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Teaching Hypothesis-Driven History taking at the Bedside: a qualitative study of perspectives, possibilities and precautions

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Abstract

Background

Diagnostic error has a significant impact on patient safety and contributes to harm globally. It is therefore unsurprising that, recently, there has been appreciation that clinical reasoning must be explicitly taught in undergraduate medical training, with diagnostics and clinical reasoning being a key outcome for graduates worldwide. Currently, how best to integrate clinical reasoning into undergraduate medical curricula has not been well explored. This study explores medical students' perceptions of hypothesis-driven history (HDH) taking in the context of bedside teaching, with the aim of informing when and how such approaches might be optimally introduced.

Methods

We used a qualitative, constructivist approach to explore medical students' understanding of HDH, history taking in general, and how it could be taught. A bedside teaching model designed to teach HDH was created and delivered to undergraduate medical students from the University of Glasgow. Focus groups were then conducted, transcribed, and thematically analysed using Braun and Clarke's approach.

Results

Two themes, each with three subthemes, were developed. The first theme reflected a re-evaluation of the purpose of history taking, with students describing it as a checklist-driven process of data collection, separate from diagnostic reasoning. The second theme captured the potential for hypothesis-driven history teaching amid pressures and constraints, highlighting both its benefits for clinical reasoning and efficiency, and the cognitive challenges and tensions with assessment expectations that limited its adoption.

Conclusions

The bedside teaching model challenged students' preconceptions of history taking, and encouraged re-evaluation of these going forward, consistent with Piaget's cognitive constructivism. Participants recognised the utility of HDH for clinical practice, but worried about its misalignment with medical school examinations. The cognitive burden expressed by students can be interpreted through the lens of cognitive load theory, particularly with respect to germane load. As such, there are clear perceived benefits of teaching HDH taking to undergraduate medical students, but careful consideration of when and how to implement this teaching is required, needing further research.

Background

The World Health Organisation states that diagnostic error has a significant impact on patient safety and contributes to harm globally (1). Diagnostic error is complex and multi-factorial, but there is growing recognition that cognitive error is a key component of errors (2, 3). Despite this, the importance of clinical reasoning has historically been underappreciated in attempts to improve patient safety (4).

History taking is a vital tool for diagnosis, accurate management plans, and patient safety (5). Research has consistently shown a hypothesis-driven approach to history taking leads to better diagnostic accuracy (6) and more sound clinical reasoning (7, 8). It is unsurprising, therefore, that history taking, diagnosis and clinical reasoning are key outcomes for physicians and medical students around the world (9, 10).

More specifically, the UK Clinical Reasoning in Medical Education Group suggests that medical graduates should be proficient in hypothesis-driven history taking (4). However, how best to teach hypothesis-driven history (HDH), and clinical reasoning more generally, is difficult to determine given the various components involved, including: ensuring sufficient clinical knowledge; practising efficient communication of medical concepts; avoiding cognitive biasing; and processing information coherently and accurately (11). Clinical reasoning teaching has thus far been focused on case discussions, creating flowcharts, utilising peer learning, and probing with ‘what if’ questions (12). Beyond this, models such as the one-minute preceptor and SNAPPS have been used to discuss cases with a focus on clinical reasoning (13, 14). However, to our knowledge, there are no current models of bedside teaching for hypothesis-driven clinical reasoning concepts.

Additionally, while expert opinion has suggested HDH is the ideal approach for undergraduate students, the feasibility of this from a student perspective has not been explored. Some research has indicated students have passively learned HDH from role models as part of a ‘hidden curriculum’ (15, 16) but none so far has looked at how students respond to dedicated, explicit teaching of HDH.

Bedside teaching has long been a widely used method in medical education, despite a decline in its use over time, and is effective for teaching history-taking and examination (17). It is particularly effective when a structured approach is used (18). Despite this, guidance on how to perform bedside teaching is lacking (17). Those models which do exist, such as the Cox model, the Three Domains model, and the MiPLAN model, agree the encounter should have three phases: before the bedside, the bedside encounter, and a debrief afterward (19–21).

In this study, we aimed to answer the question:

What are senior medical students’ perceptions of hypothesis-driven history teaching at the bedside within the current undergraduate curriculum?

Methods

Study Design

We used a qualitative, constructivist approach to explore medical students' perceptions of HDH, history taking in general, and how it could be taught. Focus groups were used to explore students' experience of the bedside teaching session and how they felt this aligned with their previous experiences of history taking.

Intervention

We utilised a novel bedside teaching model with three phases, aligned with previously mentioned models of bedside teaching (19–21). The model is described below and shown in more detail in Additional File 1.

Pre-brief – Students viewed a short, recorded presentation outlining the principles of HDH taking. They were given the patient's presenting complaint and engaged in a facilitated discussion to generate differential diagnoses and consider how targeted questioning could narrow these down. Students were allocated roles:

- *History taker* – tasked with taking the patient's history in a hypothesis-driven manner.
- *Question recorder* – recorded every question asked.
- *Differential tracker(s)* – recorded the differentials discussed and marked diagnoses as "ruled out" during the history.

Bedside history taking – The history taker conducted the interview, while the facilitator prompted reflection (e.g., "Tell me why you're asking that"). The history taker could consult peers to review remaining differentials and adapt questioning. When only three differentials remained, the history concluded.

Debrief – Students discussed their experiences, mapped remaining differentials onto a Venn diagram to visualise overlapping and distinguishing features, and developed a diagnostic plan collaboratively.

Each student took part in two bedside teaching sessions, facilitated by one member of the research team, each lasting approximately one hour. Group sizes ranged from 3 to 6 and the bedside teaching patients had a range of presenting complaints including chest pain, shortness of breath, and collapse.

Participants

Undergraduate medical students in their final clinical year from the University of Glasgow, undertaking senior medical placement in hospitals in NHS Lanarkshire and NHS Greater Glasgow and Clyde were eligible to participate. These students were purposively selected as they had experience of history-taking teaching, bedside teaching, and were approaching clinical practice. This made them suitable for reflection on the teaching of HDH on clinical placement.

Recruitment

All eligible participants were emailed, as part of the induction to placement, informing them of the study with a participant information sheet. Students who volunteered to participate gave written consent to be involved in the study. Participation in the study did not influence clinical placements or assessments.

Data Collection

Following the second teaching session, participants participated in a semi-structured focus group. The team created the focus group schedule (Additional File 2) influenced by the concept of *learning as imagined* which is inspired from Shorrock's 'work-as-imagined' in understanding the realities of clinical work (22). This concept recognises that in clinical practice, work is often not conducted as might be imagined by different stakeholders. We use the term *learning as imagined* to acknowledge that while we can anticipate the learning that may occur for students, this will likely differ from what is imagined by those who have designed and delivered teaching. A similar concept of training as imagined has been utilised to explore the impact of simulation-based education, recognising that there will be unanticipated impacts of training interventions and being open to the possibility of negative consequences (23).

Phase One

Focus groups were conducted across three different hospital sites in the West of Scotland – University Hospital Wishaw, University Hospital Hairmyres, and the Royal Alexandria Hospital. Only participants and researchers were present. Focus groups were recorded and transcribed verbatim using Microsoft Teams and each lasted between 15 to 25 minutes. The researchers then amended transcripts to ensure accuracy, after which the audio recordings were permanently deleted. No identifiable information about the participants was retained. This maintained participant anonymity.

Through the process, information power was appraised in line with the specificity of the projects' aims, the specificity of the participants with regards to these aims, and the quality of dialogue arising from the focus groups(24). After reviewing these factors, it was felt the information power of the focus groups was strong and data collection concluded.

The process of transcription served as the first step in the researcher's familiarisation with the data.

Phase Two

Focus groups were analysed using Braun and Clarke's six-step approach to thematic analysis (25), assisted by the Delve Tool. Delve tool was used as a platform on which to store codes in a structured way, that was accessible by all researchers.

After familiarising themselves with the data, PL, AM and JI interactively constructed codes and themes over a series of meetings. All authors then iteratively reviewed, discussed and refined themes and subthemes and discussed differences in interpretation through a further series of meetings, strengthening the final analysis.

Reflexivity

Researcher reflexivity was maintained through iterative discussions of individual perspectives throughout the project at regular research team meetings. When disagreements presented, they were discussed and used to strengthen the final analysis.

PL, AM, and JI are clinical teaching fellows in general medicine who regularly teach undergraduate students history-taking skills including some of the students involved in the research. This risked a power dynamic between researchers and participants. To minimise this, researchers conducting the focus groups did not know any of the students involved, and did not teach any of the students through the duration of the research.

JK is an acute medical registrar with a PhD in medical education and experience of qualitative medical education research. She did not meet any of the participants or have any prior interaction with them.

MH is an Intensive Care Physician and expert in clinical reasoning, with extensive research in the field. He did not meet any of the participants or have any prior interaction with them.

JB is a Diabetologist, clinical reasoning expert, and Lead of Year 3 of the MBChB programme at the University of Glasgow. The students participating in the study were not in Year 3; however to minimise risk of power dynamic, they were never in contact with JB about the research project.

The research team brought a wide range of experiences in medical education, clinical reasoning, and clinical practice. This heterogeneity allowed a range of perspectives to be applied during data analysis. We recognise this may have sensitised us to finding benefits in teaching HDH however the mix of roles within the team allowed critical discussion of the data which resulted in a more nuanced perception of both the challenges and benefits of HDH education.

Results

Seven focus groups (n = 21) were performed. Through reflexive thematic analysis, two themes, each with three subthemes, were developed. These captured students' perceptions of HDH, including its benefits and challenges. Together, these themes illustrate uncertainty about the role of history taking, potential opportunities for the development of clinical reasoning through hypothesis-driven approaches, and reveal apprehension from students about the perceived conflict between medical school assessment and real clinical practice.

Theme 1: Re-evaluation of the Purpose of History Taking

We defined this theme as reflecting how participants' views on history-taking changed through the sessions. Their views on the purpose of history taking were challenged and this revealed that students perceived history-taking as a structure-driven exercise, as opposed to a clinical reasoning tool.

Subtheme 1: History-taking as data collection rather than data synthesis

Based on participant responses, we defined this subtheme as the tendency for students to view history-taking as a passive collection of information, with synthesis to a differential diagnosis only happening thereafter.

Students often described history taking as a way of asking several, unfocused questions, to gather a large amount of information, which would allow them to formulate a diagnosis upon completion. Students favoured collecting a large amount of information from the patient, to then narrow down away from the bedside. As one student described:

'…[history taking is] just like throwing out like a wide net and then trying to, like narrow it down to make the symptoms fit a diagnosis' ~Participant 2, Focus Group C

This would position data synthesis and differential diagnoses creation as a process which happens after the history taking, rather than an integral part of the history itself. Other students discussed how they ask several questions in the hope that, eventually, a potential diagnosis might reveal itself.

"I think the hope is that somewhere during the history you're like 'awww' ~Participant 5, Focus Group C

These accounts reveal that history taking is viewed more as a passive process by which certain clues to the diagnosis may (or may not) be revealed as opposed to a purposeful, hypothesis driven approach to gathering relevant diagnostic information.

Subtheme 2: History-taking as distinct from diagnostic reasoning

Based on participant responses, we defined this subtheme as students perceiving history-taking and diagnostic reasoning as two distinct processes.

Students described a disconnect between taking a history and diagnostic reasoning. History taking was seen as its own process, followed by the diagnostic process. One participant explained:

'…sometimes you just go through the structure of a normal history, you get to the end, you're still sort of like, I don't really know what this person's diagnosis is, but I've taken a history' ~Participant 1, Focus Group A

This is, perhaps, partly due to the way history taking had been taught up until these sessions. Participants discussed how their experience of history-taking education thus far had lacked focus on diagnostic reasoning. When asked when they had last received teaching about how to use history taking as a tool for diagnosis, one participant replied:

'Never' ~Participant 1, Focus Group F

Therefore, these accounts suggest that the lack of explicit linkage of clinical reasoning to history taking may contribute to students seeing the two processes as separate rather than symbiotic.

Subtheme 3: History taking as assessment box-ticking, not sense-making

Based on participant responses, we defined this subtheme as students perceiving history taking as a task performed purely to pass assessments, rather than to diagnose patients.

Participants frequently described history taking as a checklist-driven structure, aimed at completeness for assessment criteria and 'box-ticking'. One participant said:

'I think the traditional one [traditional history taking structure] really helps you pass the exam because you need to tick all the boxes, and to tick all the boxes you need to have a (sic.) practiced a format to follow.' ~ Participant 3, Focus Group G

This suggests students ask questions not due to clinical relevance but in order to thoroughly gather information that may (or may not) be on an assessment grid. Participants commented on how they ask questions even if they know these questions are irrelevant to the patient's clinical condition:

'And even if [you're not] interested in what the patient eats generally in a week, you know, if that's got nothing to do with what their symptoms and complaints are then you're just saying it for the sake of saying it because it's on a checklist.' ~Participant 4, Focus Group D

These comments suggest that undergraduate students view history taking as a means to fulfil certain checklist requirements, rather than a way to diagnose the patient.

When viewed together, these subthemes highlight how students found conflict between the hypothesis-driven emphasis of these teaching sessions, and their previous perceptions of history taking. History-taking is seen as an algorithmic process adjacent to the cognitive processes involved with clinical reasoning.

Theme 2: The Potential for Hypothesis Driven History Teaching Amid Pressures and Constraints

Based on participant responses, we defined this theme as the emerging perception that teaching HDH was possible and beneficial in clinical practice but faced barriers.

Participants described both perceived values of HDH and challenges associated with applying it. Overall, this revealed a conflict between how participants feel they will perform history taking beyond graduation, and how they feel they should be performing history taking for undergraduate assessments. It also highlighted the prerequisite of knowledge organisation to facilitate engagement with HDH, and the cognitive demands of this.

Subtheme 1: Negotiating cognitive challenges when performing HDH

Based on participant responses, we defined this subtheme as the cognitive challenge participants faced when attempting HDH. Participants felt that taking an effective HDH required a prerequisite level of knowledge they may not possess:

“I think this is helpful when you have a breadth of clinical knowledge. At the early stages, though — would it be useful?” ~ Participant 4, Focus Group A

This led on to fears students have of ‘missing’ important information that could lead to mismanagement of the patient:

“But conversely, it’s like you don't wanna miss anything major as well. And like patients have so many different things” ~ Participant 5, Focus Group D

Furthermore, the shift away from the checklist structure led to uncertainty in history-taking and compounded fears of ‘missing something’:

‘I found it hard because you’re so used to having a strict structure and sometimes it [strict structure] helps.’ ~ Participant 4, Focus Group F

Collectively, these illustrate the challenges faced by senior medical students when taking a HDH. Not only do they need a reliable level of knowledge organisation, they also have to alter the way they think about history-taking; as opposed to going through a rigid structure, they must be flexible with their approach. This caused apprehension about applying HDH in clinical practice.

Subtheme 2: Newfound Benefits of HDH for reasoning and efficiency

Based on participant responses, we defined this subtheme as participants’ perceptions of the benefits of HDH taking particularly with regard to improving engagement with clinical reasoning while performing a history:

‘This makes me think a lot more. It's not just copy paste tick boxes, it's a lot more involved and I feel like you know more because you're uncovering a little bit of information and like I said, kind of sorting a puzzle’ ~ Participant 2, Focus Group G

This led to them becoming more thoughtful about questions they asked, trying to narrow down diagnostic options:

'So there's more kind of active thinking involved, I guess, because you have to slow down and really drill down your questions that you're asking' ~ Participant 5, Focus Group F

Indeed, HDH encouraged participants to think of history taking as a key part of the clinical reasoning process, as opposed to an exercise which precedes the diagnostic reasoning:

'I think you have to be constantly using your brain to not just recall, but use clinical reasoning at the time like in your head while we're speaking to the patient. Constantly, like testing each of your potential differential diagnosis' ~ Participant 3, Focus group C

Beyond the clinical reasoning aspects, participants also noted the utility of HDH in improving efficiency, particularly in a busy healthcare environment:

'so [it] seems like it's a much more efficient way of taking a history if we're having to clerk in patients' ~ Participant 2, Focus Group A

This reveals that, once cognitive challenges were put aside, participants felt HDH encouraged them to think more critically about history taking, and use more active clinical reasoning during consultations. Participants also noted the value of HDH for clinical practice where time is usually constrained.

Subtheme 3: Conflicting priorities – examinations versus clinical practice

Based on participant responses, we defined this subtheme as a perceived tension between assessment-driven history taking and what is required in real-life practice, which was leading to a hesitancy in adopting a HDH approach.

Participants perceived HDH as more relevant to their future careers, but were hesitant to adopt it as they felt it would not help them pass exams:

'Yeah, I feel this new style is very good for work and the traditional style is good for OSCEs where you are just regurgitating everything from head to toe.' ~Participant 1, Focus Group A

'Whereas this style of teaching [HDH] is more real world, take a focused history to rule in or out your differential diagnoses rather than asking questions that may not be relevant and might just waste time.' ~ Participant 2, Focus Group A

Collectively, these accounts illustrate a perceived misalignment between assessment expectations and clinical reality. This may lead to difficulties in encouraging students to adopt HDH, despite the value it seems to provide.

Overall, this theme revealed the challenges for students in adopting a hypothesis driven approach – it is cognitively testing and can provide uncertainty for medical school assessments. However, it also highlighted the perceived benefits of such an approach both in encouraging sound clinical reasoning, and also for preparation for working clinically as a postgraduate doctor.

Discussion

This study reveals a perceived misalignment in undergraduate medical education between history-taking as a checklist task, and history-taking as a clinical reasoning process. Indeed, this reveals the learning intended and *imagined* by educators is perhaps not what learners experience in reality. Participants interpret their teaching and assessment as encouraging history-taking as a data collection process rather than as a tool for hypothesis generation and deduction. Introducing HDH with bedside teaching prompted students to re-conceptualise history taking and reflect on the apparent conflict between their future clinical practice and their current impending assessments. Participants recognised the benefits of HDH for their future practice and for the development of their diagnostic thinking, but the perceived dissonance between clinical practice and assessment caused difficulty in accepting HDH as their default history taking approach. Beyond this, this study highlights the delicate balance between introducing HDH to undergraduates to promote clinical reasoning early, and introducing HDH at a point where learners do not appreciate the approach due to poorly constructed illness scripts.

These findings are well aligned with existing literature. The difficulties integrating clinical reasoning teaching into undergraduate curricula are well documented (4, 26) and, currently, there is a lack of established models for educators to use. Our study contributes to this literature by highlighting two previously underexplored barriers to HDH adoption: the cognitive demands created when illness scripts are still developing and students' perception that HDH conflicts with assessment expectations. This means there is need for consideration of how and when to teach this skill.

Students' cognitive challenges with HDH align well with cognitive load theory (27). Our findings suggest teaching HDH by the bedside increased students' intrinsic load requiring them to generate and test differential diagnoses in real time and, for learners with under-developed illness scripts, this was challenging. There was little evidence in student responses that extraneous load was introduced by the instructional design itself but, notably, students appeared to begin constructing new conceptualisations of history-taking, suggesting engagement in germane cognitive load. Medical students develop clinical reasoning over time, particularly with respect to illness scripts, as they learn more about disease processes (28). Our study supports the importance of aligning HDH teaching with learners' developmental readiness. Overall, these findings indicate that the educational value of hypothesis-driven history may depend less on the approach itself than on its timing within the curriculum, with premature introduction risking excessive intrinsic load that may impede learning.

This further aligns with Piaget's cognitive constructivism (29). It is clear the teaching sessions challenged students to re-evaluate what they already thought about history taking. It appears that

teaching HDH by the bedside created a state of ‘cognitive disequilibrium’ (30)where students’ previous conceptions of history-taking were challenged. This encouraged moving from a ‘checklist’ approach towards a hypothetico-deductive clinical reasoning process. This schema re-construction is valuable for learning but scaffolding from a tutor is vital when introducing cognitive disequilibrium (31, 32). This is an integral part of our bedside teaching model.

A finding of particular interest was students’ perception that a HDH would not allow them to pass their objective structured clinical examinations (OSCEs). The validity and reliability of OSCEs have been widely discussed (33) and how well they assess clinical reasoning is also unclear, with conflicting evidence in the literature (34–36). However, our results suggest students feel there is a disconnect between how they are assessed, and how they will work in future. A cornerstone of constructive alignment (37) is that learning is, in part, driven by assessment. Therefore, perhaps part of the difficulty integrating HDH in the curriculum is due to this perceived incongruence between learning and assessment.

Practical implications

This study suggests teaching HDH is both beneficial and feasible at the bedside if careful consideration is given to the timing of the session in the context of the wider curriculum. It is likely that HDH should be introduced later in clinical training, once students have been taught a more traditional history taking structure to allow them to form sufficient illness scripts. Therefore, we suggest HDH should not replace traditional history-taking teaching but should be introduced as a bridge between early undergraduate training and ‘data collection’ history taking, and senior clinical years where more fluid diagnostic thinking is required.

Strengths, limitations and considerations for future research

This multi-site study explored learner perspectives on teaching at an undergraduate level which are often not prioritised. Although multiple hospital sites were involved, this study involved students from a single University which could mean findings are not transferable to all undergraduate contexts; however, the aim of the study was to develop theoretical insights as opposed to statistical certainty. The participants only received two teaching sessions on HDH, and therefore it is unknown what effect repeated teaching would have. Exploring if students changed their history-taking approach following the teaching sessions was not explored and should be a consideration for future work.

Conclusion

Overall, this qualitative study highlights that teaching HDH by the bedside, if done with careful consideration to timing and student experience, can promote conceptual re-evaluation of the purpose of history taking and support learning relevant to students’ future clinical practice. Further research should explore how and when HDH can be integrated into the undergraduate curriculum, and how best to teach it to maximise learning for students.

Abbreviations

HDH
Hypothesis–Driven History

Declarations

Ethical approval

This study was approved by the ethical approval committee at the University of Glasgow.

Consent for Publication

Not Applicable.

Funding

Not applicable.

Author Contribution

PL designed the bedside teaching model and contributed to the conceptualisation of the research. He delivered bedside teaching to three participant groups and conducted three focus groups. He was involved in all stages of data analysis, including coding and theme generation, and drafted the original manuscript and subsequent revisions.AM delivered bedside teaching to three participant groups and conducted four focus groups. He contributed to data coding and reviewed and approved the final themes.JI delivered bedside teaching to one participant group and contributed to theme development.MH contributed to the conceptualisation and planning of the project. He played a key role in thematic analysis and contributed to manuscript revisions.JB contributed to the conceptualisation and planning of the project, supported and guided the thematic analysis, and made substantial revisions to the manuscript.JK contributed to the conceptualisation and planning of the project, was involved in thematic analysis, and made substantial revisions to the manuscript.All authors read and approved the final manuscript

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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