suppressor activity and likely functions in reducing the incidence of cancer in aging tissues, but it also causes a decrease in regenerative capacity (10, 11). In addition, as cells approach the end of their life span, their differentiation, in general, tends to undergo an "osteogenic to adipogenic shift" (or adipogenic switch), the phenomenon of a loss of osteogenic potential combined with a gain in adipogenesis (3, 5, 7-9). These would certainly impose a limitation on the applicability of stem cell therapy in aged donors.

p53-Rb, the gate-keeping tumor suppressor pathway, plays a central role in DNA damage response by linking damage-sensing and execution of cell cycle arrest (13, 14). DNA damage is known to be exacerbated by ROS. A number of genes that function in the damage response pathways have been shown to be involved in the modulation of the lifespan of fibroblasts and MSCs. In addition, a variety of chemicals and physical means were shown to cause a substantial increase in the

Fig. 3. Example of duplication.[8]

Duplication is the act of using a majority of another person's work word-for-word. Most duplication without appropriate citation is an intentional act of misconduct.

B. Inappropriate paraphrasing/summarizing

When introducing the work of another person, a writer must make use of paraphrasing (changing the words and structure while maintaining its meaning) and summarizing (condensing the information), so that another person's idea is introduced without copying it word-for-word. Appropriate citations to the idea are still required in the pertinent section.

Paraphrasing | Examples of inappropriate and appropriate paraphrasing. [9]

① **Original Passage:** All of our organs and tissues are comprised of cells, and the aging of our bodies is believed to be caused by the aging of these cells. In organs, cells die out for various reasons, and the dead ones are replaced with new ones. However, cells in an aged body appear to have low potential to duplicate themselves, and therefore, the dead ones cannot be easily replaced. This leads to shrinkage and loss of organ function.

- ES Hwang, "Mechanism of Aging" (2015, an imaginary paper)

② **Example of inappropriate paraphrasing:** Organs and tissues such as the stomach, kidneys, and bones are made up of cells, and our aging is thought to be caused by the aging of these cells. In our body, cells are frequently lost and replenished. However, the cells in an aged body are found to replicate slowly or stop dividing. For this reason, not all the lost cells are replaced. This would lead to reduction in size and function of organs (Hwang, 2015).

③ **Example of appropriate paraphrasing:** The aging of cells in our organs is believed to cause atrophy and the decline of organ function, which are the reasons our bodies age. When we are young, dying cells are rapidly replaced by new ones. However, as we age, cells gradually lose the potential to duplicate and dead ones are not readily replaced, leading to a decrease in the number of cells in an organ (Hwang, 2015).

---

[8] A 1997 research article, "Cancer chemopreventive activity of resveratrol, a natural product derived from grapes" (Science 1997;275:218-20) have been duplicated in two sections of the Results and Discussion (underlined section) of an almost identical study "Chemoprevention of *Scutellaria bardata* on human cancer cells and tumorigenesis in skin cancer" (Phytother Res 2007;21:135-41), excluding the drug name 'resveratrol.' There are not many cases of such duplication of the results section in science and engineering research papers. Meanwhile, an even more egregious case of duplication can be seen in "Effects of microgravity and of hypergravity on aging and longevity of insects" (Korean J Biol Sci 2000; 4:231-7), which has taken the entire work of "A review of the effects of microgravity and of hypergravity on aging and longevity" (Exp Gerontol 1999;34:319-36) published in 1999 as if it were the author's own.

[9] This is a hypothetical situation based on the writings of Eun Seong Hwang.

In the example of inappropriate paraphrasing in Section B, Inappropriate paraphrasing / summarizing, the structure of the original passage is maintained and only a few words are changed. This cannot be objectively viewed as a newly created passage. Such a situation occurs when one writes the paper in a hurry and takes the passage of another person's work verbatim in a so-called cut-and-paste manner; it is the result of poor conversion of the work and idea of others into one's own expression.

In the example of appropriate paraphrasing, not only the words, but also the entire sentence structure, are changed. A writer must be able to completely understand the works and ideas of others and convert them into his or her own thoughts (as if explaining to a more junior scholar) when introducing another person's work. Only through this process, can the writer create his or her own piece while using the work of another person.

A writer is naturally bound to introduce the results or arguments of another person's work while writing the introduction of the paper. In such a situation, the writer must remember to practice appropriate paraphrasing by understanding the information and changing the words using his or her own expressions. Writers must adopt the habit of continuous paraphrasing and familiarize themselves with such forms of writing.

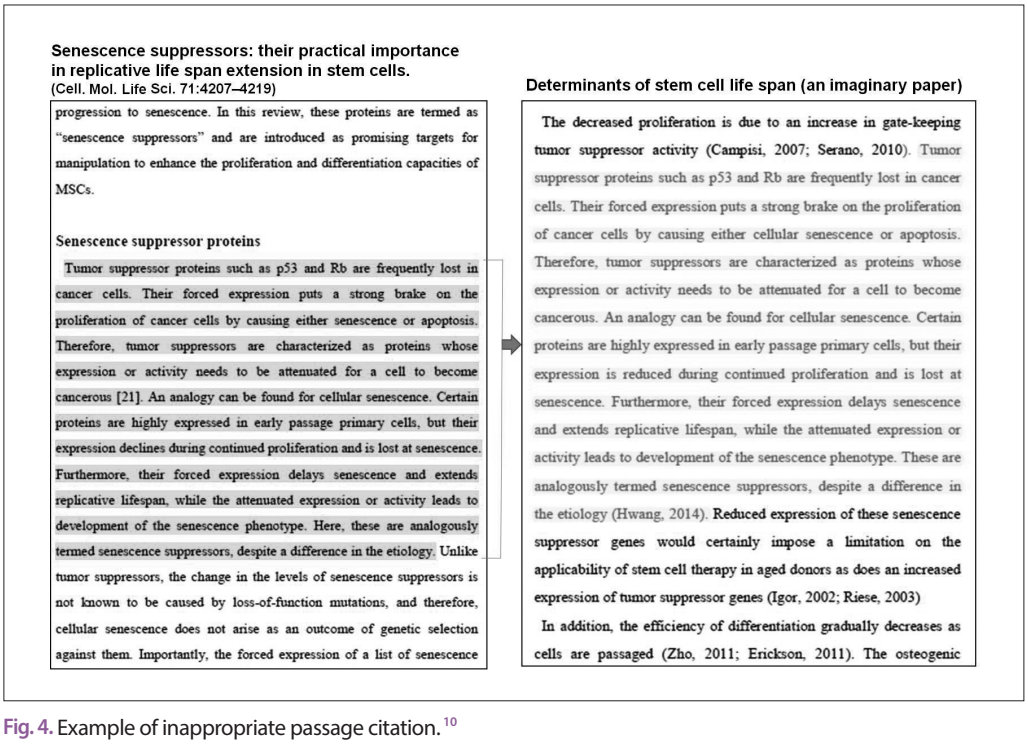


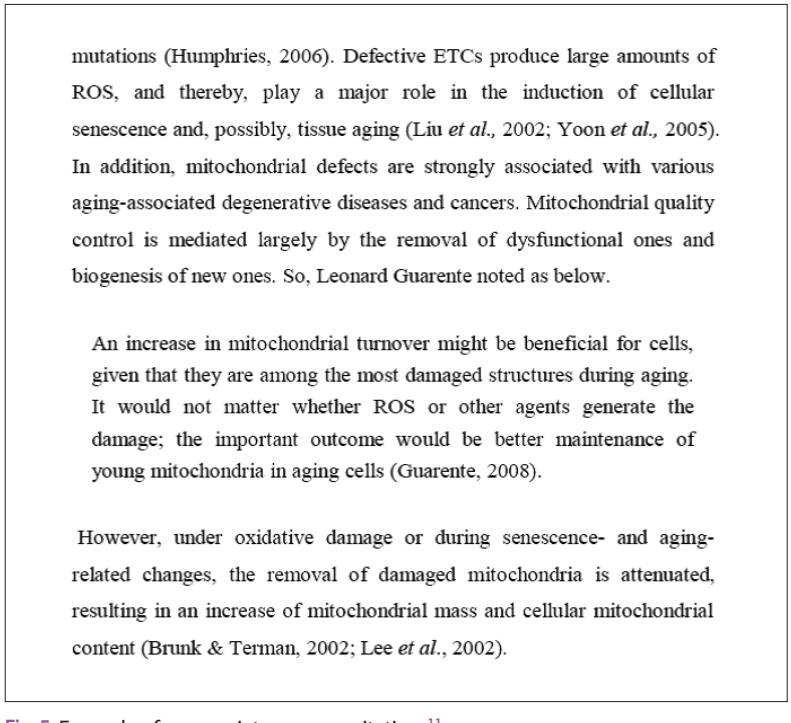
Fig. 4. Example of inappropriate passage citation.[10]

C. Inappropriate passage citations

A writer may think that there is no problem with taking an entire passage of text from another person's work word-for-word if credit is given at the end; however, in most cases, such cases are plagiarism.

In the example above, the right passage (highlighted in yellow) is basically copied word-for-word from the passage on the left (highlighted in blue) with a footnote at the very end to acknowledge the source.

In fact, this form of writing is indeed plagiarism because the added footnotes do not precisely indicate the location of the original passage. Readers will not be able to determine whether the citations refer only to the last passage followed by the footnote or to the entire passage above after the previous citation. Consequently, if the author leads the reader to believe that the passages are his/her own creations, then this author has engaged in the act of taking credit for another person's work.



mutations (Humphries, 2006). Defective ETCs produce large amounts of ROS, and thereby, play a major role in the induction of cellular senescence and, possibly, tissue aging (Liu *et al.,* 2002; Yoon *et al.,* 2005). In addition, mitochondrial defects are strongly associated with various aging-associated degenerative diseases and cancers. Mitochondrial quality control is mediated largely by the removal of dysfunctional ones and biogenesis of new ones. So, Leonard Guarente noted as below.

> An increase in mitochondrial turnover might be beneficial for cells, given that they are among the most damaged structures during aging. It would not matter whether ROS or other agents generate the damage; the important outcome would be better maintenance of young mitochondria in aging cells (Guarente, 2008).

However, under oxidative damage or during senescence- and aging-related changes, the removal of damaged mitochondria is attenuated, resulting in an increase of mitochondrial mass and cellular mitochondrial content (Brunk & Terman, 2002; Lee *et al.*, 2002).

Fig. 5. Example of appropriate passage citation.[11]

[10] This is a hypothetical situation based on the writings of Eun Seong Hwang.
[11] This is a hypothetical situation based on the writings of Eun Seong Hwang.

One must be fully aware of the appropriate method of citing passages when introducing the work of another person. As in the example of appropriate passage citation, the extracted passage can be clearly differentiated from the author's work by the use of indentation or quotation marks. As a result, the reader will not be confused between the excerpted passage and the current author's work. Additionally, citations must appear at the end of the passage used.

Passage citation is used when citing the work of another person and maintaining its original connotations is necessary. It is commonly used in the humanities and social science, but rarely in scientific papers, as there is rarely a need to retain the feelings and connotations of the original author.

D. Comprehensive citation

We will use the term "comprehensive citation" to describe a single representative citation in the beginning or at the end of the passage instead of including individual citations for each text. This is technically a form of plagiarism because, similar to the above example of inappropriate passage citations, readers cannot differentiate between the extracted passage and the author's own work; each part of the original passage must be individually cited.

> The majority of this passage has been written referencing the work of H. Smith (2015).

E. Plagiarism of data

Plagiarism of data is also an act of taking credit for another person's data (image, table, figure, etc.). This falls under the act of data fabrication because the researcher has not produced the data himself through experiments or research. Similarly, reusing the researcher's own previously published data irrelevant to the current topic cannot be exactly viewed as plagiarism, but is nonetheless an act of data fabrication.

Meanwhile, there are situations that require the introduction of another person's data. For example, when developing an idea in a review paper, it is much more effective to include data such as images and graphs presented in another's research paper and explain each component. In that case, the data can be used and presented with permission from the copyright holder. The researcher can download the 'Request for permission to reproduce published material' form from the journal homepage with the published paper and obtain permission after filling out the form and sending it to the publisher or the journal editor. The journals also recommend permission from the original author, which is an important procedure to show respect for the intellectual efforts of the original author.

3. Citation

There are many important components to a paper, such as the creative ideas, analysis system, logic, hypothesis, theory, and conclusion of the author. If the researcher has come up with or developed his ideas based on the work and ideas of others, providing citations so that the author receives the appropriate recognition for his contribution is a sign of respect for the fellow researcher who originally generated the idea or content.

Another role for references in papers and books is to provide the readers with the sources of much more extensive information than just the information provided in the author's own work. If the reader tracks down each reference and studies them thoroughly, he or she should be able to grasp the hypothesis of the paper as well as all its relevant theories rather than merely reading one article. In other words, readers can obtain much more comprehensive knowledge and information than from just the material provided within the paper.

4. Citation formatting and style guide

Citation formatting and style guide differ by the type of academic journal and university; in universities, in particular, it is up to the author, as there is no specific style guide. Basically, journal citations require the name of the author, the year of publication, article title, and the title, volume,

- Reference to personal communication or information obtained at a conference: …(John Weinberg, personal communication)
- Reference to data or information derived from oneself or a co-author: …(John Weinberg, unpublished data)
- Information to be presented in a paper already submitted for publication or that the author intends to submit: …(John Weinberg, in preparation, or John Weinberg, to be published elsewhere)
- Information to be presented in a paper that is about to be published: …(John Weinberg, in press in Nature (DOI #))
- Citing a student's graduate thesis: (based on the thesis submitted by GD Hong for a Ph.D. degree, University of Seoul, Seoul, Korea, 2011)
- Citing web material: "Shanker, T. (2011, July 6). Pentagon weighs strategy change to deter terror. *The New York Times* online edition. Two examples retrieved July 24, 2011 from http:// www.nytimes.com/2005/07/05/politics/05strategy. html?pagewanted=all&r=0' or World Health Organization Homepage. Retrieved July 17, 2011 from http:// www.who.int/en (Must include the date when the site was accessed)

and page number(s) of the journal. Book citations require the title of the chapter used, book title, publisher, year of publication, and location of the publisher.

Unpublished data or information must also be indicated with a citation. Reference to the contents presented by the speaker of a conference must also be cited. Failure to do so results in idea plagiarism. The following cases are examples of citation commonly used in various situations.

When citing secondary sources, that is, introducing the work of a third party cited in the referred primary source, it is inappropriate to only cite the third party as if one has read the original work when one has not done so. However, if the original text is unavailable, there must be a specific reference to a secondary source. This is not common in papers of science and engineering, but the following method is usually used for such citations.

- J. Weinberg (1972, as cited in Lee and Leonard, 2009) suggested that…
- It was suggested that the Earth is composed of carbon and minerals (Weinberg, 1972, as cited in Lee and Leonard, 2009).
- It was suggested that the Earth is composed of carbon and minerals [[3] as cited in [4]].
- It was suggested that the Earth is composed of carbon and minerals [[4], translation of [3]].

Academic journals provide information on the appropriate citation rules and formatting in the "Guide to Authors" or "Instructions to Authors."

IV. Unethical Practices Nearly Identical to Research Misconduct

1. Self-plagiarism (text recycling) and redundant publication (duplicate publication)

1) Definition and scope

Self-plagiarism is the reuse of a small portion of one's own published research in a new article or book. Because the term self-plagiarism sounds awkward, the term "text recycling" is more frequently used.

Redundant publication (duplicate publication) is publication of an article that is similar or identical to one's previously published works. Compared to self-plagiarism, which reuses only a small portion of the text, redundant publication reuses the same material on a much larger scale. There are many cases of redundant publication in which, particularly, the research objectives, methods, conclusion, and logical flow are quite similar.

The most common form of redundant publication is duplication of data. An example is presenting five different data in one paper and reusing three of them as results in another paper. Because the same data are used, much of the results and discussion sections inevitably overlap. Additionally, because the overall conclusions are similar, the arguments made in the papers are inevitably similar, and so not much new information is derived from the subsequent paper. Due to the overlapping data and text, problems of copyright infringement can also be involved.

Nevertheless, if only the most important portion of text (a few sentences) of one's previously published paper is reused for re-emphasis and is appropriately cited, it may be considered as acceptable. The extent of reuse allowable differs across different academic fields.

Guideline number 4 in the Guidelines for Research Ethics of the Korean Association of Academic Societies defines redundant publication as "an author using academic works identical or similar to his or her own previous research results… without proper citations of the other journals or works." This is not an accurate definition, for overuse of past works is an inappropriate practice even when proper citations are used. On the other hand, Seoul National University's Guidelines for Research Ethics defines research misconduct as "the act of relying upon the

[12] Chapter 2, Article 12, Clause 5. In: Seoul National University. Seoul National University guidelines for research ethics. Rev. ed. Seoul: Seoul National University; 2010.

research idea, research data, and text of one's previously published works, which tarnishes the originality of the research (regardless of whether references or citations are used)," [12] which is an accurate description. [12]

2) Problems of self-plagiarism and duplicate publication

Self-plagiarism and duplicate publication are not technically plagiarism because they do not steal the work of another person; however, using portions of one's previously published works is not only a copyright infringement against the first publisher, but also a depreciation of one's own work. Furthermore, it is dishonorable to increase the number of publications of one's research by producing trivial journal articles of little value.

In addition, self-plagiarism and duplicate publication waste the time and effort of fellow researchers by making them read or review papers having little informative value. They also damage the trust among researchers by raising confusion. Redundant publication also causes errors of duplicated evidence of a certain effect in current meta-analyses methods. For this reason, the majority of academic journals request that papers submitted "contain new research results that have not been published in the past." The magazine *Nature* provides a thoughtful discussion on this point.

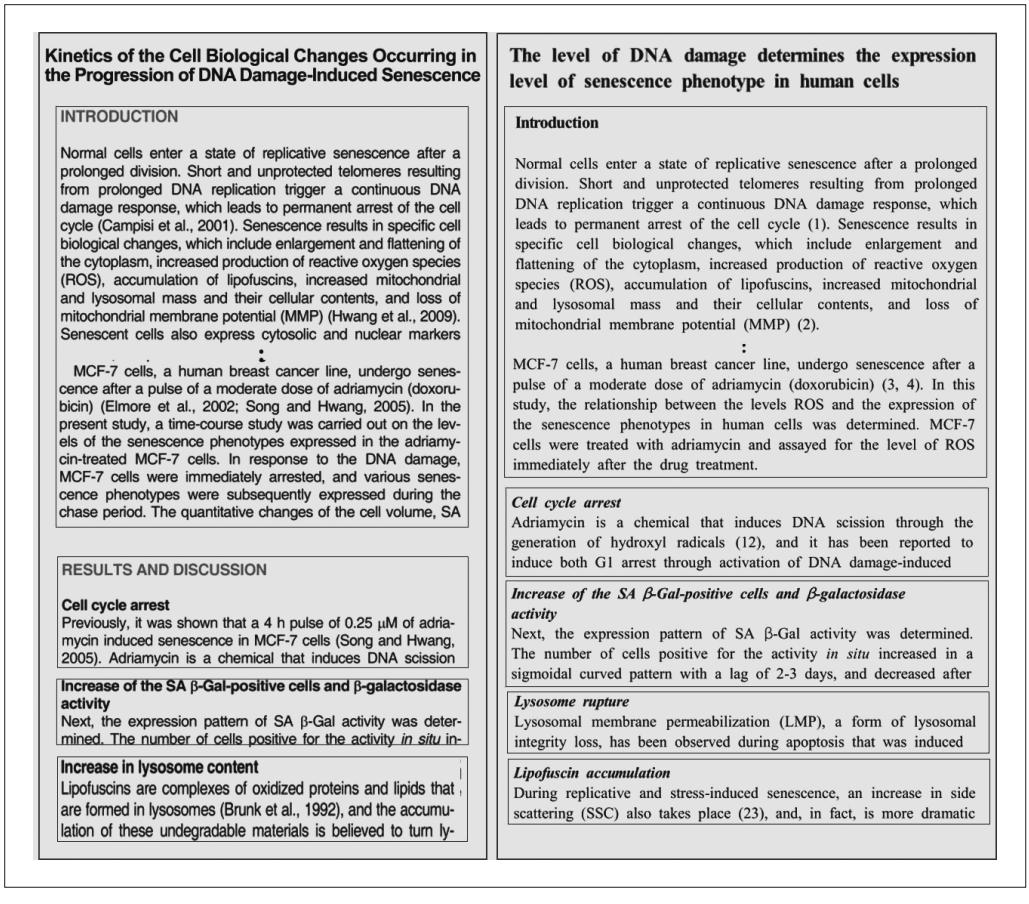
> "Many researchers say that republication without citation violates the premise that each scientific paper should be an original contribution. It can also serve to falsely inflate a researcher's CV by suggesting a higher level of productivity. And although the repetition of the methods section of a paper is not necessarily considered inappropriate by the scientific community, "we would expect that results, discussion and the abstract present novel results"
>
> **(Nature 2010, 468, p. 745)**

3) Types of duplicate publications

A. Common forms of duplicate publication

The first type of duplicate publication is consecutive publication of journal articles using identical subjects and the effects measured with the same method but with slightly different treatment. Although the results are partially different, the research outline is retained; consequently, these papers have a substantial amount of overlapping text and data. Production of a representative paper and subsequent publications of similar papers fall under this form of duplicate publication.

The example below comprises an actual journal article (left) that investigates the biological changes in a cell caused by drug treatment that damages the cell (left), and a hypothetical article (right) suggesting that the level of free oxygen radicals known to be formed by this drug determines the degree of biological changes in a cell. The second paper barely has any independent new information, has an almost identical form of idea development in the introduction, the same research method, and a substantial amount of overlapping results (three of the results have identical titles).[13]



Kinetics of the Cell Biological Changes Occurring in the Progression of DNA Damage-Induced Senescence

INTRODUCTION

Normal cells enter a state of replicative senescence after a prolonged division. Short and unprotected telomeres resulting from prolonged DNA replication trigger a continuous DNA damage response, which leads to permanent arrest of the cell cycle (Campisi et al., 2001). Senescence results in specific cell biological changes, which include enlargement and flattening of the cytoplasm, increased production of reactive oxygen species (ROS), accumulation of lipofuscins, increased mitochondrial and lysosomal mass and their cellular contents, and loss of mitochondrial membrane potential (MMP) (Hwang et al., 2009). Senescent cells also express cytosolic and nuclear markers

⋮

MCF-7 cells, a human breast cancer line, undergo senescence after a pulse of a moderate dose of adriamycin (doxorubicin) (Elmore et al., 2002; Song and Hwang, 2005). In the present study, a time-course study was carried out on the levels of the senescence phenotypes expressed in the adriamycin-treated MCF-7 cells. In response to the DNA damage, MCF-7 cells were immediately arrested, and various senescence phenotypes were subsequently expressed during the chase period. The quantitative changes of the cell volume, SA

RESULTS AND DISCUSSION

Cell cycle arrest

Previously, it was shown that a 4 h pulse of 0.25 μM of adriamycin induced senescence in MCF-7 cells (Song and Hwang, 2005). Adriamycin is a chemical that induces DNA scission

Increase of the SA β-Gal-positive cells and β-galactosidase activity

Next, the expression pattern of SA β-Gal activity was determined. The number of cells positive for the activity *in situ* in-

Increase in lysosome content

Lipofuscins are complexes of oxidized proteins and lipids that are formed in lysosomes (Brunk et al., 1992), and the accumulation of these undegradable materials is believed to turn ly-

The level of DNA damage determines the expression level of senescence phenotype in human cells

Introduction

Normal cells enter a state of replicative senescence after a prolonged division. Short and unprotected telomeres resulting from prolonged DNA replication trigger a continuous DNA damage response, which leads to permanent arrest of the cell cycle (1). Senescence results in specific cell biological changes, which include enlargement and flattening of the cytoplasm, increased production of reactive oxygen species (ROS), accumulation of lipofuscins, increased mitochondrial and lysosomal mass and their cellular contents, and loss of mitochondrial membrane potential (MMP) (2).

⋮

MCF-7 cells, a human breast cancer line, undergo senescence after a pulse of a moderate dose of adriamycin (doxorubicin) (3, 4). In this study, the relationship between the levels ROS and the expression of the senescence phenotypes in human cells was determined. MCF-7 cells were treated with adriamycin and assayed for the level of ROS immediately after the drug treatment.

Cell cycle arrest

Adriamycin is a chemical that induces DNA scission through the generation of hydroxyl radicals (12), and it has been reported to induce both G1 arrest through activation of DNA damage-induced

Increase of the SA β-Gal-positive cells and β-galactosidase activity

Next, the expression pattern of SA β-Gal activity was determined. The number of cells positive for the activity *in situ* increased in a sigmoidal curved pattern with a lag of 2-3 days, and decreased after

Lysosome rupture

Lysosomal membrane permeabilization (LMP), a form of lysosomal integrity loss, has been observed during apoptosis that was induced

Lipofuscin accumulation

During replicative and stress-induced senescence, an increase in side scattering (SSC) also takes place (23), and, in fact, is more dramatic

Fig. 6. Example of common form of duplicate publication.

[13] Kinetics of the cell biological changes occurring in the progression of DNA damage-induced senescence. Mol Cells 2011;31:539-46 (left), hypothetical text written in the form of an article by taking portions of the original paper (right). A similar case can be seen in the following two papers: *Salviae miltiorrhizae* radix increases dopamine release of rat and pheochromocytoma PC12 cells. Phytother Res 2006;20:191-9; and *Salvae miltiorrhizae* BGE radix increases rat striatal K(+)-stimulated dopamine release and activates the dopamine release with protection against hydrogen peroxide-induced injury in rat pheochromocytoma PC12 cells. Neurochem Res 2006;31:109-20.

B. Salami publication (segmented publication)

Salami publication is publishing two or more articles using the same research design and data originally derived from a single study. An example would involve publishing five parameters measured from a single research design that examined 10 parameters and drew a conclusion on the effect of a drug on diabetes in an endocrinology journal, and publishing the other five in a geriatric journal. Because a complete and accurate conclusion can only be drawn when all of the 10 original parameters are analyzed together, dividing and publishing the data in portions weakens the arguments of each paper. To prevent this reduction in quality, part of the data may be duplicated in the two papers, which leads back to the issue of redundant duplication.

In most cases, salami publication originates from a single study that gets divided into several papers during the process of data collection and completion of the paper. Consequently, the quality of each paper is low, and only when the papers are combined into one, can there be one strong convincing argument or hypothesis.

Salami publication often occurs in human subject research. Because of the difficulty of recruiting test subjects, there is pressure to produce as many papers as possible using the results obtained from those test subjects. If the original plan was to create several papers and a sufficient amount of data was collected, the issue of salami publication would not occur. Consequently, researchers must be required to undergo a thorough research design process, submit the proposal up front to publish several papers, and receive approval from the IRB prior to beginning the research. IRB reviews the validity of the proposal, including the number of the test subjects. Accordingly, this approval from the IRB can resolve the issue of duplicate publication in which the basic information on the subjects overlaps in multiple papers.

C. "Imalas" publication

"Imalas" publication (the word "salami" backwards) is publishing a similar paper after increasing the investigation period, or the number of subjects of a previously published paper, and re-investigating the same hypothesis. Publishing the results of investigating 100 subjects on the identical topic investigated with 20 subjects in the previously published paper can be an example of imalas publication. In another example, the same investigation was conducted using elementary students as subjects for the first paper and middle school students for the second paper; if there is no valid justification for why different results were expected in the second paper, it will not provide any new value and will be considered imalas publication.

On the other hand, if there are sufficient reasons to expect the subsequent study to overturn the results of the first study or new information or a hypothesis can be provided, the subsequent study can be validated. For example, if a method of measurement much more precise than the previous method is developed and another researcher has overturned the results of an existing study by

using this technique, a re-investigation of the previous study using this technique would be valuable.

D. Publishing translations

Translating a paper published in Korean into English and presenting it in an international academic journal or translating a paper published in English into Korean and presenting it in a Korean academic journal is a form of redundant publication because a single research accomplishment is published twice. This practice is only permitted under conditions described in the "Secondary publication" section below.

☞ **Secondary publication**

Since scholars present papers in order to propagate information or a hypothesis the author has generated and to receive approval for its validity from fellow scholars, prohibiting publication of translations as an act of misconduct is not the wisest thing to do. In fact, publishing translations could be acceptable because presenting research translated from Korean to English in international academic journals disseminates new information among international readers.

In the academic community, the process of translating works into another language or changing the words and format and presenting them for the readers of another academic discipline is allowed through a method of secondary publication. Three requirements must be met for secondary publication (for example, in the case of republishing a paper published in Korean journal). First, the researcher must receive permission from the editor of the Korean journal to translate the paper and allow secondary publication. Second, the researcher must receive permission from the editor of the desired international journal for submission of the translated manuscript of the primary published version. Third, when the translated manuscript is published after passing the review, citations to the original source must appear on the first page of the article: "This article is based on a study first reported in the *Korean Journal of* …"[14]

Presenting the paper of a certain academic discipline in the journal of another academic discipline is also possible through secondary publication. For example, one may publish the research results on the effect of acupuncture in the *Journal of Korean Acupuncture Society*, and then may present them in the *Journal of the Korean Physics Society* to question the significance of the physical interpretations and to transmit the information. In this case, the author must simplify the medical terms and change the writing style according to the

[14] International Committee of Medical Journal Editors (ICMJE). Recommendations for the conduct, reporting, editing and publication of scholarly work in medical journals [Internet]. ICMJE; 2014 [cited 2015 Dec 17]. Available from: http://www.icmje.org/recommendations/

conventions of the corresponding academic discipline. Additionally, the author must go through the three procedures mentioned above.

However, one problem that typically occurs in secondary publication is that there are two published papers from a single study; it is inappropriate to count both papers as part of one's publication achievement.

2. Things to consider in plagiarism and self-plagiarism

1) Borrowing text from published material

To what extent can one reuse portions of one's own previously published material in a new paper without receiving accusations of self-plagiarism? Although there is no consensus on this question, it may be determined by common sense. For example, the Guidelines for Research Ethics of Seoul National University propose that "one may use portions of his own research results within the scope of not harming the originality of the research."[15] The Research Integrity Committee of the University of Seoul has proposed in its regulations that "Duplicate publication by using the identical research idea, research data, and text of a previously published paper or book and publishing them in the same language or in a different language is an inappropriate act of misconduct; however, an exception is in cases in which only small portions overlap with the previously published paper and therefore the novelty of the new manuscript can be objectively acknowledged." Meanwhile, the specific standard of the acceptable amount differs by the academic discipline. Journals in the field of life science seem to have strict ethical standards, and they tend to suggest that "reusing texts exceeding one paragraph or five sentences… is not appropriate regardless whether they have been properly cited."[16]

2) "Materials and methods" or "Methods" section

When a researcher writes a paper using the data acquired in the same experiment or investigation method described in his previously published paper, the general consensus of journal editors is that using the same description of the methods section does not fall under self-plagiarism. Expert opinion regarding self-plagiarism proposed on the Q&A Forum of iThenticate[17], the international plagiarism detection service, also presents a similar view.

---

15 Chapter 2, Article 8, ② Use of one's research results. In: Seoul National University. Seoul National University guidelines for research ethics. Rev. ed. Seoul: Seoul National University; 2010.

16 Results of a mini questionnaire (2014.2.3-14) among member journal editors conducted by the Committee of Publication Ethics of the Korean Council of Science Editors.

17 Turnitin, LLC. iThenticate: self-plagiarism Q&A forum [Internet]. Oakland, CA: Turnitin, LLC; [cited 2015 Dec 15]. Available from: http://www.ithenticate.com/resources/webcasts/self-plagiarism/q-and-a

Q6: "If a scientist is describing a method that is used in different papers, can they use that same description?"
A: (Bob) Anecdotal feedback from CrossCheck members indicates that editors are largely unconcerned with plagiarism in method sections. In fact, it has been requested that iThenticate includes a feature that excludes methods from originality check.
(Rachael) I'd agree with Bob. An Editor reading the paper as a subject specialist will understand that there will necessarily be a degree of overlap/the same methods section if the same method has been used. (Bob Creutz, Executive Director of iThenticate; Rachael Lammey from CrossRef)

However, certain academic journals may disagree with this opinion, and so one must peruse the author's guidelines of the corresponding journal.

3) Using text considered to be common knowledge

In Korean copyright law, expressions or ideas not recognized for their creativity may be freely used without citation. Upon using the very well-known phrase from John F. Kennedy's Inaugural Address, one may avoid accusations of plagiarism and the consequences of the copyright law.

However, if it is difficult to determine whether the corresponding text is common knowledge, it is best to indicate citations. The following *Harvard Guide to Using Sources*[18] provides detailed guidance regarding citations of common knowledge.

- If you compared one of President Obama's lines to this very well-known phrase from John F. Kennedy's Inaugural Address, "Ask not what your country can do for you — ask what you can do for your country," you would not need to provide a citation for that one phrase.
- However, if you were to analyze Kennedy's speech substantively and quote additional lines, then you would need to cite anything you quoted from his speech so that your readers could confirm the original language of the speech.

4) Redundant publication in different types of documents

Reusing the contents of one's published paper when writing a chapter book generally requires an author to go through the basic procedures for secondary publication; one must receive permission

[18] Extracted from Harvard University. The exception: common knowledge. Harvard guide to using sources [Internet]. Boston, MA: Harvard University; [cited 2015 Dec 15]. Available from: http://isites.harvard.edu/icb/icb.do? keyword=k70847&pageid=icb.page342055

from the editors and the publishers of both documents and cite the original sources. Meanwhile, when using only a small portion as opposed to a form of secondary publication, one must provide clear citations and paraphrase the corresponding section properly to avoid redundant publication.

Publishing all of his or her previously published papers as a book or as an anthology or a special issue of an academic journal should follow secondary publication procedures to avoid the criticism of redundant publication. Thus, in the preface, the original sources should be clearly cited, and the fact that it is an anthology or a collection of papers should also be clearly specified. In addition, these may not be submitted as part of one's publication achievements.

A researcher may use the contents of his or her papers or other academic works, given appropriate credit, when they are explained in plain language or include some duplication in general books, educational books, or nonprofessional newsletters. However, even in these cases, it is recommended that researchers follow the procedures of secondary publication.

5) Conference abstracts

A researcher may reuse an abstract for his or her academic conference presentation or the materials and images used in the poster presentation in his or her graduate thesis or in an academic journal. Presenting the exact same material at another academic conference is not problematic because an academic conference presentation is considered to be part of the research activity of introducing a yet unverified hypothesis to colleagues of various fields questioning its validity. Accordingly, an abstract is not a complete paper and must not be counted as part of one's research accomplishment. (For students in Korea, an academic conference presentation abstract is sometimes considered to be a record of research activity but should not be counted as part of one's research achievements.)

6) Conference proceedings

Only a few copies of conference proceedings are usually published. Because their distribution is also limited, they are considered gray literature, which is not widely accessible. Unless the manuscripts are selected through a rigorous peer review process, papers presented in proceedings are generally not acknowledged as academic papers because the majority of them propose hypotheses that have not yet been evaluated.

Meanwhile, it is generally acceptable for the data presented orally or through posters at an academic conference to be published later in an academic journal. However, when the data was widely accessed (for example, online) through the proceedings, a researcher may encounter difficulties in publishing his or her data in an academic journal; the author may be criticized for

duplicate publication because it is a violation of the author's agreement upon submission that the paper consists of new information that has not been published through another medium. For a researcher who publishes his or her data in such proceedings, the report will not be recognized as an academic paper, and the author may not be able to use his or her own data elsewhere.

In the case of some engineering fields such as the Institute of Electrical and Electronics of Engineers (IEEE), the conference proceedings themselves are referred to as journals. The submission of conference abstracts to IEEE academic conferences is referred to as a "call for papers" as opposed to a "call for abstracts," and the documents published as proceedings are selected through a strict peer review process. Likewise, a contribution to conference proceedings can be acknowledged as an academic paper when a paper submitted to the academic conference is selected by a peer review and is then published and distributed online regularly and internationally, and when the academic society publicly announces that the corresponding entry to the conference proceedings is accepted as an academic journal by the academic society.

Additionally, the IEEE has a policy in which a researcher can reuse a portion of previously published data in a new paper given that original sources are properly cited, and the researcher can publish it as a full paper in one of the IEEE's own academic journals when the journal editor approves and acknowledges that the new research will make an innovative academic contribution. Even though such a policy is a breach of the general agreement in academia that "only new data that has not been previously published must be printed," the IEEE's position is that if the new research is assessed to have sufficiently innovative value, reusing data is not going to be questioned.

There are occasions in which conference proceedings that have not gone through peer review are published as a special issue of an academic journal. This may be criticized as disregarding the responsibilities of an academic journal, which are only to publish data that has exceeded a certain degree of completion and maintains research integrity.

7) Letters and brief communication

If the discovery of certain research is considered to be important and needs to be circulated immediately, it can be published in the form of a "letter" or "brief communication" first and then can be published as a full paper after the research is completed. In this case, duplicate use of the data is allowed as long as there are citations to the original papers. IEEE is representative in such cases, and some academic journals in physics fields also follow this practice. This practice is only possible between the journals of the same academic societies or journal publishers, for presenting the contents of short communication papers published in another academic journal will be an act of copyright infringement.

> Articles which mainly expand findings that were previously published as Communications in JACS or elsewhere and which only incorporate experimental data, without greatly expanded scope and without providing new in- sights or conceptual breakthroughs, will be declined. Articles that are mainly routine extensions of previously published related work will also be declined with the recommendation for submission to more specialized journals.

Overall, it is important to remember that most academic journals strictly regulate duplicate use of data. On the subject of submission regulations, the *Journal of the American Chemical Society* (JACS) writes:

Most journals require that all scientific papers must provide innovative information that has not been previously published. If the author plans to publish his or her work in the form of brief communication papers, intending to publish a full paper at a future date, the author should consult the corresponding academic journal prior to doing so.

8) Publishing a collection of reports of contract research results as a book or a journal article

A report of contract research results can be published as an academic journal article unless it is not allowed by the contract. However, a collection of submitted contract reports are compiled as a book assigned an ISBN number and uploaded to the Internet becomes a copyrighted work. Therefore, if the contract report is further developed and published as an article of an academic journal at a later time, it is violating the principle of publishing new data that has not been previously published.

On the other hand, while 76% of Korean scholars in the humanities viewed duplications across different research reports as an act of misconduct, only 53% of scholars in engineering fields had the same view.[19] These results may reflect the view in engineering that while journal papers are published in and open to the public domain, contract research reports only concern the researcher and the institution that requested the report. In addition, because duplications of reports in engineering occur mostly in the general introductory sections of objective information rather than the original hypothesis or argument section, researchers tend to view the issue less negatively.

---

[19] Park KB. Investigation of researcher's perception of research integrity. Daejeon: National Research Foundation of Korea; 2009. p. 59.

9) Publishing students' gradate theses as academic journal articles

In general, although students' graduate theses are the product of several years' hard work, data presented in a thesis should be first refined and edited through the peer review process and then should be distributed among scholars of an academic society so that it can be disseminated more widely. Accordingly, publishing theses as academic journal articles is an important academic activity of scholars that must be encouraged. In addition, in many cases, thesis publication is conducted by the student's academic advisor or the principal investigator; the advisor or the principal investigator is usually given credit as the corresponding author or the co-author.

Among humanities scholars in Korea, more than half view duplications between students' graduate theses and academic journal articles as cases of research misconduct, but this may be considered a limited perspective. In the West, dissertations are often published as books or journal articles. However, when an advisor publishes his or her student's dissertation in a journal and lists his or her name as an author, it is usually considered inappropriate in the literature, history, and philosophy disciplines; in these disciplines, the importance of individual motives and creativity in the writing process is traditionally considered very important. According to Ki-beom Park, however, only one quarter of the professors in the science and engineering fields view duplication from students' graduate theses in academic journal articles as cases of misconduct.[20] This discrepancy is probably because the views of the humanities disciplines have strongly dominated the Korean academia, not properly recognizing the fact that science and engineering research nowadays requires collaboration.

10) Using the contents of one's published academic journal article in one's own graduate thesis

Nowadays, a growing number of science and engineering disciplines have been requiring research paper publications in academic journals as part of the doctoral degree requirements. As a result, many doctoral candidates first publish portions of their research in an academic journal and later insert the previously published contents into their graduate thesis. Duplicate usage of one's research (including data and text) in both a thesis and an academic journal is an acceptable practice in the science and engineering fields, not only in Korea but also worldwide.

However, one must still exercise caution during this process. For example, if a student has co-authored a collaborative research paper with multiple researchers, and he or she uses the same contents of the research paper in his or her own graduate thesis, plagiarism and copyright infringement issues arise; in principle, the slightest bit of data and text produced by a co-researcher

[20] *Ibid.*

should not be included in a student's gradate thesis, and if they are used, it becomes a copyright infringement unless the other authors have provided written permission. However, even if prior permission is obtained, it is still considered misconduct as plagiarism and fabrication of data. If one must use the data of another person, it must be introduced as a text summary not a copy of the data figure or table from the original paper, and it must be properly cited.

■ Additional Factors to Consider: Copyright of Academic Journals in Korea

1. Current status of copyright management of academic journals in Korea

Currently, most Korean academic journals may give permission to third parties to access papers after receiving consent or copyright transfer agreement of authors to the publisher as part of a journal publishing agreement. However, neither the consent form nor the copyright transfer agreement provides any information regarding copyright ownership. Such practice by the academic society is subject to criticism because it assumes the academic society has greater authority over the submitted manuscripts than is actually allowed

Most academic societies in Korea operate a homepage on the internet for efficient management of journal articles, as well as economic benefit and ease of access for members. The academic societies often upload the journal articles to their own homepage without a clear copyright transfer agreement or legal contract with the author of the manuscript. Some academic societies have also contracted with companies that provide the articles to third parties via the internet as a paid service. [21]

These digital knowledge distribution companies (such as Korean Studies Information Inc. and Nurimedia) usually have contracts for 'right of transmission' and 'right of electronic publication' with an academic society, construct a digital database composed of the papers of the corresponding academic journal, and sell them to universities, research institutes, and businesses. However, because the main ownership of the copyright of the online version of the academic journal, as well as the digital right of reproduction, right of transmission, and right of production of secondary copyrighted work have not been clearly legally defined, conflicts regarding copyright arise. [22]

2. Examples of and precedents set in Korean academic journal article copyright disputes

There was once a legal dispute between a digital knowledge distribution company and Korea Reproduction and Transmission Rights Association (KORRA), a copyright advocacy organization, regarding the ownership of copyright of an academic journal article. KORRA filed a lawsuit against

---

[21] Hong JH. A study on copyright possession for open access and archiving of scholarly journal paper registered in Korean Research Foundation. J Korean Lib Inf Sci Soc 2008;39:431-63.
[22] *Ibid.*

Chapter 136 (Penalty)
① A person to whom any one of the following issues applies may be sentenced to up to 5 years in prison or fined up to 50 million won, or both. <revised 2011.12.2>
1. A person who has violated the intellectual property rights, and other property rights protected by this law (excluding the rights under Article 93), by duplication, performance, public transmission, exhibition, distribution, rental, or publication of secondary copyrighted work.

the digital knowledge distribution company stating that "the digital knowledge distribution company has signed a contract of right of transmission with an academic society that has not received consent of use from each individual copyright holder, which is a violation of chapter 136, article 1, clause 1 of the copyright law." The argument is that the construction of a digital database based on the original text of an academic journal paper is copyright infringement against the author as production of a secondary copyrighted work.[23]

Regarding this issue, the Seoul High Court has decided that in the "appeal hearing of a request for injunction against service of academic copyrighted work" (Case 2007-D-872), 1) if the digital distributor of the original text entered into a contract with the academic society and sold the paper published by the academic society in the form of a database, it would be a violation of the copyright of the author of the paper. 2) However, the degree of violation was not to the extent of prohibition of the service.[24]

3. Directions for improving the expansion of public access to academic journals and resolving copyright issues of Open Access journals

Because academic papers are a representative form of nonprofit copyrighted works, most authors want more people to verify and evaluate their work; as a result, the number of Open Access journals is increasing. The expansion of Open Access is also advantageous for the public.
However, to resolve the copyright issues and conflicts of academic journals, the following public policy changes must be made as soon as possible:

1) Copyright transfer agreement of the academic work from the academic society of the original author
2) Clear stipulations regarding ownership following copyright transfer
3) Clarification of ownership regarding the right of reproduction and transfer of the digital database, secondary copyrighted work (fee-based or free access to the paper online or offline)

---

[23] *Ibid.*
[24] Eom JH. Third party making · selling a published journal paper in form of DB is copyright violation. Law Times [Internet]. 2008 Mar 22 [cited 2015 Dec 15]. Available from: http://www.lawtimes.co.kr/Legal-News/ Legal-News-View?Serial=38121

V. Unjustified Authorship

In Korea, the "act of not attributing authorship to an individual who has made scientific contributions without justification or attributing authorship to an individual who has not made scientific contributions," in other words, unjustified authorship is defined as another type of research misconduct. (Ministry of Science, ICT and Future Planning ordinance No. 6 [enacted 2013.8.5], Guidelines for Assurance of Research Ethics [enforced 2012.8.1] [Ministry of Education, Science, and Technology instruction No. 206, 2012.8.1, revised section]). This is not the case in the United States.

1. What determines the authorship of a paper?

Authors of a paper must take responsibility for their work. The process of scientific verification of the research continues even after the paper is submitted or published, which is critical for strengthening the scientific discovery and the scientific value of the hypothesis. Authors must be able to properly respond to questions that may arise during the scientific verification process. For this reason, authors must be familiar with their work and be able to propose logical explanations regarding the data acquisition, method, interpretation, and validity of the results. Such a role would not be possible simply by measuring experimental points without knowing the purpose of the research.

1) People who are eligible to be listed as an author

To be listed as an author, the following conditions must be met: (1) the individual must plan or design the research, or understand the concept and purpose of the research and (2) participate in the acquisition and interpretation of data or writing the draft, and (3) read the final version of the manuscript before submission and approve it. Some of the recent academic journals include an author contribution list, in which the contributions of each author are listed in the front, or at the end, of the paper.

2) People who are ineligible to be listed as an author

The following persons would not satisfy the conditions to be listed as an author: (1) a person who only measured and acquired the data, (2) a person who only provided the laboratory, equipment, or research funds, and (3) a person who only provided the research idea. (These people should instead be acknowledged in the acknowledgments section.)

Practice of determining authorship

Dr. Kim, an assistant professor of gynecology, conducted research regarding the correlation between cervical cancer and Human Immunodeficiency Virus (HIV) and has written a paper. Which of the following people should be listed as authors of this paper?

A. The head professor who was already engaged in a project on treatment of cervical cancer heard Dr. Kim's presentation on his research plan in a departmental meeting and thought that this research would strengthen the research level of his gynecology department and provided a portion of his research funds to Dr. Kim's research.

B. A resident, during the two years of her career, collected samples from cervical cancer surgeries that were used for Dr. Kim's research.

C. An intern student decided to participate in Dr. Kim's research. After learning the necessary techniques from the research assistant in the neighboring laboratory, this intern carried out the experiment and determined the presence of virus within the samples.

D. A technical assistant of the department conducting routine typing of HPV (a type of virus frequently found in cervical cancers) in tissue samples from the outpatients for diagnostic use, recently met Dr. Kim in the hallway and explained the increasing frequency of observation of HPV and HIV co-infection in cervical cancers. Later, this technical assistant measured the frequency of co-infection from his own samples and delivered data to Dr. Kim. These were presented in the paper.

E. A postdoc taught Dr. Kim the most difficult technique that is necessary to successfully complete the last experiment.

F. A professor in the Pathology Department provided Dr. Kim with his own rare DNA samples of HIV3 and HIV4 (types of HIV strains), from which Dr. Kim acquired data shown in Fig. 4 of the paper.

G. A senior professor made comments and suggested new wording in several parts of the manuscript.

People who deserve authorship: C and D

2. Order of the listing of authors

Authorship is listed in the order of contribution to the research. A researcher or student who produced the largest part of data is generally listed as the first author; in fact, in most research institutions and academic societies, the person who made the greatest contributions to the paper is listed first. People (co-authors) who made fewer contributions than the lead author are listed as second or third authors according to their contributions, while corresponding authors are generally listed at the very end. However, because corresponding authors are marked separately, they may be listed anywhere in accordance with the production of data. In other words, if the person who produced the largest amount of data has written the paper and became a corresponding author, he is listed in the very beginning of the list of authors. To avoid disputes, it is better to decide the order of listed authors when the role of each researcher is decided at the beginning of the study, rather than at the end when the manuscript is ready for submission. Meanwhile, if the editor requests information regarding the role and contribution of each author upon the submission of the manuscript, it may be possible to reduce the issue of unjustified registration of authors to some extent.

VI. Other Behaviors to Avoid in Research Activity

The Guidelines for Assurance of Research Ethics of the Ministry of Education includes "acts that severely deviate from the acceptable range of each academic field" as research misconduct. Additionally, it notes that "research institutes may include in their regulations acts that require internal investigation or prevention in addition to the acts of research misconduct listed in Clause 1."

Depending on the situation, some acts that occur during the research process, or after the study, may not be viewed as acts of misconduct or inappropriate practice; however, they may nonetheless cause suspicion regarding research integrity, damage the conventions of the scientific society, and cause problems such as wasting time and resources. There are rarely cases in which such acts have been called into question and submitted for disciplinary measures. Nevertheless, these acts may be considered to have instigated research misconduct and so may result in disciplinary measures equal to the degree of research misconduct.

These acts are generally classified as "questionable research practice (QRP)." The following is a representative example of QPR as proposed by the US National Academy of Sciences, Institute of Engineering, and Institute of Medical Sciences.[25]

1. Act of not retaining important data for an appropriate period of time

Article 11 (Record keeping and management) states:
"① The head of the research institute has the responsibility of storing and managing the research notebook produced during the research funded by the government. Clause ② 1. The retention period of the research notebook is 30 years from the date first written."

- Guidelines for Research Notebooks
[National Science and Technology Council instruction No. 2011-19, enacted 2011.10.4]

A research notebook with data recorded or kept on file is the most important evidence proving that the researcher actually conducted the corresponding research. The research notebook is also

25 Panel on Scientific Responsibility and the Conduct of Research (PSRCR). Responsible science. Vol. 1. Washington, DC: National Academy Press; 1992.

required for reproduction of the research results. Upon retirement or movement to different institution, a researcher must pass on the research notebook to the research institution.

The instructions above and the regulations of universities do not specify what disciplinary measures will be imposed for the absence of a research notebook. However, in the absence of a research notebook or omission of important data in the notebook, a researcher cannot prove himself innocent if suspected of plagiarism or fabrication of data, and also may be suspected of manipulation of data.

2. Requesting authorship simply for contributions irrelevant to the study

The Guidelines for Assurance of Research Ethics of the Ministry of Education state that "the act of attributing authorship to an individual who has not made contributions, out of gratitude or respect" is an act of research misconduct. When a person who does not have sufficient qualifications to be registered as an author requests authorship, he/she is committing an act of misconduct, which requires a higher degree of disciplinary measures than that for other research misconduct.

3. Abusing a student or a member of research team

A student (or a member of research team) may suffer abuse at the hands of a professor (or a senior researcher.) There are often media reports of professors making personal requests irrelevant to the research or imposing financial disadvantages on students. An even more serious offense is professors demanding or inducing research misconduct by psychologically manipulating the students, which deserves greater disciplinary measures than that for actually committing research misconduct. Furthermore, cases of wasting the students' time and energy by intentionally refusing to provide the student with proper research guidance or depriving the students of the opportunity of authorship are also wrongdoings on an equal footing with research misconduct.

4. Refusing or interfering in another researcher's justified request for information or sharing of materials regarding data or research material of the paper

Refusing access to the research notebook raises the suspicion of the absence of a research notebook or of apparent misconduct evident within the contents. There are often requests for the

original data reported in the paper or portions of substances acquired from the data collection process. This is important for the reproduction of the reported results and is also a meaningful academic convention to promote further advancement of the research by sharing valuable information and substances. Refusing such a request from a fellow researcher does not lead to disciplinary measures; however, if it happens repeatedly, the researcher may be suspected of interfering in the reproduction of his research results, or engaging in closed research. In such cases, warnings may be issued if the academic society is informed of such an act.

5. Publishing or releasing information to the public about the estimated level or the expected results as if they are valid, when there have not been sufficient data provided for reproduction of the results or its verification by fellow scientists

Researcher Woo Suk Hwang has been criticized the most for this type of infraction. In 2005, he presented to the general public the results of his stem cell research as if they were valid, without first presenting the results in an academic conference or journal, that is, without having the scientific validity of his research reviewed by his fellow scholars. This is an act of deceiving the public who pay taxes for researchers to conduct research with integrity. When such acts are committed intentionally, warnings and disciplinary measures are needed; even if it is not research misconduct, it is nevertheless an inappropriate act violating personal and scientific integrity and honor.

References

Cho WI. Dismissal of professor Kang Soo-kyung of Seoul National University engaged in fabrication of 17 articles. Hankooki.com [Internet]. 2013 Mar 8 [cited 2015 Dec 15]. Available from: http://news.hankooki.com/lpage/society/201303/h2013030821055721950.htm

Eom JH. Third party making · selling a published journal paper in form of DB is copyright violation. Law Times [Internet]. 2008 Mar 22 [cited 2015 Dec 15]. Available from: http://www.lawtimes.co.kr/Legal-News/Legal-News-View?Serial=38121

Harvard University. The exception: common knowledge. Harvard guide to using sources [Internet]. Boston, MA: Harvard University; [cited 2015 Dec 15]. Available from: http://isites.harvard.edu/icb/icb.do?keyword=k70847&pageid=icb.page342055

Hong JH. A study on copyright possession for open access and archiving of scholarly journal paper registered in Korean Research Foundation. J Korean Lib Inf Sci Soc 2008;39:431-63.

Hwang ES, Song SS, Lee IJ, Park K, Sohn WC. Understanding and practice of research ethics. Daejeon: National Research Foundation of Korea; 2011.

International Committee of Medical Journal Editors (ICMJE). Recommendations for the conduct, reporting, editing and publication of scholarly work in medical journals [Internet]. ICMJE; 2014 [cited 2015 Dec 17]. Available from: http://www.icmje.org/recommendations/

Jeong JY. Court orders "50 million won compensation for substitution of authors of paper". Segye News [Internet]. 2008 Aug 13 [cited 2015 Dec 15]. Available from: http://www.segye.com/content/html/2008/08/13/20080813002762.html

Ministry of Education, Science and Technology Instructions, No. 260. Guidelines for Assurance of Research Ethics (enacted Aug. 1, 2012, revised section).

Ministry of Science, ICT and Future Planning Ordinance, No. 6. Rules Regarding Management of National Research and Development Projects (enacted Aug. 5, 2013).

Panel on Scientific Responsibility and the Conduct of Research (PSRCR). Responsible science. Vol. 1. Washington, DC: National Academy Press; 1992.

Park GH. Paper plagiarism. 2: Extracted from national project plan of professor Kim Cheol-ho of Sungkyunkwan University. Seoul News [Internet]. 2009 Jun 27 [cited 2015 Dec 15]. Available from: http://www.seoul.co.kr/news/newsView.php?id=20090627008018

Park KB. Investigation of researcher's perception of research integrity. Daejeon: National Research Foundation of Korea; 2009.

Seoul National University. Seoul National University guidelines for research ethics. Rev. ed. Seoul: Seoul National University; 2010.

Turnitin, LLC. iThenticate: self-plagiarism Q&A forum [Internet]. Oakland, CA: Turnitin, LLC; [cited 2015 Dec 15]. Available from: http://www.ithenticate.com/resources/webcasts/ self-plagiarism /q-and-a

WAME-Listserve [discussion list on the Internet]. World Association of Medical Editors; 2006 Nov 18 [cited 2015 Dec 15]. Available from: http://www.wame.org/ appropriate-use-of-of-other-authors2019-sentences

3

Publication Ethics

I. Writing and Submission Guidelines for Authors

II. Guidelines for Editors and Reviewers

III. Follow-up Measures for Published Manuscripts

IV. Utilization of Similarity Test Software

I. Writing and Submission Guidelines for Authors

1. Basic responsibilities of authors

Authors are accountable for the contents, research process, and results of their own research papers.

- Authors should double-check their own research papers in detail for accuracy in calculations, data presentation methods, analysis of results, etc.
- Authors must ensure that their research was carried out in an ethical manner, and has adhered to relevant regulations.

Authors must follow the regulations of academic journals in peer review, editing, and publication.

- Authors must submit manuscripts that are original and must not submit the same paper to more than one academic journal.
- Authors should respect the embargo regulations of an academic journal. One should not inform other media about the contents of the manuscript submitted to a journal until a designated time, and should also seek the agreement of the affiliated institution or the funding agency regarding this policy.

The author should cooperate fully with any requests made by the journal editor.

- If any errors are discovered after the submission or the publication of the manuscript, even in case of a trivial error, the author must immediately inform the journal editor and discuss follow-up measures.
- The author should submit data, regulations, procedures, software, lab notes, or other information promptly when requested by the editor.
- Even after the publication of the manuscript, the author must cooperate fully with any requests made by the editor (or the readers); in addition, any errors or problems discovered regarding the manuscript must be resolved by cooperating with the editor.

2. Ensuring the objectivity, relevance, and transparency of the paper

The researcher must ensure objectivity, relevance, and reproducibility of the research described in the paper by conducting the experiment based on ample academic evidence and analyzing the results in a logical manner.

- The research process and method of analysis suggested by the author in the manuscript must be clear so that other researchers can repeat and reproduce the same results.
- Researchers must record the procedure and results faithfully and store the evidence in a

systematic fashion. If at any point during the peer review, the reviewers or the journal editor requests the evidence, the researcher must be able to present it.
- If there are any limitations present in the research, the researcher must indicate them clearly.

Any conflicts of interest, research procedure, and support received during the writing process of the manuscript that may have affected the analysis of the results must be clearly indicated.
- Researchers must disclose all financial and non-financial conflicts of interest so that the journal editor, reviewers, and the readers are fully aware of such conflicts. Researchers can refer to the submission guidelines for conflicts of interest that must be revealed. (For information on the basics of conflicts of interest, please refer to 'Chapter 5: Conflicts of Interest'.)
- The research funding agencies must be revealed. If the funding institution provided support beyond monetary support, such as the design, performance, analysis, interpretation, translation, or report of the experiment, this must be indicated in the paper in detail. The source from which materials and equipment were provided must be specified along with any individual who supported the performance, statistical evaluations, or the conceptualization of the experiment.

3. First publication of original content

The author must ensure that the manuscript submitted is original and creative and has never been published in any other language or through a different medium.
- The author must not submit the manuscript to more than one journal concurrently.
- If the journal editor wishes to publish a manuscript previously published in another journal he or she should obtain permission from the copyright holder. The fact that the article has been reprinted should be disclosed with the source of the original publication.

☞ Even if the manuscript has never been published in a journal, if it has been presented or reported in other occasions, the individual must check submission regulations and ethics guidelines for each research report. In addition, if an author wants to publish a paper based on the results that were previously reported to a funding agency, he or she must check the agreements with the funding agency on the revelation of the research results.

If a single project generates multiple research papers, the related articles should be cross referenced so that the readers are aware of the situation.
- If the results presented in a manuscript have been reported or if the same data is analyzed differently to create multiple manuscripts, the journal editor must be informed. A copy of any relevant manuscripts or manuscripts submitted to other journals must be submitted to the editor.

4. Ensuring research ethics

Results of research studies should be reported in an honest and accurate manner.

- A significant level of data modification can be viewed as fabrication, and thus should be avoided.
- In particular, when utilizing digital images (electron microscope images, X-ray images, electrophoresis photographs, etc.), researchers should be careful not to imply a biased conclusion. In certain cases, it may be unclear whether the manipulation was appropriate or within regulations. If such doubts are raised, the author must elaborate on his or her process and justify the decision in the manuscript so that the reviewers or the readers can make a proper judgment.
- When writing a research paper, the results should not be deliberately excluded simply because they are difficult to explain, are not consistent with other data, or do not support the hypothesis or the conclusion of the paper

Any expressions used in the manuscript must all be written by the authors in their own words. The manuscript must also adhere to copyright and publication guidelines. If a source is protected under copyright, permission from the author of the source must be obtained prior to its usage.

- When referring to others' work, the author must include a proper citation of the source. This also applies to sources written by the authors themselves.
- When using data tables or diagrams from another manuscript or when using a substantial portion of another manuscript, the author should seek permission from the owner of its copyright.

Any researchers who are deemed to have played a significant role in the design and conduct of research and the writing of the manuscript must be offered authorship. (For authorship criteria, please refer to Chapter 2 Section 5 'Unjustified Authorship'.)

For research including experiments on humans or animal testing, the approval, permission, and enrollment conditions must be disclosed. Also, manuscripts should be written in a way that protects the research subjects as much as possible.

- When requested by the editor, the author must provide a copy of the relevant documents such as the approval, enrollment form, or subjects' informed consent forms. In addition, the editor can request, when needed, the research proposal to verify whether the research was conducted according to the original research design. In such cases, the author should comply with the editor's requests.
- The personal information of the subjects should be kept confidential. Any other information can be published only if agreed upon by the subjects. If some information may be offensive to the subjects or close parties of the subjects, additional consent is required even if the information is included in the scope of the original agreements.
- Statistical analysis must adhere to the research design. Any addition or modifications to the method of analysis must be identified and distinguished from the original design.

II. Guidelines for Editors and Reviewers

1. Basic responsibilities of the editor

The editor must take responsibility for all matters related to the publication of the journal. The editor-in-chief must also establish regulations and procedures that ensure the quality and publication ethics of the journal and that allow continuous modifications and improvements.

- The editor must take into account the opinions of the authors, readers, reviewers, and the journal editors. At the same time, he or she must inform these individuals of their responsibilities in the publication process. Furthermore, any other guidelines regarding policies, criteria, and the sharing of information before and after publication must be established and clearly delivered to the relevant parties.

The editor must respect freedom of expression. In addition, any secondary pressures that may affect the professionalism or morality of the manuscript must be restrained to ensure the independence of the editing.

- Any activities regarding the management of the journal should be separated from the editing and evaluation of the manuscripts. Any sponsors or publishers should be prohibited from having an inappropriate influence on the publication of manuscripts or on manuscripts that have already been published. In addition, all the necessary information should be provided to the readers so that they could understand the roles and the characteristics of the sponsors or the publishers.
- Regulations must be established so that the editor cannot be fired due to any criticism on the content of the journal by the publishing organization unless the editor-in-chief has made inappropriate edits or decisions that disrupt the objectives of the journal.
- If advertisements are included in the journal, it must be ensured that the content and tone of the advertisement does not produce any conflicts with the publication guidelines. In addition, the advertisements should not be related to the content of the journal articles and be clearly separated from the articles.

The editor must establish and maintain a transparent, effective, and fair review process.

- Timely publication of manuscripts should be ensured. A procedure to reconsider the editor's decisions must be in place in case of irregularities. The editor should also closely manage academic and ethical issues starting from the review process of the submitted manuscripts to the publication of the journal. Even after the publication of the journal article, if a problem arises regarding a manuscript, corrections, explanations, withdrawal, or an apology should be immediately issued, as appropriate, to ensure the integrity of the journal and the publication

ethics. If ethical problems arise or any allegations of research misconduct are made, a policy must be implemented to deal with the issue whenever it arises and the situation must be monitored regularly.

The editor should clearly define the situations where conflicts of interest may occur during the editing and publication process of a journal and must also structure the procedure to deal with such situations appropriately.

- At the most basic level, the authors, reviewers, editors, and the publishing organizations must each disclose any issues of conflicts of interest that are within their purview.

The editor should not leak information obtained during the editing or the peer review process to a third party. The editor should require reviewers to maintain confidentiality of such information.

- In cases where the submission and peer review process are held online, any paths that may potentially allow other irrelevant individuals to gain access without permission should be blocked.
- The editor should not utilize factitious means or abuse authority such as manipulating statistical indicators to improve the ranking of the journal.
- The reference list of a manuscript should be selected purely based on academic criteria. No influence or pressure should be put on the author for any other reason.

☞ While the editor should keep information acquired during the editing process confidential, exceptions may be made to share information. For example, if an investigation is being conducted regarding misconduct, the editor can share information and cooperate with the investigation committee or the editor-in-chief of another journal to verify the academic value and the publication ethics of relevant manuscripts. The conditions that allow information sharing must be clearly stated in the submission or the peer review guidelines.

2. Academic value of the manuscript and ensuring publication ethics

The editor must establish appropriate measures to ensure that the publication of the journal promotes both publication ethics and the development of the academic field.

The editor must strengthen regulations and procedures so that he or she can evaluate whether or not the planning and performance of the experiment was carried out rigorously, the results were obtained through relevant methods, and the results and analysis were presented in a scientific manner.

- For example, if a manuscript using statistical analysis is submitted, at least one reviewer should have statistical expertise to evaluate the statistical method, the sample size, the suitability of the analysis, and/or the potential biases.

The editor must clearly inform the authors that they must follow all domestic and international guidelines regarding the planning, performance, and publication of the research. Furthermore, the editor must only publish research results that have adhered to the aforementioned regulations.

- Especially in cases involving human subjects or animal testing, the submitted manuscript should be processed by the editor and reviewers who are well-acquainted with the guidelines.
- If there are national laws or regulations related to the research, the editor must ensure that the researchers have already consulted with the relevant ethics committee. It must be noted that even if the research had passed a pre-evaluation process, if ethical issues are raised during the peer review process, the article may be rejected.
- If a research paper involving human subjects or animal testing is submitted and the relevant national regulations are unclear, the editor should consult with the author about any laws or regulations that may exist and should verify to what degree the research has adhered to the rules.
- If the research involves human subjects, the editor must ensure that the subjects have volunteered for the research and have agreed to the publication of the research results. In addition, the editor should confirm whether the informed consent process and the content of the consent form were valid.

The editor must establish clear regulations regarding research misconduct such as violation of ethics regulations, fabrication, modification, plagiarism, or redundant publication. In addition, the editor-in-chief should reveal what types of follow-up actions he or she has planned to carry out during the editing process or after the publication in case of any research misconduct.

- Standards regarding the management and evaluation of digital image files, images, and diagrams must be clearly stated in the submission guidelines. Especially in the fields where digital images play a critical role, the journal should be well equipped with enough manpower and an adequate procedure to ensure that the digital images have been managed appropriately.
- It is recommended that editors use programs designed to search for textual similarities to ensure that no plagiarized manuscripts or manuscripts that have already been published in another journal are published. At the same time, the aforementioned editing policies should be clearly communicated to the authors.
- The editor-in-chief must establish guidelines for peer review and editing policies that prevent attempts to publish a single research result in multiple manuscripts (salami publication) and publishing the same manuscript in multiple journals (duplicate publication).

Case study | Digital image management guideline[1]

In the *Journal of Cell Biology* (JCB) where photographic data is of the utmost importance, there exists a head photograph editor who reviews digital images of manuscripts that are expected to be published. In cases of black and white photos, it is said to be possible to detect manipulated photographs since simple changes in brightness and contrast can reduce the unity of the background. The JCB photograph review procedure is being used by many other journals such as Nature. JCB requires authors to submit the original digital image files along with the final manuscript and reviews all the submitted images. In many journals, if deemed necessary by the editor-in-chief, the author can be required to submit the original files. The image management regulations as stated in the JCB submission guidelines are as follows.

① No specific feature within an image may be enhanced, obscured, moved, removed, or introduced.
② The grouping of images from different parts of the same gel, or from different gels, fields, or exposures, must be made explicit by the arrangement of the figure (i.e., using dividing lines) and in the text of the figure legend.
③ Adjustments of brightness, contrast, or color balance are acceptable if they are applied to every pixel in the image and as long as they do not obscure, eliminate, or misrepresent any information present in the original, including the background. Non-linear adjustments (e.g., changes to gamma settings) must be disclosed in the figure legend.

3. Management of the peer review process

The greatest responsibility assigned to the editor-in-chief is to establish and manage a fair and effective peer review process. The editor-in-chief should provide a thorough and complete guide to the peer review process through the submission guidelines and identify the types of manuscripts that should be allowed to go through the peer review process and those that should not.

The final decision of whether or not a manuscript is published is up to the editor in charge. The editor must make an unbiased and fair decision on whether the topic of a manuscript agrees with the field of study of the journal, whether it contains enough creative ideas to make a significant contribution to the topic, and whether the research method and analysis are appropriate. The editor should establish a peer review process that is as fair and unbiased as possible, and disclose the process clearly so that both the authors and the reviewers would have a full understanding of the peer review process.

[1] Ministry of Education, Science and Technology; National Research Foundation of Korea, editors. Good research practices' guidelines. Seoul: National Research Foundation of Korea; 2011. p. 54.

If the editor assesses the content or quality of the manuscript to be inadequate, he or she can reject the manuscript or recommend a different journal before the peer evaluation process.

The editor should send the reviewers' comments to the author in a constructive and helpful manner.

☞ In determining whether a manuscript will be published or not, the editor may utilize the review comments of experts in various ways. In some journals, the reviewers serve simply as advisors. In such journals, the editor may not directly ask the reviewer whether a manuscript should be

Case study | Blind review process for fairness

The fair review of the editor and the reviewers is of utmost importance. To ensure fairness, two types of peer review processes have been devised in which the experts in the relevant field assess the value of a manuscript and publish only those deemed worthy. There are still many attempts being made to increase fairness and objectivity of the peer review system. However, it should be noted that the existence of a procedure does not ensure unbiasedness.

① **Single-blind review by anonymous reviewers**
In single-blind peer review, the identity of the reviewer is kept anonymous from the author and readers so that the experts of each field can express their opinions freely. The author only receives the comments of an anonymous reviewer. However, the identity of the reviewer can still be revealed if he or she so desires. Certain journals think disclosing the reviewer not only increases the quality of the evaluation but also makes it possible to acknowledge the reviewer's contribution in the publication of the manuscript. *BMC Medicine*, an online journal, has adopted an open peer review process and includes the editor's opinion, signed reviewers' reports, and the first and second draft of the manuscript in the publication. The *EMBO Journal* published by the European Molecular Biology Organization does not reveal the identity of the reviewer but publishes the review process file online as an appendix along with the final manuscript. The review process files include the comments of the editor and reviewers, the reply from the author, and the first and second draft of the manuscript.

② **Double-blind review, in which both reviewers and authors are anonymous**
In double-blind peer review, in order to enable the peer review process to be based solely on the academic value of the manuscript, and not be influenced by the reputation of the author or research institution, the peer review process remains completely anonymous to both the author and the reviewer. However, such attempts may be ineffective since, in many cases, the author can be inferred by the research topic and content of the manuscript. The author can also be found while searching relevant references. As a result, the peer review may actually not be an anonymous process. Because of this, some question the effectiveness of this method and argue that fairness is better achieved if the reviewers know the author.

accepted or not, and even if their opinions are referred to, they may not necessarily be followed. Other journals take a summative opinion of the reviewers, and the editor follows the majority. Regardless of the method, the journal should make the entire process clear for the readers and the reviewers in the guidelines.

4. When allegations of misconduct are made during the review process

When research misconduct or redundant publication is discovered during the review process, the editor should institute appropriate follow-up measures and make an announcement regarding this matter so that the authors, readers, and the reviewers can inform themselves of the situation.

The editor-in-chief must establish a procedure to solve the issues raised by the reviewers. An editorial board or ethics committee meeting is usually held to review the problem. The committee identifies the severity of the issue, but does not make a final decision. Other appropriate measures, such as notifying the author's institution are followed.

☞ In Korea, there are many journals that have a separate ethics committee. In this manual, the role of the ethics committee is not specified separately. This is because the division of roles and responsibilities between the editorial board and the ethics committee can differ greatly depending on each journal's management system and situation. In any case, however, it is imperative that the management guidelines for the editorial board and the ethics committee be established and that the readers and the authors be clearly informed.

☞ If the journal is to organize an ethics committee to manage the ethical issues raised during the review or editing process, such a possibility should be clearly and separately stated in the submission guidelines. It is also possible to have the editorial board take care of the issues raised for submitted manuscripts, and have the ethics committee handle those for published papers.

If an error or some discrepancy in the data is discovered, the editor should ask the author to explain it. If necessary, the editor can request the data or research notes from the author.

- If a minor correctable error is discovered prior to publication, the error can be revised and the paper can continue to go through the review process; the reviewers should be asked to reevaluate the revised manuscript when needed.
- If a severe error that cannot be repaired without a major revision is discovered, the editor should inform the author and give him or her an opportunity to explain.
- If the situation is not resolved despite the author's explanation, the journal should inform the author's institution of affiliation and request that they investigate the matter. The author should also be informed of the actions taken by the journal with respect to the institution. The

affiliated institution should investigate whether the error is a simple mistake or intentional misconduct. The journal should ask the institution to provide the results of the investigation.

- If the institution confirms that the discrepancy in the data is not due to any research misconduct, the manuscript should be resubmitted and reevaluated. However, if intentional misconduct is identified in the investigation, the journal should inform the author of the sanctions imposed by the journal.

☞ Discrepancies in data, errors, or irreproducibility of data can be due to research misconduct, but they can also be honest mistakes. Hence, if such problems occur, the editor should not hastily judge the situation with a particular explanation in mind. The editor's responsibility is to decide whether the submitted or edited manuscript can be published in its current form or to ask for an investigation from the author's affiliated institution when the problem appears to be severe.

If a submitted manuscript is under suspicion of plagiarism or redundant publication, the editor should check for plagiarism.

- If the degree of plagiarism or redundant publication is not significant, the author can be asked to revise the manuscript to properly cite the source and continue through the review process.
- If the plagiarism in the manuscript is so severe that it cannot be revised through partial modification, the corresponding author and all the co-authors should be informed. The information should include the journal's post-publication processes. The procedures may include refusal of further manuscripts from the relevant authors for a certain period, notification of the original author who committed the plagiarism, and notification of the research institution of affiliation.
- Once plagiarism and duplication is confirmed, the editor should inform the copyright holder of the original manuscript (author and the publisher) and the author's affiliated institution of the situation. This can be understood as a part of the academia's self-regulation efforts. This prevents the problematic manuscript from being resubmitted, resulting in an increase in productivity of all journals and aids the effectiveness of the peer review system. This would lead the affiliated institutions to start investigation into the possible misconduct. It allows the identification of the one who is responsible and the severity of the errors the author has made; this is a way to protect authors with good intentions.

☞ Unlike fabrication or falsification of data, plagiarism and duplicate publication can be identified by the editor. Comparing a manuscript submitted to the journal with other manuscripts to check for plagiarism is also a responsibility of an editor. If it is discovered that the submitted manuscript has been plagiarized or contains redundant information, the editor should make a formal request for an investigation of the author's affiliated institution and ask for the results of the investigation.

Case study | Measures that the editor-in-chief should take when publication ethics are questioned

The Committee on Publication Ethics (COPE) has created flow charts to demonstrate the actions that the editor should take when ethical issues are raised about a published manuscript or a manuscript that is under review. It is extremely useful because it clearly shows the complete standard procedure that an editor should take. The following charts can be found on the COPE website (http://publicationethics.org/resources/flowcharts).

What to do if you suspect plagiarism
- Suspected plagiarism in a submitted manuscript
- Suspected plagiarism in a published manuscript

What to do if you suspect redundant (duplicate) publication
- Suspected redundant publication in a submitted manuscript
- Suspected redundant publication in a published manuscript

Changes in authorship
- Corresponding author requests addition of extra author before publication
- Corresponding author requests removal of author before publication
- Request for addition of extra author after publication
- Request for removal of author after publication
- Suspected guest, ghost or gift authorship
- How to spot authorship problems

Conflict of interest
- What to do if a reviewer suspects undisclosed conflict of interest (CoI) in a submitted manuscript
- What to do if a reader suspects undisclosed conflict of interest (CoI) in a published article

What to do if you suspect an ethical problem
- What to do if you suspect an ethical problem with a submitted manuscript

What to do if you suspect fabricated data
- Suspected fabricated data in a submitted manuscript
- Suspected fabricated data in a published manuscript

What to do if you suspect a reviewer has appropriated an author's idea or data
- What to do if you suspect a reviewer has appropriated an author's idea or data

5. Basic responsibilities of a reviewer

The reviewer should accept the request for review only if he or she has sufficient expertise on the subject for an adequate review. In the following situation, the reviewer should immediately return the manuscript describing the reasons for return.

- One should avoid reviewing a manuscript if he or she lacks expertise or has participated in the requested research a similar research recently.
- If a reviewer finds it difficult in to evaluate the entire content of the submitted manuscript or is able to evaluate the manuscript regarding only certain aspects, then it must be noted in the reviewer's report. The reviewer's field of expertise and focus of review should be described clearly.

If the reviewer agreed to review the manuscript, then the reviewer's comments should be submitted in a timely manner within the given peer review period.

The peer review should be done without consideration of any non-academic factors such as the author's nationality, religion, political beliefs, or gender.

- If the peer review must be avoided due to a conflict of interest, one must adhere to the journal's regulations. If a reviewer is in any of the following situations, and the journal does not provide a guideline, the reviewer should notify the editor.
- The reviewer should declare all personal, financial, academic, occupational, political, and religious conflicts of interest such as currently working or soon to be working in the same institution as the author(s), or if one of the authors has applied to the reviewer's institution to work. If any uncertainties are present, the reviewer should seek advice from the editor (Refer to Chapter 5: Conflicts of Interest).

The reviewer should respect the confidentiality of the content of the peer reviewed manuscript and the peer review process. Any information obtained during the peer review process must be kept secure, and any information obtained during the review process should not be used to the reviewer's own advantage.

- Once peer reviews are complete, the manuscript should either be returned or disposed of. After online review processes, the reviewer must delete the copy after returning the review.
- Individual meetings with the author should be avoided, and even if the identity of the reviewer is revealed, any questions or issues that require consultations with the author during the peer review should be reported through the editor.

The responsibility of the peer review lies with the individual invited by the editor.

- If the reviewer seeks the advice of an expert in the specific field, even if the expert is a colleague in the same institution, the reviewer must still seek approval from the editor. Some journals put responsibility on each reviewer to seek assistance from another colleague as

needed. If another researcher has contributed to the reviewer's comment, the editor should be informed of the names of those who provided assistance so that proper credit can be given. Even if the journal has allowed seeking assistance, if assistance was received, it is still wise to indicate this in the reviewer's comments.

If any major mistakes, misconduct, or misbehaviors in the data, or conflicting conclusions, errors, plagiarism, or duplicate publication are found during the review, the editor should immediately be informed.

6. Reviewers' comments

The manuscript should be evaluated to see if its characteristics suit the journal, if it contains new and scientific significance, if it is scientific and logical in the presentation of results and analysis, and if the content is coherent and understandable.

The reviewer's report should be organized by categories. They should also address the strengths and weaknesses of the manuscript appropriately and thoroughly so that the editor will be able to make an unbiased judgment.

In a critique, weaknesses must be clearly pointed out and suggestions for addressing such weaknesses should be provided.

- The reviewer should check for illogical or biased assertions and make suggestions to clarify the interpretations of the results. He or she can suggest methods to further verify the argument.
- When criticizing the manuscript's argument, the reviewer should provide the basis of such criticism, for example, by citing relevant references. Even if the reviewer decides that the manuscript is not up to publication standards, he or she should provide the reasoning behind the decision and advice for possible improvements in detail.

Unless stated otherwise by the editor, the reviewer should evaluate the entire manuscript.

- If the reviewer does not have the expertise to evaluate one section of the manuscript but thinks this section should still be reviewed, he or she should notify the editor. In such cases, the reviewer can seek an expert's opinion or tell the editor that the review was conducted while assuming the section in question was sound so that the editor can make the proper judgement.

The reviewer's report should be written objectively and fairly. In order to obtain objectivity for the review, one must not have any conflicts of interest with the content of the research or the author. If there is a potential conflict of interest, the reviewer should decline the invitation with an explanation or must seek advice from the editor. If it is believed not to be a significant conflict and

hence does not require declining the invitation, the reviewer can accept the invitation, but the situation must be declared in the reviewer's report.

☞ The reviewer must be able to advocate for both the author and the journal.[2] All effort must be made to provide both unbiased and constructive criticism on the side of the author while refraining from personal attacks. Review should be completed in a timely manner so that the manuscript can be processed without delay. Furthermore, the reviewer must make an effort to only allow manuscripts of the highest quality to be published in the journal by accurately evaluating the quality of the manuscript: more specifically by (i) reviewing any errors in the research process or conclusion, (ii) verifying that the research results support the conclusion, (iii) confirming that other research findings were properly attributed, and (iv) checking that the research has produced an original and meaningful conclusion.

[2] Benos DJ, Kirk KL, Hall JE. How to review a paper. Adv Physiol Educ 2003;27:47-52.

Ⅲ. Follow-up Measures for Published Manuscripts

1. Corrections

When journal editors encounter the following situations, they should consider issuing a corrigendum or erratum to rectify the error: (1) when errors are made during editing, (2) when minor errors in calculations or in descriptions are found after publication, or (3) when there is a need to edit the list of authors such as removing an author who does not meet authorship criteria or adding a deserving author.

2. Expression of concern

If a question raised is so severe that it questions the validity of the manuscript but has not been definitively verified, an expression of concern can be used to explain the situation to the readers and eliminate any potentially harmful effects.

- The expression of concern can be published in the following circumstances: (1) when research misconduct is suspected, but an investigative committee has not yet been formed or the conclusion of the investigation is uncertain, (2) when the validity of the investigation into the misconduct is in question, (3) if the authors or the experts of the field have conflicting opinions on the research, (4) if the result of the research has the potential to harm the readers, (5) if a manuscript that did not receive authorization has been confirmed to have been submitted as a duplicate (in this case, a separate expression of concern for redundancy can be published).

☞ In the past, the expression of concerns were usually issued in medical journals to forewarn readers of problems that have been raised in the articles and to prevent any harm that may be caused to the reader and the public. For example, when a a new drug is being used throughout the world based upon the conclusion drawn in an article that the drug does not have any side effects, the editor can publish an expression of concern informing the readers of the problem while waiting for a conclusive decision so that the risks of the drugs can be reduced.

☞ If allegations of other research misconduct are raised, and if more time is required to conclusively evaluate the validity of the manuscript regarding the research methodology, the editor can publish an expression of concern to inform the readers. Instead of hastily retracting the manuscript without the suspicions being fully confirmed, the editor can explain the situation through an expression of concern. This reduces the dangers caused by extreme measures such as retraction and also allows the readers to obtain accurate information

regarding the published article. After the expression of concern is issued, if the suspicions of research misconduct are cleared, the situation can be explained again to the readers. If the author of the paper is concluded to have committed misconduct, it should be retracted promptly to provide the readers with accurate information.

The editor should minimize the impact of the article in question by publishing the 'expression of concern' as promptly as possible. The announcement should be posted in the online database as soon as the decision is made, and should also be immediately published in the printed version of the journal.

- The fact that the 'expression of concern' regarding the relevant manuscript has been issued should clearly be detectable while searching for the published article in the database. Whenever the article is searched or is downloaded, the expression of concern should be linked to the article. The journal editors and the manager of the journal database must make the greatest effort to ensure that any expression of concern or the revised articles are linked to the relevant article so that the readers can obtain the most accurate information.

When writing an expression of concern, the editor of a journal should clearly identify the article and reveal the specific circumstances that caused the problem.

- The editor should ensure that the article in question can easily be verified in the expression of concern by clearly identifying the author and title at the beginning of the expression of concern; the sections and contents in question should be elaborated in as much detail as possible. In particular, whether the reason is due to research misconduct, or due to an honest mistake, or due to differences in the analysis of results must be clearly stated in the expression of concern. Under no circumstances should the expression of concern include hostile remarks or libelous comments, and should reveal only the contents in question in detail.

3. Retraction

Retraction is a process which announces to readers that the publication cannot be relied upon, and thus should be ignored. The editor should retract the published article within the following circumstances.

- Publications are retracted when the results presented cannot be accepted due to research misconduct, or due to honest errors such as miscalculation or experimental errors. Retractions are also used when the research is confirmed to have been plagiarized or conducted in an unethical manner.
- When a duplicate publication is confirmed without clear prior disclosure or proper permission, the reason should be clearly stated and the second duplicated manuscript should be retracted. Among the duplicated publications, the first published manuscript can remain

published as long as the validity of the study results is not questioned. However, the fact that some of the content has been duplicated should be revealed in an 'expression of concern.'

☞ In the following cases, (1) if only a portion of the manuscript has an error due to an honest mistake and (2) the validity of the manuscript can be sustained after correction, or (3) if only the author has been changed and not the content, then issuing a corrigendum should be considered first.

☞ If plagiarism has been confirmed in only a very small portion such as one or two sentences of the article, the editor should take the readers and the author who has been plagiarized into account and should make a decision on either issuing a corrigendum or retraction of the manuscript. During this process, the opinion of the original author should be fully taken into consideration.

☞ If only a small portion of the article has been duplicated, the editor should decide whether it is better to retract the whole publication or to issue an expression of concern that identifies the duplicate content and allows quoting from a previous publication. The decision can be based on the amount and the importance of the duplicated content. The editors should make an effort to make the best decision from the reader's perspective and must remember that the decision should be based not on punishing the author who committed misconduct, but on ensuring the journal publication ethics.

The notice of retraction should include specific information on who initiated the retraction and why the article is being retracted.

- At the beginning of the retraction note, the title and the author of the manuscript should be clearly identified so that the manuscript can be easily linked to the retraction.
- The reasons behind the retraction should be as detailed as possible. In particular, it should be very clear whether the reason for retraction is due to research misconduct or due to an honest mistake. If the error occurred due to miscalculation or during the experiments, (i) how the error took place in what steps, (ii) problems that resulted from the error, and (iii) which part of the study were not affected by the error, should all be clearly stated. If the error occurred due to research misconduct or duplicate publication, this fact should be accurately summarized and explained to the readers.

☞ Articles get retracted when they have been published without securing validity. This is to ensure the publication ethics, and it should not be considered a punishment for the author. Publications are retracted due to research misconduct such as falsification, fabrication, and plagiarism. But retractions are also applied in cases of honest mistakes such as miscalculation or experimental errors. Retractions should be considered a purification process to improve the

standards of academia. In no cases should hostile or libelous comments be made regarding the author, and only the problematic aspects of the article should be discussed in detail.

☞ The editor should make efforts to create a retraction note that provides accurate information to the readers and is acceptable to all parties involved. However, when the retraction was specifically due to research misconduct, the authors quite often request that instead of clearly stating the fact, the retraction note be written in a roundabout manner. In such cases, if possible, it is recommended that exact phrases are quoted from the report of the investigative committee of the research institution. The editor, while fulfilling his or her duties to truthfully inform the readers, could cooperate with the author regarding the expressions and phrases but still should issue the retraction note in a timely manner.

Retraction of a manuscript should be issued in the following ways.

- Publish the retraction note on the online database promptly after the decision has been made and publish the retraction note in the first printed version right after the decision has been made.
- The article should be retracted as promptly as possible. This is to minimize the probable damage to other researchers, who may waste their time and effort or draw incorrect conclusions based on the invalid publication. This is also to minimize cases where it may lead to a meta-analysis that reproduces the same misleading results.
- Only articles that have already been published can be retracted. If retraction was issued after being published online but before being printed, the retraction note should be linked to the online article using the same methods stated above. However, the printed journal does not need to publish the retraction note.

The retracted article should be open to the public but also clearly state that it has been retracted. When the article is found through a database search, it should be clear that the manuscript has been retracted.

- The retraction note should easily be visible on the page that contains the article. The retracted article should be available to everyone regardless of the journal or online database disclosure policy.
- It should be clearly indicated in the retracted article file that the paper has been retracted. It should also be attached so that the retraction note is automatically downloaded together whenever the manuscript is downloaded.

Retractions should be requested by the author or the publisher and authorized by the editor. The editor can also decide to retract a manuscript under his or her own authority.

Among the authors, an author or all of the authors of the manuscript can request a retraction from the editor. In such cases, the retraction must be justified, and if only a few authors are requesting the retraction, the circumstances must also be clearly explained.

IV. Utilization of Similarity Test Software

1. Two pillars of similarity tests: search engine and database

The search engine and the database are the two pillars of similarity tests. This is because the subjects of comparisons are compiled in a database and the search engine is used to check how similar the data in the database are to the selected text.

Similarity can be tested using an index of internet sources using Google or other search engines, or by utilizing a separately compiled database and search engine.

- CrossCheck, which will be explained in detail below, utilizes a database created by CrossRef. The search engine is one created for commercial use by iParadigms. Other search methods, such as the free web-based search service, eTBLAST (http://etest.vbi.vt.edu./etblast3) developed by Viginia Bioinformatics Institute; MEDLINE, a database for biomedical academics; and arXiv, a database developed by NASA for mathematics, physics, and computer science, can all be used.
- PlagScan (https://www.plagscan.com) is a program that compares the selected text with online data and also allows users to add their own text to the PlagScan database. The Korean service CopyKiller (https://www.copykiller.co.kr) also allows the selected text to be added to its own database. Hence, there are cases where the similarity rises if the same text is searched again. In addition, there are websites such as Copyscape (http://copyscape.com) that use the Google search engine to check how similar a selected webpage is compared to other existing webpages.
- When comparing Korean sentences, the similarity test software developed in English-speaking countries may not be well-suited to handling particles or changes in word order effectively. Professor Hwan-Gue Cho, a computer scientist at Pusan National University is developing DeVAS and DeVAC (http://devac.cs.pusan.ac.kr), programs specifically tailored to detect plagiarism in Korean documents.

Manuscripts that have yielded copyright to publishers are not easily found on the internet. As a result, there is a limit to testing similarity for new manuscripts to be submitted using only online data. Hence, there is a need for journals to utilize academic database search tools such as eTBLAST and CrossCheck. While it is important to use a good search engine to thoroughly screen for similarities, it is more critical to establish a broader database. Here, cases using the most widely used academic database, CrossCheck, will be illustrated as examples, but first, CrossRef, the organization that provides the CrossCheck service, will be introduced.

2. CrossRef: The organization providing the CrossCheck service

CrossRef, which provides the CrossCheck service, is an organization that registers and manages digital object identifiers (DOI).

- A digital object identifier (DOI) refers to unique identification number assigned to digital data. CrossRef links a DOI to the digital data and connects the DOI and the site providing the data.
- Even if the URL of the saved data changes, users who use the DOI numbers to access the data will not be affected. This is because CrossRef is responsible for linking the DOI to the newly changed site address. The DOI is a permanent link.
- The format of DOI is similar to "http://dx.doi.org/prefix/suffix". For example, a manuscript published in 2007 from the journal Automatica from Elsevier has the DOI "http://dx.doi.org/10.1016/j.automatica.2007.xx.xxx".

CrossRef was launched in early 2000 as an association of many scholarly publishers. As of November 2013, there were 24 employees and 18 members of the Board of Directors. Furthermore, many working groups and committees have been established. According to 2012/13 statistics,[3] around 4,500 publishers and academic societies participate in CrossRef and over 63 million journal articles have been given DOI names. Among the content items, 7 million books and around 50 million journal articles have a DOI, comprising 11% and 82% of documents with a DOI, respectively.

3. CrossCheck: similarity test service provided by CrossRef

CrossCheck refers to a service provided to member publishers and academic journals by CrossRef to screen and prevent plagiarism, and it consists of the iThenticate search tool and CrossCheck database.

Crosscheck service = CrossCheck Database + Search Tool iThenticate

CrossCheck is the name of the service and at the same time the name of a database.

The search tool iThenticate is a software program that compares and analyzes texts.

- The search can be conducted on the web (http://www.ithenticate.com), and has also been set up to allow searching from the homepages of journals that subscribe to the CrossCheck service.

[3] CrossRef. 2012/13 CrossRef annual report [Internet]. Oxford: CrossRef; [cited 2015 Dec 16]. Available from: http://goo.gl/C0wZkA

- The search tool iThenticate is a program developed by iParadigms, who also developed Turnitin. This is why CrossCheck is a paid service. Academic journals, once they become members of CrossRef, are provided with the CrossCheck service and are required to pay for an annual license or to purchase credits depending on the number of searches.

The CrossCheck database that has compiled comparable texts is based on the data provided from CrossRef member journals.

- According to 2012/13 statistics, the CrossCheck database includes 38 million items.
- In addition to CrossCheck, third party databases such as PubMed and arXiv.org are available, and internet data can also be included in the search indexes.

4. Using CrossCheck

The procedure for testing similarities is as follows:

- Login to http://ithenticate.com and create a folder to submit the selected manuscript. The search parameter can be designated while setting up the folder. Among the available search indexes, one or all among the databases <CrossCheck>, <Internet>, and <Publications> can be selected. If <CrossCheck> and <Internet> are selected, both the CrossCheck database and internet database collections are included in the data searched. In order to include a third party database as described above, <Publications> can be selected.
- An exclusion list can also be determined. Quoted material, fixed phrases, and bibliographic material can be excluded from the test, and sections such as 'Abstract' or 'Methods and Materials' can also be excluded. The reason 'Methods and Materials' is allowed to be excluded from the test is because there are topics in which the author has no choice but to use wording similar to that of other published documents.

Fig. 1. shows a screenshot of a folder-setting page that excludes quoted material, bibliographic material, and fixed phrases and that includes CrossCheck, Internet, and third party databases in the search.

- Once the settings of the folder have been verified, the similarity test begins. The program supports a variety of file formats such as PDF, Microsoft Word, and HWP (Hangul word processing file).

Fig. 2. presents a similarity report using two uploaded documents. By clicking on the similarity percentage, one can see which documents the selected manuscript is similar to and by how much. The selected manuscript and the similar manuscripts can be compared in many different ways.

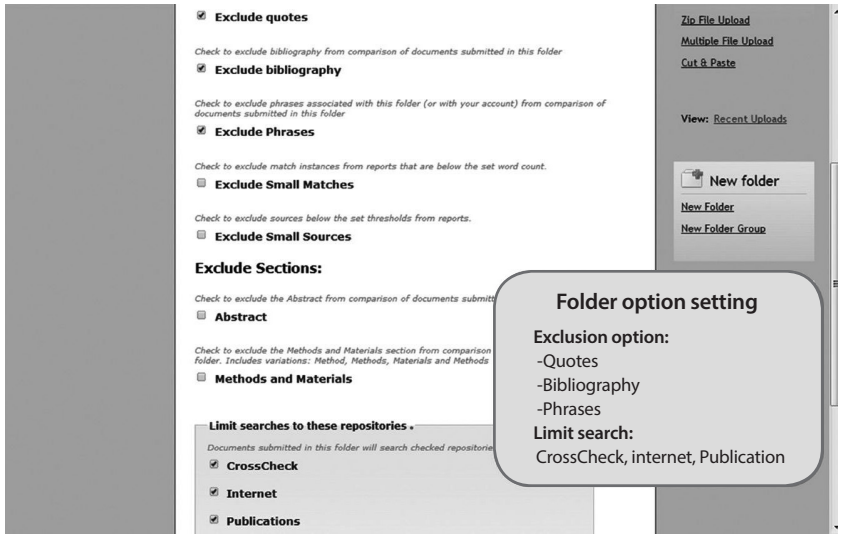


Fig. 1. Folder settings display.

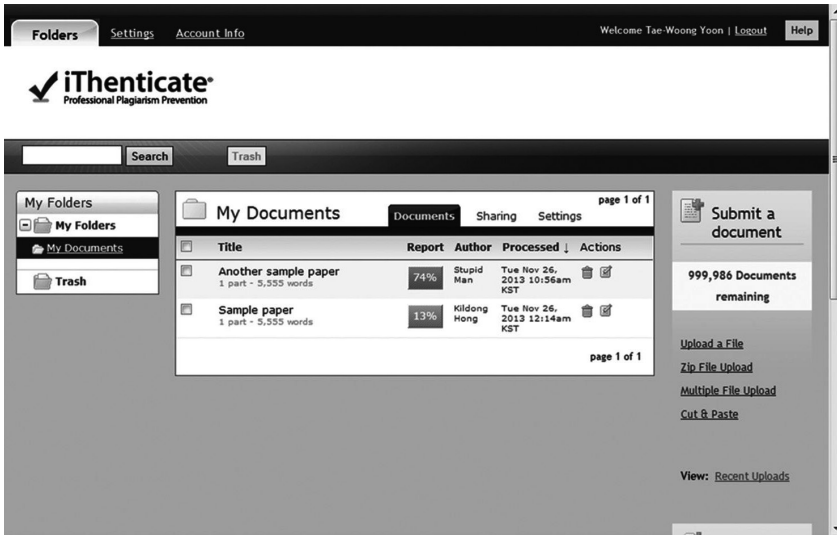


Fig. 2. A screenshot with two files uploaded. Similarity is shown as a percentage.

Figs. 3. and 4. show screenshots when using the text mode and the document viewer, respectively.

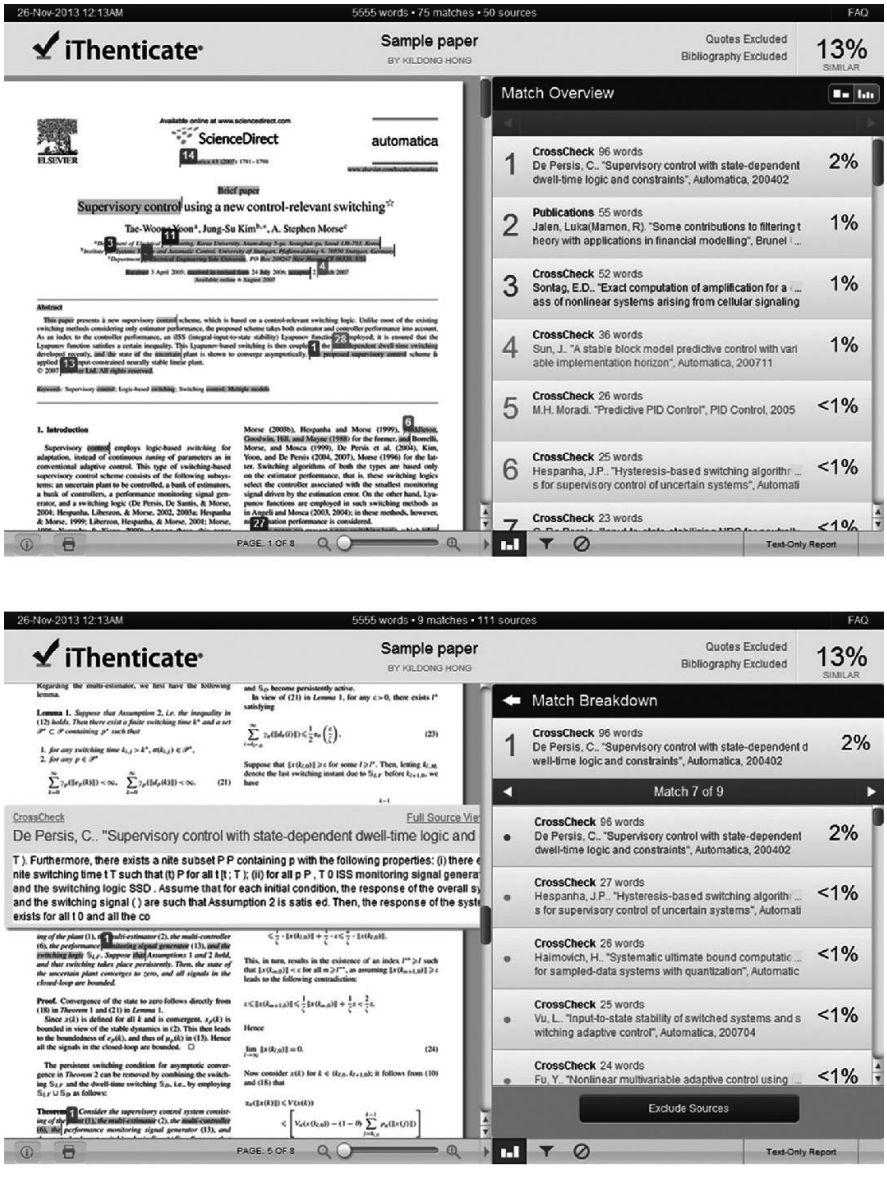


Fig. 3. A case in which the document viewer is being used.

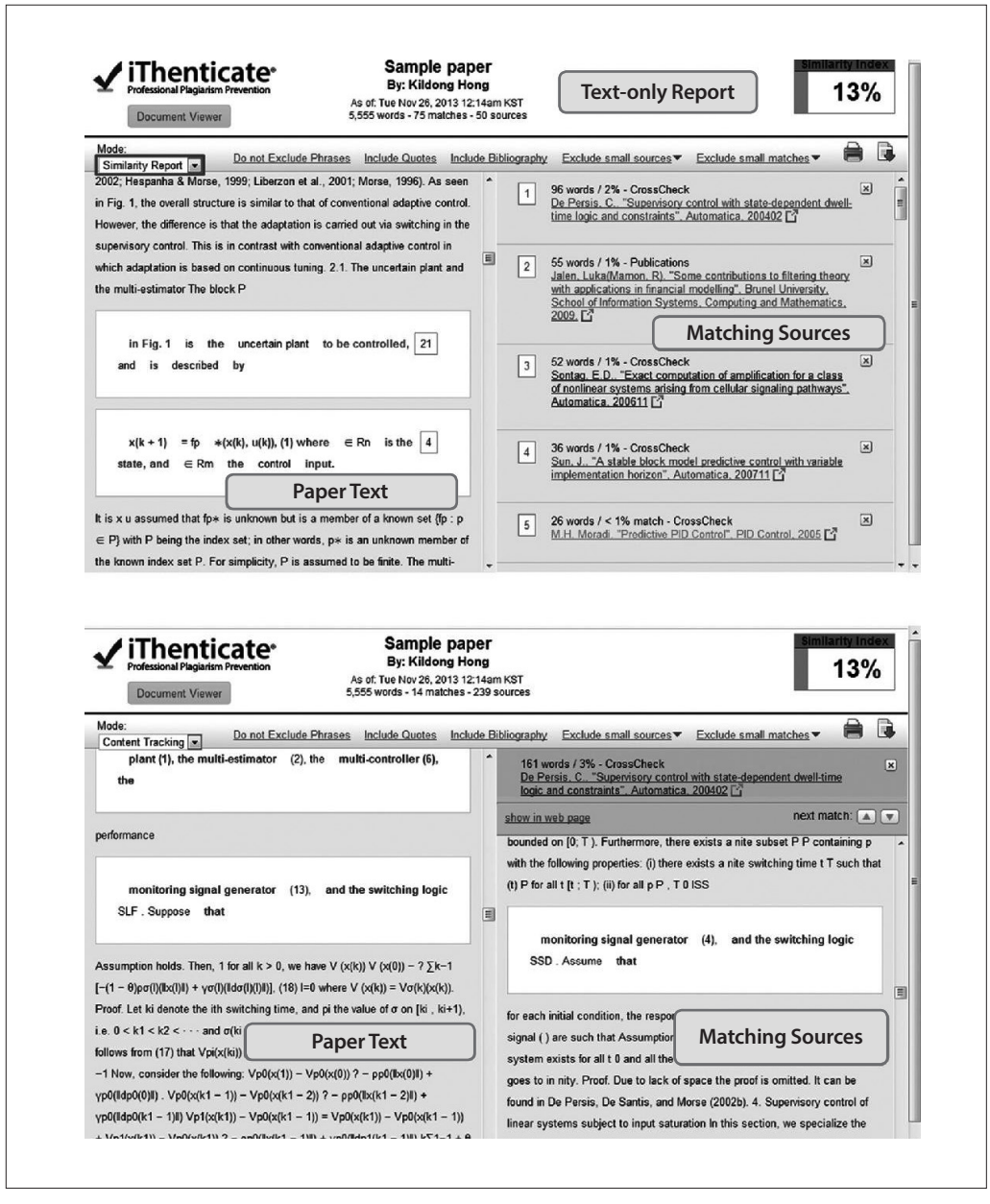


Fig. 4. A case in which the text mode is being used.

5. The significance of a similarity test using a search tool such as CrossCheck

The goal of using a search tool is plagiarism prevention. A program such as CrossCheck cannot be a mechanical tool for checking plagiarism.

- The similarity report shows the degree of the similarity of the documents and not the degree of plagiarism. Just because the similarity is high, it does not mean that it has been plagiarized, and vice versa. However, the higher the similarity percentage is, the more closely the potential for plagiarism should be examined further.
- It is important to examine in detail in what ways the submitted document is similar to other existing manuscripts as shown in Figs. 3 and 4, instead of simply relying on the numerical similarity value. What is important is the content, and the degree of similarity between the content of the submitted manuscript and the existing manuscripts can only be evaluated by the editors and reviewers with expertise.
- Usage of CrossCheck can help prevent a researcher who may have committed plagiarism from submitting the manuscript to CrossCheck member journals; in addition, it can prevent a researcher from plagiarizing from the CrossCheck member journals.
- Each journal can use the similarity test in its own way as a reference in the manuscript evaluation process. For example, if the similarity percentage is higher than a certain value, the author can be invited to rewrite and resubmit the manuscript without entering the peer review process.

Similarity detection software such as CrossCheck should be used to increase the integrity of researchers. Its goal is not to mechanically check for plagiarism.

References

Benos DJ, Kirk KL, Hall JE. How to review a paper. Adv Physiol Educ 2003;27:47-52.

Committee on Publication Ethics (COPE). Codes of conduct and best practice guidelines [Internet]. COPE; [cited 2015 Dec 17]. Available from: http://www.publicationethics.org/ resources/ code-conduct

Committee on Publication Ethics (COPE). Flowcharts [Internet] COPE; [cited 2015 Dec 17]. Available from: http://publicationethics.org/resources/flowcharts.

CrossRef. 2012/13 CrossRef annual report [Internet]. Oxford: CrossRef; [cited 2015 Dec 16]. Available from: http://goo.gl/C0wZkA

Ham CH, Kwon OH, Kim SY, et al. Good publication practice guidelines for medical journals. 2nd ed. Seoul: Korean Association of Medical Journal Editors; 2013.

International Committee of Medical Journal Editors (ICMJE). Recommendations for the conduct, reporting, editing and publication of scholarly work in medical journals [Internet]. ICMJE; 2014 [cited 2015 Dec 17]. Available from http://www.icmje.org/recommendations/

Ministry of Education, Science and Technology; National Research Foundation of Korea, editors. Good research practices' guidelines. Seoul: National Research Foundation of Korea; 2011.

Singapore Statement on Research Integrity [Internet]. [cited 2015 Dec 17]. Available from: http://www.singaporestatement.org

Wager E. Coping with scientific misconduct. BMJ 2011;343:d6586.

Wager E, Barbour V, Yentis S, Kleinert S. Retractions: guidance from the Committee on Publication Ethics (COPE). Croat Med J 2009;50:532-5.

Wager E, Kleinert S. Responsible research publication: international standards for authors. A position statement developed at the 2nd World Conference on Research Integrity, Singapore, July 22-24, 2010. In: Mayer T, Steneck N, editors. Promoting research integrity in a global environment. Singapore: Imperial College Press/World Scientific Publishing; 2011. pp. 309-16.

4

Principles and Procedures of Investigating Research Misconduct

I. Principles of Investigating Research Misconduct

1. Scope of application

When suspicion of research misconduct arises, an investigation process will be carried out according to the code of research ethics of a given research institute. Government-funded projects will have to comply with the principles articulated by the decree of the Ministry of Science, ICT, and Future Planning entitled "Regulations on the Management of National Research and Development Projects" (hereafter, the Decree) or ordinance of the Ministry of Education entitled "Guidelines for Assurance of Research Ethics" (hereafter, the Ordinance).

Rules of research ethics	Codes of the relevant research institute	Decree of the Ministry of Science, ICT, and Future Planning	Ordinance of the Ministry of Education
Legal basis	• Research institutes	• Framework Act of Science and Technology • Regulations on the Management of National Research and Development Projects	• Sciences Promotion Act • Enforcement Decree of the Sciences Promotion Act
Scope of application	• Research by a researcher affiliated with the institute • Includes dissertations, school research funds, and research funded by corporations	• National research and development projects prescribed by the Framework Act of Science and Technology	• Projects subsidized by the Sciences Promotion Act • Research and development projects under the jurisdiction of the Ministry of Education

After the 2007 research fraud incident involving Hwang Woo-suk, the government announced a set of regulations entitled "Guidelines for Assurance of Research Ethics." This was previously an ordinance of the former Ministry of Science and Technology, but is currently a decree of the Ministry of Science, ICT, and Future Planning. Moreover, the 2011 Sciences Promotion Act and the Enforcement Decree of the same act included related articles on research ethics. An ordinance of the Ministry of Education was enacted in order to implement those articles as administrative rules.

※ An ordinance is an administrative rule applied only within a specific department, whereas a decree is applied across all departments. Therefore, a decree is the more general regulation.

Dominant laws regarding research ethics

Framework Act on Science and Technology

Article 11 (Promotion of National Research and Development Projects)

③ The Government shall promote national research and development projects transparently and fairly and manage them efficiently, and determine the matters falling under any of the following subparagraphs in order to closely link the national research and development projects promoted by respective ministries:

4. Matters on the basis of research performance, such as security, information management, performance management, securing of research ethics, etc. of the national research and development projects;

Sciences Promotion Act

Article 15 (Ensuring Research Ethics)

① The Minister of Education, Science and Technology shall formulate and promote policies to ensure research ethics, such as the establishment of Guidelines for Assurance of Research Ethics (hereinafter referred to as "guidelines on research ethics") so as to prevent fraudulent research activities of researchers, which obstruct promotion of sciences, and create a sound environment for academic research.

② The Minister of Education, Science and Technology may fully or partially subsidize expenses necessary for activities of colleges, etc. so as to efficiently promote policies to ensure research ethics under paragraph 1.

③ Colleges, etc. that have received support related to project funds from the Minister of Education, Science and Technology shall establish and implement their own regulations on research ethics to prevent and verify fraudulent research activities in accordance with guidelines on research ethics, and take other necessary measures.

④ Matters necessary for establishing guidelines on research ethics under paragraph 1, the Government's subsidization under paragraph 2 and measures taken by colleges, etc. pursuant to paragraph 3 shall be prescribed by Presidential Decree.

- Articles 30 and 31 of the presidential decree "Regulations on the Management of National Research and Development Projects" present the definition of research misconduct, the obligation to implement self-regulatatory polices regarding research ethics and disciplinary measures for any violation of research ethics. The principles and process of verifying research integrity are prescribed in detail in the Decree of the Ministry of Science, ICT, and Future Planning.
- The Enforcement Decree of the Sciences Promotion Act also articulates the obligation to develop a policy of self-regulation regarding research ethics and the obligations of research institutions. The principles and process of verifying research integrity are prescribed in detail in the Ordinance of the Ministry of Education.

The processes of investigating research misconduct outlined by the Ministry of Science, ICT, and Future Planning (MSIP) and the Ministry of Education (MoE) are virtually identical. The majority of research institutes have also enacted their own codes based on the regulations in the Ordinance of the former Ministry of Science and Technology. Therefore, aside from small details (e.g., the proportion of outsiders to include when forming an investigation committee), there is no room for confusion when implementing the regulations.

- However, when an actual investigation takes place at a research institute, steps must be taken after identifying which governmental department the research development project was a part of.
- The Ministry for Food, Agriculture, Forestry and Fisheries, the Rural Development Administration, and the Ministry of Trade, Industry and Energy each enact separate administrative rules regarding research ethics for national research and development projects under their supervision. Therefore, when an actual case arises, it is necessary to confirm the regulations pertaining to the relevant research project.

2. Scope of investigation

The investigation of research misconduct will be handled by the research institute where the relevant research was conducted.

Regulations on Management, Etc of National Research and Development Projects (Presidential Decree)
Article 31 (Investigation of and Measures for Research Misconduct)
② The head of a research institute that performs a research and development task shall investigate acts suspected of research misconduct in accordance with investigation procedures prescribed in internal regulations referred to in paragraph 1 and report the outcomes thereof to the head of the central administrative agency.

Guidelines for Assurance of Research Ethics (ordinance of the MoE)
Article 13 (Subjects Responsible for the Investigation of Research Misconduct)
① The responsibility for the investigation of research misconduct lies with the research institute where the relevant research was conducted.

- The Decree of the MSIP defines the term "research institute" in Article 2 of the General Provisions section. It includes organizations such as research management institutes, collaborative research institutes, joint research institutes, and endowed research institutes. All of these organizations carry out national research and development projects through contracts with the central administrative agency.

In cases where suspicion of research misconduct arises during the evaluation of a national research and development project, the research institute must carry out the first investigation. The funding agency will then take on the secondary role of reviewing the results of the first investigation.

- In cases where suspicion of research misconduct arises during the evaluation of the final report, the funding agency should only decide whether the project succeeded or failed. Then, after reviewing the results of the research institute's verdict on the research misconduct in question, it must proceed with follow-up measures.

※ Currently, the codes of research ethics at the majority of funding agencies do not clearly define the roles and responsibilities for these matters. Improvement in this regard is urgently needed.

In cases where the researcher has become affiliated with another institution after completing the research project in question, the previous institution must investigate the misconduct and then notify the current institute of the results. Even in cases where the former institution faces challenges in carrying out the investigation due to geographical or other factors, the responsibility lies with the former institution. Moreover, even if the relevant researcher declines to cooperate with the investigation, the former institution must consider all related matters, make an autonomous decision, and then notify the current institution of the results.

In cases where the researcher has become affiliated with another institution during the course of a research project, it may be difficult to determine where the research was conducted. Most research misconduct appears in the final results of the research, such as in dissertations, reports, and other published materials. Therefore, it is reasonable to consider the institution with which the researcher was affiliated when the final results of the research were presented to be the institution where the research was conducted.

In cases where two or more institutions participated in a project, in principle, a separate investigation should be performed at each institution. However, in order to avoid unnecessary duplication and confusion, it is possible for the institutions in question to consult with each other and form a joint investigation committee.

In the following instances, it is possible to request that an investigation be performed by an umbrella organization, such as the funding agency.

Regulations on Management, Etc of National Research and Development Projects (Presidential Decree)
Article 31 (Investigation of and Measures for Research Misconduct)
② *Provided*, That when the head of a research institute that performs a research and development task requests the head of a professional agency to conduct an investigation on behalf of him/her due to difficulty, etc. of securing an investigation expert, the head of the professional agency shall conduct the investigation in accordance with investigation procedures prescribed in internal regulations referred to in paragraph 1 and inform the outcomes thereof to the head of the central administrative agency and the head of the research institute that performs the research and development task.

Regulations on the Management of National Research and Development Projects (Decree of MSIP)
Article 17 (Requesting a Funding Agency to Conduct an Investigation) "Difficulty of obtaining an expert to lead the investigation" under Article 31 2 is applicable in the following cases:
1. In cases where self-investigation is challenging due to difficulty of securing an expert to lead the investigation;
2. In cases where it is determined that carrying out an impartial and reasonable investigation is unlikely;
3. In cases where the investigation of research misconduct involves two or more research institutes and it does not proceed smoothly.

Guidelines for Assurance of Research Ethics (Ordinance of MoE)
Article 13 (Subjects Responsible for the Investigation of Research Misconduct)
② A research institute may ask the head of a funding agency to carry out an investigation on its behalf for the following cases, notwithstanding paragraph 1. A head of a funding agency who receives such a request shall comply, unless there is one of the following special reasons not to do so.
1. In cases where self-investigation is challenging due to difficulty of securing an expert to lead the investigation;
2. In cases where it is determined that carring out an impartial and reasonable investigation is unlikely;
3. In cases where the investigation of research misconduct involves two or more research institutes and it does not proceed smoothly.

3. Time limitations for investigation

The previous "Guidelines for Assurance of Research Ethics" (Ordinance of the former Ministry of Science and Technology) mandated that "misconduct that occurred five years before the reported date… shall not be handled." However, the amended 2011 ordinance and the current decree of the Ministry of Science, ICT, and Future Planning have deleted all such clauses. Therefore, misconduct in all past research can be subject to investigation.

- Currently, the codes of research ethics at the majority of research institutes still retain the rule prescribing a limitation of five years, in accordance with the previous ordinance. This prescription may be applied to dissertations or student research, but for national research and development projects or cases in which the research was subsidized by supporting organizations, all past research is subject to investigation.

The rules regarding research ethics has no relation to the regulations pertaining to disciplinary measures against faculty. Even if a time limitation for disciplinary measures expires, research integrity must be verified.

4. Burden of proof

The research institute and investigation committee have the burden to prove the allegations of misconduct, which means that it is not the respondent who has to prove his or her freedom from suspicion, but it is the investigation committee who has the responsibility of proving the allegations of misconduct of the respondent; the respondent, nevertheless, has the burden of going forward with and of proving any affirmative defenses raised, by a preponderance of the evidence.

Due to the inherent characteristics of the research process, it is very difficult for the investigation committee to become aware of the specific circumstances of the alleged research without the respondent's cooperation. Therefore, if the respondent does not actively cooperate, the committee must regard that as proof of misconduct. For instance, if a suspicion of fabrication arises and the respondent refuses to provide the original material, the investigation committee must interpret this to mean that there is, in fact, no original material.

- A criminal trial requires hard evidence that leaves no room for reasonable doubt, but in a civil trial, when both sides present conflicting evidence, the more credible side is chosen. This is called the "preponderance of the evidence" principle, and this principle is applied in investigating cases of research misconduct case. Following the "preponderance of the evidence" rule, if a respondent does not produce exculpatory evidence to the research institute that raised the allegation, then this omission is accepted as evidence that validates the suspicion of misconduct.
- The Civil Procedure Act of South Korea stipulates, "When a party fails to comply with the order [to submit documents], the court may admit that the allegations of the other party as to the entries in such document prove true. (Article 349)" and "When a party has, on purpose to prevent any use by the other party of the document which he is ordered to submit, destroyed the document or made it unusable, the court may admit that the allegations of the other party as to the entries in such document prove true. (Article 350)"

5. Investigation organizations

According to the Decree of the Ministry of Science, ICT, and Future Planning and the Ordinance of the Ministry of Education, during the preliminary inquiry stage, the institution in question may autonomously form an investigation committee. During the main investigation stage, an investigative body in the form of a committee must be assembled, and must include outsiders and experts in the relevant field of research.

- Decree of the MSIP: A committee of five to nine members.

Regulations on the Management of National Research and Development Projects (Decree of MSIP)

Article 10 (The Composition and Authority of an Investigation Committee)

① An investigation committee shall be comprised of five to nine members, including a chairman and outside experts.

② If any of the following applies, a person must not become a member of an investigation committee:

1. A person who, pursuant to Article 777 of the Civil Act, was or is a relative of the whistleblower or the repondent;
2. A person who was or is a teacher or a student of the whistleblower or the respondent;
3. A person who concerned that he or she may harm the impartiality of the investigation due to a conflict of interest with the subject of the investigation or other reasons.

Guidelines for Assurance of Research Ethics (Ordinance of the MoE)

Article 18 (The Composition of an Investigation Committee)

① The head of the relevant institution shall convene an investigation committee of more than five members, including one chairman, for the main investigation: *Provided*, That the head may establish and manage another form of investigative organization considering the institution's state of affairs, the scope and range of the research misconduct, or other factors.

② When assembling an investigation committee or an investigative organization as described in paragraph 1, outsiders, who are experts in the relevant field of research and/or have no affiliation with the relevant research institute, shall be included in the following proportions:

1. More than 50% shall be experts in the relevant field of research
2. More than 30% shall be outsiders who are not affiliated with the relevant research institute

Article 19 (Exclusion, Recusal, or Evasion of an Investigation Committee Member)

① One cannot become an investigation committee member for a given case if any of the following apply:

1. A person who, pursuant to Article 777 of the Civil Act, was or is a relative of the whistleblower or the respondent;
2. A person who was or is a teacher or a student of the whistleblower or the respondent, or a person who was involved in the same project with the whistleblower or with the respondent;
3. Any other person who concerned that he or she may harm the impartiality of the investigation.

- Ordinance of the MoE: A committee of more than five members, of whom more than 30% must be outsiders and more than 50% must be experts in the given field of research.

After an investigation committee is formed, its independence must be strictly maintained. The committee must be free of any external interventions or instructions.The code of the State Science and Technology Commission and the Ordinance of the Ministry of Education, Science and Technology state that the following persons must be excluded from being members of an

investigation committee: relatives according to civil law, teachers or students, and co-researchers.

- While it is one of the disqualifications from joining an investigation committee, excluding those who "jointly conducted the research" is a vague criterion, since it does not delineate whether "research" here means a project, a jointly written dissertation, or cooperative research in general. The clause, "conflict of interests with the subject of the investigation," is also a bit ambiguous.

Considering the size of South Korea's pool of experts, it is more important to manage conflict of interests with the respondent instead of avoiding it entirely. In addition, opportunities for recusal must be granted to whistleblowers and all statements and opinions of the members of the investigation committee made during the investigation must be recorded.

6. Protecting the rights of whistleblowers and respondents

The opportunities and rights to state an opinion, raise an objection, and present a defense should be guaranteed equally to whistleblowers and respondents. The term "equally" here does not mean granting equal amounts of time for speaking. It means that when conflicting testimonies are given, the investigation committee must not refer to just one side of the argument but must inform the other side and grant the other side the opportunity to give a counter-statement and a defense.

Since these principles were written with the assumption that the whistleblower is an individual, they may be flexibly applied in the following cases: when research misconduct is reported to a research institute after being confirmed at a conference or in a journal, when allegations of misconduct are raised via the internet or the media, when a specific whistleblower cannot be determined, and when the whistleblower is not an individual but an organization, such as a committee.

In reality, protection for whistleblowers is limited since no higher law establishes their protection. However, the investigating agency must strictly maintain the confidentiality of the whistleblower's identity and must be particularly mindful of any disadvantages or discrimination against internal whistleblowers.

Regulations on the Management of National Research and Development Projects (Decree of MSIP)

Article 13 (Protection of the Rights of Whistleblowers and Subjects of Investigation)

The protection of the rights of whistleblowers and subjects of investigation under Article 5 (5) shall be as follows:

1. The investigation agency shall be careful not to infringe upon the rights or honor of the subject of investigation during the investigation process;
2. The head of the investigation agency shall protect the whistleblower from any disadvantages in status or any discrimination in working conditions, and shall keep the whistleblower's identity from being exposed;
3. The receipt of a report on research misconduct and details of the investigation shall not be disclosed to the public until the results of the investigation are confirmed: *Provided*, That cases pursuant to Article 15 are exempt.
4. The subject of the investigation may ask the investigating agency to inform them of the investigative procedures and schedules, and the head of the relevant agency shall comply in good faith;
5. The whistleblower may ask the agency that received their report or the investigating agency to inform them of the investigative procedures and schedules, and the head of the relevant agency shall comply in good faith.

Guidelines for Assurance of Research Ethics (Ordinance of the MoE)

Article 11 (Protection of Whistleblower Rights)

① The term "whistleblower" means someone who recognizes an instance of research misconduct and informs the related evidence to the relevant research institute, the Ministry of Education, Science and Technology, or a funding agency.

② A report can be given in an oral statement, in writing, or via a telephone call or email, and as a rule, shall be given under an actual name: *Provided*, That in cases where evidence containing the name of the research project, title of the dissertation, or detailed proof of the research misconduct is received in writing or email, the research institute or funding agency may process an anonymous report in accordance with the rules of a report given under an actual name.

③ The Minister of Education, Science, and Technology and the heads of the research institute or the funding agency shall protect the whistleblower from any disadvantages in status or any discrimination in working conditions due to making a report of research misconduct.

④ Details about the identity of the whistleblower are not subject to disclosure.

⑤ In cases where, pursuant to paragraph 3, the whistleblower has experienced any disadvantages, been discriminated against, or had his/her identity exposed, the relevant institute shall take responsibility.

⑥ A whistleblower may ask the agency that received the report or the investigating agency to inform them of the procedures and schedules of the investigation after the research misconduct is reported, and the head of the respective agency shall comply in good faith.

⑦ A whistleblower who knowingly reports a false case is not subject to protection.

A respondent is not limited to the person who was reported. Participants in the relevant research or anyone suspected of additional charges during the investigation of misconduct may be added to the list.

A respondent must be presumed to be innocent until the results of the investigation are confirmed. The investigation agency has the obligation to try their best to ensure that no harm is inflicted on the respondent's integrity or rights.

During the investigation, the investigation committee may require the respondent to attend inquiries or hand in materials, but has no legal authority to enforce these actions. However, failure to cooperate with the investigation must be deemed as proof of misconduct.

When a committee takes further action to seize documents or restrict access to research labs, it must thoroughly review whether such measures conflict with laws regarding a person's fundamental rights, and only carry out such actions sparingly.

In cases where a committee collects materials such as research reports or project proposals pertaining to previous research for evidence, it must thoroughly review whether doing so conflicts with laws regarding the disclosure of information.

II. Procedures for Investigating Research Misconduct

1. The basic procedures for investigation

After an allegation of research misconduct arises, the investigative process involves a preliminary inquiry, a main investigation, and adjudication. In principle, the preliminary inquiry, completion of the final investigation, and notification of the results of the investigation must all be carried out within six months.

If, during the actual investigation, it is difficult to complete all of the procedures within six months for any reason, the term may be extended as appropriate.

Regulations on the Management, Etc of National Research and Development Projects (Decree of MSIP)

Article 7 (Investigative Procedures and Period for Research Misconduct)

① The investigative procedures, pursuant to Article 5 (3), shall be carried out through a preliminary inquiry,a main investigation, and notification of the results to the whistleblower and the subject of investigation: *Provided*, That in cases where the head of the investigation agency (hereinafter, the funding agency or research institute subject to the investigation) perceives sufficient evidence of research misconduct, he/she may omit the preliminary inquiry, and in cases where the subject of the investigation acknowledges all research misconduct during the preliminary inquiry and the facts are confirmed, the head of the investigation agency shall not carry out the main investigation.

② The investigation period, pursuant to Article 5 (3), shall last no more than six months: *Provided*, That in cases where the head of the investigation agency faces difficulties in completing the investigation in the given time frame, he/she may extend the period of the investigation after notifying the whistleblower and the subject of the investigation of the reason for doing so.

Guidelines for Assurance of Research Ethics (Ordinance of the MoE)

Article 15 (Investigative Procedures for Research Misconduct)

① When the head of a funding agency or research institute wishes to investigate research misconduct, he/she must go through the steps of a preliminary inquiry, a main investigation, and adjudication.

② The head shall form an investigation committee to carry out the preliminary inquiry and main investigation, and, if necessary, may add steps other than the ones described in paragraph 1.

③ The head of the relevant agency shall launch the main investigation without performing the preliminary inquiry if he/she perceives sufficient evidence regarding research misconduct.

Article 21 (Adjudication)
② The entire investigation, after the beginning of the preliminary inquiry to the adjudication, shall conclude within six months: *Provided*, That in cases where the relevant agency faces difficulties in completing the investigation in the given time frame, he/she may extend the investigation period after notifying the agency from whom the allegation was transferred and the subject of the investigation of the reason for doing so.

2. Preliminary inquiry

The preliminary inquiry is the process of determining whether a main investigation is needed to investigate an allegation of misconduct, and must begin within 30 days of the date of receiving an allegation. The research institute may autonomously determine the technique for executing the preliminary inquiry.

The preliminary inquiry is not required under all circumstances. In cases where there is sufficient suspicion of misconduct, the institute may begin the process with the main investigation.

- The purpose of the preliminary inquiry is to help the main investigation, which involves a significant administrative burden, proceed efficiently. Therefore, conclusions can be drawn from a preliminary inquiry alone, without a main investigation, in the following cases: if the facts of the matter are evident, if the respondent acknowledges all accusations, if the report of misconduct was inaccurate, or if the misconduct was so minor that it does not require investigation.

Regulations on the Managementof National Research and Development Projects (Decree of MSIP)
Article 8 (Preliminary Inquiry)
① A preliminary inquiry, pursuant to Article 7 (1) (hereinafter referred to as "preliminary inquiry"), determines whether a main investigation will be carried out regarding the allegations of research misconduct (hereinafter referred to as "main investigation") and the head of the investigation agency determines what form the committee in charge of the preliminary inquiry will take.
② In cases where an investigation follows an allegation, the preliminary inquiry must begin within 30 days of the date of receiving the report.

③ Even if an investigation committee, pursuant to Article 10 (1), has not yet been formed, in cases where the head of the investigating agency deems that there is a possibility of the evidence being significantly damaged or destroyed, he/she may take measures to preserve the evidence pursuant to paragraph 6 of the same article.

Guidelines for Assurance of Research Ethics (Ordinance of the MoE)
Article 16 (Preliminary Inquiry)
① A preliminary inquiry is the process of determining whether to carry out a main investigation of the allegations of misconduct, and must begin within 30 days of the date of receiving a report. The head of the investigation agency chooses what form the committeein charge of the preliminary inquiry will take.
② The head of the investigating agency may make an adjudication without carrying out the main investigation if the respondent acknowledges all facts of the research misconduct.
③ In cases where the head of the investigating agency deems that there is a possibility of of the evidence being significantly damaged or destroyed, he/she may take measures to preserve the evidence pursuant to Article 20 (2), even if an investigation committee has not yet been formed.
④ The head of the investigating agency shall notify the whistleblower of the results of the preliminary inquiry in written form within 10 days of the completion of the preliminary inquiry, and if he/she has decided not to carry out a main investigation, shall include a specific reason for doing so: *Provided*, That in cases involving an anonymous report, he/she does not have to do so.

A preliminary inquiry involves two components: the process of collecting basic information and affirming the facts before carrying out the main investigation, and the process of excluding cases that involve unreliable or insignificant accusations and therefore do not require a main investigation. Therefore, it is advisable that the preliminary inquiry should be carried out quickly, with the main goal of judging whether an allegation as valid. If so, the contents of the allegation should be evaluated in the main investigation.

- In the preliminary inquiry stage, the examiner may request an interview with the respondent and request additional materials or explanation from the whistleblower. The staff must retain records of all interviews or additional requests.
- For plagiarism or duplicate publication cases, it helps the main investigation greatly if the duplicated sections from the related dissertations or reports are checked and then organized during the preliminary inquiry stage.

The results of the preliminary inquiry must be reported to the whistleblower and, in cases where the research was funded by external sources, to the funding agency as well.

The following is the standard procedure that should be taken after the allegation and through the preliminary inquiry:

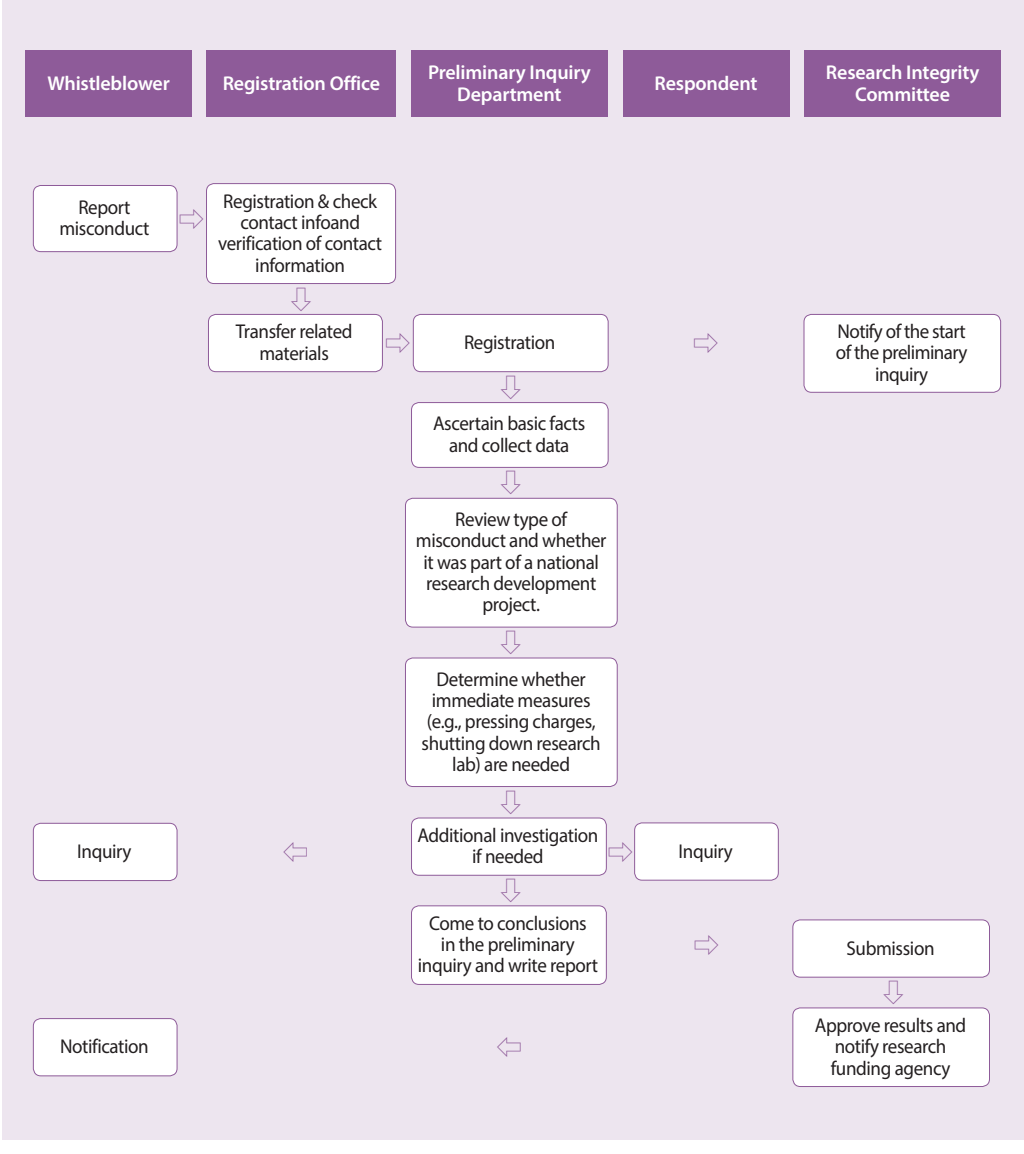


Fig. 1. Procedures for the preliminary inquiry.[1]

[1] Hwang ES, Song SS, Lee IJ, Park K, Sohn WC. Understanding and practice of research ethics. Daejeon: National Research Foundation; 2011. p. 161.

The roles of each agent during the preliminary inquiry are as follows:

Allegation Registration Process

① The person who receives an allegation must transfer materials related to the allegation and the whistleblower to the person in charge of the preliminary inquiry. The person receiving the allegation needs to determine how he or she will contact the whistleblower in the future. If the whistleblower does not want to be contacted in the future, the person receiving the allegation should verify this beforehand, if possible.

Preliminary Execution of the Inquiry

② Ascertain whether or not the basic facts are true.
- For plagiarism cases, procure and compare the reported text, dissertations, or reports.

③ Ascertain the category of misconduct.
- Ascertain whether or not the five-year term of limitations has elapsed (applicable if an institution's internal code has such a clause)
- Ascertain the respondent's affiliation and his or her institutional affiliation during the time of research.
- Ascertain whether the respondent participated in a national research and development project and review if he or she is subject to be reported to a research funding agency.

④ Ascertain whether immediate measures are needed, such as pressing charges or suspending research.
- Not applicable to plagiarism and other simple cases; immediate measures should be applied with restraint.

⑤ If necessary, carry out an inquiry targeted at the suspect
- The inquiry may ask yes or no questions since the purpose is to collect basic information before the main investigation. There is no need to carry out interviews during the preliminary inquiry stage if the research institute does not have the adequate experience or capacity for such an investigation.

⑥ If need be, request that the whistleblower provide additional materials or explanation.

⑦ Determine whether or not the allegation is concrete enough to warrant a main investigation. In cases where the allegation does not fall under the category of misconduct, is too minor, or is clearly a mistake, the main investigation is not needed.

⑧ Write a report on the results of the preliminary inquiry and notify the research integrity committee or the department handling the preliminary inquiry results.
- In cases where a main investigation will take place, the report on the preliminary inquiry results does not need to be formatted in a particular way, but in cases where a main investigation will not take place, the details of the allegation and the evidence behind the judgment must be delineated.

Research Integrity Committee (or the department handling the preliminary inquiry results)

⑨ Acknowledge the results of the preliminary inquiry and notify the parties involved (whistleblower, respondent, and research funding agency).

- In this stage, the results of the preliminary inquiry cannot be reversed by the integrity committee.

⑩ Form an investigation committee if a main investigation is needed.

The roles of each agent during the preliminary inquiry. [2]

3. Main investigation

The purpose of the main investigation is not simply to ascertain whether misconduct took place, but to make an overall judgment after considering all factors, such as the intention and severity of the misconduct, whether it was repeated, the roles of the co-researchers, and other circumstances.

- It is not important to simply determine the whether research misconduct took place; much more important is determining the degree of the misconduct, and how much the research departed from accepted practices of the relevant research community.
- Even in cases with the same quantity of of plagiarism, the judgment may vary considerably according to the intention, the extent to which the plagiarism was repeated, or other factors. Such judgment is the primary goal of the main investigation.

In cases involving suspicions of fabrication, falsification, plagiarism, or duplication, the investigation should not be limited to the specific research targeted in the allegation, but should cover all related research that the respondent carried out in the past.

The investigative process for ascertaining the facts of plagiarism or duplication is relatively simple, but the process of investigating fabrication and falsification may require a substantial amount of time and effort.

The following is the standard procedure that should be taken after the preliminary inquiry up to the beginning of the main investigation.

[2] *ibid*. p. 162.

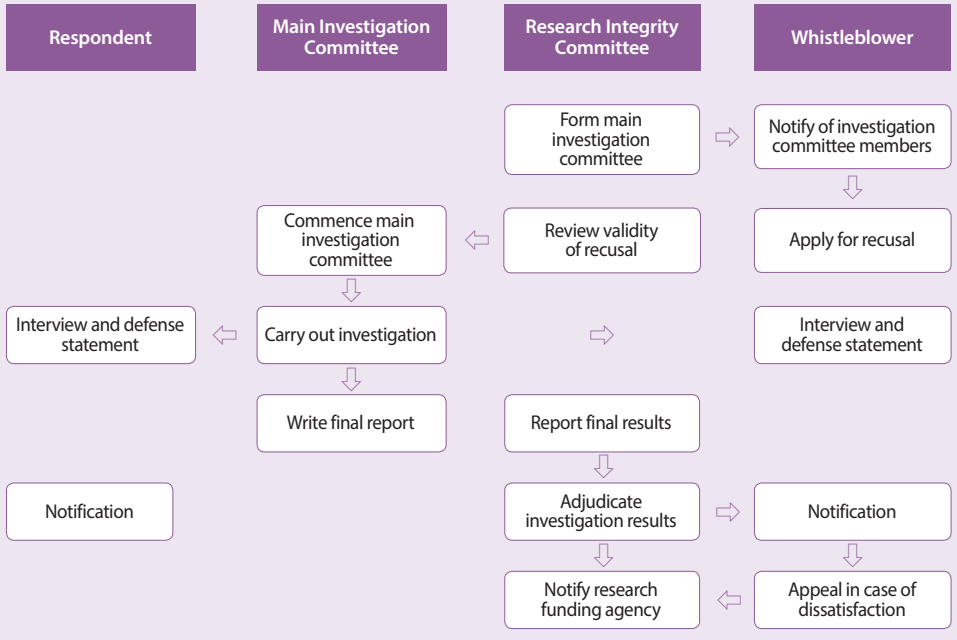


Fig. 2. Procedures for the main investigation.[3]

Research Integrity Committee (or related department) should:

① Form the main investigation committee.
- Comply with the relevant rules, such including outsiders and experts in the research field.

② Notify the whistleblower of the list of main investigation committee members and receive any objections.
- If contacting a whistleblower is difficult due to individual circumstances, the whistleblower is considered to have no objections.

③ Review the validity of the objections and how to respond to them.
- Recruit a different investigation committee member if the the objection is accepted to be valid, and notify the whistleblower again. If a whistleblower repeatedly raises objections which are not accepted to be reasonable, it is acceptable not to respond to them, but the relevant records must be kept in the final report.

④ Notify the whistleblower and the respondent that the investigation has been initiated.

[3] *ibid.* p. 164.

Main Investigation Committee

⑤ Conduct the main investigation.

- Conduct the complete investigative process, ncluding collecting basic data, reviewing, interviewing, questioning, witnesses of material fact, and expert witnesses.
- Guarantee whistleblowers and respondents the opportunity of mounting a defense.

⑥ Draw conclusions and write the final report.

- The final report must, at the very least, contain the following: 1) information about the allegation; 2) a list of the instances of misconduct that were subject to investigation by the investigation committee; 3) a summary of the progress of the investigation; 4) the results of the preliminary inquiry; 5) relevant evidence or testimony by witnesses; 6) defense arguments or statements of opinion of the whistleblowers and respondents, and the investigation committee's judgment on the matter; 7) the final conclusion about the misconduct and the role of each person concerned; 8) the investigation committee's judgment on the severity, frequency, and intention of the misconduct and proposal for the appropriate level of follow-up measures based on that judgment; 9) any issues that arose during the investigation process, limitations of the findings, or suggestions; 10) a list of the investigation committee members.
- If the decisions of the investigation committee members vary, conclusions should be drawn based on the predefined principles on voting.

⑦ Submit the final report to the research integrity committee.

Research Integrity Committee

⑧ Acknowledge the final report and notify the parties concerned, including whistleblowers, respondents, and research funding agencies.

The roles of each agent during the main investigation. [4]

The main investigation committee must establish standards of judgment in preparation for varying opinions among its members.

- Reaching a consensus on whether or not misconduct took place is straightforward, but since each individual may have different opinions regarding the severity of the misconduct, a rule regarding voting (e.g., more than two thirds of the members present must approve when more than the majority is in attendance) must be established beforehand in order to minimize confusion during the investigative process.

Even if the respondent or the whistleblower does not agree with the conclusions of the investigation committee, there is no need to conduct a further investigation.

[4] *ibid*. p. 165.

The following elements must be included in the final report:

1. Information about the allegation or the how a suspicious act was recognized.
   - When, how, and from whom was the allegation received, and what were the details of the initial allegation?
   - If a suspicious act was recognized without being reported, through what process was it recognized and what were its details?
2. The results of the preliminary inquiry.
   - Briefly explain the details of the preliminary inquiry and the reasons for conducting a main investigation.
   - Omit this section if a preliminary inquiry did not take place.
3. List of the acts of misconduct subject to investigation.
   - The investigation not only includes details of the allegations, but also facts that were confirmed during the investigation process. Since a single case involves many components, the instances of misconduct investigated by the main investigation committee should be presented in a list.
4. Progress of the investigation.
   - The progress of the preliminary inquiry after the allegation or recognition of a suspicious action, the research integrity committee, and the main investigation committee.
   - Briefly describe the details of the main investigation activities (interviews, witnesses, and expert witnesses)
   - The progress report later becomes the basis for determining the propriety of the investigation of the research institute during the review of the research funding agency's validity.
   - Records regarding the whistleblower's objections regarding investigation committee members.
5. Relevant evidence or witness testimonies.
   - Record the necessary evidence and witness statements in accordance with the list of misconduct in paragraph 3.
6. The details of the whistleblower's and the respondent's statements of opinion and the investigation committee's judgment on the matter.
   - Organize and respond to the details of the statement of opinion the person involved gave regarding the alleged misconduct, and describe the details of the investigation committee's judgment regarding the statement's veracity.
   - If the whistleblower or the respondent did not actively cooperate with the investigation, explain why.
7. Expert witness's statements needed for making a decision or additional information for review.
8. Final conclusion on the misconduct.
   - Clearly state the final conclusion regarding each article of misconduct and the roles of the persons concerned — including the respondent — in the alleged misconduct.

- Describe the investigation committee's judgment on the existence and the severity of misconduct, whether or not it occurred repeatedly, and what its purpose was.

9. Proposal for follow-up measures.
   - Propose appropriate follow-up measures based on the severity of the misconduct to the parties concerned, such as the head of the research institute, the research integrity committee, and the personnel committee.
   - The range of follow-up measures is very wide, from a warning all the way up to disciplinary action. It is reasonable to go through a separate process to determine the level of punishment, and the investigation committee should propose measures that are specifically relevant to research integrity, such as retracting dissertations, memorandums, restrictions on research and in-school activities, closer evaluation of future research, and so on.
10. Issues during the investigation process
    - Briefly describe the limitations of the investigation committee's efforts and any problems, improvements, or suggestions that arose during the investigation process.
11. A list of the investigation committee members, as well as their signatures and seals.

4. Adjudication

The investigation process is completed when the investigation committee makes a final confirmation of the results of the decisions and notifies the whistleblower and the respondent.

During the process of confirming the findings of the investigation committee, other parties, such as the research integrity committee or agency head, must not arbitrarily change the results.

5. Measures after the investigation of research misconduct

The investigation of research misconduct is completed by the adjudication process. According to the level of severity of the misconduct, follow-up measures will take place, such as personnel committees and disciplinary action.

- In cases where the funding agency is clearly identifiable, such as in national research and development projects or academic support projects, reporting the investigation results to the funding agencies is a part of the process of handling research misconduct.
- The purpose of the research misconduct investigation lies in the verification of the truth of the matter in question, so it is not suitable for the investigation committee to decide on a punishment. However, the committee may suggest a level of punishment based on the degree of severity of the relevant misconduct.

Follow-up measures not only include personnel actions, such as suspension, expulsion, or dismissal, but also include a variety of actions, such as revising or retracting a dissertation or article, taking an oath of honesty for future research, or placing restrictions on additional research.

Institutions have different rules to handle the appeals raised by whistleblowers or respondents.

- Some agencies have codes regarding objections and reinvestigation procedures, while many others do not have codes regarding reinvestigation.

In cases where the funding agency is clearly identifiable, appeals can be made to the relevant agency. Other cases, such as misconduct related to graduate dissertations, may follow the rules of the research institution. If the research institute does not have any rules regarding reinvestigation, whistleblowers and respondents who do not accept the adjudication can only rely on umbrella organizations such as the Ministry of Education, Science and Technology. Procedures on such matters are currently inadequate.

Regulations on Ensuring Research Ethics and Preventing Misconduct (State Science and Technology Commission)

Article 19 (Objections)

① In cases where the whistleblower or the respondent has an objection regarding the results of the preliminary inquiry or main investigation, he/she may appeal in writing to the head of the agency that conducted the investigation within 30 days of receiving the results. The head of the research institute shall handle the objection pursuant to paragraph 1 within 60 days of receiving it, if no special circumstances are involved.

Guidelines for Assurance of Research Ethics (Ordinance of the MoE)

Article 22 (Objections)

① In cases where the whistleblower or respondent has an objection regarding the results of the preliminary inquiry or adjudication, he/she may raise an objection, in writing, to the head of the agency that conducted the investigation within 30 days of receiving the results. The head of the research institute shall handle the objection pursuant to paragraph 1 within 60 days of receiving it, if no special circumstances are entailed. In addition to raising an objection, the whistleblower or the respondent may separately request a reinvestigation regarding the case concerned from the Minister of Education, Science, and Technology or the head of another funding agency.

III. Real-Life Cases of Investigations into Research Misconduct

The investigative procedures in Section II for cases of fabrication, falsification, plagiarism, and duplication do not vary significantly depending on the type of research misconduct.

- Checking the facts during the main investigation process for plagiarism or duplication is relatively simple and takes a short amount of time, but in cases of fabrication, falsification, or improper authorship, checking the facts takes relatively longer due to the necessity of reviewing the research materials and hearing testimony from the persons concerned.

Therefore, in this section, instead of focusing on the different types of research misconduct, we will illustrate the investigative procedures in question through real-life cases that highlight important issues such as the details of the allegation and the relationship between the funding agency and the research institute.

1. Case 1: Suspicion of research misconduct raised from the outside

June 24, 2008 | A whistleblower filed a civil petition to the Board of Audit and Inspection regarding research plagiarism.

- **The details of the allegation were as follows**: The respondent plagiarized the main idea of the research that the whistleblower had been conducting, wrote a research plan, and then applied it to an internal research project at XXX Research Institute and a national research and development project. Since a similar line of research was being conducted, the incident was categorized as plagiarism of a research plan.

September 5, 2008 | The Board of Audit and Inspection passed the relevant information on to the Ministry of Education, Science and Technology, and the Ministry requested XXX Research Institute to conduct an investigation regarding the integrity of the research.

September 11, 2008 | XXX Research Institute formed an investigation committee made up of six insiders and three outsiders and began the main investigation.

- Since the relevant information had been transferred from the Ministry of Education, Science, and Technology and the need for a main investigation was clear, the preliminary inquiry was omitted.

September 2008 | The final verdict determined that plagiarism had taken place, and the results were provided to the whistleblower, the subject of the investigation, the Board of Audit and

Inspection, and the Ministry of Education, Science, and Technology.

- The facts of plagiarism were deemed to be self-evident, so the investigation was completed in a short period of time.

October 9, 2008 | The respondent appealed to an umbrella organization and XXX Research Institute.

November 25, 2008 | XXX Research Institute responded by forming a reinvestigation committee with new members and held four meetings.

- **November 25, 2008**. The committee reviewed the results of the main investigation and composed a series of questions for the persons involved after assessing the main issues.
- **December 22, 2008**. The committee reviewed the answers to their questions and called the whistleblower and respondent for interviews.
- **January 6, 2009**. Researchers other than the respondent were interviewed.
- **January 20, 2009**. The final conclusion was made. The case was not judged to be intentional plagiarism or duplicate research, and the relevant research was allowed to continue. However, it was recognized that the respondent was inattentive in copying preceding research while writing the research plan, so warning and prevention measures were needed.)

XXX Research Institute notified the Board of Audit and Inspection, the Ministry of Education, Science, and Technology, the whistleblower, and the respondent of the findings of the investigation. The investigation was terminated since both the whistleblower and respondent had no objections to the results.

※ The main lessons of this case are that in cases of plagiarism and duplication, the most important factor is what was duplicated, instead of the amount of duplication, and that when multiple researchers are involved, the role of each researcher must be investigated. In addition, it is notable that the respondent's appeal was accepted, a reinvestigation was conducted, and the conclusion was revised as a result of the reinvestigation.

2. Case 2: Suspicion of research misconduct discovered during the evaluation process of a national research and development project

November 7, 2007 | During the final evaluation process of a national research and development project, a suspicion of duplication in the research report arose.

- The details of the annual reports of two national research and development projects the respondent had been simultaneously conducting were duplicated and also overlapped with preceding research reports and other journal articles in the related field.

December 18, 2007 | The relevant funding agency assembled a board of review and requested the university that the respondent was affiliated with to conduct an institutional investigation to evaluate those suspicions.

January 3, 2008 | The university convoked a research integrity committee and decided to launch a main investigation.

January 4, 2008 | An investigative committee was formed, consisting of seven members, and the main investigation was begun.

February 4, 2008 | The final verdict stated that all of the allegations made by the funding agency were true, meaning that the project was plagiarized.

February 13, 2008 | The university notified the funding agency of the results of the investigation.

※ The main lesson of this case is that although a funding agency presented the suspicion of research misconduct, it is the research institute's responsibility to verify the integrity of the research. The role of the funding agency is to review whether or not the integrity of the research was appropriately verified.

3. Case 3: Internal accusation

The whistleblower published an article in a Korean journal on January 2004 based on a 2003 doctoral thesis that he/she had written.

After confirming that a piece similar to his/her Korean dissertation was published in a foreign journal in 2005, but his/her name was omitted from the author list, the whistleblower reported the case to Korean and foreign journals.

- In addition, the whistleblower sued the author of the foreign study for omitting his/her name in the author list and also reported the case to the funding agency that funded the research.

2006 | The funding agency requested the relevant research institute to verify the integrity of the research.

2007 | The research institute conducted a preliminary inquiry and a main investigation.

- The investigation was focused on the primary author of the foreign study and recognized duplicate publication in the Korean journal and the foreign journal.

May 2007 | The funding agency assembled a board of review to assess the results of the research institute's investigation and requested supplemental information regarding the following points:

- Investigation of the primary author and co-authors.
- The roles of each researcher in the planning and execution of the research and in writing up the results in the first doctoral thesis and the Korean study.
- Request for the main investigation committee to confirm its impartiality.

May-September 2007 | The research institute carried out a reinvestigation with new investigation committee members, following the suggestions made by the funding agency.

September 2007 | The funding agency accepted the results of the reinvestigation and decided to replace the chief of research and restrict him/her from participating in research for the next three years.

October 2007 | The foreign journal decided to retract the study because it was a duplicate of the study published in the Korean journal.

※ In this case, a reinvestigation was carried out following the funding agency's argument that the verification of research integrity by the research institute was insufficient. The main lesson of this case is that the the subject of verification does not have to be restricted to the reported person alone and that the intention and specific circumstances of misconduct are important to consider in the judgment.

4. Case 4: Self investigation by a funding agency

September 7, 2009 | An anonymous allegation was registered at the Anti-Corruption and Civil Rights Commission, and the Commission requested the funding agency to submit relevant materials relating to the project.

- The allegation stated that the details of a 2008 annual report on a national research and development project overlapped with a final research report from 2002, and that the 2008 research report contained no actual new results.

December 18, 2009 | The Anti-Corruption and Civil Rights Commission decided that the allegations were true and reported the research misconduct to the funding agency (the Anti-Corruption and Civil Rights Commission became the whistleblower).

December 30, 2009 | The funding agency decided that a self-verification process would be difficult since the respondent was working at a small company. The agency decided to investigate

the case themselves and took measures to suspend research funding.

January 7, 2010 | The preliminary inquiry committee, consisting of 3 outside experts, realized the need for a main investigation in order to determine whether there was duplication in the annual report. The committee concluded that there was no correspondence between the national research and development project and the main points of the preceding research, which the whistleblower had argued were plagiarized. The duplicated phrases were marginal and were therefore judged not to be plagiarism.

January 18, 2010 | The relevant company was notified of results of the preliminary inquiry.

January 27, 2010 | A main investigation committee was formed and the whistleblower (Anti-Corruption and Civil Rights Commission) was notified of the beginning of the main investigation.

February 8, 2010 | The first meeting of the main investigation committee was held.
• A set of questions for the respondent was written.

February 22, 2010 | The second meeting of the main investigation committee was held.
• The answers were reviewed.

February 26, 2010 | The third meeting of the main investigation committee was held.
• The respondent attended and provided an explanation.

March 2010 | The main investigation committee concluded that the annual research report was plagiarized.

※ In this case, not only was the annual report plagiarized, but the results of the new experiments presented in the report were also highly questionable. Therefore, the case demanded a thorough verification of the research results. Moreover, since there was a possibility that the research funding was not used as planned, this process led to an additional inspection of the research funds.

Reference

Hwang ES, Song SS, Lee IJ, Park K, Sohn WC. Understanding and practice of research ethics. Daejeon: National Research Foundation; 2011.

5

Conflict of Interest

I. Definition and Scope of Conflict of Interest

1. What is a conflict of interest?

Conflict of interest can be broadly defined as a situation in which an individual or a group of people are faced with two contradictory interests and thus cannot help but give up or ignore one interest for the sake of the other.

> Conflict of interest represents a set of conditions in which one's judgment on the primary interest, such as the validity of research or the treatment of patients, is unduly affected by secondary interests such as financial gain.[1]

A conflict of interest can be resolved by giving up one of those conflicting interests either by making a conscious personal choice (i.e., giving up a good job for family) or by instituting regulations (i.e., the exclusion of professors with children in senior year from college admission processes). Since situations involving conflict of interest can, at times, have negative social consequences, various judicial and ethical guidelines have been established.

> Granting privileges to retired officials, which is prevalent in Korean society, can be seen as a prime example of conflict of interest. Major law firms and companies seek to hire recently retired high-ranking government officials in order to influence executive decisions or judicial rulings. Under these circumstances, a conflict of interest arises for both the retired government officials and those they lobby, civil servants or judges. The Lawyers Act prohibits such activities.

A conflict of interest in research ethics involves a study being influenced or having the possibility of being influenced by other concerned parties. Possible cases include: cigarette companies funding a study on the effect of smoking on health; a pharmaceutical company providing funding for research on the effectiveness of a drug produced by that particular company.

Conflict of interest could occur even in cases where no financial or other interest is involved and nobody intends to abuse such interest. For example, the religious beliefs of a researcher could hinder unbiased observation in empirical research. In such cases, conflict of interest or bias inhibits impartial research and risks the credibility of research results.

---

[1] Hong SW, Lee SW. Conflict of interest. Gwacheon: Ministry of Science and Technology; 2007. p. 8.

Although conflict of interest affects research ethics, conflict of interest itself is not considered research misconduct or misbehavior. It counts as a violation of research ethics only when the conflict of interest leads to an inappropriate action.

Hence, conflicts of interest should be managed rather than forbidden completely. Conflicts of interest must be clearly identified and be avoided as much as possible, and when unavoidable, must be mitigated appropriately.

2. Types of conflicts of interest

Conflict of interest can be classified in many different ways; however, the most basic division is between financial and non-financial conflicts of interest. Article 18 of the Seoul National University Research Ethics Guidelines outlines the relevant details as follows:

> Seoul National University Research Ethics Guidelines (2010) Article 18 (Conflict of Interest)
> A conflict of interest refers to the case in which any of the following can have negative impacts on an unbiased professional opinion or research performance.
>
> ① **Financial conflict of interest**: Conflict arising from financial gain by the researcher in relation to his/her research
> ② **Personal conflict of interest**: Conflicts resulting from personal relationships, affiliations, personal conflicts, or rivalry
> ③ **Intellectual conflict of interest**: Conflicts between the researcher's religious or moral convictions, worldview, or theoretical position and his/her research
> ④ **Conflict of interest from responsibility**: Conflicts between the researcher's affiliation with education, charity, or other external responsibilities and his/her research
> ⑤ **Other conflict of interest**: Other similar conflicts adhering to articles 1 to 4

Conflicts of interest can also be classified according to whether there is an actual or potential conflict of interest, and whether the primary and secondary interests are in a direct conflict or in an indirect conflict with each other. This classification is purely situational. The fact that a conflict of interest arises does not mean that the conflict automatically results in research misconduct or the damage of the primary interest.

There are cases where no immediate conflict of interest exists, but could arise in the future. For example, a company could pay an excessive honorarium for a lecture or excessive fees for a manuscript to a researcher in the relevant field. If it is probable that this researcher will evaluate a product produced by the company in the future, then one can say that the researcher is facing a

potential conflict of interest.

Even when the primary and the secondary interest are not in actual conflict, it might appear to be the case. It is called "apparent conflict of interest." This might be simply dismissed as misguided; however, since such conflict can unjustly undermine the integrity of the research, it is better to seek an active resolution through disclosure.

Because the primary interest of good research can be affected by the secondary interests of individuals and groups, all the situations regarding conflicts of interest illustrated above can be applied to groups as well as individuals.

3. The importance of resolving conflict of interest

Conflict of interest must be taken very seriously; primarily because it can call into question the integrity of the research. In order for researchers to fulfill their aim of conducting objective and thorough research, they must protect themselves from any conflict of interest that may affect the research. Those interests could create biases in their investigations or experiments.

Even if a specific interest did not directly affect the research, the fact that a researcher is involved in a conflict of interest may undermine the credibility of the research. Hence, even when a researcher is certain that there are no conflicts that would compromise his/her integrity, he/she needs to seek appropriate strategies to resolve the conflict of interest preemptively.

If research misconduct occurs due to mismanagement of a conflict of interest, negative social consequences may follow. In addition, when one attempts to hide or disguise the conflict while a conflict of interest actually exists or appears to exist, such attempt may result in damaging the researcher's credibility as a professional and cause a great loss in social capital. A researchers' professional opinion on a particular government policy is often considered to be twisted based on their political stances, which makes the professional opinion generally meaningless. This, in turn, may threaten the foundation of our knowledge-based society, in which professionals play a significant role.

We should pay more attention to conflict of interest, because more and more cases of unclear and subtle conflict of interest in each stage of the research process are being observed along with blatant and clear ones. In order to prevent the complications resulting from conflicts of interest, it is necessary to have a clear understanding and critical awareness of various types of conflicts of interest, which can lead to rigorous and meticulous policies.

II. Judgments and Resolutions of Conflict of Interest

1. Judgments on conflict of interest

Monetary conflicts of interest can be avoided to a certain degree by effective institutional regulations and guidelines. However, in academia, it is practically impossible to avoid all conflicts of interest. In Korea, for example, researchers in the same field are in close personal relationships and have complex social networks, as the size of academia is relatively small. Thus, it is virtually impossible to escape apparent conflicts of interest in peer reviews.

The initial judgments on conflicts of interest must be made by individual researchers themselves. They should avoid conflict-of-interest situations as much as possible, and reveal any information that may lead to unnecessary misunderstandings in advance. Researchers should actively seek to protect themselves from the inappropriate consequences of conflicts of interest, as well. Note that having a clear conscience does not mean that researchers are safe from the negative influences of conflicts of interest. Hence, researchers are required to have the wisdom and ethical disposition not to create any conflict of interest in terms of the form and contents of their research.

Evaluation of a conflict of interest can take place during the review of conflicts of interest reported by the researcher him/herself. For example, if a researcher testing the effectiveness of a drug reported that he/she owns many shares of the company that manufactures that particular drug, then he/she may be asked to sell the shares before the experiment begins or may be required to modify the contents of the research.

When an investigation of inappropriate conflicts of interest is initiated due to an allegation, there is no choice but to follow the usual procedure for handling research misconduct. However, since there is no detailed regulation regarding conflicts of interest in Korea, one has to rely on the general guidelines and the ethical judgment of the investigative panels. Article 19 of the Seoul National University Research Ethics Guideline refers to conflicts of interest, but it only requires the researcher to stop the research and report the conflict of interest. Detailed strategies regarding how to resolve situations are not provided.

Seoul National University Research Ethics Guideline Article 19 (Management of Conflicts of Interest)
③ If the degree of conflict of interest is severe and has the potential to result in a negative effect on the research, the researchers must terminate the research immediately. In order to continue the research, they must seek the supervision of a third party regarding the impartiality of the research. The lead researcher must ensure that the objectivity of the research is not sacrificed by taking necessary measures such as excluding the researcher involved in the conflict of interest from the project.

2. Resolution of conflicts of interest

As previously mentioned, conflicts of interest must be managed and not prohibited altogether. Conflicts of interest should be managed by the researcher's affiliated organization, the academic society publishing the manuscript, and the organization funding the research. Resolutions should be presented through various regulations and guidelines. They can be generally classified into two categories: prohibition of a certain act or a conflict-of-interest situation and public disclosure of any interests involved.[2]

1) Resolution through prohibition

Resolution through prohibition means either avoiding conflict situations completely or minimizing the degree of conflicts through various regulations and guidelines.

- For example, a member of an Intellectual Property Rights Dispute Committee shall be excluded from deliberation on and mediation of the relevant case, if (1) he/she has a kinship relationship with the party of the relevant case, (2) he/she was involved in that particular case in the past, or (3) he/she has a direct interest in the case (Invention Promotion Act, Article 41-2).

2) Mandatory public disclosure

In order to avoid damaging the objectivity of the research due to a conflict of interest, the researcher can be required to disclose conflicts of interest in advance.

Disclosure of conflicts of interest has many benefits. (1) It allows researchers to avoid research misconduct due to conflicts of interest in advance by taking necessary measures in the research planning stage. (2) By revealing conflicts of interest, the researcher is encouraged to pay more attention to maintaining the objectivity of the experiment. (3) By revealing conflicts of interest in advance, one can avoid unnecessary misunderstandings by evaluators and users, and achieve objective judgment on the credibility of the research.

In the United States, "significant financial interest" is clearly defined in the Code of Federal Regulations (45 CFR 94). To observe this regulation, research centers require researchers to produce conflict-of-interest prevention plans such as submission and review of financial disclosure statements.[3]

---

[2] Park KB. Researchers' conflict of interest problems and their management plans. Seoul: Science and Technology Policy Institute; 2006. pp.11-15. In this report, prohibition, disclosure, and management were suggested as resolutions for conflict of interest. In the current study, however, prohibition and disclosure are suggested as part of the management plans for minimizing or eliminating conflict of interest.

[3] Recited from Roh WJ. Conflict of interest management policy [Internet]. Cheongju: Center for Research Ethics; [cited 2014 Jan 15]. Available from: http://www.cre.or.kr/board/?board=responsibilities_articles&no=138256

United States Code of Federal Regulations 45 CFR 94.4: Responsibilities of Institutions regarding investigator financial conflicts of interest [4]

Each institution shall:

a) Maintain an up-to-date, written, enforced policy on financial conflicts of interest that complies with this part, and make such policy available via a publicly accessible Website.

b) Inform each investigator of the institution's policy on financial conflicts of interest, the investigator's responsibilities regarding disclosure of significant financial interests, and of these regulations.

c) If the institution carries out the PHS-funded research through a subrecipient (e.g., subcontractors, or consortium members), the institution (awardee Institution) must take reasonable steps to ensure that any subrecipient investigator complies with this part.

d) Designate an institutional official(s) to solicit and review disclosures of significant financial interests from each investigator who is planning to participate in, or is participating in, the PHS-funded research.

Research institutions need to identify types of conflict of interest that arise frequently and create detailed guidelines to prevent unnecessary concern and misunderstanding.

- Various institutions such as journal publishers, funding organizations, and administrative agencies responsible for management and supervision could make checklists preventing conflicts of interest and require the researchers to fill out the checklist.
- A detailed guideline will help researchers' personal judgment on their own situation.
- For example, in cases of monetary conflicts of interest, they could specify the maximum amount of funds as the criteria of prohibition and disclosure.

3. Examples of conflicts of interest and resolutions

The types of conflicts of interest illustrated above and their resolutions can be organized as follows:

		Monetary conflicts of interest	Non-monetary
Actual conflicts of interest are present.		A	B
There are no actual conflicts of interest.	Potential conflicts of interest	C	D
	Apparent conflicts of interest	E	F

[4] Extracted from the regulation. Source: http://www.ecfr.gov/cgi-bin/text-idx?SID= 40467ab1eee4986a466a3d66ca54eb b0&mc=true&node=pt45.1.94&rgn=div5

1) Actual monetary conflicts of interest (A)

Case 1 | This is a typical exemplary case as mentioned earlier: a researcher conducts a study on the hazards of smoking and receives funding from a cigarette manufacturer.

- **Resolution (individual)**: He/she does not conduct the experiment or he/she discloses the company that provided the funding.
- **Resolution (institution)**: The academic society publishing the journal requires the researcher to disclose the sponsor organization, if there was one, during the peer review or upon publication.

Case 2 | A researcher is a large shareholder in a manufacturing firm, from which the equipment necessary for the research is expected to be purchased.

- **Resolution (individual)**: The researcher reveals the ownership of the stocks and does not participate in the selection process of the equipment.
- **Resolution (institution)**: If a researcher participating in the process of selecting the equipment owns stock in the relevant company, the institution should disclose it while establishing a detailed regulation for such matters.

Case 3 | A researcher who owns some stocks in company A accepts a research and development project from a competitor company B.

Case 4 | A researcher owns stocks of a company that has close ties with his or her research.

Case 5 | A researcher is doing voluntary consulting work as a member of the Advisory Council on Science and Technology Policy and receives an offer to serve as a nonexecutive director at a company that is about to develop an advanced technology. The company plans to apply to the government for funding.

Case 6 | A researcher obtains classified bid information while serving as a director of a college classrooms improvement project and selects the company owned by his or her own relative for the project.

2) Non-monetary and actual conflicts of interest (B)

Case 1 | A researcher receives an offer to peer review a manuscript very similar to his or her own.

- **Resolution (individual)**: The researcher declines the offer or informs the editor-in-chief of the journal and asks for a re-evaluation of the situation.
- **Resolution (institution)**: Academic societies that publish a journal should develop detailed regulations for such situations.

Case 2 | A researcher is invited to serve as an outside member of a college faculty hiring committee while the researcher's own advisee applies for the position.

- **Resolution (individual)**: The researcher declines the offer to serve as an outside search committee member.
- **Resolution (institution)**: The college should establish detailed regulations on the qualifications required to be an outside search committee member.

Case 3 | A researcher serves as an outside college faculty search committee member while his or her college advisor's son or daughter is applying for a position.

Case 4 | A researcher is asked to conduct a study evaluating the campaign promise of the presidential candidate he or she supports (and a government position is expected as a payoff).

Case 5 | A researcher is asked to provide consultations on the evaluation of the chemical waste treatment of a firm. The researcher's own sibling works in the firm and is awaiting a promotion.

3) Potential monetary conflicts of interest (C)

Case 1 | A researcher is highly likely to participate in an upcoming government project assessment commission and receives an invitation to give a talk with a high honorarium at a research institute that is planning to apply for the project.

- **Resolution (individual)**: The researcher does not accept the invitation. If the researcher, however, already accepted it, he or she should either reject serving as a commissioner or inform the government agency about the invited lecture.
- **Resolution (institution)**: Government agencies providing funding for the commission should establish detailed regulations regarding the selection process of the commissioners.

Case 2 | A drug manufacturer purchases a large quantity of subscriptions to a particular pharmaceutical journal that leads to the financial benefit of the associated academic society.

- **Resolution (institution)**: The academic society should make it clear to its members and to the pharmaceutical company that such contributions should not affect the integrity of the research and also ensure that the budget is not going to rely too heavily on the company involved.

Case 3 | A son or daughter of the executive of a company funding a study applies to the graduate school of the researcher's university.

4) Potential non-monetary conflicts of interests (D)

Case 1 | Researchers had a tacit agreement not to hire females as new tenured professors regardless of their qualifications or professional suitability for the department.

- Resolution (institution): The institution should clearly specify the evaluation criteria and establish regulations prohibiting sexual discrimination.

Case 2 | An organization that the researcher is involved in conducts a study on the effectiveness of a drug manufactured by a pharmaceutical company owned by a relative (The researcher does not do the testing himself or herself).

- **Resolution (individual)**: The researcher notifies the relevant pharmaceutical company of his or her personal relationship with the organization and does not partake in the oversight of the study in any way.
- Resolution (institution): The institution performing the research should create detailed regulations on the evaluators' qualifications.

Case 3 | A researcher is asked to investigate the plagiarism allegations of a member of the same academic society.

Case 4 | A university appoints a tenured professor, while he is an advisee of a professor who is influential to a research project the university is launching.

5) Apparent monetary conflicts of interest (E)

Case 1 | Due to sudden financial troubles, a researcher secretly sold stocks of a firm that he/she has owned for a long time. The firm has recently participated in the bidding process for the sale of research equipment to the researcher's institution, and the researcher participates in the process.

- **Resolution (individual)**: Prior to the bid evaluation process, the researcher informs the other evaluation committee members of the fact that he or she has sold the stocks of the relevant company.

6) Apparent non-monetary conflicts of interest (F)

Case 1 | A researcher serves as a reviewer of an important research project evaluation committee without knowing that one of the final candidates involved in this project was a high school classmate.

- **Resolution (individual)**: The disclosure of the researcher's personal information should be forbidden, and the researcher should avoid any direct and indirect contact with the candidates to prevent any unnecessary misunderstandings.

References

Hong SW, Lee SW. Conflict of interest. Gwacheon: Ministry of Science and Technology; 2007.

Park KB. Researchers' conflict of interest problems and their management plans. Seoul: Science and Technology Policy Institute; 2006.

Roh WJ. Conflict of interest management policy [Internet]. Cheongju: Center for Research Ethics; [cited 2014 Jan 15]. Available from: http://www.cre.or.kr/board/?board =responsibilities_articles&no=138256

6

Bioethics

I. Principles and Scope of Bioethics

II. Institutional Review Boards (IRBs)

III. Institutional Animal Care and Use Committee (IACUC)

I. Principles and Scope of Bioethics

Research that tests the safety and efficacy of diverse technology and substances applied to humans can be divided into clinical research, which uses human subjects, and preclinical research, which uses animals instead of people.

Scientific research is a tool to fulfill the freedom of thought and right to know of the individual and has, at the same time, a social responsibility. The foundation of bioethical thinking with respect to research using humans and animals as subjects is maintaining dignity for life.

All research activities must comply with bioethical standards. To ensure compliance with ethical standards for research, independent organizations have been established to oversee this aspect of institutional research activities. Two of these organizations are: institutional review boards (IRBs), which deliberate on research on human subject research; and, institutional animal care and use committees (IACUCs), which monitor animal research.

Before research begins, researchers involved in human and animal testing must obtain approval from the appropriate committee by preparing protocols as prescribed by each committee (ex-post facto approval is strictly forbidden). All academic journals have considered IRB/IACUC approval of human and animal testing as a final prerequisite for publication.

1. Scope of human subject research

Human subject research is conducted not just in biomedical science, but in a variety of academic disciplines including: agricultural science; veterinary science; engineering; the humanities and social sciences; sports physiology; cosmetology; and in food science.

2. Principles of human subject research

In human subject experiments, the protection of the 'subjects' participating in the experiment is prioritized above the researcher or the ordinary people who benefit from the results of such clinical trials. Particularly, when the research subject is a human, the experiment is to be conducted only when necessary, and the subject's safety must be guaranteed in all situations. Additionally, the subject must be protected from risk and harm concomitant with the research by protecting the

subject's personal information.[1]

All research involving human subjects must comply with a variety of regulations set out in the Declaration of Helsinki, the fundamental ethics policy on human research. In South Korea, depending on the type of research and its characteristics, research must comply with regulations prescribed by the *Bioethics and Safety Act*, the *Pharmaceutical Affairs Act*, the *Medical Device Act*, and the *Personal Information Protection Act*.

The credibility of the data must be ensured through the whole research process. To increase credibility, the experimental techniques of the research must be standardized and a sample selection ought to be generalized by random selection. The adoption of standard operating protocols (SOP) and good laboratory practices (GLP) greatly help to generate credible research results.

Natural Sciences	Humanities & Social Sciences	Other
University Hospital - Medical records research - Cohort research - Clinical studies of previously approved medicine - Research on human - biological material such as tissue or blood	**Questionnaires** **Behavioral science research** **Interviews** **Observational studies**	**Sports physiology** **Use of human biological materials** **Animal studies**

Fig. 1. Scope of experimentation involving human subjects (Korean Council of Science Editors Symposium Presentation Materials, 2013).

3. Types of human subject research

1) Observational studies

Observational studies include: research that directly or indirectly uses identifiable personal information on research subjects; research that collects information through human relationship; and research that uses human biological materials.

[1] Ham CH, Kwon OH, Kim SY, et al. Good publication practice guidelines for medical journals. 2nd ed. Seoul: Korean Association of Medical Journal Editors; 2013. pp. 2-3.

In observational studies, the protection of personal information and management of human biological materials is critically important. In addition, the study's objective and plans, any benefits or compensation, the process and method of participation, as well as the risks involved in participating in the experiment must be clearly explained to the candidates expecting to participate in the experiment. Based on this, the study candidates must make their own decisions on whether or not to participate in the study. Referred to as 'informed consent,' this is the most fundamental element of such research.

Criteria for the waiver of informed consent in observational studies prescribed by the Bioethics and Safety Act (determined by the IRB)

- When it is not possible to collect consent forms from all subjects providing data due to the use of big data or a large volume of data as research material
- When the subjects' consent was not obtained but there are no risk factors that arise from carrying out the research
- When there seems to be no reason for the subject to refuse consent (Even with a waiver of informed consent, measures such as: identification coding; isolation of data collected on subjects; and, separation of the observer-researcher must be implemented in order to minimize risk factors.)

2) Experimental studies

Experimental studies can be defined as a type of research in which some variables of a standardized experimental process are intentionally changed or altered, and their effects are observed. These alterations increase the level of risk in these studies compared to simple observational studies.

Check list for determining the validity of an experimental study

- Did the subject provide voluntary consent to participate in the experiment based on a sufficient explanation by the researcher?
- Does the study protect vulnerable subjects who may have difficulty protecting themselves (children, students, employees, senior citizens, etc.)?
- Does the study's research design have appropriate social value?
- Does the benefit given to the public through the study outweigh the risk related to the subject?
- Does the study expose subjects to ethical injustice caused by the experimental treatment (deprivation of opportunity for treatment, etc.)?
- Does the study guarantee the privacy of the subjects' personal information?
- Does the study pass legitimate IRB review?

4. Principles in experimentation on animals

1) Research on animals

Laboratory animals essential for clinical study are defined as "animals that are developed, improved, and produced in order to be used in experiments, diagnosis, teaching, research, and the manufacturing of medical substances and devices."

Quality assurance is needed in order to ensure the credibility of all clinical research, and all stages of the experimental procedure and animal management should be standardized. Quality control of laboratory animals includes disease management based on microbial control, breeding control to maintain genetic quality, the use of materials as regulated, and environmental control to maintain a uniform facility environment.

To obtain credible research results by complying with and maintaining quality control specifications in all clinical experiments, research institutions established the IACUC, which operates as an independent entity. Additionally, a non-governmental civil organization, the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC International) evaluates the qualifications of the institution and the conditions of the animal research facilities with the goal of enhancing the credibility of research institutions.

2) Guidelines for animal research

Experimentation on animals must be conducted while taking into consideration both the dignity of the life of the animal and the advancement of human welfare. Experimentation must be carried out by a person possessing knowledge and experience with the ethical treatment and scientific use of animals.

All researchers must comply with the basic principles of animal testing, called the 3Rs (replacement, reduction, refinement).

- Replacement: Where possible, methodologies that do not require animal testing should be implemented.
- Reduction: The numbers of animals used in experiments should be minimized.
- Refinement: To improve animal welfare, methods that eliminate or reduce unnecessary pain and distress should be used. To improve research credibility, research protocols should be simplified and refined.

In potential painful experiments, species of laboratory animals which have a lower sensitivity to pain should be used. Appropriate treatments, such as the use of analgesics, sedatives, or anesthetic agents, should be administered to mitigate the pain.

In cases where a post-trial exam reveals that an animal is not expected to recover or will live in pain, euthanasia must be carried out.

The Royal Society for the Prevention of Cruelty to Animals in England identifies five freedoms possessed by animals. The animals having these protected rights include farm animals, exhibition animals, household pets, and laboratory animals:

- Freedom from hunger or thirst;
- Freedom from fear and distress;
- Freedom to express normal behavior;
- Freedom from pain, injury, and disease; and,
- Freedom from discomfort

While difficult to implement in their entirety, suggestions by environmental NGOs regarding laboratory animal research, do offer opportunities for researchers to adopt common sense practices which can improve the performance of rational animal research.

In the case of South Korea, besides the 3Rs, effort is being made to enhance the credibility, ethicalness, and proper management of experimentation on animals through the enactment of the *Animal Protection Act* (2007) and the *Laboratory Animal Act* (2010).

The implementation of the *Bioethics and Safety Act* contributes to the promotion of national health by creating a morally sound life sciences field respectful of the dignity of human and animal life.

3) Procedures for experimentation on animals

The procedures for animal experimentation involve: animal resource management; researcher education; IACUC review; and performance evaluations of the experiment. At each stage, professional standardized management is needed. Each process is systemically connected, and only research procedures that have obtained approval through IACUC can conduct animal experimentations.

As science develops and new academic activities, such as convergence research, gain momentum; the kinds of laboratory animals used in research have has diversified. Accordingly, the establishment of special rearing facilities and proper management of animals is becoming very important. Depending on the research institution, comprehensive management of animal resources is carried out through a dedicated laboratory animal resource center.

II. Institutional Review Boards (IRBs)

1. IRB mission

In accordance with Korea's *Bioethics and Safety Act*, IRBs conduct reviews, investigations, and supervision concerning: research involving humans; research using human biomaterial specimens; and research using people's personal information.

2. Background of IRB establishment

A fundamental idea guiding human subject research is Bernard's assertion (1865) that: "the moral principle of medical testing is to not conduct experiments which could cause harm to a human subject even if the test results would be highly beneficial to science and helpful to the health of others."

Major reports and declarations forming the basis of IRB establishment.

- The Nuremburg Code: After the Second World War, this document stipulated that voluntary consent of the subject of human experimentation is required.
- The Declaration of Helsinki: This document presents the theoretical basis for the establishment of IRBs, emphasizing the protection of vulnerable test subjects and the responsibility (prudence, sense of responsibility, and qualifications) of the researcher.
- The Belmont Report: This document defined "scientific activity as based on respect for people, beneficence, and justice."
- Afterwards, the International Conference on Harmonisation Good Clinical Practice (ICH-GCP) strongly advocated for the standardization of clinical trial processes and reporting. As well, the ethical guidelines of the Council for International Organizations of Medical Science (CIOMS), suggest conducting trials within a country's socio-economic landscape.

3. Role of IRBs

As prescribed in the Bioethics and Safety Act, researchers seeking to conduct human subject research must submit their research protocol to the IRB for a review of its ethical validity prior to commencing research (Article 15).

IRBs review the research protocol to ensure the subject's protection (guarantee the rights, ensure the safety, and maintain the welfare of the subject) by:

- Determining the ethical and scientific validity of the proposed research protocol;
- Inquiring into whether consent was obtained from the research subjects following valid procedures;
- Complying with matters related to the safety of the research subjects;
- Determining whether measures were established for the protection of the research subject's personal information; and,
- When reviewing the research of an institution with (or without) an IRB, determining whether there was compliance with all bioethics regulations.

IRBs can perform the following activities independently: plan and conduct education initiatives for related staff and researchers at an institution; provide ethical guidelines for researchers; and conduct bioethics-related research and services deemed necessary by the board.

Human subject research may only begin after the review and approval by the IRB. Ex-post facto review is strictly prohibited.

4. IRB composition and main members

The number of IRB members varies depending on the research institution, and the member qualifications are as follows:

- A member from within the life sciences or medical fields or someone with expertise in human subject research
- A member from outside of the life sciences or medical fields, who is able to evaluate the ethical and scientific validity of human subject research as well as its social influence
- An external member who represents the public good with respect to bioethics and safety (a member, who is not related to the corresponding institution that conducts the experiment such as a lawyer, religious leader, ethicist, etc., should be appointed)

The head of a research institution has full responsibility for every case decided independently by the IRB. Parts of these responsibilities include ensuring the effective operation and independence of the IRB.

5. IRB review

In medical and bioengineering research, obtaining IRB/IACUC approval is a prerequisite to publishing an academic paper. Recently, approval for research involving human or animal subjects has become required, not just for academic papers, but for graduate theses and dissertations.

Depending on the content, the IRB reviews the submitted research protocols in one of three ways: full board review; expedited review; and exempt review.

1) Expedited review categories of research

- Research using a minimal quantity of biological specimens or materials and the data derived from medical devices
- Research using biological specimens from subjects at another institution and with IRB approval from that institution
- Research conducted using interviews or questionnaires
- Research requiring a second review after the expiration of the original research project
- A previously approved research proposal requiring an amendment

2) Exempt review categories of research

- Research involving surveys or observation of simple behaviors without collecting private or sensitive information from research subjects
- Research using human biological materials that has minimal risk to the donor and the public
- Research that does not collect personal information and is carried out within the scope of normal educational practices
- Research requested by federal or local government in emergency situations (i.e. public health matters)
- Research conducted using materials from a human biological material bank
- Research using human biological materials leftover from diagnosis and treatment
- Research using donated samples whose genetic traits and personal information are unidentifiable

When a research protocol receives a review exemption, the researcher is notified immediately. In the case of an expedited review, the board members review the protocol and can approve it, approve it with corrections required but without further review, approve it with corrections and further review or return it to full board review.

In full board reviews, protocols are either: approved, approved as modified by the IRB, deferred for expedited review, or rejected. The research protocol must include an informed consent form which is reviewed in an identical manner and determined to: be approved, require revisions, require

additions, needing full board review, or exempt from review. Other materials reviewed as part of the protocol include the researcher's credentials, a case report form, as well as documents provided to research participants.

Should a protocol be rejected or require changes, the principal investigator must re-submit the protocol with the required changes; the protocol is reviewed a second time depending on its appropriate level of review. Generally, the principal investigator provides a written response but may also be invited by the board to answer questions in person.

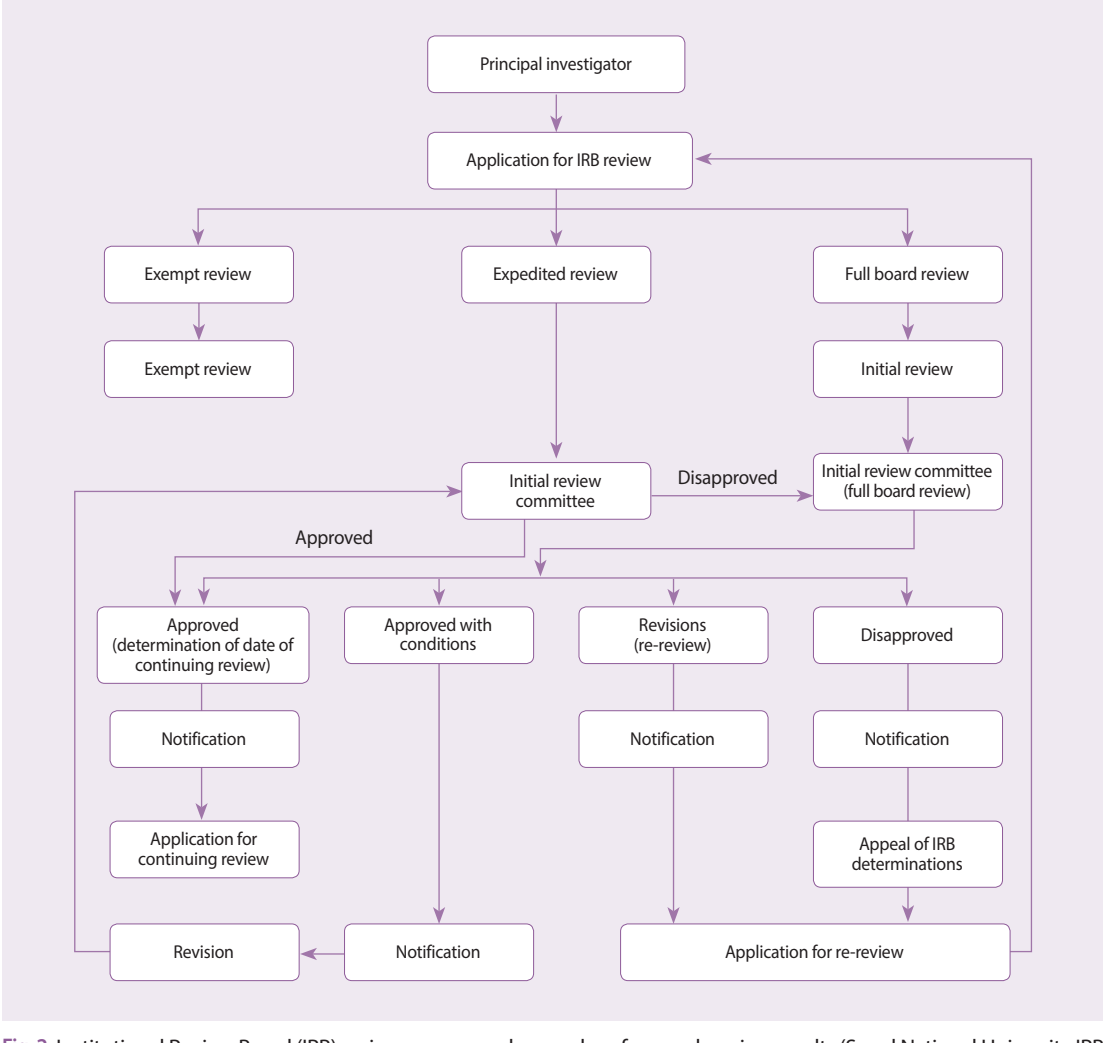


Fig. 2. Institutional Review Board (IRB) review process and examples of research review results (Seoul National University IRB data; http://snuethics.snu.ac.kr).

III. Institutional Animal Care and Use Committee (IACUC)

1. IACUC mission

In accordance with the Animal Protection Act (2007) the heads of institutions conducting animal testing must establish and operate an IACUC in order to ensure the ethical treatment and protection of laboratory animals.

The IACUC ensures the credibility, safety, and ethics in experimentation on animals and promotes the ethical treatment and protection of laboratory animals. To this end, IACUC reviews all activities using animals, which includes research, investigation and educational training, within animal facilities.

Researchers conducting animal research must submit an application for approval to the IACUC, and may only begin research after obtaining the board's approval.

2. IACUC's review objectives and criteria

IACUC's animal testing research review includes:

① Determining the ethical and scientific validity of the research protocol;
② Determining the appropriateness of the production, introduction, management, testing, use, and disposal of the laboratory animals;
③ Evaluating and confirming the training and education of personnel involved in experimentation on animals; and,
④ Evaluating and confirming the operating conditions of the animal research facilities.

IACUC uses the following criteria to review animal research protocols:

① Consideration of animal welfare;
② Adequacy of alternatives to animal experimentation and methods to minimize or alleviate pain and anxiety in animals;
③ Appropriateness of the reasons for using animals / Justification for proceeding with the proposed experimentation on animals;
④ Justification for the number of animals and species;
⑤ Appropriateness of the proposed methods of euthanasia;
⑥ Whether research practices are unnecessary or may worsen the condition of the animal;
⑦ Application of appropriate veterinarian techniques for aseptic surgery and preoperative and postoperative care;

⑧ Establishment of testing facilities appropriate to the animal and to the safety of the researcher;
⑨ Appropriateness of using hazardous materials for experimentation on animals; and,
⑩ Other considerations of the ethical animal experimentation and scientific validity

3. IACUC review process

The IACUC review process consists of a preliminary review of protocols received online by an expert member, after which the proposal is designated for: an expedited review; a regular review; or a full board review.

1) Expedited review

Used to evaluate research protocols that involve the use of established research techniques and where review is relatively straightforward.

- Simple experiments using rodent subjects and microorganisms monitoring
- After committee review, the chair decides the acceptance or rejection of the protocol.

2) Regular review

Used to evaluate interdisciplinary research protocols.

- Multiple reviewers from a number of relevant fields are selected, and after the review, the chair decides on the acceptance or rejection of the protocol.

3) Full board review

Full board review used in cases where the research protocol involves animal testing in which new testing methods are developed or where there is the possibility of serious ethical issues or physical harm to the researcher or animal.

- After all IACUC members have participated in the review, the chair decides upon the acceptance or rejection of the protocol.

Based on the nature of the protocol, there may be research that requires initial approval multiple committee approval for example: approval by the IACUC, as well as an IRB from another field.

① Protocols that require initial review from an IRB include:
- Research using imported genetically modified organisms (GMO)
- Animal experiments conducting genetically modified or pathogenic organisms
- Manufacturing or causing genetically modified organisms to occur through the research and experiment

② Protocols required to go before the IRB include: Research using animals and human subjects, or human biological materials

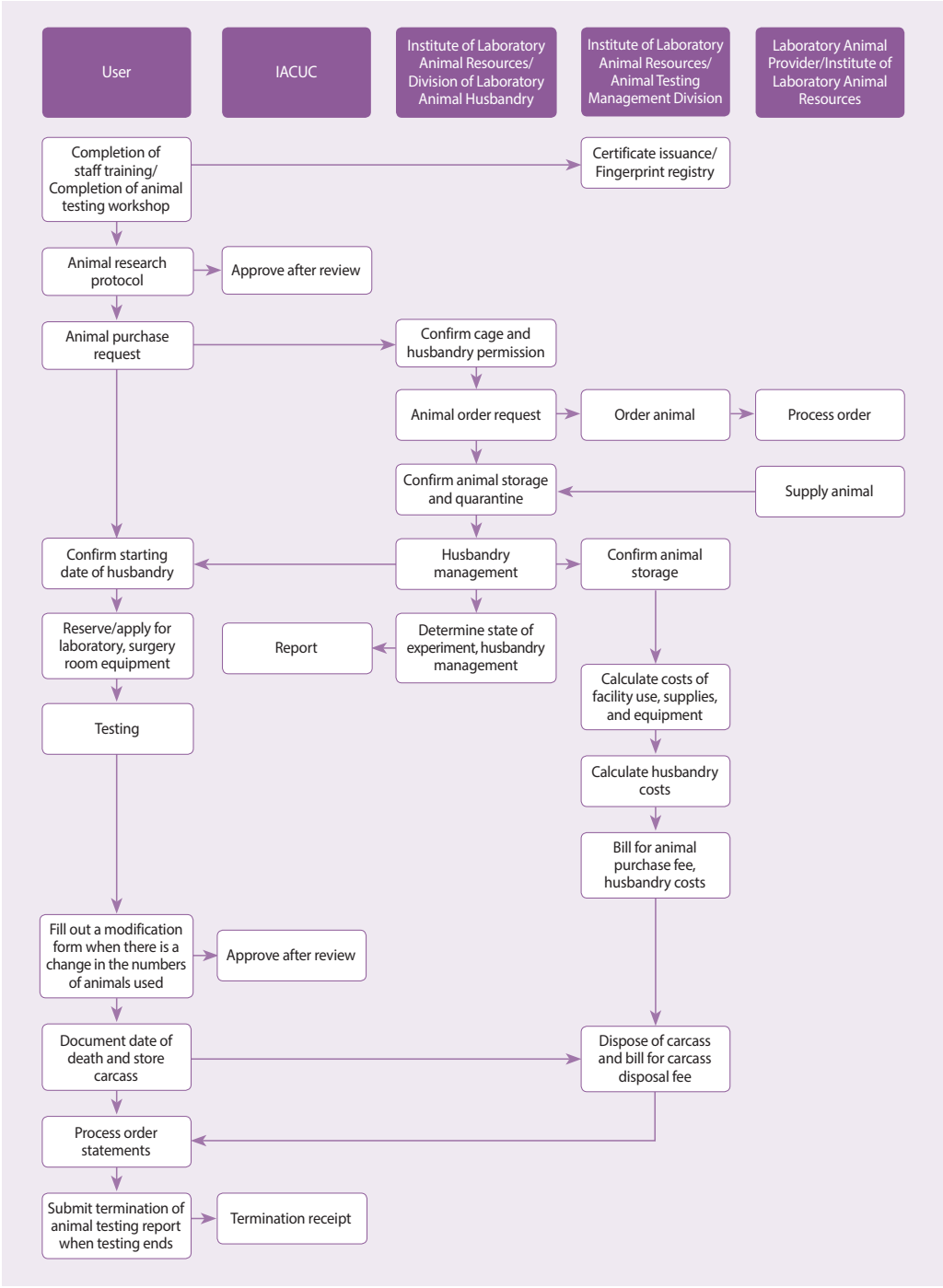


Fig. 3. Animal Experiment Procedures (Seoul National University Institutional Animal Care and Use Committee data; http://snuethics.snu.ac.kr).

Reference

Ham CH, Kwon OH, Kim SY, et al. Good publication practice guidelines for medical journals. 2nd ed. Seoul: Korean Association of Medical Journal Editors; 2013.

7

Appropriate Research Practices for Preventing Research Misconduct

I. Scientific Thinking and Research Originality

II. Research Design

III. Research Practice and Data Management

IV. Writing Reports and Research Papers

V. Lab Management and the Lab Environment

I. Scientific Thinking and Research Originality

Scientific thinking is based on a rationale and originality.

- **Rationale**: Research must be conducted only when its scientific necessity is acknowledged. In modern society, which has advanced to a science- and knowledge-based community, scientific technique may become a method of earning profit and a great influence upon social development and the maintenance of stability. In other words, even if research simply originates from personal curiosity based on one's individual freedom of thought, the research may still impact the development of modern society; therefore, a meticulous deliberation upon the necessity of the research may help in eliminating the economic and social risks arising from scientific misconduct. A scientific rationale is the most essential factor for determining the range of research subjects and the kind of samples, thereby greatly impacting research on human or animal subjects to meet the requirements of bioethics.
- **Originality**: Research originality may be achieved by proposing (1) a verification of fact that has not yet been proven or a process being tested for the first time or (2) a technique or method that overcomes current limitations. Research that has developed improved techniques instead of simply reproducing the results of past research is also acknowledged for its originality.

Characteristics of scientific research are (1) ability to self-correct, (2) objectivity, and (3) reproducibility.

- **Ability to self-correct**: The ability to self-correct involves acknowledging that the method proposed by the researcher is not the absolute truth and may be modified in future research.
- **Objectivity**: Objectivity is conducting research and analyzing its results in a rational, impartial manner without imposing one's personal beliefs, perception, values, or empathy.
- **Reproducibility**: Reproducibility represents the validity of the results; if the research is re-conducted in the same conditions by another researcher, identical results must be achieved.

Research activity should be original and based on a rationale, and it must ensure self-correction, objectivity, and reproducibility for proper hypothesis verification.

Research topics and hypotheses are established based on rationale and originality; the relevant scientific activities must be limited to proving or rejecting the proposed research hypothesis. A research hypothesis is a sentence expressing facts or phenomena to be explored by the researcher. Research activity that determines the authenticity of the hypothesis is referred to as the process of 'hypothesis verification.'

When the hypothesis is rejected, additional research can be conducted to determine the reason for hypothesis rejection, and through this process, the researcher discovers what he or she has not recognized previously. Therefore, rejection of the hypothesis is not a 'research failure,' and neither rejection nor acceptance of the hypothesis functions as an obstacle in research practice; in fact, this is an important process in discovering new facts or phenomena in nature.

II. Research Design

Research design must be based on the standard operating protocol (SOP) and bioethics.

1. Standard operating protocol

The SOP is a document detailing the procedure and methods of a certain task in order to achieve consistency by standardizing all lab techniques conducted in a laboratory.

Not only researchers affiliated with their own research lab, but also external researchers working in the corresponding lab must follow the protocol.

In order to test a hypothesis, a researcher conducts an experiment with two different groups: a test group to which some special treatment is applied, and a control group to which nothing is applied. All procedures of the experiment being conducted in a laboratory must be conducted and standardized according to the SOP of that laboratory.

The SOP must be updated continuously and should be disclosed to all researchers conducting their experiments in the laboratory.

An SOP is available only for the laboratory establishing the SOP, and may not be suitable for other laboratories exposed to different environments.

2. Compliance with bioethics (refer to Chapter 6)

In the case of research involving human participants, the core basis of bioethics is protecting the subjects; in the case of research involving animals it is acknowledging the value of their lives.

An institutional review board (IRB) and institutional animal care and use committee (IACUC) are both established and managed in each university and institute, and they review various ethical issues related to studies using human subjects and animals.

Academic journals require the researchers to observe the standards of bioethics in all research procedures and also require that approval of the IRB or the IACUC be stated in the text of the final manuscript.

3. Methods of prospective study and retrospective study

Prospective study | Prospective study is a method of planning and conducting research for hypothesis verification (observational study). The researcher can intentionally design control and treatment groups and set up the experiment environment according to the research purpose and hypothesis and all experimentation should be conducted observing the SOP. Compared to the retrospective study which requires differentiation and collection of data on many different variables, a prospective study allows precise analysis of the effect of the experimental treatment. Laboratory research and typical study designs are generally prospective studies.

Retrospective study | Retrospective study is the interpretation of previously collected data (a review of the medical records) on subjects of investigation from a period prior to when the study is carried out. This method requires examination and collection of data from the observation group with varying parameters, and therefore the various factors in the control group should be standardized in order to evaluate the hypothesis.

4. Principles of randomization, even distribution, and replication of experiments

Researchers must have a good understanding of the following principles for their research design.

1) Randomization

- Randomization refers to a method of randomly selecting subjects in order to reduce bias stemming from experimental conditions and the environment. When selecting the control group and experimental group for hypothesis verification, the randomization process implies assigning humans, animals, or objects to each group on a random basis so that each group has identical characteristics and traits.
- Due to the diversity of biological experiments, even if each group is selected on the basis of strict criteria, it is almost impossible to assign the experimental group and the control group to have identical characteristics. Consequently, subjects are randomly selected to prevent unintentional bias resulting from biological diversity.

2) Replication

- Replication is repeating an identical treatment regularly in a single set of experiments for at least a certain number of times (usually 4 times).
- To minimize any bias that may naturally occur in spite of the randomized selection of the control group, the experiment is repeated in an identical fashion and the data obtained from

each experiment should be analyzed using the appropriate statistical methods.

- This is essential for not only confirmation of data reproducibility but also proper statistical analysis.

☞ **Confusion between replication and duplication of experiments**

Researchers often confuse replication of experiments and duplication of measurements or observations. Replication of an experiment is repeating the whole experiment using the same experimental procedures but independently with different samples; duplication of measurement, however, is repeating the readings of experimental results from a single sample in order to reduce data fluctuation. Each replicated experiment is considered to be an independent experiment, while duplicate measurements, as merely repeat observations, should be considered statistically as one experiment. When an experiment is replicated and observed a couple of times to be able to obtain the necessary amount of samples, it should still be considered as a single replicate experiment. Likewise, when the obtained samples in an experiment are divided and measured a couple of times, it should still be considered a single replicate experiment. Duplication of measurement must be distinguished from replication of experiment, and when a disparity arises, it is considered to be an error in the data.

3) Even distribution

- Unlike randomly selecting each experimental and control group to be identical in both quantity and quality, even distribution is selecting the experimental and the control group to be evenly constituted by establishing a special order or rule.
- Randomization and even distribution are rules used complementarily to form a valid experimental group and control group (only one difference exists and the rest of the characteristics are the same).
- An example of combining even distribution and randomization: In an experiment using newborn offspring (such as of mice), it is impossible to predict the number of newborns. When three separate experimental groups are designed, the mother must bear her offspring in multiples of three to achieve even distribution; however, it is impossible to artificially manipulate the subjects accordingly. Therefore, when the number of offspring is not in multiples of three, newborn offspring born on the same day must be randomly selected in multiples of 3 to achieve even distribution, and the remaining offspring must be excluded from the experimental treatment or be used in another experiment. When this type of distribution is ignored and if the offspring born from all the replicate experiments are randomly allotted, ignoring the differences in numbers, to each experimental group, the offspring cannot be considered evenly distributed.

III. Research Practice and Data Management

1. Laboratory notebook

Researchers must keep records of their research data in their lab notebooks in order to collect and assess the data of their results in an objective, unbiased manner.

Researchers must not only record their data directly in the notebook, but also enter all procedures performed during the experiments along with any environmental factors. The lab notebook is used effectively for research data quality management (to ensure originality and reproducibility) as well as to eliminate risk factors (to resolve problems).

In the case that the results are unexpected or difficult to understand, by closely scrutinizing the lab notebooks, the researchers can find the causes or discover new facts or phenomena that have not previously been discovered. In other words, by utilizing the information recorded in the lab notebook, researchers can design new experiments and troubleshoot problems from difficult experiments.

Writing the lab notebook: Choosing a notebook

- **A hard copy notebook**: For most purposes, a bound notebook rather than a spiral bound notebook is used with no set format other than the ruled lines.
- **E-notebook**: An E-notebook uses the web and software as well as a database. Although it has the advantage of being able to set the format suitable for an SOP, unauthorized modifications must be prevented and risk factors such as data loss caused by technical problems must be eliminated. Researchers must manage their data by using a cloud-based system or an archive service, which requires establishing the required infrastructure. Although an E-notebook allows for the use of various devices such as touch pads to compensate for the lack of mobility compared to a paper lab notebook, the relevant software must also be developed at the same time.

Management of a lab notebook

- Researcher must use a non-modifiable medium such as a PDF file or ink to prevent arbitrary modifications, deletion, or unexpected loss of data. The lab notebook must be kept in a safe, permanent location and should be retained securely during the required data retention period and as long as the laboratory is in operation.
- In principle, a lab notebook may not be taken out of the laboratory and should be retained inside the laboratory permanently. When a researcher is going to transfer to another job, he or she may keep a copy of the lab notebook by obtaining an approval from the principal investigator or the head of the laboratory.

2. Statistical analysis of research data

The first thing to check in order to achieve an accurate statistical analysis of experimental data is the number of samples assigned to the groups of the experiment (control and treatment groups).

Different methods of analysis must be used depending on whether the number of samples in each experimental group is identical or different. Generally, when the number of samples is identical in each group, a t-test can be used, but when the number of samples differs among groups, methods such as linear model analysis must be used.

When comparing the experimental effect among more than two groups, the model effect (used to evaluate the differences in normal distribution among all of the groups) must be first tested prior to conducting the comparison among each of the individual groups (paired test: comparing the three experimental groups—A, B, C— testing for a significant difference between A-B, B-C, and C-A). When analyzing the model effect, analysis of variance (ANOVA) is used, and if the model effect is not significant, there is no need for a paired test.

3. GLP, GMP, GCP

Standardization of both laboratory management and research techniques are criteria for achieving reliable results.

Applying the criteria of good laboratory practice (GLP), good manufacturing practice (GMP), and good clinical practice (GCP) are global trends in establishing standardization, and they are used as guidelines to ensure credibility of experimental results and industrial products. In Korea, the relevant regulations are established and applied in each field through agencies such as the Ministry of Food and Drug Safety, Ministry of Environment, and Ministry of Agriculture and Forestry.

1) Good laboratory practice

- GLP provides guidelines for good laboratory management.
- GLP is the regulation applied to non-clinical laboratory studies conducted for the assessment of the safety and efficacy of medicine, pesticide, chemicals, and commodities.
- GLP is not simply limited to the standardization of experimental methods or facilities, but embodies a set of comprehensive principles that regulates the laboratory management system and the entire procedures and conditions of the research related to study design, experimental execution, data monitoring, recording, and reporting; for example, it includes the issues of securing the appropriate number of subjects, as well as education.

2) Good manufacturing practice

- Expanding upon GLP, GMP provides the minimum requirement guidelines for facilities in manufacturing products with high quality assurance.
- The facility standards of GMP may vary by the manufacturing facility, but like GLP, GMP provides guidelines for the overall manufacturing process.

3) Good clinical practice

- GCP provides management guidelines for clinical trials involving pharmaceutical products.
- GCP describes the guidelines that must be observed in conducting clinical trials.
- GCP is the ethical guideline that should be followed in designing, conducting, recording, and reporting clinical trials involving human subjects, and is the minimum detailed set of standards for scientific practice.

IV. Writing Reports and Research Papers

When writing a research paper or a report, the researcher must report the results of the study following the author guidelines. The general guidelines for writing a scientific research paper are as follows:

- Write as concisely as possible.
- Avoid unnecessary words and expressions.
- Write appropriately for each section.
- Write only about the relevant research, and avoid speculative expressions and interpretations.
- Always cite the source of other researchers' work, and do not include their data in your own data.
- Use a consistent scientific style and format throughout the paper.
- Try to achieve unity and coherence and maintain continuity in your writing.
- Follow the standard organizational style for scientific publications: title, abstract, introduction, materials & methods, results, discussion, references, and acknowledgements.

The following are the detailed guidelines for writing each section.

1. Title

The title must specify the basis or the hypothesis of the study in a sentence or a phrase.

2. Abstract

The abstract is a summary of the key contents of the study, and each academic journal has its own word limit (around 200-250 words, in general, in English). The abstract generally describes the study in one sentence in the order of research purpose and hypothesis, research methods and design, and the samples or the animal subjects used in the study, followed by a description of each experiment method and its results. The last sentence in the abstract is the overall conclusion of the study, presenting the results of the hypothesis verification.

3. Introduction

The introduction should clearly state the rationale of the research.

- The introduction is generally presented in the order of the present conditions of research development, current issues or the necessity of the research, and the hypothesis and design.

- The present conditions of research development are succinctly described in the discussion so the readers can have a clear understanding of the research background.

4. Materials and Methods

Research ethics as well as the human and animal subjects of study are presented first, followed by basic experimental methods and a brief description of the specific experimental methods pertaining to the research process. Experimental design (experimental group, independent variables, parameters) and methods of data analysis are also presented; however, experimental design may be required to be presented at the beginning of the materials and methods or at the beginning of the statistical analysis methods depending on the academic journal.

5. Results

The results are a succinct description of experimental observations for hypothesis verification based on statistical analyses. Only the numerical data and the observed/measured results essential to the main points are presented, and their interpretation is presented in the discussion.

6. Discussion

The description of the discussion section should be restricted to the interpretation of the hypothesis and the experimental results of the study. The discussion should focus on the most important interpretation of the results, and should avoid lengthy or speculative explanations of other researchers' experimental results. Even when describing future study plans, it is best to compare only the experimental results directly associated with the experiments being reported.

A research proposal, unlike a research paper, must present a clear research design and must describe the preliminary experimental results with a relevant working hypothesis. Because the research plan and design conducted according to the research proposal may change after the start of the experiment, it is most efficient for the research proposal to focus only on the first experiment.

V. Lab Management and the Lab Environment

1. Communication

The most important virtue in the laboratory is communication.

Having effective communication among laboratory members is essential because the members, by being affiliated with the same laboratory, not only use the same experimental devices and share the general SOP, but also share the same data and materials.

- Communication among the lab members: Since a lab member's research directly affects the research results of his or her colleagues, communication among the researchers is essential for the quality management of the laboratory and the research results.
- Communication between the principal investigator and the research staff: Research staff members who are responsible for conducting the experiment itself and the principal investigator responsible for supervising the overall experiment should complement each other, and failure to do so may easily cause errors in interpretation of the research results as well as manipulation of the research process. The principal investigator must refrain from giving authoritarian-style research guidance, and lab members must avoid omitting or distorting reports of research results.

Regular and irregular lab meetings

- In addition to the regular laboratory meetings, lab members and the principal investigator should actively engage in informal meetings.
- A forceful atmosphere in the management of the laboratory as well as a command-submission style of meetings should be avoided.
- Laboratory meetings often take the 'business meeting' format, and therefore detailed reports of the research as well as members' review and discussion on the direction of research are critical. Lab members tend to place high importance only on presenting the data results and exaggeration in order to receive good evaluation by the principal investigator, which should be discouraged; in fact, the discussion of the assessment of the experimental results and the establishment of proper research strategy should be emphasized more.

Any topics including changes in the standard research technique, writing the lab notebook, and resolution of problems may be discussed. The minutes of all lab meetings must be recorded and be copied to all lab members who have attended the meetings.

2. Research practice

Research must be conducted providing equal status to the principal investigator and the other research staff members; agreement on the direction of research and consistent implementation of the experiments are essential for good research practice.

Research conducted based on effective communication and agreement among the principal investigator and the other research staff members is directly connected to the planning stage of the experimental design and greatly affects legal issues such as copyright issues.

REFERENCES

Anti-Corruption and Civil Rights Commission of Korea. Manual on management of conflict of interest for fair work performance [Internet]. Sejong: Anti-Corruption And Civil Rights Commission of Korea; 2012 [cited 2015 Dec 15]. Available from: http://www.acrc.go.kr/ acrc/index.do

Benos DJ, Kirk KL, Hall JE. How to review a paper. Adv Physiol Educ 2003;27:47-52.

Center for Research Ethics Information/Biological Research Information Center. Research ethics, how far have we come? SciON, 2013.1.23-30 [Internet]. Pohang: BRIC; 2013 [cited 2015 Dec 15]. Available from: http://bric.postech.ac.kr/scion/survey/result.php?PID=236&STA=1

Cho HW. Professor Kang Soo-kyung of Seoul National University has fabricated 17 articles of paper. Kormedi.com News [Internet]. 2012 Dec 5 [cited 2015 Dec 15]. Available from: http://www.kormedi.com/news/article/1205326_2892.html

Cho WI. Dismissal of professor Kang Soo-kyung of Seoul National University engaged in fabrication of 17 articles. Hankooki.com [Internet]. 2013 Mar 8 [cited 2015 Dec 15]. Available from: http://news.hankooki.com/lpage/society/201303/h2013030821055721950.htm

Committee on Assessing Integrity in Research Environments, National Research Council, Institute of Medicine. Integrity in scientific research: creating an environment that promotes responsible conduct [Internet]. Washington, DC: National Academies Press; 2002. Box 1, Integrity in research (individual level); [cited 2015 Dec 15]; p. 5. Available from: http://www.ncbi.nlm.nih.gov/books/NBK208712/pdf/Bookshelf_NBK208712.pdf

Committee on Publication Ethics (COPE). Codes of conduct and best practice guidelines [Internet]. COPE; [cited 2015 Dec 17]. Available from: http://www.publicationethics.org/resources/code-conduct

Committee on Publication Ethics (COPE). Flowcharts [Internet]. COPE; [cited 2015 Dec 17]. Available from: http://publicationethics.org/resources/flowcharts

CrossRef. 2012/13 CrossRef annual report [Internet]. Oxford: CrossRef; [cited 2015 Dec 16]. Available from: http://goo.gl/C0wZkA

Dolgin E. Korean scientist fired for fraud. The Scientist [Internet]. 2008 Mar 3 [cited 2015 Dec 15]. Available from: http://www.the-scientist.com/?articles.view/articleNo/26181/title/ Korean-researcher-fired-for-fraud

Engleberg I, Raimes A. Pocket keys for writers. 1st ed. Boston, MA: Cengage Learning; 2003.

Eom JH. Third party making·selling a published journal paper in form of DB is copyright violation. Law Times [Internet]. 2008 Mar 22 [cited 2015 Dec 15]. Available from: http://www.lawtimes.co.kr/Legal-News/Legal-News-View?Serial=38121

Ham CH, Kwon OH, Kim SY, et al. Good publication practice guidelines for medical journals. 2nd ed. Seoul: Korean Association of Medical Journal Editors; 2013.

Harvard University. The exception: common knowledge. Harvard guide to using sources [Internet]. Boston, MA: Harvard University; [cited 2015 Dec 15]. Available from: http://isites.harvard.edu/icb/icb.do?keyword=k70847&pageid=icb.page342055

Hong JH. A study on copyright possession for open access and archiving of scholarly journal paper registered in Korean Research Foundation. J Korean Lib Inf Sci Soc 2008;39:431-63.

Hong SW, Lee SW. Conflict of interest. Gwacheon: Ministry of Science and Technology; 2007.

Huth EJ. Irresponsible authorship and wasteful publication. Ann Intern Med 1986;104:257-9.

Hwang ES, Song SS, Lee IJ, Park K, Sohn WC. Understanding and practice of research ethics. Daejeon: National Research Foundation; 2011.

International Committee of Medical Journal Editors (ICMJE). Recommendations for the conduct, reporting, editing and publication of scholarly work in medical journals [Internet]. ICMJE; 2014 [cited 2015 Dec 17]. Available from: http://www.icmje.org/recommendations/

Jang YJ. Dishonorable acts account for 86% of violations of university research ethics during the past 5 years. Share Channel News [Internet]. 2013 Oct 31 [cited 2015 Dec 15]. Available from: http://www.e-nanoom.com/news/articleView.html?idxno=620

Jeong JY. Court orders "50 million won compensation for substitution of authors of paper". Segye News [Internet]. 2008 Aug 13 [cited 2015 Dec 15]. Available from: http://www.segye.com/content/html/2008/08/13/20080813002762.html

Kennedy D. On academic authorship. Stanford, CA: Stanford University Press; 1985.

Kim DR. Hwang Woo Suk puts media manipulation before research. Oh My News [Internet]. 2006 Sep 27 [cited 2015 Dec 15]. Available from: http://www.ohmynews.com/NWS_Web/View/at_pg.aspx?CNTN_CD=A0000303778

Kim HM. Ewha Woman's University, "controversies of Nature article author" seem to continue. The Kyunghyang News [Internet]. 2012 Jul 23 [cited 2015 Dec 15]. Available from:http://news.khan.co.kr/kh_news/khan_art_view.html?artid=201207231815381&code=940202

Kim HS . Research ethics in the era of science and technology: focusing on biotechnology area. J Korea Bioeth Assoc 2001;2:58-72.

Lee WY. Investigation and analysis study of current status of research ethics activity. Daejeon: National Research Foundation of Korea; 2011.

Lee WY. Survey and analysis on research ethics activities of universities and academic societies in Korea 2010. Daejeon: National Research Foundation in Korea; 2011.

Merton RK. The sociology of science: theoretical and empirical investigations. Chicago: University of Chicago Press; 1973.

Ministry of Education (MOE) [Internet]. Sejong: MOE; [cited 2015 Dec 15]. Available from: http://english.moe.go.kr/enMain.do

Ministry of Education, Science and Technology Instructions, No. 260. Guidelines for Assurance of Research Ethics (enacted Aug. 1, 2012, revised section).

Ministry of Education, Science and Technology; National Research Foundation of Korea, editors. Good research practices' guidelines. Seoul: National Research Foundation of Korea; 2011.

Ministry of Science, ICT and Future Planning Ordinance, No. 6. Rules Regarding Management of National Research and Development Projects (enacted Aug. 5, 2013).

Morgan JD. Significance and responsibilities of thanatology. Paper presented at: International Academic Seminar of The Korean Gerontological Society; 2000 Nov 28-29; Seoul, Korea.

The National Research Foundation of Korea (NRF) [Internet]. Daejeon: NRF; [cited 2015 Dec 15]. Available from: http://www.nrf.re.kr/nrf_eng_cms/

Oh CW. Major defects in the Science paper by KAIST professor Kim Tae-gook. Hankyoreh News [Intnernt]. 2009 Feb 29 [cited 2015 Dec 15]. Available from: http://www.hani.co.kr/arti/society/society_general/272972.html

Panel on Scientific Responsibility and the Conduct of Research (PSRCR). Responsible science. Vol. 1. Washington, DC: National Academy Press; 1992.

Park GH. Paper plagiarism. 2: Extracted from national project plan of professor Kim Cheol-ho of Sungkyunkwan University. Seoul News [Internet]. 2009 Jun 27 [cited 2015 Dec 15]. Available from: http://www.seoul.co.kr/news/newsView.php?id=20090627008018

Park KB. Investigation of researcher's perception of research integrity. Daejeon: National Research Foundation of Korea; 2009.

Park KB. Researchers' conflict of interest problems and their management plans. Seoul: Science and Technology Policy Institute; 2006.

Park MS. Ewha Woman's University, "Nature acknowledges the co-authorship of graduate student in Professor Nam Goo-hyun's paper." The Korea Times [Internet]. 2012 Jul 23 [cited 2015 Dec 15]. Available from: http://news.hankooki.com/lpage/society/201207/h2012072323161321950.htm

Resnik DB. The ethics of science: an introduction. London: Routledge; 1998.

Roh WJ. Conflict of interest management policy [Internet]. Cheongju: Center for Research Ethics; [cited 2014 Jan 15]. Available from: http://www.cre.or.kr/board/?board=responsibilities_articles&no=138256

Seoul National University. Seoul National University guidelines for research ethics. Rev. ed. Seoul: Seoul National University; 2010.

Shamoo AE, Resnik DB. Responsible conduct of research. New York: Oxford; 2009.

Singapore Statement on Research Integrity [Internet]. [cited 2015 Dec 17]. Available from: http://www.singaporestatement.org

Stokes TL. Korean stem cell investigation expands to another researcher, and more papers. Retraction Watch [Internet]. 2012 Jun 8 [cited 2015 Dec 15]. Available from: http://retractionwatch.com/2012/06/08/korean-stem-cell-investigation-expands-to-another-researcher-and-more-papers/

Turnitin, LLC. iThenticate: self-plagiarism Q&A forum [Internet]. Oakland, CA: Turnitin, LLC; [cited 2015 Dec 15]. Available from: http://www.ithenticate.com/resources/webcasts/ self-plagiarism/q-and-a

University of Seoul. 47th evaluation of academic advisor/research director by graduate students/researchers studying science. SciON, 2006.11.21-11.30 [Internet]. Pohang: BRIC; 2006 [cited 2015 Dec 15]. Available from: http://bric.postech.ac.kr/scion/survey/result.php?STA= 1&PID=169

Wager E. Coping with scientific misconduct. BMJ 2011;343:d6586.

Wager E, Barbour V, Yentis S, Kleinert S. Retractions: guidance from the Committee on Publication Ethics (COPE). Croat Med J 2009;50:532-5.

Wager E, Kleinert S. Responsible research publication: international standards for authors. A position statement developed at the 2nd World Conference on Research Integrity, Singapore, July 22-24, 2010. In: Mayer T, Steneck N, editors. Promoting research integrity in a global environment. Singapore: Imperial College Press/World Scientific Publishing; 2011. pp. 309-16.

WAME-Listserve [discussion list on the Internet]. World Association of Medical Editors; 2006 Nov 18 [cited 2015 Dec 15]. Available from: http://www.wame.org/appropriate-use-of-of-other-authors2019-sentences