

An Overview of Learning Methodology for Clinical Pharmacokinetics Course during the Covid-19 pandemic

**Hannani Mawarddah Muhammad Abdul Hafidz¹, Nur Wahida Zulkifli^{1*},
Farhana Fakhira Ismail¹.**

*¹Faculty of Pharmacy, Universiti Teknologi MARA,
Campus Puncak Alam, 42300 Puncak Alam, Selangor, Malaysia*

**wahidazulkifli@uitm.edu.my*

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Abstract: Due to the Covid-19 pandemic, the clinical pharmacokinetics course had to undergo a few modifications to its curriculum content. During the curriculum realignment, the Faculty of Pharmacy at UiTM Puncak Alam was obliged to adapting rapidly to these conditions by developing a few new strategies by implementing interesting learning methodologies that can suit students during the pandemic. In addition, despite being an interesting course, students are still afraid of clinical pharmacokinetics, thinking it difficult to understand. This study reviewed students' perceptions and satisfaction with the course and examples of learning methodologies which are suitable for pharmacokinetics course.

Keywords: clinical, COVID-19, learning, pandemic, pharmacokinetics

INTRODUCTION

The World Health Organization (WHO) has declared the coronavirus disease 2019 (COVID-19) as a pandemic in March 2020 which had given tremendous effect on people lives. More than 2.4 million Malaysians were infected with COVID-19 as of September 2022, about 36 245 fatalities were reported (1). This pandemic outbreak has caused many devastating effects in many aspects primarily on the healthcare and educational system, leading to adverse changes and shifts in education.

Consequently, this has also resulted in educational institutions' emergency responses during the pandemic, Emergency Remote Education (ERE) which refers to the shift in teaching and assessment was implemented. It involves adapting material for lessons which were once delivered face to face but now are partially distance-based or in a blended learning mode (2) To meet students' needs, many universities have previously implemented strategies to make their education delivery flexible and accessible.

Universities are facing various unprecedented difficulties, especially in the field of clinical education due to the COVID-19 outbreak. Despite this, hospitals had to stop accepting students for attachment because of safety concerns as some of them were designated as COVID-19 facilities which affect practical sessions and experiential learning (3). Clinical pharmacokinetic course is one of the courses that has undergone a few changes in its curriculum content due to the pandemic. To shape a competent future clinical pharmacist, pharmacy students must have a solid foundation in pharmacokinetics and its mathematical model to advocate effective therapeutic drug monitoring (TDM) in pharmaceutical care during real clinical settings (4). Hence, having good skills to perform pharmacokinetics calculations and strong command of the applications of the clinical skills are important, for the students to have a better understanding of its effects on evolving patient cases (5).

In response to that, various pedagogical methods and active-learning techniques are thought of as solutions to these problems (6). In UiTM, the Faculty of Pharmacy have been mandated to adapt quickly in overcoming these circumstances by implementing a few approaches during the

curriculum recalibration. Teaching teams have been generating some changes and appraising the curricular content for courses like clinical pharmacokinetics by inventing an in-house training module for third-year students. The reason to amend the in-house training is to reduce the student learning time from 3 credit hours to 2 credit hours.

This module consists of a laboratory activity that exposes students to the COBAS machine which requires students to interpret the result of drugs tested. Besides, students are exposed to an external lecture regarding TDM cases by a hospital pharmacists. Presentation, on the other hand, aims to enhance students' practical skills towards the recommendation of the dose where they are required to present three real case scenarios- meanwhile, case discussions expose them to calculation as well as dose recommendation.

Perception is the way you think about something, your conception of what it is like, or your natural capacity for comprehension or swift observation of things (7). Most students view mathematics as an exhausting and difficult subject that induces fear and worry as it is a dynamic process that requires planning and readiness (8). In the pharmacokinetics course, students face difficulties linking the fundamental concepts with clinical relevance due to its mathematical foundation (9). Furthermore, according on the students' perspective, a high-quality education provides superior learning possibilities, and their levels of contentment or discontent have a significant impact on their learning success or failure (10). Studies reveal that an effective instructional approach, plays a significant role in fostering student engagement and reinforcing difficult concepts taught in lectures to promote learning (11). Understanding current perceptions and measuring satisfaction held by future pharmacists regarding pharmacokinetics and its role in both research and clinical practice may be helpful in improving teaching of this subject and introducing appropriate changes into the curricula where and when necessary.

The pandemic situation has obligated the teaching teams to implement changes in the curriculum to ensure the continuity of exposure of clinical settings and practices among pharmacy students. Due to this complexity, students might face challenges to relate the fundamental knowledge of this course with its application in solving TDM cases.

PEDAGOGY OF CLINICAL PHARMACOKINETICS COURSE DURING THE COVID-19 PANDEMIC

The outbreak of COVID-19 has harmed the health, economy, and social life of the global population. As a result, governments have employed extreme measures such as quarantines, lockdowns, social isolation, and movement restrictions. Most educational institutions throughout the world that have been affected have taken the initiative to stop in-school instruction to break the chain of virus transmission (13). Students' access to educational resources has been impacted by the closing of educational institutions. Evidently, higher education is still struggling with how the epidemic will impact its programs' educational outcomes as well as teaching, learning, research, and innovation. Following the WHO's announcement regarding the severity of the epidemic, rapid action was taken within a few days to switch to distance learning (14).

2.1 PEDAGOGICAL APPROACHES

Literally, pedagogy can be defined as the art or science of educating children. It is a synonym for teaching or education in contemporary usage, especially in scholarly literature (15). It implied that the learner's social and psychological needs drove the relationship between the teacher or facilitator and the student. To put it another way, pedagogy outlines how teaching and learning should be delivered based on how the learner learns and the understanding that person has, before beginning to prepare the lesson or the course.

Amidst of pandemic crisis, pedagogical shifts in the teaching-learning paradigm have become an unavoidable necessity. Due to the movement control order, higher education institutions have quickly adopted this strategy, shifting as many teachings, and learning activities online as they could. This led to the emergence of several new terms for the process, including "remote learning," "home-based learning," and "emergency remote education", in addition to terms for technology-enabled learning at a distance, like "online learning" and "distance learning"(16). Other than blended learning which comprises some elements of online course delivery, other strategies, like the hybrid model, which combines online and face-to-face sessions which necessitates students attending both modalities, is also practiced (17).

Significantly these learning alternatives can ensure the continuity of learning while protecting students against the risk of COVID-19 infection (18). Various strategies enable students to interact with learning resources, teachers, peers, employers, and other students as well as give opportunities for planned, active learning (19). Besides, the adoption of emerging technologies during the pandemic as well as in many other areas can enhance the efficiency in teaching and learning through connection with students and educators (20). As a conclusion, these methods are relatively recent and are fast becoming expanding strategies, especially in health profession education that provides a flexible learning environment (21).

2.2 FLIPPED CLASSROOM

Flipped learning approach was initially described as “the inverted classroom” (22). Till 2012, only The United States had been widely using the application of this new learning paradigm in pharmacy education. It creates a framework that may facilitate a more individualized education for students. The flipped classroom pedagogical method aims for students to commit to and actively participate in learning activities both before and during class, all with the assistance of IT (19). This broad approach allows for the flexibility in how activities are carried out both within and outside of the classroom. Pre-recorded lectures in the form of podcasts/vodcasts, screencasts, annotated notes, and captured videos, as well as pre-readings and interactive videos from an online repository are all options for pre-class preparation in the flipped classroom. These tools allow students to learn reflectively and at their own pace (23).

In another way, the flipped classroom is used to create a pharmacokinetics course with a student-centered approach to learning using pre-recorded material and actively engage students in problem-solving, critical thinking, and the application of pharmacokinetics knowledge in a clinical setting while face-to-face class time is used for a deep learning through problem solving and discussions. Several pharmacy educators in Malaysia have embraced this active learning approach. For instance, Malaysian pharmacy students have received a complementary medicine module through the use of an audience response system in flipped classrooms (24). Later, a study in Universiti Sains Malaysia,

Penang, which utilized the active learning idea of the flipped classroom to drug delivery systems, revealed an improvement in the learning process and engagement of pharmacy students in Malaysia as well as positive outcomes from this approach (25). In conclusion, this pedagogy encourages students to take ownership of their learning and to start developing higher level learning skills for life-long learning in the future working environment (26).

2.3 TEAM-BASED LEARNING (TBL)

Team-Based Learning methodology promotes learner outcomes in a setting that fosters student involvement and development of their professional as well as interpersonal skills. TBL incorporates pre-class individual work and in-class team exercises with expert debriefs offered by the instructor, in contrast to standard lecture-based training (27). TBL is an active-learning pedagogy that adheres to a prescribed sequence and is utilized to actively stimulate student engagement where it produces additional essential outcomes for practising pharmacists, including improved communication, critical thinking, and preparation to confidently manage clinical situations in which students' engagement is a critical component to the success of TBL (28). It is shown to be successful for teaching applied pharmacokinetics in both face-to-face and online courses, according to a study conducted in the United States. Therefore, a clear, organized, and instructional learning format of TBL enables the learner to engage in various class situations, including online and face-to-face models, in addition to facilitating a high-quality online team experience at a distance (29).

2.4 CASE-BASED LEARNING (CBL)

Problem-based learning and inquiry-based education both contribute to construct-based learning (CBL) (30). CBL has been highly regarded as a teaching method for fundamental medical sciences. It has been demonstrated to enhance students' comprehension of the material, which has led to improved performance on assessments and in actual instruction (31). CBL is used to disseminate knowledge in a variety of medical and health-related sectors. According to the review's findings,

this approach has been used in pharmacology, occupational and physical therapy, nursing, allied health areas, and child development among other fields. In addition, higher education has seen a shift away from conventional, purely didactic forms of teaching in the pursuit of creating more socially and clinically oriented pharmacists (32). Pharmacy educators are utilizing CBL to supplement conventional pedagogical approaches to foster collaborative learning and higher order thinking (33). CBL allows a group of students to complete the given clinical cases and display their presentation followed by active interaction with the lecturers and constructive feedback. It exposes students to teaching and learning activities that are reflective of their future professional working roles, which in turn helps them develop problem-solving skills and clinical reasoning (34). As evidence, CBL gives students a platform for student-centered learning activities, which improves their capacity for critical thought and problem-solving in the early stages of their medical careers (35).

3. CLINICAL PHARMACY EDUCATION

Clinical education requires a different approach in the context of each discipline, which may lead to pedagogical uncertainty when attempting to define the term's meaning or goals. Clinical education in higher education institutions has long been recognized and successfully applied in health professional disciplines, but it has recently become a focus of legal education. To develop and implement opportunities for students to engage in experiential learning, clinical education has transformed into multifaceted educational models that have been embraced by many disciplines (36). In other words, the delivery methods, strategies, and educational curricula are all changing significantly because of the rapid global evolution of pharmacy education (37). In addition, modules and programs for clinical training should be continuously improved to provide more engaging levels of education, and ensure clinical education is beneficial and relevant to healthcare professionals. In German clinical pharmacy academic education, new clinical competencies and skills must be taught using new teaching methods to enable the next generation of pharmacists to meet these new challenges and actively advance the profession (38). Additionally, other

clinical disciplines, like nursing and medicine, have demonstrated the value of clinical education (39). Ultimately, clinical pharmacy education provides a strong foundation in clinical knowledge which is designed to develop professional competencies among the students.

3.1 IMPORTANCE OF PHARMACOKINETICS COURSE

In just seven years, the overall number of instances tracked by TDM services for the entire nation climbed from 25,756 in 1998 to 61,907 in 2005, a 140.4% increase (40). With the knowledge and expertise in pharmacokinetics, healthcare professionals, especially pharmacists, are expected to make decisions or interventions to promote better outcomes for patients (41). For instance, therapeutic drug monitoring service is fundamentally based on pharmacokinetics concepts that requires the monitoring of narrow therapeutic medications, the concentrations within, and the ensuring that therapeutic optimum effect is achieved without unintended side effects (4). Therapeutic failure as a result of suboptimal routine vancomycin use, is an issue which frequently occurs in clinical practice and is linked to negative health outcomes such as nephrotoxicity. To increase the effectiveness, prevent failure, and lower significant toxicities related to vancomycin medication, adequate TDM practise is an important exercise (42). Evidently, a solid foundation of pharmacokinetics is not only important for future careers among students, but also play a vital role in predicting the effects of changes in dosing regimens, disease states, and medication interactions as well as important towards pharmaceutical industry and generic pharmaceuticals regulation as bioequivalence is one of regulatory considerations in creating generic medications (4).

3.2 FACTORS INFLUENCING THE PERCEPTION TOWARDS PHARMACOKINETICS COURSE

Perception is the way you think about something, your conception of what it is like, or your natural capacity for comprehension or swift observation of things (43). Students' opinions include a range of efficient teaching strategies for improving the instruction of foundational clinical sciences like pharmacology and pharmacokinetics in health education (44). While most of the students' clinical decision-making develops during their professional pharmacy experiences, the classroom can offer the first opportunities for students to start

enhancing their problem-solving, critical thinking, and communication skills in relation to pharmacokinetic principles (45).

To improve student learning, many games are employed in the pharmacokinetic courses at The University of North Carolina School of Pharmacy. This publication presents our initial experiences with these games. Incorporating problem-solving, critical thinking, cooperative learning, group work, and pharmacokinetic principles into these games was one of their main design goals. However, findings from the study had shown that students loved games as something different, the games were scored poorly in terms of the perception of learning. Students reported in response to a survey question addressing their preferred and favoured classroom activities - lecture paired with case studies and handouts (46).

According to a study on pharmacy students' attitudes towards a blended-learning pharmacokinetics course, 60% of the participants indicated that the face-to-face problem-solving tutorials were helpful. There was a positive association between time and students' enthusiasm for contact with online course modules, and at the end of the course, students are more enthusiastic about face-to-face interaction with the lecturers than at the beginning (47)

3.3 FACTORS CONTRIBUTING TO THE SATISFACTION TOWARDS PHARMACOKINETIC COURSE

The students' opinions on a range of efficient teaching strategies for numerous variables that have been noted may have an impact on a student's satisfaction with the various educational services provided by universities, including the expertise of the instructors, the courses offered, the learning environment, and the classroom facilities (48). Higher levels of learning, such as critical thinking, improved knowledge retention, and the analysis, synthesis, and evaluation of material, are made possible through student-centered learning. The

study revealed an effective instructional approach plays a significant role in fostering student engagement and reinforcing difficult concepts taught in lectures to promote learning (26).

A previous study had shown that a module that consists of tutorials and quizzes provides corrective feedback which improves student satisfaction and learning outcomes in clinical pharmacokinetic courses (49). A larger proportion of students in the third-year course who received quizzes during Cohort 2 of clinical pharmacokinetic course were satisfied with the feedback they received compared to Cohort 1, consisting of those who did not complete quizzes in their tutorials which were 68% and 60% respectively (49). Furthermore, another finding also shows that more than 75% of students strongly agreed or agreed with that learning pharmacokinetic principles was improved by the instructor's implementation of simulation modules in-class sessions (50). Also, a study on medical students' perception and received feedback on teaching and learning of pharmacology in a medical college shows about 50% of students believed that didactic lectures and small-group discussions were the best teaching methods for learning pharmacology (44). Therefore, it is important to understand the current perceptions and the satisfaction among the students by looking into the elements of the learning methodology and their effectiveness in a clinical pharmacokinetics course.

CONCLUSION

The review can help lecturers use different learning methodologies for a clinical pharmacokinetics course. This can enhance students' knowledge and improve their understanding about this course. In addition, it can also increase students' satisfaction with the course as well as to make further improvements in the teaching and learning methodology of the module involving various array of tools, organizational arrangement, and pedagogical approaches.

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