Abstracts in Medical Science Journals: An Analysis of Subheadings in Structured Abstracts

의학 저널에서 사용되는 구조적 초록의 소표제들에 관한 분석

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ABSTRACT

This study aimed to investigate the current uses of subheadings that appear in medical science journal abstracts and to discuss its potential implications for medical science from the perspectives of library and information science. To conduct this study, the following nine sub-fields in medical science were selected: cancer, ethics, genetics, infectious disease, neurology, pediatrics, immunology, psychiatry, and cardiology. Random sample data were drawn based on the years 2010 to 2015 from the *PubMed* database. This study investigated the extent of the uses of subheadings, variants of subheadings, and common formation of subheadings with the help of a frequency analysis. The specific findings of this study are summarized as the following: 1) more traditional abstracts are used across almost all sub-fields of medical science; 2) on average, 4.1 subheadings were used in the sample dataset; and 3) the most frequently used set of subheadings is *OBJECTIVES, METHODS, RESULTS,* and *CONCLUSIONS*. This subheading set appears to be the de facto standard across all medical science journals. The analysis of subheadings in structured abstracts and the issues raised in this study can be beneficial for journal editors and other academics in medical science as well as library and information science.

Keywords: Structured abstracts, Traditional abstracts, Moves, Subheadings, Objectives, Methods, Results, Conclusions

초 록

본 논문은 의학분야 논문가운데 구조적 초록만을 선별하여 소표제들을 분석함으로서 문헌정보학 관점에서 의학분야의 논문초록양식에 소표제의 의미를 논의하였다. 다양한 의학분야 가운데 암, 윤리, 유전학, 감염성 질환, 신경과, 소아과, 면역학, 정신의학 및 심장학의 9개 세부분야를 선택하였고, PubMed 데이터베이스에서 샘플 데이터로 출판된 논문초록 정보를 추출하였다. 이러한 데이터는 최근 초록인 2010년부터 2015까지 5년 동안 출판된 초록들로 제한하였다. 연구는 추출된 샘플들의 양상과 구조적 형식에서 사용된 소표제들의 변종과 변종의 빈도 수 등을 분석하였다. 요약한 연구 결과는 다음과 같다. 1) 대다수의 세부 의학분야에서 출판되는 논문들은 구조적 초록이 아닌 비구조화 초록을 주로 사용하고 있다는 것이 드러났다. 2) 의학분야의 논문에서는 소표제 항목을 평균적으로 4.1을 사용하는 것으로 나타났다. 3) 일반적으로 가장 자주 사용되는 부제는 OBJECTIVES(목적), METHODS(방법), RESULTS(결과), CONCLUSIONS(결론)이였다. 특히 이 연구에서 제기된 문제점들과 보고된 소표제 분석결과가 의료과학 저널 편집자와 의학 및 문헌정보학자들에게 유용한 정보가 될 것이다.

키워드: 구조적 초록, 비구조적 초록, 이동마디, 목적, 소표제, 방법, 결과, 결론

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Ⅰ. Introduction

The importance of abstracts has been recognized by many academic disciplines. Abstracts play a critical role in disseminating information. In general, two distinctive forms of abstracts – traditional and structured – are used in academia. A traditional (unstructured) abstract provides authors the flexibility and liberty of writing in a single paragraph form, whereas in a structured abstract, authors need to write the abstract in a confined manner using specific subheadings (Kim 2014). These subheadings are explicit labels (e.g., *Background, Aims, Methods,* etc.) that are used in structured abstracts. For instance, while this paper's abstract, which appears on the first page of this paper, is presented in a traditional form, a structured abstract is one with subheadings as shown in Figure 1. Generally, if a journal publisher chooses to adopt a structured abstract, authors would need to follow the subheadings pre-defined by a particular journal publisher.

AIM: This study aimed to investigate the current uses of subheadings that appear in medical science journal abstracts and to discuss its potential implications for medical science from the perspectives of library and information science.

METHODS: To conduct this study, the following nine sub-fields in medical science were selected: cancer, ethics, genetics, infectious disease, neurology, pediatrics, immunology, psychiatry, and cardiology. Random sample data were drawn based on the years 2010 to 2015 from the *PubMed* database. This study investigated the extent of the uses of subheadings, variants of subheadings, and common formation of subheadings using a frequency analysis.

RESULTS: The specific findings of this study are summarized as the following: 1) more traditional abstracts are used across almost all sub-fields of medical science; 2) on average, 4.1 subheadings were used in the sample dataset; and 3) the most frequently used set of subheadings is *OBJECTIVES, METHODS, RESULTS,* and *CONCLUSIONS.* This subheading set appears to be the de facto standard across all medical science journals.

CONCLUSIONS: The analysis of subheadings in structured abstracts and the issues raised in this study can be beneficial for journal editors and other academics in medical science as well as library and information science.

〈Figure 1〉 An Example of a Structured Abstract

Proponents of structured abstracts have argued that structured abstracts contain information that is more organized, are less difficult to peruse and easier to search for, and are generally welcomed by readers and authors. Nonetheless, opponents of structured abstracts point out that structured abstracts are longer than traditional structured abstracts and are not equivalent to traditional abstracts due to structuring of abstracts (Hartley 2004). Additionally, opponents of structured abstracts journals suggest that journals should have clear guidelines for the components of abstracts rather than just structuring abstracts with subheadings (Jamar, Sauperl, and Bawden 2014). It is even possible to write an abstract in which each sentence corresponds to a section in a paper. In such a case, only one paragraph is typically used without subheadings. This form of abstract is referred to as a semi-structured abstract (Camps 2010).

Regardless of the form of abstracts, the consensus among academics in the medical community, at least, is that structured abstracts generally have many advantages. Although traditional abstracts are still used in the medical fields, studies have revealed that structured abstracts nowadays are used more extensively in medical journals than previously (Hartley 2014; Ripple et al. 2011). When a journal publisher decides to use structured abstracts instead of traditional abstracts, the appropriate selection of subheadings is important because the subheadings guide authors through the form.

Structured abstract subheadings have evolved over the years. Structured abstracts date back several two decades (Guimarães 2006; Hartley 2014). The general framework of *IMRAD* – which includes the Introduction, Methods, Results, and Discussion sections – had an enormous influence on the development of structured abstracts. By 1975, the majority of abstracts had an *IMRAD* structure (Sollaci and Pereira 2004). During this period, the subheadings of structured abstracts also evolved. In the late 1980's, the Ad Hoc Working Group for Critical Appraisal of the Medical Literature (1987) proposed using seven subheadings: 1) *Objective,* 2) *Design,* 3) *Setting,* 4) *Patients or Participants,* 5) *Interventions,* 6) *Measurements,* and 7) *Conclusion.* This structured abstract format was comparable to the IMRAD format (Fontelo, Gavino, and Francis 2013). In recent years, structured abstracts have contained variations of the IMRAD structure (Martha 2015). Occasionally additional subheadings, such as *Discussion* or alternative names for *Methods* (*Materials and Methods, Patients and Methods*), continue to be required by some scientific and medical journals.

Due to the wide variety of possible subheadings and the evolving nature of structured abstracts, it is beneficial to examine the patterns of structured abstract subheadings in order to discover their relevance. As a wide range of subheadings has been proposed in the past, the actual use of structured abstract subheadings in practice is not clear. Consequently, the aim of this research is to examine the individual subheadings in detail and to discuss the potential implications for medical science. Furthermore, since the issue of selecting appropriate structured abstract subheadings is closely related to the subject area of indexing and abstracting, the result of this study is discussed from a Library and Information Science (LIS) perspective.

In order to conduct this study, sample data consisting of abstracts were downloaded from *PubMed*. In particular, this study examined the subheadings appearing in structured abstracts pertaining to nine medical sub-fields: cancer, medical ethics, genetics, infectious disease, neurology, pediatrics, immunology, psychiatry, and cardiovascular disease.

Ⅱ. Related Study

A number of studies related to the use of structured abstracts in the medical field have been conducted in the past. In particular, appropriate selection of subheadings has been suggested by many researchers, such as Hartley (2004). A decade later, Hartley (2014), commented on subheadings. He noted that the justification for using structured abstracts has been substantiated because many scholars are now using them in the fields related to medical science.

Some researchers have examined the subheadings in structured abstracts for various purposes in their research. One notable benefit of examining the subheadings of structured abstracts is the fact that common subheadings used in an academic community can be identified. Also, in the process, the extent of the uses of structured abstracts and their subheadings can be determined. Previous research has shown that the adoption of structured abstracts by journal publishers had continually increased until recently. Also, according to previous studies, structured abstract subheadings themselves have evolved over the years. The following studies have specifically examined the patterns of structured abstract subheadings.

A study conducted by Nakayama et al. (2000) provides a glimpse of the subheadings used in structured abstracts in prominent medical science journals. The authors examined the extent of use of structured abstracts in the top thirty journals in accordance with the impact factors noted in the “Medicine, General and Internal” category of the ISI Journal Citation Reports. The authors reported that 66.5% of the abstracts used the introduction, methods, results, and discussion (IMRAD) format, whereas 33.5% used the eight-heading format. Their results showed that not all abstracts of original articles are structured. Regarding the extent of use of structured abstracts, the authors indicated 61.8% structured abstracts and 38.2% traditional abstracts.

Shimbo, Yamasaki, and Matsumoto (2003) reported that, in *MEDLINE* 2002, 94% of the abstracts were traditional, whereas only 6% of the abstracts were structured. Although most of the subheadings could be categorized into *BACKGROUND, OBJECTIVE, METHODS, RESULTS, and CONCLUSIONS,* the authors reported that more than 6000 distinctive subheadings existed in *MEDLINE* 2002. A range of formations could be detected primarily due to linguistic variations (e.g., singular versus plural, synonyms, and the combination of two categories). Nonetheless, the distribution of commonly found subheading sets – a set of explicit labels in structured abstracts – were the following:

- *BACKGOUND: METHOD(S): RESULTS: CONCLUSION(S):* was 16.6%,
- *OBJECTIVE(S): METHOD(S): RESULTS: CONCLUSION(S):* was 14.7%, and
- *PURPOSE: METHOD(S): RESULTS: CONCLUSION(S):* was 6.6%.

Hopewell et al. (2008) attempted to extend the CONSORT (Consolidated Standards of Reporting Trials) abstracts. They recommend that medical journal articles related to randomized controlled trials should include "details of trial objectives; trial design (e.g., method of allocation, blinding/masking); trial participants (i.e., description, numbers randomized, and number analyzed); interventions intended for each randomized group and their impact on primary efficacy outcomes and harms; trial conclusions; trial registration name and number; and source of funding." (Hopewell et al. 2008, 48). Adopting such a recommendation might be appropriate for reporting randomized controlled trials, but it may also add additional variants of subheadings that may not apply to other medical science sub-fields or other fields of study. Whether incorporating specialized structured abstract subheadings outweighs the benefits of having cross-disciplinary subheadings appearing in structured abstracts needs to be resolved by a medical community. Consequently, the investigating the overall uses of these types of subheadings in the medical journal database should be beneficial since it would indicate how prevalent they are in the medical journals.

Ripple et al. (2011) provided more recent findings regarding the structured abstract. Using

7,163,494 *MEDLINE* records, the authors found that *MEDLINE* records containing structured abstracts rose from 2.5% in 1992 to 20.3% in 2005. The authors reported that a set of 1,335 subheadings with 784 minor variants of subheadings were extracted. For the most commonly used subheadings, the authors reported the following: *BACKGROUND* (10.0%), *OBJECTIVES* (16.2%), *METHODS* (28.2%), *RESULTS* (22.4%), and *CONCLUSIONS* (23.2%). The authors also identified some other subheading variants used less frequently in their dataset. Although the work of Ripple et al. (2011) is based on a large dataset, variants of subheadings were not discussed in detail. Thus, by extending the research carried out by Ripple et al. (2011), this study conducted a more thorough investigation on subheading patterns found in medical science sub-fields.

Overall, considering all the pertinent previous studies, it appears that the usage of structured abstracts has increased in medical science. More specifically, it appears that the most common subheadings, namely *BACKGROUND, OBJECTIVES, METHODS, RESULTS, and CONCLUSION* have emerged over the years. Yet, more specific patterns of subheadings used in medical science and sub-areas of medical science since sub-areas of medical science have not been compared with each other. Thus this study investigates the extent of the type of subheadings that are more specific to medical science (e.g., Trial and Registration, and Participants) and the general types of subheadings (e.g., Background, Objectives, Methods, Results, and Conclusions) that could be applied to other fields of study.

Ⅲ. Methods

In this study, the comparison of the subheadings used among medical sub-fields was sought-after since it is valuable in gaining insights into the characteristics of structured abstracts frequently used within medical science. Taking this into account, for the purpose of conducting this study, a random selection of nine sub-fields pertaining to medical science was made using the list of subheadings published by the U.S. National Library of Medicine (2015). The selected medical sub-fields include the cancer, ethics, genetics, infectious disease, neurology, pediatrics, immunology, psychiatry, and cardiology. After this initial step, using the keywords that represent each sub-field (e.g., the keyword “cancer” for the sub-field *Cancer*), random sample data were drawn from *PubMed* database for the years 2010 to 2015. *PubMed* contains citation information from the *US National Library of Medicine* (NLM). A *UNIX* script was developed in order to perform the following tasks:

- An extraction of the subheadings from the dataset. The structured abstract subheadings appear in all uppercase letters followed by a colon. This pattern, along with other patterns, was extracted in order to perform various frequency counts.
- A frequency count of structured and non-structured abstracts using the capitalization and punctuation mark pattern.
- An extraction of sample journals. For each field, 24 journals were randomly selected from the journal list provided by the *U.S. National Library of Medicine* (https://www.nlm.nih.gov/bsd/serfile_addedinfo.html). Since a journal may use both structured abstracts and traditional abstracts, up to ten journals were randomly selected from *PubMed* database by using the key terms that best represent each sub-field (e.g., the term "cancer" for the sub-field *Cancer*). The selected journals corresponding to their sub-fields are shown in the Appendix.

Once the sample dataset was constructed, the raw results were obtained using the program. Then, the results were exported into *Microsoft Excel* for further processing. The findings in this study were compared to the previous research in order to have comprehensive understandings of the subheading patterns.

Ⅳ. Results

1. Structured Abstracts versus Traditional Abstracts

The extent of the uses of structured abstracts can be measured by counting a specific text pattern used in subheadings. The following specification can roughly identify subheadings: a string that starts with a blank space followed by all capitalized letters followed by a punctuation mark, such as a slash or a blank space followed by a colon. In order to extract subheadings, this study used UNIX based tools that support *regular expressions.* A regular expression is a sequence of characters used for pattern matching (Friedl 2006). For example, for the subheading specifications mentioned above, a regular expression which can be specified using the UNIX based tool called *grep* is as follows:

```
grep -o '\. [A-Z][A-Z] [A-Z / ][A-Z]*:'
```

Abstracts containing subheadings were automatically categorized as structured abstracts, while abstracts that did not contain subheadings were automatically categorized as traditional abstracts. The numbers of structured and traditional abstracts in the dataset are shown in Table 1. A total of 1,530 journal articles were used in this study. As depicted in Table 1, there are more traditional abstracts than structured abstracts across all nine sub-fields within medical science. Since an abstract has to be either structured or traditional, having increased numbers in one category would mean a decrease in another category, and vice versa.

<Table 1> The Number of Structured and Traditional Abstracts in the Dataset

	Structured Abstracts		Traditional Abstracts		Total	
	Raw Count	Percentage	Raw Count	Percentage	Raw Count	Percentage
Cancer	67	44%	87	56%	154	100%
Ethics	6	4%	150	96%	156	100%
Genetics	17	9%	177	91%	194	100%
Infectious Disease	29	17%	144	83%	173	100%
Neurology	43	26%	125	74%	168	100%
Pediatrics	32	22%	111	78%	143	100%
Immunology	40	19%	174	81%	214	100%
Psychiatry	85	49%	89	51%	174	100%
Cardiology	60	39%	94	61%	154	100%
Total	379	25%	1151	75%	1530	100%

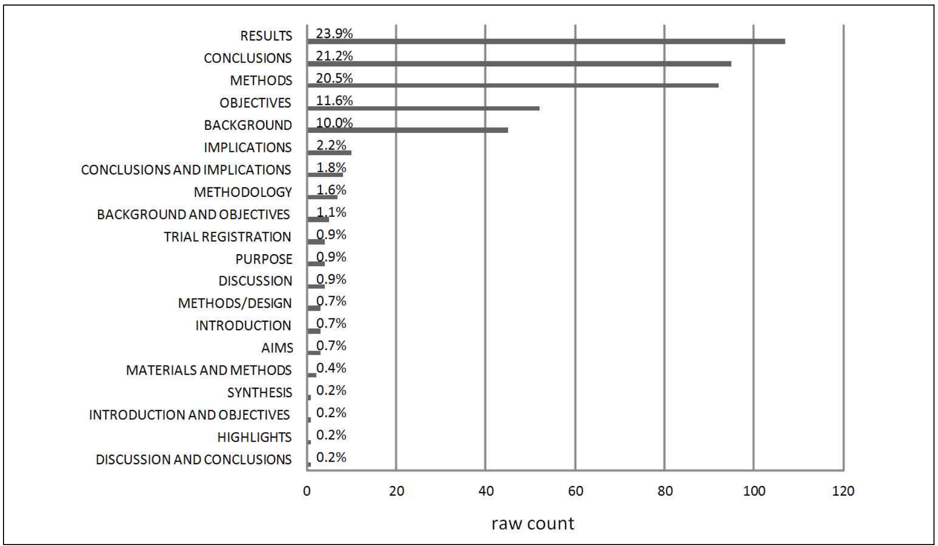
The results indicated that most journal abstracts in *Ethics* were traditional, whereas the least amount of structured abstracts was found in the sub-field *Ethics.* In contrast, *Psychiatry* has slightly more traditional abstracts (51%) than structured abstracts (49%). On the whole, structured abstracts represented only 25% of total abstracts, while traditional abstracts accounted for 75% of total abstracts. Consequentially, *Ethics,* a sub-field of medical science, showed that it is not a 'hard' medical science and does not tend to follow the pattern of other sub-fields, at least with regards to abstracts. Since Ripple et al. (2011) reported 20% structured abstracts in *MEDLINE* 2005, it appears that structured abstracts have increased remarkably since that time period. However, this relatively small percentage of structured abstracts (25%) might pertain to the *MEDLINE/PubMed* database only because the results of the Nakayama et al. (2005) study more than a decade earlier indicated that 61.8% of the abstracts in their *Web of Science* dataset were structured.

2. Subheadings

Figure 2 shows frequency counts of subheadings found in the dataset. It is important to note that some singular words (e.g., Result, Method, etc.) have been normalized to a plural form. As shown in Table 2, the most frequently used subheading is *RESULTS* (23%), although the frequency counts of *CONCLUSIONS* (21.2%) and *METHODS* (20.5%) are fairly close to the frequency count of *RESULTS.* Consequently, the frequency counts of subheadings suggest that *RESULTS, CONCLUSIONS,* and *METHODS* are the most commonly used subheadings. Surprisingly, *AIM(S)* (0.7%), and *PURPOSE* (0.9%) are less frequently used, although the terms are synonyms for *Objectives.* Also, the subheading *DISCUSSION* (0.9%) may have become outdated since it is less frequently used despite the results from the study done by Sollici (2004). In fact, in Figure 1, with the exception of *TRIAL REGISTRATION,* the terms used in most subheadings are variations of the terms used in informative abstracts. These are *BACKGROUND, AIMS, METHODS, RESULTS, and CONCLUSIONS (BAMRC).*

Another worth-mentioning characteristic of structured abstracts is the fact that some subheadings utilize the coordinating conjunction “AND” or a slash “/” to form a paired-subheading. For example, *BACKGROUND AND OBJECTIVE,* and *METHODS/DESIGN* are the paired forms of subheadings that use “ND” and “/” . Certain patterns associated with the pairing of terms involve a coordinating conjunction “AND” and the slash “/”. The pairings are typically done with subheadings that are next to each other (e.g., *BACKGROUND AND OBJECTIVES*) or with concepts that are closely related (e.g., *METHODS/DESIGN*).

It should be noted that informative abstracts are the most commonly used abstracts regardless of their form: structured, semi-structured, or traditional. Informative abstracts provide key information drawn from the full paper, and they can be viewed as a mini representation of it. Since structured abstracts are inherently informative due to their use of subheadings, the subheadings typically follow the ‘moves’ - a unit of text that displays a specific rhetorical function of the paper (Swales and Feak 2003; Salager-Meyer 1992). Moves in traditional abstracts have been analyzed often, especially as they pertain to a specific genre or academic community (Kim 2014). In general, abstracts having a *BACKGROUND, AIMS, METHODS, RESULTS,* and *CONCLUSION* (*BAMRC*) structure are considered informative abstracts (Hartley and Betts 2009). Because of this, the common paired subheadings should be recognized since the pairings appear to be more natural when the order of move is done in a sequence. For example, terms related to *BACKGROUND* and *OBJECTIVES* are more common (e.g., *BACKGROUND AND PURPOSE* and *INTRODUCTION AND OBJECTIVES*) and the index of these moves are either one or two if we follow the *BAMRC* structure. It is quite uncommon to have a pair with move indexes that are not next to each other (e.g., 1 and 3). However the frequency counts of paired subheadings are much lower compared to the top subheadings regardless of pairing patterns. Thus the coordinating conjunction "AND" and "/" should be judiciously selected for new journals since they do not frequently appear in the majority of journals examined in this study.



<Figure 2> Frequency Counts of Subheadings

Table 2 shows the frequency counts of subheadings based on sub-fields. Some notable results are as follows. As shown in this table, *Ethics* (4.8) has the highest number of subheadings. The standard deviation is the highest in *Ethics* and *Pediatrics.* Considering the standard deviation, it is apparent that greater numbers of subheading uses are found in *Ethics.* In contrast, *Genetics* (3.3) has the lowest number of subheadings, and the results show a relatively low standard deviation of 0.7. The most common subheading set in *Genetics* is *BACKGROUND: RESULTS: CONCLUSIONS:*. However, it is difficult to determine the underlying reason behind the fewer numbers of subheadings in *Genetics*, although it could indicate a general practice in a given academic sub-field.

On the other hand, since the subject matter of *Ethics* is more closely related to the social sciences than any other sub-fields in medical science, the results pertaining to *Ethics* can be more easily explained. The five-subheading abstract appears to be more common in the social sciences (Hartley and Betts 2009; Kim 2014). Due to the topicality nature of *Ethics,* this could be the underlying reason for the presence of a wide variety of subheadings since medical science ethics is more closely related to subject areas of ethics discussed in the social sciences or humanities. Meanwhile, the standard deviation was the lowest for *Cardiology* (0.4). On the average, the number of structured subheadings is 4.1 – in other words, 4 to 5 subheadings. Despite the less frequent uses of this type of subheadings, the results shown in Table 2 suggest that structured abstracts may consist of only two subheadings.

〈Table 2〉 Subheadings Across Sub-fields

	Average	StdDev	Median	Lowest	Highest	Top Most Used Subheadings Sets	%
Cancer	4.0	0.5	4	2	6	BACKGROUND: METHODS: RESULTS: CONCLUSIONS:	34.9%
Ethics	4.8	1.6	4	2	8	BACKGROUND: METHODS: RESULTS: CONCLUSIONS:	32.4%
Genetics	3.3	0.7	3	2	5	BACKGROUND: RESULTS: CONCLUSIONS:	39.1%
Infectious Disease	4.0	0.8	4	2	6	BACKGROUND: METHODS: RESULTS: CONCLUSIONS:	38.0%
Neurology	4.0	0.8	4	2	7	OBJECTIVES: METHODS: RESULTS: INTERPRETATION:	15.5%
Pediatrics	4.1	1.6	4	2	9	OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:	13.5%
Immunology	4.3	0.6	4	3	5	BACKGROUND: OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:	28.4%
Psychiatry	4.2	1.0	4	3	8	OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:	40.3%
Cardiology	4.0	0.4	4	3	5	OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:	33.9%
AVERAGE	4.1	0.9	3.9	2.3	6.6	N/A	N/A

Table 3 highlights the frequency counts of subheading sets according to their rank. The most commonly used subheading set is *OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:* at 34%, while the second most commonly used subheading set is *BACKGROUND: METHODS: RESULTS: CONCLUSIONS:* at 27%. These two sets have a combined percentage of 61%, which suggests that a majority of the subheadings sets found in medical journal abstracts use either of these two forms. Shimbo, Yamasaki, and Matsumoto (2003) reported that *BACKGROUND: METHOD(S): RESULTS: CONCLUSION(S):* was used 16% of the time, while *OBJECTIVE(S): METHOD(S): RESULTS: CONCLUSION(S):* was used 14.7% of the time. Regarding the subheading set *BACKGROUND: METHOD(S): RESULTS: CONCLUSION(S):*, the percentage of the use changed from 16% to 27%, while the percentage of use for *OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:* changed from 14.7% to 34%. Thus this could be a general trend since a subheading set that contains *OBJECTIVES* has increased much more than a subheading set that contains *BACKGROUND*. Nevertheless, the total frequency count of subheading sets is 111. This disparity is partly due to the small sample size, and the variants of subheading sets are much lower than 6,000 subheading sets reported by Shimbo, Yamasaki, and Matsumoto

<Table 3> Frequency Count of Subheading Set

Rank	Subheading Set	Raw Frequency Count	%
1	OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:	38	34%
2	BACKGROUND: METHODS: RESULTS: CONCLUSIONS:	30	27%
3	OBJECTIVES: METHODS: RESULTS: CONCLUSIONS: IMPLICATIONS:	5	5%
4	BACKGROUND AND OBJECTIVES: METHODOLOGY: RESULTS: CONCLUSIONS AND IMPLICATIONS:	5	5%
5	METHODS: RESULTS: CONCLUSIONS: IMPLICATIONS:	3	3%
6	BACKGROUND: METHODS/DESIGN: DISCUSSION: TRIAL REGISTRATION:	3	3%
7	METHODS: RESULTS: CONCLUSIONS:	2	2%
8	BACKGROUND: PURPOSE: METHODS: RESULTS: IMPLICATIONS:	2	2%
9	BACKGROUND: OBJECTIVES: RESULTS: CONCLUSIONS:	2	2%
10	BACKGROUND: METHODOLOGY: RESULTS: CONCLUSIONS AND IMPLICATIONS:	2	2%
. . . .			
30	AIMS: RESULTS: CONCLUSIONS:	1	1%
	Total	111	100%

(2003). Nevertheless, compared to the results of Shimbo, Yamasaki, and Matsumoto (2003), it appears that there has been a substantial decrease in the overall number of these variants as well as an increase in the number of the most common subheadings.

Ⅴ. Discussion and Conclusion

So far, various subheading patterns extracted from the sample dataset were analyzed in this paper. This study has used a bottom up, empirical approach in finding common subheadings in order to determine commonly used trends and to gain insights into how they are being used. Some of the findings of this study were compared with the results of previous research, particularly with Shimbo, Yamasaki, and Matsumoto (2003) and Ripple et al. (2012). Taking these previous studies into account, this research has demonstrated that the use of structured abstracts has continually increased over the past decade. Based on the increase in usage highlighted by these author's studies, the results suggest that adaptation of structured abstracts in medical journals is likely to continue for some time in the future. However, this adaptation of structured abstracts might be somewhat restricted in the more distinctive medical science sub-fields such as *Ethics*. The use of structured abstract subheadings in this field might be less effective than in other fields of study. Thus, although *Ethics* can be considered as a sub-field in the medical science, *Ethics* tends to follow the research methods and styles provided in the social sciences rather than the hard medical science sub-fields.

Although variants of subheadings still exist in medical journal abstracts, the results of this study show that commonly used subheading set, specifically *OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:*, have increased substantially. Considering the increase in the number of the subheading set *OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:*, it is clear that this pattern has become a de facto standard in most sub-fields of medical science. More interestingly, the result of this study is slightly different from Matha's (2015) generalization with regards to subheadings that appear in medical science journal abstracts as four-subheadings were predominantly found in this study's dataset.

Also, due to the increases in commonly used subheading sets among medical disciplines, the variants of subheadings appear to have decreased since the work of Shimbo, Yamasaki, and

Matsumoto (2003). However, at the macro-level, a question can be raised as to whether the current trend of using subheadings might evolve even further. Improving existing subheadings means that modifications to the terms used in subheadings might be necessary.

For example, the results suggest that some linguistic term variations could be more easily reduced (e.g., singular versus plural, the use of “AND” versus “/”, *BACKGROUND* versus *INTRODUCTION.*). The selection of proper subheadings for journal publications is a required procedure that needs to be decided by the journal editors. Adapting new subheadings for medical journals may take some time. Future studies may reveal whether the most common subheading sets, such as *OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:*, have reached their peak in terms of popularity.

Given the results provided in this study, journal editors need to assess how well the subheadings represent the focus of the journal with the discourse used in particular academic fields. In a way, the selection of subheadings is equivalent to defining the context of the academic journal articles as a whole by identifying the most appropriate terms which can be used as subheadings. This, however, is somewhat complex not only because it is difficult to come up with appropriate terms but also because other related issues need to be considered. In providing online database services, standardizing subheadings in structured abstracts is likely to increase interoperability and increase retrievability; thereby, subheadings can be utilized in locating pertinent information more efficiently and accurately. On the other hand, using standardized subheadings might be too general in the case of the subheading set *OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:* and less effective in terms of reflecting the journal's focus. For instance, the subheading *TRIAL REGISTRATION* may be more appropriate for journals that focus on research related to clinical research.

In a larger sense, the findings reported in this study could be used not only by the individuals who are involved with journal publications but also for LIS education. This study has some noteworthy implications for abstracting and indexing, both of which have been the subject areas of LIS for several decades (Lancaster 1991; Cleveland and Cleveland 2013). Considering the fact that abstracting and indexing are one of the traditional areas within LIS, it appears that learning some details regarding subheading set patterns found in structured abstracts could be beneficial, particularly in courses related to indexing and abstracting.

As the use of subheading set *OBJECTIVES: METHODS: RESULTS: CONCLUSIONS:* has increased in the recent decades, one of the pertinent questions from the LIS field is "What are its implications on abstracting and indexing?" In teaching indexing and abstracting, abstractors, in particular, should be encouraged to be aware of some factual patterns found in studies such as this; by doing so, an abstractor can make more prudent, conscientious choices while writing abstracts. For the time being, additional studies based on different genres and differing fields are desirable so that both abstractors and authors can better recognize the degree of common subheading patterns while writing structured or traditional abstracts.

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Appendix A

Cancer	Ethics	Genetics
Adv Breast Cancer Res.	AMA J Ethics.	Addict Genet.
Adv Cancer Res.	BMC Med Ethics.	Adv Genet Res.
Am J Cancer Res.	Camb Q Healthc Ethics.	Adv Genet.
Am J Cancer Ther Pharmacol.	Clin Ethics.	Adv Genomics Genet.
Asian Pac J Cancer Prev.	Indian J Med Ethics.	AIMS Genet.
Biomark Cancer.	J Agric Environ Ethics.	Am J Hum Genet.
Blood Cancer J.	J Bus Ethics.	Am J Med Genet A.
BMC Cancer.	J Clin Ethics.	Am J Med Genet B Neuropsychiatr Genet.
Br J Cancer.	J Empir Res Hum Res Ethics.	Am J Med Genet C Semin Med Genet.
Breast Cancer Manag.	J Ethics.	Anim Genet.
Breast Cancer Res Treat.	J Law Enforc Leadersh Ethics.	Ann Hum Genet.
Breast Cancer Res.	J Law Med Ethics.	Annu Rev Genet.
Breast Cancer.	J Med Ethics Hist Med.	Annu Rev Genomics Hum Genet.
Bull Cancer.	J Med Ethics.	Appl Clin Genet.
CA Cancer J Clin.	J Med Law Ethics.	Balkan J Med Genet.
Chin J Cancer Res.	J Soc Work Values Ethics.	Behav Genet.
Chin J Cancer.	JONAS Healthc Law Ethics Regul.	Biochem Genet.
Clin Breast Cancer.	Kennedy Inst Ethics J.	Biotechnol Genet Eng Rev.
Clin Cancer Investig J.	Nurs Ethics.	BMC Genet.
Clin Cancer Res.	Philos Ethics Humanit Med.	BMC Med Genet.
Clin Colorectal Cancer.	Public Health Ethics.	Cancer Genet.
Clin Genitourin Cancer.	Res Ethics.	Canine Genet Epidemiol.
Clin Lung Cancer.	Sci Eng Ethics.	Case Rep Genet.
Colorectal Cancer.	Yale J Health Policy Law Ethics.	Circ Cardiovasc Genet.
Infectious Disease	**Neurology**	**Pediatrics**
ACS Infect Dis.	ACS Chem Neurosci.	Acad Pediatr.
Adv Infect Dis.	Acta Neurochir Suppl.	Adv Pediatr Res.
Afr J Infect Dis.	Acta Neurol Belg.	Adv Pediatr.
Am J Infect Control.	Acta Neurol Scand Suppl.	Ann Pediatr Cardiol.
Am J Infect Dis.	Acta Neurol Scand.	Ann Pediatr Endocrinol Metab.
Antimicrob Resist Infect Control.	Acta Neurol Taiwan.	Arch Argent Pediatr.
BMC Infect Dis.	Acta Neuropathol Commun.	Arch Pediatr Adolesc Med.
Braz J Infect Dis.	Acta Neuropathol.	Arch Pediatr.
Can J Infect Dis Med Microbiol.	Acta Neuropsychiatr.	BMC Pediatr.
Case Rep Infect Dis.	Adv Neurobiol.	Case Rep Pediatr.
Clin Infect Dis.	Adv Tech Stand Neurosurg.	Cir Pediatr.
Clin Microbiol Infect.	AJNR Am J Neuroradiol.	Clin Med Insights Pediatr.
Clin Res Infect Dis.	AJOB Neurosci.	Clin Pediatr Emerg Med.
Comp Immunol Microbiol Infect Dis.	Am J Med Genet B Neuropsychiatr Genet.	Clin Pediatr Endocrinol.
Curr Fungal Infect Rep.	Am J Neurodegener Dis.	Clin Pract Pediatr Psychol.
Curr Infect Dis Rep.	Am J Neuroprot Neuroregen.	Curr Opin Pediatr.
Curr Opin Infect Dis.	Ann Clin Transl Neurol.	Curr Pediatr Rep.
Curr Treat Options Infect Dis.	Ann Indian Acad Neurol.	Curr Pediatr Rev.
Diagn Microbiol Infect Dis.	Ann Neurol.	Curr Probl Pediatr Adolesc Health Care.
Emerg Infect Dis.	Ann Neurosci.	Curr Treat Options Pediatr.

Emerg Microbes Infect. Epidemiol Infect. Eur J Clin Microbiol Infect Dis. Expert Rev Anti Infect Ther.	Annu Rev Neurosci. Appl Neuropsychol Adult. Appl Neuropsychol Child. Appl Neuropsychol.	Eur J Pediatr Surg. Eur J Pediatr. European J Pediatr Surg Rep. Fetal Pediatr Pathol.
Immunology	Psychiatry	Cardiology
Acta Microbiol Immunol Hung. Adv Immunol. Allergy Asthma Clin Immunol. Allergy Asthma Immunol Res. Am J Clin Exp Immunol. Am J Reprod Immunol. Ann Allergy Asthma Immunol. Annu Rev Immunol. Appl Immunohistochem Mol Morphol. Asian Pac J Allergy Immunol. BMC Immunol. Cancer Immunol Immunother. Cancer Immunol Res. Case Reports Immunol. Cell Immunol. Cell Mol Immunol. Cent Eur J Immunol. Chem Immunol Allergy. Clin Dev Immunol. Clin Exp Immunol. Clin Immunol. Clin Rev Allergy Immunol. Clin Transl Immunology. Clin Vaccine Immunol.	Acad Psychiatry. Am J Geriatr Psychiatry. Am J Psychiatry. Ann Clin Psychiatry. Ann Gen Psychiatry. Arch Gen Psychiatry. Asia Pac Psychiatry. Aust N Z J Psychiatry. Australas Psychiatry. Biol Psychiatry Cogn Neurosci Neuroimaging. Biol Psychiatry. BMC Psychiatry. Br J Psychiatry Suppl. Br J Psychiatry. Can J Psychiatry. Cardiovasc Psychiatry Neurol. Case Rep Psychiatry. Child Adolesc Psychiatry Ment Health. Child Psychiatry Hum Dev. Clin Child Psychol Psychiatry. Compr Psychiatry. Cult Med Psychiatry. Curr Opin Psychiatry. Curr Psychiatry Rep.	Acta Cardiol. Adv Cardiol. Am J Cardiol. Am J Cardiovasc Dis. Am J Cardiovasc Drugs. Anatol J Cardiol. Ann Cardiothorac Surg. Ann Pediatr Cardiol. Ann Thorac Cardiovasc Surg. Arch Cardiol Mex. Arch Cardiovasc Dis. Arq Bras Cardiol. Asian Cardiovasc Thorac Ann. Austin J Clin Cardiol. Basic Res Cardiol. BMC Cardiovasc Disord. Can J Cardiol. Can J Cardiovasc Nurs. Case Rep Cardiol. Catheter Cardiovasc Interv. Circ Cardiovasc Genet. Circ Cardiovasc Imaging. Circ Cardiovasc Interv. Circ Cardiovasc Qual Outcomes.