

The abstract format of original articles: differences between imaging and non-imaging journals

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Abstract

Objectives To compare the abstract structure in the 70 highest-rank imaging journals with that of the two highest-rank journals in each of 35 non-imaging biomedical categories, according to 2008 impact factors.

Methods We searched on MEDLINE for articles published in high-ranking imaging and non-imaging journals. Abstract format was considered as: IMRaD (Introduction, Methods, Results, and Discussion/conclusion); extended structured (ES), when including headings other than IMRaD; or narrative (without headings).

Results Abstracts of the 70 highest-rank imaging journals were: IMRaD, $n=43$ (61%); narrative, $n=27$ (39%); ES, $n=0$. Abstracts of the 70 highest-rank non-imaging journals were: IMRaD, $n=26$ (37%); narrative, $n=35$ (50%); ES, $n=9$ (13%) ($p=0.001$). Additional headings were: study design, $n=7$; measurements, $n=7$; context/setting, $n=4$; interventions, $n=2$; rationale, $n=1$; level of evidence, $n=1$; clinical relevance, $n=1$. Study design was declared in 12/23 abstracts (57%) and 21/

23 (91%) article bodies in Radiology, 6/21 (29%) and 10/21 (48%) in Investigative Radiology, 11/24 (46%) and 18/24 (75%) in European Radiology, and 12/30 (40%) and 23/30 (77%) in American Journal of Roentgenology, respectively.

Conclusions Although about 60% of imaging journals adhere to IMRaD format, 13% of non-imaging journals requires additional headings; ES abstracts may assist readers in selecting full articles to be read.

Keywords Abstracting · Indexing · Imaging journals · Biomedical journals · Literature research

Introduction

Communication is of paramount importance in medical science. Presenting new results and delivering new information are basic aims of medical research. The introduction of several web-based search engines and databases, such as MEDLINE (PubMed) [1], Embase [2], Scopus [3], etc., represents a powerful tool to access the huge amount of medical literature ever published. However, these databases are simply tools that can be used to search, retrieve, and organize information therein contained. Thus, the result of a research is tightly related not only to the amount of data included in a specific database but also to how these data are organized and presented. The most common method used to retrieve data by such search engines is to match some key words entered by the operator with other words included in the title and the abstract of each paper. If the title can provide only little general information about topic and content of a paper, the abstract represents the true essence of what is contained in that paper. Quite apart

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from the originality and value of the research, effective presentation of the material is extremely important, possibly impacting on the reader's decision of whether downloading or not the full paper.

Generally, the abstract format of original articles reflects the typical internal logics of a manuscript organization: 1. an introduction; 2. a section where materials and research methods are illustrated; 3. the results of the study; and 4. a conclusion on the meaning of results and their potential clinical applications. This is commonly known as IMRaD format (Introduction, Methods, Results, and Discussion) [4]. In abstracts, the fourth headings is almost always Conclusion(s) and contains short sentence(s) summarizing findings and, sometimes, the main interpretation(s). In this paper, we decided to use the well known IMRaD acronym, instead of introducing IMRaC, for this usual 4-headings abstract format. However, we can find abstracts that do not strictly adhere to the IMRaD format, others that include additional headings (importantly, an explicit definition of the study design), and others that are completely narrative, i.e. without headings.

Analysis of abstract format has already been performed on general medical journals [5–7], and on medical education journals [8]. However, at the best of our knowledge, data on imaging journals are missing. Thus, the purpose of our work was to compare the abstract format of the 70 highest-rank imaging journals with that of the two highest-rank journals of each of 35 non-imaging biomedical clinical categories, as ranked for the 2008 impact factor.

Materials and methods

We searched on the Impact Factor database edition 2008 of the Journal Citation Report Science [9] for the impact factor of imaging journals included in the subject category “radiology, nuclear medicine & medical imaging”. Among them, we selected the 70 journals with the highest impact factor, excluding those publishing only reviews. The list of journals that entered the analysis is reported in Table 1. We also retrieved the list of the first five journals for each of 35 non-imaging biomedical clinical categories included in Journal Citation Report [9]. From this, we selected the two highest-rank journals for each category, excluding those publishing only reviews. Thus, a total of 70 non-imaging biomedical journals were included in our analysis. Categories and journals are reported in Table 2.

From December 23rd, 2010 to January 7th, 2011, we searched on the MEDLINE (PubMed) database [1] for each journal of the two afore-mentioned lists, using no specific

keywords. Among results, we selected the first twenty presented abstracts, excluding non-original articles (e.g. those marked as “review article”, “letter”, “commentary”, etc.), those where an abstract was not available (indicated with “No abstract available”), and meta-analyses. Abstract formats of the included studies were then classified as IMRaD, extended structured—when additional information were required using mandatory headings other than IMRaD (e.g. Setting, Study design, Outcome measures, etc.), or narrative—i.e. without headings. All cases where two IMRaD headings were merged but still declared were considered as IMRaD.

Thereafter, we evaluated the January 2011 issue of Radiology [10], European Radiology [11], American Journal of Roentgenology [12], and Investigative Radiology [13], i.e. the four highest-rank general imaging journals, identifying the abstracts of original articles. Due to the lower number of clinical original articles per issue published by Investigative Radiology, we needed to evaluate six issues of this journal (from August 2010 to January 2011) to have a number of abstracts comparable to a single issue of the other three selected journals. For each of these four journals, we noted whether the study design was explicitly declared in the abstract and whether any statement about Institutional Review Board approval and/or written patients' informed consent was included. Also, we noted whether study design was explicitly described within the article body. Studies on phantoms (Radiology, $n=1$; Investigative Radiology, $n=6$), on animal models (Radiology, $n=1$; Investigative Radiology, $n=16$; European Radiology, $n=1$; AJR American Journal of Roentgenology, $n=1$), and in vitro studies (Investigative Radiology, $n=12$) were excluded from our evaluation, as well as surveys and special reports (Radiology, $n=4$). Due to possible discrepancies between requirements provided by the Instructions for Authors and the published abstract, we performed our analysis on the latter.

Statistical analysis

The distribution of the abstract format published in imaging journals was compared to that of abstracts published in non-imaging journals using the Chi-square test. A p -value less than 0.05 was considered as significant.

Results

For each group of twenty abstracts published in each journal, we found a homogeneous distribution of the abstract format. In other words, no variability of abstract format was found within each individual journal.

Table 1 First 70 imaging journals as ranked for the 2008 impact factor

Ranking 2008	Imaging journals with narrative abstract	Ranking 2008	Imaging journals with IMRaD abstract
3	Neuroimage	1	Journal of Nuclear Medicine
4	Human Brain Mapping	2	Radiology
6	Seminars in Nuclear Medicine	5	Investigative Radiology
9	NMR in Biomedicine	7	International Journal of Radiation Oncology
15	Medical Images Analysis	8	European Journal of Nuclear Medicine and Molecular Imaging
16	Magnetic Resonance in Medicine	12	Radiotherapy and Oncology
18	Molecular Imaging	13	Medical Physics
19	Contrast Media and Molecular Imaging	14	European Radiology
21	Radiation Research	17	Molecular Imaging and Biology
23	Journal of Biomedical Optics	20	Clinical Nuclear Medicine
25	Physics in Medicine and Biology	22	Strahlentherapie und Onkologie
27	Ultrasound in Obstetrics and Gynecology	24	AJR American Journal of Roentgenology
32	Ultrasound in Medicine and Biology	26	American Journal of Neuroradiology
37	Medical Dosimetry	28	Journal of Magnetic Resonance Imaging
46	Magnetic Resonance Imaging	29	Quarterly Journal of Nuclear Medicine and Molecular Imaging
50	Radiation International Biophysics	30	Journal of Nuclear Cardiology
52	Ultrasonic Imaging	31	Nuclear Medicine in Biology
59	Journal of Radiation Research	33	Ultraschall in der Medizin
61	Concepts in Magnetic Resonance part A	34	British Journal of Radiology
63	Cancer Biotherapy and Radiopharmaceuticals	35	European Journal of Radiology
64	International Journal of Cardiovascular Imaging	36	International Journal of Hyperthermia
65	Journal of Applied Clinical Medical Physics	39	Journal of Vascular and Interventional Radiology
66	Computerized Medical Imaging and Graphics	40	International Journal of Radiation Biology
69	Journal of Radiological Protection	41	Journal of Cardiovascular Magnetic Resonance
70	Applied Radiation and Isotopes	42	Radiation Oncology
		43	Neuroradiology
		44	Academic Radiology
		45	Brachytherapy
		47	Nuklearmedizin
		48	Magnetic Resonance Materials in Physics, Biology, and Medicine
		49	Journal of Neuroimaging
		51	Cardiovascular and Interventional Radiology
		53	Nuclear Medicine Community
		54	Journal of Thoracic Imaging
		55	ROFO-Fortschr Rontg
		56	Clinical Radiology
		58	Abdominal Imaging
		60	Journal of Computed Assisted Tomography
		62	Journal de Neuroradiologie
		67	Pediatric Radiology
		68	Dentomaxillofacial Radiology

IMRaD Introduction, methods, results, and discussion/conclusion

Among the 70 highest-rank imaging journals, 43 (61%) had IMRaD abstracts, while the remaining 27 (39%)

journals had narrative abstracts (see Table 1). Among the 70 highest-rank non-imaging journals, 26 (37%) had

Table 2 First 70 non-imaging journals as ranked for the 2008 impact factor

Ranking 2008	Categories and journals	Abstract format	Additional headings
	<i>Allergy</i>		
1	Journal of Allergy and Clinical Immunology	IMRaD	
2	Allergy	IMRaD	
	<i>Anatomy and Morphology</i>		
1	Developmental Dynamics	Narrative	
2	Brain Structure and Function	Narrative	
	<i>Andrology</i>		
1	International Journal of Andrology	Narrative	
2	Journal of Andrology	Narrative	
	<i>Anesthesiology</i>		
1	Pain	Narrative	
2	Anesthesiology	IMRaD	
	<i>Cardiac and Cardiovascular System</i>		
1	Circulation ^a	IMRaD	
2	Journal of American College of Cardiology	IMRaD	
	<i>Clinical Neurology</i>		
1	Lancet Neurology	Extended structured	Funding
2	Annals of Neurology	IMRaD	
	<i>Critical Care Medicine</i>		
1	American Journal of Respiratory Critical Care ^b	Extended structured	Rationale; Measurements
2	Critical Care Medicine	Extended structured	Design; Setting; Interventions; Measurements
	<i>Emergency Medicine</i>		
1	Annals of Emergency Medicine	IMRaD	
2	Resuscitation	IMRaD	
	<i>Endocrinology and Metabolism</i>		
2	Cell Metabolism	Narrative	
3	Frontiers in Neuroendocrinology	Narrative	
	<i>Gastroenterology and Hepatology</i>		
1	Gastroenterology	IMRaD	
2	Hepatology	Narrative	
	<i>Genetics and Heredity</i>		
1	Nature Genetics	Narrative	
3	Genes and Development	Narrative	
	<i>Geriatrics and Gerontology</i>		
1	Aging Cell	Narrative	
3	Neurobiology of Aging	Narrative	
Ranking 2008	Categories and Journals	Type of abstract	Additional headings
	<i>Hematology</i>		
2	Blood	Narrative	
3	Circulation Research ^c	IMRaD	
	<i>Immunology</i>		
3	Nature Immunology	Narrative	
4	Immunity	Narrative	
	<i>Infectious Diseases</i>		
1	Lancet Infectious Diseases	Narrative	
2	Clinical Infectious Diseases	IMRaD	
	<i>Legal Medicine</i>		

Table 2 (continued)

Ranking 2008	Categories and journals	Abstract format	Additional headings
1	International Journal of Legal Medicine	Narrative	
2	Regulation in Toxicology and Pharmacology <i>Medical Informatics</i>	Narrative	
1	Journal of Medical Internet Research	IMRaD	
2	Journal of American Medical Informatics Association <i>Medical Laboratory Technology</i>	Extended structured	Design; Measurements
1	Clinical Chemistry	IMRaD	
2	Clinica Chimica Acta <i>Medicine General and Internal</i>	IMRaD	
1	New England Journal of Medicine	IMRaD	
2	JAMA-Journal of American Medical Association <i>Medicine Research and Experimental</i>	Extended structured	Context; Design; Setting; Interventions; Main outcome measures
1	Nature Medicine	Narrative	
2	Journal of Clinical Investigation <i>Neurosciences</i>	Narrative	
3	Neuron	Narrative	
4	Nature Neuroscience <i>Obstetrics and Gynecologics</i>	Narrative	
2	Obstetrics and Gynecology	Extended structured	Level of evidence
3	Fertility and Sterility <i>Oncology</i>	Extended structured	Design; Setting; Interventions; Main outcome measures
1	CA: A Cancer Journal for Clinicians	Narrative	
3	Cancer Cell <i>Ophthalmology</i>	Narrative	
1	Progress in Retinal and Eye Research	Narrative	
2	Ophthalmology <i>Orthopedics</i>	Extended structured	Design; Main outcome measures; Financial disclosures
1	Osteoarthritis and Cartilage	IMRaD	
2	American Journal of Sport Medicine <i>Otorhinolaryngology</i>	Extended structured	Study design; Clinical relevance
1	Head and Neck	IMRaD	
2	Journal of the Association for Research in Otolaryngology <i>Pathology</i>	Narrative	
2	American Journal of Pathology	Narrative	
3	Brain Pathology <i>Pharmacology</i>	Narrative	
4	Pharmacology and Therapeutics	Narrative	
6	Trends in Pharmacology Sciences <i>Pediatrics</i>	Narrative	
1	Journal of the American Academy of Child and Adolescent Psychiatry	IMRaD	
2	Pediatrics <i>Peripheral Vascular Diseases</i>	IMRaD	
3	Hypertension	Narrative	
4	Arteriosclerosis, Thrombosis, and Vascular Biology	IMRaD	

Table 2 (continued)

Ranking 2008	Categories and journals	Abstract format	Additional headings
	<i>Respiratory System</i>		
2	Thorax	IMRaD	
3	European Respiratory Journal	Narrative	
	<i>Rheumatology</i>		
1	Annals of Rheumatic Diseases	IMRaD	
2	Arthritis and Rheumatism	IMRaD	
	<i>Surgery</i>		
1	Annals of Surgery	IMRaD	
3	Endoscopy	IMRaD	
	<i>Transplantation</i>		
1	American Journal of Transplantation ^d	Narrative	
2	Cell Transplantation	Narrative	
	<i>Urology and Nephrology</i>		
1	Journal of American Society of Nephrology	Narrative	
2	European Urology	Extended structured	Design; Setting; Measurements; Limitations

Each journal was considered once, also when included in two categories. In particular:

^a *Circulation* was included in *Cardiac and Cardiovascular System* category and excluded from *Peripheral Vascular Disease* category

^b *American Journal of Respiratory Critical Care* category was included in *Critical Care Medicine* and excluded from *Respiratory System* category

^c *Circulation Research* was included in *Hematology* category and excluded from *Peripheral Vascular Disease* category

^d *American Journal of Transplantation* was included in *Transplantation* category and excluded from *Surgery* category

IMRaD Introduction, methods, results, and discussion/conclusion

IMRaD abstracts, 35 (50%) narrative abstracts, and 9 (13%) extended structured abstracts ($p=0.001$) (see Table 2). The comparison of the abstract format between imaging and non-imaging journals is summarized in Table 3. The extended structured format included a more detailed description of methods using mandatory headings such as design/study design ($n=7$), main outcome measures/measurements ($n=7$), context/setting ($n=4$), interventions ($n=2$), rationale ($n=1$), level of evidence ($n=1$), or clinical relevance ($n=1$).

Data regarding the explicit declaration or description of study design of original articles published in the four highest-rank general imaging journals are reported in Table 4. Radiology is the only journal requiring the

inclusion into the abstract statements regarding Institutional Review Board approval, patients' informed consent, and compliance to Health Insurance Portability and Accountability Act (for studies originating in the United States only) [14]. Conversely, Investigative Radiology, European Radiology, and American Journal of Roentgenology do not require the inclusion of such declarations [15–17].

Discussion

Our report showed that the abstract adopted by imaging journals presents the IMRaD format or are narrative, never

Table 3 Comparison of abstract format between the first 70 imaging journals and in 70 non-imaging clinical journals, as ranked for the 2008 impact factor

Abstract format	Journals	
	Non-imaging	Imaging
IMRaD	26/70 (37%)	43/70 (61%)
Extended structured	9/70 (13%)	–
Narrative	35/70 (50%)	27/70 (39%)

IMRaD Introduction, methods, results, and discussion/conclusion

Table 4 Study design declaration/description into abstract and/or into the article body of original articles of recent issues of the first four general imaging journals as ranked for the 2008 impact factor

Journal	Study design declaration/Description	
	Abstract	Article body
Radiology	13/23 (57%)	21/23 (91%)
Investigative Radiology	6/21 (29%)	10/21 (48%)
European Radiology	11/24 (46%)	18/24 (75%)
American Journal of Roentgenology	12/30 (40%)	23/30 (77%)

defining additional mandatory headings. On the other hand, about 13% of the highest-rank journals of 35 other clinical specialties require additional headings. Moreover, the abstracts recently published in the four highest-rank general imaging journals explicitly include study design declaration in 29%–57% of cases.

In 1983, Kerkut [18] calculated that for every 500 people reading the title of a paper, only one read also the whole text. We do not know if this ratio has changed in almost three decades. In the Internet era, the access to the full article text is undoubtedly easier but it is also true that much more people can read a paper title. The article title is important in order to present the reader what is contained into an article. However, the title is necessarily short and many journals restrict its length to a fixed number of words or characters. Titles can be descriptive, declarative, or interrogative. Neutral descriptive and assertive declarative titles are usually more suitable for original articles, the latter having stronger impact on the reader than the former, while interrogative titles can be more suitable for narrative reviews that consider different answers for a single question. Moreover, we should note that some highly-ranked medical journals frequently do not accept assertive declarative titles [19].

Including additional headings in the abstract can be interpreted as a refinement of its format. This aspect should be considered with reference to the increasing application of principles and rules of evidence-based medicine to radiology and medical imaging. In particular, the value of a research could be faster and better appreciated if the study design (not mandatorily or routinely included in the IMRaD format) would be immediately readable in the abstract. This can be inferred by our analysis. Abstracts published in Radiology lack information about study design in 10/23 cases (43%), while the same data is missing in 15/21(71%), 13/24 (54%), and 18/30 (60%) abstracts in Investigative Radiology, European Radiology, and AJR American Journal of Roentgenology, respectively. This means that abstract readers (that are probably only a small fraction of those who read the title [18]) will never know whether the conclusions of most of original articles published on such journals were based on a prospective or a retrospective study design. Surprisingly, study design declaration is not included within the article body of 26/98 papers (27%) included in our analysis. Regarding the comparison of the abstract format between imaging and non-imaging journals, we note that despite the lack of extended structured abstracts in imaging journals, these latter included a lower percentage of narrative abstracts compared to non-imaging journals (39% versus 50%; see Table 3).

In 2007, Cook et al. [8] published a paper evaluating—among other things—the abstract format of full-length

reports of experimental studies in medical education. They reported 79% of IMRaD, 11% of narrative, and 10% of extended structured abstracts. In our study, similar values were found only for extended structured abstracts of non-imaging journals (13%) and IMRaD abstracts of imaging journals (61%), as reported in Table 3. Our data also agree with those obtained by Berwanger et al. on the quality of abstracts reporting on randomized controlled trials published in the main general medical journals [5].

An ad hoc working group for critical appraisal of the medical literature published in 1997 “a proposal for more informative abstracts of clinical articles” [20]. To permit quick and selective scanning, this working group suggested the following headings: Objective, Design, Setting, Patients or Participants, Interventions, Measurements and Results, Conclusions. This format, including explicit declaration of Study Design, Setting, and Interventions has relations with the application of principles and rules of evidence-based medicine and its delayed application to radiology [21]. Especially in the bottom-up approach of evidence-based medicine, when a physician tries to solve a clinical problem “using the best external evidence for individual patient care” [22], a rapid access to information like study design or level of evidence of original articles (i.e., primary studies) may be crucial. Although the value of a research may be fully appreciated only reading the entire text, a set of crucial information should be included into the abstract. Regarding the study aim, we should note that Radiology requires for the purpose of the study provided in the abstract to be restated at the end of introduction. However, as a matter of fact, in only one paper [23] the purpose of the work was reported both in the abstract and in the article body, except for the words “prospectively and independently”, that were excluded from abstract. On the other hand, contrary to what might be expected, this was not due to space shortage, as it had a length of 336 words (compared to a maximum length of 250 words required in the Instructions for Authors). Interestingly, Investigative Radiology is the only journal among the four highest-rank evaluated that poses no limits on length for the abstract [15] and it is also the journal in which study design declaration is less frequently included in both abstract and article body. As a matter of fact, Radiology recently (2006 and 2007) introduced two dedicated questions to be answered by the authors of original articles, i.e. “Advances in Knowledge” and “Implications for Patient Care”. Those paragraphs are highlighted in the text. However, neither is included in the abstract.

Narrative and IMRaD abstracts frequently do not provide information about primary and secondary study endpoints. As a consequence, authors can focus the study results on the most attractive even if it was a secondary

endpoint, maybe skipping on a less significant result regarding the primary endpoint.

Another important issue regarding IMRaD or narrative abstracts is the application of international standards, such as the Standards for Reporting of Diagnostic Accuracy (STARD) [24] or the Consolidated Standards of Reporting Trials (CONSORT) [25]. STARD is a checklist for the quality control of manuscripts reporting on diagnostic performance, while CONSORT is a minimum set of recommendations for reporting on randomized controlled trials. Both standards consist of a list of numerous items that should be considered when editing papers dealing with diagnostic accuracy or randomized trials. While STARD does not focus on abstracts, CONSORT has a specific paragraph on that [26]. However, although CONSORT rules could be respected using an IMRaD or a narrative abstract, the combination of space shortage and lack of mandatory headings works against this.

The role of radiology in the relation with other medical disciplines such as internal medicine, cardiology, oncology, neurology can be enhanced by a higher attention paid to a presentation of imaging studies—also in the abstract—more fitting with evidence-based principles. For example, this approach may play a role in favour of vascular and extra-vascular interventional radiology compared with alternative procedures.

The decision on whether including or not additional headings into the abstract has a scientific basis and is usually decided by the editorial board of a journal. On the other hand, reviewers could suggest that the authors should include all essential information within abstracts as well as within the body of the article. When an information is not explicitly required, the probability for an author of not including this information rises. The same is for reviewers of manuscripts, who may forget to ask the authors for such essential information. This is also true from our personal experience as authors and reviewers.

Our study has several limitations. First, we compared a large number of imaging journals ($n=70$) with the two highest-rank journals of 35 biomedical subspecialties. However, none of the highest-rank imaging journals present any extended structured format. Second, we evaluated only the first twenty abstracts of original articles presented for each journal in the MEDLINE (PubMed). However, for each journal, abstract format was homogeneous and a different format was adopted only in case of non-original articles. Thirdly, we evaluated abstracts belonging to original articles only. Secondary studies, such as systematic reviews and meta-analyses, provide different types of results and require a different abstract format. This issue should be properly addressed by a dedicated analysis. Finally, we only considered explicit

declaration or description of study design while sometimes it could be inferred from a deep analysis of the entire article body.

Summarizing, although imaging journals usually adhere to the IMRaD abstract format, 13% of non-imaging journals require additional mandatory information. Extended structured abstracts may assist readers in selecting full articles to be read. Imaging journals should consider this possibility.

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