INTRODUCTION

The importance of educational programs on biomedical writing, editing, and publishing has attracted growing attention in recent years, particularly in non-Anglophone countries. Such programs are not widely available, and there is still no strong evidence to support specific format and contents acceptable for trainees globally (1). Based on empirical experience, these programs can be successfully established in institutions with relevant departments, rendering science writing and editing services (2).

In the Asia-Pacific region, Tokyo Medical University is one of the few universities that provide biomedical writing, editing, and publishing programs to its faculty and staff (2). Educational programs at the Department of International Medical Communications of Tokyo Medical University are updated regularly to adjust their curricula to the upgrading standards of research reporting, ethical editing, and publishing. A variety of individual consultations, lectures, graduate courses, and services through an electronic editorial platform are now offered to faculty and visitors of the university.

The objective of well-structured educational programs in biomedical writing, editing, and publishing is to transfer essential knowledge and skills to those who wish to master science writing. The program’s concept, organization, mentorship, evaluation, and follow-up require careful attention. Faculty of the department can tailor a specific program for a target group of participants by selecting and enhancing relevant training components. The ultimate goal of the program is to facilitate publishing in leading biomedical periodicals. The mechanics and essential components of the program are described in this article.

MECHANICS

The mechanics described here cover some of the important logistical aspects crucial in developing the programs. These include the objectives, design, benefits, duration, participants and qualifications, program formats, administrative issues, and mentorship.

Objectives

The primary objectives of the program are to train qualified professionals to be competent in writing, editing, and publishing biomedical articles, and to be proficient in rendering a full range of assistance in any of these areas.

The specific objectives may include the following: 1) to teach effective writing and communication of research results, highlighting the importance and reliability of the study; 2) to pass on basic and advanced knowledge and skills in biomedical writing, editing, and publishing under the close supervision of senior biomedical mentors and science editors; 3) to provide in-depth knowledge and guidelines on key aspects of ethical publishing, peer review, journal indexing, and archiving; 4) to train biomedical writers and editors who will be ethical contributors of research publications; and 5) to promote international collaboration through joint local and international courses.
Participants completing these programs should possess advanced knowledge and skills in biomedical nomenclature, evidence-based writing, editing, and publishing.

Design
The programs should be designed to provide a foundation for manuscript writing in compliance with established research reporting standards. An additional value of the programs is to enhance post-publication communication skills of the participants. The programs can be designed to help biomedical professionals, graduate students, and researchers publish their papers in the best target journals indexed by MEDLINE, Scopus, and Web of Science with high impact factors (IFs).

Benefits
By completing the training programs, participants may boost their confidence in biomedical writing and editing. Professional orientation can be realized through the exchange of experiences among the participants, aiming at enhancing writing skills and publishing capacity. A clear understanding of the ethical basis and benefits of biomedical writing, editing, and publishing can be achieved and new networks of competent writers, editors, and publishers can be established.

Duration
The duration of the programs can vary widely, depending on the needs of the target audience. Short courses can be organized daily for two weeks. Longer programs may take three to six months.

Participants and qualifications
To substantially benefit from the training programs, participants should have an academic degree in the natural sciences, medicine, linguistics, translation studies, or science journalism, or have work experience at a biomedical or pharmaceutical company.

Participants must have some science writing and editing experience, basic knowledge of the structure of a scholarly paper, and good interpersonal communication skills. Health professionals, researchers, educators, medical writers, authors’ editors, and translators can also participate in the programs.

Intermediate to advanced knowledge of written English and spoken English skills are expected from each participant to benefit fully from the program and facilitate interactions.

Format of programs
At present, educational programs in the form of graduate degree courses are scarcely available and are mostly offered online. The Science Writing Program at Johns Hopkins University covers basic skills and a master’s in science writing (3). The University of Chicago Graham School offers a certified program in medical writing and editing (4). On the other hand, the Master of Science (MS) in Biomedical Writing at the University of the Sciences in Philadelphia offers instructions in basic skills for medical writers and electives focusing on regulatory or nonregulatory writing. Finally, there is a new MS program in medical writing which is offered by the University of Innsbruck in Austria (6).

The advantage of the present educational program is that it is not restricted to the graduate degree course format, but it can be arranged in the format of either internships, certified courses, symposia, seminars, webinars, public lectures, academic visits, fellowships, collaborative research, or graduate degree courses. As the main objective is to transfer essential knowledge and skills to those who wish to master science writing, faculty of the department can tailor a specific program for a target group of participants by selecting and enhancing relevant training components. This makes the program more flexible and adaptable. Moreover, the program puts emphasis in facilitating publishing in leading biomedical periodicals.

Administrative issues
Contents of the documents and manuscripts used for the trainings should be kept confidential. The roles of the coordinators and collaborators should be clarified at the start of the program, with careful planning of the participants’ residence and expenses. Upon successful completion of a certain course, a certificate informing about its contents and academic hours is awarded. For the materials and manpower system, hosting universities or institutions should ideally have a special academic unit (or aim to develop one) with tenured faculty members who handle courses in medical English, communications, and writing. They will serve as a team of editors developing the editing, writing, and publishing materials and the programs; providing editorial support using electronic editorial services; and promoting international publications.

Mentorship
Good educational programs should be spearheaded by experienced academic mentors who generously share their knowledge, skills, and experience. The academic mentors must be highly skilled medical doctors or biomedical experts with a record of high-quality scholarly publications, extensive experience in teaching biomedical courses or editing, and history of successful academic mentorship.

ESSENTIAL COMPONENTS
The essential components of the programs can be divided into three schedules: I. Basic aspects of biomedical writing, editing, and communications; II. Essential skills in biomedical writing, editing, and publishing; III. Interactive lectures on relevant topics.
Table 1. Schedule I: Basic aspects of biomedical writing, editing, and communications

| Topics | Core activities | Acquired skills |
|--------|----------------|-----------------|
| 1. Basic grammar usage (7) | - Identifying correct grammar use in scientific language | - Correct use of grammar in scientific texts |
| 2. Editorial/scientific style (8) | - Correct punctuations, hyphenations, spelling, capitalization, surnames, trademarks, abbreviations, numbers, units of measure, and plurals | - Attention to details of editorial/scientific style |
| 3. Sentence structures and patterns (9) | - Mastering different sentence structures and patterns | - Consistency in language and style |
| 4. Proper use of statistics for biomedical writers and editors (10) | - Familiarizing with basic statistical terminology and methods | - Proper use of statistical tests and concepts |
| 5. Tables, graphs, and biomedical images (11) | - Identifying and editing different types of tables, graphs, and images | - Correct use of tables, graphs, and images |
| 6. Components of a scientific paper (12) | - Appropriate use of style and words | - Mastery of article components |
| 7. Conference communications (13, 14) | - Identifying and editing different components of a scientific paper | - Familiarity with different types of articles |
| 8. Preparing an article for publication (15-17) | - Learning how to draft effective oral presentations | - Upgrading oral and poster presentation skills |
| | - Writing informative and reflective conference reports | - Accuracy in conference report writing |
| | - Familiarizing with different types of articles | - Familiarity with different types of articles |
| | - Correct citing and referencing | - Organization of manuscript and data |
| | - Improving visual presentation of data | |

Schedule I: Basic aspects of biomedical writing, editing, and communications

This schedule involves lectures, presentations, workshops, and feedback on the following topics: basic English grammar, editorial/scientific styles, sentence structures and patterns, statistics for medical writers and editors, tables and graphs, components of a paper, conference communications, and preparing an article for publication (Table 1).

The following areas are discussed in detail: 1) basic writing and correct use of words, phrases, and clauses; 2) types and structures of biomedical articles; 3) composing titles, structuring abstracts, designing methodologies, reporting results, writing discussions, and formatting references; 4) editing tables and graphs, diagnostic images in clinical medicine and analytical images in basic sciences; and 5) interpreting statistical analyses.

Schedule II: Essential skills in biomedical writing, editing, and publishing

This schedule covers lectures, presentations, or workshops and feedback to build skills in biomedical writing, editing, and publishing. Participants critically appraise biomedical manuscripts and develop skills in substantive editing and copyediting of different parts of a manuscript (Introduction, Methods, Results, and Discussion). These activities are also aimed at evaluating the scientific merit of the results and the validity of the conclusions.

Participants also gain skills in searching through bibliographic databases, institutional repositories, detecting scientific misconduct, and communicating with authors, reviewers, and editors. Practical exercises cover scientific authorship (criteria of authorship, inappropriate authorship), conflicts of interest, plagiarism detection, and other issues in publication ethics. Familiarizing with study designs, research reporting guidelines of the Enhancing the QUAlity and Transparency Of health Research (EQUATOR) Network (http://www.equator-network.org/), and guidance from global editorial associations are also included in this schedule (Table 2).

Schedule III: Interactive lectures on relevant topics

This schedule involves interactive lectures, presentations, workshops, and feedback on topics in medical writing, editing, and publishing. These activities allow improvement in analytical thinking. The topics covered range from peer review, journal indexing, impact indicators, editorial management systems, research designs, publication misconduct, editorial decision-making, open access, and digital publishing (Table 3).

EVALUATION AND FEEDBACK

Participants of the program will receive a written evaluation regarding their performance for the activities covered. To reinforce the learning process, feedback emphasizing points for improvement is provided. Verbal evaluation and feedback may also be provided daily during the programs.

Halfway through the program, participants receive evaluations regarding their ability to 1) consistently correct the English or scientific language, 2) identify and correct ambiguities and inconsistencies, 3) edit to the journal language requirements, and 4) write the required statements, disclosures, and information.

At the end of a program, participants receive evaluations regarding their ability to 1) evaluate the research design, 2) determine the internal validity of the results and conclusions, 3) identify potential errors and biases that may distort the results or study interpretation, 4) suggest new sentences or sections for
### Topics Core activities Acquired skills

1. **Appraisal of a scholarly article** *(18)*  
   - Editing, writing, formatting, reviewing, and confirming scientific text  
   - Correct use of format, style, grammar, words, and phrases  
   - Analysis of research significance

2. **Handling PDF files of galley proofs**  
   - Presenting research methods clearly  
   - Use of scientific nomenclature  
   - Attention to study details

3. **Composing an effective cover letter** *(19)*  
   - Checking text and tone  
   - Highlighting significant findings and novelty  
   - Synthesis of the article

4. **Understanding and interpreting editorial decisions**  
   - Interpreting decisions regarding acceptance, revision, and rejection  
   - Clarifying journal instructions regarding revision and resubmission  
   - Interpretation of editorial decisions and reviewer comments

5. **Resubmission** *(20)*  
   - Providing point-by-point responses to reviewer comments  
   - Re-editing and proof-checking of rebuttal letters  
   - Reassessment of manuscripts

6. **Editing poster presentations** *(21)*  
   - Streamlining/organizing headings and content  
   - Evaluating layout and presentation script  
   - Familiarity with poster preparation

7. **Editing oral presentations** *(22)*  
   - Editing text to ensure interactivity  
   - Audio and video recording at various speeds  
   - Composing interactive script

8. **Conforming to journal instructions** *(19, 23)*  
   - Identifying the type of submission  
   - Structuring abstracts  
   - Detail orientation

9. **Editing text to ensure interactivity**  
   - Completing the manuscript  
   - Resubmitting the manuscript  
   - Choosing best target journals and avoiding ‘illegitimate/ predatory’ journals

10. **Online submission** *(24)*  
    - Preparation of all necessary files  
    - Completing the online submission step-by-step  
    - Familiarity with online submission systems

11. **Galley proofreading** *(25)*  
    - Handling PDF files of galley proofs  
    - Meeting proofreading deadlines  
    - Handling and editing PDF files

12. **Citing web resources** *(26)*  
    - Citing non-print materials, including grey literature  
    - Citation of and familiarity with online materials

13. **Editing references** *(17, 27)*  
    - Correcting citation format  
    - Accuracy in following journal instructions

14. **Title and abstract editing** *(28)*  
    - Title and abstract formatting, editing, and styling  
    - Learning rules of title and abstract writing

(Continued to the next page)
### Table 3. Schedule III: Interactive lectures on relevant topics

| Topics | Core activities | Acquired skills |
|--------|-----------------|-----------------|
| 1. Peer review | - Restraining "rational cheating" in peer review | - Improved author-reviewer-editor communication |
|  | - Open-access publishing and cascading peer review |  |
|  | - Instructions for reviewers |  |
|  | - Models of peer review |  |
|  | - How to pick best peer reviewers |  |
| 2. Impact indicators | - Recognizing various types of studies | - Acuity in identifying research study types |
|  | - Meeting formatting and structural requirements of each study type | - Familiarity with research study designs |
|  | - Conforming to research reporting guidelines | - Knowledge of research reporting standards |
| 3. Writing courses | - Highlighting manuscript sections | - Mastery of manuscript sections |
|  | - Checking appropriateness of each manuscript section | - Correct presentation of text according to the manuscript sections |
| 4. Editorial management systems | - Assessing manuscript level and matching it with the best target journals | - Familiarity with journal rankings |
|  | - Identifying journal rankings according to traditional and alternative impact indicators | - Enhanced skills in journal appraisal and suitability assessment |
| 5. Research methodology | - Clarifying the journal's scope, aims, and editorial policies |  |
| 6. Internships | - Understanding financial and nonfinancial conflicts of interest | - Familiarity and knowledge of appropriate disclosures |
|  | - Writing conflicts of interest statements |  |
| 7. Publication misconduct | - Searching online databases such as Scopus, Web of Science, MEDLINE | - Enhanced skills in searching through search engines to retrieve biomedical information |
|  | - Traditional, alternative, and spurious impact indicators |  |
| 8. Scholarly publishing | - Identifying different types of studies in medical research | - Familiarity with global editorial associations and their educational resources |
|  | - Meeting formatting and structural requirements of each study type | - Familiarity with global editorial associations and their educational resources |
| 9. Editorial policies and processes | - Conforming to research reporting guidelines | - Familiarity with good publishing practice |
| 10. Open access | - Clarifying the journal's scope, aims, and editorial policies |  |
| 11. Digital publishing | - Assessing manuscript level and matching it with the best target journals |  |
| 12. Elements of proper biomedical writing | - Identifying journal rankings according to traditional and alternative impact indicators |  |
| 13. Global editorial associations | - Clarifying the journal's scope, aims, and editorial policies |  |
| 14. Journal publishing | - Clarifying the journal's scope, aims, and editorial policies |  |
| 15. Introductory biomedical statistics | - Improving the quality of scholarly articles |  |
| 16. Scientific publication quality | - Research validation standards |  |

Table 2. Continued

| Topics | Core activities | Acquired skills |
|--------|-----------------|-----------------|
| 15. Author-reviewer-editor relationship (2) | - Clarifying author-reviewer-editor relationship | - Improved author-reviewer-editor communication |
|  | - Writing queries to authors |  |
|  | - Following reviewer and editor comments/ instructions |  |
| 16. Identifying different types of studies in medical research (29) | - Recognizing various types of studies | - Acuity in identifying research study types |
|  | - Meeting formatting and structural requirements of each study type | - Familiarity with research study designs |
|  | - Conforming to research reporting guidelines | - Knowledge of research reporting standards |
| 17. Identifying manuscript sections (30) | - Highlighting manuscript sections | - Mastery of manuscript sections |
|  | - Checking appropriateness of each manuscript section | - Correct presentation of text according to the manuscript sections |
| 18. Familiarizing with conflicts of interest disclosures (31) | - Understanding financial and nonfinancial conflicts of interest | - Familiarity and knowledge of appropriate disclosures |
|  | - Writing conflicts of interest statements |  |
| 19. Searching through online databases (32) | - Searching online databases such as Scopus, Web of Science, MEDLINE | - Enhanced skills in searching through search engines to retrieve biomedical information |
| 20. Choosing target journals (33) | - Assessing manuscript level and matching it with the best target journals | - Familiarity with journal rankings |
|  | - Identifying journal rankings according to traditional and alternative impact indicators | - Enhanced skills in journal appraisal and suitability assessment |
| 21. Familiarizing with global editorial associations and their educational resources (34) | - Clarifying the journal's scope, aims, and editorial policies | - Familiarity with good publishing practice |
omission, and 5) give advice for manuscripts that fail to meet content and formatting guidelines.

**TARGET OUTCOME**

Upon completion of a certain educational program, participants will be encouraged to write a publishable paper on one of the topics covered during the program. The paper will be submitted to a suitable target journal indexed in MEDLINE, Scopus, and Web of Science.

**CONCLUSION**

Educational programs in biomedical writing, editing, and publishing should be organized to provide a foundation for improving skills and competence in these fields, as well as for gaining in-depth knowledge and understanding of research methodology, science communication, and scholarly publication (Fig. 1).

**DISCLOSURE**

The authors have no potential conflicts of interest to disclose.

**AUTHOR CONTRIBUTION**

Conception, design, writing, review and revision: Barroga E, Vardaman M.

**ORCID**

Edward Barroga  [http://orcid.org/0000-0002-8920-2607](http://orcid.org/0000-0002-8920-2607)  
Maya Vardaman  [http://orcid.org/0000-0002-5452-0664](http://orcid.org/0000-0002-5452-0664)

**REFERENCES**

1. Galipeau J, Moher D, Skidmore B, Campbell C, Hendry P, Cameron DW, Hébert PC, Palepu A. Systematic review of the effectiveness of training programs in writing for scholarly publication, journal editing, and manuscript peer review (protocol). Syst Rev 2013; 2: 41.
2. Barroga EF, Turner RJ, Breuimmelns R, Barron JP. An adaptable model of electronic editorial services for medical universities. Eur Sci Ed 2012; 38: 32-5.
3. John Hopkins University. Science writing at hopkins. Available at [http://advanced.jhu.edu/academics/graduate-degree-programs/writing/the-experience/science-writing-at-hopkins/](http://advanced.jhu.edu/academics/graduate-degree-programs/writing/the-experience/science-writing-at-hopkins/) [accessed on 25 March 2015].
4. The University of Chicago Graham School. Medical writing and editing. Available at [https://grahamschool.uchicago.edu/noncredit/certificates/medical-writing-editing/index](https://grahamschool.uchicago.edu/noncredit/certificates/medical-writing-editing/index) [accessed on 25 March 2015].
5. University of the Sciences. Biomedical writing program, medical & regulatory writing certificates overview. Available at [http://www.gradschool.usciences.edu/biomedical-writing/biomedical-writing-program-overview](http://www.gradschool.usciences.edu/biomedical-writing/biomedical-writing-program-overview) [accessed on 25 March 2015].
6. University of Innsbruck. Master of science in medical writing. Available at [https://www.i-med.ac.at/studium/fort_weiterbildung/Medical-Writing-Mainpage-EN.html.html](https://www.i-med.ac.at/studium/fort_weiterbildung/Medical-Writing-Mainpage-EN.html.html) [accessed on 25 March 2015].
7. Coghill AM, Garson LR; American Chemical Society. The ACS style guide: effective communication of scientific information. 3rd ed. Washington, DC; Oxford; New York: American Chemical Society; Oxford University Press, 2006, p59-76.
8. Rabinowitz H, Vogel S, eds. The manual of scientific style. Elements of style and usage. The manual of scientific style : a guide for authors, editors, and researchers. Amsterdam; Burlington, MA: Elsevier/Academic Press, 2009, p137-231.
9. Forlini G, Bauer MB, Biener L, Capo I, Kenyon KM, Shaw DH, Verner Z.
Grammar and composition. Singapore: Pearson Education South Asia Pte Ltd., 2004, p73-104, 185-215.

10. Thiese MS, Arnold ZC, Walker SD. The misuse and abuse of statistics in biomedical research. Biochem Med (Zagreb) 2015; 25: 5-11.

11. Durbin CG Jr. Effective use of tables and figures in abstracts, presentations, and papers. Respir Care 2004; 49: 1233-7.

12. EASE Guidelines for Authors and Translators of Scientific Articles to be Published in English. Acta Inform Med 2014; 22: 210-7.

13. Miller JE. Preparing and presenting effective research posters. Health Serv Res 2007; 42: 311-28.

14. Longo A, Tierney C. Presentation skills for the nurse educator. J Nurses Staff Dev 2012; 28: 16-23.

15. Gasparyan AY, Ayvazyan L, Blackmore H, Kitas GD. Writing a narrative biomedical review: considerations for authors, peer reviewers, and editors. Rheumatol Int 2011; 31: 1409-17.

16. Hong ST. Ten tips for authors of scientific articles. J Korean Med Sci 2014; 29: 1035-7.

17. Barroga EF. Reference accuracy: authors’ reviewers’ editors’ and publishers’ contributions. J Korean Med Sci 2014; 29: 1587-9.

18. Sengupta S, Shukla D, Ramulu P, Natarajan S, Biswas J. Publish or perish: The art of scientific writing. Indian J Ophthalmol 2014; 62: 1089-93.

19. Setiati S, Harimurti K. Writing for scientific medical manuscript: a guide for preparing manuscript submitted to biomedical journals. Acta Med Indones 2007; 39: 50-5.

20. Stolerman I. Preparing manuscripts and responding to reviewers’ reports: inside the editorial black box. Chapter 9, Publishing addiction science: a guide for the perplexed. Publishing addiction science: a guide for the perplexed. Available at http://www.parint.org/isajewebsite/bookimages/isaje_2nd_edition_chapter9.pdf [accessed on 23 March 2015].

21. Tips for creating and delivering an effective presentation. Available at https://support.office.com/en-gb/article/Tips-for-creating-and-delivering-an-effective-presentation-f63156b0-20d2-4c51-8345-0c337cef88b [accessed on 23 March 2015].

22. Presentation skills. Available at http://www.skillsyouneed.com/presentation-skills.html [accessed on 23 March 2015].

23. Groves T. What makes a high quality clinical research paper? Oral Dis 2010; 16: 313-5.

24. Welch SJ. Preparing manuscripts for online clinical research paper. Chest 2006; 129: 822-5.

25. Editing: annotating PDF page proofs. Available at https://www.youtube.com/watch?v=qMGWVQbIXo [accessed on 23 March 2015].

26. Snyder PJ, Peterson A. The referencing of internet web sites in medical and scientific publications. Brain Cogn 2002; 50: 335-7.

27. Foote M. Why references: giving credit and growing the field. Chest 2007; 132: 344-6.

28. Cals JW, Kotz D. Effective writing and publishing scientific papers, part II: title and abstract. J Clin Epidemiol 2013; 66: 585.

29. Röhrig B, du Prel JB, Wachtlin D, Blettner M. Types of study in medical research: part 3 of a series on evaluation of scientific publications. Dtsch Arztebl Int 2009; 106: 262-8.

30. Baron TH. ABC’s of writing medical papers in English. Korean J Radiol 2012; 13 S1-11.

31. Gasparyan AY, Ayvazyan L, Akazhanov NA, Kitas GD. Conflicts of interest in biomedical publications: considerations for authors, peer reviewers, and editors. Croat Med J 2013; 54: 690-8.

32. Gasparyan AY, Ayvazyan L, Kitas GD. Multidisciplinary bibliographic databases. J Korean Med Sci 2013; 28: 1270-5.

33. Gasparyan AY. Choosing the target journal: do authors need a comprehensive approach? J Korean Med Sci 2013; 28: 1117-9.

34. Gasparyan AY. Familiarizing with science editors’ associations. Croat Med J 2011; 52: 735-9.