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RESEARCH ARTICLE

REFLECTING ON EXCHANGED STUDENTS' LEARNING: BEDSIDE DEMONSTRATION, CASE REPORTING AND CLINICAL REASONING

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ABSTRACT

Introduction: The increasing opportunities for medical students to participate in international, supervised and structured electives have been evidenced to enhance medical students' professionalism, cultural competence and clinical reasoning (CR) skills in preclinical years. Evidence is scant in achieving the specific learning objectives and improving CR during senior-years. This study evaluates how supervised elective can improve medical students' CR skills through bedside demonstration, case presentation and reporting. **Methods:** This qualitative pilot study recorded daily bedside discussions and cases collections with six students during international elective in a focus-group style. The recorded CR discussions and case collections form the students' reflective themes including CR learning, journal case report writing and impact on ongoing learning. The individual interview design is based on SNAPPS feedback tool and PICO framework. We also collected 6-months/18-months/30-months post-elective reflections for evaluating longer-term academic impact of the elective. **Results:** The five domains of CR learning identified in daily students-supervisors discussions were reflected in-depth by students, and pedagogically evaluated by supervisors in a focus-group style and individual interview. The SNAPPS feedback tool and PICO framework enabled students' completion of case reports for successful journal publication. Students' reflections on their learning at the time of the exchange, 6-months, 18-months and 30-months post-exchange have demonstrated that the elective can improve CR skill learning, case report writing skill, clinical competency. **Conclusions:** This study demonstrated through students' reflections that SNAPPS feedback tool and PICO framework are most valuable for CR learning, case presentation and reporting. The students' reflections have provided insight into how this elective can improve students' CR learning, enhance academic writing skills and facilitate competent clinical practice as junior doctors.

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INTRODUCTION

The increasing opportunities for medical students to participate in international, supervised, and structured electives have been shown in recent study¹ enhancing students' professionalism, cultural competence, and clinical reasoning introduction in preclinical-years. However, evidence is scant in achieving the same goals on clinical reasoning learning during senior clinical-years, especially focusing on the five domains of clinical reasoning including clinical reasoning concepts, history and physical examination, choosing and interpreting diagnostic tests, problem identification and management, and shared decision making.² This study aims to demonstrate how short-term supervised elective can improve students' clinical reasoning skills to empower ongoing self-directed clinical learning through bedside demonstration, case presentation, case report writing for publication.

The integration of bedside demonstration and case report writing into clinical reasoning learning is the central theme for the discussion on the five domain of clinical reasoning learning in this exchanged elective. The 6-stepmodified SNAPPS feedback tool (Table 1) including six sets of questions is used for the interview for evaluating students' reflections, while the case selection for journal case report writing is through the 4-step PICO framework (Table 1) to select the cases with the most learning points for journal publication. Students' reflections at multiple time-points post-elective were collected and evaluated. The ultimate goal is to improve academic performance, promote ongoing learning and ensure clinical competency as a practicing clinician.

METHODS

This is a qualitative pilot study through a small group of medical students' reflections evaluating the impact of using SNAPPS feedback tool and PICO framework for CR learning, case presentation and case report for publication during exchanged elective. This study is qualitative in nature because the study results are generated from the small group of 6 students' thematic reflections at the time of the elective via both focus-group style and individual interviews with longitudinal follow-up reflections via email at three different time points after the elective. Through students' qualitative reflections, the ultimate goal of the study is to investigate whether and how this international elective may improve students' clinical reasoning learning, enhance scientific writing skills with journal case reporting, strengthen academic performance and facilitate clinician readiness for competent clinical practice.

Setting: The six medical students from Australia were in their transition year from preclinical year to the combined preclinical-clinical and full-clinical year. The tertiary hospital in China is one of China's most prestigious hospitals, hosting medical students enrolled in the affiliated medical school. The hospital is ranked second in terms of undergraduate teaching and fifth in clinical services and medical research in China, providing students with plenty of clinical teaching resources. The two medical schools jointly developed the Specific Learning Objectives for the students prior to the commencement of the exchanged elective program. The 19-day program included a 14-day academic program at the tertiary hospital, a regional hospital and an eye hospital. The fourteen-day academic program was pre-planned and the students would visit one or two disciplines daily, based on the outlined Anticipated Learning Opportunities with clinical cases and Case Selection for discussion. Table 2 illustrated the anticipated learning opportunities and case selection and academic schedules.

Participants and analysis: During the nineteen-day period, six Australian medical students attended the academic schedules listed in Table 2 under joint supervision. During the daily ward rounds, students were exposed clinically at the bedside to case studies in medicine, surgery, pathology, laboratory medicine and radiology. The daily schedule included the morning and afternoon sessions with either the end-of-session group plus individual debrief or the end-of-the-day summary plus individual interview for collecting and evaluating reflections. Individual reflection and feedback were again collected via email at 6-months, 18-months and 30-months after the elective to examine the potential impact on ongoing learning and clinical practice as junior doctors. The key takeaways from individual, group debriefs/interview and email collections form the students' reflections in individual presentation. Both individual and group debriefs/interview were conducted using semi-structured individual interview format. A semi-structured individual interview format is the most widely used method in qualitative research, and enables students to delve deeply and reflect on their experiences in anticipation of the emergence of new themes during the reflection.³ The design of individual interviews is based on the modified SNAPPS 6-step feedback tool including the following sets of questions: 'have you Summarized briefly the history and examination problem lists?', 'have you Narrowed the problem lists to the two commonest possibilities and one "not-to-be-missed" red-flag possibility?', 'have you Analyzed the problem lists by comparing and contrasting the possibilities?', 'have you Probed the supervisor by asking questions about uncertainties, difficulties, or alternative approaches?', 'have you Picked the unique case and plan for the case writing for journal submission?', and 'have you Selected learning points for both case reporting and ongoing self-directed learning in the topic?'⁴ During the interview section of case selection for journal publication, supervisors interact with the students through the PICO framework including the following points: 'Problem lists creation in history taking, physical examination and bedside investigation', 'Investigate for supporting evidence to integrate into clinical assessment', 'Correct mistakes, teach general rules and reinforce what was right', 'Outcome

analysis to identify the learning points'. All the reflections were recorded immediately after debrief/interview by the supervisor, then summarized and analyzed by the supervisors from both institutions for the eventual generation of three reflective learning themes including SNAPPS tool with CR learning, PICO framework with case report writing for journal publication and overall impact on ongoing clinical learning.⁵ We chose this thematic approach because it is suitable for analyzing semi-structured, text-based data in an inclusive and rigorous manner.⁶ The students read the transcripts and discussed with supervisors the identified cases for case report writing and case-specific clinical-reasoning learning. This dual process was adopted to achieve higher reliability of the interview-generated reflection, consequently strengthening the learning of both case reporting and clinical reasoning. Two of the case presentations and bedside demonstrations were selected by individual student for case report writing for journal publication. The students have also provided 6-months, 18-months and 30-months post-elective reflection and feedback via email regarding the overall impact on clinical reasoning learning, OSCE exam preparation, academic outcomes and clinical practice as junior doctors.

RESULTS

The students' reflections on the elective's impact on their bedside assessment skills, case report writing, clinical reasoning, ongoing learning, academic performance and clinical practice as junior doctors have formed the results of this article in three themes mentioned previously as SNAPPS for CR learning, case report writing for journal publication and overall impact on ongoing learning. The main themes of case-based clinical reasoning learning identified in the daily discussions and feedbacks were reflected in-depth by the students, and pedagogically evaluated by the supervisors. During bedside demonstration, students mastered the modified SNAPPS framework as an important clinical assessment and reflected discussion tool (Table 1). During case presentations, 123 cases in 23 disciplines were distributed amongst the six students with each student having an average of 20 case presentations during the elective. Each student selected two cases to write case report for journal publication by using PICO framework (Table 1). The five domains of clinical reasoning have been constantly taught under supervision to the students by bedside case presentation and case report writing for submissions to be published in Australian Doctor, International Journal of Clinical Studies and Medical Case Report, and British Medical Journal (BMJ) Case Report. The subsequent observed improvement in clinical reasoning has been well demonstrated in students' clinical placement, case report publication, academic performance. Another bonus point was that students have been introduced to scientific writing through case report writing for journal publication with observed improvement of writing skills while interacting with journal editors and reviewers. All students have passed final examinations of their corresponding academic years with excellent academic results in the top 10% of the corresponding cohorts. Three students have integrated well into clinical practice as intern junior doctors, and provided 30-months post elective reflections claiming the very positive impact of the CR learning through SNAPPS tool and PICO framework on daily clinical practice and ongoing learning. Overall, students' reflections on their learning at the time of the exchange, 6-months, 18-months and 30-months post-exchange have demonstrated the immense academic value of the exchanged elective in improving CR skill learning, case reporting skill associated with scientific writing, clinical competency as junior doctors. Individual reflection in the format of the emerging three themes from the six students has been highlighted below:

Student one: CR learning; I found my supervised elective rewarding. The bedside demonstration, case presentation and case selection provided ample opportunities for senior supervising clinicians and myself exercising "SNAPP/PICO" to obtain a comprehensive management plan and select the case for reporting in journals.

My bedside learning of clinical assessment has been unique, as I was allowed unprecedented access to patients' entire clinical journeys from admission to discharge.

Case report writing for journal publication: The process of selecting case presentation/report writing helped me to deeply understand the complexity and the importance of using the five domains of clinical reasoning in prioritizing management, refine my history-taking skills, understand clinical sequelae and gain confidence in patient-centered communication. I can foresee the "SNAPPS" and "PICO" frameworks being effective clinical reasoning learning tools for future curricular study, internship and career medical practice.

Overall impact on ongoing learning: Six to eighteen months onwards, case report writing created a platform for the academic-nurturing interaction between supervisors and students. These ongoing interactions through case report writing and editing have strengthened my clinical reasoning skills in my clinical placements in rural Perth, in which I have been appraised by supervisors. My Objective Structured Clinical Examination (OSCE) skill has improved through case report writing in time for my exam preparation achieving satisfactory academic results. The most rewarding news would be the two published case reports in *Australian Doctor*⁷ and *BMJ Case Report*⁸ as the formal acknowledgement of the academic achievements. The published case in *Australian Doctor* consolidated my clinical reasoning learning of investigation, diagnosis and management in endocrinology, surgery and medical oncology.⁷ The *BMJ* case report highlighted the clinical learning in the systems of gastrointestinal tract, cardiovascular medicine, and innovative vascular surgery.⁸ I am now confident in clinical assessment, differential diagnosis, and management during my clinical rotations, which help both my final OSCE exam preparation and my intern year in 2022 and serve me well to become a competent clinician.

Now 30-months post elective, I have been junior doctor for 10 months reflecting on the elective with daily clinical experience under constant supervision and support being extremely helpful for my rapport building skill as junior doctor and time management skill. The excellent teaching during the elective helped me as an intern to develop the skills of making connections between different comorbidities and exploring all the different factors that contribute towards a patient's health. Another invaluable skill I gained during the elective was of effective communication using interpreters and learning to respect patients' different cultural norms. Taking together, the elective help make me a more skilled, efficient and empathetic intern than I otherwise would have been. Another reflecting point is of improvement in presentation skills during my elective. Constant constructive feedback every day gave me ample opportunity to learn, apply and refine knowledge. I practiced my summaries and presentations so they were succinct and concise, and, most importantly, I could refine my handovers for different specialties. This quality of bedside teaching is extremely rare, and by the end of the elective I could confidently discuss a patient's case and hand over to every type of health professional. This proved an invaluable skill in every day of my intern year. Throughout the elective, I also gained experience with researching and collaboration, and reading and responding to feedback from editors. This has demystified the process of medical research and made it less intimidating and confusing for me. I have used my personal experience to explain the process of scientific research to my patients, and this has helped them make informed choices about sourcing health-related information. The elective has greatly helped me interpret new medical data and given me essential experience in presenting new information to my colleagues and to patients, both of which have suited me well as an intern.

Student two: CR learning: Our exchange elective to China was incredibly valuable in developing our approach to clinical reasoning. Interacting with patients under supervision allowed us to understand the clinical reasoning process to reach a diagnosis. Bedside clinical assessment under supervision allowed using the "SNAPPS/PICO" frameworks for feedback, reflection discussion and case selection.

Case report writing for journal publication; Case report writing, as a practice of the five domains of clinical reasoning, was effective in improving my clinical approach in comprehensive history-taking, examination, and relevant investigations, also showed me the necessity of explorative process to avoid missing a red-flag diagnosis. During this exchange elective, I wrote up two case reports with the first one being published in *Australian Doctor* on External Counterpulsation, a device used to increase blood return to coronary vessels during diastole,⁹ and the second was published in *BMJ* regarding recurrent polychondritis, a disease diagnosed after exclusion of more serious causes.¹⁰ Case reporting in this way was effective in improving my general structure and approach to a patient including taking a comprehensive history, examination, and ordering the appropriate investigations. It also showed me the necessity of comprehensively going through this process to avoid missing an important diagnosis or red flag symptom. Ultimately, the experience has highlighted diagnostic clinical reasoning in enquiring broadly without confining to a diagnosis early, while critical thinking with systematic approach has put me ahead in my transition into full-clinical years.

Overall impact on ongoing learning; Six months after the elective, I have commenced clinical rotations at rural hospital in Australia, and observed the difference in types of cases presenting to a tertiary hospital in China in comparison to Australia. I found the China elective extremely valuable in practicing the five domains of clinical reasoning at the bedside through exposing me to large volumes of clinical cases in different body-systems. During these placements, I have used "SNAPPS" and "PICO" frameworks in my daily feedback discussion and was constantly watching for case report writing to share with fellow students and supervisors, whom were impressed with my presentation of the case I saw during the elective. Now eighteen months on, my graduation was approaching with intense OSCE exam preparation by applying the style of case-based clinical reasoning discussion and case report writing we constantly used during the elective. I am now very comfortable to be an intern, knowing that I can deliver competent clinical services to the patients.

Thirty months after the elective, I am now an intern at a tertiary hospital in Australia. As I reflect deeply again on our exchange elective, the main skills that were developed during the elective related to how a patient's diagnosis was elicited through a thorough history and examination, followed by relevant imaging and blood tests, with the emergence of the term "Choosing wisely". Seeing more senior clinicians demonstrate their problem solving and reasoning has helped me, particularly for medical specialties, to think holistically for my patients and ensure that all aspects of their care are covered. The elective also strengthened my ability to present cases to my registrar, consultant, and senior doctors at other hospitals or on other teams. Through practice and receiving feedback on our visit, I was able to better identify what was relevant for a case presentation and what could be excluded. This has helped enhance my clinical care by being able to hand over more effectively as well as identify when case presentations are missing relevant information. Additionally, through exposure to case report writing, I have gained the ability to identify what makes a case report good and when it may be lacking in certain information. This has been particularly relevant in weekly department teaching where a member of the team brings a case to discuss. I have felt more confident in voicing my opinions and thoughts about the case and how I may have approached a scenario differently.

Student three: CR learning; "SNAPPS/PICO" was a great outline to keep in my mind entering the exchange program second-time, this goal-orientated approach for feedback discussion at the bedside allowed me to exercise the five domains of clinical reasoning in obtaining key information required to complete the case reports. Information gathering through this approach was invaluable both clinically and professionally for education and collegiality. Under close supervision, I completed two case reports for submission to journals with ongoing clinical reasoning learning through interaction with the journal reviewers. Now the first case was published in *Australian Doctor* regarding a near fatal *Vibrio Vulnificus* Infection

leading to amputation,¹¹ while the second was published in BMJ about a carotid artery dissection and subsequent massive stroke caused by chiropractic massage.¹² Daily reflection with supervisors by using SNAPPS/PICO on the cases and recalling the bedside interaction was an effective way to consolidate clinical reasoning learning from experienced clinicians.

Case report writing for journal publication; Case report writing is an important skill to allow clinicians sharing and disseminating knowledge especially, learning from mistakes, guiding evidence-based practice. As medical students with limited experience and opportunities, case report writing provided the stepping stone to develop both clinical assessment and reasoning skills, thus decision making. This experience has facilitated better transition into full-time case-based learning and effectively retaining critical information. Ultimately, the case report writing and clinical reasoning skills through this elective was vital to my progression from learning to critical thinking to fulfil the requirement of the domains of clinical reasoning, especially in terms of history and physical examination, choosing and interpreting diagnostic tests, problem identification and management.

Overall impact on ongoing learning; The last six to eighteen months of clinical rotations have highlighted the value of the elective with efficient use of SNAPPS/PICO daily with supervisors to consolidate knowledge, promote confidence and critical thinking. The rare cases encountered were also invaluable as I was able to share my experience with clinicians and get an alternate perspective or experience from their careers, motivating ongoing study. Finally, the case report writing has refined my clinical writing skills of getting salient information, enhancing clinical reasoning skills, thus contributing to OSCE and competent intern preparation. After almost 30-months, the skills and knowledge gained during the exchange elective greatly impact my practice as a junior doctor today. The clinical reasoning and case report writing skills developed from the exchange allowed me to think more critically towards each individual patient and provided a framework for me to approach clinical complexities and decision making. I can still recall the unique and rare cases we experienced during the exchange, and it has been extremely satisfying to apply these experiences to my daily clinical practice. A recent example was during a "Hospital Grand Round" where I presented a unique and complex case to the entire hospital. I am grateful for the opportunity given to us to complete case reports as they have helped develop my clinical writing and these skills were invaluable to me during the completion of future manuscripts. Overall, the exchange has shaped my clinical practice and has allowed me to develop into a better clinician.

Student four: CR learning; By applying the "SNAPPS/PICO" frameworks at the bedside discussion with supervisor and case selection, the elective enabled us to improve our clinical reasoning in an engaging manner. After taking histories and performing examinations on patients, we brainstormed and excluded possible differentials as a team. A salient learning point was the process of systematically excluding differentials by analyzing the patient's history, physical examination and investigation results, re-enforcing the significance of using five domains of clinical reasoning in daily practice.

Case report writing for journal publication; Getting involved with case reporting has provided incredibly valuable insight into the thinking processes medical students should adopt when approaching patients. This clinical reasoning process was well reflected in two selected case reports- one was published in Australian Doctor about an unusual case of recurrent pneumonia caused by a tracheoesophageal fistula¹³ and the other was published in BMJ regarding a rare complication of acute retinal necrosis in a young immunocompetent patient.¹⁴ Writing the case reports has reinforced the use of SNAPPS/PICO when approaching both supervisors and patients. The SNAPPS/PICO and five domains of clinical reasoning learning will undoubtedly assist me in my clinical years and postgraduate training.

Overall impact on ongoing learning; Upon reflection 6-18 months later, I have found the SNAPPS framework useful in conjunction with our PBL (problem-based learning) cases. This became particularly useful as contact hours at university were reduced due to the COVID-19 pandemic, and having a systematic approach to new cases enabled me to further self-direct my own learning. The PICO framework has been useful for my interaction with supervisors to select cases for specific learning points and preparation of OSCE exam. 30-months after the elective, my clinical reasoning skill continues to improve, particularly as a year 4 medical student commencing full time placement. The constant use of SNAPPS/PICO during daily placement strengthening my CR skills and case presentation and reporting to my supervisors. The two case report writing has enabled me to interact with editors with improvement in my scientific writing skills and research capability. The learning style I adopted during the elective has now become my main study style, and by applying the style, it is easier for me to remember and understand different pathologies.

Student five: CR learning; An intensive two-week elective to practice clinical assessment skills daily with bedside demonstration by using the "SNAPPS/PICO" framework has changed the way I study medicine for the better. Supervised history taking highlighted the importance of having a systematic and logical approach, categorizing differentials in an organized manner either by body-systems, pathological processes, or by 'can't be missed' - red flag diagnoses. This approach has echoed the five domains of clinical reasoning learning and become the center of my studies after the elective, allowing me to envisage theory into a clinical context. As a result, I now write down three-to-five pertinent questions to ask for every disease/pathology, making me to choose wisely on relevant investigations and management, as how I prepared the two published case reports including one case on achalasia in a patient with progressively worsening dysphagia¹⁵ and another case about cervical spine abscess and osteomyelitis in a patient with rapidly progressive body paralysis.¹⁶

Case report writing for journal publication; In preparing the case report on achalasia, I was able to learn about several esophageal and gastric conditions that present with dysphagia, and history taking 'clues' that can assist in narrowing down the condition. Furthermore, I was able to research several surgical techniques in esophageal motility dysfunction. The case report on cervical spine abscess taught me the more structured "SNAPPS" approach to history taking, physical examination and investigations regarding widespread paresis. I was interacting with my supervisor by using the SNAPPS/PICO and taking 'clues' that can assist in narrowing down the diagnosis and establishing the most appropriate management. I found the task to write case reports after the bedside history taking essential in reinforcing the knowledge I learnt in wards and teaching me the real-life clinical reasoning process, which I need to become a competent intern as well as preparing my OSCE.

Overall impact on ongoing learning; My ongoing study 6-months/18-months after the elective has greatly reminded me the "SNAPPS/PICO" framework used for clinical assessment and case selection. The COVID-19 pandemic has had a significant impact on our contact hours at university, and studying medicine became more self-directed than ever before. I really learnt to appreciate the bedside demonstration, case presentations and the five domains of clinical reasoning during the elective, through simulated patients I found "SNAPPS/PICO" framework can prioritize my clinical reasoning learning to progress me from student to clinician. During the last 12 months of my rural clinical rotation, I had many opportunities to clinically apply the "SNAPPS/PICO" framework with real-life patients. I found the framework and case report writing extremely helpful to prepare me to be a competent intern in the year of 2023. 30-months has lapsed since the elective as I just completed my final exam and will start practice as an intern in 2023, I reflected in retrospect the elective was concise, intensive across major specialties in Medicine.

The high volume of patients from each specialty, as well as seeing the common, dangerous, and rare conditions of each specialty introduced a wide differentials list, that was vital when starting clinical placement. One particularly skill that I constantly use, is eliciting specific symptoms to narrow the differential tree; such targeted history taking was a key focus in SYSU, where language barrier necessitated focus questions. This has also kept me in good stead with case presentations, where focus questions highlight the relevant negatives. Furthermore, the presentations and teachings from consultants and SYSU continue to form important considerations in my case presentations, especially with regards to determining patient disposition and further care. The elective also encouraged us to keep case notes / reports for interesting teaching points. I continue to practice this in my weekly learning practice, where case reports inform further learning points for myself. The elective, therefore, has put me in good stead as an intern next year for continued learning, daily clinical practice, and case presentations to senior doctors.

Student six: CR learning; The elective has given the opportunity to develop our clinical reasoning skills, primarily through interaction with supervisors by using “SNAPPS/PICO” during bedside demonstrations and case report writing. “SNAPPS/PICO” allowed me to identify the key points in a given case with more clarity and direction. The demonstration of clinical skills in a structured bedside setting helped shed light on the thought process clinicians undergo. The active participation in clinical reasoning with experienced doctors has built the confidence of patient interaction, case identification and case report writing. Writing case report allowed me to dissect and reflect on the five domains of clinical reasoning process for a final shared decision making under the close supervision of experienced doctors, whom discussed the case with us in great detail, allowing us to develop a deep understanding and appreciation of the clinical reasoning process.

Case report writing for journal publication; Scientific writing is fundamental for career clinicians, introduction of case report writing included one patient with aortic dissection and another with sciatic nerve endometriosis. The case report writing built starting points for scientific writing and research. Clinical reasoning learning in five domains has been efficacious through bedside clinical assessment using “SNAPPS/PICO” and interacting with editors and supervisors when answering editorial questions, a boost to OSCE preparation. The most rewarding news is the publications in reputable journals of both cases including one case with aortic dissection¹⁷ and another case with sciatic nerve endometriosis¹⁸. I am now looking forward to progressing to be a competent intern in my final year study as long as I can continue to apply the “SNAPPS/PICO” framework in the daily clinical reasoning learning.

Overall impact on ongoing learning; Six to eighteen months on, the elective has paid great dividends in three areas including knowledge retention, clinical reasoning and scientific writing. A wide range of patients with various conditions, both common and rare, enhanced my knowledge retention by making the link of pre-clinical learning with real-life patients. The various rare cases extended the learning boundary to case report writing. I just passed my final exam and will start career medical practice in 2023. As I reflected on the elective again 30-months after, the impact of the elective for my CR learning as a final year student, whilst positive, is difficult to quantify. The primary benefits of the elective come from its nature of being, in essence, an intensive bedside teaching round, in which we were encouraged to use our reasoning to diagnose and formulate management plans across various specialties in a supportive environment. As a result, going into clinical placements I had more confidence in my own clinical reasoning. The elective took place in a major teaching hospital, giving access to patients with rare pathologies or atypical presentations, the so called ‘zebras’ of medicine. As such during final year, I feel more confident in recognizing them should they present, whilst also serving as a constant reminder that there is still a lot in medicine that I haven’t come across yet. As the elective was my first real-life experience with case presentations, where we were given close supervision to work on our

presentations, my presentation skills had progressed greatly, giving me a solid foundation to build in the ensuing clinical years. Another great outcome of the elective that I was most appreciative and impressed was those of two published care report and the academic interaction with journal reviewers and editors. This interactive academic discussion helped me familiarize myself with case report writing early in my education, making the process easier for career medical practice in 2023.

DISCUSSION

This reflection has demonstrated how the five domains of clinical reasoning was taught and learned through bedside demonstration, case presentation with reflective discussion, and case selection for case report writing. The ultimate goals of this qualitative study through students’ reflections will include improving students’ clinical competency, reducing theory-practice gap, consolidating the learning of clinical reasoning, understanding the essential preparations to become a competent junior doctor for safe and patient-centered career medical practice

Bedside clinical skill demonstration: Bedside clinical teaching is known to be difficult to implement because it is obviously resource intensive with many factors including increasing workload and need for efficiency in clinical departments, service provision, and patient care, which may take priority over teaching when resources are limited.⁷ There may be factors specific to the learner, teacher, patient, environment, and ethical issues. However, bedside teaching has been well documented to provide benefits in terms of role modelling, staff recruitment and retention, formative assessment of learner’s performance, continuing professional development of the teacher and quality improvement, both clinically and educationally. The elective students had been provided with formal bedside teaching including pre-selected cases, two dedicated tutors, and inpatient availability of all departments. Recent evidence has demonstrated that formal bedside teaching is effective if organized with adequate staffing to quarantine the teachers or tutors, and concentrating on case presentation, case selection and clinical reasoning discussion.¹⁹ The five domains of clinical reasoning were perceived to be most important, exerting good patient outcome through comprehensive assessment with “SNAPPS” and “PICO” frameworks leading to prompt shared decision making.² Bedside demonstration has laid the foundation for the eventual case presentation and selection for writing case report and integrate the clinical reasoning into the learning objectives. Bedside demonstrations have also been shown to be useful for providing an overview of the complete set of clinical skills to be learned, especially when an overview is provided early in the learning process of preclinical and transitional clinical years, as evident in this elective of how the five domains of clinical reasoning were taught and learned.^{20,21,22}

Another salient point from the reflection is case presentation and selection for case report writing for journal submission. It has been shown to be an expected outcome of this elective in enhancing clinical reasoning skill. Case presentation has always been one of the most valuable and evidence-based tools of medical education for presenting challenging medical cases to medical students, junior doctors and even consultant physicians.²³ Clinical learning during medical school is mainly case-based.²⁴ Most of the important educational objectives that case reports introduce include enhancing awareness of rare disorders to facilitate diagnosis, clarifying new aspects on disease’s etiology, clarifying misunderstood treatment response, and describing how to avoid future mistakes.²⁵ During this elective, students have been able to select the cases from their many bedside demonstrations and recognize the answerable clinical question, and then to find current best evidence to answer this question by performing a thorough and effective literature review. During the literature review, students critically analyzed the medical literature and chose the appropriate reference to support the case. By writing a case report, students gain experience in literature review and medical writing as well as experiencing the steps of evidence-based

Table 1. Modified SNAPPS and PICO

Modified SNAPPS for the exchanged students' case report writing	
1.	Summarize briefly the history and examination problem lists
2.	Narrow the problem lists to the two commonest possibilities and one "not-to-be-missed" red-flag possibility
3.	Analyze the problem lists by comparing and contrasting the possibilities
4.	Probe the supervisor by asking questions about uncertainties, difficulties, or alternative approaches
5.	Pick the unique case and plan for the case writing for journal submission
6.	Select learning points for both case reporting and ongoing self-directed learning in the topic
Modified PICO for supervisors' & students' bedside teaching of clinical reasoning	
1.	Problem lists creation in history taking, physical examination and bedside investigation
2.	Investigate for supporting evidence to integrate into clinical assessment
3.	Correct mistakes, teach general rules and reinforce what was right
4.	Outcome analysis to identify the learning points

Table 2. Illustrated the anticipated learning opportunities and case selection and academic schedules

Academic Schedules	Anticipated Learning Opportunities and Case Selection
Day 1 Department of Laboratory Medicine and Department of Cardiology	Brief Introductory Lectures on haematology, serology, microbiology and immunology with case studies; Common cases (Ischaemic Heart Diseases, Heart Failure & Atrial Fibrillation) teaching ward round, Case selection discussion
Day 2 Department of General Surgery (Thyroid and Breast) and Department of Gastrointestinal Surgery	Common cases (Thyroid and Breast surgery) Teaching ward round with Case selection discussion & Operating Rooms observation, Common cases (Upper and Lower GI malignancy and Inflammatory Bowel Diseases) Teaching ward round with Case selection discussion & Operating Rooms observation
Day 3 Department of Medical Imaging (Radiology and Nuclear Medicine) and Department of Intensive Care Unit	Brief Introductory Lectures on X-ray, Ultrasound, CT scan & MRI Scan; X-ray case studies and learn to interpret CXR, AXR and Musculoskeletal X-ray with Case selection discussion; Common cases (Respiratory Failure, Multiorgan Failure and Septic shock) Teaching ward round with Case selection discussion
Day 4 Department of Hepato-Biliary Surgery and Department of Respiratory Medicine	Common cases (Heart, Respiratory and Multi-organ failure; Renal failure and other Chronic Renal Diseases) teaching ward round, Routine Renal Medicine ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection
Day 5 Department of Gastrointestinal Medicine (Endoscopy Unit) and Department of Obstetrics	Lectures on basic blood test results (FBC, U+E, LFT, TFT, Fasting Glucose, HbA1c, Lipid profile) interpretation and case studies; Histology sample preparation (Frozen section) Teaching ward round with Case selection discussion
Day 6 Department of Neurology and Department of Rehabilitation Medicine	Lectures on X-ray, Ultrasound, CT scan and MRI Scan; X-ray case studies and learn to interpret CXR, AXR and Musculoskeletal X-ray; Teaching ward round with Case selection discussion
Day 7 Department of Anaesthesia and Pain Medicine	Common cases (Lower limb trauma, Joint replacement and Osteoarthritis) teaching ward round, Operating Rooms observation, Physical Signs Learning and Discussion of Surgical Complications; Emergency case management
Day 8 Department of Plastic Surgery and Microsurgery and Department of Vascular Surgery	Common cases (Stroke, Movement Disorder and Degenerative disorders) teaching ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection
Day 9 Department of Haematology and Department of Bone Marrow Transplant & Plasmapheresis	Common cases (Ischaemic Heart Diseases, Heart Failure and Atrial Fibrillation) teaching ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection
Day 10 Department of Endocrinology and Department of Dermatology	Common cases (Type I and II Diabetes and its complications, Thyroid diseases and Pituitary diseases) teaching ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection
Day 11 Department of Paediatric Medicine and Department of Neonatal Intensive Care Unit	Common cases (Rheumatoid Arthritis, Cutaneous and Systemic Lupus and Mixed Connective tissue diseases) teaching ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection
Day 12 Department of Ophthalmology and the Eye Hospital	Common cases (Asthma, Chronic Obstructive Pulmonary Diseases, Interstitial Lung Diseases and Lung Cancer) teaching ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection
Day 13 Department of Renal Medicine and the Dialysis Centre	Common cases (Anaemia, Clotting Disorder and Malignancy) teaching ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection
Day 14 Department of Rheumatology and Immunology and Department of Medical Oncology and Radiation Oncology	Common cases (Connective tissue diseases, Leukaemia and Lymphoma) teaching ward round, Physical Signs Learning and Discussion of Diagnostic workup and case selection

medical practice, which consists of formulating a clinical question, finding the best evidence, critically appraising the evidence, and applying the evidence to the patient. Each of the six students has already had one case report published in *Australian Doctor*, which is the most read clinical journals among clinicians. Another case for each student has been published in *BMJ Case Report*. A case report including evaluating a patient's medical history, performing a physical examination, considering various differential diagnosis, selecting a treatment plan, and considering various side effects and outcomes of treatments provide an educational platform for students' learning of the five domains of clinical reasoning, albeit will not have as much potential impact on clinical practice as randomized controlled trials or other cohort research.²⁶

However, well-written and appropriately structured case reports with meticulous attention to the very minute details will contribute to the medical literature and can still enrich our knowledge in today's evidence-based medical education. The case reports written by the students from this elective certainly reflect this important educational message despite the fact that they are inexperienced and novice authors.

In line with the students' reflection, case reports provide the opportunity to engage in simpler scientific writing before pursuing more advanced forms of medical writing. Case reports provide an early opportunity to publish outside formal scientific research projects.^{27,28}

They engage a pertinent clinical question, and give students practice in research and assessment skills that forge competent clinicians.²⁹ Another recent study identified five educational benefits of case reports for medical students including developing observation and pattern recognition skills, developing hypothesis-generating skills, understanding patient-centered care, writing skills and rhetorical versatility, and the case report as a “mini-thesis”.³⁰ Such benefits have been observed in the clinical placement after the elective, when students learn self-criticism, hone hypothesis-generating skills through case report writing and answer editors’ arguments and criticisms by analyzing how to implement the most up-to-date research evidence into clinical practice. Implementing updated research evidence into clinical practice is the fundamental element of ongoing training for a competent clinician, as evidenced by a recent study.³¹ In this study, graduate trainees stated that they acquired most of their competences of implementing research into practice by on-the-job experience of clinical case management, self-study and ongoing professional education. Case reporting writing with this elective has certainly laid the foundation of ongoing training for medical students in terms of evidence-implementation skills in clinical practice, consequently fostering the lifelong learning of a competent clinician. This elective highlighted two other educational points including students’ longitudinal follow-up reflections at different time-points and the integration of bedside demonstration and case report writing into the five domains of clinical reasoning. Clinical reasoning has been defined as a way of critical thinking and decision making in clinical practice³², requiring clinicians to analyze a cluster of clinical presentations, create a list of differential diagnosis and develop a management strategy.³³ The process of clinical reasoning is undertaken by all clinicians, usually automatically, similar to the “SNAPPS” and “PICO” approaches used in this elective, and is the cognitive process that underlies differential diagnosis and management of clinical presentations.³⁴ The dual cognitive process from cognitive psychology theory^{35,36,37} showed that the reasoning process consists of System 1 and System 2 processes.^{38,39} System 1 is an intuitive thinking process, which is unconscious and quick but at the same time it is prone to various cognitive biases⁴⁰, while System 2 is an analytical thinking process, which is deliberate and slow⁴¹ to reduce System 1 biases physicians use instead with System 2 process that assesses whether a diagnosis made using the intuitive process is correct or not by analyzing more information.^{42,43} The combination of System 1 and 2 will certainly ensure the safest outcome of the clinical reasoning process applied by the clinician. Recent research indicated clinical reasoning is fundamental to medical education and practice⁴⁴ and was one of the most important indicators of competent clinicians. However, clinical reasoning is often regarded as difficult to conceptualize and teach, posing challenges to clinical teachers.^{45,46} Recent evidence showed motivated clinicians showcasing the pivotal role of clinical reasoning for more efficient teaching and practice in systematic and evidence-based manner, making clinical reasoning being regarded as an art rather than a science.⁴⁷ This reflection paper has certainly focused on promoting the learning of the five domains of clinical reasoning through the students’ reflections during the elective and six months after. CR learned by the students during this elective and after is using system 2 by dissecting the clinical management steps through case report writing. Selecting an appropriate case to report for publication is how system 2 was used in practice. The academic benefits of writing a case report for journal submission will inform curricular development in terms of theoretical study, OSCE exam and clinical placement. CR learned by the students through bedside demonstration and case report writing during this elective has a similar approach as the Script Concordance Test (SCT) being increasingly used in ongoing postgraduate medical education in CR. Script theory explains how physicians progressively acquire knowledge adapted to their clinical tasks.^{48,49} The SCT is a tool for assessment of clinical reasoning that is increasingly being used in continuing professional development in medical education.⁵⁰ SCT is the unique form of clinical assessment based on clinical scenarios designed to measure clinical data interpretation. An expert reference panel, including 10-20 members with different disciplines, are recommended for optimal reliability on the learning outcomes.⁵¹

Reflecting on our exchange elective, and students’ reflections in terms of bedside demonstration, case reports and integrated clinical reasoning learning have only two supervisors on the expert reference panel. One would propose that we will gain more learning points for CR if their reflections can be reviewed and discussed by more supervisors from different disciplines. Thus, we can plan our next exchange elective by adopting SCT style with involvement of more supervisors for discussion and feedback from research perspectives. Our case report writing for the students has provided a platform for case-based review of the selected cases to maximize the learning outcome. The highlighted benefit of this collaborative exchange elective is of adequate resources of cases especially for the students to learn on a pre-organized teaching ward round. We need to plan multi-specialty feedback sessions at the next exchange elective. During the ensuing clinical placement, they have not only used the “SNAPPS” and “PICO” frameworks but also referred the cases to multiple supervisors for advice to increase the learning input. Another important aspect of clinical reasoning during the elective is that recent review⁵² has observed clinical reasoning’s variation with the clinical context influenced by patient factors, doctor factors, and environmental factors. Research about clinical reasoning has tended to focus on the individual, assessing their ability to perform clinical reasoning tasks. This review identifies areas for continued research, including which contexts have a negative or positive impact, and the effect of multiple contexts (cognitive loading) on clinical reasoning. In terms of patient factors, recent study showed 25 physicians videotaped encounters by altering one or more contextual factors including low English proficiency, emotional volatility, incorrect diagnosis suggestion, or atypical presentation. The research team found that participating physicians were more likely to misinterpret key clinical reasoning data if two contextual factors were present. The research team postulated that multiple contextual factors led to increased cognitive load, leading to a negative perception of the clinical situation, consequent mistaken interpretation, and adverse clinical reasoning outcome.⁵³ During our exchange elective, low English proficiency may be one of the major patient factors impacting on the clinical reasoning learning despite our supervisors being shadow as language translators. Another study looked at patient’s disruptive behavior and diagnostic difficulty of presentation. Diagnostic accuracy was significantly lower for both the difficult patients ($p=0.017$) and the diagnostically difficult cases ($p<0.001$), however applying clinical reasoning with critical reflection did improve diagnostic rates ($p=0.002$).⁵⁴ The research team repeated the study by investigating why difficult patients reduced diagnostic accuracy by providing cases to 74 physicians including half with ‘difficult patient’ and half with ‘neutral patient’.

The study concluded that diagnostic scores were significantly lower for difficult patients ($p < 0.01$) and participating physicians recalled fewer clinical findings and more behavior observations from the difficult patients ($p < 0.001$).⁵⁵ During our elective, we have come across ‘difficult patients’ with behavioral issues impairing the accuracy of the clinical reasoning process and the initial clinical diagnosis. The eventual positive outcome was reached by the clinical management discussion with the patient and next of kin in a clinical priority way. The students did greatly appreciate their clinical reasoning learning through a difficult patient. Another interesting study looked at patient appearance and the effect on clinical reasoning. Participating physicians were given case-based scenarios with classed patient pictures as ‘poor and dirty’ in appearance or as ‘rich and clean’. There was no significant difference in diagnostic accuracy, however participating physicians reported processing the case more extensively if the patient appeared ‘rich and clean’ ($p = 0.04$).⁵⁶ The study has three major limitations. One was that we only collect feedback or reflections from supervisors at one tertiary hospital about the students’ learning during the elective. Further research should focus on feedback from both supervisors and students. A second limitation of this study is that longer term reflections and learning outcome is somewhat disrupted by the COVID-19 lockdown and online curriculum delivery, at least with the 6-months and 18-months post elective. Students have very limited face-to-face access to patients and cases during the longer-term

follow-up. Through further face-to-face follow-up interview with both students and supervisors, the five domains of clinical reasoning will be even more integrated into their future daily clinical practice with facilitation of career choices and evidence-based care for patients. The third limitation about the study will be lack of adequate consideration of teaching clinical reasoning at real life context, especially patient factors because supervisors in charge have preselected all the cases for a teaching ward round at different disciplines.

CONCLUSION

This qualitative study clearly demonstrated through students' reflections that SNAPPS feedback tool and PICO framework are most valuable for CR learning, case presentation, case report for publication and ongoing postgraduate learning as practicing clinicians. The students' reflections certainly provide insight into how this international, supervised and structural elective can improve students' learning of the five domains of clinical reasoning in ongoing medical training, enhance scientific writing skills through case report writing, and strengthen academic performance in achieving the designed outcomes of competent clinicians. These students accomplished their learning outcomes under joint supervision from both institutions by daily case discussion and using the five domains of clinical reasoning framework in different disciplines at the tertiary hospital in China. The students have been provided many opportunities to incorporate the clinical reasoning learning into the case report writing and learning during their placements. The clinical reasoning skills learned from these experiences enhance the way clinical reasoning being taught by supervisor to improve students' clinical placement training, which has translated into their clinical academic performance and ensure the smooth transition from medical students to competent interns. This paper has improved the understanding of both supervisors and students in recognizing the effect of this elective on motivating the ongoing learning of clinical reasoning at the bedside. The paper also suggests that short-term elective of undergraduate medical students may open an exciting avenue for further research with international collaboration to build upon the existing literature and innovative ways of teaching clinical reasoning and facilitating the transition from students to competent clinicians.

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Consent to Participate: I confirm all participants have provided appropriate informed consent to participate in the study.

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