**Background**

***What is clinical reasoning and why is it important for paramedic students to learn this?***

Clinical reasoning is a situated, practice-based form of reasoning requiring background scientific knowledge, and applying this to a particular patient using the presented clinical evidence (Benner, Hughes and Sutphen, 2008). Clinical reasoning is an essential component of professional practice and enables health care professionals to analyse the information relevant to patient care. Modern healthcare involves complex decision-making processes, often under conditions of uncertainty (Simmons et al, 2003), necessitating strong clinical reasoning skills in practitioners.

Patient safety is paramount to a healthcare provider (Berwick, 2013); however preventable patient harm affects nearly one in 20 patients within health care services in the UK (Panagioti et a, 2017. In the 2017/18 financial year the NHS paid out more than £1.63bn in damages to clinical negligence claimants (NHS Resolution, 2018). Improving clinical reasoning may strengthen professional practice by increasing the accuracy of decisions and therefore improve patient outcomes (Simmons et al, 2003).

Clinical reasoning is a difficult skill for students to develop due in part to the inability to guarantee awareness or opportunity to develop within time spent in practice. Whilst professional developments within the past few years have established a supportive preceptorship programme within NHS Trusts for new paramedic registrants (The NHS Staff Council, 2016), enhancing activities to develop these crucial skills within a pre-registrant programme should be prioritised in order to enhance the abilities of students and subsequently our new registrants (Quality Assurance Agency for Higher Education, 2016; Health and Care Professions Council, 2017). A better understanding of the reasoning processes used during clinical reasoning may help health care professionals with less experience develop their processes in their own clinical reasoning (Simmons et al, 2003).

The Higher Education environment for health science students is in a period of significant transformation, with changes such as the removal of the bursary, the introduction and first awarding of the Teaching Excellence and Student Outcomes Framework (TEF), the newly established Office for Students (OfS) as well as the increasing effects of Brexit (Council of Deans, 2018). The provision of a high quality academic experience for students with significance placed upon student outcomes and learning gain remains central in the changing environment (OfS, 2018). The University of Surrey was awarded Gold in 2017, in particular for the innovative provisions and digital resources that enhance learning and encourage a high degree of commitment (Bhardwa, 2019). Future iterations of the TEF are to become programme specific and therefore there is a need to evidence the student experience.

***How can we improve the teaching of clinical reasoning?***

Upon successful completion of their degree, students will register and become remote and autonomous practitioners: whilst emphasis within the current curriculum highlights the necessity of awareness of decision making processes, applying these in a non-practice and safe environment is difficult and problematic. Clinical reasoning is complex for teachers to train (Linn et al, 2012), with theory often being difficult to apply explicably within practice, due to unpredictable exposure and practicalities, combined with a lack of time to reflect upon these opportunities. Whilst recent professional developments have established a supportive preceptorship programme for new paramedic registrants, developing these crucial skills within a pre-registrant programme will hopefully enhance the abilities of current students.

‘Think aloud’ is a technique of collecting verbal data about an individual’s cognitive processes during a specific task (Simmons et al, 2003). Following a ‘Think-aloud Loud’ case study presented by Veterinary School colleagues (Trace and Tisdall, 2018), this was adapted to enhance and develop the skills required by health science students. Within the classroom this provided the opportunity for the students to explore gaps in knowledge, developing a socially constructed understanding of concepts and thinking more deeply about those concepts (Bergman and Sams, 2012) in a learner centred model. ‘Think Aloud’ has been utilised in other practise areas and disciplines but has not been applied to UK paramedic education previously. Studies have, however, applied this within a UK higher education model with positive evaluation (Trace and Tisdall, 2018).

**Aim**

This study aimed to evaluate a teaching tool, established in other disciplines, for developing students’ clinical reasoning skills, addressing three objectives: to seek the opinions and experiences of students undertaking this learning activity and their level of enjoyment; a qualitative evaluation to ascertain student belief of validity and awareness of the skills it wishes to develop; and to ascertain the feasibility of this as an ongoing method for enhancing the teaching of clinical reasoning skills. It also explored the potential for embedding similar exercises throughout the programme, assisting students in applying theoretical components of the course to clinical situations.

**Exercise Methodology and Evaluation**

The learning activity was undertaken with 39 third year Paramedic Science students within the induction week for their compulsory and final third year practice module. Details of the exercise were briefed at the start of the session, including its aims and objectives. For this study, participants spoke their thought processes out loud while working through a clinical case. A written case study allows researchers to present essential elements of the case in the order they choose (most likely to reflect best practice) and therefore closely simulate an actual patient with information revealed in segments (Fonteyn et al, 1993). Recordings of these cases can then be listened back to, allowing students to reflect upon their approach to clinical reasoning. Participation in the ‘think aloud loud’ exercise was non-voluntary as a learning exercise to be undertaken. Upon completion of the activity students were given the opportunity to voluntarily participate in an online semi-structured questionnaire evaluating the exercise. There was no requirement to complete the questionnaire and students were free to leave at the end of the teaching session. 32 of 39 students consented to participate. Completion of the evaluation was taken as provision of informed consent. Students were able to contact the lead researcher post completion if they wished to withdraw their consent (none did). The questionnaire responses, including free text answers, were subsequently collated and analysed to allow for an evaluation of the teaching tool and application to clinical decision making, assessing both consideration of self-awareness pre-and post-exercise as well as student evaluation of activity relative to clinical decision making

The research was approved by the University’s Ethics Committee (University of Surrey, 2018).

**Results**

The post-session questionnaire was answered by 32 of the 39 student paramedics, although not all individuals answered every question. The analysis focused on whether or not the students had enjoyed the activity and how easy it had been to navigate; the systematic approach required; the potential benefits of talking aloud; influences on decision making; how the activity could be implemented; and what, if anything, could be improved upon. Verbatim quotations are provided with their unique participant identifier.

Table 1: Participant demographics

|  |  |  |
| --- | --- | --- |
| Age range (years) | Female | Male |
| 18-24 | 15 | 6 |
| 25-34 | 7 | 3 |
| 35-44 | 0 | 0 |
| 45-54 | 1 | 0 |
| Total | 23 | 9 |

When asked about their enjoyment of the exercise, only two students had not enjoyed it, with both commenting that they did not feel comfortable speaking out loud to themselves with other people in the room. Of those who did enjoy it, the task was seen as a novel teaching approach:

 ‘[It was a] fun, useful way to challenge clinical decision making and knowledge’ (P31).

In particular, the logical and systematic approach required was found to be useful, especially when students were only able to see certain information (such as medical history, observations, clinical assessment of systems and clinical predictive scores) at a time.

 ‘It allowed me to apply a very systematic approach and explore all angles of assessment’ (P14).

In terms of how the activity was presented, the format was seen as particularly useful, and students acknowledged that this was an accurate reflection of what they were experiencing in their practice.

 ‘It really helped being able to navigate back to things previously said as in real life you would be able to go back through paperwork, if you have these things written down’ (P24).

Nine students commented specifically on the benefits they perceived from having to talking aloud, with particular reference to the structural approach created. This is in line with historical opinion and teachings within the field and medical consultation models (Croskerry and Nimmo, 2011; Brown et al, 2016; Brown et al, 2017).

 ‘Verbalising my thought process helped organise my thoughts and use a more structural approach’ (P17).

The process of talking out loud was useful for a number of students as a way of ensuring their thought processes were clear and potentially useable by others. If assumptions were made, these could be identified and addressed, as students were aware they were talking out loud and being recorded.

 ‘Talking out loud was a good way to make sure the thought process made some sense because it was like I was trying to explain it to someone else’ (P28).

 ‘Kept correcting self as I made assumptions because I was talking out loud/being recorded’ (P31).

***Implementation into Teaching***

When asked how this technique could be developed for wider use within the curriculum, a variety of clinical presentations were suggested. ‘Homework’ or consistent practice were mentioned – perhaps in the form of a case to work on at home (P1 and P12), after a lecture (P10) or:

‘at the end of a simulation scenario, the exercise could be used as a way of putting into practice what we have learned in a real life setting’ (P11).

 ‘I would like a session with lots of clinical scenarios, 10 different ones that are ‘serious’ jobs that we may not have been to in practice’ (P21).

Timings are a consideration for this format of activity, and how often exposure to it should be in order to achieve optimal benefit. The students were about to enter the final consolidated period of practice placement: one student suggested that:

 ‘it should be implemented regularly to help improve our confidence going back to placement as it enables us to feel more confident ruling out most other differential diagnoses’ (P14).

***Influences on decision making***

Many students commented on how the process of talking aloud had enabled them to question their decisions, allowing them to see where they were potentially forming early conclusions which were not necessarily correct.

 ‘Made me consider differential diagnosis rather than having one idea and sticking with it, which I sometimes do when I think I’m right. Challenged my thought process’ (P6).

‘Talking through findings and referring to guidelines helped my understanding and differentials. Allowed me to explore all options as if I were with a crew’ (P19).

 ‘It put me in the position as the sole decision making using the cues presented. This made me think more than I would in practice where others have an input. This allowed me to explore my clinical reasoning and thought processes’ (P5).

This paradigm is interesting considering the dynamic of supernumerary placements, where the students will have had an ever-present safety net, and absence of overall responsibility; removal of this appears to have prompted reliance upon other clinicians.

Whilst students overwhelmingly enjoyed the exercise, with six commenting specifically that there was not anything they would change, a number of suggestions were put forward by others. The opportunity to debrief afterwards was suggested by three students:

 ‘A debrief discussion afterwards to determine what the answer was and the correct management plan’ (P12).

Other students would have preferred a different environment, or the opportunity to complete it at home.

 ‘I think it would have been better doing it individually without loads of people around as it was quite distracting’ (P29).

Regarding the clinical information provided, there was disparity among some students as to whether there was too little, or too much, and the effects this may have had.

 ‘Whilst I appreciate not everything could be accounted for, [I] would’ve like things like [a] full set of obs as an option, possibly OPQRST pain assessment’ (P10).

‘Maybe remove some of the available tests ‘Wells’ criteria’ etc as they can influence thinking, I never would have thought of Wells’ criteria if it had not been a choice’ (P6).

**Discussion and Conclusion**

Clinical reasoning is key to good practice, as strategies for preventing and reducing diagnostic incidents have the potential to improve patient safety within health care (Panagioti et al, 2017). However, its teaching presents a challenge to both students and teachers. The process of ‘think aloud’ makes the clinical reasoning processes more explicit, enabling inexperienced clinicians to learn from the processes (Pinnock et al, 2015). The exercise allowed students to critically engage with their own methods and processes of working, giving explicit mention to the considerations that had been highlighted through theoretical context with a true clinical focus, in a safe setting. Key aspects highlighted were the opportunity to respond to the information gathered throughout the exercise at their own speed, and with their own prioritisation, rather than anticipating and responding to the perceived will of mentors or staff in practice. Students highlighted that it made them more aware of assumptions they made throughout their patient encounters, and the opportunity to explore information potentially, not immediately apparent, gave further consideration.

The participants voiced disagreement as to whether the information provided in the exercise was satisfactory in quantity and content. The flexible nature of such a format could permit adaptation of the information and difficulty of the activity to the level of student and availability of tests and information within their clinical setting; for example input of radiographs and blood gases for hospital based clinicians, and omission of acute out of hospital providers. Consideration can further be given to omission of certain elements to challenge experienced clinicians undertaking continuing professional development (CPD).

Due to our focus on the reflective process of this learning activity, with the opportunity for self-appraisal at a subsequent time, there was not scope in this initial evaluation to implement a structured debrief. However, for expansion of this across related modules, an opportunity to discuss the case confounding factors and differing opinions and treatment options presented by students is to be incorporated alongside the previously identified mechanisms.

The ability for students to be self-reliant throughout the exercise promotes the independence of thought expected of them as autonomous practitioners upon qualification and subsequent registration, and could assist with transition into practice.

The results of this case study indicate that the teaching method has potential to be effective in its premise of developing clinical reasoning skills within student paramedic education. It stands to complement established teaching strategies, such as core lectures, seminars and supervised practice. This could inform future curricula design and teaching strategy: if its use were to be expanded throughout the course (as requested by a number of participants), it could reinforce and enhance desired student attributes, including self-awareness, and appraisal of individual decision making. It could also contribute to lifelong learning principles and the consideration of the holistic development of healthcare practitioners. This is in line with evidence and conclusions from evaluations within other practice settings (Trace and Tisdall, 2018). If these can be attained, this has the potential to lead to increased patient safety through the increased efficacy and safe working of the registrant paramedic upon graduating from university.

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**Appendix 1- Question Set**

**All questions aside cohort demographics (Q1 &Q2) permitted free text answers;**

1. Gender of Participant

2. Age of Participant

3. Did you enjoy the exercise?

4. Did you find the exercise and the case easy to navigate?

5. To what extent did you consciously think of your clinical reasoning prior to this exercise?

6. To what extent do you agree with the statement "this exercise has developed my awareness of how information and cues affect my clinical reasoning during patient encounters"?

7. In what way did the exercise allow you to explore your clinical reasoning and thought processes as you looked at the case?

8. Do you feel that the exercise allowed you to develop an awareness of your own potential bias or anchoring points within a patient encounter? If so how?

9. Do you feel that repeating this exercise at multiple stages within your course would be beneficial?

10. What would change or adapt about the exercise?