

# Evaluation of a Web-based Diagnosis Reminder System for Difficult Diagnostic Reasoning

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Abstract: A web-based diagnosis reminder system may help physicians to perform difficult diagnostic reasoning but its performance has not been evaluated in comparison to that of expert physicians. Clinical case conference was conducted using 10 difficult cases related to internal medicine. Two experienced and expert diagnosticians were invited to comprise a team. A physician assisted with a web-based diagnosis reminder system also participated. Two groups were allowed to propose three possibilities for each case immediately obtaining information on history, physical exam and simple tests. Total scores and the number of accurate diagnoses were greater in the computer-assisted physicianthan in the expert physician team. In conclusion, A web-based diagnosis reminder system can help physicians to well perform difficult diagnostic reasoningcompared to expert physicians.

Key words: Computer-aided, decision support, diagnosis reminder, diagnostic error, patient safety.

## 1. Introduction

Diagnostic error has been recognized as an important issue in patient care and innovations have been needed to reduce it. A web-based diagnostic reminder system may be a candidate as an innovative tool. Our system, the Diagnosis Reminder (DR), has been developed as such a diagnostic decision-support tool for physicians in clinics and hospitals (URL: http://60.32.120.74/examples/en/syoujou1.jsp). This web- based system is available to public as open resource and has the English language version. Users can input clinical findings from a patient as key wordsand quickly obtain a list of disease possibilities as about 20-100 diagnoses.

In a previous study [1], its usefulness has been empirically assessed by applying it to the case reports in the New England Journal of Medicine with good results.In the current study, we aimed to prove its usefulness for reminding a physician of a list for probable diagnosis in the setting of clinical conference with cases of difficult diagnosis.

## 2. Methods

Clinical conference was organized for diagnosing 10 cases which were selected from the clinical care conundrums cases of the Journal of Hospital Medicine digest book [2]. The cases are related to general internal medicine or hospital medicine. Two physicians (PGY 40 and 13) who had expertise in the diagnosis of general medicine were recruited from local medical community, Kansai area, a southwestern region of Japan, and they were considered as the expert diagnostician team. The DR system was used by author (KT, a physician) of the current study (the computer-assisted physician).

A diagnostic question for each case was asked at the timing immediately after providing history, physical exams, and simple laboratory and imaging test results. The two groups were allowed to provide maximum numbers of three diagnoses with probability ranking (most likely, 2nd likely, 3rd likely) to each case.

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Case No.     Most likely possibility     2nd likely     3rd likely     score       1     Esophagad perforation*     Mediastratis     Esophagad carcer     3       2     Scarry synchome     Cytomegalovirus infection     Tuberculosis     0       3     Whippe disease*     Coccritiodiomycosis     Ampkohosis     3       4     Hashimoto encephalopuby*     Beninsem encephalitis     Lapus crythematoxis     3       5     Thrombotic thrombocytopenic pupma     Toxis shock syndrome*     Evans synchrome     2       6     Constrictive perioditis*     Amykohosis     Tuberculosis     0       7     Ding-induced hypersensitivity syndrome     Psortasis     Yersinosis     0       9     Crow-Firkase syndrome     Multiple myeloma     Amykohosis     0       10     Amykohosis     Tuberculosis     Amskasis     0       10     Amykohosis     Tuberculosis     Amskasis     0       10     Amykohosis     Tuberculosis     Amskasis     0       10     Amykohosis     Daterculosis     NP.     3			Expert diagnostician team			
1     Esophageal perforation*     Mediasinitis     Esophageal cancer     3       2     Searry syndrome     Cytomegalovins infection     Tubercalosis     0       3     Whitple disease*     Coexcitoidomycosis     Amyloidosis     3       4     Hashimoto encephabopathy*     Braissien mesciphalitis     Lupus cythernatosus     3       5     Thrombotic thrombocytopenic purpura     Toxi: shock syndrome*     Evans syndrome     2       6     Constrictive pericacilities     Amyloidosis     Tubercalosis     0       7     Drag-induced hypersenitivity syndrome     Positisis     Yesninosis     0       8     Crow-Fakase syndrome     Multiple myckma     Agrif-related disease     0       9     Crow-Fakase syndrome     Multiple myckma     Antovickosis     0       10     Amyloidosis     Date     14     14       Computer-assisted physicinn       Case No     Most Bedy possibility     2nd Bedy     3rd Bedy     3rd Bedy       3     Whitpple disease*     N.P.     N.P.     3       4     Croutifi	Case No.	Most likely possibility	2nd likely	3rd likely	score	
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4 Hashimoto exceptalopathy* Brainstem enceptalitis Lupus erythematosus 3   5 Thrombotic thrombocytopenic purpura Toxis shock syndrome** Evans syndrome 2   6 Constrictive pericarditis* Amyloidosis Tuberculosis 0   7 Drug-induced Inpersensitivity syndrome Multiple myeloma Ig64-related disease 0   9 Crow-Fukase syndrome Multiple myeloma Amyloidosis 0   10 Amyloidosis Tuberculosis Aniskasis 0   10al Conv-Fukase syndrome Multiple myeloma Amyloidosis 0   10al Conv-Fukase syndrome Ne Ne Ne   2 Synbilis* N.P. NP. 3   2 Synbilis* N.P. NP. 3   3 Whaphe disease* N.P. NP. 3   4 Cereatizefuk tracob disease N.P. NP. 0   5 Disseminated intravascular congulation Toxis shock syndrome* Evans syndrome 2   6 Bodd Chiari syndrome* N.P. NP. 0 0   7 Antiphospholipit syndrome* NP. NP. 0   7 Antiphospholipit syndrome* NP. <t< td=""><td>3</td><td>Whipple disease*</td><td>Coccidioidomycosis</td><td>Amyloidosis</td><td>3</td></t<>	3	Whipple disease*	Coccidioidomycosis	Amyloidosis	3	
5     Thrombotic thrombocytopenic purpura     Toxic shock syndrome*     Evans syndrome     2       6     Constrictive pericardifs*     Annykiokosis     Toheradosis     3       7     Drug-induced hypersensitivity syndrome     Psoriasis     Yersiniosis     0       8     Crow-Fukase syndrome     Multiple myeloma     Ig64-related disease     0       9     Crow-Fukase syndrome     Multiple myeloma     Annykiokosis     0       10     Annykiokosis     Tubercuksis     Ansakiasis     0       Total     Computer-assisted physician     1     1     Esophageal perforation*     N.P.     3       2     Styphils*     N.P.     N.P.     3     3     Multiple disease*     N.P.     3       3     Whipple disease*     N.P.     N.P.     3     1     Evants syndrome     2       6     Bud Chiari syndrome     Antriphospholipid syndrome*     N.P.     3     3     9     Sarcoidosis     N.P.     1       7     Annykiakosis     Dermatomyositis*     N.P.     0     1	4	Hashimoto encephalopathy*	Brainstem encephalitis	Lupus erythematosus	3	
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Case No.     Most likely possibility     2nd likely     3rd likely     score       1     Esophageal perforation*     N.P.     N.P.     3       2     Syphilis*     N.P.     N.P.     3       3     Whipple disease*     N.P.     N.P.     3       4     Creutzickit/Jacob disease     N.P.     N.P.     0       5     Disseminated intravascular coagulation     Toxic shock syndrome*     Evans syndrome     2       6     Budd Chair syndrome     Antiphospholipid syndrome*     N.P.     0     7       7     Antiphospholipid syndrome*     N.P.     N.P.     3     9       9     Sarcoldosis     N.P.     N.P.     0     10       Computer-generated list of possibilities       Computer-generated list of possibilities       Computer-generated list of possibilities       Case No.     Most likely possibility     2nd likely     3rd likely     score       1     Actute pericarditis     Empyema     Esophageal perforation*     1       Computer-generat			Computer-assisted physician			
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Total   16     Computer-generated list of possibilities     Case No.   Most likely possibility   2nd likely   3rd likely   score     1   Acute pericarditis   Empyema   Esophageal perforation*   1     2   Drug-induced disease   Cutanepus lymphoma   Intravascular lymphoma   0     3   Whipple disease*   AIDS   Amyloidosis   3     4   Paraneoplastic syndrome   Drug-induced disease   Refeeding syndrome   0     5   Sepsis   Disseminated intravascular coagulation   Toxic shock syndrome*   1     6   Pulmonary embolism   Amyloidosis   Cardiomyopathy   0     7   Syphilis   Talium intoxication   Lupus erythematosus   0     8   Liver cirrhosis   Antiphospholipid syndrome*   Systemic sclerosis   2     9   Hepatocellular carcinoma*   Insulinoma   Lung cancer   3     10   Gastric cancer   Sepsis   Tuberculosis   0	10	Fulminant Streptococcal infection	N.P.	N.P.	0	
Computer-generated list of possibilitiesCase No.Most likely possibility2nd likely3rd likelyscore1Acute pericarditisEmpyemaEsophageal perforation*12Drug-induced diseaseCutanepus lymphomaIntravascular lymphoma03Whipple disease*AIDSAmyloidosis34Paraneoplastic syndromeDrug-induced diseaseRefeeding syndrome05SepsisDisseminated intravascular coagulationToxic shock syndrome*16Pulmonary embolismAmyloidosisCardiomyopathy07SyphilisTalium intoxicationLupus erythematosus08Liver cirrhosisAntiphospholipid syndrome*Systemic sclerosis29Hepatocellular carcinoma*InsulinomaLung cancer310Gastric cancerSepsisTuberculosis0	Total	1			16	
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1FunctionError index distanceFunctionFunction05SepsisDisseminated intravascular coagulationToxic shock syndrome*16Pulmonary embolismAmyloidosisCardiomyopathy07SyphilisTalium intoxicationLupus erythematosus08Liver cirrhosisAntiphospholipid syndrome*Systemic sclerosis29Hepatocellular carcinoma*InsulinomaLung cancer310Gastric cancerSepsisTuberculosis0	4	Paraneonlastic syndrome	Drug-induced disease	Refeeding syndrome	0	
6 Pulmonary embolism Amyloidosis Cardiomyopathy 0   7 Syphilis Talium intoxication Lupus erythematosus 0   8 Liver cirrhosis Antiphospholipid syndrome* Systemic sclerosis 2   9 Hepatocellular carcinoma* Insulinoma Lung cancer 3   10 Gastric cancer Sepsis Tuberculosis 0	5	Sensis	Disseminated intravascular coagulation	Toxic shock syndrome*	1	
7 Syphilis Talium intoxication Lupus erythematosus 0   8 Liver cirrhosis Antiphospholipid syndrome* Systemic sclerosis 2   9 Hepatocellular carcinoma* Insulinoma Lung cancer 3   10 Gastric cancer Sepsis Tuberculosis 0	6	Pulmonary emholism	Amyloidosis	Cardiomyonathy	0	
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10 Gastric cancer Sepsis Tuberculosis 0   Total 10 10 10 10	9	Henatocellular carcinoma*		Ling cancer	2	
Total	10	Gastric cancer	Sensis	Tuberculosis	0	
	Total		- Color	100100000	10	

Table 1 Diagnostic possibilities proposed by Expert diagnostician team, Computer-assisted physician, and Computer-generated list of possibilities.

\*Correct diagnosis. The correct diagnosis of the case 10 was Strongyloidiasis.

Scoring was conducted as follows: 3 points for making most likely diagnosis correct, 2 points for 2nd likely, and 1 point for 3rd likely.

# 3. Results

Proposed diagnoses and scoring are shown in Table 1. Total score of the expert diagnostician team was 14 points, while that of the computer-assisted physician was 16 points. The expert diagnostician team provided a total of five correct diagnoses over the 10 cases. The computer-assisted physician provided a total of six correct diagnoses over the 10 cases. Total score of the DR-generated diagnostic list without diagnostic decision by the physician was 10 points. The case number 10 (strongyloidiasis) was not proposed by two groups.

### 4. Discussion

Our results suggest that the DR system could provideuseful information by listing diagnostic possibilities to a physician. In fact, the diagnostic accuracy of the computer-assisted physician was greater than that of the expert diagnostician team. The results of the current study may indicate the preliminary evidence for its usefulness in the setting of clinical conference. However, sole use of the system without decision of a physician performed relatively poorly.

The DR system has disease knowledge database including over 2,000 diseases and 630 clinical manifestations. Our previous report [1] indicated potential usefulness for assisting diagnostic reasoning in cases selected from a major medical journal but a physician assisted with the system had been needed to show good performance comparable to that of expert diagnosticians.

In conclusion, DR systems can be considered useful for assisting good diagnostic reasoning for a physician since it performed better than a team of two expert diagnostician. Further studies are needed for validating its usefulness in diagnosing greater number of cases as well as actual clinical cases.

#### References

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