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## Original Article

# Mapping the Japanese orthopedic association national registry (JOANR) to the international classification of health interventions (ICHI)

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## ABSTRACT

**Background:** The Japanese Orthopedic Association launched the Japanese Orthopedic Association National Registry (JOANR), Japan's first large-scale nationwide musculoskeletal disease registry, in 2020. The World Health Organization released the International Classification of Health Interventions (ICHI) Beta-3 version in the same year. This concurrence served as an impetus to examine the relationship between domestic and international classification for orthopedic interventions.

**Our objective** was to evaluate the possibility of utilizing JOANR for international comparison and the potential usage of ICHI in the domestic medical fee reimbursement system. This study is a novel attempt at mapping a domestic orthopedic scheme to the ICHI.

**Methods:** We mapped 149 codes out of 581 orthopedic surgical codes, on JOANR's registration form, to the ICHI, and then classified the nature of JOANR codes' relationship, to both ICHI single stem codes and stem codes accompanied by other additional stem codes, extension codes, and International Classification of Diseases for Mortality and Morbidity Statistics (ICD) codes, into five categories: Equivalent (exact match), Narrower (compared to ICHI; can be smoothly incorporated into ICHI), Broader (compared to ICHI), Slipped (combination of both Narrower and Broader), and None (no appropriate code). Finally, debatable issues that arose during the mapping operation were noted.

**Results:** The domestic codes' relationship to ICHI single stem code by category were Equivalent: 27 (18.1%) and Narrower: 65 (43.6%), respectively. Further, the rate of Equivalent rose to 120 (80.5%) on adding other stem codes, extension codes, and ICD codes. Additionally, certain domestic titles, which were unsuitable for classification as they included diagnostic information, and arthroscopic surgeries without corresponding ICHI codes, were recoded.

**Conclusions:** JOANR can be converted to an international comparison standard via ICHI to a certain extent, and ICHI accompanied by ICD codes has potential for deployment in the domestic medical fee reimbursement system.

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## 1. Introduction

The Japanese Ministry of Health, Labour and Welfare has been promoting the creation of a clinical efficacy database since 2013 [1]. In response to this policy, the Japanese Orthopaedic Association

(JOA) started developing the Japanese Orthopedic Association National Registry (JOANR) [2], Japan's first large-scale nationwide musculoskeletal disease registry system, and launched it on a full-scale in 2020, with the aim of building evidence based on big data on surgical treatment for musculoskeletal diseases.

The World Health Organization (WHO), which has been developing the International Classification of Health Interventions (ICHI) since 2007, released the Beta-3 version in 2020 [3]. It is related to health interventions for clinical and statistical purposes and is closely compatible with International Classification of Diseases for Mortality and Morbidity Statistics Eleventh Revision (ICD-11) which has been in effect since February 2022.

This is an ideal time to examine the relationship between domestic and international classification standards for orthopedic interventions. Our objective was to evaluate the possibility of JOANR as a data source in international comparison and the potential usage of ICHI in the domestic medical fee reimbursement system. Despite having huge and complicated orthopedic treatments targets, we believed that this mapping research was an urgent and irremissible task. This study is a novel attempt at mapping a domestic orthopedic scheme to ICHI.

### 1.1. The Japanese orthopedic association national registry: JOANR

JOANR has a two-tier structure; on the first level, all basic details of surgical cases, such as surgery title, diagnosis, surgical time, surgeon's name, staff size, complications, and outcome, are registered and the second level records detailed information on more specialized surgeries, such as artificial joint surgeries, arthroscopic surgeries, and spinal surgeries. The surgery titles on the registry form are taken from the segment number codes on the medical fee schedule, called "K-code". Each K-code on JOANR is accompanied by 9-digit numbers for electronic processing (Table 1). They are the most popular medical intervention codes in Japan, although they were originally intended for medical fee rather than statistical purposes.

### 1.2. The international classification of health interventions: ICHI

The ICHI, an international classification standard, covers all categories health care interventions with each intervention represented by a unique 7-digit code called "stem code" [4,5]. It contains more than 8000 stem codes with around 1300 codes for musculoskeletal surgeries. Each stem code consists of 3-axes; "Target," represented by three characters, is the entity on which the "Action" is carried out; "Action," represented by two characters, indicates the deed performed on the "Target"; and "Means," represented by two characters, indicates processes and methods by which the

**Table 1**  
Use case of domestic codes and ICHI codes.

Domestic code on JOANR K076 1 (150045310)		
(Title)	Release of hip joint by open surgery <sup>a</sup>	
ICHI code	<b>MLJ.FC.AA</b>	
Stem code	(Title)	Release of hip joint
	(Axes)	<Target> MLJ (Hip joint) <Action> FC (Release) <Means> AA (open approach)

On JOANR form a domestic code "K076 1 (150045310)" represents a surgical title "Release of hip joint by open surgery". In ICHI code, each axis, MLJ, FC, AA represents "Hip joint" as a surgical site, "Release" as a deed, and "by open approach", respectively. Hence, this code represents "Release of hip joint". These codes were judged to represent the same procedure.

<sup>a</sup> a tentative translation.

"Action" is carried out (Table 1). However, not every possible combination of Target, Action and Means represent an ICHI stem code. WHO manages the quality and quantities of stem codes.

If needed, for a more detailed description, it could be combined with another stem code by a slash '/', or extension codes can be appended by an ampersand '&' (Table 2). ICHI, ICD-11, and International Classification of Functioning, Disability and Health (ICF) are closely linked and complement each other, and are called "reference classifications" in the international classification family [3].

## 2. Materials and methods

We mapped to the ICHI a total of 149 surgical codes including 29 artificial joint surgeries, 71 arthroscopic surgeries, and 49 spinal surgeries, out of the 581 orthopedic surgical intervention codes on the JOANR registration form. These 149 codes had extensive records maintained by JOA; therefore, we adopted them as source codes for the present mapping research.

In the first phase, two surgeons familiar with both ICHI and domestic surgical codes mapped them independently using the WHO-FIC Platform [6]. Initially, only single stem ICHI codes were utilized. After discussions, they confirmed that the most appropriate code in the ICHI was assigned for each domestic title. The level of equivalence between each domestic code's title concept and its assigned ICHI code was then classified into 5 categories: 1) Equivalent (title concept was an exact match between the domestic and ICHI codes); 2) Narrower (domestic code implied a deeper or more specialized concept compared to its ICHI counterpart). In this case, the domestic code could easily be assigned to the ICHI code; however, different JOANR codes were applied to the same ICHI code or extension codes were added to the ICHI code to adjust just for granularity in the domestic code. 3) Broader (domestic code concept was broader compared to the ICHI code). In this case, we needed to combine two or more ICHI codes as complements. 4) Slipped (domestic code had both broader and deeper implication than the ICHI code). Here, the ICHI codes needed elaborate adjustment such as using additional ICHI stem codes and extension codes. 5) None (domestic code could not be expressed by ICHI codes) (Fig. 1). If domestic codes are classified as Equivalent, it indicates that the domestic and ICHI codes can be converted mutually

**Table 2**  
ICHI code's use case in which another code and extension codes are combined.

Domestic code on JOANR K142 1 (150282510)		
(Title)	Spinal anterior interbody fusion <sup>a</sup>	
ICHI code	<b>MBV.LE.AA/MBV.DN.AA &amp; XK7V &amp; XT09.15</b>	
Stem code 1	(Code)	MBV.LE.AA
	(Title)	Spinal fusion, not elsewhere classified
	(Axes)	<Target> MBV (Vertebral column, not elsewhere classified) <Action> LE (fusion) <Means> AA (open approach)
Stem code 2	(Code)	MBV.DN.AA
	(Title)	Implantation of device into spine, not elsewhere classified
	(Axes)	<Target> MBV (Vertebral column, not elsewhere classified) <Action> DN (Implantation of device) <Means> AA (open approach)
Extension code 1	(Code)	XK7V
	(Title)	Anterior
Extension code 2	(Code)	XT09.15
	(Title)	Interbody fusion spine cage NOS

Two stem codes and two extension codes shown as "Stem code 1,2" and "Extension code 1, 2", respectively, can be combined by "/" and "&".

<sup>a</sup> a tentative translation.

Domestic code	ICHI code	Level of equivalence (Relation)	Explanaiton
		Equivalent	Exact match between domestic codes and ICHI code. No need to add any extention code.
		Narrower	Domestic code indicates narrower concept than ICHI code. ICHI code has to be added some extension codes to adjust
		Broader	Domestic code means broader concept than ICHI' s. Two or more ICHI codes should be combined.
		Slipped	Domestic code has both of broader and narrower implication than ICHI' s. Need elaborate adjusment
		None	Domestic code can't be expressed by ICHI codes.

**Fig. 1.** Level of equivalence between domestic code and ICHI. The Venn diagrams schematically represent relations between domestic code and ICHI. These diagrams were modified from the 2018 WHO-FIC Family Development Committee Mid-year Meeting 14–15 April 2018 Geneva, Switzerland, 'ICHI Mapping Process' paper.

on a one-on-one basis. If classified as Equivalent or Narrower, it indicates that domestic codes can apply to the ICHI code smoothly.

In the second phase, JOA certified orthopedic surgeons validated the relation between domestic and the assigned ICHI codes with reference to the WHO-FIC Platform [6]. If necessary, each stem code was combined with other stem codes or extension codes. We incorporated the patient's diagnosis by combining ICD-11 codes with ICHI codes to adjust for granularity in certain domestic codes. We then evaluated the levels of equivalence between the two codes in each condition using additional stem codes, extension codes, or diagnostic codes of ICD-11 (Table 3). As seen in Example 7 in Table 3, the domestic code K136-2/150354810 representing Total en bloc spondylectomy for tumors (a tentative translation) is assigned to MBV.JK.AA (Total ostectomy of vertebra, not elsewhere classified) as the most appropriate ICHI code. However, the domestic code's title implies that total resection should be routinely followed by reconstruction surgery comprising rod and pedicle screw implantation. Hence, we added both MBV.MLAA (Reconstruction of vertebra, not elsewhere classified) and MBV.DN.AA (Implantation of device into spine, not elsewhere). Further, the title also indicates that it is a spinal tumor procedure. Therefore, we considered the diagnostic codes for tumor, either 2B5Z (Malignant mesenchymal neoplasm of unspecified type) or 2E83.2 (Benign osteogenic tumors of bone or articular cartilage of vertebral column), based on ICD-11 to adjust for granularity. Thus, the level of equivalence was first classified as Slipped using only the single stem code MBV.JK.AA. It was re-evaluated as Narrower by adding MBV.MLAA and MBV.DN.AA, and finally classified as Equivalent by combining with the diagnostic code 2B5Z. Finally, debatable issues which arose during mapping operation were noted.

### 3. Results

In the first phase, two surgeons individually mapped 149 domestic codes to appropriate ICHI codes using the WHO-FIC Platform (accessed on April and May 2022) [6]. There was consensus on 98 titles (65.8%). Of the remaining 51 titles (34.1%), 14 had discrepancies in Target axis, 31 in Action axis, 1 in Means axis, and 5 in both Target and Action axes. After discussion, they achieved consensus on all 149 titles. The level of equivalence between the

JOANR and ICHI codes using single stem code alone were as follows: Equivalent, 27 (18.1%); Narrower, 65 (43.6%); Broader, 10 (6.7%); Slipped, 33 (22.1%); None, 14 (9.4%).

In the second phase, JOA qualified orthopedic surgeons validated the results and, if necessary, added other stem codes, extension codes, or both, resulting in Equivalent, 65 (43.6%); Narrower, 61(40.9%); Broader, 9(6.0%); Slipped, 1 (0.7%); and None, 13 (8.7%). Next, ICD-11 codes were added as diagnosis for more detailing, resulting in: Equivalent, 120 (80.5%); Narrower, 6 (4.0%); Broader, 10 (6.7%); Slipped, 0 (0%); and None, 13 (8.7%) (Table 4). Among 6 titles categorized in Narrow, 2 titles were due to lack of appropriate ICHI extension codes and 4 were deficiencies of correspondent ICD-11 codes to adjust granularities. Among 10 categorized in Broader, where although JOANR code's concept partially matched to ICHI, the rest part could not be assigned appropriate ICHI codes, 9 were due to lack of arthroscopic surgeries' codes and the another was due to a lack of appropriate ICHI stem code for percutaneous surgery. 13 titles of None were all attributed to lack of arthroscopic surgeries' codes.

#### 3.1. Debatable issues found during mapping operation

##### 3.1.1. Lack of appropriate ICHI codes for arthroscopic surgeries

We could not find appropriate ICHI codes for 22 (14.7%) domestic codes related to arthroscopic surgeries. If enough codes for arthroscopic surgeries were provided in ICHI, final rate of Equivalent could go up to 95.3%. As seen in Examples 1 to 3 in Table 3, we found suitable codes for "Release of hip joint" and "Arthroscopic release of knee joint," but not for "Arthroscopic release of hip joint,"

##### 3.1.2. Diagnosis in domestic code title

We found that 18 (12.1%) domestic codes involved diagnoses in their titles rather than concrete procedures. As seen in Example 4 in Table 3, the domestic title "Scoliosis surgery" conventionally implies "reduction, fusion, and implantation of device" of spine only for scoliosis, which is much narrower than ICHI stem code MBV.LD.AA/MBV.LE.AA/MBV.DN.AA that represent reduction/fusion/implantation of device. This domestic code's concept is limited by its diagnostic name "Scoliosis." Hence, this domestic code must not be assigned to interventions that target anything

**Table 3**  
Examples for mapping process indicating the level of equivalence in each condition.

	Domestic code on JOANR		ICHI code			adscript ICD code <sup>*1</sup>		
	K-code (9-digit code)	Title (as a tentative translation)	ICHI stem code (descriptive title)	Level of equivalence (with single ICHI code alone)	Additional stem codes and extension codes (descriptive title)	Level of equivalence (plus other stem codes and extension codes)	ICD code (title)	Level of equivalence (alongside ICD code)
Example 1	K076 1 (150045310)	Release of hip joint by open surgery	MLJ.FC.AA (Release of hip joint)	Equivalent		Equivalent		Equivalent
Example 2	K076-2 1 (150396210)	Arthroscopic release of hip joint	N/A <sup>*2</sup>	None		None		None
Example 3	K076-2 1 (150396310)	Arthroscopic release of knee joint	MMJ.FC.AB (Arthroscopic release of knee joint)	Equivalent		Equivalent		Equivalent
Example 4	K142-2 1 (150282750)	Scoliosis surgery, (fusion surgery)	MBV.LD.AA (Open reduction of vertebra, not elsewhere classified)	Slipped	MBV.LE.AA (Spinal fusion, not elsewhere classified)  MBV.DN.AA (Implantation of device into spine, not elsewhere)	Narrower	FA70.1 (Scoliosis)	Equivalent
Example 5	K135 (150063710)	Resection of spinal tumor	MBV.JJ.AA (Partial ostectomy of vertebra, not elsewhere classified)	Narrower	MBV.DN.AA (Implantation of device into spine, not elsewhere)	Narrower	2E83.2 (Benign osteogenic tumors of bone or articular cartilage of vertebral column)	Equivalent
Example 6	K136 (150063910)	Resection of malignant spinal tumor	MBV.JJ.AA (Partial ostectomy of vertebra, not elsewhere classified)	Narrower	MBV.DN.AA (Implantation of device into spine, not elsewhere)	Narrower	2B5Z (Malignant mesenchymal neoplasm of unspecified type)	Equivalent
Example 7	K136-2 (150354810)	Total en bloc spondylectomy for tumors	MBV.JK.AA (Total ostectomy of vertebra, not elsewhere classified)	Slipped	MBV.ML.AA (Reconstruction of vertebra, not elsewhere classified) MBV.DN.AA (Implantation of device into spine, not elsewhere)	Narrower	2B5Z (Malignant mesenchymal neoplasm of unspecified type) <sup>*3</sup>	Equivalent

<sup>\*1</sup> If necessary, ICD code was added alongside.

<sup>\*2</sup> The appropriate ICHI code was not available.

<sup>\*3</sup> If target is benign osteogenic tumors, 2E83.2 should be put down here instead of 2B5Z.

**Table 4**

The results of level of equivalence between the JOANR and ICHI codes in each condition.

Level of equivalence	single stem code alone		with additional stem codes		with ICD 11 code	
	Count	Percentage	Count	Percentage	Count	Percentage
Equivalent	27	18.1%	65	43.6%	120	80.5%
Narrower	65	43.6%	61	40.9%	6	4.0%
Broader	10	6.7%	9	6.0%	10	6.7%
Slipped	33	22.1%	1	0.7%	0	0.0%
None	14	9.4%	13	8.7%	13	8.7%
Total	149	100% <sup>a</sup>	149	100% <sup>a</sup>	149	100% <sup>a</sup>

<sup>a</sup> The composition ratio is rounded to the second decimal place therefore the total does not necessarily add up to 100.

other than scoliosis, even though same procedures are performed. Especially for tumor surgeries, domestic codes are differentiated based on tumor type as mentioned in titles, even if the procedure is not so different (Table 3, Examples 5 & 6). However, in ICHI, resection surgeries for both malignant and benign tumors have same codes as long as procedures are nearly the same. While it might seem odd to add diagnoses to intervention codes in mapping research, we decided to add ICD-11 codes considering the specificity in the domestic code.

## 4. Discussion

### 4.1. Trends in building big databases

The Ministry of Health, Labour and Welfare, Japan, has been promoting the construction of a clinical efficacy database since 2013 to improve the quality of medical care and select cost-effective, high-quality interventions [1]. In response to this policy, JOA launched the JOANR, a large-scale database, registering almost all surgeries in Japan for locomotor disorders since 2020. Although it fell behind certain academic societies' precursive registries [7], the JOANR collected 899,431 cases in the initial year [2], and is comparable to the Japan Surgical Society's National Clinical Database (NCD) for gastrointestinal surgery, a pioneer Japanese database [8]. Around the same time, the WHO released ICHI Beta-3, which could also serve as valuable indicators for monitoring the implementation of Universal Health Coverage (UHC), which is a major WHO priority. This is a significant opportunity to consider the possibility of converting JOANR data to ICHI codes, because Japan, too, should contribute to UHC. Further, it is expected that international comparison of surgical procedures will be performed using the ICHI code in the future. The current study is the first trial to map items on a domestic database to ICHI.

### 4.2. Differences in coding

In this mapping trial, discrepancies on 51 titles (34.1%) between two surgeons were pointed out, all of which were attributed to trivial differences of opinions in terms of advanced procedures and jargon-filled anatomical targets in orthopedic surgeries. Although the two coders are familiar with both surgical procedures and the structure of ICHI, the subject of orthopedic surgery is far too vast and highly specialized to classify at first attempt. This resulted in bringing in expert orthopedic surgeons. More discussions with health information managers and experts are required before public introduction of ICHI in Japan.

### 4.3. The level of equivalence between the JOANR and ICHI codes

Initially, the rate of Equivalent was 18.1% and Narrower was 43.6% while using single stem codes alone, indicating that a total of

61.7% of domestic code titles could be mapped to ICHI codes without discrepancies. Next, by using other stem codes and extension codes, the rate of Equivalent and Narrower rose to 43.6% and 40.9%, respectively, indicating that 84.5% of domestic titles can be mapped to items in an international database using ICHI codes. Finally, we obtained 80.5% for Equivalent category by adding ICD codes.

Previously, Kin et al. reported that the rate of Equivalent was 52.8% with stem code alone and 72.0% with extension codes while mapping 229 items of common surgical procedures to ICHI codes [9]. Nicola F. et al. [10] presented that while mapping 80 nursing interventions to ICHI codes using only stem codes, 34% of items were Equivalent. The present study showed a lower rate of Equivalent by using stem codes alone than the previous reports. We believe this can be attributed to two issues. First, currently, ICHI does not have appropriate codes for some arthroscopic surgeries. By enough arthroscopic codes, the final rate of Equivalent could go up to 95.3%, as we mentioned in the results. Second, some domestic titles are unsuitable for classifying interventions as they are based on claim codes in the medical fee schedule. Hence, they contain diagnoses to provide information on reason for intervention, which determines technical service payments, although the latter is not included in ICHI codes. We consider that JOANR could be used as source of data for international comparison via ICHI, and ICHI has potential as an alternative coding in domestic reimbursement system after addressing these issues. Although we assume that putting down with adscript ICD codes or developing some domestic ICHI codes are choices, more discussions among orthopedic surgery experts and medical information managers can help resolve these issues.

### 4.4. Debatable issues identified during the mapping operation

#### 4.4.1. Deficiency of codes for arthroscopic surgeries

Currently, we could not find any appropriate codes for 22 (14.7%) arthroscopic surgeries in ICHI. Recently arthroscopic surgeries have been performed increasingly, and more minimum invasive surgeries will still be preferable [11,12]. Although many new codes for arthroscopic surgeries have been populated responding to our and other's proposals on the ICHI platform [5], the current study did not show the sufficient codes yet. However, we also know that the ICHI cannot have high granularity because it should be easily applicable to both areas that do not have a classification system in place and to countries such as Japan that already have a classification scheme. Therefore, we might have to prepare appropriate domestic codes for arthroscopic surgeries to accommodate the domestic condition in ICHI.

#### 4.4.2. Diagnoses in domestic code titles

We found that 18 (12.1%) domestic codes had titles involving diagnoses, because they were originally taken from items on the medical fee schedule, which were replenished iteratively at the time of revision of the medical insurance system and not systematized for statistics of medical interventions. The reason for intervention, however, is not included in ICHI [3]. In such a case, the rate of equivalence rose to 80.5% when ICD-11 codes were added. We consider that using ICHI codes with adscript ICD code is one of the feasible ways to introduce ICHI in Japan. The ICHI reference guide mentions that ICHI can be used with ICD and ICF if required [3]. With regard to codes on tumor surgeries, the domestic scheme based on tumor type has been in place for many years and cannot be easily revised. The ICHI, however, is not affected by tumor type and does not include the reason(s) for an intervention. This issue is complicated and beyond the scope of this study. Therefore, extensive discussions with experts and stakeholders are required.



#### 4.5. Limitations

The current research operated on only 149 code titles out of 581 items in JOANR as a trial. Moreover, some details of the ICHI are subject to change because it is under construction and awaiting approval at the World Health Assembly. Therefore, we must re-evaluate the relationship between domestic and ICHI codes in the near future.

Further, in the present study, we only examined “K-code” with 9-digit health insurance claims codes on the registration form of JOANR, but another surgical code called “STEM7” having a 3-axis structure similar to that of ICHI has been in use in recent years in Japan [13]. We would like to consider adding this code to this mapping study in the future.

We hope that the present trial will act as the base for future ICHI mapping studies, and would arouse the interest of domestic orthopedic surgeons and health information managers in ICHI and would help world experts recognize the status of medical statistics in the orthopedic field in Japan. We expect that more discussions with stakeholders would resolve the remaining issues, such as the demand for more suitable entities for interventions in the domestic scheme and handling of deficiencies in ICHI codes for arthroscopic surgeries.

##### 4.5.1. Ethics statement

This study is not a clinical trial and did not involve any human subjects or animal experiments. As there is no identifiable human material or data, informed consent was not required and therefore Helsinki Declaration and Directive 2010/63/EU are not applicable. This research has been approved by the IRB of the authors' affiliated institutions and the manuscript has been prepared in accordance with the Uniform Requirements for Manuscripts Submitted to Biomedical Journals.

#### Ethics Statement

This study was approved by Japan Community Health Care Organization Funabashi Central Hospital Institutional Review Board (approval No. R04-14).

#### Declaration of competing interest

The first author is a member of The Collaborating Centre for the WHO-FIC in Japan and a study group for ICHI domestic adaptation receiving the Health and Labor Sciences Research Grant and

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