

**Supplementary Table 1****Appropriateness of Examination Orders Reported by Medical Centers and Local Institutions**

Inclusion of Clinical History in Examination Orders		
Proportion of Examination Orders Containing the Clinical History *	Reported by Medical Centers (N=18)	Reported by Local Institutions (N=15)
< 40%	2 (11%)	8 (53%)
40-60%	3 (17%)	2 (13%)
60-100%	13 (72%)	5 (34%)

The inclusion of complete clinical history in examination orders in different numerical levels was taken as an indicator of examination order appropriateness. Statistical independence between clinical history preparation and hospital categories was analyzed through chi-square test, revealing significant differences ( $p < 0.050$ ) in the inclusion of clinical history between medical centers and local institutions.

\*  $p = 0.028$  for the significant difference of clinical history inclusion between medical centers and local institutions with the chi-square test.

**Supplementary Table 2**  
**Summary of Examination Scheduling**

Access Times <sup>a</sup> (Times for Next Available Appointments)			
(Unit: Days)			
	Median	Interquartile Range	p-value
<b>MRI*</b>			
MC (N= 18)	7.00	29.50	0.034
LI (N= 15)	3.50	3.50	
<b>CT</b>			
MC (N= 18)	4.65	7.00	0.095
LI (N= 16)	2.65	2.13	
<b>Ultrasonography</b>			
MC (N= 14)	7.00	10.75	0.610
LI (N= 8)	8.00	11.28	
<b>Mammography</b>			
MC (N= 16)	2.00	4.00	0.105
LI (N= 12)	1.00	0.60	
<b>Special Procedures</b>			
MC (N= 18)	2.50	2.75	0.246
LI (N= 15)	2.00	1.25	

<sup>a</sup> Access time (wait time till scheduled exams) did not include the time of pre-scheduled follow-up appointments. The Mann-Whitney U two-tailed test was applied for the statistical analysis.

\* A significant statistical difference ( $p < 0.050$ ) in the access time of MRI between medical centers and local institutions.

Abbreviation: MC, medical centers; LI, local institutions.

### Supplementary Table 3

#### The Performance of Healthcare Education among Radiologists, Radiologic Technologist, and Nurses in Medical Centers versus Local Institutions

Patient Education (Multiple Sources)				
	Total No. of Hospitals	Radiologist	Radiologic Technologist	Nurse
<b>MRI*</b>				
MC	18	4 (22%)	10 (56%)	14 (78%)
LI	16	1 (6%)	14 (88%)	12 (75%)
<b>CT**</b>				
MC	18	5 (28%)	10 (56%)	17 (94%)
LI	16	1 (6%)	12 (75%)	12 (75%)
<b>Ultrasonography</b>				
MC	14	4 (29%)	10 (71%)	2 (14%)
LI	10	2 (20%)	8 (80%)	2 (20%)
<b>Mammography</b>				
MC	18	2 (11%)	18 (100%)	2 (11%)
LI	16	0 (0%)	16 (100%)	1 (6%)
<b>Special Procedures***</b>				
MC	18	14 (78%)	8 (44%)	12 (67%)
LI	16	7 (44%)	12 (75%)	12 (75%)
<b>Total****</b>				
MC	86	29 (34%)	56 (65%)	47 (55%)
LI	64	11 (17%)	62 (97%)	39 (61%)

The chi-square test was applied for the statistical analysis.

\* A significant statistical difference ( $p= 0.041$ ) in the performance of patient education led by radiologic technologists for MRI exams between medical centers and local institutions.

\*\* A significant statistical difference ( $p= 0.028$ ) in the performance of patient education led by radiologists for CT exams between medical centers and local institutions.

\*\*\* A significant statistical difference ( $p= 0.042$ ) in the performance of patient education led by radiologists for special radiologic procedures between medical centers and local institutions.

\*\*\*\* Significant statistical differences in the overall performance of patient education led by radiologists ( $p= 0.014$ ) and radiologic technologists ( $p= 0.008$ ) between medical centers and local institutions.

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# **Supplementary Table 4**

## **Utilization of Standardized Imaging Protocols Based on Clinical Orders for Each Radiologic Examination**

Use of Standardized Imaging Protocols			
	No. of Hospitals	%	p-value
<b>MRI</b>	MC (N= 18)	18	1.000
	LI (N= 17)	17	
<b>CT</b>	MC (N= 18)	18	1.000
	LI (N= 17)	17	
<b>Ultrasonography</b>	MC (N= 15)	14	0.216
	LI (N= 13)	10	
<b>Mammography</b>	MC (N= 18)	18	1.000
	LI (N= 16)	16	
<b>Special Procedures*</b>	MC (N= 18)	18	0.024
	LI (N= 16)	12	

The chi-square test was applied for the statistical analysis.

\* A significant statistical difference (p= 0.024) in the utilization of clinical order-based imaging protocols between medical centers and local institutions.

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**Supplementary Table 5**

**Statistics of Time-Out Prior to an Interventional or Imaging-Guided Procedure**

	No. of Hospitals	%	p-value
<b>Time-Out Prior to an Interventional Procedure</b>			
MC (N= 18)	16	89	0.581
LI (N= 17)	14	82	
<b>Time-Out Checklist Archived into Medical Records</b>			
MC (N= 17)	11	65	0.784
LI (N= 15)	9	60	
<b>Items of Verification</b>			
<i>Correctness of patient consents</i>			
MC (N= 16)	16	100	0.277
LI (N= 14)	13	93	
<i>Correctness of patient identities</i>			
MC (N= 16)	16	100	1.000
LI (N= 14)	14	100	
<i>Correctness of examination procedures</i>			
MC (N= 16)	16	100	1.000
LI (N= 14)	14	100	
<i>Correctness of puncture sites</i>			
MC (N= 16)	16	100	1.000
LI (N= 14)	14	100	
<i>Readiness of instruments</i>			
MC (N= 16)	13	81	0.351
LI (N= 14)	13	93	

The chi-square test was applied for the statistical analysis.

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**Supplementary Table 6**

**Comparison of Radiograph Retake and Suboptimal Radiographs between Medical and Local Institutions**

Frequencies of Defective Radiographs and Radiograph Retake			
(Unit: % in a Month)			
	Median	Interquartile Range	p-value
Retake Rate*			
MC (N= 11)	0.03	0.04	0.029
LI (N= 14)	1.00	2.18	
Rate of Suboptimal Radiographs*			
MC (N= 11)	0.00	0.01	0.001
LI (N= 10)	0.64	1.84	
(Unit: No. of Hospitals, %)			
Major Causes		Image Reject	Image Retake
Incorrect positioning			
MC		15 (88%)	12 (75%)
LI		13 (100%)	12 (100%)
Wrong imaging location			
MC		9 (53%)	9 (56%)
LI		7 (54%)	6 (50%)
Blank image <sup>a</sup>			
MC		7 (41%)	8 (50%)
LI		1 (8%)	1 (8%)
Mislabeling of right and left sides			
MC		6 (35%)	6 (38%)
LI		4 (31%)	4 (33%)
Wrong registration of patient ID			
MC		5 (29%)	6 (38%)
LI		3 (23%)	5 (42%)

The Mann-Whitney U two-tailed test was applied for the statistical analysis of image retake rate and the rate of suboptimal radiographs; the chi-square test was applied for analyzing the major causes of image reject and retake. \* Significant statistical differences ( $p < 0.050$ ) in retake rates of radiographs and defect rates of radiographs between medical centers and local institutions. <sup>‡</sup> Significant statistical differences in the production of blank images as major causes of image reject ( $p= 0.004$ ) and retake ( $p= 0.020$ ) radiographs between medical centers and local institutions. Abbreviation: MC, medical centers; LI, local institutions.

**Supplementary Table 7****Performance of Patient Satisfaction Survey for Each Radiologic Examination during the Study Year**

Survey Performance for Patient Satisfaction				
		No. of Hospitals	%	p-value
MRI				
	MC (N= 18)	14	78	0.227
	LI (N= 17)	10	59	
CT				
	MC (N= 18)	14	78	0.227
	LI (N= 17)	10	59	
Ultrasonography				
	MC (N= 16)	11	69	0.103
	LI (N= 13)	5	35	
Mammography				
	MC (N= 17)	13	77	0.452
	LI (N= 17)	11	65	
Special Procedures				
	MC (N= 17)	12	71	0.473
	LI (N= 17)	10	59	
Total*				
	MC (N= 86)	64	74	0.016
	LI (N= 81)	46	57	

The chi-square test was applied for the statistical analysis.

\* A significant statistical difference ( $p= 0.016$ ) in overall practices of survey for patient satisfaction between medical centers and local institutions. Abbreviation: MC, medical centers; LI, local institutions.

**Supplementary Table 8**

**Report Turnaround Efficiency of Medical Centers versus Local Institutions**

Turnaround Times (The Time for the Images to be Available to the Radiologist to Write a Final Report)					
		Total No. of Hospitals	(Unit: Days [mean±SD])		
			Inpatients	EMS Patients	Outpatients
<b>MRI</b>					
	MC	18	2.15±0.82	0.67±0.43	4.72±1.81
	LI	15, 16 <sup>a</sup>	2.50±1.67	1.18±1.65	4.81±1.76
<b>CT</b>					
	MC	18	1.12±1.68	0.60±0.43	4.83±1.76
	LI	15, 16 <sup>a</sup>	2.44±1.71	1.12±1.68	4.81±1.76
<b>General Radiography</b>					
	MC	18	2.29±1.09	1.13±1.52	4.72±1.81
	LI	15, 16 <sup>a</sup>	2.75±1.57	1.39±1.72	5.25±1.57
<b>Special Procedures</b>					
	MC	18	2.21±0.85	0.70±0.41	4.83±1.76
	LI	15, 16 <sup>a</sup>	2.31±1.74	1.25±1.67	4.13±1.89

The Student t-test was applied for the analysis.

<sup>a</sup> Numbers of hospitals were 15 for the average reporting time of EMS patients and 16 for the times of both inpatients and outpatients. Abbreviation: MC, medical centers; LI, local institutions.



**Supplementary Table 9****Status of Incidents and the Review in Medical Centers versus Local Institutions**

	Median	Interquartile Range	p-value
Yearly Incident Events			
MC (N= 13)	30.00	353.50	0.624
LI (N= 13)	72.00	296.50	
Post-Incident Review and Improvement			
	No. of Hospitals	%	p-value
Incident recording			
MC (N= 17)	17	100	0.145
LI (N= 17)	15	88	
Regular review conferences*			
MC (N= 18)	16	89	0.008
LI (N= 17)	8	47	
Post-review reformation with a PDCA procedure <sup>a</sup>			
MC (N= 17)	15	88	0.106
LI (N= 17)	11	65	
Methods for improving other relevant care quality			
MC (N= 6)	5	83	0.264
LI (N= 9)	5	56	
Analyses of patients' appeals			
MC (N= 17)	15	88	0.628
LI (N= 17)	14	82	

The Mann-Whitney U test was applied for analyzing yearly incident events; the chi-square test was applied for analyzing post-incident review and improvement.

<sup>a</sup> PDCA procedure is a plan–do–check–act four-step model for carrying out a change.

\* A significant statistical difference (p= 0.008) in holding post-incident regular review conferences between medical centers and local institutions.

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