Bekti RS & Seputra KP, JPKI, 2025;14(2): 116-129
doi: 10.22146/jpki.105471

CASE STUDY/CURRICULUM STUDY/POLICY STUDY

Clinico-moleculo-pathological Conference (CMPC): A Clinical Teaching Method to Optimise Knowledge Integration and Collaboration in the Workplace-based Specialist Education

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Submitted: 17 March 2035; Final Revision: 4 June 2025; Accepted: 18 June 2025

ABSTRACT

Integrating current molecular knowledge and research with real-world clinical and pathological conditions is a critical step in finding the most appropriate approach for modern and personalized patient care. A modified clinicopathological conference, called the Clinico-molecular-pathological conference (CMPC), was introduced in one out of five introductory specialist training courses at our teaching hospital. It is intended to enhance the application of basic biomedical sciences, particularly biomolecular aspects, in integrated clinical care and personalised medicine. We attempted to analyse the CMPC's implementation and its educational impact from the perspectives of trainees through a program evaluation activity adopting the first two levels of the Kirkpatrick Pyramid. From 4 batches (2022-2024), 433 out of 447 residents (96.87% response rate) responded to our online program evaluation questionnaire. From the reaction and learning level, the CMPC has convincingly been favoured by residents as an engaged learning method for elaborating basic medical sciences, especially biomolecular topics, into a real clinical and patient care context. Despite the poor correlation of the course's overall satisfaction to the CMPC mark and final course marks ($p>0.05$), there is a positive and significant correlation between CMPC mark and Course Final mark ($r=0.39$; $p=0.00$). Qualitative response to the survey triangulated the acceptance of CMPC as a promising learning method to promote integrated learning as well as multidisciplinary collaboration. The case study provides insight into how CMPC is favoured by the residents to learn difficult subjects, and is related to academic achievement. CMPC is also perceived to be a promising method to promote integration in patient care in medical specialist education. Further research is needed to optimise both the educational and quality service impact of the CMPC in the workplace-based medical specialist education.

Keywords: CPC, postgraduate medical education, program evaluation, teaching in the workplace

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INTRODUCTION

With the development of science, technology, and the latest medical services, it is possible to take an individual approach by considering the genetic uniqueness and physiological response of the patient so that therapy is carried out in a personal and precise manner, which is later known as the precision medicine approach[1,2]. In developing countries, the practice of precision medicine has often appeared as a discourse rather than a progressive practice due to many challenges, such as the inability to purchase high-technology, or supply chain problems in the availability of cutting-edge biology materials/ reagents to perform biomolecular laboratory examinations. However, the development of internet access has made it possible to scientifically address patient problems with the knowledge gained from literature reviews of the latest approaches, including molecular and genomic approaches that form the basis of precision and personalised medicine practice. Despite a lack of use of the latest medical technologies, medical specialist education still has to prepare future specialists with the necessary knowledge about molecular and genomic aspects of medical care by providing sufficient time and learning modalities. Unfortunately, there has been a limited choice of teaching-learning modalities that can stimulate integration of molecular and genomic knowledge and care in our medical specialist programs.

Exposure to applied molecular medicine knowledge to clinical practice has been carried out as a mandatory course in our medical specialist education/residency training for all specialist fields since 2018 through a course called the Molecular Biology and Immunology Applied for Clinical Practice (MBIACP). The course is part of an intercalated integrated program called the Pre-Residency Education and Training Program (P4R), which is required to be taken by all specialty trainees (residents) before their specialty training. However, in its implementation, the MBIACP course received unfavourable feedback from trainees related to its daunting applicability and difficulty in integrating into clinical (routine) practice. After the COVID-19 pandemic, the P4R team tried to redesign the learning method in the MBIACP course by introducing the clinico-moleculo-pathological conference (CMPC). The CMPC model was introduced as a development of the Clinico-Pathological Conferences (CPC), which have been traditionally used in a limited number of our specialist education programs to discuss and find cross-speciality solutions for highly complex clinical cases. In our experience, CPC has primarily been used for service purposes, and therefore, only a few specialist education programs use it. However, with the increasing demand for integrated and personalised medical services that require multidisciplinary approaches to solve unique patient problems, CPC has the potential to be a promising learning method to enhance not only collaborative handling skills, but also in-depth analysis of molecular and genomic aspects of patients' problems. CMPC was introduced in 2022 with an additional requirement to elaborate on the biomolecular aspects of the problem or disease discussed. Therefore, the introduction of CMPC aimed at two purposes: 1) to explicate the molecular aspects of disease in a real case discussion and 2) to promote the integration of knowledge on molecular aspects of disease into integrated and individualised patient care.

This study aimed to evaluate the utility of the clinico-moleculo-pathological conference (CMPC) as an adaptive teaching learning method to raise awareness about the importance of precision medicine literacies, especially on the integration of molecular and genomic knowledge into integrated medical specialty practices.

METHODS

Sample

The study is a part of a program evaluation framework using data from the program evaluation questionnaire distributed at the end of the MBIACP course. All specialist residents were provided with an anonymous questionnaire asking about their perception of the satisfaction and the value of

the course being conducted. The questionnaire contains quantitative and qualitative components. The quantitative uses a 5-Likert Scale response, and qualitative components consist of open questions regarding the general and specific feedback to any course or concerns. The data for the study were extracted from batch one (2022) to batch four of the program (January 2024). The quantitative analyses were performed by using RStudio, and the qualitative responses relevant to MBIACP were analysed using content analysis.

CMPC as a modification of CPC

Clinico-Moleculo-Pathology Conference (CMPC) is a development of the activities Clinicopathological Conference (CPC). CPC is a form of clinical practice-based activity introduced by Dr. Walter B Cannon and Dr. Richard Cabot at Massachusetts General Hospital (MGH), one of the main teaching hospitals in the Harvard Medical School, United States, in 1910[3]. The idea of CPC, from the story told by Canon in the inaugural edition of CPC in the Boston Medical and Surgical Journal (precursor to the New England Journal of Medicine /NEJM), was adopted from the case-based teaching supervised by Professor Christopher Langdell at Harvard Law School[3]. As a form of learning activity, CPC was introduced by Richard Cabot in the form of a 4-hour activity. This CPC report then becomes one of the forms of scientific activities/publications in the NEJM journal since 1924. The classic CPC model usually begins with a case presentation by an educator doctor at MGH who provides an opinion in the form of a diagnosis from the patient's initial data, which is usually in the form of anamnesis data recordings and initial laboratory tests. Then the confirmation diagnosis is presented rationally, accompanied by empirical evidence from specialist doctors working in the Pathology Service at MGH[4]. In its development, CPC not only became part of the medical audit standards for services in hospitals, but also became an important form of learning in the residency program[4–7]. A survey conducted by Haudebert and McKinney (1999) showed that at least 80% of the 278 Internal Medicine residency programs in the United States scheduled CPC as a routine activity of trainee education.[4]

However, along with the rapid development of molecular biomedical knowledge and technology, much criticism has been given regarding the relevance and the classical CPC model that is considered an anachronistic practice[4]. The classical CPC model is considered cooptative (relying on the seniority of staff whose knowledge is often considered outdated), as well as histopathology and radiology-centric, while discussions related to disease pathomechanisms need to be expanded to include biochemical, cellular, and even molecular aspects[3,5]. It is difficult for us to track down the history of CPC and how this approach was introduced and popularized in Indonesian medical Education practice. CPC was part of my clinical education activity as a medical student in the surgical department. However, from our best guess, the CPC should have been introduced in Indonesian medical education around the 1960s when there was a shift from Dutch-style medical education to the American Model[8].

Considering the importance of discussing molecular and biochemical aspects of the clinical condition of the disease and its management, the P4R Team and MKK MBIACP Contributors designed a learning format adopted from the CPC. Hence, this learning format is named Clinico-Moleculo-Pathology Conference. Despite respecting the classical method, the addition of the molecule in the abbreviation is to highlight the molecular aspect in the sequence of conference sequence. However, the different naming is not only to promote the integrative discussion of the latest molecular aspects of disease mechanisms, but the CMPC is also designed to integrate the principles of professional learning (e.g., adult learning, activity theory and student-centred learning) which have been the underpinning learning theories behind the CPC development and preservation[9,10]. The principal distinctions of CPC and CMPS are presented in the Table.1.

Table 1. Comparative Summary of CPC and CMPC as Learning Methods

CPC[5,6]	CMPC
1. Case presentation by the trainee of the patient recipient a. Summary of anamnesis b. Summary of clinical symptoms c. Laboratory Data Summary d. Summary Diagnosis and Management Plan 2. Discussion from the aspects of pathology, radiology 3. Discussion from clinical aspects other than the presenter 4. Follow-up plan recommendations 5. Reflection of students 6. Marking by supervisors and/or peer trainees	1. Selection of Cases that will be the object of CMPC 2. Starting with Journal Reading from the key reference 3. Case presentation by a group of trainees a. Summary of anamnesis b. Summary of clinical symptoms c. Laboratory Data Summary d. Summary Diagnosis and Management Plan e. Biomolecular studies of clinical phenomena found f. Study/Biomolecular justification of treatment 4. Discussion by biomedical-biomolecular experts, 5. Discussion by a pathologist 6. Discussion by relevant clinical specialists 7. Follow-up plan recommendations and insights for further clinical study and/or research 8. Reflection of students 9. Marking by supervisors and/or peer trainees

Technical implementation of CMPC

CMPC was carried out by a trainee as a group work. In one group, CMPC consisted of 6-8 trainees from a minimum of 3 different specialist departments. The origin of the department is adjusted to the old CPC pattern, which is usually carried out by the doctor in charge of the patient (DPJP). Each CMPC group is supervised by two mentors who act as evaluators to supervise written CMPC reports and also as supervisors during discussions and journal reading. The CMPC cases are set aside by the report supervisor mentor, and the journal supervisor mentor will facilitate the journal reading session and literature review conducted before the CMPC presentation is carried out. Trainee's performance assessment was carried out both when reading journals, literature review writing guidance, and CMPC reports and presentations (marked with a black star in Figure 1). The topics discussed in MBIACP, which are also the areas of discussion in the CMPC, are presented in Table 2. The series of activities and assignments of CMPC are carried out by trainees in groups consisting of different specialists in accordance with the division of Essential by Integrated System topics in Table 2.

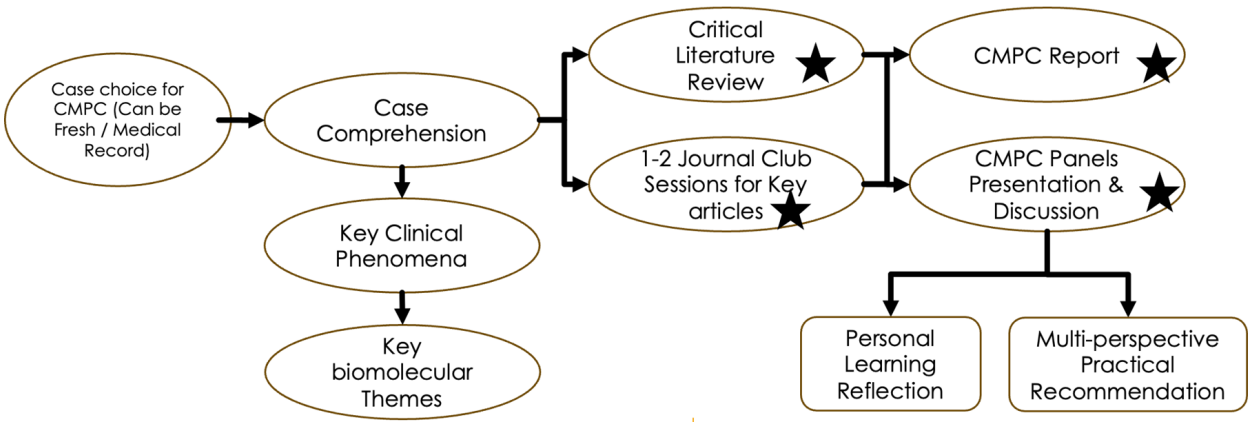

Figure 1. CMPC Implementation Flow (Stars depict the moment the trainee is assessed and given feedback)

Table 2. Course Learning Outcomes and Topics in MBIACP where CMPC is used

CPC[5,6]	CMPC
1. applying creative and innovative biomolecular science to practice and services to improve diagnosis and therapy capabilities (CLO1) 2. applying biomolecular science at the individual, organizational, and interprofessional levels in academic and non-academic activities to improve diagnosis and therapy capabilities. (CLO2) 3. applying biomolecular science both in the clinical setting and in the community with an accurate diagnosis and therapy approach based on biomolecular science (CLO3) 4. understand the fundamentals of biomolecular science in the pathogenesis of a disease and therapy (CLO4) 5. understand and explain the basics of biomolecular science in the pathogenesis of a disease and therapy (CLO5) 6. Make review articles related to the topic of molecular biology and immunology (CLO6)	**Innate & Adaptive Immune Response and Hypersensitivity Disease agents (Sitostatika, Steroid)** • Types of the immune system • Acute Immune response (inflammation, hypersensitivity) **Cell biology approach to investigating human disease** • Characterize the structure and function of an organelle • Explain the connection between organelles and human disease **Essential Pathobiology: Cell Injury, Inflammation & Healing** • cell injury, inflammation, healing, and application in context **Pathways to oncogenesis and treatment, including tumor immunity** • Carcinogenesis (Oncogen and Tumor suppressor) • Immune response in the tumor **Human Genome, Stem Cell, Gene & Targeted Therapy** Human genome • Genomic to Clinical Practice • Gene-targeted therapy • Stem cell **Signalling Pathway in Gene Control & intercellular communication, proteomic and metabolomic** • How genes are organized in DNA • Transcription of genes • Control of gene expression • Corticosteroid effects on cell signalling **Essential Microbiology for Clinicians (Host-Agent Interaction) & Immunity to Microbe** • Normal flora • Pathogenesis of infectious disease **Diagnostic Immunology & Vaccine Research** • Explain molecular pathogenesis and vaccine production and effects **Pharmacology of Chemotherapy Agents and Immunosuppressants** • Groups of immunosuppressive drugs and mechanisms of inhibition of the immune system **Essential by an integrated system** 1. Neuromuscular (Orthopedics, Neurology, Surgery, Medical Rehab, Radiology, Anatomical Pathology, Microbiology) 2. Genitourinary and reproduction (Urology, Obgyn, IPD, Pediatrics, Radiology, Anatomical Pathology, Clinical Pathology, Microbiology) 3. Digestivus (Surgery, IPD, Pediatrics, Anesthesia, Radiology, Anatomical Pathology, Clinical Pathology, Microbiology) 4. Sensory System (Eye, ENT, DV, Nerve 5. Hematology (IPD, IKA, Clinical Pathology) 6. Cardiorespiratory (IPD, Pulmonary, ENT, Pediatrics, Anesthesia, Cardiology, Surgery, Radiology, Microbiology)

ANALYSIS

Out of many program evaluation frameworks, our training program chose to apply the Kirkpatrick Pyramid framework for its practicality and alignment with the existing internal quality assurance system. Originally, in the Kirkpatrick framework, a training program can be evaluated for the 1) reaction (e.g, participant satisfaction), 2) learning (e.g, trainee's score mark), 3) behavioural impact, and 4) impact on the organization for both education and services (See table 3). However, in this study, we will focus on the first two aspects of the framework, which are mainly deployed to quantitative and qualitative questionnaires and the trainee's course mark. Although aspects 3 and 4 are important, and potentially we are still unable to report it requires data informing the status of the students. The overall program evaluation design is presented in Table 3. We performed descriptive and comparative analyses, including correlational analysis by using several packages (tidyverse, ggpubr, ggplot) in RStudio. The free text responses of participants are analysed by applying content analysis[11].

Table 3. CMPC Program Evaluation Framework

Evaluation Level	Evaluation Objectives	Data Source	Method
Reaction	Assess the perception of implementation satisfaction Assessing the perception of the relevance of CMPC to the needs of learning outcomes	- Trainee - Mentor CMPC	Program evaluation survey
Learning	Evaluate MBIACP Final Score Correlation of CMPC performance score and MBIACP Final mark	- CMPC marks - MBIACP Final Score	Score analysis & correlation
Behaviour	Resident's performance in the Scientific session of the National Examination Feedback analysis on longitudinal scientific assignments	**Not Yet Reportable**	
Organizational Result	Patients' perception of scientific literacy and personalized medicine approaches by TRAINEE and clinical supervisors	**Not yet reportable**	

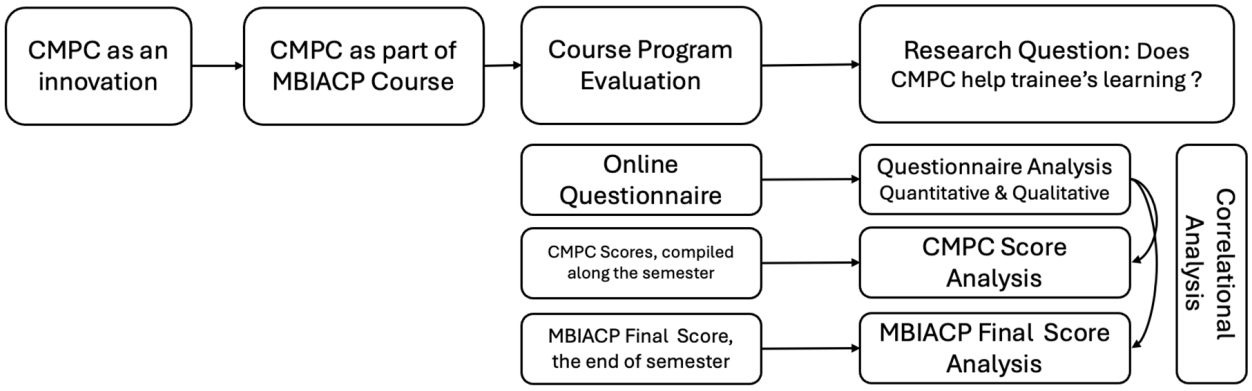

Figure 2: Study Flow

RESULTS

Respondent Demography

The online survey was completed by 433 residents from 4 batches (96.87% response rate) through voluntary and anonymous responses. No dropouts or incomplete responses were recorded. The proportion of males and females is not matched, representing almost the real proportion of the population (See Table 4). The survey contains quantitative (38 questionnaire items) and three qualitative open-response questions covering reaction components of evaluation about all five courses in P4R (see Appendix 2). Six questions are related to the MBIACP course where CMPC is being introduced.

Table 4. Respondents Demography

Respondent Characteristic	Batch-I July 2022 (Batch A1)	Batch-II Jan 2023 (Batch A2)	Batch-III July 2023 (Batch A3)	Batch-IV Jan 2024 (Batch A4)	Total (n)
Respondent	99	114	111	109	433 (96.87%)
Male	56	48	58	53	215 (49.65%)
Female	43	66	53	56	218 (50.35%)
Population	112	114	111	110	447
Specialist Branch of Respondents:					
Anesthesiology and Intensive Care	7	7	6	3	23
Plastic Surgery and Reconstruction and Ethics	0	0	1	2	3
Dermatology & Venereology	4	2	4	4	14
General Surgery	8	8	7	5	28
Pediatric	6	6	5	5	22
Eye	9	6	8	9	32
ENT	4	4	4	4	16
Internal Medicine	12	10	10	10	42
Heart & Cardiovascular	8	8	8	7	31
Emergency Medicine	0	8	8	12	28
Physical and Rehabilitation Medicine	5	6	6	6	23
Clinical Microbiology	3	2	1	1	7
Neurology	7	7	7	7	28
Obstetrics dan Gynekology	8	8	7	6	29
Orthopaedic and Traumatology	4	7	5	2	18
Anatomical Pathology	2	2	0	2	6
Clinical Pathology	6	6	7	7	26
Pulmonology and Respiratory Medicine	4	8	7	8	27
Radiology	9	3	5	4	21
Urology	6	6	5	6	23

Reaction

The responses to six questions and the total mark related to the CMPC quality in the MBIACP course were extracted and reported in Table 5. The mean score is gathered from calculating the responses of the respondents by using 5 5-tier Likert scale (1=strongly disagree, 5=strongly agree). Internal Consistency analysis of 6 questions showed the Cronbach Alpha was 0.69 (moderate internal consistency). The Pearson product-moment coefficient of the items is provided in Table 5. Pearson coefficients for the questionnaire items are moderate (0.3-0.5) and strong (0.5 – 0.8), which confirms that the items are justifiable to be used.

Table 5 Pearson Product Moment Questionnaire Items

Items	r*
q1	0.545*
q2	0.293*
q3	0.667*
q4	0.670*
q5	0.709*
q6	0.735*

Notes: *significant p<0.05

In Table 6, responses to Questions No.2-6 indicated that trainees who underwent the MBIACP course in all specialist departments expressed positive acceptance (mean score > 3.0) towards CMPC as a learning method at the MBIACP course. From the responses, all respondents in four batches agreed that CMPC activities aligned well with the intended learning outcomes of the MBIACP course. In the same Table 6, however, despite the significant improvement trend (significant mean score difference in an increasing mean score trend), from response to question 1, MBIACP is still regarded as a difficult learning subject (mean score <3) among resident trainees. The last column on the right side of Table 6 shows the result of non-parametric comparative analysis (i.e., Kruskal-Wallis) for each question. The decision to apply non-parametric analysis is that the questionnaire response data was not normally distributed (Levene Test for homogeneity and Shapiro-Wilk test confirmed has p value > 0.05).

The text responses of open-ended questions to MBIACP were extracted and analysed by applying corpus-based content analysis in the RStudio application. A total of 431 out of 447 residents (96.42%) completed the qualitative survey. Applying sentiment analysis within RStudio (fortified with katadasaR package to elaborate tokenization in Bahasa Indonesia), trainees provide more positive sentiment comments (see Figure 3).

Table 6: The mean Score of the Reaction Questionnaire

No	Evaluation items	Batch	Mean* (%)	SD	Kruskall-Wallis chi square (X2) dan p value
1	The MBIACP course is easy to comprehend	II-2022	2.46 (49,2)	0.82	X2 = 9.6388, p= 0.0219*
		I-2023	2.71 (54.2)	0.70	
		II-2023	2.77 (55.4)	0.93	
		I-2024	2.85 (57)	0.69	
2	The preparedness to apply course learning outcomes in the further phase	II-2022	3.42 (68.4)	0.40	X2= 18.641 p-value = 0.000*
		I-2023	3.61 (72.2)	0.42	
		II-2023	3.80 (76)	0.29	
		I-2024	3.85 (77)	0.23	
3	The rate of performance of instructor and facilitator in delivering MBIACP	II-2022	4.10 (82)	0.27	X2= 17.923, p= 0.000*
		I-2023	4.11 (82.2)	0.21	
		II-2023	4.34 (86.8)	0.20	
		I-2024	4.41 (88.2)	0.10	

No	Evaluation items	Batch	Mean* (%)	SD	Kruskall-Wallis chi square (X2) dan p value
4	The MBIACP course teaching strategies align with the course purpose	II-2022	3.33 (66.6)	3.00	X2= 91.94, p =0.000*
		I-2023	3.89 (77.8)	0.26	
		II-2023	4.05 (81)	0.21	
		I-2024	4.17 (83.4)	0.12	
5	Journal reading assignments align with the intended learning outcomes	II-2022	4.29 (85.8)	0.22	X2= 9.6169, p= 0.022*
		I-2023	4.20 (84)	0.21	
		II-2023	4.41 (88.2)	0.23	
		I-2024	4.45 (89)	0.12	
6	CMPC activities align with the learning outcomes of the MBIACP course	II-2022	4.18 (83.6)	0.25	X2= 3.8716, p = 0.2757
		I-2023	4.21 (84.2)	0.25	
		II-2023	4.30 (86)	0.31	
		I-2024	4.35 (87)	0.13	
	Mean of total score	II-2022	21.99 (73.3)	2.9	X2=26.054, p=0.00*
		I-2023	22.63 (75.4))	2.97	
		II-2023	22.87 (76.2)	2.92	
			24.22 (80.74)	2.40	

Note Table 6: * The response was in 5 Likert Scale (1-5), where the least shows the least favourable and 5 the most favourable conditions. The mean score is also featured in percentage (Normalised).

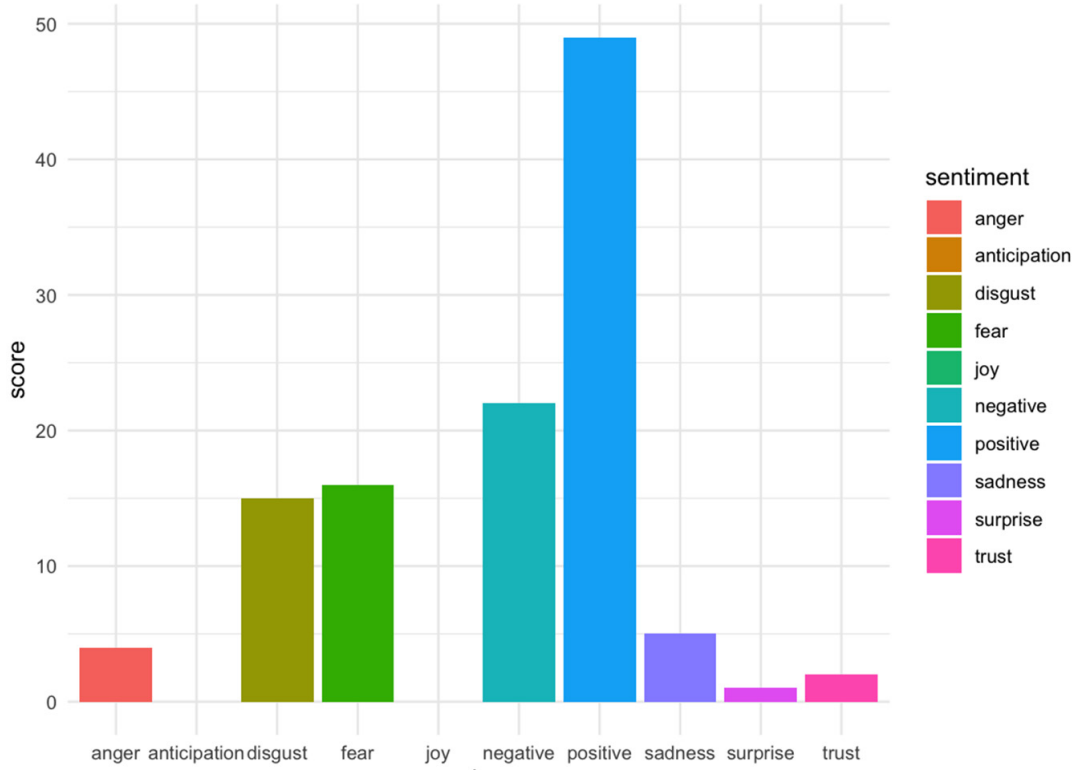

Figure 3. Sentiment Analysis Summary of Open Response. The Graph is made by using GGplot2 package in R version 4.4.3 (2025-02-28)

However, only a few (41 out of 447 trainees) addressed CMPC and MBIACP specifically. From these few, trainees positively saw CMPC as a learning method that: 1) enhanced their knowledge acquisition on difficult subjects, 2) had relevance to the practical application of knowledge to practice, and 3) stimulated multidisciplinary collaboration. The verbatim examples of these views will be elaborated in the learning results section.

Learning

To evaluate the learning aspect of CMPC, we analysed the assessment score in the MBIACP course. The result of trainees in the MBIACP course is represented through the course's final mark, which is calculated by a composite score consisting of several components (e.g., written tests, journal club presentations, CMPC reports, and presentation). The comparison of the means of the final Mark of trainees in 4 batches is shown in Figure 2. Mean comparison analysis using non-parametric measure in 4 batches shows Kruskal-Wallis chi-squared = 233.1999, p-value = 0,000). This can be interpreted that the mean scores of batches are significantly different. However, from Figure 2, we see the difference does not necessarily indicate improvement of the trainee's score from time to time.

To evaluate whether there is a correlation between the questionnaire total score and CMPC and MBIACP final mark, we performed a non-parametric correlational analysis. The Spearman correlation coefficients are shown in Table 7. From Table 7, we may see there is a statistically significant correlation between CMPC score and MBIACP Final Mark (r=0.39, p=0.0000). This significant positive correlation of CMPC score marks with MBIACP final score confirms a theoretical relation between clinical learning engagement to academic achievement. This indicates that the current method of marking CMPCs as a group assignment reflects the participants' engagement and excitement during the activity. However, a week association between the total score of the questionnaire was recorded, neither with the CMPC score nor the MBIACP final mark. This weak association of trainees' positive view on the questionnaire with the CMPC score (r=0.0232, p>0.05) and MBIACP final mark (r=0.047, p>0.05) could be an indication of a misalignment in assessment blueprinting of MBIACP that requires attention.

Table 6: The mean Score of the Reaction Questionnaire

	TQ (p)	CMPC	MBIACP
TQ	1	0.023	0.047
CMPC	0.0232	1	0.390*
MBIACP	0.0472	0.390	1

Notes: *statistically significant if p value<0.05' TQ: Total Score of the questionnaire, CMPC: Score Mark CMPC; MBIACP: Final Course Mark of MBIACP.

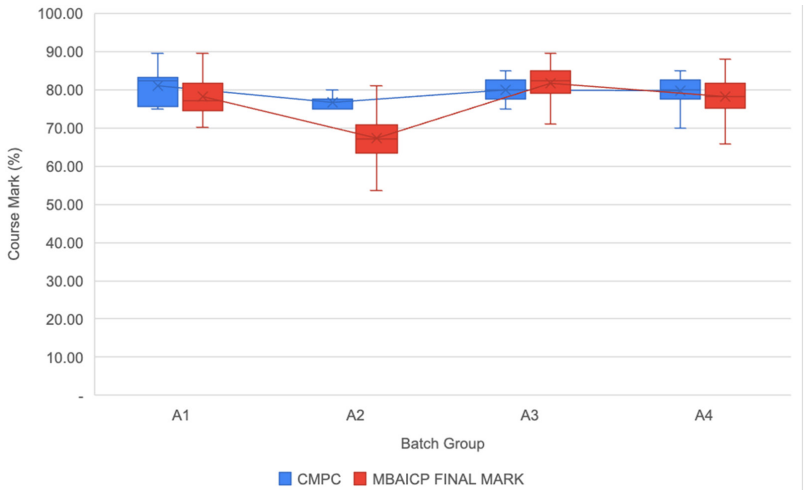

Figure 4. The Comparison of CMPC and Final Mark in MBIACP for 4 batches. A1: Batch July-2022; A2: batch January-2023; A3: batch July-2023, and A4: Batch Jan 2024

As part of the course, CMPC is expected to contribute to the achievement of learning outcomes in MBIACP measured through several assessment modalities, including written tests, journal club presentations, CMPC reports, and presentations. This is due to the policy of applying a composite score mark system to the calculation of the course's final mark. However, in the MBIACP course, the CMPC's mark contributes to one-third (33.33%) of the final mark for the course.

The quality of learning has also been drawn from qualitative responses to open questions. The responses are mostly conveyed in positive sentiment. As previously mentioned, the response of trainees on CMPC or MBIACP provides insights into how the CMPC influences the quality of their learning. We found, the positive impact of CMPC on learning can be categorized into three aspects, which are summarised in Table 8.

Table 8: Example of Excerpts that Build The Emerging Themes on CMPC as a Constructive Learning Method

Positive Learning Aspects of CMPC	Excerpt from Trainee's response
Enhancing knowledge acquisition	*"MBIACP was going well, especially MBIACP teachers and lectures" (A1, R4).* *"The task is appropriate, so it makes me understand better. Not all of them advanced at the time of the presentation of the Reading journal, but with what has been presented, I understand more than before" (A2, R5).* *"Journal Reading and CMPC is a good combination for learning" (A3, R50).* *"Reading journals is good because they can add to our scientific insight" (A4, R3)*
Relevant and applicable, fit with clinical context	*"Applicable tasks such as effective communication (sbar tbk), JR, CMPC, RAT (mr and bst) that we will apply when we are residents." (A1, R6)* *"The assignments for the Reading Journal and CMPC are very good, so later we will be ready to undergo education" (A2, R75)* *"The material presented is quite relevant and useful, indeed, there are some materials that are presented unclearly in my personal opinion (for example, MBIACP and one other)" (A4, R10)*
Stimulate Collaboration	*"Tasks are given in groups such as CMPC so that they can collaborate with other departments" (A1, R33)* *"The implementation of group tasks is, for example, at CMPC, which builds cooperation."(A3,35)* *"Practice experience, where it is required to make a CMPC report. This will be very useful for the residents' scientific tasks in the future, as well as to foster coordination and other cooperation between the service sections." (A2, R33)* *"Randomly assigning assignments made each study program can contribute to each other according to the scientific basis" (A2, R62).*

Behaviour & impact on health care performance

The data from supervisors' reflections on the behavior of trainees throughout the curriculum cannot yet be reported. However, it can be noted that the number of specialist departments incorporating CMPC into their routine clinical management has increased since the introduction of the activity. Initially, only three departments (surgery, radiology, and anatomical pathology) were reported to adopt CMPC. At the time this report was written, this number has expanded to seven departments (surgery, radiology, medical oncology, obstetrics and gynaecology, dermatology and venereology, anatomical pathology, and clinical pathology). Despite this increase, the proportion is still estimated to be below the critical mass necessary to sustain significant improvements in integrated clinical care. Although most ongoing CMPCs are collaborative events attended by various medical specialties, many do not involve professions outside of medicine (i.e., nursing, dietitian, etc). From a face validity perspective, it appears that the behavior and communication among residents from different specialties have improved since the introduction

of CMPCs. However, this observation requires confirmation through robust quantitative measures, which are currently being collected.

DISCUSSION

The teaching-learning approach in our specialist program traditionally relied on established pedagogic methods that are nearly a century old, such as rounds, clinical-pathology conferences (CPC), case reports, and morning reports, all of which are conducted exclusively within particular medical specialties. Concurrently, the demand for personalised medicine, patient-centred care, and collaborative practices necessitates that teaching staff and residents need to be more adaptive in finding the most plausible intervention approach and treatment modalities. This is especially in integrating basic biomedical sciences (e.g., biomolecular, nanomolecular) literacies into clinical practice while at the same time being well prepared to communicate and cooperate with other professions[12].

The introduction of the CMPC model in this study is perceived by trainees to be a constructive and promising method to stimulate the integration of basic sciences, biomolecular themes, and clinical knowledge in workplace-based learning. CMPC, as an extension of CPC, has been reflected upon by trainees and specialist teaching staff as "… an effective approach to stimulate interdisciplinary collaboration…" in clinical practice within teaching hospitals and to enhance scientific integration. This observation aligns with the benefits noted in the current form of CPC and other modified versions of this model[3,5,9,13].

Although the CMPC has received positive quantitative evaluations in the reaction aspect of the Kirkpatrick evaluation framework, further comprehensive evaluations are still needed. These would include the involvement of the head of the study program and all specialist practitioners, as the use of the new CMPC is currently limited to the P4R program and involves only departments that run a residency program. Moreover, the report presented in this article is only a part of a general program evaluation in one Faculty of Medicine. Therefore, the results presented are not specifically designed as a robust study design to evaluate the efficacy of CMPC. A deeper qualitative study design is potentially needed to evaluate the impact of CMPC on the expected outcome, while further case and control or experimental design might also be advised to examine the cause-and-effect benefit of CMPC on wider aspects of resident learning.

In our teaching hospital, compared to many publications in other countries[4,14], CMPC has not yet been fully accepted and adopted as a general clinical policy for clinical audit methods. However, advocacy efforts are ongoing, given that many clinical departments in our teaching hospital have progressively been using CPC activities as their clinical audit method. The positive acceptance of integration in CMPC inspires a further idea to involve clinical educators from health professionals other than medical specialists' disciplines. This would potentially stimulate more elaborate interdisciplinary discussions and potentially promote the spirit of personalised medicine, i.e., respecting unique biomolecular aspects of the patient (individualised) and at the same time providing multidisciplinary patient care.

CONCLUSION

The introduction of the CMPC model in specialist resident training provides a promising benefit for supporting student learning in the difficult subjects, such as the Molecular aspects of disease. CMPC has been perceived as a constructive and promising method to stimulate the integration of basic sciences, biomolecular themes, and clinical knowledge in workplace-based specialist practices. The CMPC has potentially become a learning method to stimulate multidisciplinary learning as well as collaborative patient care.

ETHICAL CLEARANCE

This article is a report on the development of educational programs and their evaluation so that all data used from respondents is obtained anonymously and voluntarily. Ethical clearance has also been sought from the research ethics commission of our Faculty of Medicine.

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Appendix 1

CMPC Conference Discussion Model

1. The conference session was held in a special week according to the schedule issued by the Secretariat of the Specialist Department/ Subspecialist of FKUB
2. The definitive schedule of the conference (days and hours) is made based on the group's agreement with the two CMPC supervisors
3. One CMPC session is conducted for 100 minutes. However, if it is agreed, it can be added according to the group's agreement with the two supervisors
4. At the time of the CMPC session,
   a. Starting with an introduction/opening is carried out by the supervisor. The supervisor guides the selection of moderators (as well as the time-keeper), minutes, and presenters of CMPC cases
   b. The supervisor invited the group moderator to start the presentation
   c. Group representation starts the presentation of the CMPC case in a maximum of 20 minutes
   d. The moderator guides the multidisciplinary discussion for 30' and then asks for minutes to read the minutes of the discussion
   e. The moderator asked participants from different areas of specialization

to provide comments, criticisms, and recommendations
   f. Minutes read out a summary of recommendations
   g. The moderator closes the CMPC session and returns to the supervisor for feedback.
5. The supervisor provided assessment and appraisal/and feedback on the course of CMPC. The trainee's performance assessment by the tutor is carried out in writing using the assessment rubric that has been provided, and the giving of feedback is given in writing and also delivered orally.

Appendix 2

Evaluation Questionnaire The full version can be accessed in https://docs.google.com/forms/d/e/1FAIpQLSeqg1dkPkRXdvqAA8TeVI_WWYdU1evuRZzbnA5Oy925XWxlVw/viewform

Quantitative with Likert style response Items

1. What is your opinion on the usefulness of the P4R Course (MKKDU) material in fulfilling the competencies of the specialist resident?
2. What is your opinion on the workload of the P4R?
3. What is your opinion on the duration of the P4R?
4. What is your opinion on the daily schedule of the P4R?
5. What is your opinion on the realization of the P4R schedule?
6. How effective is the online learning method?
7. Do you find the MKKDU course easy to understand? [rate on each course]
8. How prepared are you to implement the MKKDU course in to further phase? [rate on each course]
9. How would you rate the performance of the instructor/facilitator in delivering the P4R course? [rate on each course]
10. How appropriate is the alignment between the course material and MKKDU assignments? [rate on each course]
11. Were the assessment & assignments of observing the learning activities of Young Doctors in the Department aligned with the intended learning outcome of the P4R course? [rate on each course]
12. Is the Journal Reading assignment aligned with the learning objectives of Molecular Biology and Immunology Applied for Clinical Practice?
13. Are the CMPC (Comprehensive Case Report) activities aligned with the learning outcomes of the Molecular Biology and Immunology Applied for Clinical Practice course?
14. What is your opinion on the readiness of the educational staff in the Department of Specialist and Subspecialist Medicine in implementing the P4R?

Qualitative free response:

15. What are your suggestions for the future implementation of the P4R?
16. What are the best practices in the implementation of the P4R during this period? (Briefly describe)
17. What needs to be improved for the next implementation of the P4R? [Briefly describe)