Niger J Paediatr 2020; 47 (2):79 – 84

ORIGINAL

Yarhere IE
Briggs DC
Okechukwu C
Ogbonnaa-Njoku C

Comparative analyses of knowledge, attitude and practice of medical undergraduates and early career doctors about the use of clinical reasoning as a tool for medical diagnosis and management

DOI:http://dx.doi.org/10.4314/njp.v47i2.5

Accepted: 6th April 2020

Yarhere, IE, (✉)
Briggs DC, Okechukwu C
Ogbonnaa-Njoku C
Department of Paediatrics,
University of Port Harcourt
Teaching Hospital, Nigeria
Email:
iroro.yarhere@uniport.edu.ng

Abstract*: Introduction:* Developing the skills of clinical reasoning is a tedious process, especially for the novice learner and requires practice. The clinical reasoning skill is a cognitive process of systematic clinical decision making needed to reduce diagnostic errors. A clinical reasoning tool for diagnosis using the Bloom's taxonomy of critical thinking has been in use in the Paediatrics Department of the University of Port Harcourt. However, little is known about the difficulties encountered by trainees (medical students and early career doctors) while using the tool during daily clinical clerkship. We aimed to determine aspects of the clinical reasoning process trainees find difficult and ways to make this easier.

Methods: A well-structured, pretested questionnaire was administered to 67 medical undergraduates and 99 early career medical doctors which assessed responses to the definition of clinical reasoning, matching Bloom's taxonomy hierarchy with steps in clinical reasoning, functional and structural abnormalities and attitudes towards the use of the clinical reasoning tool. The Likert 5 point scale tool was used to assess attitudes and practice difficulties during the use of the tool. The differences in responses were tested for significance using Student's T test, and Chi squared test, with p values <0.05 as significant.

Results: Of the 166 respondents analysed, 103 (62%) got the correct definition of clinical reasoning with early career doctors having a higher proportion of correct respondents, $\chi 2 = 4.59$, $p = 0.032$. Specific areas of difficulties identified were with making clinical diagnosis in 50 (30.1%) and pathologic diagnosis (es) in 38 (22.9%). Ninety-nine (59.6%) responded that clinical reasoning was time consuming and 42 (25.3%) thought it was difficult to practice in a busy clinic. One hundred and six (64.1%) respondents suggested a view of basic clinical studies before starting clinical practice in order to improve clinical reasoning.

Conclusion/Recommendation: Making clinical diagnosis is difficult for the clinical trainee while using the clinical reasoning tool, therefore the clinical teacher should help trainees move from one cognitive level to the next until the trainee can create logical conclusions from information gathered following clerking.

Keywords: Clinical reasoning, critical thinking, medical students, interns

Introduction

Clinical reasoning (CR) is a process by which a clinician considers the patient's situation, collects clues, processes the information, comes to an understanding of a patient's problem, plans and carries out interventions, evaluates outcomes and learns from the entire process.[1,2] CR is a concept that lays emphasis on the cognitive processes used by a clinician as diagnostic reasoning begins while gathering information that can be used in forming management strategies for the patient.[3] CR has been in existence from as early as the practice of medicine in the Hippocrates era and had been modified as understanding of the concept continued to increase.[4] Effective teaching of CR however has challenges due to the likely' retrospective bias' teaching problem which

arguably reduces the effectiveness in problem-solving and the fact that it may not be properly taught or accurately assessed in an authentic ever-changing context when learners have to deal with real patients.[5,6] It is therefore suggested that teaching CR should follow a step-by-step approach and emphasis should be on formulating an accurate list of comprehensive differential diagnoses.[4]

Bloom's taxonomy of cognitive domain identifies six dynamic levels of cognition and classifies them according to increasing complexity, from knowledge as the lowest through comprehension, application, analysis, synthesis and evaluation as the highest level.[7] These cognitive domains if grasped and applied by clinical teachers and students has been proposed to ease both the awareness and understanding of thought processes involved in clinical decision making needed to reduce diagnostic errors.[7] Hence, for the physician-in-training, learning the skill and teaching this is usually more important than arriving at a diagnosis.[7] This is because the process by which a diagnosis is arrived at, gives a more distinct analysis of the physician's thought processes. Clinical reasoning helps one integrate basic medical and scientific knowledge with clinical knowledge in solving medical issues. One must appreciate that the theoretical background of basic medical science of physiology, anatomy, biochemistry, pathology and pharmacology should be well above average before signing on to use the clinical reasoning tool effectively.

The process of CR has been on going in the Department of Paediatrics, University of Port Harcourt for over 10 years now using a standardised CR tool but there is little consensus in some aspects of the process. Here, the user gathers information of symptoms, including presenting complaints, review of systems and other important aspects of history, then decides which systems are involved in the disease process. The signs help buttress the systemic involvement(s) and the particular tissue or organ abnormality (ies) presenting with the pathological process(es) e.g. trauma, dysgenesis, inflammation, deranged metabolism etc. Being able to determine the abnormalities in organ and tissue helps in arriving at a clinical diagnosis from which the differential pathologic diagnosis can be determined. This particular process helps to remove common cognitive biases including premature closure, anchoring and availability that can influence reasoning and wrong diagnosis of the patient's condition.[8]

Clinical skills of interpreting physical examination findings with respect to disease process complete the clinical reasoning skill of information gathering. Analysing the information, synthesizing and evaluation, and creating clinical diagnosis from first principles makes it difficult for errors to occur.[7] Documented errors in the clinical reasoning process since its inception include inadequate knowledge, faulty data gathering, faulty data processing, and faulty metacognition.[9] Based on these difficulties, the authors embarked on this project to understand the base for this lack of consensus with the medical undergraduates and the early career doctors. The aim of this study was to determine the aspects of the clinical reasoning process that trainees (medical undergraduates and early career doctors) find difficult as taught and practiced today and ways to make this easier.

Methods

This was a descriptive and comparative study of knowledge, attitude and practice of clinical reasoning between the final year medical undergraduates and early career doctors (intending interns) at the University of Port Harcourt. A pre-tested well-structured self-administered questionnaire was distributed to final year medical undergraduates in their classroom before the commencement of one of their class tests. All 67 final year medical undergraduates in the class filled and submitted the questionnaire within the time stipulated i.e. 45 minutes. The same questionnaire was administered to early career doctors who were shortlisted for the written interview to start internship in University of Port Harcourt Teaching Hospital.

Ethical considerations

The research ethics committee of the University of Port Harcourt Teaching Hospital granted ethical approval before commencement of the study (UPTH/ADM/90/S.II/VOL.XI/903). Informed verbal consent was also obtained from participants before they filled the questionnaire.

Survey development and structure

The questionnaire tested simple knowledge of definition, domains of clinical reasoning, application of Bloom's taxonomy with the domains of clinical reasoning, and multiple-choice options of structural and functional abnormalities. Thereafter, the perceived difficulties experienced by final year medical undergraduates and interns in navigating the process of clinical reasoning were explored. We then asked the responders to provide suggestions on ways to improve the process through multiple choices and open-end response.

Scoring system

Each item correctly matched with the domain of clinical reasoning and Bloom's taxonomy was marked as correct while incorrectly matched options were marked wrong. They were scored and converted to percentages (fractions) and scores less than 50% were considered poor.

To assess attitude towards utilisation of clinical reasoning and the difficulties encountered, responses were graded on a Likert scale of "strongly agree", "agree", (considered as positive) "neutral", "disagree" and "strongly disagree" (considered as negative) for the particular questions raised.

Data was analysed using SPSS version 24 for IBM with

categorical variables expressed as means and standard deviations while qualitative variables were expressed in proportions. Mean and proportional differences between medical students and early career doctors, sociodemographic characteristics of respondents were compared across knowledge and attitudes using Student's t test and Chi squared tests respectively. For all test, a p value < 0.05 was considered statistically significant.

Results

Demographic characteristics

One hundred and thirty one early career doctors eligible for the study were given the questionnaire but only 99 completed the survey at the end of the exercise, giving a response rate of 75.6%. All 67 final year medical undergraduates completed their questionnaires. There were more males, 102 (61.4%) than females 64 (38.6%) and the difference was significant, $\chi 2 = 8.69$, $p = 0.003$. Majority of the respondents 161 (97.0%) had formal training in clinical reasoning during their medical education but only a few, 6 (3.6%)non University of Port Harcourt graduate did not receive any formal training. The average duration spent in medical school was 7.27 ±1.03years and there was no statistical difference in duration of studies between early career doctors and final year medical undergraduates, t – 2.12 p = 0.121. More than half the respondents 95 (57.2%) had references in their basic medical education (anatomy, physiology and biochemistry) and this was equally distributed among interns and final year medical undergraduates, $\chi 2 = 2.36$, $p = 0.596$, see table 1.

Table 1: Demographic characteristics of interns and students

Variable	Interns (N=99)	Final year (N=67)	Total (N=166)	p value
Demographic and characteristics				
Age —years				
Mean	28	26	27	0.73
Female sex—no.(%)	39(39.4)	25(37.3)	64(38.6)	0.787
Formal training in Clinical reasoning in medical school no. (%)	94(94.9)	67(100)	161(97.0)	0.067
Duration of medical school (mean) SD	7.37±1.21	7.12±0.87	7.27±1.03	0.121
References in basic medical sciences no. (%)	55(55.6)	40(59.7)	95(57.2)	0.596
Reference in pathology and pharmacology no. (%)	48(48.5)	37(50.7)	82(49.4)	0.775

Knowledge

One hundred and three (62%) of the respondents got the correct definition of clinical reasoning as practiced with the early career doctors, having a higher proportion of correct respondents, $\chi 2 = 4.59$, $p = 0.032$. The mean scores of respondents when asked the main domains in clinical reasoning was 0.46±0.47 and the difference in scores between the early career doctors and final year medical undergraduates was not significant, t = 2.44, p = 0.808. Many respondents did not give correct responses to the Bloom's taxonomy of critical thinking and thus could not apply them to the domains of clinical reasoning so the mean score was 0.15±0.17 but there was no difference between the two groups, t = 1.88, p = 0.237. However, the respondents had a mean score of 0.51±0.35 when asked to pick out functional abnormalities from a list of options and 35% ± 32% for structural abnormalities.

Further scrutiny of the data revealed that early career doctors that graduated from University of Port Harcourt had mean scores above average 0.58±0.318 for (structural abnormalities), and 0.54±0.35for (functional abnormalities). Their scores were significantly higher than those early career doctors who did not graduate from the University of Port Harcourt, t = 2.2, p = 0.027 for structural abnormalities, and t = 2.87, p = 0.005 for functional abnormalities. However, more non University of Port Harcourt graduates were able to identify abnormalities that could also be clinical diagnoses though the difference in scores was not significant, t = 0.952, p = 0.361, see table 2

Table 2: Comparison of knowledge of clinical reasoning among students and interns

Knowledge	Interns (N = 99)	Final year (67)	Total (N = 166)	p value
What is clinical reasoning? Correct response no. (%)	68(68.7)	35(52.2)	103(62.0)	0.032*
Domains in clinical reasoning mean (SD)	0.46± 0.49	0.48±0.44	0.46±0.47	0.808
Domains of clinical reasoning matched with Bloom's taxonomy of critical thinking, mean (SD)	0.14± 0.18	17%± 18%	0.15%±0.17	0.237
Correct response functional abnormalities—mean (SD)	0.57± 0.32	0.53 ± 0.33	0.51± 0.35	0.380
Correct response structural abnormalities—mean (SD)	0.53± 0.34	0.48 ± 0.36	0.56± 0.33	0.441
Which structural / functional abnormality is a clinical diagnosis? mean (SD)	0.33± 0.32	0.38± 0.33	0.35± 0.32	0.326

Attitude

While 146 respondents (88.0%) agreed clinical reasoning was important in clinical practice, 75 (45.2%) believed that having an average grasp of basic medical science was enough to practice clinical reasoning effectively and an almost equal proportion78 (47.0%) believed it was a difficult process to practice. Forty-two respondents (25.3%) agreed that clinical reasoning was difficult in a busy clinic with 95 (57.2%) disagreeing to that assertion. The difference in distribution of early career doctors and students who agreed that undertaking

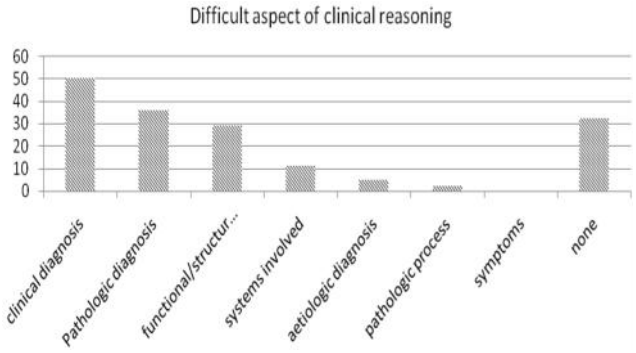
this task in a busy clinic was difficult, was not significant,$\chi 2 = 0.636$, $p = 0.728$.

More than half the respondents 99 (59.6%) agreed that clinical reasoning was time consuming and though the proportion was more within the final year students, the difference was not significant, $\chi 2 = 0.883$, $p = 0.643$. Some respondents, 50 (30.1%) thought that making a clinical diagnosis during the clinical reasoning process was the most difficult aspect, while recognizing symptoms and signs 1 (0.6%) was the least difficult, fig 1.

Table 3: Perceived attitude of respondents towards clinical reasoning and the difficulties encountered

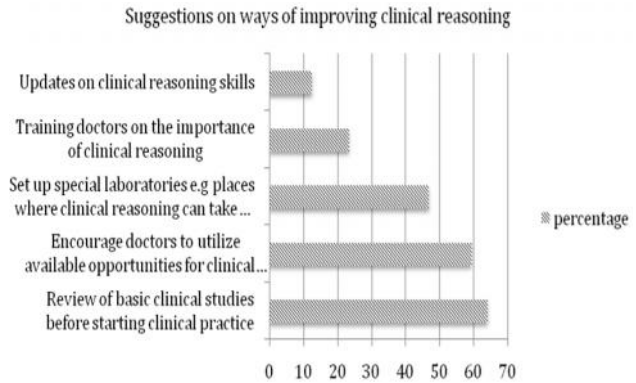
Attitude	Interns (N = 99)	Final year (67)	Total (N = 166)	p value
Clinical reasoning is important in medical practice agree no. (%)	88 (88.9)	58(86.6)	146(88.0)	0.880
Having an average grasp of basic medical science is enough for clinical reasoning agree no. (%)	43(43.4)	32 (47.8)	75 (45.2)	0.745
Clinical reasoning is difficult to practice in a busy clinic agree no. (%)	27 (27.3)	15 (22.4)	42 (25.3)	0.728
Clinical reasoning is time consuming agree no. (%)	58 (58.6)	41 (61.2)	99 (59.6)	0.643

Fig 1: Frequency distribution of difficult aspects of clinical reasoning as perceived by respondents



Many respondents (50) believed making clinical diagnosis was the most difficult aspect of clinical reasoning followed by pathologic diagnosis and functional/ structural abnormalities

Fig 2: Respondents suggestions on ways of improving clinical reasoning



Discussion

The clinical reasoning tool practiced in paediatric of University of Port Harcourt and its Teaching Hospital was developed from the work of one of its professors who made attempt to utilize the Bloom's classification scheme to arrive at diagnosis going through a process of analytic principles.[7] The alternative (non-analytic) principle of reaching a diagnosis is usually instinctive and borne out of "expert" practice and experience. Non-analytic principle is fast, acts in the subconscious and usually involuntary with low effort.[10] However, the medical undergraduate or newly qualified doctor does not have this expertise or experience and thus will need to go through a process that makes clinical diagnosis accurate bringing to bear, the knowledge and application of basic medical and clinical science. As interesting as this tool is, early career doctors, did not have the opportunity of going through it in medical school and this is understandable as many are not exposed to the philosophy of critical thinking early in their educational careers. Many students are taught according to systems and thus their knowledge and comprehension will be organized in that manner when attempting to make diagnosis, not realizing that clinical problems need system analysis and evaluation at the same time.[9] Clinical educators must be teachers and clinicians at the same time, and since their primary occupation is geared towards the patient, they will rather go through the fast convenient method to arrive at their diagnosis.[11]

More than half the study population had reference in the basic medical sciences, and nearly half had reference in pathology and pharmacology, which simply means they could not get above average scores in their first attempt at the examination. It is at this stage the teacher realizes the reason clinical reasoning in clinical posting for medical undergraduates and early career doctors will be slow, and possibly difficult. About 68% of the respondents gave accurate definition of clinical reasoning, but they could not match the domains of clinical reasoning with the Bloom's taxonomy of critical thinking. This is a reflection of the lack of philosophical training of students by their teachers or facilitators of learning who are occupied with clinical skills of system examination, disease diagnosis and treatment of management of patients.[9,11,12] Respondents were able to identify abnormalities presented to them with average scores, but could not make or recognize accurate clinical diagnoses from these abnormalities reflecting inability to analyse patterns and evaluate after applying their knowledge and comprehension to the information that was given to them.

Even though a large proportion of respondents agreed that clinical reasoning is important in medical practice, it was obvious that few of them used this tool considering the difficulties they expressed. No doubt, for the novice student and inexperienced intern, using this tool will be time consuming as expressed by about 60% of the respondents. This is agreed in the medical teaching community and that is why many still use the intuitive pat-

tern of arriving at clinical diagnosis.[3,11] Again this is understandable, as the respondents believed that having just an average grasp of basic medical science could help them navigate the process of clinical reasoning and this is a common problem with clinical reasoning.[11] The onus is on the teacher or facilitator of learning to help the student improve his comprehension time, in the first instance and then analyse, synthesize and evaluate relationships of clinical information within the shortest possible time. Many experts have the ability to use the dual process (intuitive and analytic) effectively with each concept coming into play at different times of their clerkship.[3] When the student has been able to successfully use either of these processes over time, he will start creating hypothesis that can be tested and answered using tools he will generate.

Respondents can easily recognize signs and symptoms, pathologic processes, and to some extent, the system involved the patients' pathology. These are all within the realm of knowledge, comprehension, and application. However, more respondents agreed that making clinical diagnosis and recognizing body system abnormalities were difficult for them. It is possible to have symptoms that are attributable to different systems with the simple example of body oedema or swelling which can be caused by cardiovascular, digestive or genitourinary systems pathologies. Some medical undergraduates will need to undergo series of practice sessions to get a grasp of this concept and feel comfortable using the tool during the course of their training. Recognising that this can be a potential pitfall for the learner, a clinical teacher can help the learner go through the process from first principles gathering the information, highlighting the discriminating features and weighing these to draw conclusions.[12-14] It is at this point a medical undergraduate will differentiate between anaemic heart failure of fever, cough, fast breathing, crepitation and paleness, from bronchopneumonia because he has identified the haematologic system as the primary system involved and cardiovascular as the secondary system, so that the crepitation heard is that of pulmonary oedema, rather than alveolar congestion.

Clinical diagnosis is a final conclusion of all abnormalities presenting in the patient at the bedside or clinic without having the hindsight of investigations and their results. It is easy to make diagnosis of heart failure, anaemic or congestive at this stage, but the pathology causing the heart failure will need laboratory testing like electrocardiography, echocardiographyor a Complete blood count. Students having difficulty with this stage is possibly because they have not been able to create diagnosis from abnormalities and small group case based scenarios can be used to help them through this difficulty. This should be incorporated into curriculum from the beginning of the clinical programme to help improve their knowledge, competence and confidence before they graduate from medical school.[15]

Not many respondents believed that update courses on clinical reasoning was needed, but several thought a review of basic medical courses before clinical postings started was necessary to improve the utility of clinical reasoning. This is different from the feedback responses from the workshop organized by Weinstein et al,[8] where respondents and participants believed that more time for case discussions, and debrief, refinement of instructions to approach cases could improve their skills. Quite a number also believed that encouraging medical doctors to utilize all opportunities for clinical reasoning will help them improve their skills and this supposes that during their clinical postings, not many doctors or teachers use this tool in training the students.[7,10,13] Many early career doctors were possibly taught to arrive at diagnosis in the intuitive manner as this is fast and convenient but many medical diagnostic errors are as a result of this processing pathway, which lead to premature conclusion of diagnosis.[3] It will also mean that not many teachers believe in this structured pathway of arriving at diagnosis but for the inexperienced, this should be the standard and evaluation methods must also be standardized.[16]

The strength of our study is that it highlights the challenges encountered by medical undergraduates and early career doctors who were exposed to a clinical reasoning tool and provides suggestions to improve clinical reasoning from the trainees' perspective. This study is however limited by the non-random assignment of respondents, high non-response rate among the early career doctors and study was conducted in one training centre, hence our findings should be interpreted cautiously as it may not be generalizable. We are aware that some of the respondents may not have been familiar with the clinical reasoning tool used in the University of Port Harcourt. The conceptual frame work, therefore could be enriched by comparing clinical reasoning among respondents familiar with the tool and among similar cadre of clinical trainees in different training centres.

Conclusion

In conclusion, our findings suggest that the clinical teacher has to help the clinical-trainee (medical undergraduate and early career doctor) move from one cognitive level to the next according to expectations and developmental strides until the trainee can create logical conclusions from information gathered following clerking. Applying the clinical reasoning tool to all discipline of medicine including the surgical fields will be the line of future research in medical practice.

Conflict of interest: None
Funding: None

Acknowledgement

The authors appreciate the efforts of Dr. Abuwa Chidinma and Dr. Nnaemeka for assisting in distributing the questionnaires and retrieving same from the respondents.

References

1. Kraischsk M and Anthony M. Benefits and outcomes of staff nurses' participation in decision -making. *J Nursing Administration. 2001;31(1):16-23.*
2. Lauri S, Salantera S, Chalmers K, Ekman S, Kim H, Hesook S, et al. An exploratory study of clinical decision-making in five countries. *Image-J nursing Scholarship. 2001;33(1):83-90.*
3. Pelaccia TTJ, Triby E, Charlin B. An analysis of clinical reasoning through a recent and comprehensive approach: the dual-process theory. *Med Edu Online. 2011;16:5890:1 - 9.*
4. Custers EJFM. Training Clinical Reasoning: Histotical and Theoretical Background. In: ten Cate O, Custers E, Durning S. (eds) Principles and Practice of case-based Clinical Reasoning Education. Innovation and Change in Professional Education. 2018;15. Doi:10.1007/978 -3-319-64828-6_2.
5. Kassirer JP. Teaching clinical reasoning: Case-based and coached. *Academic Medicine. 2010;85(7):1118-1124.*
6. van Merrienboer JJG and Sweller J. Cognitive load theory in health professional education: Design principles and strategies. *Medical Education. 2010;44(1):85-93*
7. Nkanginieme KEO. Clinical Diagnosis as a Dynamic Cognitive Process: Application of Bloom's Taxonomy for Educational Objectives in the Cognitive Domain. *Med Educ Online. 1997;2:1 - 6.*
8. Weinstein A, Gupta S, Pinto-Powell R, Jackson J, Appel J, Roussel D, Daniel M. Diagnosing and remediating clinical reasoning difficulties: A faculty development workshop. *MedEdPortal 2017:13;1- 5*
9. Amey L Donald KJ, Teodorczuk A. Teaching clinical reasoning to medical students. *British J Hosp Med. 2017;78:399-401.*
10. Gay S BM, McKinley R. Teaching Clinical reasoning to medical students. *Clinical Teacher. 2013;10:308 -3012.*
11. Aude´tat MC LS, Sanche G, Be´I¨Que C, Fon NC, Blais J, Charlin B. Clinical reasoning difficulties: A taxonomy for clinical teachers. *Med Teach. 2012; e1 - e6.*
12. Aude´tat MC LS, Dory V, Charlin B, Nendaz M. Diagnosis and management of clinical reasoning difficulties: Part I. Clinical reasoning supervision and educational diagnosis. *Med Teach. 20171 - 5.*
13. Bowen JL. Educational strategies to promote clinical diagnostic reasoning. *N Eng J Med. 2006;355:2217 - 25.*
14. Aude´tat MC LS, Dory V, Charlin B, Nendaz M. Diagnosis and management of clinical reasoning difficulties: Part II. Clinical reasoning difficulties: Management and remediation strategies. *Med Teach. 2017*
15. Levin M, Cennimo D, Chen S, Lamba S. Teaching clinical reasoning to medical students: a case-based illness script worksheet approach. *MedEdPortal 2016:12; 1-7*
16. Nouh T MB, Gagnon R, Reid S, Leslie K, Pace D, Pitt D, Walker R, Schiller D, et al. The script concordance test as a measure of clinical reasoning: a national validation study. *Am J Surg. 2012;203:530 - 534.*