Use of SNOMED CT to Represent Traditional Korean Medicine Concepts: A Semantic Characterization of Migraine-Related Concepts from Korean Medicine Clinical Practice Guideline

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SNOMED CT를 활용한 한의약 개념 매핑 : 한의임상진료지침에서 도출된 편두통 관련 개념의 의미론적 표현

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Abstract

목적 : 본 연구는 한의약에서 사용하는 용어가 SNOMED CT로 매핑 가능한지 여부를 조사하고, 한의약 용어를 표현하기 위해 기존 SNOMED CT 온톨로지를 개선할 수 있는 방안을 제안하는 것을 목표로 하였다.

방법 : 선행 연구의 매핑 가이드라인에서 제시된 7단계 과정을 수정하여 활용하였다. 매핑의 목적 및 범위 정의, 용어 추

출, 개념 추출, 매핑을 위한 소스 용어 작업, SNOMED CT 개념 검색, 매핑 관계 분류 및 매핑 검증의 과정을 수행하였다. 매핑의 목적은 한의약 임상 아이디어를 표현하는 표준 용어로서 SNOMED CT를 평가하는 것이고, 범위에는 편두통 환자 관리의 평가, 진단, 치료 및 예방을 포함하였다.

결과 : 총 546개의 용어가 추출되었다. 중복된 용어를 제거한 후, 271개의 개념이 SNOMED CT 매핑에 사용되었다. 이 중 43.2%는 SNOMED CT 개념과 의미론적으로 동등하게 매핑되었고(117개 개념), 39.1%는 SNOMED CT 개념이 더 포괄적인 의미를 가지도록 매핑되었다(106개 개념). 상대적으로 포괄적인 의미를 가지는 SNOMED CT 개념에 매핑된 한의약 개념 106개 중 19개는 SNOMED CT 후조합을 이용하여 의미론적으로 동등하게 표현이 가능하였다. 나머지 17.7%의 한의약 개념은 SNOMED CT에 매핑할 수 없었다.

결론 : 본 연구는 한의약에서 사용되는 개념을 SNOMED CT에 매핑하여 한의약 용어를 표준화하였다. 연구 결과를 바탕으로, 한의약에서 사용되는 용어를 표준의료용어로 표현하기 위하여 SNOMED CT에 새로운 개념과 속성을 추가하는 것을 제안한다.

I. Introduction

Traditional Korean medicine (TKM) and Western medicine have coexisted within the Korean healthcare system since the enactment of the National Medical Services Law in 1951.[1] According to the 2021 Health Care Service Utilization published by the Ministry of Health and Welfare (MOHW) of South Korea, 12.28% of patients used TKM for outpatient care and 7.01% for inpatient care.[2] Another survey conducted by the MOHW in 2022 on TKM utilization reported that 71.0% of Korean citizens who were 19 years or older used TKM at least once in their lifetime.[3]

The healthcare sector generates a large amount of data. The Korean government has promoted initiatives to facilitate efficient data utilization. For Western medicine, these include the Data-Centered Hospital, the K-CURE Library, and the Korea Healthcare Bigdata Platform. For TKM, the National Institute for Korean Medicine Development (NIKOM) initiated development of a traditional Korean Medicine Big Data Platform. The objective of the platform is to support data-driven research which facilitates evidence-based practice, to standardize TKM services, and to exchange TKM data to improve efficiency of patient-centered treatment.[4]

In accordance with the third TKM Promotion and Development Plan 2016-2020, Korean Medicine Clinical Practice Guidelines (KMCPGs) on 30 diseases were developed by 2020 aiming to standardize and promote evidence-based TKM practices.[5] The 30 diseases were selected following a comprehensive review of factors such as areas of strength in TKM and the most frequently treated diseases.[6] In addition, a standard terminology library based on the KMCPGs is being developed and is anticipated to play a pivotal role in the development of electronic medical records for TKM.[7]

In healthcare, one of the commonly used standard terminologies is Systematized Nomenclature of MEDicine Clinical Terms (SNOMED CT). SNOMED CT is the most comprehensive and multilingual clinical terminology adopted in more than 70 countries. A collection of more than 350,000 unique and active SNOMED CT concepts covers a broad range of clinical domains such as diagnosis, surgical procedures, signs and symptoms, and therapeutic procedures.[8] Recently, SNOMED International made their efforts to build a separate ontology for traditional medicine.

Given the ongoing effort to develop the standard terminology library based on the KMCPGs,

it would be interesting to examine the coverage of SNOMED CT for standardizing terms used in these guidelines. Among the 30 topics of the KMCPGs, migraine was selected for the assessment. Migraine is a severe form of headache that has a substantial impact on both its sufferers and society as a whole, with a prevalence of 6% nationally and 10% globally.[9] It is also commonly treated in TKM, with 166,430 cases treated with acupuncture over 9 years.[10] Other types of treatments in TKM such as herbal medicine, moxibustion, and cupping therapy are also applied for effective management of migraine.[11]

With this background, our aim was to investigate whether SNOMED CT, a standardized clinical terminology system, could cover the concepts describing assessment, evaluation, diagnosis, treatment, and prevention of migraine patient care in TKM. Additionally, we aimed to investigate how SNOMED CT ontology could semantically represent concepts describing knowledge in TKM.

II. Methods

Terms used to describe migraine patient care in TKM were mapped to SNOMED CT using a modified seven-step process outlined in the mapping guideline of Sung et al.[12]

A. Defining the purpose and scope of the map

The purpose of building the map is to examine SNOMED CT as a standard terminology describing clinical ideas of TKM. In terms of the scope of the map, the source codes include terms from the assessment, evaluation, diagnosis, treatment, and prevention domains of the migraine patient care. The target codes include SNOMED CT International Edition, released on August 31, 2023, and SNOMED CT Traditional Medicine Community Content ontology, which is currently under development and management by SNOMED International in an effort to build a specialized ontology for traditional medicine terms.

B. Extracting terms

In order to extract terms, a TKM terminology library developed by NIKOM was reviewed. Terms in the library were derived from the KMCPGs which were also developed by NIKOM.[13] Extracted terms describing clinical ideas of migraine patient care were categorized into five domains and nine subdomains (Table 1).

C. Extracting concepts

Duplicate terms were eliminated and concepts

Table 1. Domains and Subdomains of Terms Used in Migraine Patient Care

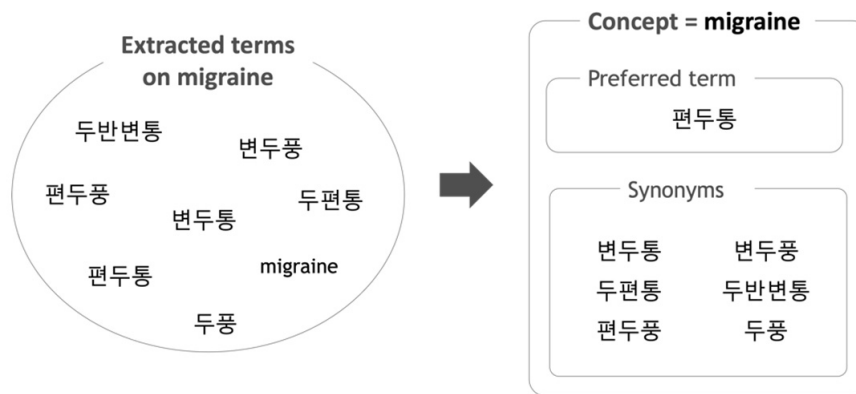| Domains	Subdomains
Assessment	Sign and symptom
Evaluation	Lab and test
	Assessment tool
Diagnosis	Disease
	Pattern
Treatment	Traditional Korean medicine treatment procedure
	Herbal medicine: Herbal ingredient
	Herbal medicine: Herbal concoction
Prevention	Lifestyle management

Figure 1. Preferred term and synonyms for the concept migraine.

were extracted by grouping semantically equivalent terms. From these semantically equivalent terms, one was selected as a preferred term and the remaining terms were treated as synonyms. For example, terms describing migraine include 편두통, 변두통, 두편통, 변두풍, 두풍, 편두풍, and 두반변통. 편두통 was selected as the preferred term and the remaining terms were synonyms (Figure 1).

D. Preparing source terms for mapping

TKM treatment procedures consist of treatment methods and body sites, though the same methods and body sites are used repeatedly. The treatment procedure was dissected into treatment method and body site to minimize combinatorial explosion of treatment procedures.

Korean terms were translated into English by referring to an English Summary chapter of the Migraine KMCPG.[14] We also used Medical Term 6th Edition published by the Korean Medical Association (KMA) and the Korean Medical Library Engine (KMLE), ICD-11 and the Herb Information provided by the Korean Pharmaceutical Information Center.[15),16),17),18] For herbal concoction, we used phonetic representations of terms since English terms were not available. For example, the herbal concoction called 온담탕 was phonetically represented as '*On-dam-tang*'.

E. Searching equivalent SNOMED CT concepts

Mapping was conducted by the first author, who completed SNOMED CT authoring level 1 course offered by the SNOMED International, and participated in mapping TKM terminologies to SNOMED CT and developing Korean extension of SNOMED CT.

When searching equivalent SNOMED CT concepts, we used at least first 3 characters of the words of the source terms to identify terms sharing the same stem such as assess, assessment, and assessing.[19] SNOMED CT concepts were also searched using terms with broad or narrow meaning. Search results were filtered by semantic tags to limit the search to specific top-level hierarchies or branches for appropriate domains and subdomains of the source terms (Table 2).[19] Finally, we reviewed parent, child, and sibling concepts to examine semantic equivalence. The same approach was used for both SNOMED CT International Edition and Traditional Medicine Community Content.

F. Classifying mapping correlations

When there was a semantically equivalent SNOMED CT concept for a source term, the map was classified as exactly mapped. When the source term was mapped to a broader SNOMED

Table 2. Source Terms and Target SNOMED CT Top-level Hierarchies or Branches

Domain	Subdomains	SNOMED CT top-level hierarchies or branches
Assessment	Sign and symptom	Clinical finding, Situation with explicit context
Evaluation	Lab and test	Procedure
	Assessment tool	Assessment scale
Diagnosis	Disease	Disorder, Situation with explicit context
	Pattern	Pattern*
Treatment	Traditional Korean medicine treatment procedure: treatment method	Procedure
	Traditional Korean medicine treatment procedure: body site	Body structure
	Herbal medicine: herbal ingredient	Organism
	Herbal medicine: herbal concoction	Pharmaceutical / biologic product
Prevention	Lifestyle management	Procedure

*Concepts available only in the SNOMED CT Traditional Medicine Community Content

CT concept, the map was classified as broadly mapped. Among these broadly mapped, if it was possible to represent the source term by combining existing SNOMED CT concepts, the map was categorized further as able to be represented with post-coordination. If the source term could be neither mapped to semantically equivalent SNOMED CT concepts nor represented with post-coordinated expressions, the map was classified as not mapped.

G. Validating the map

The map was validated using a validation and review process provided by SNOMED International[20] and a validation step of the mapping guideline published by Sung et al.[12] The map was validated internally for semantic equivalency between the source term and the target concept by the second author, who has over 30 years of experience in authoring and teaching SNOMED CT. If the second author agreed with the map, the map was considered valid. In case of disagreement between the first and the second authors, a meeting was convened to reach a consensus between the mapper and the reviewer. External validation was conducted by a TKM physician who did not participate in the mapping but has knowledge of SNOMED CT and experience of mapping TKM terminologies to SNOMED CT. For those concepts unique to TKM, the external reviewer was asked to examine maps for pattern, body site, and acupoint concepts. If the external reviewer agreed with the map, the map was considered valid. If not, the map was revised according to suggestions and comments provided by the external reviewer.

III. Results

A. Term Extraction

The number of terms extracted across clinical domains and subdomains is presented in Table 3 under the column 'Number of extracted terms before removing duplicates'. A total of 546 terms were extracted. The subdomain with the most terms extracted was disease with 166 terms. This was followed by TKM treatment procedure subdomain with 118 terms extracted. The subdomain with the fewest terms extracted was lab and test with only 5 terms.

Table 3. Number of Terms and Concepts   Unit: N

Domain	Subdomain	Number of extracted terms before removing duplicates	Number of unique terms after removing duplicates	Number of concepts after removing duplicate meaning	Average number of unique terms per concept*
Assessment	Sign and symptom	99	67	60	1.12
Evaluation	Lab and test	5	4	4	1
	Assessment tool	46	28	11	2.55
Diagnosis	Disease	166	90	45	2.00
	Pattern	32	18	18	1
Treatment	Traditional Korean medicine treatment procedure	118	84	83	1.01
	Herbal medicine: herbal ingredient	32	31	31	1
	Herbal medicine: herbal concoction	22	22	22	1
Prevention	Lifestyle management	26	21	20	1.05
Total		546	365	294	1.24

*Average number of unique terms per concept = Number of unique terms after removing duplicates / Number of concepts after removing duplicate meaning

B. Concept Extraction

Of the 546 extracted terms, 365 were syntactically unique after eliminating duplicates. Table 3 illustrates the number of extracted terms, unique terms, and concepts by clinical subdomains. The number of unique terms for each concept ranged from one to seven, with migraine having the highest number. On average, each concept had 1.24 unique terms.

C. Source Term Preparation for Mapping

TKM treatment procedures were dissected into 16 treatment methods and 44 body sites. Examples of treatment methods include acupuncture, electroacupuncture, cupping therapy, bloodletting, chuna therapy, and pharmacopuncture. Body sites include acupoints or body parts such as BL17 (Taekye), BL23 (Shinsoo), and GB7 (Gokbin).

English translations of the source terms describing assessment tools, disease, treatment methods, and body sites were found in the English Summary section of the Migraine KMCPG[14]. The source terms in the sign and symptom, lab and test, and lifestyle management subdomains were translated into English by searching medical English terms in the KMA Medical Term 6th edition or the KMLE.[15),16)] English representations of source terms in the pattern subdomain were found in the Migraine KMCPG and by searching ICD-11 and the Herbal Medicine Resources Research Center database.[14),17),21)] Source terms representing herbal ingredients were translated using databases in the Korea Pharmaceutical Information Center or the Standard Herbal Resources Library of Korea Institute of Oriental Medicine.[18),21)] Since English representations were not available for herbal concoctions, all source terms were expressed with phonetic expressions in English.

Table 4. SNOMED CT Mapping Results   Unit: N (%)

Domain	Subdomain	Exactly mapped	Broadly mapped		Not mapped	Total
			Unable to represent with post-coordinated expression	Able to represent with post-coordinated expression		
Assessment	Sign and symptom	27 (45.0)	23 (38.3)	4 (6.7)	6 (10.0)	60
Evaluation	Lab and test	2 (50.0)	1 (25.0)	1 (25.0)	–	4
	Assessment tool	4 (36.4)	1 (9.1)	–	6 (54.5)	11
Diagnosis	Disease	25 (55.6)	11 (24.4)	9 (20.0)	–	45
	Pattern*	8 (44.4)	–	6 (33.3)	4 (22.2)	18
Treatment	Traditional Korean medicine treatment procedure: treatment method	6 (37.5)	10 (62.5)	–	–	16
	Traditional Korean medicine treatment procedure: body site	41 (93.2)	–	–	3 (6.8)	44
	Herbal medicine: herbal ingredient	–	25 (80.6)	–	6 (19.4)	31
	Herbal medicine: herbal concoction	–	–	–	22 (100)	22
Prevention	Lifestyle management	4 (20.0)	16 (80.0)	–	–	20
Total		117 (43.2)	87 (32.1)	20 (7.4)	47 (17.3)	271

*Mapped to concepts in SNOMED CT Traditional Medicine Community Content

D. Mapping Result

Of 271 concepts, 117 were equivalently mapped to SNOMED CT pre-coordinated concepts (43.2%). Among these, 8 were found in the SNOMED CT Traditional Medicine Community Content ontology. There were 107 concepts broadly mapped to SNOMED CT (39.5%). Of these, 20 (7.4%) were represented with post-coordinated expressions. Forty-seven concepts (17.3%) were not mapped to SNOMED CT (Table 4).

The subdomain with the greatest number of concepts equivalently mapped to SNOMED CT was TKM treatment procedure. In total, 6 treatment method and 41 body site concepts were equivalently mapped to SNOMED CT (78.3%). For instance, the treatment concept "electroacupuncture" was mapped to 231102004 |Electrical stimulation of acupuncture needle (procedure)| and the body site concept "GB8" was mapped to 273016008 |GB8 (body structure)|. The greatest number of concepts broadly mapped to SNOMED CT concepts were signs and symptoms followed by herbal ingredients. For example, there was no semantically equivalent SNOMED CT concept for "reversible aura" so we broadly mapped the concept to 18618006 |Aura (finding)|. Of the 107 concepts broadly mapped, we were able to represent 20 using post-coordinated expressions. The greatest number of concepts representing disease were able to be represented with SNOMED CT post-coordinated expressions. For example, the concept "recurrent migraine" was represented with the post-coordinated expression, 37796009 |Migraine (disorder)|: {263502005 |Clinical course (attribute)| = 255227004 |Recurrent (qualifier value)|}.

Herbal concoction concepts such as "On-dam-tang (온담탕)" and "Ban-ha-baek-chul-cheon-ma-tang (반하백출천마탕)" could not be mapped to SNOMED CT International Edition. When searching SNOMED CT International Edition for pattern concepts, we could not map any. However, 8 pattern concepts were equivalently mapped to concepts in SNOMED CT Traditional Medicine Community Content. For example, concepts, "Qi deficiency" and "stagnant blood" were mapped to 1119481002 | Qi deficiency pattern (pattern)| and 1222613000 | Blood stasis pattern (pattern)|, respectively.

E. Map Validation

After the internal validation process, the second author who conducted the full review of the map agreed with 94.1% of the mapping result completed by the first author. The maps of concepts describing a TKM treatment method and lifestyle management needed further discussion between the first and the second authors to agree on which SNOMED CT concept to use. For example, a concept "pharmacopuncture" was not initially mapped to any SNOMED CT concept by the first author. The second author proposed mapping it to 1217591002 |Injection of drug or medicament (procedure)| which was agreed by the first author. For the external validation, the TKM physician reviewed the maps of 18 pattern concepts, one body site concept indicating where chuna therapy is applied, one acupoint, and six body site concepts grouping different acupoints. These body site and acupoint concepts were selected for the expert review since their mapping was less straight-forward than the others. In most cases, the concepts for body sites were in GB7 form which could be equivalently mapped to SNOMED CT concept 273015007 |GB7 (body structure)|. Of the 26 concepts requested for external review, the external reviewer agreed with 69.2% of the map

and provided her opinions on eight concepts. The first and the second authors agreed with the proposal and the maps were revised accordingly.

IV. Discussion

In this study, terms extracted from the Migraine KMCPG were mapped to SNOMED CT to explore the coverage of SNOMED CT for terms in the assessment, evaluation, diagnosis, treatment, and prevention domains of migraine patient care. In this section, we discuss characteristics of TKM terms and difficulties encountered during term translation and mapping. We also make suggestions to improve the coverage of SNOMED CT for terms used in TKM.

Source Term Extraction

During the extraction of terms, we discovered that terms describing signs and symptoms in the assessment domain, labs and tests and assessment tools in the evaluation domain, diseases in the diagnosis domain and lifestyle managements in the prevention domain were similar to ones used in Western medicine. However, terms describing patterns in the diagnosis domain and TKM treatment procedures and herbal medicines in the treatment domain were unique to TKM.

A pattern is named based on a cluster of associated signs and symptoms illustrated in terms of yin and yang, exterior and interior, cold and heat, and deficiency and excess and is used to decide how, where, and what to treat in traditional medicine.[22),23),24)] Examples of patterns identified in the migraine patients include ascendant hyperactivity of liver yang (간양상항), deficiency of yin and blood (음혈휴허), wind phlegm and blood stasis (풍담어조), and wind-heat disturbances (풍열상요). Although each pattern consists of multiple theoretical entities, we used it as one source term

for SNOMED CT mapping.

Treatment methods such as acupuncture, electroacupuncture, bloodletting, cupping therapy, and pharmacopuncture use multiple body sites. For example, when acupuncture is prescribed to a migraine patient, acupoints such as TE23, GB41, LR2, EX-HN5, and TE5 can be used. In addition, different treatment methods share multiple body sites. For example, wet cupping therapy prescribed to migraine patients could be performed at acupoints such as EX-HN5 and GB20. These two acupoints are also applicable to treating migraine with electroacupuncture, bloodletting, and pharmacopuncture. Since the same treatment methods and body sites were used repeatedly in the treatment procedures, we used the treatment method and the body site as separate search terms for the SNOMED CT mapping.

When treating migraine patients with herbal medicine, an herbal concoction is prescribed and an individual herbal ingredient could be added based on identified pattern. We used a single herbal ingredient term as the search keyword for SNOMED CT mapping. Since herbal concoctions are prepared by brewing multiple herbal ingredients in different strengths, it would have been possible to represent herbal concoction concepts with post-coordination by identifying herbal ingredients which constitute specific herbal concoction. However, detailed information on herbal ingredients and strengths in herbal concoction was not provided in the Migraine KMCPG. Therefore, herbal concoction terms were used as their own search terms for SNOMED CT mapping.

Source Term Translation

Source terms used in Western medicine were readily translated into English by referring to the KMLE. Terms describing herbal ingredients and TKM treatment procedures were translated by referring to the Korea Pharmaceutical Information Center and the Migraine KMCPG. However, translating herbal concoction terms was not straightforward. The guideline provides no information on the herbal ingredients of herbal concoctions and no other standardized information was available. Furthermore, English phonetic expressions are used in published articles on specific herbal concoctions and in the Oriental Medicine Advanced Searching Integrated System (OASIS) developed by the Korea Institute of Oriental Medicine.[25] For these reasons, we used the English phonetic expression for herbal concoction terms. Standardized information on the ingredients of herbal concoctions would facilitate their translation into English.

SNOMED CT Mapping

Concepts describing signs and symptoms, labs and tests, diseases, and lifestyle managements had semantically equivalent SNOMED CT concepts since these are used in Western medicine. However, even though assessment scales are used in Western medicine, only a third of concepts describing these had semantically equivalent SNOMED CT concepts.

The majority of patterns had semantically equivalent SNOMED CT concepts in Traditional Medicine Community Content ontology. Our study had a higher mapping rate for pattern concepts than a previous study which only mapped one pattern concept to SNOMED CT out of 260 from ICD-11-CH26 (0.38%).[26] This discrepancy can be attributed to the fact that the previous study used SNOMED CT International Edition as target codes, while we used SNOMED CT Traditional Medicine Community Content ontology. About 80% of concepts describing herbal ingredients had SNOMED CT concepts broader in meaning, representing the botanical family of each herbal ingredient. More granular SNOMED CT concepts would be necessary to represent individual herbal ingredients. Herbal concoction had no semantically

equivalent SNOMED CT concepts as these have not yet been developed.

Based on the study findings, we would like to make recommendations for SNOMED CT ontology to better represent TKM terms.

First, new treatment procedure, acupoint and assessment scale concepts could be added to the SNOMED CT International Edition. For example, "wet cupping therapy" could be added as a child concept of 231097002 |Cupping (regime/therapy)| to Procedure top-level hierarchy, "EX-HN1 (Shi-shencong)" and "back shu point" as child concepts of 272743000 |Acupuncture point (body structure)| to Body structure top-level hierarchy, and "Migraine Disability Assessment Scale" along with names of other specific assessment scales as child concepts of 273249006 |Assessment scales (assessment scale)| to Staging and scales top-level hierarchy. In addition, "concoction" could be added as a child concept of 736478001 |Basic dose form (basic dose form)| to describe the dose form of herbal concoction.

Second, four pattern concepts not mapped to SNOMED CT could be added to SNOMED CT Traditional Medicine Community Content ontology. "Damp phlegm upward harassment (담탁상요)", "Wind-heat disturbance (풍열상요)", "Phlegm (담)", and "Hyperactivity of liver fire (간화왕성)" could be added as child concepts of 1119477002 |Pattern (pattern)| to the Clinical finding top-level hierarchy.

Third, new organism and product concepts could be added to SNOMED CT Korean Extension. For example, herbal ingredients could be added to the Organism top-level hierarchy, herbal concoctions could be added as child concepts of 349365008 |Herbal medicine (product)|, and herbal extracts could be added to the Pharmaceutical/biologic product top-level hierarchy. Adding herbal ingredient and herbal concoction concepts would increase the coverage of SNOMED CT for these concepts. Furthermore, herbal ingredient concepts would be adopted as ingredients used in herbal concoction concepts. Adding concepts for herbal extracts would represent different types of pharmacopuncture. Pharmacopuncture is a type of acupuncture treatment in traditional medicine which involves injecting herbal extracts into acupoints and it is used in Korea and China.[27] Examples of herbal extracts include *Amydae Carapax* (별갑) and *Carthami Flos* (홍화).

Fourth, "has active herbal ingredient" could be added as an attribute to SNOMED CT Korean Extension to link herbal ingredients to herbal concoctions. The domain of this attribute would be any herbal concoction concepts added as child concepts of 349365008 |Herbal medicine (product)|. The range of this attribute would include concepts describing herbal ingredients under Organism top-level hierarchy. This attribute would be used more than once when defining herbal concoction concepts and used only once within a relationship group.

V. Conclusion

This study presents the first attempt to map concepts used in TKM to SNOMED CT. Western medicine concepts used in TKM were semantically mapped to SNOMED CT, but concepts unique to TKM, especially herbal ingredients and herbal concoctions, were not. Based on the study findings, we suggest the addition of new concepts such as treatment procedures, acupoints, patterns, assessment scales, herbal ingredients, herbal extracts, and an attribute "has active herbal ingredient" to increase the coverage of SNOMED CT for TKM.

The limitations of this study underscore the need for further research. First, only terms describing different domains of migraine have been used as source terms for SNOMED CT mapping.

Terms used in other diseases or conditions should be investigated to examine the coverage of SNOMED CT for TKM. Second, this study used terms from the clinical practice guideline but may not fully cover concepts used in clinical settings. Third, herbal concoction concepts could not be authored and added to the Korean Extension since standardized information on herbal ingredients and their strengths was not available. Lastly, the reviewer for the external validation was not selected randomly due to limited pool of experts with knowledge in both domain and standard health terminology. If there were more domain and standard health terminology experts available in the future, the map can be validated by the reviewers selected randomly, in turn, the quality of the map can be improved.

Conflict of interest

The authors declare that they have no conflicts of interest.

Ethical statement

No ethical approval was required as this study did not involve human participants or laboratory animals.

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