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Review of the Registration in the Clinical Research Information Service

Eun-Kyoung Choi, Mi-Jung Kim, Nam-Kyoo Lim, and Hyun-Young Park

Division of Cardiovascular and Rare Disease, Center for Biomedical Science, Korea National Institute of Health, Cheongju, Korea

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Address for Correspondence:
Hyun-Young Park, MD
Division of Cardiovascular and Rare Disease, Korea National Institute of Health, 187 Osongsaengmyeong 2-ro, Heungdeok-gu, Cheongju 28159, Korea
Tel: +82.43-719-8650, Fax: +82.43-719-8689
E-mail: hypark65@korea.kr

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Clinical research registration is required in many countries to improve transparency of clinical research and to ensure subject safety. Developed in February 2010, the Clinical Research Information Service (CRIS) is an online registration system for clinical studies in Korea and one of the primary registries of the World Health Organization (WHO) International Clinical Trials Registry Platform. The present analysis investigated the characteristics of studies registered in the CRIS between February 2010 and December 2014. Data for the analysis were extracted from the CRIS database. As of December 31, 2014, 1,323 clinical studies were registered. Of these, 938 (70.9%) were interventional studies and 385 (29.1%) were observational studies. A total of 248 (18.7%) studies were funded by government sources, 1,051 (79.4%) by non-government sources, and 24 (1.8%) by both. The most frequently studied disease category based on the ICD-10 classification was the digestive system (13.1%), followed by the nervous system (9.4%) and musculoskeletal system (9.1%). Only 17.8% of the studies were registered prior to enrollment of the first subject. Comparing the number of registered or approved clinical studies between the CRIS, the Ministry of Food and Drug Safety, and ClinicalTrials.gov suggests that a considerable number of clinical studies are not registered with the CRIS; therefore, we would suggest that such registration should be the mandatory legal requirement.

Keywords: Clinical Trials as Topic; Databases, Factual; Information Dissemination; Internet; Registries; Republic of Korea

INTRODUCTION

Selective outcome reporting and publication bias have long been recognized in the clinical research field (1), and concerns have increased about the resulting negative impact on medical science (2). Clinical research registration may help resolve these concerns (3) and improve both the transparency and credibility of clinical research conduct (4-6). Since 2005, the International Committee of Medical Journal Editors (ICMJE) has required that authors register their clinical trial for consideration of publication (7). Moreover, the Declaration of Helsinki, the ethical guidelines for clinical research acknowledged worldwide, stipulates that every clinical research study must be registered in a publicly accessible database before recruitment of the first subject (8).

In response to this necessity, many regulatory and funding entities throughout the world require clinical trial registration by law or research guidelines (5,9), and a public registration system has been established in many countries (10). In 2007, the World Health Organization (WHO) developed a single platform, called the International Clinical Trials Registry Platform (ICTRP), to prevent ambiguous identification of the clinical trials. The ICTRP displays all registered clinical trials from the participating primary registries and presents the duplicate trials identified by study title (11). As of May 2015, 15 public registries from various countries were participating as primary registries in the WHO ICTRP. In 2010, the Korea Centers for Disease Control and Prevention (KCDC) developed the Clinical Research Information Service (CRIS, https://cris.nih.go.kr), an online registration system for clinical research, with support from the Ministry of Health and Welfare (MOHW). Although registration of clinical research into a public registry system is not legally mandated in Korea, the MOHW issued a regulation in 2012 that requires registration of MOHW-funded clinical research into the CRIS, which it designated as the public registry (12,13). The CRIS joined the WHO ICTRP as a primary registry in May 2010, and the Ministry of Food and Drug Safety (MFDS) recommends that investigators or sponsors register their clinical trial upon MFDS approval. Registration of clinical research with the CRIS requires entry of data elements in both Korean and English (Table 1), and all information entered is subject to internal review and open to the public upon completion of review and clarification. Furthermore, the information is sent to the WHO ICTRP every 4 weeks and shared worldwide (Fig. 1). Clinical research

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Table 1. Required data elements for research registration with the CRIS

Items	Data element
1. Background	- Unique protocol ID, Public/Brief title, Scientific title, Acronym, MFDS regulated study, IND/IDE protocol, Other registry if applicable (name, registration number)
2. Institutional Review Board/Ethics Committee*	- Board approval status, Board approval number, Approval date, Name of Board, Data Monitoring Committee
3. Contact details	- Name, Title, Telephone, email, Affiliation of the following persons: Contact person for principal investigator/scientific queries, Contact person for public queries, Contact person for updating information
4. Study status	- Overall recruitment status: Study site, Date of first enrollment, Status of first enrollment, Target sample size, Primary completion date, Study completion date - Recruitment status by participating study site: Name of study site, Recruitment status, Date of first enrollment, Status of first enrollment
5. Source(s) of monetary/material support	- Organization name, Organization type, Project ID
6. Sponsor organization(s)	- Organization name, Organization type
7. Study summary	- Summary
8. Study design	- Interventional study: Study purpose, Phase, Intervention model, Blinding/masking, Allocation, Intervention type, Intervention description, Arm label, Target sample size, Arm type, Arm description - Observational study: Observational study model, Time perspective, Target sample size, Cohort/group label, Cohort/group description, Biospecimen collection & Archiving, Biospecimen description
9. Subject eligibility†	- Condition(s)/disease(s), Rare disease, Inclusion/Exclusion criteria
10. Outcome measure(s)	- Type of primary outcome, Primary outcome, Secondary outcome
11. Publication information	- If applicable, Author, Title, Journal name, Publication year

Source: https://cris.nih.go.kr/cris/en/images/explain_en.pdf. *Approval letter should be uploaded; †Registrant selects the disease category according to the ICD-10 classification and then enters the details. CRIS, Clinical Research Information Service; MFDS, Ministry of Food and Drug Safety; IND/IDE, Investigational New Drug/Investigational Device Exemption.

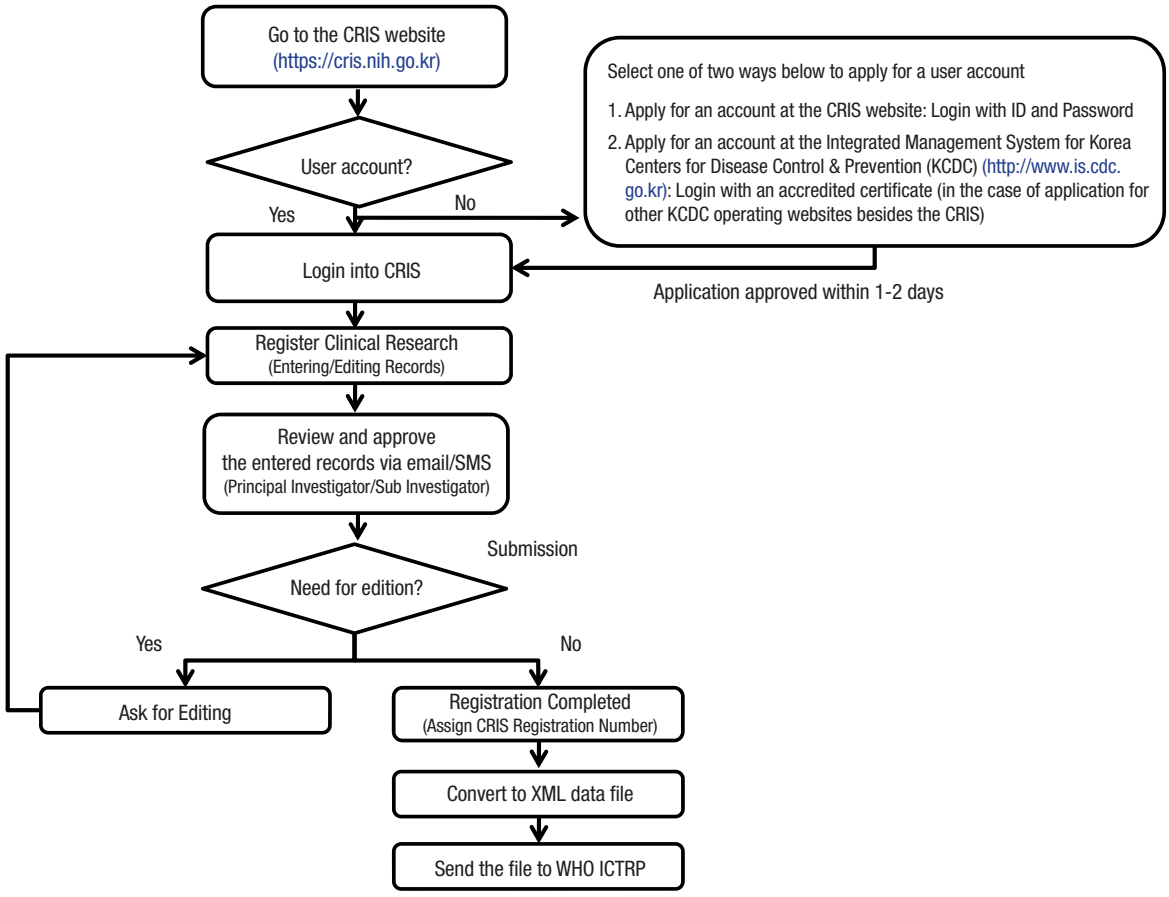

Fig. 1. Registration process in the CRIS and information sharing with WHO ICTRP. CRIS, Clinical Research Information Service; WHO ICTRP, World Health Organization International Clinical Trials Registry Platform.

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registration has gradually increased since the launch of the CRIS.

This paper analyzed the clinical research registered in the CRIS. Results were presented in the following order: overall characteristics of the registered research; analysis of registered research by research type, disease category and intervention type; trend of registration; and visits to the CRIS website. This information may help increase understanding about the current status of clinical research conducted in Korea.

MATERIALS AND METHODS

In this paper, clinical research was defined as studies involving human subjects and included interventional research (also known as a clinical trial). All types of clinical study were registered in the CRIS; therefore, we used the term 'clinical research' to indicate such studies. In addition, the phrases 'clinical trial' and 'interventional research' were used interchangeably for indicating interventional research (also known as a study with experimental design) registered with the CRIS or the clinical trial approved by the MFDS.

All records of the registered research between February 1, 2010 and December 31, 2014 were obtained from the CRIS database and imported into an Excel file on February 16, 2015. Statistical analyses were performed using SAS software (version 9.3; SAS Institute, Cary, NC, USA) and a two-tailed *P* value less than 0.05 indicated statistical significance.

Classification and analysis were performed on the subjects; research type, funding source, disease category, gender, age and timing of research registration. All records with the exception of funding source were classified according to the defined data element of the CRIS website. Funding source was entered into the CRIS website by selecting one of the following categories: 'pharmaceutical company', 'hospital', 'research institute', 'university', 'government', or 'others'. After reviewing all the entered records, we revised this categorization by changing 'pharmacy company' to 'company' to classify non-government funding sources with more clarity. Under this revised classification, non-pharmaceutical companies were manually reclassified from 'others' to 'company'. For the classification by research type, the research studies were divided into observational research and interventional research. The name of disease was entered and classified by a registrant according to the ICD-10 classification and the six most frequently studied disease categories were presented. Gender was classified as male only, female only, or both genders. Studies enrolling subjects less than 18 yr-of-age or over 65 yr-of-age were counted to present the numbers of the studies for those specific populations. As stated in the Declaration of Helsinki, registration of clinical research was required prior to enrollment of the first subject. Therefore, for the timing of research registration, we presented the number of research studies that were registered prior to enrollment of the first subject. We also counted the number of studies regulated by the MFDS, those registered into both the CRIS and ClinicalTrials.gov, and those conducted in multiple countries. The registered interventional studies were further subclassified by intervention type.

The average monthly number of visits and page views of the CRIS website was obtained using Google Analytics on January 26, 2015. We started using the weblog analysis service for the CRIS website in July 2011. Therefore, the data for the average monthly number of visits and page views between July 1, 2011 and December 31, 2014 were available and obtained from Google Analytics.

RESULTS

Overall characteristics of the registered clinical studies

A total of 1,323 clinical research studies was registered with the CRIS from the launch of the CRIS through 2014. Table 2 shows the characteristics of those registered clinical research studies. Of the 1,323 registered studies, 938 were interventional studies (70.9%) and 385 were observational studies (29.1%). According to the type of funding source, 18.7% (n = 248) were funded by the government and 79.4% (n = 1,051) were funded by non-government sources. The MOHW (192/248, 77.4%) was the major funder among the government-funded sources, and the hospital was the most common non-government funded source (507/1,051, 48.2%).

The classification of the registered studies by disease category showed that the digestive system accounted for the greatest proportion of studies (13.1%, n = 173), followed by the nervous system (9.4%, n = 125), the musculoskeletal system (9.1%, n = 121), the circulatory system (9.0%, n = 119), neoplasm (8.0%, n = 106), and the endocrine system (7.0%, n = 92). Of the registered clinical studies, 129 (9.8%) had male subjects only and 93 (7.0%) had female subjects only. Fifty (3.8%) studies investigated children, and 16 (1.2%) investigated elderly individuals only. Only 17.8% (n = 235) of all registered clinical studies and 18.9% (n = 177) of interventional research studies were registered prior to enrollment of the first subject. Of the registered studies, 24.6% (n = 325) were regulated by the MFDS and 14.0% (n = 185) were registered into the CRIS with the registration number of ClinicalTrials.gov. A total of 46 (3.5%) studies were conducted in multiple countries (termed 'multinational research' in the required data item of the CRIS).

Analysis of registered research studies based on specific subjects

The registered clinical research studies classified by funding source (Table 2) were subdivided by research type (Fig. 2). Of the government-funded studies, 147 (59.3%) were observational studies and 101 (40.7%) were interventional studies. Among

Table 2. Characteristics of the registered clinical research in the CRIS

Characteristics	No. (%) of registered research					
	Total (n = 1,323)	2010 (n = 71)	2011 (n = 231)	2012 (n = 313)	2013 (n = 347)	2014 (n = 361)
Research type						
Observational researches	385 (29.1)	16 (22.5)	81 (35.1)	73 (23.3)	114 (32.9)	101 (28.0)
Interventional researches	938 (70.9)	55 (77.5)	150 (64.9)	240 (76.7)	233 (67.1)	260 (72.0)
Funding source						
Government	248 (18.7)	9 (12.7)	52 (22.5)	47 (15.0)	79 (22.8)	61 (16.9)
MOHW	192 (14.5)	7 (9.9)	48 (20.8)	35 (11.2)	61 (17.6)	41 (11.4)
Others*	56 (4.2)	2 (2.8)	4 (1.7)	12 (3.8)	18 (5.2)	20 (5.5)
Non-government	1,051 (79.4)	61 (85.9)	170 (73.6)	261 (83.4)	262 (75.5)	297 (82.3)
Hospital	507 (38.3)	31 (43.7)	98 (42.4)	110 (35.1)	129 (37.2)	139 (38.5)
University	78 (5.9)	11 (15.5)	9 (3.9)	17 (5.4)	22 (6.3)	19 (5.3)
Company	376 (28.4)	12 (16.9)	48 (20.8)	117 (37.4)	86 (24.8)	113 (31.3)
Research Institute	54 (4.1)	0 (0.0)	9 (3.9)	11 (3.5)	15 (4.3)	19 (5.3)
Others†	36 (2.7)	7 (9.9)	6 (2.6)	6 (1.9)	10 (2.9)	7 (1.9)
Government & Non-government‡	24 (1.8)	1 (1.4)	9 (3.9)	5 (1.6)	6 (1.7)	3 (0.8)
Disease category§						
Digestive	173 (13.1)	10 (14.1)	26 (11.3)	36 (11.5)	55 (15.9)	46 (12.7)
Nervous	125 (9.4)	1 (1.4)	40 (17.3)	26 (8.3)	38 (11.0)	20 (5.5)
Musculoskeletal	121 (9.1)	9 (12.7)	32 (13.9)	21 (6.7)	21 (6.1)	38 (10.5)
Circulatory	119 (9.0)	9 (12.7)	25 (10.8)	28 (8.9)	31 (8.9)	26 (7.2)
Neoplasm	106 (8.0)	8 (11.3)	15 (6.5)	24 (7.7)	31 (8.9)	28 (7.8)
Endocrine	92 (7.0)	4 (5.6)	4 (1.7)	27 (8.6)	24 (6.9)	33 (9.1)
Others	587 (44.4)	30 (42.3)	89 (38.5)	151 (48.2)	147 (42.4)	170 (47.1)
Gender						
Male only	129 (9.8)	2 (2.8)	18 (7.8)	29 (9.3)	29 (8.4)	51 (14.1)
Female only	93 (7.0)	9 (12.7)	15 (6.5)	19 (6.1)	31 (8.9)	19 (5.3)
Both	1,101 (83.2)	60 (84.5)	198 (85.7)	265 (84.7)	287 (82.7)	291 (80.6)
Age						
Children only (< 18 yr)	50 (3.8)	0 (0.0)	7 (3.0)	14 (4.5)	17 (4.9)	12 (3.3)
The elderly only (≥ 65 yr)	16 (1.2)	0 (0.0)	3 (1.3)	2 (0.6)	6 (1.7)	5 (1.4)
Registration before first enrollment						
All registered researches	235 (17.8)	11 (15.5)	48 (20.8)	67 (21.4)	54 (15.6)	55 (15.2)
Interventional researches‖	177 (18.9)	8 (14.5)	37 (24.7)	52 (21.7)	43 (18.5)	37 (14.2)
Regulated by the MFDS	325 (24.6)	6 (8.5)	40 (17.3)	98 (31.3)	77 (22.2)	105 (29.1)
Dually registered into ClinicalTrials.gov	185 (14.0)	7 (9.9)	19 (8.2)	51 (16.3)	42 (12.1)	66 (18.3)
Conducted in multi-countries¶	46 (3.5)	0 (0.0)	3 (1.3)	18 (5.8)	8 (2.3)	17 (4.7)

Data are expressed as No. (%). *The other government funding sources were included except the MOHW; †Non-profit organizations and academic associations were included; ‡The researches were funded both by government source(s) and non-government source(s); §The ICD-10 classification was used for disease category; ‖For this item, total number was 938 and the percentage was calculated based on this total number; ¶The entering item for classification of multinational research was made starting from May 2011. CRIS, Clinical Research Information Service; MOHW, Ministry of Health and Welfare; MFDS, Ministry of Food and Drug Safety.

the government funding sources, the MOHW supported significantly more observational (71.9%) than the interventional studies (28.1%). By contrast, other departments or agencies funded significantly more than interventional (83.9%) than observational studies (16.1%) ($\chi^2 = 55.9$, $P < 0.001$). Non-government sources funded significantly more interventional (78.2%) than observational studies (21.8%). The type of research supported by government and non-government funding sources was significantly different ($\chi^2 = 137.1$, $P < 0.001$). Among the non-government funding sources, company supported more interventional studies (92.6%) than observational studies (7.4%). Both hospital and university also support more interventional studies than observational studies.

To review the frequently studied disease categories in detail, we listed the three most frequently studied disease categories according to research type, gender and age (Table 3). Among observational research studies, the nervous system was the most frequently studied category (19.2%), whereas the digestive system was the most frequently studied category among the interventional research studies (12.5%). Of the registered clinical studies including males only, the circulatory system was the most frequently studied category (15.5%). Neoplasm (14.0%), the endocrine system (14.0%), and the genitourinary system (14.0%) were the most frequently studied categories in studies of females only. In the studies of subjects less than 18 yr-of-age, the mental disorders (10.0%) and skin (10.0%) were the most frequently studied categories. For studies of the elderly population, the nervous system and neoplasm were the most frequently studied categories (both 18.8%).

The most frequent intervention type was drug/biological therapy (55.8%), followed by surgery/procedure (11.9%) and medical devices (9.6%) (Fig. 3).

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Table 3. Three most frequently studied disease categories among the registered clinical researches

No.	Total (n = 1,323)	Research type		Gender			Age (yr)	
		Observational (n = 385)	Interventional (n = 938)	Male only (n = 129)	Female only (n = 93)	Both (n = 1,101)	< 18 only (n = 50)	≥ 65 only (n = 16)
1	Digestive 173 (13.1)	Nervous 74 (19.2)	Digestive 117 (12.5)	Circulatory 20 (15.5)	Neoplasm 13 (14.0), Endocrine 13 (14.0), Genitourinary 13 (14.0)	Digestive 169 (15.3)	Mental 5 (10.0), Skin 5 (10.0)	Nervous 3 (18.8), Neoplasm 3 (18.8)
2	Nervous 125 (9.4)	Digestive 56 (14.5)	Musculoskeletal 100 (10.7)	Genitourinary 17 (13.2)	-	Nervous 122 (11.1)	-	-
3	Musculoskeletal 121 (9.1)	Circulatory 36 (9.4)	Circulatory 79 (8.4)	Endocrine 10 (7.8)	-	Musculoskeletal 108 (9.8)	Nervous 4 (8.0)	Circulatory 2 (12.5), Blood & Immune 2 (12.5)

Data are expressed as the disease category and No. (%).

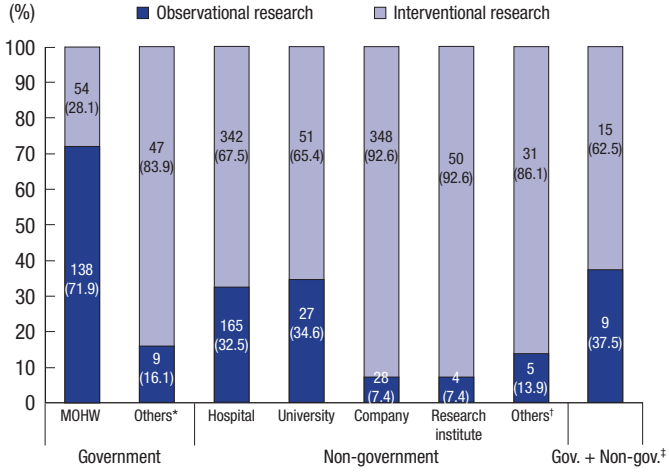

Fig. 2. Classification of research types of registered clinical research by funding source. Data are expressed as No. (%). *The other government funding sources were included except the MOHW; †Non-profit organizations and academic associations were included; ‡The researches were funded both by government source(s) and non-government source(s). MOHW, Ministry of Health and Welfare.

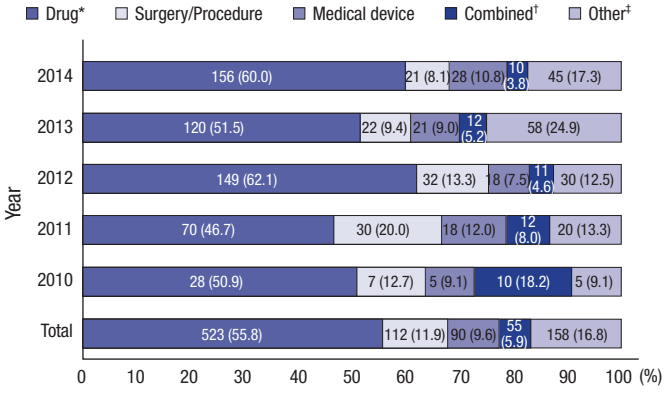

Fig. 3. Classification of the registered research by intervention. Data are expressed as No. (%). *Drug includes biological and vaccine; †Combined intervention includes more than two interventions; ‡Others include behavioral therapy, dietary supplement, radiation therapy and non-listed interventions.

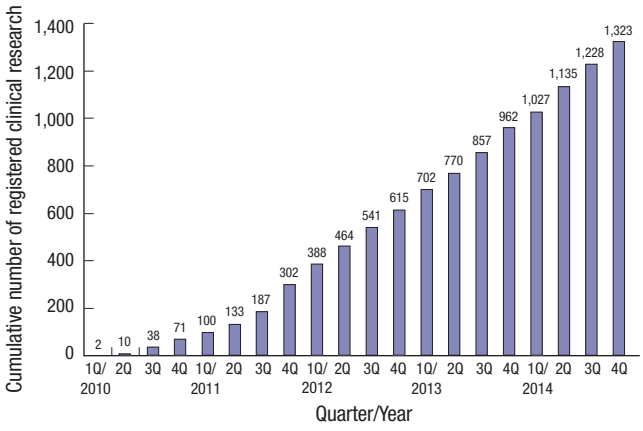

Fig. 4. Accumulated number of registered clinical researches in the CRIS. CRIS, Clinical Research Information Service.

Trend of registration and visits to the CRIS website

The number of registered clinical research studies in the CRIS has consistently increased since the CRIS was launched in February 2010 (Fig. 4). The average monthly number of visits and page views of the CRIS website also increased gradually to approximately 4,600 and 47,000, respectively, in 2014. According to Google Analytics, the countries that accessed the CRIS website included (but were not limited to) the United States, Singapore, Spain, the United Kingdom, Japan, China, Hong Kong, Germany, Australia, and New Zealand.

DISCUSSION

Our results showed that the number of clinical studies registered with the CRIS has increased consistently since it became the 11th primary registry of the WHO ICTRP in 2010. We compared the number of clinical studies registered or approved by the CRIS, the MFDS, or ClinicalTrials.gov. While only 325 studies regulated by the MFDS were entered in the CRIS between February 1,

2010 and December 31, 2014 (Table 2), 2,871 clinical trials were approved by the MFDS between January 1, 2010 and December 31, 2014 (14,15). Although the time periods compared were not identical and CRIS registration and MFDS approval did not always occur during the same year, many clinical trials approved by the MFDS were likely not registered with the CRIS in 2010-2014. Additionally, clinical studies that were exempt from MFDS approval or not regulated by the MFDS were registered into the CRIS. Furthermore, the number of studies registered with ClinicalTrials.gov was approximately three times more than those registered with the CRIS, as 4,290 clinical studies conducted in Korea were registered with ClinicalTrials.gov between February 1, 2010 and December 31, 2014. This data was obtained on May 11, 2015 and was obtained by performing an advanced search of 'Republic of Korea' in the country field and '02/01/2010 to 12/31/2014' in the first received date field on the ClinicalTrials.gov website. During this same period, only 185 studies were registered with both the CRIS and ClinicalTrials.gov (Table 2). Accordingly, we also inferred that a considerable number of the clinical studies conducted in Korea were registered with ClinicalTrials.gov, but not with the CRIS.

A 1997 law required that certain types of Food and Drug Administration (FDA)-regulated clinical trials be registered into ClinicalTrials.gov (16). The FDA Amendment Act of 2007 expanded this requirement by requiring registration of a greater scope of trials and submission of results summaries, and allowed enforcement of penalties in cases of noncompliance (17). Therefore, many multinational companies are more likely to register their trials with ClinicalTrials.gov, rather than with the CRIS. With this consideration, we compared the number of multinational studies registered with the CRIS and the number of MFDS-approved clinical trials conducted by the multinational companies (assuming that the multinational research was conducted by a multinational company). Although more than 40% of the clinical trials approved by the MFDS (n = 1,212) between 2010 and 2014 were conducted by multinational companies (14,15), only 3.5% of the clinical studies registered in the CRIS (n = 46) were classified as multinational research (Table 2). Therefore, many multinational clinical studies were missing registration with the CRIS. While registration of certain clinical trials is legally required in the United States, other countries require that all clinical trials conducted in their countries are registered (18). For example, in India and Brazil, registration of all clinical trials into a public registry established by a governmental body is mandatory to obtain approval for conducting the clinical trial from the relevant government agency (19,20). The European Union (EU) also provides some clinical trial information to the public through the EU Clinical Trials Register based on the Article 57 of Regulation (EC) No. 726/2004 (21).

Clinical research registration is encouraged or required to protect the potential research subjects by informing them of the contents and design of the trial prior to their participation. Therefore, clinical research information should be available to the public in the language of the country where the research is being conducted, and clinical research conducted in Korea should be registered with the CRIS to provide trial information in the Korean language. The MOHW issued a regulation in 2012 that requires registration for clinical research funded by the MOHW. Furthermore, the MFDS recommends (but does not require) clinical trial registration. Currently, the legal basis for clinical research registration in Korea is very limited and needs to be established to enforce clinical research registration with the CRIS, as is the case in other countries.

Analysis of clinical studies by funding source and research type showed that the government, especially the MOHW, funded more observational studies than interventional studies. The circulatory system was the most frequent disease category for studies that included males only, whereas it was not among the top three for studies with females only or both genders. The digestive system was the most frequently studied disease category in the general population, but not in trials of children or elderly individuals, respectively.

Characteristics of the research studies registered in the CRIS provide insight into the current status of clinical studies conducted in Korea. Through the information provided in the CRIS, both researchers and policy makers can obtain ideas for future research plans or relevant policies, and potential subjects can obtain information about clinical studies. However, the information presented in this paper may not reflect the true status of clinical studies conducted in Korea, because a significant number of these were not registered with the CRIS. Encouraging registration of clinical trials will help enable good decision-making and implement strategies based on accurate information reflecting the current status of the studies.

The importance of registration timing must be stressed, while at the same time encouraging the registration of clinical studies. According to a statement from the WHO (11) and guidelines from the ICMJE (7), clinical trials must be registered prior to enrollment of the first subject. Our results showed that a considerable number of clinical trials were registered after the first subject was enrolled, and the number of the interventional studies registered prior to enrollment tended to decrease over time (Table 2). Providing open access to information on clinical trials currently underway (even if the trial is registered after the first subject has been enrolled), as well as to those that have already been completed, is meaningful and beneficial to both the public and researchers. Nevertheless, timing of registration should be actively promoted among researchers and sponsors to improve transparency in conducting and reporting clinical research, and to ensure subject safety. The ICMJE requires the observance of registration timing in its 'the Uniform Requirement' (7). Requiring authors to adhere to appropriate registration tim-

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ing as a condition for publication in journals that are published in Korea may help increase awareness of registration timing among researchers.

In Korea, the registered information of clinical trials includes the summary of the protocol, but not the results of the trial. The evolution of evidence-based medicine has increased the publication of systematic reviews of clinical trials results (22); as such, the importance of reporting clinical trial results has been stressed to prevent dissemination bias (23) and it is also suggested that dissemination of research results is an ethical obligation for researchers involved in conducting or publishing clinical research (24). Since 2007, the FDA has required both registration of the clinical trial and submission of the results summary (17). In April 2015, WHO released a statement on the public disclosure of clinical trial results that describes the background of the statement and defines reporting timeframes (25). A survey on clinical trials registration was conducted by the National Institute of Food and Drug Safety Evaluation with the cooperation of Korea National Institute of Health in 2014 among domestic clinical researchers, employees of pharmaceutical companies, and staff working for the institutional review board of each institute in Korea. Of the 494 participants, 93.5% replied that the reporting of clinical trials results should be eventually become a legal requirement, although this may need to be achieved in stages (26); this indicates a consensus opinion among the relevant communities and parties in clinical research field regarding the reporting of clinical trial results.

There are some issues which need to be studied further. In order to maximize the use of the information registered with the registry, it is important to ensure the quality of registered data. Viergever et al. (27) assessed the quality of registered data which were taken from the WHO ICTRP and showed that the quality of the data needs to be improved. In this regard, the further studies are required to evaluate the quality of registered data in the CRIS and the appropriateness of the process reviewing the entered data based on the experts' analysis although we check systematically and manually the completeness of the entered data and consistency between them. Moreover, the further studies are also required to examine the relationship between the publication and registration. There are several reports on the relationship between registration of clinical trial and its publication (28-31). Reveiz et al. (28) indicated that the registration of randomized clinical trials was positively associated with the improvement in reporting of their results. Killeen et al. (29) found a discrepancy between the registered primary outcome and that published in the surgical literature and they reported that more than 90% of the articles shown the discrepancy favored a statistically positive outcome. The report from Gandhi pointed out that the registrations were not consistent with the results in the publication of orthopedic trauma trials (30). Bourgeois et al. (31) analyzed the trial records and publication derived from ClinicalTrials.gov and reported that the trials funded by industry were more likely to report positive outcomes than were trials funded by other sources. Accordingly, we need to conduct further studies regarding the influence of registration on the publication or selective outcome reporting and comparison between registration and publication. In general, it takes several years for a clinical study to be completed and published. The previous studies allowed some period of time for completion of study and submission of a manuscript. Bourgeois et al. allowed at least 3 yr between trial completion and the literature search for publication of results (31). Therefore, it is necessary to allow several years to get the publication data of the registered clinical studies. For this reason, the further studies are required in the future to analyze the relationship between registration and publication of the clinical studies registered with the CRIS after allowing more time for completion of study and preparation of its publication.

The CRIS is a registry for clinical research registration acknowledged by the WHO and operated by a governmental body in Korea. Through the CRIS, information about observational studies and clinical trials conducted in Korea is more accessible. To increase the usefulness of information in the CRIS, establishment of a concrete consensus and legal foundation for the reporting of clinical trial results and registration of clinical research studies will be essential.

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DISCLOSURE

The authors have no potential conflicts of interest to disclose.

AUTHOR CONTRIBUTION

Study concept and design: Choi EK, Park HY. Writing: Choi EK. Revision: Park HY. Review of entered data and support for data analysis: Kim MJ. Statistical analysis: Lim NK. Manuscript approval: all authors.

ORCID

Eun-Kyoung Choi *http://orcid.org/0000-0003-2047-2497*
Mi-Jung Kim *http://orcid.org/0000-0001-5903-2320*
Nam-Kyoo Lim *http://orcid.org/0000-0002-3354-7040*
Hyun-Young Park *http://orcid.org/0000-0002-6698-7368*

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