RESEARCH ARTICLE

Cancer Registration Manual Understanding by Medical Record Administrators

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Abstract

Background: This study examined: (a) whether medical record administrators (MRAs) properly understand and apply a cancer registration manual; (b) weaknesses in cancer registration: and (c) factors influencing the accuracy of cancer registration. **Methods:** MRAs dealing with cancer registration in 81 national member hospitals were asked by mail to answer 17 questions about cancer information among registration items. After calculating rates of correct and incorrect answers to each question, an analysis was conducted of whether they were related to particular factors (hospital type, hospital location, number of hospital beds, experience of cancer registration, and experience of consulting cancer registration). **Results:** A total of 45.7% of the participants gave approximately 90% correct answers. The rates for correct answers about general rules were under 90% for objectives of cancer registration and treatment. The rate concerning histologic type was over 90%, while few correct answers exceeded 50% to questions concerning newly revised rules for the colorectal system. For questions about initial treatment, date of diagnosis, and method of final diagnosis, as well as four questions on checking the validity of registered data, the correct answer rates were 70-90%. Regarding the features of hospitals and respondents, number of hospital beds and prior experience in cancer registration questions were found to contribute to the high rate of correct answers. **Conclusion:** To improve the accuracy of cancer registration, the manual needs to be supplemented in areas demonstrating low correct answer rates. Education opportunities and methods for MRAs should be diversified.

Keywords: Medical record administrators- quality- cancer registration- manual

Introduction

After the Korea Central Cancer Registry (KCCR) was established in 1980 and grounds for enforcement of cancer registration work were legislated in 2003 by the Cancer Control Act, registration reports from nationwide KCCR member hospitals provide 90% of the total cancer registration in South Korea (Shin et al., 2005). The professional responsible for cancer registration at these hospitals is called the medical record administrator (MRA); they work in the hospital's medical record department or cancer centre, maintaining the system of registering and reporting the extracted cancer case for official records.

Because cancer incidence rate and consequential death rate have been increasing not only globally but also nationally due to environmental factors such as aging population and change in diet (Jung et al., 2015), a government-wide cancer policy is currently being executed. Cancer registration is indispensable as the only data acquisition system, and it provides baseline data to evaluate the effect of the malignant tumour on the population group and reduce the burden from cancer

(Jensen and Storm, 1991). Cancer registration data must be reliable and of quality; information containing its essential items must be especially consistent and accurate. The aspects of validity and accuracy are particularly important to evaluate the quality of cancer registration data, which can be defined as increasing the reliability of data by abstracting accurate information regarding the cancer registration items (Parkin et al., 1994). The tumour registrar is responsible for the most basic quality management task of data such as abstraction of the registration objects, accurate input and encoding of the registered information, and internal consistency check between items (Larsen et al., 2009).

In the U.S., the National Cancer Registrars Association (NCRA) has operated a certification system for cancer registration professionals called Certified Tumour Registrar (CTR) since 1983. Professionals who wish to work in cancer registration must obtain this certificate and strengthen their professional skills by completing certain minimum hours of various education and training programs offered both offline and online (NCRA, 2012; NCRA, 2013; NCRA, 2014; Hawhee and Williams, 2015).

To date, there is no cancer registration professional

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certification system in South Korea. However, KCCR has been offering information and accepting questions regarding cancer registration, via both online and offline resources. Offline education courses – at basic, intermediate, and advanced levels – have been operated by nationwide hospitals for MRAs working in cancer registration biannually since 2008. Online education offers manuals, revised information, registration guidelines for each category, and clinical knowledge for each cancer, as well as the answers to the questions they receive from MRAs through the cancer registration education centre webpage (https://training.kccr.cancer.go.kr:9443/user/data/register_list.do?type=01). However, gaps in professional knowledge and performance among MRAs definitely exist due to the lack of more mandatory and strict completion of education within the legal and institutional boundaries provided by a professional certification system (Boo et al., 2014). Accuracy of medical records, system support of medical institutes, relative importance of cancer registration, and the encoding and data-abstracting capability of the tumour registrar have been shown to be the factors affecting the quality of cancer registration data (Hsieh et al., 2012; KMRA, 2012; Peterson, 2012).

This study developed the example scenario questions to evaluate the ability of MRAs performing cancer registration in South Korea to memorize and understand the cancer registration guidelines and to properly apply each rule to the given case. This paper proposes issues that need to be reflected in the future revision of the cancer registration manual and matters that need to be supplemented in the training program. These proposals are based on analysis of the results to identify areas that need additional training and that need to be supplemented with more detailed guidelines in the manual. Finally, the paper considers the factors that affect low answer rates.

Materials and Methods

Materials

In October and November of 2014, questionnaires comprising 17 multiple-choice questions were mailed to 131 KCCP member hospitals, and the retrieved questionnaires completed by a total of 81 cancer registration administrators were analysed.

The questionnaire has three major sections. The first section comprises three questions regarding the object of cancer registration and general manuals:
• multiple primary cancer (Q1);
• objects of cancer registration (Q2); and
• classification of cancer treatment (Q3)

The second section comprises ten questions about detailed guidelines/manuals about cancer registration items:
• combinations of histopathologic diagnosis and SEER stage (Q4 and Q5);
• multiple lesions occurred on the same primary site (Q6);
• combinations of primary sites and histopathologic diagnosis (Q7);
• method of final diagnosis (Q8);
• initial treatment (Q9);

• date of cancer diagnosis (Q10 and Q11); and
• complexed histopathologic code (Q12 and Q13)

The third comprises four questions about the consistency of data items:
• combinations of primary site and method of final diagnosis (Q14);
• combinations of primary site and histopathologic diagnosis code (Q15);
• combinations of gender and histopathologic diagnosis code (Q16); and
• combinations of histopathologic diagnosis code and SEER stage (Q17)

All answers were based on Cancer Registration Manual (CRM; 2012) distributed by the KCCR, which is identical to the global standard of the International Agency for Research on Cancer (IARC) manual (Esteban et al., 1995; DM et al., 1994), ICD-O-3 (Fritz et al., 2000), and SEER stage (NCI, 2001).

Analysis

Analysis was performed in two stages. The first stage was to analyse the answer rate for each question and to understand the cause of incorrect answers for each question. The second was to separate the impact factor of the respondents' answer rate into hospital regions, the number of beds, cancer registration experience, and past cancer registration questions experience, and calculate each answer rate. A statistical analysis was performed using logistic regression to explore whether each factor affects the answer rate of about 90% (more than 15 questions answered correctly). The standard of 90% was decided by consulting the members of the cancer registration committee under the KMRA. The rules applied to the questionnaire are detailed in CRM and the sample scenarios for its application in the questionnaire were fairly common to ensure that the respondents should have been able to select correct answers for all of the questions.

However, a correct answer rate of 90% can be accepted as full understanding of CRM, assuming that the simple mistakes of giving incorrect responses to one or two questions were due to lack of attention or the habit of 'top-of-the page syndrome' (Feigl et al., 1982) from the respondent's surroundings or conditions, rather than actual lack of knowledge or understanding of CRM. All p values are two-tailed, with $p<0.05$ considered to be statistically significant. All statistical analyses were conducted using SPSS Statistics 21 (SPSS, Chicago, IL, USA).

Results

Table 1 presents the general characteristics of the hospitals answering the distributed questionnaires in order to examine their understanding and applications of the CRM. All 81 participating hospitals were larger in scale than general hospitals, with 42 tertiary general hospitals (51.9%) and 39 general hospitals (48.1%). They were located across the capital regions including Seoul, Incheon, and Gyeonggi-do (38 respondents, 46.9%) and the other regions (43 respondents, 53.1%), but there were few regional differences in the characteristics. Concerning

Table 1. General Characteristics of Participating Hospitals

		N (81)	Percentage (%)
Type	Tertiary General Hospital	42	51.9
	General Hospital	39	48.1
Location	Seoul and capital regions	38	46.9
	Non-capital regions	43	53.1
No Beds	100-300	8	9.9
	301-600	13	16
	601-1000	37	45.7
	Over 1000	23	28.4
Experiences of Cancer Registration	None	4	4.9
	Less than 1 year	15	18.5
	1-5 years	28	34.6
	6-10 years	15	18.5
	Over 10 years	19	23.5
Experiences of Consulting Cancer Registration	None	29	35.8
	1~5	29	35.8
	6~10	12	14.8
	Over 10	11	13.6

hospital bed numbers, hospitals with between 600 and 1,000 beds comprised the largest respondent group (37 hospitals, 45.7%), and those with fewer than 300 beds comprised the smallest respondent group (8 hospitals, 9.9%). Concerning the respondents' experiences of cancer registration in each hospital, 1 to 5 years' experience was the most common (28 hospitals, 34.6%), and over 10 years' experience was second most common (19 hospitals, 23.5%). 29 respondents, 35.8% of the total, had no past experience of cancer registration questions, and 64.2% had experienced them more than once.

Table 2 shows the results concerning questions about the object of cancer registration and the general rule. Questions regarding the object of cancer registration (Q2) and cancer treatment classification (Q3) showed similar correct answer rates of 82.7% and 86.4% respectively, whereas questions about multiple primary cancer (Q1) had a correct answer rate of only 48.1%.

Ten questions about detailed guidelines are shown in Table 3. The questions about morphology code (Q4, Q12, and Q13) all had correct answer rates exceeding 90%. Conversely, Q5 and Q6 both exhibited low correct answer rates, of 51.9% and 59.3%, respectively. Additionally, the final diagnosis method question (Q8) had a 77.8% correct answer rate, while the two questions about initial diagnosis date (Q10 and Q11) had correct answer rates

of 81.5% and 87.7% respectively.

Regarding the questions on checking the data's internal consistency, questions about the combination of primary site and histological diagnosis code (Q15) displayed a 82.7% correct answer rate; the combination of gender and primary side code (Q16) that of histological diagnosis code and SEER stage (Q17) both had a correct answer rate of 86.7%. However, only 71.6% correctly answered the question about primary site and the final diagnostic method (Q14), which is more than 10% lower than the rate for the other questions (Table 4).

The distributions of correct responses to each of the 17 questions across characteristics including hospital type, hospital locations, number of beds, experiences of cancer registration, and experiences of consulting cancer registration are presented in Table 5. The rate of correct responses against the total number of questions was found to be higher in tertiary general hospitals than in general hospitals. In particular, 25 of 42 tertiary general hospitals were found to provide 80% correct responses. The rate of correct responses to the category of objects of cancer registration and general manuals was much higher in general hospitals (69.2%) than that in tertiary general hospitals (38.1%). Conversely, the rate of correct responses to the category of managing the quality of cancer registration data was much higher in tertiary general

Table 2. Questions about the Object of Cancer Registration and General Manuals

Question Number	Scenario description	Answer	
		True	False
Q1	TURB operated with the occurrence of Transitional carcinoma, sarcomatoid type on the left bladder in 2007. In 2009, papillary transitional cell carcinoma occurred on the right bladder. This case belongs to Multiple Primary Cancers.	42(51.9)	**39(48.1)**
Q2	Anaplastic meningioma is the object of cancer registration.	**67(82.7)**	14(17.3)
Q3	For stomach cancer, exploratory laparotomy regarded as surgical therapy.	11(13.6)	**70(86.4)**

Shaded gray, number of correct answer (rate); TURB, Transurethral resection of bladder

Table 3. Questions about Detailed Guidelines/Manuals about Cancer Registration Items

Question Number	Items	Scenario description	Multiple choices (select only one)	Response	frequencies (%)
Q4	Morphology and SEER codes	Cytology: Cervix: Squamous cell carcinoma, microinvasion	1- M8070/2 SEER : 0	2	2.5
			2- M8070/3 SEER : 0	0	0
			3- M8070/2 SEER : 1	1	1.2
			4- M8070/3 SEER : 1	78	96.3
Q5	Morphology and SEER codes	Hemicolectomy, ascending colon: well differentiated adenocarcinoma, intramucosal invasion	1- M8140/3 SEER : 1	34	42
			2- M8140/2 SEER : 1	42	51.9
			3- M8140/3 SEER : 0	1	1.2
			4- M8140/2 SEER : 0	4	4.9
Q6	Primary site code	In the EDG for a female patient vising a hospital for a three-month long indigestion, mucinous carcinoma was diagnosed in the stomach & cardia. In the total gastrectomy, later, mucinous adenocarcinoma was diagnosed in stomach, cardia, & pylorus.	1- C16.0	2	2.5
			2- C16.4	4	4.9
			3- C16.8	27	33.3
			4- C16.9	48	59.3
Q7	Combination between primary site and morphology	Choose the one requiring reexamination among the linked T code and M code.	**1- C41.1 – M8070/3**	74	91.4
			2- C53.0 – M8072/3	6	7.4
			3- C22.0 – M8170/3	0	0
			4- C34.1 – M8250/3	1	1.2
Q8	Method of final diagnosis	No cancer tissues were found in the histopathologic examination during colonoscopy of a patient with severe abdominal pain. However, the doctor gave the patient a definite diagnosis of colorectal cancer from the results of abdomen MRI and CEA examinations.	1- Pathology	1	1.2
			2- Cytology	0	0
			3- Clinical Test	17	21
			4- Special biochemistry or immunological tests	63	77.8
Q9	Treatment	After being diagnosed with a brain tumour on 1 March 2009, the patient had surgery on March 20 and started chemotherapy on April 1. However, metastasis to the lung was found in August 2009, and radiation therapy started on August 20.	1- Surgery, chemotherapy and radiotherapy	3	3.7
			2- Surgery and radiotherapy	1	1.2
			3-Chemotherapy and radiotherapy	4	4.9
			4-Surgery and chemotherapy	73	90.1
Q10	Date of diagnosis	The patient visited a local hospital with the symptoms of hematochezia at the end of May 2011. Advised to visit a larger hospital, the patient visited the OPD of the current hospital on June 1 and was hospitalized on June 2. After being diagnosed with colorectal cancer via colon biopsy on June 5, they were discharged on June 10.	1- May 2011	4	4.9
			2- June 1, 2011	66	81.5
			3- June 2, 2011	7	8.6
			4- June 5, 2011	4	4.9
Q11	Date of diagnosis	A patient was hospitalized with a femur fracture from a traffic accident on 2 April 2013. Having problems in digestion while getting treatment after OR&IF surgery on April 4, the patient had an endoscopy and was diagnosed with stomach cancer on 7 April.	1- April 2013	1	1.2
			2- April 2, 2013	7	8.6
			3-April 4, 2013	2	2.5
			4- April 7, 2013	71	87.7
Q12	Complexed histopathologic code	Signet ring cell carcinoma (50%),acinar cell carcinoma (50%)	1- M8490/3 (signet ring cell carcinoma)	0	0
			2- M8550/3 (acinar cell carcinoma)	74	91.4
			3- M8940/3 (mixed tumour, malignant)	7	8.6
Q13	Complexed histopathologic code	Poorly differentiated carcinoma, with features of cholangiocarcinoma	1- M8010/3 (carcinoma, NOS)	3	3.7
			2- M8020/3 (carcinoma, undifferentiated)	2	2.5
			3- M8160/3 (cholangiocarcinoma)	76	93.8

Shaded gray, number of correct answer (rate); EDG, esophagogastroduodenoscopy; MRI, Magnetic resonance imaging; CEA, Carcinoembryonic antigen; OPD, Out- patient department; OR&IF, Open reduction and internal fixation

hospitals (81.0%) than in general hospitals (48.7%). Comparing the rate of correct responses between capital and noncapital regions, hospitals in Seoul and the capital areas had a higher rate of correct responses for all of the categories (57.9%). Analysing correct response rates for each category in relation to the number of beds, in large hospitals with more than 1,000 beds, the highest rate of total correct responses was 87.0%, which is more than twice the rate of hospitals with fewer than 1,000 beds. In contrast, the rate of correct responses to all three questions

Table 4. Questions about Choice of Confirmation Required among Cancer Data Items

Question Number	Sex	Date of diagnosis	Primary site code	Histopathologic code	Method of final diagnosis	SEER stage code	Correct answer (%)	Answer description
Q14	Male	20081203	C809	81403	7	9	58 (71.6)	primary site unknown vs. histological diagnosis for primary site
Q15	Female	20110810	C165	87203	7	3	67 (82.7)	lesser curvature of stomach, NOS vs. malignant melanoma for skin
Q16	**Female**	20110416	**C619**	81403	7	1	70 (86.4)	female vs. prostate gland
Q17	Female	20080107	C539	**80702**	7	**1**	70 (86.4)	squamous cell carcinoma in situ vs. invasive and localized

Shaded gray, wrong combination; NOS, Not otherwise specified; Method of final diagnosis; 7 is histological diagnosis for primary site ; SEER stage code; 1 is localized, 3 is regional lymph node(s) involved only and 9 is unknown if extension or metastasis

Table 5. Analysis of the Rate of Correct Responses in Relation to Characteristics

Question categories	Number of correct answers	hospital type		hospital location		Number of beds		Experiences of Cancer Registration		Experiences of Consulting Cancer Registration		Total (N=81)
		Tertiary General Hospital (N=42)	General Hospital (N=39)	Seoul & capital regions (N=38)	Non-capital regions (N=43)	Fewer than 1,000 (N=58)	More than 1,000 (N=23)	None or less than 5 years (N=47)	More than 5 years (N=34)	Not experienced (N=29)	Experienced (N=52)	
General guideline (Q1~Q3)	0~1	10(23.8)	4(10.3)	10(26.3)	4(9.3)	13(22.4)	1(4.3)	9(19.1)	5(14.7)	8(27.6)	6(11.5)	14(17.3)
	2	16(38.1)	8(20.5)	17(44.7)	7(16.3)	9(15.5)	15(65.2)	17(36.2)	7(20.6)	10(34.5)	14(26.9)	24(29.6)
	3	16(38.1)	27(69.2)	11(28.9)	32(74.4)	36(62.1)	7(30.4)	21(44.7)	22(64.7)	11(37.9)	32(61.5)	43(53.1)
Detailed guidelines (Q4~Q13)	=<5	0(0.0)	6(15.4)	1(2.6)	5(11.6)	6(10.3)	0(0.0)	4(8.5)	2(5.9)	4(13.8)	2(3.8)	6(7.4)
	6~8	13(31.0)	25(64.1)	12(31.6)	26(60.5)	32(55.2)	6(26.1)	21(44.7)	17(50.0)	13(44.8)	25(48.1)	38(46.9)
	9~10	29(69.0)	8(20.5)	25(65.8)	12(27.9)	20(34.5)	17(73.9)	22(46.8)	15(44.1)	12(41.4)	25(48.1)	37(45.7)
Quality control (Q14~Q17)	0~2	5(11.9)	10(25.6)	5(11.9)	10(25.6)	14(24.1)	1(4.3)	10(21.3)	5(14.7)	7(24.1)	8(15.4)	15(18.5)
	3	3(7.1)	10(25.6)	3(7.1)	10(25.6)	11(19.0)	2(8.7)	6(12.8)	7(20.6)	3(10.3)	10(19.2)	13(16.0)
	4	34(81.0)	19(48.7)	34(81.0)	19(48.7)	33(56.9)	20(87.0)	31(66.0)	22(64.7)	19(65.5)	34(65.4)	53(65.4)
Total	=<10	1(2.4)	10(25.6)	1(2.6)	10(23.3)	10(17.2)	1(4.3)	8(17.0)	3(8.8)	7(24.1)	4(7.7)	11(13.6)
	11~14	16(38.1)	17(43.6)	15(39.5)	18(41.9)	31(53.4)	2(8.7)	18(38.3)	15(44.1)	13(44.8)	20(38.5)	33(40.7)
	15~17	25(59.5)	12(30.8)	22(57.9)	15(34.9)	17(29.3)	20(87.0)	21(44.7)	16(47.1)	9(31.0)	28(53.8)	37(45.7)

Table 6. Factors Associated with Rate of Correct Responses by Logistic Regression (N=81)

	Exp (B)	P-value	95% CI
Type			
General Hospital	1(ref)		
Tertiary General Hospital	0.76	0.687	0.21-2.83
Location			
Non-capital regions	1(ref)		
Seoul and capital regions	0.47	0.213	0.14-1.55
No Beds			
= <1000	1(ref)		
> 1000	19.37	0.000*	3.76-99.70
Experiences of Cancer Registration			
None or =<5years	1(ref)		
> 5years	0.64	0.497	0.17-2.34
Experiences of Consulting Cancer Registration			
None	1(ref)		
Experienced	5.43	0.025*	1.24-23.85

* Statistical significant p<0.05

about the objects of cancer registration and general manuals was 62.1% in the hospitals with fewer than 1,000 beds, which is more than twice the rate of hospitals with more than 1,000 beds (30.4%). Considering correct responses to each category against experiences of cancer registration, there were no distinctive differences in the rates of correct responses in relation to the existence of experiences or a career in cancer registration. Comparing the rates of correct responses to all of the questions and the highest rates in each category, the differences were found to be less than 5% in every category except that of the objects of cancer registration and general manuals.

In the rate of correct responses to total questions, the hospitals with experiences of cancer registration consultation provided a rate of correct responses more than 20% higher than the rate of those without these experiences. Furthermore, hospitals with consultation experiences showed higher rates of correct responses in general.

Finally, Table 6 shows whether there is any difference in the answer rate of around 90% depending on the five characteristics of the respondent's hospitals suggested in Table 5. The number of hospital beds (p=0.000) and whether the hospital has experienced cancer registration questions (p=0.025) were selected as factors with statistical significance. The results show that hospitals with more than 1,000 beds were expected to have 19 times greater probability of achieving a total correct answer rate of 90% or higher than the hospitals with 1,000 beds or fewer. However, regarding the cancer registration question experience, respondents with this experience are five times more likely to answer 15 or more questions correctly than respondents without this experience.

Discussion

This study analysed how well the KCCR's CRM are understood and applied in practice (KCCR, 2012; Fritz et al., 2000; Esteban et al., 1995).

As detailed above, Q1-Q3 concern the objects of cancer registration and general manuals. Q1, which asks about the multiple primary neoplasm guidelines, showed the lowest correct answer rate of 48.1%, probably because all three rules described below have to be applied. According to the IARC rules, respondents first have to know that both transitional cell carcinoma and papillary transitional cell carcinoma belong to the same morphology group; next, they also have to be aware that the right and the left of the paired organ are considered to be the same organ; finally, they have to consider that the times of the occurrence of the two cancers are not related to each other. Alternatively, the fact that cases to which this knowledge can be applied occur too infrequently for respondents to sufficiently learn the rules for multi primary cancer could also explain the low answer rate. Q2 concerns the objects of cancer registration involving only carcinoma in situ (behaviour code /2) and primary malignant tumour (behaviour code /3). Tumours on the brain are also objects of registration when they are benign; anaplastic meningioma is a benign tumour. Registration of brain tumours follows the registration rule ICD-O-3, which has operated since 2005 for registration data in South Korea (KCCR, 2012). Treatment refers to any operations or medication to influence the primary sites, but the definition excludes pain treatments, X-ray, endoscopy, or biopsy used to improve the symptoms (KCCR, 2012; Esteban et al., 1995). Q3 is to evaluate the definition of treatments related directly to cancer.

The outcome for the detailed rules concerning each cancer registration category was provided from Q4 to Q13, with correct answer rates varying between 51.9% and 96.3% for each question. Describing the rule concerning combinations of tissue pathological diagnoses and SEER stage, Q5 shows the lowest correct answer rate (51.9%) among the ten questions on the detailed guidelines. The applied rule states that if differentiation of adenocarcinoma occurring in the colon is 'well', it is considered as intraepithelial carcinoma and its behaviour code must

be '2'. However, its SEER code must be classified as localized where an intramural invasion has occurred. Although publicity and training were deployed to raise awareness of this CRM rule following changes to its application in early 2014, most of the respondents were not fully aware of it. Judging from the 42.0% rate of the correct response 'M8140/3, SEER code is 1', the changed rule does not seem to be considered by respondents in practice. The correct answer rate for Q6 – concerning cases of unknown specific subsites within the same primary site – was quite low (59.3%). When the same histological types exist in the same organ, they are considered to be one primary tumour. If each specific site is adjacent or not overlapped, code 9, referring to an unspecified site, should be assigned. The 33.3% response rate for the incorrect response C16.8 (overlapping, stomach) (among other incorrect answers) indicates either a lack of anatomical knowledge regarding stomach subsites or ignorance of how to apply the rules about the overlapping lesion. The correct response rate to Q7 was a relatively high 91.4%. This question concerns combinations of topography and histological diagnosis, and its correct answer is that types of epithelial carcinoma should not occur in the musculoskeletal system as primary cancer, which can be checked during the internal consistency of data (Parkin et al., 1994). The response options of Q8 use a very rare case to evaluate how carefully and precisely the respondents approach cancer registration work when determining the method of final diagnosis. When a histopathology test does not find tumour tissues but the doctor gives a definite diagnosis of cancer, the primary examination method used to confirm the cancer is referred to as the final diagnosis method. In this question, the cancer was confirmed via abdomen MRI and Carcinoma embryonic antigen examinations, which belong to clinical tests (category 2) and special biochemistry or immunological tests (category 4) respectively. Thus, these examinations are coded with the higher category number 4 as the final diagnosis method. Respondents whose answers selected clinical tests (21.0%) do not seem to have considered if definite diagnosis of the cancer cells can affect how to determine the diagnostic method of the cases already confirmed as cancer.

The definition of the time for initial treatment is addressed through Q9. Treatment is acknowledged only when it is provided within four months of the cancer diagnosis. According to KCCR's CRM, since the radiation therapy started after that in this question's scenario, it is excluded from treatments. Q10 and Q11 concern the rules on defining the date of cancer diagnosis. The earliest date on which the doctor diagnosed the cancer should be chosen. In the Q10 scenario, the end of May 2011 was excluded because the patient was advised to visit a larger hospital, rather than being diagnosed as cancer. As the patient received the definite diagnosis of colorectal cancer on June 5 by having the colon biopsy on June 1, 2011, the initial date of diagnosis is June 1, when the biopsy was performed. When the patient was incidentally diagnosed as having cancer having been hospitalized for illnesses or symptoms not related to cancer, the date of diagnosis is determined as the initial date of cancer diagnosis (Q10 and

Q11). Q12 and Q13 are about the complexed morphologic diagnosis; the questions evaluate if the respondents know how to apply the rules in cases of one mixed tumour or multiple histological diagnoses with the assigned order of combination code, more specific code, majority of the code, and highest code; both questions showed correct answer rates higher than 90%.

There are two potential reasons why the questions to check logical relations between the items (Q14-Q17) unexpectedly revealed correct answer rates of 90% or below. First, some respondents may not have fully understood the question type and consequently made errors in choosing two answers for each question. Second, and alternatively, it is rare to check the internal consistency of the whole cancer registration database as hospital-based cancer registration is generally limited to collecting data registered by each case and delivering them to KCCR.

Having analysed the answer rate distribution and its relevant factors according to the characteristics of the participating hospitals and the MRAs, it can be concluded that the group of hospitals correctly answering over 90% of all 17 questions contained 20% or higher fractions of tertiary hospitals, Seoul and capital regions hospitals, and hospitals with more than 1,000 beds compared to the other group. If those characteristics are typical of large hospitals that are favoured by patients with severe symptoms, these results can be attributed to greater numbers of opportunities for these hospitals to register severe-symptom cancer cases, therefore granting more experience to the MRAs working at these hospitals. Regarding the MRAs' characteristics, the group with 5 years' (and above) experience had only a 3% higher answer rate than the group with fewer than 5 years' experience; conversely, the group with at least one past experience of questions showed a 20% higher correct answer rate. These findings generate two potential interpretations. First, the MRAs who might be recently educated must be more aware of the recent rules compared to MRAs with merely longer experience: the rules applicable to the study's questions were amended or newly added in the past ten years. Second, MRAs with past experience of questions are more likely to have examined the CRM more precisely and meticulously. Ultimately, considering all the five factors that were analysed above, prior experience with cancer registration questions was the factor with the most significant effect on the correct answer rate. This means that it is the interest and the effort of the MRA themselves regarding cancer registration that affects the accuracy of data, rather than the environment of the medical institutions in which they practice.

Overall, only five hospitals (6.2%) were found to provide correct responses to all 17 questions (not presented in a table). However, the fact that around half of the participating hospital members had a correct answer rate of 90% is fairly encouraging, considering South Korea's legal and institutional environment regarding cancer registrations. With institutionalization of qualifications and supplementary education for cancer registration professionals, as well as addition of cancer registration data during accreditation of medical institutions, hospital departments can award cancer registration a higher work

priority and increase recognition of its importance, thus boosting education for cancer registration professionals.

The weakness of the study is that it relied on a mailed questionnaire, affecting the correct answer rate depending on each respondent's surroundings, concentration level, or their sincerity as regards completing the questionnaire. However, its sample is reasonably representative, since the participating hospitals are all KCCR members.

Improving cancer registration is not a one-time project and must be continually pursued to increase the accuracy and reliability of the data. To improve the accuracy of hospital-based cancer registration data, the following steps are required: 1) active education about and promotion of revised or added rules and items, 2) improving manual guidelines about the rules generating a high frequency of questions from MRAs or high error rates, including extensive examples, and 3) diversifying the education for medical record administrators dealing with cancer registration. The results of this study suggest that the parts of the cancer registration guidelines that need to be better-understood should be derived and arranged with appropriate levels of detail. This is a process that should be led through feedback and requests from MRAs, establishing guidelines that can be used as a baseline for performing accurate cancer registration.

Conflict of interests

All authors have no conflicts of interest to disclose.

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References

Boo YK, Lim HS, Won YJ (2014). Implementation plans for the Korean certified tumor registrar qualification system. *Asian Pac J Cancer Prev*, **15**, 9411-16.

DM P, VW C, J F, et al (1994). Comparability and quality control in cancer registration: IARC.

Esteban D, Whelan S, Laudico A, et al (1995). Manual for cancer registry personnel: IARC, **10**, 1-82

Feigl P, Polissar L, Lane WW, et al (1982). Reliability of basic cancer patient data. *Stat Med*, **1**, 191-204.

Fritz A, Percy C, Jach A, et al (2000). International classification of diseases for oncology: World Health Organizaion, 3 1-240

Hawhee V, Williams VL (2015). Registry resources: A summary resource guide for education, training, and online help for new and current cancer registrars. J *Registry Manag*, **42**, 117-20.

Hsieh MC, Yu Q, Wu XC, et al (2012). Evaluating factors associated with unknown SEER Summary Stage 2000 derived from collaborative stage at central registry level. *J Registry Manag*, **39**, 101-6.

Jensen OM, Storm HH (1991). Cancer registration: principles and methods. Reporting of results. *IARC Sci Publ,* **95**, 108-25.

Jung KW, Won YJ, Oh CM, et al (2015). Prediction of cancer incidence and mortality in Korea, 2015. *Cancer Res Treat* **47**, 142-8.

KCCR (2012). Cancer Registration Manual. Available at: https://training.kccr.cancer.go.kr:9443/user/data/register_list.do?type=01.

KMRA (2012). Analysis of status to improve accuracy and fidelity of CS registraion data. In final report on the current subsidy to private sector project for the national health promotion fund in 2012.

Larsen IK, Smastuen M, Johannesen TB, et al (2009). Data quality at the cancer registry of Norway: an overview of comparability, completeness, validity and timeliness. *Eur J Cancer*, 45, 1218-31.

NCI (2001). SEER summary staging manual-2000: codes and coding instructions, Bethesda, MD: National Cancer Institute, 1-293

NCRA (2012). Full report of the job analysis study for cancer registrars. Available at: http://www.ncra-usa.org/i4a/ams/amsstore/category.cfm?product_id=308.

NCRA (2013). Certified tumor registrar continuing education hanbook: a guide for maintaining the CTR credential. Available at: http://www.ncra-usa.org/files/public/CEHandbook-2013v2.pdf.

NCRA (2014). CTR certification esamination: candidate handbook and application. Available at: http://www.ncra-usa.org/files/public/CTRExamHandbook2014.pdf.

Parkin D, Chen V, Ferlay J, et al (1994). Comparability and quality control in cancer registration. Technical Report. IARC, **19**, 42-63

Peterson J (2012) Implementing quality oncology practice initiative (QOPI) participation in a community oncology practice. *J Registry Manag*, **39**, 154-7.

Shin HR, Won YJ, Jung KW, et al (2005). Nationwide cancer incidence in Korea, 1999~2001; first result using the national cancer incidence database. *Cancer Res Treat*, **37**, 325-31.