Journal of
Problem Based Learning
in Higher Education

VOL 13 • 1

Vol 13, No. 1, 2025 – Page 270-309
doi.org/10.54337/ojs.jpblhe.v13i1.10495

Graduate Entry Students' Reflection on Alternating Problem-Based Learning and Clinical Placements

Enjy Abouzeid * | Ulster University, United Kingdom
Rita Wassef | Ulster University, United Kingdom
Julia Blitz | Ulster University, United Kingdom & Stellenbosch University, South Africa
Patricia Harris | Ulster University, United Kingdom

Abstract

Problem-based learning (PBL) and early clinical placements (CP) are recognised as complementary strategies for developing clinical reasoning (CR) in medical education. However, how alternating between these formats influences the CR process from students' perspectives remains underexplored. This qualitative-led exploratory mixed-methods study examined how curriculum sequencing shapes Graduate Entry Medical students' perceptions of their CR process. Fourteen Year-2 students participated across two pre-existing streams: one began with PBL and the other with CP before switching. Across these alternating phases, students completed the Self-Assessment of Clinical Reflection and Reasoning (SACRR), applied reasoning through vignette-based single-best-answer (SBA) questions to prompt reflection on their reasoning processes. Students' reflections were further explored through in-depth semi-structured interviews. Thematic analysis formed the primary interpretive strand, supported by descriptive quantitative data. Interview findings revealed that alternating PBL and CP encouraged students to reflect on, apply, and

* Corresponding author:
Enjy Abouzeid, Email: e.abouzeid@ulster.ac.uk

Received 11 June 2025 | Accepted 4 December 2025 | Published 16 December 2025

progressively refine their reasoning skills. Students valued the complementary relationship between classroom discussion and authentic clinical exposure, citing case-based dialogue, GP teaching, and supportive environments as key enablers, while heavy workloads, examination pressures, and over-guided PBL sessions were perceived as barriers to CR process. Overall, CR development emerged as a gradual, experiential process enhanced by the dynamic interplay of PBL and clinical learning. These findings underscore the importance of integrating structured discussion with authentic patient encounters rather than privileging one learning format or sequence over the other.

Keywords: Clinical reasoning; Problem-based learning; Clinical placement; Graduate Entry Medicine; Medical education

Introduction

The School of Medicine at Ulster University employs problem-based learning (PBL) and early clinical placements (CP) to bridge the gap between theoretical and practical learning. These complementary formats encourage students to integrate biomedical knowledge with clinical experience and to develop the higher-order thinking processes that underpin clinical reasoning (CR). When designing placement models, logistical factors such as scheduling and cost often outweigh pedagogical considerations, even though sequencing between classroom-based and clinical experiences may affect the way reasoning skills evolve. Understanding this interaction is therefore essential for optimising curricula in graduate-entry medical education.

In medical education, PBL has long been recognised as a powerful approach for fostering the development of clinical reasoning and self-directed learning. By engaging students in authentic, context-rich problems, PBL promotes hypothesis generation, analytical thinking, and reflection, key components of clinical reasoning (Koh et al., 2008). Recent work further supports this link, showing that PBL not only enhances diagnostic reasoning but also improves knowledge integration, teamwork, and metacognitive awareness across different cultural and educational settings (Ishizuka et al., 2025).

Clinical reasoning is a multifaceted process encompassing data gathering, interpretation, hypothesis generation, and decision-making (Gruppen, 2017; Thampy et al., 2019). It has been described as *the cognitive and metacognitive processes clinicians use to evaluate and treat patients* (Crabtree, 2001). Other scholars have defined it as a cyclical process integrating knowledge with patient information to reach and test diagnostic hypotheses (Young et al., 2018). This study adopts the definition by Royeen et al. (2001), which conceptualises CR as

a reflective thought process integrating information to guide action. Although originally developed in occupational-therapy education, this definition underpins the validated Self-Assessment of Clinical Reflection and Reasoning (SACRR) instrument used in this study and is consistent with reflective and constructivist learning theories widely applied in medical education.

The theoretical framework guiding this study draws on social constructivism and situativity theory, which view reasoning as emerging through interaction with authentic contexts and social dialogue (Vygotsky, 1978; Dornan et al., 2012; Billett, 2016). Within this lens, PBL provides a structured environment for collaborative hypothesis generation and reflection, while clinical placements situate reasoning in real-world uncertainty, allowing students to test, refine, and adapt their thinking through patient encounters and tutor feedback. In the Ulster model, PBL cases are designed to prompt diagnostic and therapeutic reasoning through scaffolded group discussion led by trained facilitators who guide questioning, hypothesis generation, and integration of new information. Clinical placements, in turn, enable students to apply and refine these reasoning processes with real patients under supervision from clinicians and general practitioners.

Meta-analytic evidence suggests that PBL enhances CR more effectively than traditional teaching (Wang et al., 2016; Trullàs et al., 2022). However, most studies examine PBL or placements in isolation; few explore their combined or sequential impact (Willis et al., 2018). Furthermore, quantitative evaluations of CR often overlook students' lived experiences of reasoning across settings. A qualitative-led mixed-methods approach allows both the measurable trends and the interpretive richness of these experiences to be captured.

Graduate Entry Medical (GEM) students represent a distinct population, typically older and with diverse academic backgrounds (Medical Schools Council, 2023). Their prior experiences may influence how they perceive and articulate reasoning processes, making them particularly suitable for an in-depth exploration of the CR process.

This study aimed to explore how curriculum design and the sequencing of learning experiences influence GEM students' perceptions of their CR process. Specifically, it sought to:

1. Understand students' experiences and perceptions of how alternation between settings affects their reasoning; and
2. Identify activities, sequences and approaches that students perceive affect their CR.

Materials and methods

Research design & sample

This study employed a qualitative-led exploratory mixed-methods design. This design was built on prior qualitative work in the field and provided a richer understanding of how PBL and CP interact to shape reasoning skills. Given the small cohort size typical of GEM programmes, quantitative data were analysed descriptively to contextualise qualitative insights, while qualitative findings provided the main interpretive depth. Integration aimed to achieve triangulation rather than statistical generalisation (Creswell & Plano Clark, 2018).

A convenience sample of fourteen Year-2 Graduate Entry Medical (GEM) students participated voluntarily. All Year-2 students (N = 72) enrolled in the 2022–2023 academic year were informed about the study via email. The cohort reflected the demographic profile of UK GEM programmes, comprising students aged 21 years and above with diverse academic and professional backgrounds (Medical Schools Council, 2023). While there are demographic differences between GEM and SE, graduate students make up approximately 20% of students studying medicine in the UK. Therefore, studies involving GEM student populations can be considered to represent a good proportion of students overall (Vasileiou et al., 2018). Students who expressed interest were provided with detailed study information and consent forms, and only those who returned signed consent forms were included in the study.

Curriculum design in Year 2:

Within Year 2 of the Ulster University School of Medicine programme, students complete a total of three PBL blocks and three placement blocks, alternating between them. Students are divided into two streams (Stream A & B): Stream A undertook PBL first, followed by placement, while Stream B started with placement before moving to PBL. This division was pre-determined by the existing timetable but allowed exploration of whether sequence influenced CR development. During the placement blocks, students alternated among three clinical settings: Medicine, Surgery, and General Practice (GP), in different sequences but same structure and teaching opportunities. Each rotation runs for a 5-week duration.

The sequencing of PBL and clinical placement blocks was primarily shaped by logistical considerations, with PBL following a module-based rather than system-based structure. Where feasible, PBL cases were thematically aligned

with the content and clinical conditions students encountered during concurrent placements in general practice and hospital settings.

Stream A	**Stream B**
Induction	
PBL	Clinical placement
SACRR & SBAs for both streams	
PBL	Clinical placement
SACRR & SBAs for both streams	
PBL	Clinical placement
Semi-structured Interview	

Figure 1. The study design and curriculum sequence.

Study Steps & Data Collection

The main source of data in this study was semi-structured interviews designed to explore students' perceptions of their CR process. This qualitative approach was chosen because it allowed participants to articulate their experiences, reflections, and reasoning processes in depth, capturing the complexity and contextual nature of CR that could not be fully understood through quantitative measures alone. At the end of the first semester, after students had completed different clinical placements and PBL blocks, semi-structured interviews were conducted to capture their perceptions of the overall learning experience.

To complement and contextualise these insights, two quantitative data collection tools were employed to engage students in thinking about and reflecting on their CR processes before interviews. Students completed the self-reported Self-Assessment of Clinical Reflection and Reasoning (SACRR) questionnaire and answered a set of Vignette-based Single Best answers (SBAs) focused on reasoning after each rotation. These tools were selected to provide measurable indicators of students' self-perceived reasoning development (via SACRR) and to prompt analytical thinking through applied reasoning tasks (via SBAs), thereby reinforcing reflective engagement with the topic.

Quantitative data from the SACRR and SBA were analysed descriptively to identify indicative trends, while qualitative interview data formed the primary interpretive strand of the study and were analysed thematically to provide an in-depth understanding of students' perceptions and experiences.

Data Collection Methods

A: The Self-Assessment of Clinical Reflection and Reasoning (SACRR) Survey

The SACRR was used to capture students' self-perceived development of clinical reasoning (CR) across the study period. SACRR consists of 26 Likert-scale items (1 = strongly disagree to 5 = strongly agree) assessing reflection, metacognition, and reasoning processes within health-professional education contexts. Originally developed by Royeen et al. (2001), the instrument was selected for this study because it aligns conceptually with the reflective learning framework underpinning both PBL and clinical placements and provides a validated measure of self-perceived CR growth. Additionally, Reliability evidence from prior studies (α = 0.87–0.92) supports its use (Willis et al., 2018).

The tool was adapted for medical students by replacing the term *"client"* with *"patient"* to enhance contextual relevance. Question 24 was removed as it was not applicable to undergraduate learners, and Question 8 was modified to include *"if applicable"* because participants had limited experience in intervention planning (Appendix 1). The survey was administered via MS Forms, with clear instructions to create and maintain a unique, anonymous ID throughout the study.

B: *S*ingle-best answer (SBA)

A short set of vignette-based Single Best Answer (SBA) questions was developed to engage students in analytical reasoning and to assess their application of knowledge within authentic clinical contexts. This tool was designed to complement the SACRR by providing a task-based measure of students' reasoning processes, encouraging them to think through diagnostic and management decisions rather than recall isolated facts.

Questions were constructed using a PBL–CR table of specifications to ensure content validity and alignment with the learning objectives of the PBL and clinical placement blocks (Appendix 2). Each question mirrored the types of reasoning challenges students encountered in their actual cases, reinforcing transfer between tutorial discussion and clinical practice. The vignettes were developed by the school assessment lead and reviewed by two experienced medical educators to ensure clarity, relevance, and cognitive alignment with the intended reasoning level.

Students completed the same set of SBAs after each rotation to maintain internal consistency and to allow comparison of reasoning development across learning contexts. Responses were scored and analysed descriptively to identify indicative trends in students' reasoning performance. The findings were used

to contextualise and triangulate the qualitative data from the interviews, providing an integrated understanding of students' reasoning development.

Since the SBA format aligns with summative assessments, these SBAs served as formative practice assessments, reducing participant burden. All students (regardless of consent) had answered SBAs, and cohort-level feedback was provided post-study. Consenting students' responses were anonymised using unique IDs.

C: Semi-Structured Interviews

Semi-structured interviews served as the primary qualitative data source in this study, allowing for an in-depth exploration of students' perceptions of how alternating PBL and clinical placements influenced their CR development. This approach was chosen to capture the nuanced, reflective, and experiential dimensions of CR that could not be fully accessed through quantitative instruments alone.

The interview guide was developed collaboratively by the research team and informed by the study's conceptual framework, relevant literature on PBL and CR, and the quantitative data collection tools. The CR definition was shared with the students at the start of the interview to ensure shared understanding. Questions prompted students to reflect on their reasoning experiences, perceived enablers and barriers, and the influence of sequencing between PBL and placements. The guide was reviewed for clarity and refined accordingly. The final version is included in Appendix 3.

Interviews were conducted at the end of the first semester, after students had completed both PBL and clinical placement rotations, to enable reflection on their full learning experience. Each interview was conducted in English via Microsoft Teams, lasted approximately 60–90 minutes, and was audio-recorded with consent before being transcribed verbatim. The insider-researcher status of the two interviewers (EA and RW) was acknowledged, and students were randomly assigned to interviewers to minimise potential bias.

Unique participant identifiers were used throughout the study, combining a participant number (1–14) with a cohort code to indicate the sequence of learning experiences. The code "AB" refers to students who experienced PBL first, followed by clinical placement, while "BA" refers to those who experienced clinical placement first, followed by PBL (e.g., Participant 1BA).

Data Analysis

Quantitative data were analysed descriptively (means, SDs, and patterns) using SPSS v29. Given the small sample, no inferential tests were applied, and the

results were used primarily to provide context and support for the qualitative findings.

A small amount of missing quantitative data (n = 2 responses from stream B) occurred due to incomplete submissions of the second post-rotation assessment; these cases were excluded from analysis but retained in the qualitative sample to preserve participant representation.

Qualitative data from the semi-structured interviews constituted the primary analytic strand of the study. Qualitative themes were reviewed for any apparent differences between sequences (PBL-first vs CP-first); however, no consistent divergence was observed. The data were examined through thematic analysis following Braun and Clarke's (2006) six-step framework. Two researchers independently reviewed transcripts and engaged in deductive/reflective coding, reaching a consensus to ensure consistent interpretation of student experiences. The phases were:

Familiarization with the data: High-quality video recordings and verbatim transcriptions of each interview were stored using corresponding interview codes. Authors EA and RW immersed themselves in the data by repeated reading and listening, making preliminary analytic notes and reflective observations.

Code generation: Both researchers independently generated concise labels for significant data features relevant to the research questions. Each transcript was coded systematically, and codes were collated into an initial coding framework. Coding was conducted using a deductive/reflective approach guided by the study's conceptual framework of PBL and CR.

Theme identification: Codes were compared and clustered into broader themes that reflected patterns across participants. This stage involved identifying relationships and contrasts between PBL and clinical learning experiences.

Theme review: The developing themes were iteratively reviewed against the coded extracts and the complete dataset to ensure coherence and credibility. The Authors, EA and RW assessed whether the themes provided a convincing narrative of the data, while also refining the definition of each theme and exploring their interrelationships.

Determining theme significance: JB and PH contributed to the in-depth review of each theme, helping to define their conceptual boundaries and ensure analytic depth. Each theme was given a concise, descriptive name representing its core meaning.

Reporting findings: EA and RW collaboratively crafted a coherent narrative that integrated the thematic findings with supporting data extracts. The narrative was contextualised within existing literature on clinical reasoning and experiential learning, highlighting convergence and contrast with prior studies. The final thematic structure and interpretations were reviewed and approved by all authors to ensure analytical rigour and consensus.

Results

A: The Self-Assessment of Clinical Reflection and Reasoning (SACRR)

Descriptive analysis of the Self-Assessment of Clinical Reflection and Reasoning (SACRR) data revealed small variations in self-perceived development of clinical reasoning (CR) between streams across the study period. As shown in Table 1, students who began with PBL (stream A) reported slightly higher mean SACRR scores after the first learning block (Post-test 1: *M* = 4.04, SD = 0.30) compared with those who began with clinical placements (stream B: *M* = 3.87, SD = 0.12). However, this difference was not sustained by the end of the second learning block (Post-test 2: stream A *M* = 3.92, SD = 0.34; stream B *M* = 3.86, SD = 0.31).

	Streams	N	Mean
Post-test 1	B	5	3.87 (SD .121)
	A	9	4.04 (SD .302)
Post-test 2	B	5	3.86 (SD .314)
	A	9	3.92 (SD .340)

Table 1. Descriptive analysis of the SACRR mean score among study groups, N=14.

At the item level, four SACRR statements showed noticeable early differences between stream A (PBL first) and stream B (placement first). These items are: *'I ask myself and others questions as a way of learning'*, *'I think in terms of comparing and contrasting information about a patient's problems and the proposed solutions to them'*, *'I try to understand clinical problems by using a variety of frames of reference'*, and *'I ask for colleagues' ideas and viewpoints'*. All four reflect higher-order reflective and analytical thinking. By the second assessment, these differences had diminished, and both cohorts demonstrated similar patterns of reflective

reasoning. Across the full sample, stream A showed improvement on 7 of 25 items, while stream B improved on 10 of 25 items.

B: Vignette-Based Single Best Answer (SBA) Questions

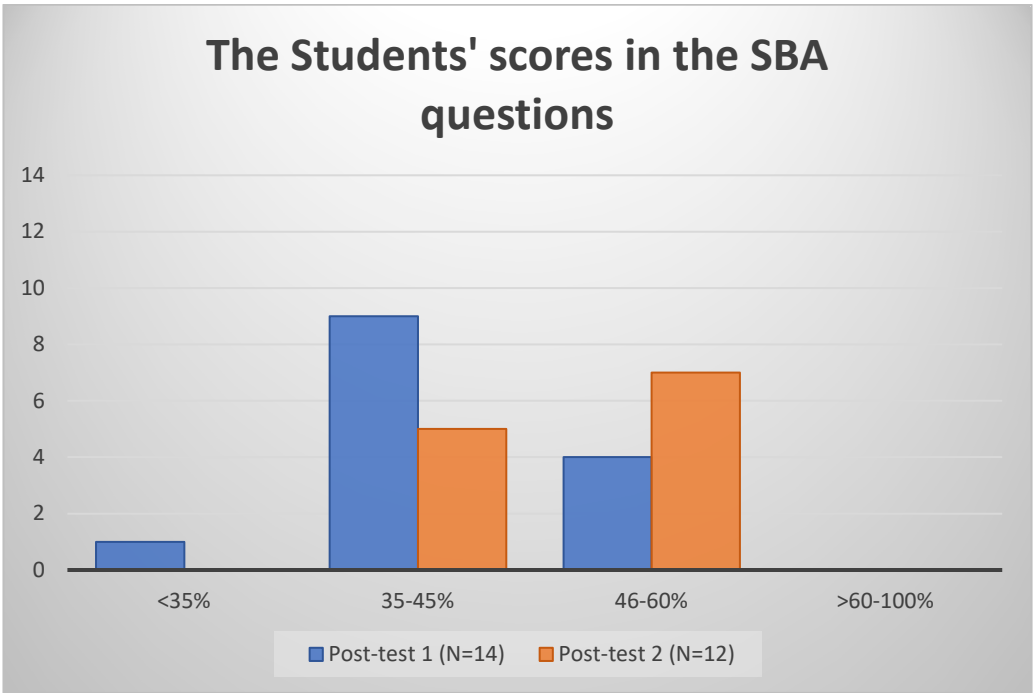

Figure 2. The students' scores in the SBA questions, N=14.

Descriptive findings from the vignette-based SBA assessments provided complementary insights into students' applied reasoning. When all students were considered collectively, the mean SBA score was 45.4% (SD = 7.46, n = 14) after the first block and 44.2% (SD = 7.33, n = 12) after the second block. Although overall scores remained stable, the distribution of results shifted slightly upward, with a higher proportion of students achieving scores in the 46–60% range after the second assessment. This suggests greater consistency in reasoning performance over time rather than dramatic gains. Figure 2 illustrates the spread of SBA results across the two time points.

C: Semi-structured interviews

These descriptive trends indicate that students' self-perceived reflection (from SACRR) and applied reasoning (from SBAs) developed gradually and in parallel across the semester. Quantitative findings, therefore, provided contextual support for the qualitative analysis, which explored how students experienced and described these shifts in reasoning during alternating PBL and clinical placement learning.

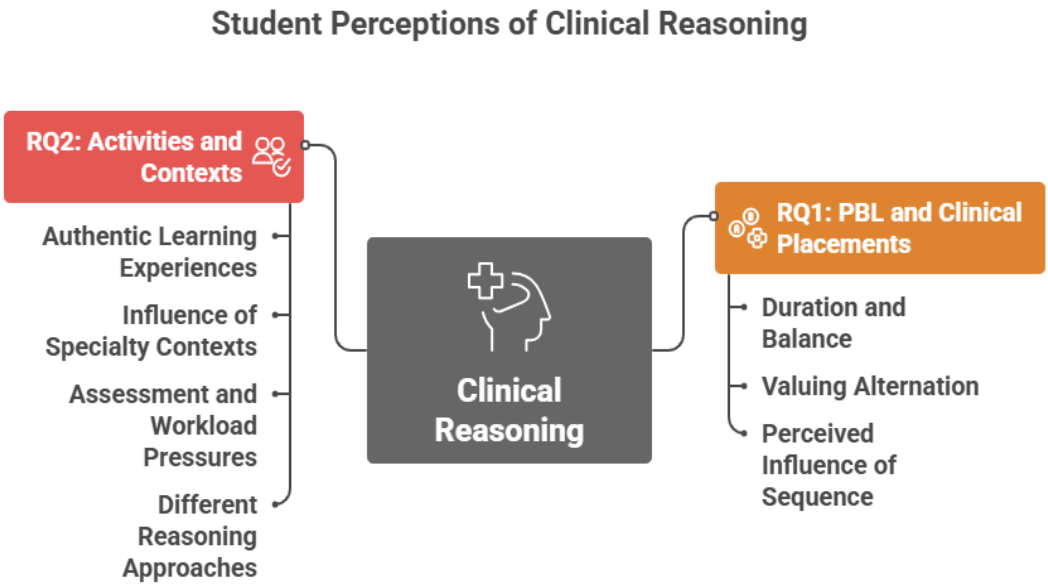

Figure 3. Thematic analysis of the interview data.

RQ1: How do students perceive the alternation of PBL and clinical placements as shaping their clinical reasoning (CR)?

Students described alternating between PBL and clinical placements as a cyclical, integrative process that enabled them to build, apply, and refine their reasoning skills. Rather than viewing each format as separate, they recognised that PBL supported analytical understanding, while clinical placements deepened practical application. Together, these experiences created a "layered learning" cycle that progressively enhanced their clinical reasoning. These qualitative insights correspond with the SACRR trends, which showed modest early gains that later stabilised, suggesting reflective maturity rather than simple linear improvement.

Duration and Balance

Before considering their perception of alternation, students reflected on the balance of time between the two settings. Some viewed the five-week rotation as well-paced, offering sufficient immersion in both environments, while others found the frequency of transitions demanding:

> "It probably takes you about three or four weeks to feel settled on a placement. And then you basically have one more week to go… you're also constantly making new starts which is physically and emotionally draining." (3AB)

This recurring shift required adaptability but also encouraged flexibility and resilience, traits students later linked to clinical reasoning.

Valuing Alternation and Complementarity

Students consistently highlighted the complementary relationship between PBL and placements. PBL enabled analytical thinking and pattern recognition, while placements contextualised and reinforced learning:

Students recognised the value of PBL in facilitating a thorough understanding of medical cases. PBL allows them the time and opportunity to delve into cases, analyse details, and extract important information. This understanding, acquired through PBL, then serves as a foundation for better performance during clinical placements. *"PBL gives you time to go back and have a thorough read to make sure that you can pull out important bits"* (3BA); while placement allows application to reinforce learning.

Meanwhile, placements allowed the application to reinforce learning. Clinical placements were seen as an opportunity to witness real patients and understand how CR is applied in practice.

Students express that this practical experience during placements makes the theoretical knowledge gained from PBL *"make more sense"*. A second student agreed and argued that *"PBL mirrors placement"* (7AB) due to the way the cases are structured which forces them to stop and think.

Students explained that alternating between PBL and placement helped them to understand relevant PBL content and the reason for each word mentioned in the case, hence improving performance:

> "Seeing how the doctor's CR was based on what went before and what is happening now, made a lot more sense." (7AB)

One student noted that real patient encounters improved memory, while PBL allowed deeper exploration of differentials:

> "I think ward rounds are very useful because you're seeing that CR process over and over and over again in the morning. this helps you to remember… and PBL is just full as well because you are helped that time to work out what's happening and why it's happening, and you have a bit of a safety net, to pose there to ask maybe questions that you wouldn't ask on a ward round." (1BA)

A student emphasised the reciprocal benefit of PBL and placement on each other and explained that placement helped them to pick more important bits

easier whenever they get back to PBL and equally PBL lets them think and make connections with patients that you can see on placement,

> "I think you do become a bit more biased to what you've seen on your placement, but I do think that also let us narrow down a differential that we've got more. Whereas in the first PBL block, we were just putting up everything that we could think of and write it down on the board. On the other hand, placement engrave it in your brain in a wee bit better." (8AB)

This cyclical approach contributes to ongoing learning and skill development. The alternation of PBL and clinical placement was seen as a way to build layers of understanding.

Students described how PBL lays the foundation of knowledge, and clinical placement adds practical depth to their learning. This layering approach was seen as valuable in gradually expanding their clinical competence

> "...both bring different things to your ability to understand the CR and I think it's nice that you alternate them because you know one layer a bit and the other one layers on top of it and I feel like it's building block really and it's learned different things as you go." (1BA)

Students noted that their ability to **narrow down differential diagnoses** became more refined over time, attributing this growth to alternation between PBL and placements:

> "I think it improves it and I think every time you go back to PBL, especially in the first week, that's when you notice it because you start thinking, I've seen different conditions. So you start to think…you start to realise that your differentials are getting better." (3AB)

> "Every time we come back from a round of placement, we were just a lot more good and like you haven't missed any differential diagnosis. Like we were just all working through the systems in a systematic way." (6AB)

Perceived Influence of Sequence

Students expressed different preferences regarding the sequence of PBL and placements. Some perceived no difference, noting that:

As stated earlier, one thought that *"PBL mirrors placement due to the way the cases are structured that enforce them to stop and think"*.

Others valued starting with PBL as it provided preparation and confidence before applying learning in clinical settings. Having PBL first was thought to

consolidate information, allow talking about learnt topics and clarify misunderstanding or unanswered questions therefore it enriches the discussion during placement which promotes learning:

> "PBL gives you time to go back and have a thorough read to make sure that you can pull out important bits."

> "I like learning first and then doing the placement…I do find the placement more challenging and I'm glad that I was learning first and then trying to put it into practice." (1AB)

> "I don't think if you've done the placement without having done PBL first, I think I would have struggled with it… I think doing PBL first is valuable in that lets you get the most out of your placement." (8AB)

> "I think maybe prefer to do PBL first, because then you've got a quite good amount of questions that you've learned for the five weeks and then you can come into GP practice and ask those questions." (3BA)

> "I do think having PBL sessions, those three sessions beforehand [during induction] really helped by getting us back into the way of thinking." (5BA)

Some argued for starting with GP placements as a foundational experience due to their exposure to undifferentiated presentations, while others suggested beginning with GP before progressing to more specialised secondary care.

These discissions demonstrated that students were not considering year 2 clinical placement as building on Year 1 PBL (as intended in the curriculum), and students were seeking an explicate correlation between the year 2 PBL cases and their placement rotation:

> "If they match the colorectal stuff that we went through…with the surgery rotation, I think that would really just match up so well because you're really going through the in depth study of PBL and then you're maybe matching that with what you've just learned or what you're about to go out and learn on placement." (5BA)

RQ2: What are the activities, sequences and approaches that students perceive affect their CR?

Authentic, discussion-rich, and feedback-oriented contexts were perceived as key enablers of CR development, while excessive workload, assessment pressures, and overly structured materials acted as barriers. This theme aligns with the gradual reflective growth shown in SACRR data, suggesting that CR

flourishes in flexible, supportive environments that encourage independent reasoning.

Authentic learning experiences

The use of clinical cases in teaching enables clinical reasoning (CR), allowing students to apply knowledge.

> "Looking into patients' files and making sense of all things that the consultants have written on." (1AB)

Exposure to undifferentiated presentations, especially in PBL and GP placements, is beneficial, as engaging GP tutors challenges students and encourage participation.

> "The real enabler is getting access to undifferentiated presentation... sitting in with the GP and then letting me do three things, taking a history, examining a patient and presenting my findings... triggered me to think." (3AB)

Discussion of cases, whether in PBL or placement, enhances CR, with tutor competency playing a role. *"Big influence on the dynamic of the group"* (3AB), "*Getting feedback from someone who knows the game as well*" (7AB).

Various teaching methods, such as ward rounds, simulations, mock OSCEs, and bedside teaching, bridge theory and practice.

> "I love PBL... but on placement, I really utilised the resources... simulation sessions… bedside teaching was brilliant." (5BA)

A supportive learning environment is crucial, as a dyslexic student shared, "*It just takes me a wee bit longer... I've had a lot of support... once I find that I see improvement*" (5BA).

Specialties

There was a distinction in students' perceptions towards placement rotation allocation.

PBL and GP placements were seen as highly beneficial for CR skills and therefore it were better to have early in the year, Surgery and Medicine placements are mentioned as less helpful in this regard.

> "PBL and GP placement are great to develop clinical reasoning skills due to undifferentiated presentation; while Surgery and Medicine placements didn't help a lot in this regards." (4BA)

One student mentioned that hospital placements are *"somehow different"* being *"more methodical and practical"*.

This difference in the effect of learning methods on different specialisations is noteworthy.

> "I think that GP and PBL are building the bases for when you go to the hospital…to have GP first out of the three was really good because it was like a good introduction, built on the knowledge that we learned from first year which was like a lot of the communication with the patient and a lot of very common general Conditions that come in." (3BA)

Another student agreed that starting with GP placement gives a "*really good overview*" and allows for the development of different skills. Similarly, a student who started with Medicine placement before PBL suggested that PBL and GP before other placements would have been better:

> "I think I would like to do probably PBL first, then GP, and then keep your medicine in the middle and then surgery last, I think that would probably be a good way of doing it." (5BA)

In contrast, another student valued starting with Medicine:

> "Starting with Medicine. I think that it was like basically what you do in PBL." (6AB)

Assessment and Workload Pressures

Students highlighted a potential tension between exam requirements and CR skill development.

One explained that exam schedules shaped their views on sequencing more than CR itself:

> "Well, actually probably, it helped me cope more with the exam times, in general. Take the exams out of the equation and not sure it would. I would mind the order." (8AB)

> "I felt GP placement was less heavy in terms of running into the exams….I felt we were so well supported in the hospital, that it wouldn't really matter what order would it be done." (1BA)

Others suggested that alternation itself, rather than order, was the key benefit:

> "I don't think the order had any effect on CR. I just think the way it was broke up into five weeks on five weeks off [placement]. That was really good." (7AB)

Students also described **lecture overload** and **over-structured PBL-cases** as barriers to CR:

> "I find the options in the PBL... leading because you find yourself jumping a few crucial steps... The GP would turn out and ask what test do you want to run? And I'm in my head going ohh because I haven't had the opportunity to select." (3BA)

> "The number of lectures in the last five weeks and the specialty programme is very heavy." (3BA)

> "It can feel overwhelming at the start because not everything makes sense." (1BA)

Despite these challenges, students still valued structured learning in supporting CR skill development.

Different reasoning approaches

Through the interviews, students described how they approached the SBA reasoning questions, providing insight into the ways their cognitive strategies evolved through the alternation of PBL and clinical placements. These reflections highlight how students experienced assessment as both an opportunity and a challenge in developing CR.

Educated guessing and Familiarity

Students often rely on familiarity with certain options or educated guesses when faced with unfamiliar situations or questions.

> "There were a lot of times when I knew what all the information was, but I couldn't work out how to answer the questions. So definitely it wasn't a problem of recognising the words and the questions. It was definitely a question of application of the knowledge to work out the answer." (1AB)

> "... one of the options was something I've seen before, so, I was more inclined to pick that option I think it was mainly just like familiarity with that option. So, I think it's like a pattern-based." (4BA)

> "there were some things that you recognise. But you're just trying to put things together. The majority of them I might have an educated guess. ... I made the guess probably from the knowledge that I already had." (1BA)

Building blocks from Experience

Students also attempted to build their reasoning based on what they had learned in PBL sessions and during clinical placements. They draw on their limited understanding to answer questions, particularly when encountering unfamiliar scenarios.

> 'If you haven't really seen it, you're basically just either taking an educated guess or just trying to build from what you know, your limited understanding from what you've learned from PBL and all that sort of stuff... (3BA)'

> "Compared to last year, we have a much more broader amount of clinical conditions like a like a library of clinical conditions that we can build on and because you get a patent of the signs and symptoms, you can pick those up and then decide sort of narrow down which signs and symptoms are much more significant for you to sort of have it like a top two to three differential diagnosis. For those conditions. So I think it's really good. And then placement has really like being able to consolidate that information. And then again ask questions and stuff about you know, like do blood tests or imaging that that normally gets done..." (8AB)

Better-informed decisions with practice

Some students noted that question uncertainty stimulated deeper reasoning. Consequently, they had to thoroughly analyse and compare the information in order to make an informed decision, leading to uncertainty in their choices.

> "The main problem I found there was so much uncertainty about choosing an answer. All the other options were like… Very close to being correct as well. ... I found those questions really good." (3AB)

They expressed that retaking assessments allowed reflection and improved decision-making:

> "I was just looking for a jump-out Thing I remember not properly paying attention to Every bit of detail on the first one. I think the second time I noticed details. So on the second one, after placement I Approached that more with sort of everything here is important." (7AB)

> "where I felt a big shortcoming the first time I did it. I felt slightly better about it the second time I did it. I felt I was better able to apply the knowledge, but I was still aware that there were things where I was guessing." (1AB)

> "The second one I think I was much more like ah well they're having this symptom so you could rule that one out and then use the information that you had gathered from the last few questions to answer the next one. I probably got the questions wrong, but just my mindset was different going into the second one because I had a bit more, PBL and placement, maybe a bit more experience." (6AB)

A student suggested tracking progress over time to enhance reflection:

> "I think in an ideal world, it would be if you got a bit of feedback saying no, you... have Progressed, we can see it or so you're just in that you are progressing from the previous exam. OK. So, I like a progress test throughout the year. You don't always need a tangible percentage. You just need to reflect on yourself and say well what was your thought process during that?" (6AB)

Emotional Response and Guilt

On the other hand, some students did not notice improvement between assessments, leading to frustration and guilt:

> "Yes, I found those very difficult, and some of them to be fair, I should have known them. But most of them, I think, were very difficult. I found no difference between both tests, only more guilt at feeling that I should have known them." (3AB)

Others felt the second test was less focused on CR but on recall:

> "The second one was very much; it didn't test my clinical reason as much. It was more to remember what question I had answered before." (8AB)

Discussion

At Ulster University, CR is emphasized both implicitly through curriculum design and explicitly in teaching. This study explored how curriculum design and the sequencing of learning experiences influence GEM students' perceptions of their CR process.

Students perceived alternating PBL and CP as a cyclical and complementary process that allowed them to build, apply, and refine their reasoning progressively. This dynamic reflects the theoretical view that reasoning is both socially constructed and situated within authentic practice (Vygotsky, 1978; Dornan et al., 2012; Billett, 2016).

The alternation between settings encouraged students to integrate conceptual and experiential learning. This interplay supports the notion that clinical reasoning develops not linearly but through recursive exposure to varied contexts, enabling iterative reflection and synthesis (Gruppen, 2017). The absence of significant quantitative differences between streams suggests that sequence alone was less influential than the overall integration of both learning environments. This interpretation is based on the modest variations observed in SACRR and SBA scores, which suggest gradual reflective growth, and is further reinforced by students' interview accounts describing how alternation between PBL and clinical placements progressively shaped their reasoning processes. Students' reflections thus highlight that CR is enhanced when theoretical and practical reasoning are closely interwoven, regardless of order.

Students attributed their CR development to opportunities for discussion and application across different learning contexts. While PBL group discussions were valued for fostering analytical thinking and long-term knowledge retention (Posner et al., 2023; Trullàs et al., 2022), most students reported that engaging with undifferentiated patient cases during general practice (GP) placements had a stronger impact on their reasoning skills. They perceived that GP tutors' questioning and feedback encouraged deeper analysis and hypothesis generation, supporting previous evidence that primary care settings are uniquely effective for developing broad diagnostic reasoning due to the prevalence of uncertainty and diverse presentations (Fazio et al., 2016; Bansal et al., 2020). These experiences mirror findings on the effectiveness of structured case discussions in promoting reasoning (Weidenbusch et al., 2019) and reflect the critical role of history-taking and symptom interpretation, which underpin most diagnoses in general practice (Baerheim, 2001; Stolper, 2010). Unlike speciality care, where presentations are more defined, GP settings expose students to early, ambiguous stages of illness that demand flexibility and the formulation of distinct diagnostic hypotheses (McWhinney, 1980; Roger et al., 2010).

Students did not perceive that the sequence of PBL and clinical rotations influenced CR process, suggesting that the juxtaposition of these learning opportunities at short intervals (e.g., 5 weeks) reinforces CR skills. Clinical teaching aligns with the "acquisition metaphor," where competence is transferred from teachers to learners, while PBL embodies the "participation metaphor," framing learning as a social process (Dornan et al., 2012). Alternating these approaches provides students with a comprehensive, integrative experience, enabling them to apply knowledge in authentic settings. Studies show that courses combining case vignettes and PBL-style teaching yield higher student performance, underscoring the value of this model (Dubin, 2016).

Beyond their perceptions of curriculum design, students' reflections revealed distinct reasoning approaches that evolved across the alternating learning contexts. Initially, many described relying on recognition-based strategies, choosing answers through *familiarity* or *pattern recognition* without fully analysing the underlying logic. This early dependence on surface cues and "educated guessing" aligns with novice reasoning models, in which learners apply intuitive heuristics before developing integrated illness scripts (Norman, 2005; Monteiro & Norman, 2013).

As students engaged in both PBL and clinical placements, their reasoning became progressively analytical and experience-informed. They began to connect symptoms, patterns, and contextual information, demonstrating movement from *non-analytical recognition* toward hypothetico-deductive reasoning. This developmental trajectory reflects the dual-process theory of clinical reasoning, which suggests that Type 1 intuitive reasoning (rapid, recognition-based) gradually integrates with Type 2 analytical reasoning (deliberate, reflective) as expertise grows (Croskerry, 2009; Eva, 2005).

Students who described "building from experience" exemplified this shift. Exposure to real patients allowed them to test and refine hypotheses, fostering the construction of illness scripts, structured cognitive representations that link clinical features to underlying mechanisms (Lubarsky et al., 2015). PBL discussions supported this process by encouraging collaborative analysis and articulation of reasoning steps, reinforcing metacognitive awareness (Schmidt & Mamede, 2015).

By the second SBA's experience, some students described approaching reasoning tasks with greater attention to detail and *self-monitoring*, consistent with metacognitive calibration, the ability to evaluate and adjust one's reasoning process (Croskerry et al., 2013). Others expressed frustration or guilt at not perceiving improvement, suggesting varying degrees of self-efficacy and tolerance of diagnostic uncertainty, both critical affective components of CR (Ilgen et al., 2011).

Students identified several enablers and barriers to CR development that align with existing research. Enablers included authentic patient encounters, case-based discussions, opportunities for feedback, and supportive tutor relationships. These features mirror conditions described as conducive to clinical learning, namely, authenticity, reflection, and feedback within safe environments (Dornan et al., 2012; Thampy et al., 2019). GP placements were particularly valued for involving undifferentiated presentations, echoing prior work showing that general practice fosters broad diagnostic reasoning through exposure to clinical uncertainty (Fazio et al., 2016; Bansal et al., 2020). Barriers included heavy workload, examination pressure, and over-guided PBL

sessions, which students felt restricted independent reasoning. These findings align with literature on cognitive load and performance, showing that excessive structure or stress can limit analytical depth and reflection (Jordan et al., 2019; Dendle et al., 2018). Medical students face unique stressors, including workload and curriculum demands, which can hinder skill acquisition and academic achievement (Aziz et al., 2020). Importantly, students noted that alignment between PBL cases and clinical experiences enhanced learning transfer and reinforced reasoning processes, supporting evidence that curricular coherence strengthens the integration of theoretical and practical knowledge (Brauer & Ferguson, 2015).

For curriculum design, the findings emphasise the importance of integrating authentic case discussions with early clinical exposure, allowing students to connect theoretical understanding with real patient contexts. Facilitators play a crucial role in this process by using questioning techniques that stimulate reasoning rather than simple recall, prompting learners to articulate hypotheses, justify decisions, and explore alternative explanations. Additionally, structured opportunities for reflection and feedback are essential to nurture metacognitive awareness, helping students evaluate their own thinking processes, recognise reasoning gaps, and progressively refine their clinical judgement.

Despite the study's methodological rigour, the results should be interpreted with caution due to some limitations. This qualitative-led exploratory mixed-methods study is based on a small, single-institution sample (n=14) of volunteers, which limits generalisability and precludes inferential testing; self-report measures (SACRR) are susceptible to response bias; incomplete SBA data in one cohort reduced comparability; insider-researcher involvement risks relational/confirmatory bias despite reflexive safeguards; and the short, single-semester window captures perceptions rather than longer-term reasoning performance. To strengthen causal inference and validate these conclusions, future work should use a longitudinal, mixed-methods cohort following students across multiple rotations (and into clinical years) could combine validated CR assessments (e.g., Script Concordance Test, Key-Features/SBA items mapped to CR, CR-focused OSCE stations, workplace-based assessments with reasoning anchors) with repeated SACRR and interview/reflection data.

Conclusion

In conclusion, students perceive the alternation between PBL and clinical placements as a dynamic, cyclical process that progressively shapes their clinical reasoning. Rather than privileging one learning format or sequence,

participants viewed the interplay between analytical discussion and authentic patient contact as fundamental to their reasoning process. Authentic, discussion-rich, and feedback-oriented activities, particularly exposure to undifferentiated cases, structured reflection, and Feedback, emerged as key enablers of reasoning development. Conversely, assessment pressures, lecture overload, and overly structured PBL materials were perceived as barriers that limited independent thought. Students suggested that aligning PBL cases with placement encounters, embedding formative reasoning assessments, and fostering a safe environment for reflection may collectively enhance the experiential development of clinical reasoning.

Acknowledgements

Authors contributions

All authors contributed to the study's conception and design.

Declarations

Ethical Consideration
This study was performed in line with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ulster University School of Biomedical Sciences Ethics Filter Committee (FCBMS) FCBMS-22-122-D. The two streams were exposed to the same educational strategies and measurement tools. Students who did not take part in the research experienced no disadvantage. Only those who agreed to be involved in the study and who provided written informed consent were included under the reassurance that any information the participants provided in the survey or interview would be dealt with anonymously.

Disclosure statement
The authors report there are no competing interests to declare.

Data availability
Minimal data for this study are publicly available. Appendices 1–3 available as online supplementary materials upon publication

Funding details
The authors did not receive support from any organisation for the submitted work.

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Appendix 1

The SACRR scores among the study groups in post-test 1, N=14

Questions	Groups	N	Mean	Std. Deviation
1. I question how, what, and why I do things in practice	B	5	4.20	.447
	A	9	4.44	.527
2. I ask myself and others questions as a way of learning.	B	5	4.60	.548
	A	9	4.89	.333
3. I do not make judgments until I have sufficient data	B	5	3.80	1.095
	A	9	3.89	.782
4. Before acting, I seek various solutions	B	5	3.80	.447
	A	9	4.00	.707
5. Regarding the outcome of proposed interventions, I try to keep an open mind	B	5	4.20	.447
	A	9	4.11	.333
6. I think in terms of comparing and contrasting information about a patient's problems and the proposed solutions to them.	B	5	3.40	1.140
	A	9	4.00	.500
7. I look to theory for understanding a patient's problems and the proposed solutions to them.	B	5	4.40	.548
	A	9	4.00	.707
8. If applicable, I check multiple resources/references for planning my intervention strategy	B	5	4.00	1.000
	A	9	4.22	.833
9. I use theory to understand treatment techniques.	B	5	4.40	.548
	A	9	4.44	.527
10. I try to understand clinical problems by using a variety of frames of reference.	B	5	4.00	.000
	A	9	3.78	.667
11. When there is conflicting information about a clinical problem, I identify assumptions underlying the differing views.	B	5	3.00	.707
	A	9	3.44	1.014
12. When planning intervention strategies, I ask "What if" for a variety of options.	B	5	3.20	.837
	A	9	3.89	.601
13. I ask for colleagues' ideas and viewpoints	B	5	5.00	.000
	A	9	4.56	.527
14. I would ask for the viewpoints of the patient's family members.	B	5	4.20	.447
	A	9	3.44	.527
15. I cope well with change.	B	5	3.40	.894
	A	9	3.44	1.014
16. I can function with uncertainty.	B	5	3.20	1.095
	A	9	3.67	.866

17. I regularly hypothesize about the reasons for my patients' problems.	B	5	4.20	.447
	A	9	4.44	.527
18. I must validate clinical hypotheses through my own experience.	B	5	3.00	1.414
	A	9	3.78	1.093
19. I clearly identify the clinical problems prior to planning interventions.	B	5	4.20	.447
	A	9	4.33	.500
20. I anticipate the sequence of events likely to result from planned interventions.	B	5	3.60	.894
	A	9	3.89	.782
21. Regarding a proposed intervention strategy, I think, "What makes it work?"	B	5	4.00	.707
	A	9	4.11	.601
22. Regarding a particular intervention, I ask, "In what context would it work?"	B	5	3.00	.707
	A	9	3.89	.782
23. Regarding a particular intervention with a particular patient, I determine whether it worked.	B	5	4.40	.548
	A	9	4.11	.601
24. Regarding a particular intervention with a particular patient, I determine whether it worked.	B	5	3.40	1.140
	A	9	3.67	1.118
25. I use theory to understand intervention strategies.	B	5	4.20	.447
	A	9	4.44	.527

The SACRR scores among the study groups in post-test 2, N=14

Questions	Groups	N	Mean	Std. Deviation
1. I question how, what, and why I do things in practice	B	5	4.40	.548
	A	9	4.33	.500
2. I ask myself and others questions as a way of learning.	B	5	4.60	.548
	A	9	4.67	.500
3. I do not make judgments until I have sufficient data	B	5	3.80	1.304
	A	9	3.78	.833
4. Before acting, I seek various solutions	B	5	3.20	1.304
	A	9	3.67	.866
5. Regarding the outcome of proposed interventions, I try to keep an open mind	B	5	4.20	.447
	A	9	4.22	.833
6. I think in terms of comparing and contrasting information about a patient's problems and the proposed solutions to them.	B	5	3.60	1.140
	A	9	3.78	.667
7. I look to theory for understanding a patient's problems and the proposed solutions to them.	B	5	4.40	.548
	A	9	4.00	.866
8. If applicable, I check multiple resources/references for planning my intervention strategy	B	5	4.20	.837
	A	9	3.56	1.130

9. I use theory to understand treatment techniques.	B	5	4.20	.447
	A	9	4.44	.527
10. I try to understand clinical problems by using a variety of frames of reference.	B	5	3.80	1.095
	A	9	4.33	.707
11. When there is conflicting information about a clinical problem, I identify assumptions underlying the differing views.	B	5	3.20	1.095
	A	9	3.67	.707
12. When planning intervention strategies, I ask "What if" for a variety of options.	B	5	4.00	.707
	A	9	4.00	.866
13. I ask for colleagues' ideas and viewpoints	B	5	4.80	.447
	A	9	4.44	.726
14. I would ask for the viewpoints of the patient's family members.	B	5	4.20	.447
	A	9	3.89	.928
15. I cope well with change.	B	5	3.60	1.140
	A	9	2.89	1.167
16. I can function with uncertainty.	B	5	3.20	1.095
	A	9	3.22	1.093
17. I regularly hypothesize about the reasons for my patients' problems.	B	5	3.20	1.304
	A	9	4.22	.667
18. I must validate clinical hypotheses through my own experience.	B	5	2.80	1.095
	A	9	3.33	1.323
19. I clearly identify the clinical problems prior to planning interventions.	B	5	4.00	.707
	A	9	3.56	.882
20. I anticipate the sequence of events likely to result from planned interventions.	B	5	3.40	.894
	A	9	3.67	.707
21. Regarding a proposed intervention strategy, I think, "What makes it work?"	B	5	4.20	.447
	A	9	4.22	.441
22. Regarding a particular intervention, I ask, "In what context would it work?"	B	5	3.20	.837
	A	9	3.78	.667
23. Regarding a particular intervention with a particular patient, I determine whether it worked.	B	5	4.00	.707
	A	9	3.89	.782
24. Regarding a particular intervention with a particular patient, I determine whether it worked.	B	5	3.60	1.140
	A	9	4.00	1.000
25. I use theory to understand intervention strategies.	B	5	4.60	.548
	A	9	4.33	.707

Appendix 2

Clinical reasoning questions

Ulster University
SCHOOL OF MEDICINE

Clinical Reasoning MCQs

PBL Case 1:

Unit: Life Protection

Learning objectives:

- **Describe the clinical features of meningitis at each age. (PBL 2)**
- **Discuss the acute and long-term management of meningitis. (PBL 2)**

PBL Case 2:

Unit: Life Control

Learning objectives:

- **Define hydrocephalus and describe its causes and consequences. (PBL 2)**
- **Describe the different modalities for imaging the brain and identify key radiological characteristics of common clinical conditions, with reference to clinical examples. (session)**

A 49 year old man presents to the emergency department complaining of gradual onset headache, malaise and feeling dizzy. He has alcohol dependence and drinks approximately 1 litre of vodka daily. He has not had any alcohol for 12 hours. On examination, he looks unwell, is photo- and phonophobic. His heart rate is 120bpm, blood pressure is 82/42mmHg, respiratory rate is 28/min, his temperature is 38.2°C and his GCS is 11/15 [E3, V3, M5]. He has no known drug allergies. Serum blood glucose is 7.5mmol/L.

Q1. What is the most likely diagnosis?

A. Acute alcohol withdrawal
B. Encephalitis
C. Meningitis
D. Subarachnoid haemorrhage
E. Wernicke's encephalopathy

Q2. What is the most important investigation to perform?

A. Blood culture
B. CT Brain
C. Full blood count
D. Lumbar puncture
E. Throat swab

Q3. If an infective aetiology was considered, what is the most likely potential organism in this patient?

A. Haemophilus influenzae type b (Hib) bacteria
B. Herpes Simplex virus
C. Listeria monocytogenes
D. Neisseria meningitidis
E. **Streptococcus pneumonia**

Q4. What is the most important therapeutic intervention in this case?

A. Acyclovir 800mg IV
B. Ceftriaxone 2g IV
C. Ceftriaxone 2g IV and amoxicillin 2g
D. Dexamethasone 10mg IV
E. Vancomycin IV

A lumbar puncture and cerebral spinal (CSF) analysis is performed following administration of your therapy in Q4.

Results: White cell count 89 – predominantly lymphocytes (Normal range <10)
Gram stain – negative
Protein 1.7g/l (Normal rage 0.1-0.4g/l)
Glucose 3.2mmol/l

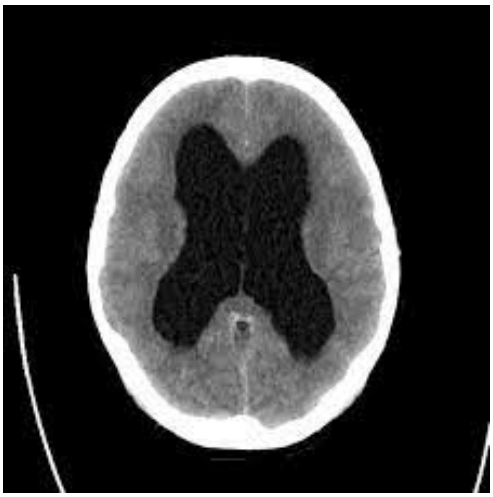
Q5. From the results above, what is the most likely diagnosis now?

A. Ascetic meningitis
B. Bacterial meningitis
C. TB meningitis
D. Viral encephalitis
E. Viral meningitis

Q6. What other investigations would now be a priority?

A. Blood film
B. CSF polymerase chain reaction (PCR)
C. CT thorax and abdomen
D. HIV p24 Antigen
E. Interferon gamma release assay (IGRA)

Within 24 hours of admission, the patient deteriorates further, and his GCS falls rapidly. An emergency CT is undertaken and shown below:



Q7. What is the CT brain scan in keeping with?

A. Acute hydrocephalus
B. Ischaemic stroke
C. Normal brain
D. Periventricular haemorrhage
E. Subarachnoid haemorrhage

The patient is subjected to a trapezius squeeze and is observed to move their arm up to their shoulder. Their eyes open and they make incomprehensible sounds.

Q8. What is their Glasgow Coma Score (GCS)?

A. GCS 7
B. GCS 8
C. GCS 9
D. GCS 10
E. GCS 11

Q9. Given the history and image above, what is the most appropriate immediate management?

A. Administer nimodipine
B. Administer phenytoin
C. Call neurosurgery
D. Ensure patient is lying flat
E. Neurological observations hourly

PBL Case 3:

Unit: Life Maintenance

Learning Objectives:

- **Describe and explain the principal laboratory findings that indicate acute kidney injury. (PBL 1 + session)**
- **Explain how the classification of pre-renal, renal, and post-renal failure determines initial investigation and management of acute kidney injury. (PBL 1)**

A 74-year-old lady is admitted medically with gastroenteritis. She has been vomiting and having severe diarrhoea for two days. On examination, she looks dehydrated. Past medical history includes atrial fibrillation (on bisoprolol and warfarin), hypertension (on lisinopril and amlodipine) and osteoarthritis. Urea and electrolytes reveal:

	Result	Normal ranges
Sodium (mmol/l)	149	**135 – 145**
Potassium (mmol/l)	7.2	**3.5 – 5.4**
Bicarbonate (mmol/l)	18	**22 – 28**
Urea (mmol/l)	19.4	**2.5 – 6.7**
Creatinine (μmol/l)	198	**50 – 110**

Q10. What is the diagnosis?

A. Haemolytic uraemic syndrome

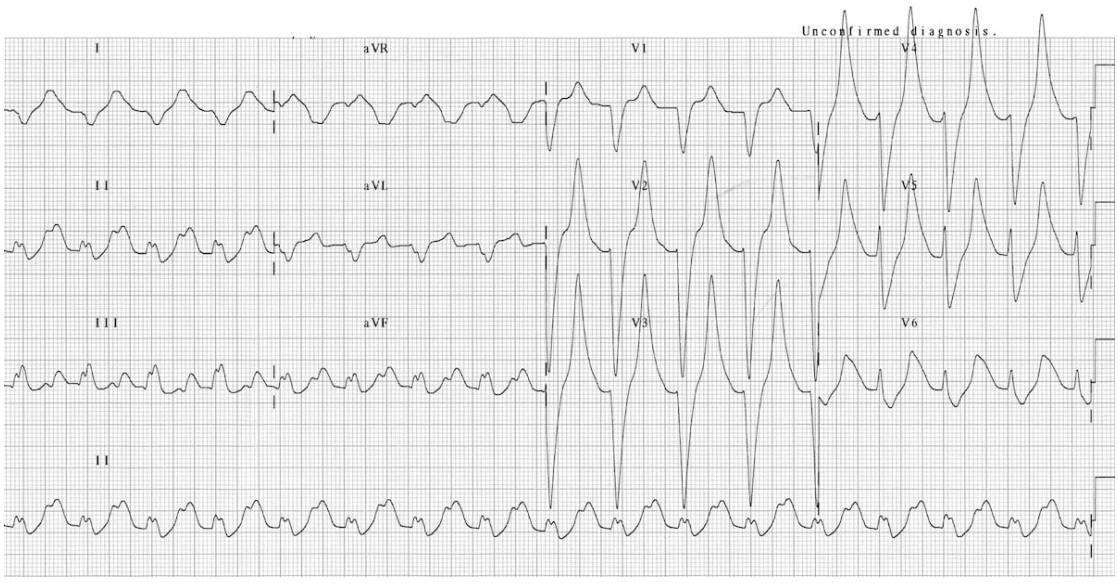
B. Intravascular depletion

C. Post-renal acute kidney injury

D. Pre-renal acute kidney injury

E. Renal acute kidney injury

A 12 lead ECG from this patient shows the following:



Q11. The first line treatment to prevent this patient from having a cardiac arrest should be to?

A. Give 500ml of 0.9% sodium chloride IV
B. Give 50ml of 8.4% sodium bicarbonate IV
C. Give 50ml of 50% glucose and 10 units of actrapid insulin IV over 5 minutes
D. Give 10ml of 10% calcium gluconate over 2 minutes
E. Give 10ml of 10% calcium chloride over 20 minutes

Following administering your treatment in Q11, you review this 74-year-old woman's drug Kardex:

Drug	Dose	Route	Frequency	Sign
LISINOPRIL	10mg	PO	OD	GM
BISOPROLOL	5mg	PO	OD	GM
SPIRONOLACTONE	50mg	PO	BD	GM
TRIMETHOPRIM	200mg	PO	BD	GM
AMLODIPINE	10mg	PO	OD	GM

Q12. Which one of these drugs would unlikely exacerbate the underlying problem causing the ECG changes in Q11?

A. Amlodipine
B. Bisoprolol
C. Digoxin
D. Spironolactone
E. Trimethoprim

The 74 year old woman is admitted to hospital and becomes confused with impaired attention and poor concentration. She is restless and frightened. She is verbally abusive and has perceptual abnormalities. There is no significant previous psychiatric history.

Q13. What is the single most likely diagnosis?

A. Delirium
B. Drug induced psychosis
C. Lewy body dementia
D. Multi-infarct dementia
E. Psychotic depression

PBL Case 4:

Unit: Life Support

Learning Objectives:

- **Define asthma and outline its prevalence in the UK. (PBL 1 + Management session)**
- **Be able to perform and interpret peak flow, spirometry and understand measurement of transfer factor. (PBL 1 + Resp workshop)**
- **Describe the control of respiration and explain common abnormalities of arterial blood gases seen in clinical practice. (ABG session)**

A 27-year-old woman presents to the emergency department with a 4-hour history of shortness of breath and wheezing. Following your assessment of her, you find features of acute asthma. She has a history of multiple admissions for acute exacerbations of asthma.

Q14. What finding would indicate that this exacerbation of his asthma should be regarded as life threatening?

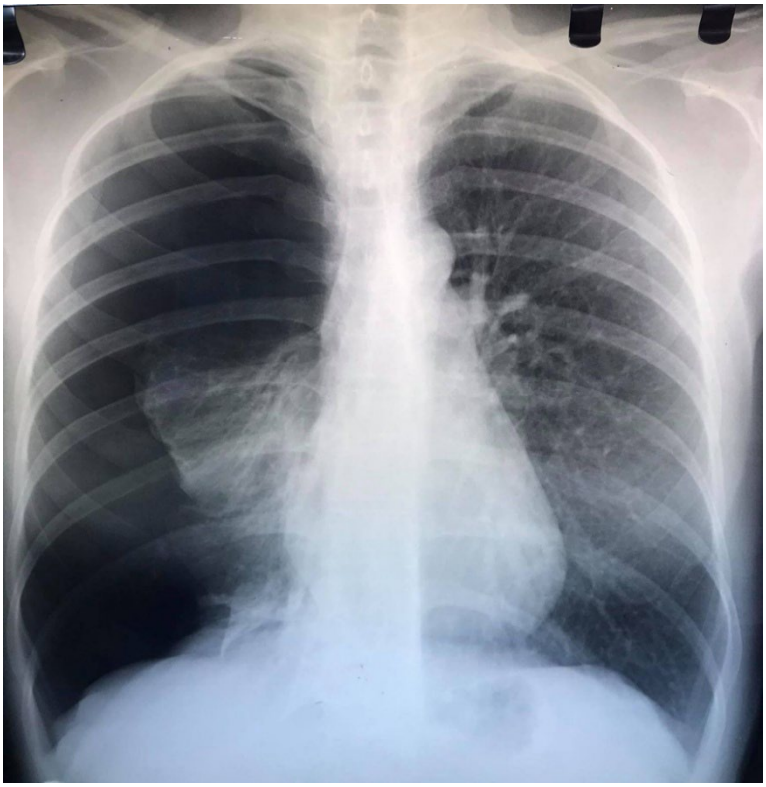
A. $PaCO_2$ 5.3 Kpa
B. PaO_2 of 8.4 KPa on room air
C. Peak flow 35% predicted
D. Pulse 116 beats per minute
E. Respiratory rate 30 breaths per minute

The patient with life threatening asthma is being treated with bronchodilators. She weighs 50Kg and has a current theophylline plasma concentration of 5 mg/L. As she has not improved, the plan is to increase her plasma theophylline concentration from 5 mg/L to 15 mg/L. Theophylline has a volume of distribution (Vd) of 0.5L/Kg.

Q15. What would be the precise loading dose needed to increase the theophylline plasma concentration?

A. 100mg
B. 125mg
C. 375mg
D. 500mg
E. 750mg

The patient deteriorates further with increasing respiratory distress. A chest x-ray is taken and shown below.



Q16. What is the most likely cause of this patient's deterioration?

A. Concurrent lower respiratory tract infection

B. Exhaustion and decompensation

C. Failure of bronchodilator therapy

D. Progression to near fatal asthma

E. Tension pneumothorax

You are a foundation doctor on a respiratory ward managing the asthmatic patient above. You are asked by the respiratory to obtain the patients consent for a chest drain procedure but are unsure of the complications when asked by the patient.

Q17.What is the most appropriate next action?

A. Ask her to sign the form but leave the complications as blank

B. Ask the registrar performing the procedure to obtain consent

C. Due to the urgency, continue without further explanation

D. Give a standard list of complications such as pain and bleeding

E. Tell her that verbal consent is all that is needed

PBL Case 5:

Unit: Life Cycle

Learning Objectives:

- **Outline the basic orthopaedic management of a Colles' fracture.**
- **Describe the pathology and the management of osteoporosis. (PBL 1)**
- **Describe how bone mineral density is used to derive T- and Z- scores in order to diagnose osteoporosis and osteopenia. (PBL 1)**

A 66-year-old woman presents to the emergency department after falling onto her flexed wrist. She is fit and well, a non-smoker and consumes 12 units of alcohol per week. She has never had a fracture before and there is no family history of fractures.

X-rays (AP and lateral) are taken and shown below.

Q18. What is the eponymous name of the fracture shown in the image above?

A. Barton fracture
B. Colle's fracture
C. Reverse Barton fracture
D. Scaphoid fracture
E. Smith fracture

The patient is in severe pain, and you are asked to prescribe analgesia.

Q19. When prescribing for the elderly, which pharmacokinetic factor needs to be considered?

A. Increased albumin binding
B. Increased first pass hepatic metabolism
C. Increased renal clearance
D. Reduced distribution volume for fat soluble drugs
E. Reduced distribution volume for water soluble drugs

This patient is subsequently sent for a dual energy x-ray absorptiometry (DEXA) scan. The results show a T-score of -4.1 in her hip and -2.9 in her spine.

Q20. What is the next most appropriate step in her management?

A. Assess diet and consider calcium and vitamin D supplementation
B. Commence a bisphosphonate, and calcium and vitamin D supplementation
C. Commence denusomab
D. Commence on hormone replacement therapy
E. No treatment, repeat DEXA in 1 year

Appendix 3

The interview guide

Thank you for being available to talk about your experience in developing CR.

I just want to be sure that we are on the same page in terms of discussing CR. It is a term that has many different interpretations and synonyms. What we want to explore is thinking and decision-making processes associated with a clinical practice including the diagnosis of the patient's problem, making a therapeutic decision and estimating the prognosis for the patient.

1. Can I confirm whether did you the clinical placement before or after your PBL sessions?

2. Firstly, I'd like to ask you how you approached the CR test questions. Did the questions provoke any thoughts about your CR skills?

Secondly, I'd like to move on to your own experience of learning CR.

3. Could you describe what differences you noticed in the approach to CR between clinical placement and problem-based learning sessions? Learning approach

4. From your experience what was the effect of alternating clinical placement and problem-based learning sessions on your progressive development of CR skills and how did you cope with change? Which arrangement do you think would allow better development of CR and why?

5. What are the most effective activities that you participated in that promoted your development of CR skills and why?

6. Is there anything else that you'd like to tell me about how your CR has developed during the last year? What were enablers and what were barriers?