Diagnostic Reasoning by Master Clinicians: What Distinguishes Them From Their Peers?

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Abstract

Introduction: Master clinicians are a group of physicians recognized in large part for their superior diagnostic reasoning abilities. However, their reasoning skills have not been rigorously and quantitatively compared to other clinicians using a validated instrument.

Methods: We surveyed Internal Medicine physicians at the University of Iowa to identify the master clinicians. These master clinicians were administered the Diagnostic Thinking Inventory, along with an equivalent number of their peers in the general population of internists. Scores were tabulated for structure and thinking, as well as four previously identified elements of diagnostic reasoning (data acquisition, problem representation, hypothesis generation, and illness script search and selection). The 2-sample t-test was used to compare scores between the two groups.

Results: 17 master clinicians were identified, of whom 17 (100%) completed the inventory. 19 out of 25 randomly-selected internists also completed the inventory (76%). Mean total scores were 187.2 and 175.8 for the Master Clinician (MC) and the Internist (IM) groups respectively. Thinking and structure subscores were 91.5 and 95.71 for MCs, compared to 85.5 and 90.3 for IMs (p-values: 0.0783 and 0.1199, respectively). The mean data acquisition, problem representation, hypothesis generation, and illness script selection subscores for MCs were 4.46, 4.57, 4.71, and 4.46, compared to 4.13, 4.38, 4.45, and 4.13 in the IM group (p-values: 0.2077, 0.4528, 0.095, and 0.029, respectively).

Conclusions: Master Clinicians have greater proficiency in searching for and selecting illness scripts compared to their peers. There were no statistically significant differences between the other scores and subscores. These results will help to inform continuing medical education efforts to improve diagnostic reasoning.

Background

In recent years, the term “master clinician” has been used to describe physicians who have attained high levels of proficiency in a variety of skills considered essential to clinical practice and education. Although the specific definition has remained elusive, master clinicians are acknowledged to be superior diagnosticians from whom trainees can learn valuable lessons. For that reason, “Master Clinician” programs have been established at sites like the University of Iowa. This study aims to distinguish elements of diagnostic reasoning that characterize master clinicians compared to peers, using the previously validated Diagnosing Thinking Inventory.

Methods

This study was approved by the Institutional Review Board at the University of Iowa. All methods were carried out in accordance with relevant guidelines and regulations, and informed consent was obtained from all participants. The investigation was split into three parts.

First, each question in the Diagnostic Thinking Inventory was classified into one of four categories: data acquisition, problem representation, hypothesis generation, and illness script search and selection. Definitions for these four steps of diagnostic reasoning were adopted from Bowen and colleagues.⁴ The wording of each question was scrutinized independently by two investigators (BK and MS), and results were compared. Two rounds of reconciliation were pursued in order to obtain a consensus classification of these questions.

Secondly, master clinicians were identified through a survey of all Internal Medicine physicians at the University of Iowa. Inclusion criteria were permanent faculty status, appointment within the Department of Internal Medicine, and over 50% clinical effort. Exclusion criteria were adjunct or visitor status, and research or administrative effort greater than 50%. They were asked to identify which clinicians amongst themselves are considered “master clinicians” based on their diagnostic skills. Those nominated by at least five colleagues were designated as master clinicians. Once identified, they were administered the Diagnostic Thinking Inventory.

Finally, a third investigator (KF) used a random number generator to identify a sample of 25 internists not recognized as Master Clinicians who were then administered the Diagnostic Thinking Inventory.

Results were tabulated and uploaded into SAS® (SAS Institute, Cary, North Carolina). Descriptive statistics, including mean, median, and variance were calculated for the scores and subscores. The 2-sample t-test was employed to compare means between the MC and IM groups.

Results

The Diagnostic Thinking Inventory was split into the above four categories, composed of 8 to 12 questions each (Figure 1). There was agreement among the two investigators for 38 out of 41 at the first round, and 41/41 by the second round for reconciliation.

Surveys asking for the names for master clinicians were distributed to the Internal Medicine physicians (n=82), of which 78 replied (95.1%). Seventeen master clinicians were identified through this process. Twenty-five of the remaining 65 internists (38.5%) received the DTI, of which 19 completed the questionnaires (76%).

Master clinicians exhibited a higher total mean score (187.2), thinking subtotal (95.7), and structure subtotal (91.5) compared to the IM group, whose means were 175.8, 90.3, and 85.5, respectively (Figure 2). The standard deviations among Master Clinicians were lower for the total (14.6) as well as thinking and structure subtotals (8.6 and 7.1), compared to IM physicians (21.8, 11.4, and 11.8, respectively). The differences in means were not statistically significant (0.0783 for thinking and 0.1199 for structure).

When grouped by the elements of diagnostic reasoning, the Master Clinicians still had higher scores for all four elements, although this difference was statistically significant for only illness script selection, where the mean MC subscore was 4.46 (0.31), vs. 4.13 (0.53) in the IM group (p-value: 0.029). For data

acquisition, problem representation, and hypothesis generation, subscore means (and associated standard deviations) were 4.13 (standard deviation = 0.93), 4.38 (0.85), and 4.45 (0.46) for the IM group, compared to 4.46 (0.53), 4.57 (0.56), and 4.71 (0.47) for the Master Clinician group, respectively. The associated p-values were 0.2077, 0.4528, and 0.095, respectively (Table 1).

Discussion

This study demonstrates that the diagnostic approach of master clinicians may be different than their peers. Specifically, master clinicians seem to be more proficient in searching and selecting for illness scripts. Illness Scripts are defined as “conceptual models, such as groups of diseases [or] representational memories of specific syndromes.”⁴ Illness scripts are the result of experience and deliberate practice, suggesting that peer-recognized master clinicians continuously hone their understanding of key discriminating features, risk factors, and pathophysiologic mechanisms that define illness scripts.⁵ This helps to explain findings from previously published literature that expert diagnosticians are able to diagnose conditions using relatively few pieces of clinical data.⁶ It also reinforces the observations that master clinicians improve their diagnostic skills through continuous reflection.^{7,8}

Interestingly, there was no statistically significant difference in scores among the other elements of diagnostic reasoning. Hypothesis generation and data acquisition appeared to approach significance but were not significant at the $p=0.05$ significance level. Of note, illness script selection had the lowest score in both groups, suggesting that this is a more advanced skill to master, compared to the other three.

Likewise, there was no statistically significant difference between the ‘structure’ and ‘knowledge’ subscores in the Diagnostic Thinking Inventory, which have been the two traditional categories used in prior analyses. Therefore, based on our analysis, it may be more appropriate to use this modified four-category breakdown to characterize the diagnostic reasoning process, using the same questions.

Strengths of our study include a robust prospective study design with high participation of staff physicians, including all of the identified master clinicians. The Diagnostic Thinking Instrument has been validated as a tool to identify diagnostic reasoning skills.³ The methodology by which the investigators categorized the questions was predetermined based on established definitions and criteria, enabling high rates of agreement after two rounds of reconciliation.

However, there are some notable limitations. The Diagnostic Thinking Inventory is a self-administered test, so it is subject to social desirability biases. Also, this study was only conducted at one institution, the University of Iowa. However, the mean scores for the master clinician group have been higher than previously reported numbers for physicians in general, suggesting that they truly possess better diagnostic reasoning skills.⁸ Finally, the numbers are relatively modest (36 total), which may explain why some of the other elements of diagnostic reasoning did not demonstrate statistical significance. While more participants may reduce the standard deviations, it is unclear how the means would change,

particularly if the Master Clinician group were expanded. Lastly, the DTI was not designed to identify what aspects of illness script search and selection are most discriminating. Regardless, our data suggest that, in these four steps of diagnostic reasoning, the ability to search and select for illness scripts is the most specific marker of being a peer-recognized master clinician.

Conclusions

Master clinicians are recognized by peers in large part due to their diagnostic reasoning abilities. Compared to their peers in the general population of internists, master clinicians have greater proficiency in searching for and selecting illness scripts. This aligns well with prior observations that master clinicians engage in deliberate practice to build upon their prior experiences. Replication of these findings at other institutions may bolster such conclusions. Furthermore, these findings inform the development of master clinician and continuing medical education programs at other institutions.

Abbreviations

DTI: Diagnostic Thinking Inventory

IM: Internal Medicine

MC: Master Clinician

Declarations

Ethics approval and consent to participate: This study was approved by the University of Iowa Institutional Review Board

-Consent for publication: Not applicable

-Availability of data and material: The datasets that support the findings of this study are available from the corresponding author upon reasonable request

-Competing interests: The authors declare they have no competing interests.

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-Authors' contributions: BK, KF, and MS, contributed towards developing the research design. BK was responsible for data collection and KF was responsible for data analysis. KF prepared Figures 1 and 2. BK and MLS prepared Table 1. BK, KF, MLS, and MS contributed towards writing the main manuscript text. All authors reviewed the manuscript.

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References

1. Glick JH, Mulhern V, Olthoff KM, et al. The Academy of Master Clinicians: Recognition of Clinical Excellence Within an Academic Medical Center. Acad Med. 2017 Aug 8.

2. Brush JE Jr, Sherbino J, Norman GR. How Expert Clinicians Intuitively Recognize a Medical Diagnosis. Am J Med. 2017 Jun;130(6):629-634. doi: 10.1016/j.amjmed.2017.01.045.

3. Bordage G, Grant J, Marsden P. Quantitative assessment of diagnostic ability. Med Educ. 1990 Sep;24(5):413-25.

4. Bowen JL. Educational strategies to promote clinical diagnostic reasoning. N Engl J Med. 2006 Nov 23;355(21):2217-25.

5. Ilgen JS, Bowen JL, Eva KW. Reflecting upon reflection in diagnostic reasoning. Acad Med. 2014 Sep;89(9):1195-6.

6. Groves M, O'Rourke P, Alexander H. The clinical reasoning characteristics of diagnostic experts. Med Teach. 2003 May;25(3):308-13.

7. Lubarsky S, Dory V, Audétat MC, et al. Using script theory to cultivate illness script formation and clinical reasoning in health professions education. Can Med Educ J. 2015 Dec 11;6(2):e61-70.

8. Cunha BA. The Master Clinician's Approach to Diagnostic Reasoning. Am J Med. 2017 Jan;130(1):5-7.

Tables

Table 1: Diagnostic Thinking Inventory Item Classification, Mean Values, and Standard Deviations

The only element of diagnostic reasoning in which there is a statistically significant difference between master clinicians (MC) and other internists (IM) is 'Illness Script Search and Selection.'

Element of Diagnostic Reasoning	Definition	Number of Pertinent Items	IM Mean	MC Mean	P-value
Data Acquisition	Elements of the history, the findings on physical examination, and the results of laboratory testing and imaging studies ³	10	4.13 (0.93)	4.46 (0.53)	0.2077
Problem Representation	A one-sentence summary defining the specific case in abstract terms ... illustrates the transformation of patient-specific details into abstract terms ³	8	4.38 (0.85)	4.57 (0.56)	0.4528
Hypothesis Generation	The defining and discriminating clinical features of a disease, condition, or syndrome ³	14	4.45 (0.46)	4.71 (0.47)	0.095
Illness Script Search and Selection	Conceptual models, such as groups of diseases, whereas others are representational memories of specific syndromes ³	9	4.13 (0.52)	4.46 (0.31)	0.029
Structure	Availability of knowledge, stored in memory, during the diagnostic process. It is assumed that availability is a direct consequence of adequate knowledge organization ⁷	20	90.3 (11.4)	95.71 (8.6)	0.1199
Thinking	The use of a variety of thinking means or processes that can be applied during the diagnostic process ⁷	21	85.5 (11.8)	91.5 (7.1)	0.0783
Total		41	175.8 (21.8)	187.2 (14.6)	.0766

Figures

Figure 1

Distribution of Diagnostic Thinking Inventory Subscores Based on the Elements of Diagnostic Reasoning

Box plots of the Diagnostic Thinking Inventory subscores based on the elements of diagnostic reasoning show the minimum, first quartile, median, third quartile, and maximum values for both the Internal Medicine and Master Clinician groups.

Figure 2

Distribution of Diagnostic Thinking Inventory Total Scores, Thinking Subscores, and Structure Subscores
Box plots of the Diagnostic Thinking Inventory total composite scores, thinking subscores, and structure subscores show the minimum, first quartile, median, third quartile, and maximum values for both the Internal Medicine and Master Clinician groups.