Developing Simulation-Based Interprofessional Education for Entrustable Professional Activities; Presenting Clinical Cases

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Developing Simulation-Based Interprofessional Education for Entrustable Professional Activities; Presenting Clinical Cases

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ABSTRACT

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Background: Hue University of Medicine and Pharmacy (HueUMP) has piloted Entrustable Professional Activities (EPAs) and officially implemented several EPAs in 2022. Furthermore, a pilot Interprofessional Education (IPE) module in 2022 involved students from various medical disciplines, emphasizing teamwork and patient care through simulations through group discussions, communication with standardized patients, home visits, and primary healthcare center visits. Therefore, this study aimed to experiment with a new teaching method: Simulation-Based Education (SBE) using Low-Fidelity (LF) and High-Fidelity (HF) simulation at the Skills-Lab Center. This approach focused on teaching scenarios involving medical errors that cannot be effectively addressed with the current methods.

Methods: The ADDIE (Analyze-Design-Development-Implementation-Evaluation) Model was employed to develop this pilot class. It starts with an analysis of the curriculum, targeted learners, and available resources. The design and development phases follow, guided by Harden's ten questions for curriculum development.

Results: The outcomes of the class were designed, incorporating two selected medical error scenarios: ineffective communication leads to medical errors (urinary retention) and ineffective communication leads to medical errors (insulin dosing). The assessment method was designed based on the Kirkpatrick model, utilizing satisfaction surveys, pre and post-tests, and reflection essays for evaluation. Information about the class will be uploaded to the HueUMP Learning Management System, and it will commence in

January 2025, with the participation of a representative group of students and two instructors: one physician and one faculty member from the nursing department.

Conclusion: Simulation-based IPE using LF and HF simulations can be alternated with the current educational methods used in the IPE module at HueUMP, depending on case scenarios, thereby enabling students to effectively achieve EPAs.

Keywords: Interprofessional Education, Simulation-Based Education, Entrustable Professional Activities, Communication, Patient Safety.

I. Introduction

1. Background

a) Competency-Based Education (CBE) and Current Reforms in Medical Education in Vietnam

Competency-Based Education (CBE) significantly improves the clinical performance of healthcare providers by structuring educational experiences around specific competencies and focusing on measurable outcomes (1). This approach emphasizes student-centered, measurable outcomes, enhancing accountability to patients and encouraging continuous learning. CBE is currently used in various fields of healthcare education, including medical education, pharmacy education, and nursing education. (1-3).

Despite significant progress in other sectors and evolving patient health needs, medical education in Vietnam has seen minimal changes (4). Historically, efforts to reform medical education were confined to specific departments within individual medical universities, rather than being comprehensive and implemented across the country (5). Since 1999, there has been a concerted effort among medical educators nationwide to advocate for a more community-oriented approach in Undergraduate Medical Education (UME) (6). During this period, there was a pivotal shift towards identifying clear learning objectives and outcomes that delineate the essential knowledge, attitudes, and skills expected from graduates (6). In 2015, the Ministry of Health (MOH) established a set of standardized competencies for general doctors (6). However, there are challenges in the full implementation and integration of these competencies into medical education programs across Vietnam. Since then, Vietnamese medical schools have undergone curricular reforms. Among 29 medical universities, five public medical universities are transforming their UME programs to CBE just only for medical students, including the University of Medicine and Pharmacy (UMP) at Ho Chi Minh City (HCMC), Hue University of Medicine and Pharmacy (HueUMP), Thai Binh University of Medicine and Pharmacy (Thai Binh UMP), Hai Phong University of Medicine and Pharmacy (Hai Phong UMP) and Thai Nguyen University of Medicine and Pharmacy (Thai Nguyen UMP) (6).

b) Background of Hue University of Medicine and Pharmacy (HueUMP)

Hue Medical College has been established on 1957. Since 2007, the institution underwent a renaming to become Hue University of Medicine and Pharmacy (HueUMP). Operating under the guidance of the Ministry of Education and Training (MOET) and Hue University, the university aligns its development in health specialties with the directives of the MOH.

HueUMP has been training over 20,000 doctors, pharmacists, bachelors, and more than 8,000 graduate students and has played an important role in training healthcare personnel for the Central Highlands Region in Vietnam. Beyond training, the university places a significant emphasis on research and the application of cutting-edge medical technology in healthcare. Noteworthy achievements include successful scientific research conducted both nationally and internationally, with a notable increase in international publications. The university's vision and strategic plan for the year 2030 aspire to position itself as a national leader, concentrating on high-quality training programs, collaborative training initiatives, advanced scientific research, technological applications, and elevated medical service quality. The integration of the University Hospital model stands as a key component of this ambitious plan.

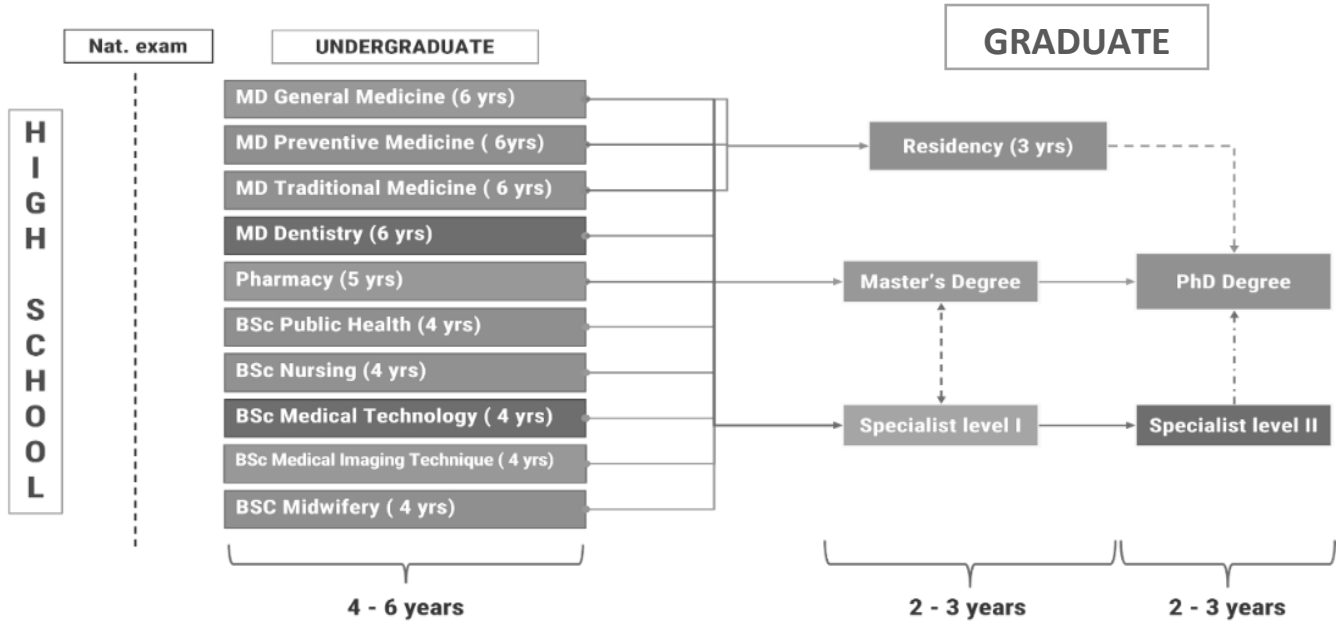

Figure 1. Academic Program at HueUMP

(Adapted from https://www.huemed-univ.edu.vn/ve-nha-truong)

The UME program at HueUMP spans a duration of 4 to 6 years (Figure 1), encompassing a curriculum that includes basic medical sciences, clinical sciences, clinical rotations, and practical experiences. Commencing with a strong focus on fundamental sciences, the program advances to clinical rotations across various medical specialties. The curriculum places a significant emphasis on practical training, community engagement initiatives, and opportunities for research exploration. After the UME phase, the Graduate Medical Education (GME) stage (Figure 1) last between 2 to 3 years for master's, PhD., specialist level I and II degrees, and 3 years for the residency course. Continuing Medical Education (CME) remains integral, ensuring that healthcare professionals stay abreast of the latest advancements in their field. The outcomes of HueUMP also play a crucial role in this process (Table 1) (7).

Table 1. HueUMP Outcomes

	HueUMP Outcomes
Knowledge	**1.1) General Knowledge at Hue University** 1.1.1) Political Education: Understand and apply Marxist-Leninist worldview, methodology, Marxist-Leninist political economy, scientific socialism, Ho Chi Minh's ideology, and the history of the Communist Party of Vietnam to life and profession. 1.1.2) National Defense and Security: Possess a certificate in National Defense and Security; apply knowledge of national defense and security to meet the requirements of building and protecting the country. 1.1.3) Physical Education: Have a physical education certificate and meet health requirements for the profession 1.1.4) Foreign Language: Attain a minimum level of 3/6 or equivalent according to the Vietnamese Foreign Language Proficiency Framework 1.1.5) Information Technology: Attain basic information technology skills according to the standards specified in the Ministry of Information and Communication's Circular 03/2014/TT-BTTTT **1.2) General Knowledge by Field of Study** 1.2.1) Statistics, Informatics 1.2.2) Physics-Biophysics, Chemistry 1.2.3) Biology, Genetics 1.2.4) English for Specialized Fields 1.2.5) Communication and Health Education 1.2.6) Professionalism 1.2.7) Master basic knowledge in natural sciences and social sciences for further stages of the program

1.3) General Knowledge for the Group of Specialities

1.3.1) Master basic knowledge of the structure and function of the human body under normal and pathological conditions

1.3.2) Understand the factors causing diseases and explain the mechanisms of disease causation

1.3.3) Apply knowledge to symptomatology, pharmacology, pathology, patient care, and scientific research

1.4) Branch/Field-specific Knowledge and Support

1.4.1) Understand the methods of medical history-taking to record physical symptoms

1.4.2) Understand diagnostic standards, treatment principles, and preventive measures

1.4.3) Apply methodology in diagnosis

1.4.4) Understand the use of appropriate clinical and imaging tests

1.4.5) Understand the principles and concepts of community medicine, public health, family medicine, and social medicine

1.4.6) Understand findings and address common community health issues

1.4.7) Understand health planning, public health plans, hospital management, health services, health education, control of community-related causes and risks

1.4.8) Organize and participate in the management and supervision of community patient care activities

1.4.9) Master communication, examination, medical testing skills

1.4.10) Identify functional symptoms, detect real symptoms through clinical examination, and identify signs of pathology early

1.4.11) Synthesize and analyze functional symptoms, entities, and results of clinical tests for early and accurate diagnosis and appropriate differential diagnosis

	1.4.12) Use basic medical equipment and emergency care: ECG machines, blood glucose monitors, monitoring devices, biochemical machines, etc 1.4.13) Care, advise, especially for chronic patients, preventive measures in common diseases, guide patients on appropriate lifestyle, nutrition, and work 1.4.14) Know how to communicate with patients, relatives, and colleagues. Know how to listen, ask questions, express yourself to the public, and persuade. Know how to resolve conflicts 1.4.15) Decision-making skills based on medical evidence, compliance with department and hospital regulations in decision-making in diagnosis, treatment, hospitalization, transfer, consultation, or discharge 1.4.16) Perform teamwork skills, cooperate in learning, respect group discipline, have team spirit 1.4.17) Diagnose and treat common diseases (according to the list of common diseases) 1.4.18) Diagnose and treat some specialized diseases (according to the list of specialized diseases) 1.4.19) Prescribe drugs correctly according to the regulations for treating common diseases and some specialized diseases (according to the attached list)
Skills	**2.1) Logical Reasoning and Problem-Solving Skills** 2.1.1) Ability to reason, think critically, and solve problems in daily work and in potentially risky situations when providing patient care according to the Ministry of Health's competency standards. 2.1.2) Ability to solve problems appropriate to individual needs, cultural factors, and community beliefs 2.1.3) Ability to reason, solve problems in compliance with legal regulations, and national guidelines on healthcare services at medical and community facilities

2.1.4) Efficiently perform work appropriate to the resources of the healthcare facility

2.2) Research and Knowledge Exploration Skills

2.2.1) Ability to continuously self-improve through self-study, self-research

2.2.2) Ability to think scientifically, understand and conduct basic scientific research in the field of health education

2.2.3) Ability to interpret information from scientific data tables and know how to interpret, design relevant research topics

2.2.4) Ability to write a professional manuscript

2.2.5) Ability to independently research and implement research topics for the working unit

2.3) Systematic Thinking Skills

2.3.1) Integrate basic knowledge of the industry and specialized knowledge to apply in professional practice

2.3.2) Identify the professional relationship with other medical fields to coordinate specialties in treating and consulting related diseases

2.3.3) Efficiently perform diagnosis, early intervention or referral at the right time, and appropriate technical differentiation in the healthcare system and comply with national guidelines

2.4) Professional Skills

2.4.1) Perform diagnosis and make treatment decisions based on evidence with the participation of patients, family members, and relevant healthcare personnel according to the actual conditions

2.4.2) Apply knowledge and methodologies related to behavior, psychology, and society in medical care practice

2.4.3) Administer safe, cost-effective drug treatment

2.4.4) Have skills in maternal health care

	2.4.5) Perform first aid, resuscitation, and active care
	2.4.6) Provide prolonged care, mild care for chronic or terminally ill patients
	2.4.7) Implement treatment, pain control
	2.4.8) Combine traditional medicine and non-pharmacological methods in the treatment, prevention, and functional recovery of common diseases
	2.4.9) Participate in infection control
	2.4.10) Advocate, educate, mobilize for health enhancement and disease
	2.4.11) Managing Death
	2.4.12) Building Friendly, Cooperative, Trusting Relationships with Patients, Patient Families, and the Community
	2.4.13) Effective Communication. Efficient Collaboration with Colleagues and Partners
	2.4.14) Applying Communication Principles with Patients, Patient Families, and Colleagues in Daily Patient Care, Conflict Situations, and Emergency Situations
Autonomy and Responsibility Competencies	**3.1) Personal Autonomy and Responsibility**
	3.1.1) Adherence to Professional Standards, Legal Regulations, and Professional Ethics
	3.1.2) Respecting the Human Rights Values of Patients and Colleagues in Professional Practice
	3.1.3) Capacity for self-learning, working independently, or teamwork in daily work or emergency situations
	3.2) Autonomy and Responsibility in the Profession
	3.2.1) Autonomy to implement and take responsibility for clinical practice decisions
	3.2.2) Accountability for results related to the provision of care services within the scope of professional practice

3.2.3) Ability to manage and operate healthcare resources, ensuring their proper and safe utilization

3.3) Autonomy and Responsibility to Society

3.3.1) Ability to understand/have knowledge about the community and issues related to community health

3.3.2) Ability to perceive and use strategies to improve health, diagnose the community while practicing the profession

3.3.3) Ability to be autonomous and responsible in the process of providing healthcare to patients and the community

(Adapted from https://www.huemed-univ.edu.vn/dao-tao/dai-hoc/y-khoa-1)

c) Entrustable Professional Activities (EPAs) Implementation at HueUMP

The renewed curriculum emphasizes the application of knowledge to real-world practice-based situations, fostering problem-solving abilities (8). HueUMP has proactively embraced various contemporary learning methodologies, such as Electonic-Learning (E-Learning), Ubiquitous-Learning (U-Learning), Problem-Based Learning (PBL), Team-Based Learning (TBL), Simulation-Based Learning, and Case-Based Learning (CBL) (8). These innovations complement the traditional learning approach, resulting in positive outcomes in learning events (9). HueUMP initiated a pilot project in 2020 to evaluate EPAs during clinical clerkships (10). The university officially implemented EPA1, EPA2, and EPA3 according to Association of American Medical Colleges (AAMC) for fourth-year medical students to sixth-year medical students since March 2022 (Table 2) during their clinical clerkship, receiving positive feedback from a study involving 400 students and 40 faculty members (11).

Table 2. AAMC EPAs and Implementation Process at HueUMP

AAMC EPA	Implementation
EPA 1: Taking a patient history and performing a physical examination	Since 2022 for 4-6th year medical students
EPA 2: Prioritizing differential diagnoses in clinical cases	
EPA 3: Ordering and interpreting common diagnostic tests for diagnosis	
EPA 4: Making and discussing care plans and prescriptions	Since 2023 for 4-6th year medical students
EPA 5: Document a clinical encounter in the patient record	Have not been implemented yet
EPA 6: Providing an oral presentation of a clinical encounters	Since 2023 for 4-6th year medical students
EPA 7: Form clinical questions and retrieve evidence to advance patient care	Have not been implemented yet
EPA 8: Give or receive a patient handover to transition care responsibility	
EPA 9: Collaborate as a member of an interprofessional team	
EPA 10: Recognize a patient requiring urgent or emergent care and initiate evaluation and management	
EPA 11: Obtain informed consent for tests and/or procedures	
EPA 12: Perform general procedures of a physician	
EPA 13: Identify system failures and contribute to a culture of safety and improvement	

Based on the Medical Doctor Competency Standards of MOH and the Program Learning Outcomes of HueUMP, a survey was conducted among the Board of Department Heads and Undergraduate Academic Affairs of the departments teaching 4th, 5th, and 6th-year medical students. The aim was to vote on adding two more EPAs to be assessed alongside EPAs 1, 2, and 3, due to limitations in staff and time. Among the remaining EPAs, all are necessary; however, for the immediate training of medical doctors, EPAs 4 and 6 are considered essential and suitable for implementation starting in 2023.

d) Interprofessional Education (IPE) Module at HueUMP

The pilot study on the IPE Module at HueUMP took place from May 28th to July 30th in 2022, with one session per week (12) (Table 3). The targeted learners are the fifth year in Medicine, the fifth year in Odonto-Stomatology, the fifth year in Preventive Medicine, the fifth year in Vietnamese Traditional Medicine (VTM), the fourth year in Pharmacy, and the third year in Nursing, and the second year in Midwifery. The first session focused on introducing IPE, team-building exercises, and establishing stable groups of seven students. In the second session, students engaged in small group discussions to address four case studies. Session three involved a simulation with a standardized patient, where interprofessional student teams communicated with the patient and collaborated on developing care plans. The fourth session involved clinical practice in primary care facilities, where students interacted with real patients with chronic conditions and designed care plans in their teams. In session five, students will have home visit activities to explore patients' family situations and develop comprehensive care plans. Session six focused on presenteing interprofessional care plans, received feedback, and engaged in self-reflection activities. Sessions four, five, and six were repeated in sessions seven, eight, and nine to allow students to follow up with patients and improve their performance. The tenth session involved the assessment of students' Interprofessional Collaborative Care (IPCC) skills.

Table 3. IPE Module at HueUMP

Session	Learning activities
Session 1	1) Plenary session of IPE introduction 2) Getting to know each other 3) Team-building exercise 4) Debriefing
Session 2	1) Group discussion on two paper cases of medical/ethical errors, role clarification 2) Group discussion on two video-based cases of interprofessional communication and sharing leadership 3) Debriefing
Session 3	1) Communicating with a standardized patients 2) Making an interprofessional care plan 3) Consulting with a standardized patients 4) Debriefing
Sessions 4 & 7	1) Visiting a primary health facility 2) Communicating with a patient with a morbidity condition 3) Making an interprofessional care plan 4) Debriefing
Sessions 5 &8	1) Visiting a patient's house 2) Making an interprofessional care plan for the patient and a health preventive/screaming plan for the whole family 3) Debriefing

Sessions 6 & 9	1) Presenting care plans to other groups and groups of tutors from different professions 2) Debriefing 3) Self-reflection
Session 10	Organizing IPCC assessment

(Adapted from Nguyen, Huyen Thi Thanh, et al. "A study of the impact of an interprofessional education module in Vietnam on students' readiness and competencies." Plos one 19.2 (2024): e0296759.)

A limitation of the IPE Module is the comparison between midwifery students and those from other programs, due to midwifery students' limited clinical practice experience and professional identity. The midwifery educational program had only been implemented for two years, so there were no higher-year midwifery students included. In designing the IPE Module, second-year midwifery students were considered for participation in all module activities to enhance their IPE learning.

2. Statement of Problem

The transformative changes in medical education in Vietnam, driven by a commitment to internationalization and innovation. While the current educational paradigm is undergoing renewal, with a focus on CBE, and design a curriculum based on EPAs, significant challenges persist, particularly within the medical education sector (11).

At HueUMP, challenges threaten to impede the progress and efficacy of teaching and learning methodologies. Foremost among these challenges is the imperative for thoughtful faculty development and standardization. The introduction of innovative learning methodologies, particularly EPAs, and IPE necessitates a paradigm shift in pedagogical approaches. Faculty members must be equipped with skills and knowledge to adeptly facilitate these novel methods. Concurrently, a standardized framework for assessment and evaluation becomes imperative to ensure consistency and fairness across the diverse landscape of medical universities.

Another significant challenge lies in fostering interdisciplinary collaboration among healthcare disciplines. The traditional approach in medical education often hinders effective teamwork and holistic patient care. Introducing a course that foster healthcare professionals to work collaboratively from diverse disciplinary perspectives is becoming crucial. This interdisciplinary approach not only enhances patient outcomes but also prepares students to navigate complex healthcare environments seamlessly.

Additionally, the integration of technology also poses a challenge and opportunity for medical education. While advancements in technology offer unprecedented opportunities for interactive and immersive learning experiences, there is a pressing need to ensure equitable access and competency among both faculty and students.

At HueUMP, IPE Module has been integrated for seven different disciplines into its curriculum since 2022. Teaching methods include group discussions, communication with standardized patients, and home visits, which are considered effective. However, my research focuses on the use of Simulation-Based IPE to address medical errors and enhance patient safety.

3. The Needs for Simulation-Based Education (SBE)

SBE has been seen as a crucial methodology across various fields, addressing the demand for experiential learning in complex and dynamic environments (13). This approach involves creating scenarios that mimic real-life situations, allowing learners to engage actively in decision-making, problem-solving, and skill development in a controlled setting (14).

Firstly, SBE provides a safe and controlled environment where learners can make mistakes without real-world consequences, fostering a risk-free space for experimentation and learning from errors (15). This aspect is particularly valuable in disciplines such as healthcare and aviation, where mistakes can have severe repercussions (16).

Moreover, SBE enable learners to encounter scenarios that are infrequent or impossible to reproduce in real life due to cost, safety concerns, or ethical reasons (17). Medical students, for instance, can practice with complex surgical procedures repeatedly in a simulated environment before performing them on actual patients, thereby enhancing their proficiency and confidence (18).

Another benefit of SBE lies in its ability to standardize learning experiences. By using scenarios and assessment criteria, educators can ensure that all learners receive uniform training, regardless of their location or access to resources (19). This standardization contributes to higher competency levels among graduates and professionals entering their respective fields (20).

Furthermore, SBE also supports interprofessional collaboration by bringing experts from various domains to design and implement realistic scenarios (19). This collaborative effort not only enriches the learning experience but also mirrors the teamwork required in real-world settings, preparing learners to effectively navigate diverse professional environments.

At HueUMP, the Skills-Lab Center was established in 2019 with the goal of training clinical skills based on SBE for medical students through the Practice of Medicine (POM) Module before they engage in clinical practice at hospitals. The Skills-Lab Center is well-equipped with advanced simulation models and a group of standardized patients. With the increasing emphasis on interprofessional collaboration and patient safety in healthcare, it is essential to adopt educational strategies that reflect these priorities. Simulation-Based IPE at the Skills-Lab Center is crucial for several reasons.

Firstly, it aligns with global trends in medical education, ensuring that our training programs are on par with international standards.

Secondly, the use of Simulation-Based IPE provides a safe and controlled environment for students from different healthcare backgrounds to interact, communicate, and collaborate effectively. This interprofessional interaction is vital for developing teamwork skills that are critical in real-world clinical settings, where coordinated efforts are necessary for optimal patient care.

Thirdly, by incorporating Simulation-Based IPE at the Skills-Lab Center, there are possibilities for enhancing patient safety. By allowing students to practice and refine their skills in a simulated environment, we can reduce the risk of errors in actual clinical practice. This hands-on experience helps students to better understand and manage complex clinical scenarios, leading to improved patient outcomes.

4. Purposes of the Study

This Simulation-Based IPE will not only support the implementation of EPAs for medical students but also providing core competencies related to interprofessional collaboration as outlined by the American Association of Colleges of Nursing for nursing students. The specific objectives are:

- Developing an Simulation-Based IPE at HueUMP using Low-Fidelity (LF) and High-Fidelity (HF) Simulation for medical and nursing students.

- Designing and implementing structured learning activities to promote interaction between medical and nursing students.

- Enhancing teamwork and communication for interprofessional collaboration.

5. Research Questions

- What are the key components and specifications required for designing a Simulation-Based IPE class?

- How can Simulation-Based IPE be effectively integrated within the existing IPE Module of HueUMP to enhance the overall learning experience for medical and nursing students about EPA 6: Oral Presentation at Clinical Encounters?

- How effective is SBE in enhancing the overall learning experience and assessment efficiency for medical and nursing students, particularly in the context of EPA 6 at Hue UMP?

- What are the distinctive features of Simulation-Based IPE using LF and HF Simulation compared to other educational methods?

6. Significances of the Study

- Enhancing EPAs achievement: The study significantly contributes to enhancing EPAs implementation by utilizing Simulation-Based IPE. By practicing communication and teamwork skills, students can better understand each other's roles and responsibilities. This not only fosters mutual respect but also enhances the quality of patient care delivery. Achieving EPAs becomes more feasible as students gain confidence in their collaborative abilities, ensuring they meet the required competencies for practice.

- Improving communication through simulation: Simulation-Based IPE play a pivotal role in improving communication. By replicating real-world clinical situations in a controlled environment, students can apply their theoretical knowledge and skills without compromising patient well-being.

- Engagement and active learning: SBE is known for the ability of enhancing student engagement. Unlike traditional educational methods, simulations actively involve students in problem-solving and decision-making processes. This active participation not only sustains their interest but also promotes deeper learning and retention of knowledge.

- Integration of technology and innovation: The study's use of SBE also underscores its commitment to integrating technology and innovation in education. Modern healthcare environments increasingly rely on technology to improve efficiency and outcomes. By

familiarizing students with simulation tools and techniques early in their education, the study prepares them to adapt to future technological advancements in healthcare. Moreover, it cultivates a mindset of continuous learning and innovation, essential for staying current in a rapidly evolving field like healthcare.

7. Definitions of Terms

- Competency-Based Education (CBE): CBE represents a changing in medical education from time-based learning to an outcome-focused approach (21). CBE organizes educational experiences based on competencies, emphasizing the learner, outcomes, and independence from time constraints (21). It aims to enhance accountability to patients, encourage continuous learning, and adaptability to professional changes.

- Entrustable Professional Activities (EPAs): EPAs serve as a link between competencies and their practical application in clinical settings (22). A framework is provided for assessing and developing essential professional skills, emphasizing their viability and relevance (22). Widely embraced by medical educators, EPAs stand out as a preferred assessment framework due to their ability to anchor competencies in practical day-to-day skills. EPAs involve practical tasks within professional activities that require sufficient knowledge, skills, and attitudes, producing recognizable outcomes of professional work (22). These tasks are observable benchmarks that learners must demonstrate independently upon reaching a specific level of competence (22). EPAs are implemented in both UME and PGME in various countries, emphasizing their broad applicability in medical education (23).

- Milestones: Milestones are crucial markers that define observable progression and exit levels of performance in CBE (24). They are created based on criteria and map a learner's journey through specific competencies, emphasizing deliberate practice and feedback (24, 25). Milestones provide a sequential foundation for expected behaviors, guiding learners and assessors with a shared mental model (25).

- Interprofessional Collaboration (IPC) and Interprofessional Education (IPE): IPC and IPE refer to the cooperative efforts and partnerships among healthcare professionals from different disciplines to provide integrated and patient-centered care. According to the World Health Organization (WHO), IPC involves "multiple health workers from different professional backgrounds working together with patients, families, carers, and communities to deliver the highest quality of care." (26). IPC is essential in healthcare

settings as it enhances patient outcomes through shared decision-making, coordinated care plans, and improved communication among team members. A study by Reeves et al. (2013) highlights that effective IPC can lead to better patient satisfaction, reduced medical errors, and optimized resource utilization (27). While, IPE may include joint lectures, simulations, case studies, and clinical rotations where students from various disciplines (e.g., medicine, nursing, pharmacy) interact to better understand each other's roles and responsibilities in patient care. Such initiatives are increasingly recognized as integral to addressing the complexities of modern healthcare and promoting patient-centered care (26).

- Simulation-Based Education (SBE): SBE refers to educational activities that use simulated scenarios or environments to replicate real-life situations to enhance learning, practice skills, and improve competency in various fields, including healthcare (15, 19). According to McGaghie et al. (2010) (20), SBE involves "activities that mimic important aspects of the real world in a fully interactive manner.". This approach allows learners to engage in hands-on practice without the risks associated with real patient care situations, thereby promoting safe and effective learning environments.

- Patient Safety encompasses the fundamental principle of ensuring that patients are protected from any avoidable harm or potential risks that could arise during their interactions with healthcare services (28). This includes preventing errors in diagnosis, treatment, medication administration, and overall healthcare delivery processes (29). The goal is to maintain a safe environment where patients feel secure and confident in receiving appropriate and effective care without the threat of adverse events that could compromise their health or well-being (28).

- Medical Errors refer to mistakes from intended medical practices that may result in harm to patients (30). These errors can occur in various aspects of healthcare delivery, such as diagnosis, treatment, medication administration, surgical procedures, record-keeping, communication, collaboration and system management (30, 31).

- Instructional Design (ID) Models: ID Models are dedicated to crafting educational experiences that enhance the acquisition of knowledge and skills (32). ID ensures that decisions are rooted in sound principles of learning and instruction (32). ID create experiences that facilitate improved learning, employing various instructional methods to support human learning and development (33). The process of instructional design is systematic, prioritizing the delivery of high-quality instruction (34). It involves a comprehensive analysis of learning needs and goals, the creation of a delivery system tailored to address those needs, the development of instructional materials and activities, and the systematic trial and evaluation of all instruction and learner activities (35).

II. Literature Review

1. Overview of CBE, EPAs, and Milestones

a) CBE

Since the 20th century, Medical education has undergone a significant transformation, moving away from time-based learning to an outcome-focused approach known as CBE (36). CBE is considered crucial for various reasons, particularly in diverse educational fields, including medicine (37). This approach organizes educational experiences based on competencies, prioritizing the learner, emphasizing outcomes, and operating independently of time constraints, promising of enhanced accountability to patients, encouraging continuous learning, and fostering adaptability to innovations and changes in various professional landscapes (38). Although the term "competency" has rapidly gained widespread use and is now prevalent in various contexts, there is a lack of consensus on its precise meaning (39). Competencies emerge in a multitude of intricate and diverse forms, constituting a nuanced tapestry woven with a spectrum of attributes and skills. Consequently, the evaluation of workplace competencies necessitates the implementation of an assessment system that can capture the multifaceted nature of these competencies. This is the juncture where the concept of EPAs comes to the forefront (23).

b) EPAs

EPAs were crafted to establish a connection between competencies and their practical application in clinical settings, ensuring their viability and relevance (38), and providing a framework for the assessment and development of essential professional skills (1). The notion of EPAs stands out as an assessment framework embraced by medical educators (40). This preference stems from its ability to anchor competencies in a spectrum of practical day-to-day skills, offering a comprehensive and nuanced approach to assessment. EPAs are practical tasks within a professional activity that demand sufficient knowledge, skills, and attitudes, producing recognizable outcomes of professional work. These tasks can be observed, serving as benchmarks for learners to demonstrate their ability to perform them independently upon reaching a specific level of competence (41). These activities are

introduced for both postgraduate training (42) and undergraduate training in several countries (1).

c) Milestones

The focus is on crafting milestones that can effectively capture both progression and exit levels of performance (24). Described as "defined, observable markers along a developmental continuum," milestones are criterion-based and collectively map a learner's journey through a specific competency or performance (25). Emphasizing deliberate practice and feedback, milestones with progressive steps provide a clear foundation for expected sequential behaviors, fostering a shared mental model for both learners and assessors to guide the learning process (24). The attainment of a well-defined exit milestone may dictate promotion to the next level of training or responsibility, and this achievement can vary among trainees. These milestones are integral to CBE, aligning with the principles of deliberate practice and feedback, ensuring that learners progress at their own pace. Furthermore, in GME, milestones serve as pivotal markers in development (43). They furnish narrative descriptions for competencies and sub-competencies, creating a developmental continuum with varying levels of detail. These milestones succinctly depict expected performance levels for residents and fellows across the six Core Competency domains, encompassing skills, knowledge, and behaviors.

Collectively, in modern medical education, the interconnection between CBE, EPAs, and milestones plays a crucial role in shaping a competency-focused educational model, this connection forms an interactive, cohesive, and meaningful system in building a modern medical education foundation (44). CBE, as an approach centered around learners demonstrating specific competencies, closely aligns with EPAs and milestones to create a flexible and effective assessment and guidance system (45). Together, they provide a basis for a comprehensive competency assessment and support learners in the step-by-step development towards becoming reliable healthcare experts (46).

2. Global Perspectives on EPAs and Core Competencies for Nursing Education

a) The United States

The Association of American Medical Colleges (AAMC) issued new guidelines in May 2014 to address a recognized performance gap during the transition from medical school to residency training (47). These guidelines aim to establish expectations for both learners and educators within the medical field. Introducing the concept of 13 Core Entrustable Professional Activities for Entering Residency (AAMC Core EPAs) (47) (Table 4), these guidelines outline essential tasks expected of every medical student upon entering residency, irrespective of their chosen specialty.

Table 4. AAMC EPAs for Entering Residency

	EPAs
EPA 1	Taking a patient history and performing a physical examination
EPA 2	Prioritizing differential diagnoses in clinical cases
EPA 3	Ordering and interpreting common diagnostic tests for diagnosis
EPA 4	Making and discussing care plans and prescriptions
EPA 5	Documenting patient information in medical records
EPA 6	Providing an oral presentation of a clinical encounters
EPA 7	Formulating clinical questions and seeking evidence for care planning
EPA 8	Handover and receiving patients

EPA 9	Collaborating as a member of a multidisciplinary team
EPA 10	Recognizing urgent patient needs and evaluating initial management
EPA 11	Gaining consent for tests and procedures
EPA 12	Performing common procedures as a general practitioner
EPA 13	Identifying system errors and contributing to safety culture and improvement

(Adapted from https://store.aamc.org/downloadable/download/sample/sample_id/63/%20)

The selection of EPAs as the framework for these guidelines was purposeful, driven by their practicality in assessing competence within real-world clinical settings. This approach not only impacts learners but also has implications for patient care.

Within the landscape of medical education, the Liaison Committee for Medical Education (LCME) standards mandate accredited medical schools to establish educational objectives rooted in outcomes valued by the medical profession and the public (48). Concurrently, in 2013, the Accreditation Council for Graduate Medical Education (ACGME), in collaboration with the American Board of Medical Specialties (ABMS), launched the Milestone Project (49). This initiative aimed to define progressive levels of performance for each competency, with the expectation that residents achieve specific milestones before completing their training and undertaking specialty certification examinations.

The Core Entrustable Professional Activities for Entering Residency initiative reflects the ongoing momentum to identify a concise list of integrated activities expected of all graduates transitioning from medical school to residency program. This strategic move represents a significant step toward addressing the observed performance gap and ensuring a standardized set of expectations for medical graduates embarking on their residency journey.

b) Australia

In Australia, the EPAs have been derived from the Royal Australasian College of Physician (RACP) Basic Training Curriculum, with due permission granted (50, 51). These EPAs, shaped by insights presented at the "Ins and Outs of Entrustable Professional Activities" event, represent critical work tasks for trainees in medical education (50) (Table 5). By the culmination of Basic Training, trainees are expected to demonstrate the ability to perform each EPA under distant supervision. Each EPA, defined as an illustrative, discrete task related to patient care, is easily observable and assessable. Furthermore, these tasks hold implications for workplace safety, with irreversible consequences. The EPAs articulate specific behaviors indicative of a trainee capable of performing the task under distant supervision, contrasting with behaviors signifying a trainee who is not yet prepared for such independent execution.

Table 5. EPAs - National Framework for Prevocational (PGY 1 and PGY 2) Medical Training

	EPAs
EPA 1	Clinical assessment
EPA 2	Recognition and care of the acutely unwell patient
EPA 3	Prescribing
EPA 4	Team communication

(Adapted from https://www.amc.org.au/accredited-organisations/prevocational-training/new-national-framework-for-prevocational-pgy1-and-pgy2-medical-training-2024/.)

c) Canada

In Canada, the alignment of EPAs is frequently with the CanMEDS framework (52), which the Royal College of Physicians and Surgeons of Canada adopted in 1996 to delineate essential competencies across all areas of medical practice, serving as a comprehensive foundation for medical education and practice in the country (53, 54). The Royal College EPAs are intricately connected to each stage of training, encompassing the transition to discipline, foundations of discipline, core of discipline, and transition to practice (55). The development of Canadian EPAs for entry into residency was influenced by the 13 core EPAs initially outlined by the AAMC. Drawing inspiration from the AAMC's core EPAs, the CanMEDS framework, and EPAs from Utrecht University, the Association of Faculties of Medicine of Canada (AFMC) identified and adapted their own set of EPAs (56) (Table 6). This collaborative approach aimed to integrate key elements from various reputable sources, ensuring a comprehensive and well-rounded framework for medical professionals entering residency in Canada.

Table 6. The AFMC EPAs

	EPAs
EPA 1	Obtain a history and perform a physical examination adapted to the patient's clinical situation
EPA 2	Formulate and justify a prioritized differential diagnosis
EPA 3	Formulate an initial plan of investigation based on the diagnostic hypotheses
EPA 4	Interpret and communicate results of common diagnostic and screening tests
EPA 5	Formulate, communicate and implement management plans
EPA 6	Present oral and written reports that document a clinical encounter
EPA 7	Provide and receive the handover in transitions of care
EPA 8	Recognize a patient requiring urgent or emergent care, provide initial management and seek help
EPA 9	Communicate in difficult situations
EPA 10	Participate in health quality improvement initiatives
EPA 11	Perform general procedures of a physician
EPA 12	Educate patients on disease management, health promotion and preventive medicine

(Adapted from Touchie C. AFMC Entrustable professional activities for the transition from medical school to residency. 2021)

d) The Republic of Korea

In the Republic of Korea (Korea), the development of EPAs is closely based on the framework outlined in "The Role of the Korean Doctor, 2014" by the Korea Association of Medical Colleges (KAMC) (57) (Table 7). This framework emphasizes the crucial responsibilities and expected activities that medical graduates should be capable of performing, taking into account the unique context and healthcare priorities of Korea (57). The EPAs, aligned with this framework, play a pivotal role in shaping medical education in the country (57, 58).

The focus on graduate outcomes underscores the commitment of Korean medical education to produce doctors who are not only academically proficient but also well-prepared to meet the specific challenges and demands of the local healthcare landscape (57). Korean EPAs serve as a guide for assessing these outcomes, ensuring that medical graduates possess the necessary skills and competencies to excel in their professional roles (58).

Table 7. KAMC EPAs for the Transition from Medical School to Internship

Korean EPAs	
Korean EPA 1	Personnel Interview and Physical Examination
Korean EPA 2	Inspection, Differential Diagnosis, Evidence-Based Treatment
Korean EPA 3	Medical Record Keeping, Progress Note and Prescription Writing
Korean EPA 4	Doctor-Patient Communication, Patient and Guardian Education
Korean EPA 5	Information Exchange through Collaboration, Leadership, Interprofessional Cooperation
Korean EPA 6	Informed Consent and Procedures
Korean EPA 7	Emergency Situations, Safety Management
Korean EPA 8	Medical Advancement, Environmental Improvement, Research
Korean EPA 9	Social Contribution, Social Responsibility, International Cooperation, Disaster Response
Korean EPA 10	Professionalism, Self-Regulation, Healthcare Management, Lifelong Education

(Adapted from Lee Sun-woo. A Study on the Development of General Competencies and Entrustable Professional Activities (EPA) Based on the Medical Ideals of Korea. Medical Policy Forum. 2019;16(4):80-5.)

While the EPAs are tailored to the specific needs of Korea, there is an awareness of medical education in global perspectives (57). This includes an understanding of international best practices and trends. The integration of global perspectives ensures that South Korea's approach to EPAs remains dynamic and responsive to advancements and innovations in medical education on a global scale.

The adaptability of the Korean EPA framework to international standards reflects a commitment to ensuring that medical graduates from the country are well-equipped to contribute not only to the local healthcare system but also to engage effectively in the broader global medical community (57). This nuanced approach positions Korea within the broader context of global medical education trends, emphasizing continuous improvement and alignment with international standards.

e) Core Competencies for Nursing Education

Nursing education in the 21st century is evolving to meet diverse healthcare needs (59). Promoting diversity, equity, and inclusion to address systemic healthcare disparities are included as key points (59). Nursing education now encompasses four critical spheres of care: disease prevention, chronic disease management, regenerative care, and hospice/palliative care, reflecting a shift towards comprehensive healthcare delivery. Nurses are increasingly trained in systems-based practice to navigate complex healthcare systems and advocate for equitable care. Integration of informatics and technology is essential for enhancing patient outcomes and efficiency. Academic-practice partnerships are pivotal in advancing nursing education and practice, fostering collaboration and innovation. Emphasis on career-long learning supports ongoing professional development. According to the American Association of Colleges of Nursing, the framework of nursing education is structured around ten essential domains, ensuring competency across knowledge application, person-centered care, population health, scholarship, quality and safety, interprofessional collaboration, informatics, professionalism, and personal/professional/leadership development (Figure 2) (59). These elements collectively prepare nurses to excel in a dynamic healthcare landscape and deliver high-quality, patient-centered care.

Figure 2. Core Competencies of Nursing Education of American Association of Colleges of Nursing (2021)

(Adapted from Nursing AAoCo. The essentials: Core competencies for professional nursing education. 2021.)

In Nursing education, each domain plays a crucial role in shaping competent and compassionate nurses capable of meeting the demands of modern healthcare. Knowledge for Nursing Practice ensures that nurses are equipped with up-to-date medical knowledge and the ability to apply it effectively in clinical settings. person-centered care emphasizes the importance of individualized and respectful patient care, considering their unique needs and preferences. Population Health equips nurses with the skills to contribute to community health and disease prevention initiatives. Scholarship for Nursing Discipline promotes a culture of research and evidence-based practice, driving continuous improvement in healthcare delivery. Quality and Safety ensures that nurses adhere to rigorous standards to provide safe and effective care. Interprofessional Collaboration prepares nurses to work collaboratively with other healthcare professionals, enhancing patient outcomes through coordinated care. Informatics and Healthcare Technologies integrate technology into nursing practice, facilitating data-driven decision-making and improving efficiency. Professionalism instills ethical principles and professional integrity in nurses, fostering trust and respect within the healthcare community. Personal, Professional, and Leadership Development encourages lifelong learning and career advancement, empowering nurses to take on leadership roles and drive innovation in healthcare delivery.

Together, these domains form a comprehensive framework that not only prepares nurses to navigate complex healthcare systems but also empowers them to advocate for equitable care and promote positive health outcomes for patients worldwide.

3. Learning Theories and Educational Methods

a) Learning Theories

The connection between instructional strategies and human learning theories is highlighted by Ertmer and Newby (60, 61), emphasizing that these theories not only validate instructional methods but also guide the selection of specific strategies. They underscore the significance of learning theories in offering insights into the relationships among strategies, context, and learner characteristics, enabling better integration. Importantly, learning theories facilitate the reliable prediction of the effectiveness of chosen instructional strategies.

Three primary learning theories—Behaviorism, cognitivism, and constructivism (60)—play distinct roles in shaping how learning is defined, influencing learner roles, and dictating appropriate teaching methods and assessment strategies. Beyond these primary theories, the basics of adult learning theory, cognitive load theory, and multimedia theory are also pivotal in informing instructional design to accommodate learners' characteristics and experiences (62). In the adult learning theory, framed by andragogy and self-directed learning principles (63, 64), emphasizes the importance of capitalizing on the learner's experience in instructional design. It acknowledges adult learners' independence, rich life experiences, professional and personal goals, internal motivation, and problem-centered approach, advocating for active participation and experiential learning (62).

- **Behaviorism**

Behaviorism places its primary focus on observable indicators as evidence of learning, contrasting with cognitive psychology, which associates learning with mental processes (60). Although behaviorists acknowledge the existence of these mental processes, they view them as unobservable indications of learning. Behaviorism, pioneered by J.B. Watson, centers on conditioning observable human behavior (65). Watson defined learning as a sequence of stimulus and response actions within observable cause-and-effect relationships. One key tenet of behaviorism is the concept of environmental determinism, asserting that external stimuli and reinforcement play crucial roles in shaping behavior (60). Notably, behaviorism does not emphasize internal mental processes, instead concentrating on observable actions and their environmental triggers. Despite its contributions to psychology

and education, behaviorism has faced criticism for oversimplifying human behavior by neglecting cognitive processes. Modern perspectives, such as cognitive psychology, have since incorporated both observable behaviors and internal mental states for a more comprehensive understanding of human behavior (60).

- **Cognitivism**

Cognitivism, a psychological and educational theory that emerged as a reaction to behaviorism, delves into the intricate processes of the mind involved in learning (60). Unlike behaviorism, which focuses on observable behaviors, cognitivism places a profound emphasis on internal mental processes (60). Central to this perspective is the information processing model, likening the mind to a sophisticated computer system that encodes, stores, retrieves, and processes information. One key concept within cognitivism is the notion of schemas—mental frameworks that organize and interpret information, shaping how individuals perceive, remember, and problem-solve based on existing knowledge structures (60).

Metacognition, a crucial aspect of cognitivism, involves the awareness and control of one's cognitive processes (66). Learners actively engage in planning, monitoring, and evaluating their own learning strategies. Moreover, cognitivism explores the transfer of learning, examining how knowledge acquired in one context can be applied to another. The theory also sheds light on problem-solving strategies (67), emphasizing the use of heuristics (68), algorithms (69), and critical thinking skills in navigating challenges (70).

Language holds a significant role in cognitivism, seen as both a tool for thought and a means of communicating and organizing knowledge (71). Furthermore, cognitivism aligns with constructivism by recognizing that learners actively construct their understanding of the world through mental processes (60). This perspective has greatly influenced education, contributing to the development of instructional strategies, curriculum design, and educational technologies. Cognitivism continues to shape the fields of educational psychology and cognitive science, offering valuable insights into the intricacies of how individuals acquire, process, and retain information.

- **Constructivism**

Constructivism, a prominent learning theory developed by educational psychologists such as Jean Piaget and Lev Vygotsky, underscores the active role of learners in the construction of their own knowledge (72). This theory asserts that learning is a dynamic process wherein individuals create meaning through personal experiences, reflection, and the integration of new information with existing knowledge (60, 72). At its core, constructivism advocates for active engagement, encouraging learners to explore, question, and interact with information (60). Social interaction plays a pivotal role, with collaboration and communication with peers seen as essential for enhanced learning. Constructivist environments often feature authentic tasks and real-world problems, fostering critical thinking and relevance in learning (66). The concept of scaffolding, introduced by Vygotsky, underscores the importance of guidance from more knowledgeable individuals to support learners as they build understanding (72, 73). Reflective practices and metacognition are integral components, promoting self-awareness and monitoring of one's own learning process. Acknowledging the validity of multiple perspectives, constructivism encourages learners to consider diverse viewpoints for a more comprehensive understanding. Ultimately, constructivism has significantly influenced education, shaping teaching practices, curriculum design, and the integration of technology in classrooms, all while fostering a continuous love for learning and adaptability throughout one's life.

- **Cognitive Load Theory (CLT)**

CLT proposed by Sweller (74, 75), emphasizes the importance of aligning instructional conditions with the learner's cognitive architecture, including sensory memory, working memory, and long-term memory. CLT distinguishes between intrinsic, extraneous, and germane cognitive loads (62, 76). Intrinsic load relates to the complexity of concepts, extraneous load arises from suboptimal presentation, and germane load results from learner interactions contributing to the learning process. The overarching principle is to minimize extraneous load, manage intrinsic load, and promote germane load, considering the limitations of working memory (62). Neglecting cognitive load considerations can lead to inadequate instruction. Applying CLT principles is crucial for designing effective instruction, especially for complex physiological concepts. Various design guidelines aim to reduce extraneous load, handle intrinsic load, and optimize germane load in instructional materials (77, 78).

Multimedia theory, rooted in the cognitive theory of multimedia learning (79), operates on the principles of dual-channel processing, limited capacity, and active processing (62). Aimed at reducing extraneous cognitive processing, multimedia theory aligns with cognitive load theory to inform evidence-based instructional design. Issa and colleagues' work (80) demonstrates the positive impact of applying multimedia design principles in medical education.

b) Educational Methods

Learning methods in medical education refer to the various strategies, techniques, and approaches employed to facilitate the acquisition of knowledge, skills, and attitudes relevant to the practice of medicine (81). These methods are designed to engage and educate medical students, residents, and other healthcare professionals, ensuring that they develop the necessary competencies to provide effective patient care. Delving into educational research, these methods intricately align with foundational learning theories (82) and there are several teaching methods have been introduced in medical education (83).

- **Lecture**

Lectures play a pivotal role in the instructional design, providing a platform for the dissemination of essential knowledge and theoretical foundations (84). Lectures serve as a foundational component, delivering key concepts, theoretical frameworks, and critical information related to oral presentations in clinical encounters.

During lectures, students receive comprehensive insights into the principles of effective oral communication, including content organization, visual aids utilization, and interpersonal skills (84). Theoretical foundations are explored, connecting the lecture content to the broader context of medical practice (84, 85).

While interactive learning strategie are emphasized for practical skill development, lectures provide the necessary theoretical underpinning (86). This combination ensures a well-rounded educational experience, where theoretical knowledge is seamlessly integrated with practical application, preparing students for the complex demands of clinical encounters in their medical careers.

- **Case-Based Learning (CBL)**

CBL is an educational approach that immerses students in real-world scenarios, encouraging active participation and critical thinking (87, 88). Instead of traditional lectures, students work collaboratively in groups to analyze and discuss cases derived from actual experiences. These cases span multiple disciplines, emphasizing the interconnected nature of knowledge (87). CBL aims to bridge the gap between theory and practice, requiring students to apply their knowledge to specific situations (88). Through problem-solving, class discussions, and reflection, students develop not only subject-specific skills but also essential collaborative and communication abilities. Assessment in CBL often evaluates the entire learning process, including decision-making and teamwork (88). The continuous presentation of cases ensures an ongoing learning experience, allowing students to build upon their knowledge sequentially. Widely used across various fields (88, 89), from medicine to business, case-based learning provides a dynamic and engaging platform for students to apply theoretical concepts in practical contexts, fostering a holistic and applicable understanding of their studies.

- **Team-Based Learning (TBL)**

TBL represents a pedagogical approach that deviates from traditional teaching methods, offering a structured framework designed to foster active engagement, collaborative learning, and the practical application of knowledge (90). Unlike conventional lectures where information is passively received, TBL places students in small, diverse teams, sparking active participation and stimulating critical thinking (91). The TBL process unfolds in a sequence of meticulously designed activities, commencing with individual preparation to ensure a baseline understanding (92). This preparation is followed by the readiness assurance process, encompassing both individual and team assessments. Such dual assessments serve to uphold accountability at both the individual and collective levels (93). Furthermore, TBL diverges from Problem-Based Learning (PBL), which centers on solving intricate problems through self-directed exploration. While both approaches share a commitment to active learning, TBL integrates problem-solving elements within a more structured format (94). The incorporation of pre-class preparation, immediate feedback, and team collaboration forms the cornerstone of TBL, differentiating it from the flipped classroom model, where traditional lectures are consumed outside class hours. In this multifaceted approach, TBL amalgamates the benefits of flipped learning with in-person

team activities, providing a balanced and holistic educational experience (95). As an active learning strategy, TBL stands out in its emphasis on cultivating critical thinking skills through problem-solving scenarios and collaborative discussions (90, 96). While it shares common objectives with various active learning methods, such as online learning, TBL uniquely champions face-to-face interactions, thereby enriching the learning experience. In essence, Team-Based Learning transcends traditional boundaries, delivering a structured yet dynamic approach that not only instills knowledge but nurtures the skills essential for success in the evolving landscape of education and professional practice (96).

- **IPE**

IPE is an educational approach where students or professionals from multiple healthcare disciplines learn together with the goal of fostering collaborative practice and enhancing the quality of patient care. According to the World Health Organization (WHO), IPE occurs when "two or more professions learn with, from and about each other to improve collaboration and the quality of care" (26). This definition underscores the intent of IPE to break down traditional professional silos, enabling a better understanding and respect among different healthcare professions, ultimately leading to improved patient outcomes.

IPE is increasingly integrated into contemporary healthcare education as it prepares healthcare professionals to operate effectively in complex, team-based environments. Research supports that IPE leads to improved health outcomes, more efficient teamwork, and enhanced patient safety. Reeves et al. (2016) (97) highlight that IPE can result in better communication among healthcare providers, more coordinated care, and a reduction in clinical errors.

Modern IPE programs employ a variety of interactive and innovative teaching methods to achieve their objectives. These methods include high-fidelity simulations that provide a safe environment for practicing clinical skills and teamwork, case-based learning that involves students from different disciplines working together to solve clinical problems, and clinical rotations that allow for real-world collaborative practice. Additionally, interdisciplinary workshops and seminars focus on developing essential competencies such as communication, teamwork, and ethical practice (97).

The benefits of IPE are well-documented. It enhances teamwork by fostering a better understanding of the roles and responsibilities of different healthcare professionals, which leads to improved coordination and collaboration. Improved communication strategies developed through IPE are critical for effective patient care and safety. Evidence also

suggests that IPE leads to better patient outcomes and higher levels of job satisfaction among healthcare professionals, as it promotes a sense of professional identity and mutual respect (97)

Despite its advantages, IPE faces several challenges. Institutional barriers such as differences in curricula and schedules across disciplines can complicate the implementation of IPE programs. Resource constraints, including the need for trained faculty and adequate infrastructure, also pose significant hurdles. Furthermore, there may be cultural resistance to IPE from faculty and students who are accustomed to traditional, discipline-specific education models.

- **SBE**

SBE is an innovative approach used across various disciplines, notably in healthcare, to enhance learning through realistic scenarios replicated in controlled environments (18, 19, 98). This educational method allows learners to practice and refine clinical skills, make critical decisions, and improve teamwork and communication without posing risks to real patients.

In healthcare, SBE utilizes different types of simulations tailored to specific learning objectives. High-Fidelity (HF) Simulations employ advanced technology such as lifelike manikins or virtual reality environments to simulate complex medical scenarios like surgical procedures or emergency situations (98). These simulations provide learners with realistic experiences that closely resemble actual clinical settings, enabling them to develop and assess their clinical competencies in a safe and supportive environment.

On the other hand, Low-Fidelity (LF) Simulations are simpler and less costly, involving task trainers or basic models to teach fundamental skills or procedures before advancing to more complex scenarios (98). Standardized patient simulations utilize trained actors who portray patients with specific medical conditions, allowing learners to practice clinical interactions, history-taking, and physical examinations realistically (98). SBE also encompass role-playing, is an innovative educational strategy used widely across healthcare and other disciplines to enhance learning in simulated real-world scenarios (98). This approach allows learners to engage actively in realistic situations, practicing clinical skills, making critical decisions, and refining teamwork and communication abilities in a controlled environment.

The educational objectives of SBE are manifold. It aims to enhance skill acquisition by providing hands-on practice, improve decision-making abilities through exposure to diverse clinical scenarios, and foster effective teamwork and communication among healthcare professionals. SBE also contributes to patient safety by allowing healthcare providers to practice rare or high-risk procedures and refine protocols without compromising patient care (15, 18).

Research supports the effectiveness of SBE in improving learner outcomes. Studies have shown that SBE enhances clinical competence, increases learner confidence, and improves performance in real-world clinical settings (15, 98). Immediate feedback provided during debriefing sessions following simulations is crucial in reinforcing learning objectives, addressing challenges encountered during simulations, and promoting reflective practice among learners.

Despite its benefits, SBE faces challenges such as the initial cost of simulation equipment, the need for specialized training for instructors, and the logistical complexities of scheduling and coordinating simulation sessions within educational programs (99). However, ongoing advancements in simulation technology, including virtual reality and augmented reality, continue to expand the possibilities and effectiveness of SBE in healthcare education.

4. EPAs-Based Curriculum

At University Medical Center Utrecht, Netherland, the Utrecht medical program features a well-structured six-year curriculum, compliant with Dutch regulations that delineate Bachelor and Master phases (100). Students, meeting stringent admission criteria and possessing a high school diploma, traverse a carefully designed educational journey encompassing both non-clinical and clinical aspects. The EPA framework, comprising five core EPAs, serves as the backbone of the program. It reflects a deliberate effort to prepare students for the competence to execute core EPAs during the final transitional year. This preparation involves mastering smaller activities, considered as small EPAs, during integrated clerkships in preceding years. The connection between core EPAs and the CanMEDS competency framework is carefully delineated, ensuring a comprehensive evaluation of students' performance. Assessment and documentation play a crucial role in the curriculum. The entrustment decisions, based on a nuanced five-level supervision framework, are continuous throughout the program (101). The process involves evaluating students' readiness for various activities, reflecting a commitment to gradual increments of independence. Assessment methods include short practice observations and case-based discussions, focusing on fictional patient characteristics and situations variations. The implementation of an electronic portfolio system adds efficiency to the documentation process, providing a student-friendly interface. This system enables tracking of formative and summative assessments, ensuring a comprehensive overview of student progress. The emphasis on a competency-based approach, continuous assessment, and entrustment decisions highlights the Utrecht medical program's dedication to nurturing well-rounded and proficient medical professionals.

The UME curriculum at the Faculty of Medicine of the National Autonomous University of Mexico (UNAM) is structured across three interconnected levels: macro, meso, and micro (102). At the macro level, a flexible modular system organizes comprehensive learning units, aligning with curricular principles and the APROC framework. The six General APROC define the graduate profile, encompassing diverse medical activities. Assessment at this level involves Comprehensive Modular Assessments (CMA), Collegiate Evaluation (CE), and Academic Advance Assessments (AAA), ensuring a holistic evaluation of competencies. Moving to the meso level, the curriculum unfolds over six phases, emphasizing foundational knowledge and clinical practice. The integration of APROC with each module ensures a balanced approach, promoting interdisciplinary patient care. Elective subjects and Social Projects enhance the practical application of learning. Career Choices, introduced for professional development, align

with the graduate profile. At the micro level, the CARAIPER scheme (CARAIPER, standing for case, clarification of terms, representation of the activity, analysis, integration, questions, independent study, and feedback) (103) guides learning and teaching strategies, emphasizing clinical reasoning through case-based methodologies. The fifth phase incorporates a transformative assessment system using an app, encouraging metacognition and providing multi-level feedback from students, clinical teachers, physicians, and residents. This innovative approach aims to align assessment with the evolving paradigms of medical education.

5. Global Perspectives on IPE

a) The United States

In 2009, AAMC collaborated with five other prominent education associations—representing nursing, pharmacy, osteopathic medicine, dentistry, and public health—to establish the Interprofessional Education Collaborative (IPEC) (104). This collaborative initiative aims to promote and facilitate meaningful interprofessional learning experiences. Such efforts are crucial for equipping future clinicians with the necessary skills to collaborate effectively in team-based patient care, thereby enhancing overall healthcare delivery and patient outcomes.

The 2023 IPEC competencies retain the overarching singular domain of IPC comprised of the following four competency areas (Table 8) (105):

Table 8. IPEC Core Competencies for Interprofessional Collaborative Practice: Version 3 (2023)

	Values and Ethics
VE1	Promote the values and interests of persons and populations in health care delivery, One Health, and population health initiatives
VE2	Advocate for social justice and health equity of persons and populations across the life span
VE3	Uphold the dignity, privacy, identity, and autonomy of persons while maintaining confidentiality in the delivery of team-based care
VE4	Value diversity, identities, cultures, and differences
VE5	Value the expertise of health professionals and its impacts on team functions and health outcomes
VE6	Collaborate with honesty and integrity while striving for health equity and improvements in health outcomes
VE7	Practice trust, empathy, respect, and compassion with persons, caregivers, health professionals, and populations
VE8	Apply high standards of ethical conduct and quality in contributions to team-based care
VE9	Maintain competence in one's own profession in order to contribute to interprofessional care
VE10	Contribute to a just culture that fosters self-fulfillment, collegiality, and civility across the team
VE11	Support a workplace where differences are respected, career satisfaction is supported, and well-being is prioritized

	Roles and Responsibilities
RR1	Include the full scope of knowledge, skills, and attitudes of team members to provide care that is person-centered, safe, cost-effective, timely, efficient, effective, and equitable
RR2	Collaborate with others within and outside of the health system to improve health outcomes
RR3	Incorporate complementary expertise to meet health needs including the determinants of health
RR4	Differentiate each team member's role, scope of practice, and responsibility in promoting health outcomes
RR5	Practice cultural humility in interprofessional teamwork
	Communication
C1	Communicate one's roles and responsibilities clearly
C2	Use communication tools, techniques, and technologies to enhance team function, well-being, and health outcomes
C3	Communicate clearly with authenticity and cultural humility, avoiding discipline-specific terminology
C4	Promote common understanding of shared goals
C5	Practice active listening that encourages ideas and opinions of other team members
C6	Use constructive feedback to connect, align, and accomplish team goals
C7	Examine one's position, power, role, unique experience, expertise, and culture towards improving communication and managing conflicts

Teams and Teamwork	
TT1	Describe evidence-informed processes of team development and team practices
TT2	Appreciate team members' diverse experiences, expertise, cultures, positions, power, and roles towards improving team function
TT3	Practice team reasoning, problem-solving, and decision-making
TT4	Use shared leadership practices to support team effectiveness
TT5	Apply interprofessional conflict management methods, including identifying conflict cause and addressing divergent perspectives
TT6	Reflect on self and team performance to inform and improve team effectiveness
TT7	Share team accountability for outcomes
TT8	Facilitate team coordination to achieve safe, effective care and health outcomes
TT9	Operate from a shared framework that supports resiliency, well-being, safety, and efficacy
TT10	Discuss organizational structures, policies, practices, resources, access to information, and timing issues that impact the effectiveness of the team.

(Adapted from IPEC Core Competencies for Interprofessional Collaborative Practice, https://www.ipecollaborative.org/assets/core-competencies/IPEC_Core_Competencies_Version_3_2023.pdf)

b) Canada

In 2007, Health Canada provided fund to bring together six health and human service professions (medical, nursing, occupational therapy, pharmacy, physical therapy, and social work) for the purpose of integrating IPE standards into the accreditation programs of each profession's education system (106, 107). The Association of Faculties of Medicine (AFMC) provided the secretariat for the Accreditation for Interprofessional Health Education (AIPHE) group (106, 107) (Figure 3).

An IPE curriculum was developed, implemented, and evaluated health professions by the Office of Interprofessional Education (OIPE) within the Faculty of Medicine at McGill University in Montreal, Quebec (108) . The curriculum is rooted in evidence-based practices and designed according to best practices in IPE. It integrates the IPE competencies outlined in the Canadian Interprofessional Health Collaborative Framework (CIHC, 2010). These domains encompass role clarification, team functioning, interprofessional communication, patient/client/family/community-centered care, interprofessional conflict resolution, and collaborative leadership.

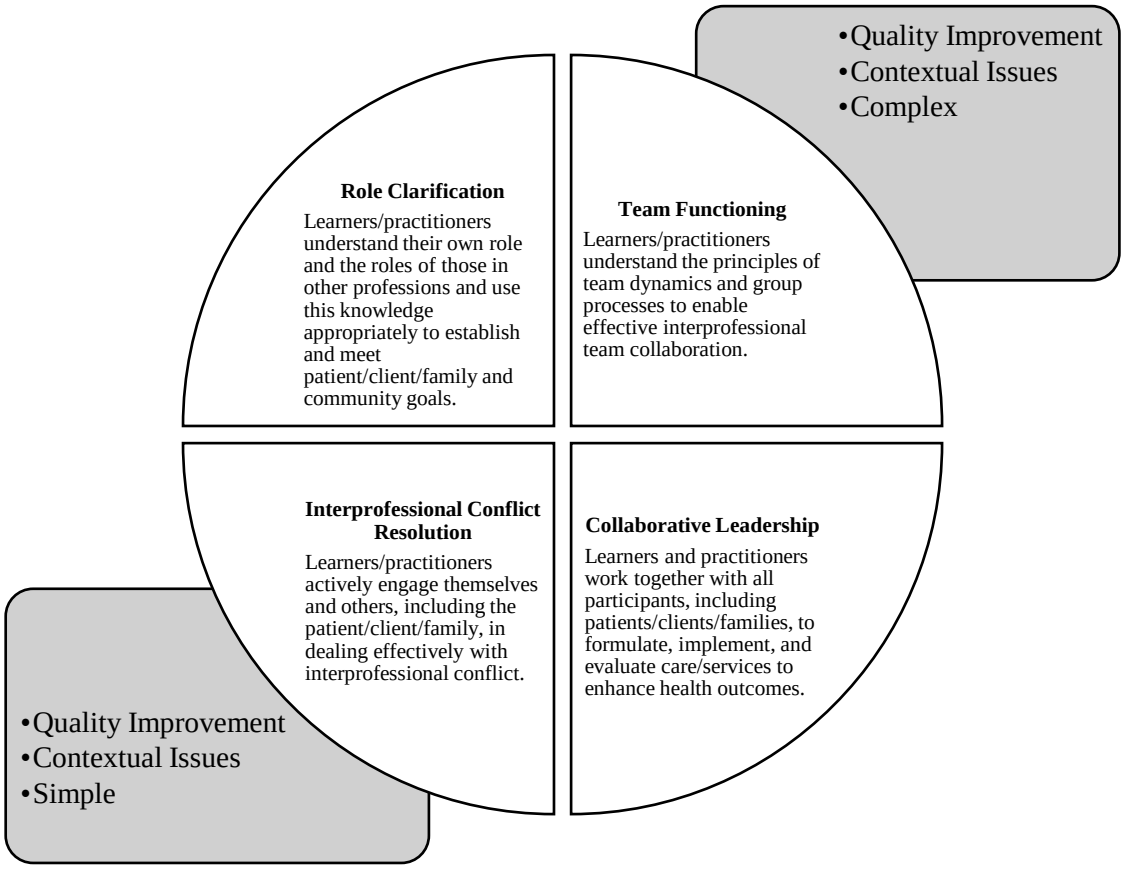

Figure 3. Canadian Interprofessional Health Collaborative Framework

(Adapted from Canadian Interprofessional Health Collaborative (CIHC) framework, https://www.mcgill.ca/ipeoffice/ipe-curriculum/cihc-framework)

c) United Kingdom

IPE is being integrated into the core of professional education for all health and social care professions across the United Kingdom (UK) (109). This initiative was driven by the Labour Government elected in 1997, coinciding with the hosting of the first All Together Better Health conference in London by this Journal. IPE is defined as a collaborative learning process where two or more professions learn with, from, and about each other to enhance collaboration and the quality of care by Centre for Advancement of Interprofessional Education (CAIPE) (109). Governments, healthcare regulators, and academic institutions continue to advocate for IPE as a crucial element in educating healthcare professionals (Figure 4) (110). The aim is to enhance collaborative interprofessional practice in healthcare settings.

Figure 4. Interprofessional Capability Framework

(Adapted from Walsh, Claire L., et al. "Interprofessional capability: A developing framework for interprofessional education." Nurse Education in Practice 5.4 (2005): 230-237.)

6. Current Trends in SBE

SBE is a rapidly advancing educational method that utilizes immersive and interactive technologies to enhance learning outcomes across various disciplines (111, 112). Defined as the use of simulated environments and scenarios for experiential learning, SBE allows learners to practice and refine skills in a controlled, risk-free setting, which is particularly beneficial in fields like medicine, aviation, and military training (46, 111, 112). Recent advancements in virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) have significantly enhanced the effectiveness of SBE by creating more realistic and engaging learning experiences (113).

In medical education, SBE enables students to perform surgical procedures, diagnose illnesses, and manage patient care in virtual environments, thereby reducing the risk of real-life errors and improving patient safety (19, 112). SBE is widely integrated into medical curricula across the globe. For instance, a study by Okuda et al. (2009)(114) reported that 87% of U.S. medical schools included some form of simulation in their training programs. The integration ranges from basic procedural training to complex scenario-based exercises that cover various medical disciplines (114). Similarly, Australian medical schools have been proactive in adopting SBE. Institutions such as the University of Sydney and Monash University have state-of-the-art simulation centers. A study by Nestel et al. (2018) (115) noted that simulation is embedded in both undergraduate and postgraduate medical education in Australia. The focus is on patient safety, clinical competence, and interprofessional education. Canadian medical schools also emphasize the importance of SBE. The Royal College of Physicians and Surgeons of Canada mandates the inclusion of simulation in residency training programs. 95% of Canadian medical schools use high-fidelity simulation for teaching critical care and emergency medicine (116).

7. Instructional Design (ID) Models

a) Definition

ID is the art and science of crafting educational experiences that enhance the acquisition of knowledge and skills, making the learning process more efficient, effective, and engaging(32). Several instructional design models have been utilized in educational development (117-119).

This practice relies on well-established education theories, ensuring decisions are grounded in sound principles of learning and instruction. In essence, ID revolves around creating experiences that facilitate improved learning (33). It encompasses various methods of instruction, offering diverse approaches to support human learning and development, with careful consideration of when to employ each method (120).

The ID process is systematic, emphasizing the delivery of high-quality instruction (34). It encompasses a thorough analysis of learning needs and goals (121), the creation of a delivery system to address those needs (121), the development of instructional materials and activities (34), and the systematic trial and evaluation of all instruction and learner activities (117). ID is a versatile tool applicable in various contexts within medical education (118). It serves as a guiding framework for educators in health professions, aiding in the development of classes, online modules, courses, simulation scenarios, continuing education conferences, and clinical teaching sessions. ID principles and theories are adaptable to formal large group classes, small group discussions, workshops, laboratory teaching, and online learning environments. Additionally, ID can enhance teaching in clinical settings, addressing challenges like opportunistic cases, diverse learner levels, potential teacher expertise variations, the presence of patients, and the balance between teaching and clinical care. In the continuum of medical education, ID finds utility in instructing medical students, postgraduate trainees, and practicing physicians. Each group's unique characteristics are considered during the ID decision-making process. While some areas of medical education involve scripted lesson plans from central organizations or government entities, clinical teaching often relies on the opportunistic nature of cases, with teachers drawing on experience to create dynamic learning scripts. This highlights the adaptability and broad applicability of instructional design in the dynamic field of medical education.

b) ID Models

- **The Dick and Carey Model**

The Dick and Carey systems approach to instructional design is a nine-step process that provides a systematic framework for developing effective curricula (122).

The first stage involves identifying instructional goals, which is crucial for determining the desired outcomes of the educational process (122). Collaboration with subject matter experts and conducting a needs assessment are integral to understanding the gap between the intended and current competency levels of learners. Once the instructional goals are established, the next step is to conduct an instructional analysis. This step involves identifying the specific skills and knowledge that should be incorporated into the curriculum (122). The analysis aligns each instructional goal with the appropriate learning domain, as defined by Bloom's taxonomy, which includes the psychomotor, affective (attitude), and cognitive domains (123). Analyzing learners and their context is the third stage of the process. Understanding the target population goes beyond merely considering the learners' context; it involves assessing their skills, prior knowledge, attitudes, motivation, education levels, learning preferences, and group characteristics. This holistic approach ensures that the curriculum is tailored to meet the specific needs and characteristics of the learners (122). The fourth stage focuses on writing performance objectives. A performance objective outlines what learners should be able to do by the end of the instructional unit. These objectives are written in three parts: conditions, behavior, and criteria (122, 123). Conditions describe the tools and resources needed, behavior outlines the skill, and criteria specify the acceptable performance level. The fifth stage involves developing assessment instruments, considering the type of assessments that align with the performance objectives. Various assessment methods, such as questioning, observations, interviews, and quizzes, are chosen based on the environment, response time, and probability of guessing the correct answer (123). The sixth stage revolves around developing an instructional strategy. This includes selecting various teaching and learning strategies, such as group discussions, lectures, simulations, and worksheets (123). The choice of instructional strategies is influenced by factors such as the instructional goals, learner motivation, learning objectives, assessment requirements, and the performance context. The seventh stage is about developing and selecting instructional materials. These materials can be written information or resources that facilitate learning (122). Examples include student workbooks, activity guides, textbooks, and simulations (123). The

instructional materials need to align with the performance objectives and assessment instruments. Formative evaluation, the eighth stage, involves collecting data and information during instruction to assess its effectiveness (122). This ongoing evaluation occurs during the instructional process and includes methods such as questioning, observations, record analysis, interviews, self-assessments, short quizzes, and discussions (123). The final stage, stage nine, focuses on designing and conducting summative evaluation. Summative evaluation assesses the overall effectiveness of the instruction after its completion (122). It looks at the entire instructional unit and evaluates multiple performance objectives (123). The purpose of summative evaluation is to identify strengths and areas for improvement in the instructional design.

- **The 4C/ID Model**

The 4C/ID Model, developed by Jeroen J. G. van Merriënboer, Richard E. Clark, and Marcel B. M. de Croock, is a comprehensive instructional design model that focuses on complex learning environments (124). The 4C/ID Model stands for "Four Components Instructional Design," and it emphasizes the integration of four key components in the design of complex learning tasks (124). These components are:

Learning Tasks: learning tasks are the foundation, providing learners with whole-task practice in a real or simulated environment (124). These tasks aim to engage learners actively with the constituent skills, promoting schema construction through inductive processing. To manage complexity, a thoughtful progression from simpler to more intricate tasks is adopted, guided by task classes (75). These classes define categories of learning tasks and determine the sequence of the training program. Starting with basic assumptions for simpler tasks, complexity increases gradually (125). Learner support is integral, with a saw-tooth pattern of scaffolding, offering varied levels of product-oriented and process-oriented support (124). From case studies to modeling examples, the support structures adapt to learners' evolving expertise(126). This systematic approach ensures a well-organized and supportive learning experience, vital for mastering complex skills (124).

Supportive Information: The 4C/ID Model emphasizes the critical role of supportive information in facilitating effective learning (124). Acting as a bridge between learners' existing knowledge and nonrecurrent aspects of tasks, this information is class-associated rather than task-specific (124). It evolves across task classes, promoting schema construction through elaboration for deep understanding (124).

Mental models and cognitive strategies are vital components of cognitive schemata (124). Mental models represent declarative knowledge about the world's organization, categorized into conceptual, structural, and causal perspectives (124). Experiential relationships connect abstract knowledge to concrete cases, illustrated through case studies. Instructional methods, spanning expository and inquiry approaches, stress nonarbitrary relationships. Inductive and deductive strategies guide supportive information presentation. Inductive strategies, recommended by default, involve presenting case studies before general information. Cognitive strategies, akin to mental models, involve systematic approaches to problem-solving (SAPs) (124). Inquiry methods engage learners in qualitative reasoning about cognitive strategies, with modeling examples illustrating their application. An inductive-expository strategy is recommended for presenting cognitive strategies. Cognitive feedback, addressing nonrecurrent performance aspects, encourages reflection after task or class completion. Debriefing sessions and group discussions enable learners to compare their processes and solutions with presented SAPs and modeling examples. In essence, the 4C/ID Model underscores the strategic presentation of supportive information to foster effective learning, tailored to mental models, cognitive strategies, and cognitive feedback.

Just-in-Time Information: JIT (Just-In-Time) information is distinct from supportive information, focusing on the recurrent aspects of a complex skill—constituent skills performed consistently across various scenarios post-training (124). It offers step-by-step guidance for executing these recurrent skills, fading as learners gain expertise. JIT information is organized into information displays, small units providing rules for correct performance and prerequisite knowledge (124). Unlike supportive information, JIT emphasizes compilation through encoding situation-specific knowledge into cognitive rules (124).

Instructional methods for JIT promote active learning during practice, avoiding memorization (124). The information is introduced when needed for learning tasks, often during the first relevant task, and gradually fades (124). Control over learning tasks is essential for direct presentation; otherwise, learning aids like online help systems are utilized (124). Demonstrations (illustrating rules) and instances (exemplifying prerequisite knowledge) are integrated into learning tasks (127).

Feedback on recurrent performance aspects is crucial, focusing on errors and their recovery (124). Unlike errorless learning, the 4C/ID Model encourages recognizing and recovering from errors. Immediate corrective feedback, including suggestions or hints, aids learners in understanding the reasons behind errors and how to rectify them effectively

(124). This approach aligns with the model's emphasis on promoting compilation for effective skill acquisition.

Part-Task Practice: The instructional design emphasizes a balanced approach in learning tasks to promote schema construction and compilation of both recurrent and nonrecurrent constituent skills in complex tasks (124). Learning tasks are strategically crafted to provide opportunities for repeated practice, and additional part-task practice is introduced selectively for achieving a high level of automaticity in critical recurrent aspects (128). Part-task practice involves focused repetition of specific skills, with an emphasis on gradual complexity.

Practice items for part-task practice are designed to encourage learners to repeatedly perform targeted recurrent skills, fostering a divergent set of situations representative of real-world applications (124). The approach recognizes the importance of performance support during part-task practice, emphasizing procedures over problem-solving approaches (124). Just-In-Time (JIT) information is integrated not only into learning tasks but also into part-task practice, employing single-step instruction and providing demonstrations and instances separately but concurrently with information displays (124).

Overtraining is acknowledged as a requirement for achieving full automaticity in skills, with a gradual shift in performance criteria from accuracy to speed under varying conditions (124). Distributed practice, intertwined with learning tasks, is recommended for effective skill strengthening (129). The blueprint of a training program for literature research illustrates these principles across task classes, incorporating inductive-expository, inductive-inquiry, and deductive approaches (124). The program also highlights the initiation of additional part-task practice and the provision of cognitive feedback at specific points in the learning process.

- **The Analyze-Design-Development-Implementation-Evaluation (ADDIE) Model**

The ADDIE Model, known for its simplicity and user-friendly nature, serves as a foundational tool for instructional design. When a more in-depth comprehension and detailed explanations of each phase are necessary, the Dick and Carey model proves to be a valuable resource (62). However, in situations dealing with highly intricate materials, the 4CD/ID model emerges as the preferred choice (62). The ADDIE Model, a foundational framework in instructional design, operates as a systematic guide for the development of

effective learning experiences (130). Comprising five interconnected phases—Analysis, Design, Development, Implementation, and Evaluation—each stage serves a distinctive yet interdependent purpose in the process of crafting instructional materials and programs (130).

In the Analysis phase, the focus is on meticulously identifying the learning needs, objectives, and constraints through comprehensive needs analysis, thereby laying the groundwork for subsequent decisions. Following this, the Design phase seamlessly integrates the gathered insights to meticulously plan the structure, format, and content of the instructional materials. This strategic planning involves creating a detailed course outline and designing the instructional strategy, ensuring alignment with the predetermined objectives. Transitioning to the Development phase, the theoretical blueprint takes tangible form as instructional materials are produced and refined based on ongoing feedback. This stage involves the assembly of multimedia elements and the creation of prototypes, constituting a pivotal bridge to the subsequent Implementation phase. In Implementation, the meticulously crafted instructional plan unfolds in a real-world setting, necessitating the training of instructors and a pilot test to preemptively address potential challenges. The culminating phase, Evaluation, rigorously assesses the effectiveness and efficiency of the instructional program. Employing diverse evaluation methods and collecting comprehensive data, this phase facilitates an analytical scrutiny of the program's success in meeting its objectives. This evaluative feedback not only serves as a tool for continuous improvement but also informs future iterations of the instructional design process.

The iterative nature of the ADDIE Model, marked by a constant feedback loop, exemplifies its adaptability and commitment to refinement (131). This cyclic progression ensures that each phase is not only connected to its predecessor but is also informed by the outcomes of the subsequent stage.

8. ID in Medical Education

ID in Medical Education is a systematic approach aimed at developing and delivering effective educational experiences tailored to the unique needs of medical learners (132). This process involves conducting thorough needs assessments, setting clear and measurable objectives, integrating competencies (117), and focusing on CBE (119). Varied learning modalities, including traditional and technology-enhanced methods, are employed to accommodate diverse learning styles. Assessment strategies align with instructional objectives, providing feedback for continuous improvement. The flexible and adaptable nature of ID in Medical Education ensures responsiveness to evolving curricular and healthcare demands(133, 134), while a commitment to continuous improvement and alignment with accreditation standards ensures the production of competent healthcare professionals prepared for contemporary medical practice (135).

Developing competency models is essential for both CBE and traditional credit hour-based programs, ensuring that graduates possess problem-solving abilities within their specific fields of study (136). An examination of higher education course design in a 2015 analysis identified a common but somewhat intuitive process lacking detailed instructional goals and analysis within an Illinois college's programs (136). To address this, an approach involves collaboration with industry representatives, utilizing focus groups to define entry-level roles, essential skills, and industry-standard competency models (136). A deeper level of analysis, incorporating interviews with employees and their supervisors, informs the definition of program-level competencies. This includes specifying competencies with a proficiency scale and indicating behaviors that describe performance at each proficiency level. After establishing the competency model, the instructional design process follows the ADDIE model, emphasizing critical phases of analysis and design (136). Beyond the five phases, effective instructional design, guided by M. David Merrill's principles, underscores engagement in real-life tasks, activation of existing knowledge, demonstration and application of new knowledge, and its integration into the learner's world (137). Merrill's principles shift the focus from a mere interaction on a screen to engaging the learner's nervous system in problem-solving. For the effective integration of theory and practice with authentic contexts and tasks, a key factor for success is a thorough analysis and design, exemplified by the 4C/ID Model. This model serves as a guide for better integration of knowledge, skills, and abilities with real-world challenges, aiming for a more holistic and effective educational experience (138).

CBE is transforming how students earn college credit and how educators deliver instruction (136). All stakeholders in education, including administrators, students, and employers, anticipate a curriculum that equips individuals to make decisions and apply their knowledge across diverse domain problems (136). To implement CBE successfully, a well-defined competency model is essential, leveraging insights from industry sources and well-designed courses centered around authentic tasks (136). Research has consistently shown that CBE is enhanced when knowledge, skills, and attitudes are integrated into the learning experience, departing from traditional compartmentalized instruction (139-141). However, achieving this integration is complex and demands heightened attention to analysis and design compared to conventional knowledge transfer methods (136). The 4C/ID approach has been specifically designed for CBE, where students earn credit as they master new academic content (139).

9. Debriefing Models

Debriefing models serve as structured frameworks essential for promoting reflective learning and enhancing performance in various critical settings such as healthcare, military operations, and emergency response (142). These models are categorized into two main types: 3-Phase Conversation Structures and Multiphase Conversation Structures, each designed to facilitate comprehensive learning and improvement following simulated or real-life events (142).

Within the 3-Phase Conversation Structures, the Gather, Analyze, Summarize (GAS) Model stands out for its simplicity and adaptability across different contexts. Initially, it involves Gathering observations and initial thoughts from participants to ensure a comprehensive understanding of the event. This is followed by an Analyze phase where participants delve into identifying root causes, contributing factors, and areas for improvement. Finally, the Summarize phase consolidates key findings and actionable insights, providing a clear roadmap for implementing changes and enhancing future performance. This structured approach is valued for its ability to guide debriefing discussions effectively and foster meaningful learning outcomes (142).

Debriefing with Good Judgment focuses on fostering reflective learning and improving decision-making by exploring participants' underlying assumptions and cognitive processes. It begins with acknowledging initial emotional reactions (Reaction), proceeds to a detailed Analysis focusing on understanding the reasoning behind actions taken, and

concludes with synthesizing key insights and lessons learned (Summary). This method encourages participants to critically evaluate their decisions and errors in a supportive environment, aiming for deeper comprehension and continuous improvement (142).

The 3D Model (Defusing, Discovering, Deepening) emphasizes emotional and cognitive processing during debriefing. It starts with Defusing emotional responses to create a conducive atmosphere for constructive discussion. Participants then Discover underlying issues and insights through systematic analysis of the event. The Deepening phase connects these insights to broader principles and practical applications, facilitating the transfer of learning into real-world practice. This model proves particularly effective in high-stress environments like healthcare, where emotional responses can significantly impact decision-making and learning outcomes (142).

In Multiphase Conversation Structures, PEARLS guides participants through stages including expressing initial emotional responses, recounting specific actions taken, analyzing decision-making processes, and summarizing key insights and lessons learned. This structured approach promotes deep reflection and identification of areas for improvement in clinical practice (142).

TeamGAINS focuses on enhancing teamwork and communication effectiveness by establishing clear rules, aligning participants with learning objectives, discussing clinical scenarios, transferring simulation experiences to real-world applications, addressing behavioral dynamics, reviewing performance against expected standards, and formalizing learning outcomes. This model emphasizes collaborative learning and skill enhancement crucial for effective team functioning in healthcare settings (142).

III. Research Methods

1. Course Development Strategy

ADDIE Model was used as a framework for piloting an IPE class using SBE at Skills-Lab Center, HueUMP (Figure 5) because ADDIE Model is widely favored in instructional design for its systematic, iterative, and comprehensive approach. Structured around Analysis, Design, Development, Implementation, and Evaluation, ADDIE Model ensures that every phase of creating instructional materials is methodically addressed, minimizing the risk of overlooking critical aspects (34). This model's flexibility allows for continuous improvement and adaptability throughout the design process, which is essential for crafting effective learning experiences (117). Moreover, ADDIE's holistic approach integrates all essential elements of instructional design, ensuring a well-rounded final product.

Compared to other models like the Dick and Carey Model and the 4C/ID Model, ADDIE Model stands out for its systematic framework that supports iterative development. While the Dick and Carey Model emphasizes a systems approach and meticulous alignment with learning objectives and assessments (123), and the 4C/ID Model focuses on integrating complex tasks and real-world applications (34), ADDIE's flexibility and comprehensive nature make it adaptable to a wide range of instructional design needs and contexts. This adaptability and thoroughness make the ADDIE Model a preferred choice for educators and instructional designers aiming to create effective and impactful learning experiences.

This pilot class aims to test a new teaching method for medical and nursing students to help them learn about medical error scenarios related to communication and collaboration. Nevertheless, our research will primarily center on the initial three steps of the ADDIE approach: analysis, design, and development. These early steps are integral to shaping the instructional framework. The subsequent two stages serve as the action plan in the culmination of our study.

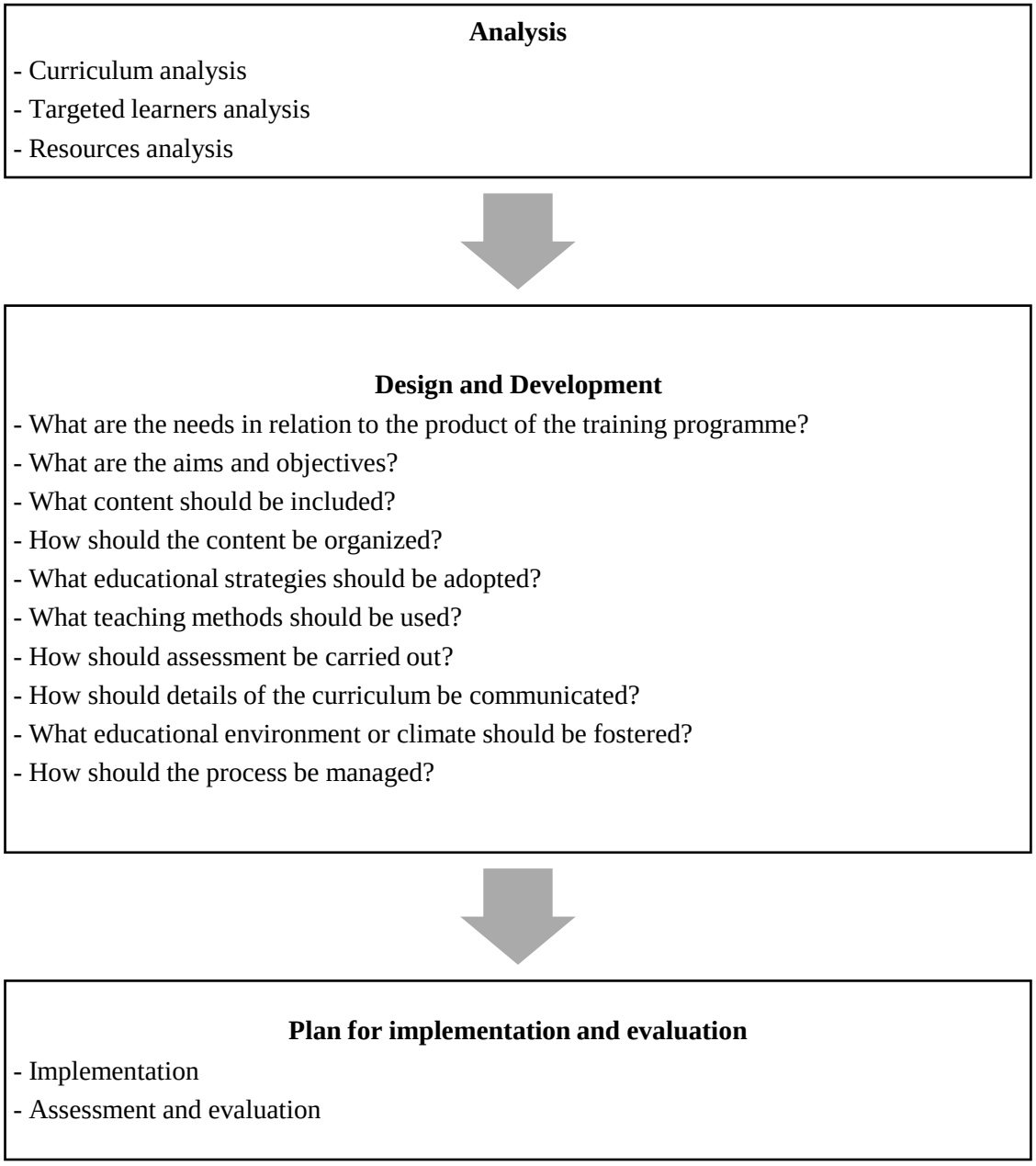

Figure 5. Development Process

2. Analysis

At this stage, we conducted an analysis of the curriculum, targeted learners, and resources to gain a clear understanding of what needs to be taught, who our target learners are, and what resources are available to support the learning process (143). This analysis helps us establish clear goals, develop educational content that aligns with the specific needs of learners, and optimize the use of available resources to ensure the highest quality learning environment.

- **Curriculum Analysis**

The curriculum was analyzed by reviewing the curriculum map of HueUMP. This examination focused on understanding how the curriculum was documented, the context that led to its development, the perspectives it represents, its purposes and content, organizational structure, strengths, and limitations.

- **Targeted Learner Analysis**

We have conducted an analysis, examining the targeted learner (143) (Table 9):

- Previous training and experiences relevant to the course module

- Already planned training and experiences relevant to the course module

- Existing characteristics/proficiencies/practices

+ Cognitive: knowledge, problem-solving abilities

+ Affective: attitudes, values, beliefs, role expectations

+ Psychomotor: skills/capabilities (e.g., history, physical examination, procedures, counseling), current behaviors/performance/practices,

- Preferences and experiences regarding different learning strategies.

Table 9. Targeted Learner Analysis

Targeted learners	Analysis
Targeted learners	1) Previous training and experiences 2) Already planned training and experiences 3) Existing characteristics/proficiencies/practices 4) Different learning strategies

(Adapted from Curriculum Development for Medical Education: A Six-Step Approach, https://books.google.co.kr/books/about/Curriculum_Development_for_Medical_Educa.html?id=9yB0EAAAQBAJ&redir_esc=y)

- **Resources Analysis**

In our resource analysis, we thoroughly examined various aspects crucial to curriculum development, encompassing personnel, time, facilities, and funding/cost considerations (Table 10) (143).

Personnel: We evaluated the roles and requirements of curriculum directors, faculty members, instructors, and teaching assistants, emphasizing the importance of skilled faculty and considering the utilization of standardized patients for clinical training.

Facilities: We analyzed the necessity for suitable facilities, including adequate space, equipment, and clinical sites, with a recognition of specialized resources such as simulation centers, medical equipment, and educational technology, exemplified by the detailed requirements of a resuscitation skills curriculum.

Funding/Costs: Our analysis encompassed the consideration of both financial and opportunity costs, identifying existing resources and potential redeployment.

Table 10. Resources Analysis

Resources	Analysis
Resources	1) Personnel 2) Facilities 3) Funding/costs

(Adapted from Curriculum Development for Medical Education: A Six-Step Approach, https://books.google.co.kr/books/about/Curriculum_Development_for_Medical_Educa.html?id=9yB0EAAAQBAJ&redir_esc=y)

3. Design and Development

To design and develop the pilot class, we addressed 10 key questions (Table 11) (144), which are applicable in various contexts, whether it's for an undergraduate program, a short postgraduate course, or even a brief one-hour lecture. The questions encompassed identifying training program needs, establishing clear aims and objectives, determining content inclusion, organizing structure, selecting educational strategies and teaching methods, designing assessment procedures, outlining communication methods for curriculum details, fostering an optimal educational environment, and managing the entire process efficiently.

To answer these 10 questions, we reviewed existing literature, standards, and guidelines pertaining to EPAs, competency standards for Vietnamese medical doctors, expected outcomes at Hue UMP for medical doctors, and EPA outcomes as per the AAMC Guideline for entering residency and adhered to the following guidelines

- Maintain congruence between objectives and educational methods: We ensure that each educational method chosen aligns with the specific measurable objectives set for the course module. For example, if the objective is to enhance problem-solving skills, employing methods such as case-based discussions or role-playing scenarios would be appropriate.

- Use multiple educational methods: Incorporate a variety of educational methods throughout the course to cater to diverse learning styles and preferences.

- Choose educational methods that are feasible in terms of resource: We choose educational methods that are feasible within the available resources, including faculty expertise, time constraints, and technological support. For instance, if the course lacks sufficient access to simulation facilities for hands-on training, alternative methods like virtual simulations or case studies can be employed to achieve similar learning outcomes.

Table 11. Development Questions

Ten questions to ask when planning a course or curriculum
1. What are the needs in relation to the product of the training program?
2. What are the aims and objectives?
3. What content should be included?
4. How should the content be organized?
5. What educational strategies should be adopted?
6. What teaching methods should be used?
7. How should assessment be carried out?
8. How should details of the curriculum be communicated?
9. What educational environment should be fostered?
10. How should the process be managed?

(Adapted from Harden RM. Ten questions to ask when planning a course or curriculum. Med Educ. 1986 Jul;20(4):356-65. doi: 10.1111/j.1365-2923.1986.tb01379.x. PMID: 3747885.)

The study began by developing the outcomes of the pilot class based on the related competencies of EPA 6 and HueUMP outcome standards, focusing on Level 3 of Bloom's Taxonomy (145). We identified specific learning outcomes related to applying communication and collaboration skills to manage medical errors. To ensure relevance, we selected common medical error scenarios encountered in Vietnam and at HueUMP Hospital, working closely with a physician and a nursing faculty member for their expertise. We then analyzed existing simulation models at our Skills-Lab Center to design two clinical scenarios: one using LF Simulation and one using HF Simulation. These scenarios provided hands-on experience, challenging students to apply theoretical knowledge in real-world situations. Based on these scenarios, we developed lesson content that included interactive discussions, debriefing sessions, and reflective practices. The pilot class was implemented with medical and nursing students, with facilitators providing real-time feedback and conducting debriefing sessions. We assessted and evaluated the class using the Kirkpatrick Model (146), assessing reaction, learning, behavior, and results through feedback, pre- and post-tests, observation of skill application, and overall impact on managing medical errors and enhancing patient safety. This comprehensive approach aimed to pilot and evaluate a new simulation-based teaching method for the IPE Module at HueUMP, ultimately enhancing medical education and clinical practice.

4. Plan for Implementation and Evaluation

The pilot implementation of the Simulation-Based IPE is scheduled to commence in 8th January 2025, engaging one physician and one nursing specialist as instructors, supported by an operator at the Skills-Lab Center. The center will be equipped with necessary models, equipment, and classrooms to facilitate the pilot. A voluntary group of medical and nursing students will participate in structured Simulation-Based IPE designed to promote interprofessional collaboration and enhance teamwork and communication skills. The program's effectiveness will be evaluated using the Kirkpatrick’s Model (146), which includes four levels: Reaction, Learning, Behavior, and Results. For this pilot phase, the focus will be on the first three levels. Data collection and analysis will include both quantitative and qualitative methods.

IV. Results

1. Analysis

a) Curriculum Analysis

Based on the public reports of HueUMP (147), we observed that the pre-clinical phase spans from the first year to the first semester of the third year (Table 12). During this period, students engage in integrated courses covering topics such as the cardiovascular system, musculoskeletal system, and more. Additionally, students refine their medical skills through Practice of Medicine (POM), which includes communication skills, history-taking skills, clinical skills, and professionalism. Progressing further, beginning from the second semester of the third year, students commence clinical clerkships at hospitals. These include core clerkships in internal medicine, surgery, obstetrics and gynecology, and pediatrics, as well as secondary clerkships in emergency medicine, family medicine, and others.

Table 12. Curriculum Map of Medical Students at HueUMP

Year	First		Second		Third		Fourth		Fifth		Sixth	
Semester	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**	**10th**	**11th**	**12th**
Course	Basic science	From molecules to cells	Immunity and immune response	Cardiovascular system	Digestive system	Reproductive system	Family medicine	Obstetrics and Gynecology			Practice of Pathology and Treatment in Internal medicine	
		From cells to tissues	Respiratory system	Musculoskeletal system	Renal and urinary system	Internal medicine					Practice of Pathology and Treatment in Surgery	
			Practice of Medicine (POM)		Nervous and endocrine system	Surgery					Practice of Pathology and Treatment in Obstetric and Gynecology	
						Community Health 1		Pediatric			Practice of Pathology and Treatment in Pediatrics	
							Community Health 2					
									Hematology and Oncology			
									Emergency medicine, Anesthesia and Resuscitation			
									Vietnamese Traditional Medicine, Rehabilitation			
									Infectious Diseases, Tuberculosis, Dermatology			
									Psychiatry, Neurology			
									Ophthalmology, Dentistry and Maxillofacial Surgery, Otorhinolaryngology			
	Pre-clinical phase								**Clinical phase**			

Nursing students undergo a comprehensive four-year training program (Table 13). The first two years of the curriculum are dedicated to foundational courses, encompassing basic sciences, humanities, and introductory subjects relevant to healthcare. These initial years lay the groundwork for a thorough understanding of the biological, social, and psychological principles that underpin nursing practice. As students progress into the latter half of their education, the focus shifts towards clinical training. The third and fourth years are primarily spent in hands-on practice, where students are immersed in clinical environments, including hospitals and various healthcare facilities. During these years, students apply theoretical knowledge to real-world scenarios, developing critical skills in patient care, clinical decision-making, and interprofessional collaboration

Table 13. Curriculum Map of Nursing Students at HueUMP

Year	First		Second		Third		Fourth	
Semester	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**
Course	Biology and Genetics	Chemistry and Physics - Biophysics	Pathophysiology - Immunology	Health Education in Nursing Practice	Research Methodology	Infection Control in Nursing Practice	Elderly Patient Care	Care of Adult Patients with Internal Medicine II
	Anatomy	Medical Psychology - Medical Ethics, Law - Health Organization	Pharmacology	Basic Nursing 2	Vietnamese Traditional Medicine	Emergency and Critical Care Nursing 1	Women's Health, Motherhood, Family, and Nursing Care I	Care of Adult Patients with Surgical Conditions II
	Biochemistry	Histology	Nutrition - Environmental Health, Epidemiology	Basic Nursing 3	Care of Adult Patients with Internal Medicine I	Care of Infectious Disease Patients	Women's Health, Motherhood, Family, and Nursing Care II	Professional Practice Experience
		Physiology	Health - Health Promotion & Human Behavior	Nursing Management	Care of Adult Patients with Surgical Conditions I		Pediatric Health Care I	
		Microbiology	Communication Skills in Nursing Practice	Basic Surgery and Pathology	Dermatological Patient Care		Pediatric Health Care II	
		Parasitology	Basic Nursing 1		Ophthalmological Patient Care		Mental Health Care	
					Ear, Nose, and Throat Patient Care			
			Basic Internal Medicine and Pathology		Obstetrics and Gynecology Basics and Pathology	Care for Patients Needing Rehabilitation	Community Health Care	
					Pediatrics Basics and Pathology	Care of Tuberculosis Patients	Emergency and Critical Care Nursing 2	
	Pre-clinical phase				**Clinical phase**			

b) Targeted Learner and Resources Analysis

Fifth-year medical students and third-year nursing students were selected for three reasons. Firstly, at HueUMP only medical, nursing, and dental students receive training through SBE at designated centers: medical students at the Skills-Lab Center, nursing students at the Nursing Lab of Faculty of Nursing, and dental students at the Simulation Center of the Faculty of Dentistry. This selection is driven by the fact that medical and nursing curricula inherently share more similarities in clinical skills and patient care responsibilities compared to dental curricula (148). Secondly, these students are currently engaged in clinical practice at hospitals, making it very practical and relevant for them to study Simulation-Based IPE at this time. Lastly, the IPE Module at HueUMP is designed specifically for fifth-year medical students and third-year nursing students. Additionally, it is also tailored for fifth-year students in the six-year medical program, fourth-year students in the five-year medical program, third-year students in the four-year nursing program, and second-year students in the midwifery program at HueUMP.

The rationale behind targeting these particular student groups lies in their active involvement in clinical settings, which enhances the relevance and applicability of interprofessional learning experiences. This approach aims to foster collaborative skills among future healthcare professionals early in their education, preparing them for interdisciplinary teamwork in real-world healthcare environments.

Fifth-year medical students and third-year nursing students at HueUMP have completed their pre-clinical phase, gaining essential knowledge and skills for their clinical clerkships (Table 14). They are actively involved in hands-on clinical practice in hospital settings and participate in IPE modules, applying their pre-clinical knowledge under the supervision of experienced clinicians across various specialties, including internal medicine, surgery, pediatrics, obstetrics and gynecology, psychiatry, and primary care. HueUMP employs modern teaching approaches such as Electronic Learning (E-Learning), Ubiquitous Learning (U-Learning), Problem-Based Learning (PBL), Team-Based Learning (TBL), Simulations, and Case-Based Learning, enhancing the traditional curriculum. The educational structure is managed by the School Council and the Board of Directors, with a Curriculum Core Group overseeing the CBE curriculum. The faculty team, comprising 452 members, supports teaching, student learning, extracurricular activities, and addressing student issues. HueUMP also has a team of six standardized patients to prepare students for real clinical experiences. The Skills-Lab Center, operational for five years, provides facilities for practicing clinical skills. Funding for HueUMP comes from the state budget,

tuition fees, scholarships, service revenues, and international organizations, supporting the university's mission to provide high-quality medical education despite financial constraints.

Table 14. Targeted Learner and Resources Analysis (Result)

Targeted learners	• **Previous training and experiences** Fifth-year medical students and third-year nursig students have completed their pre-clinical phase, a critical period in their education that lays the foundation for their upcoming clinical clerkships. This phase, typically encompassing the first few years of their respective programs, is designed to equip students with essential knowledge and skills that are fundamental to their future roles as healthcare providers **(**147**).**
	• **Already planned training and experiences** These students are not only engaged in hands-on clinical practice in hospital settings but are also actively participating in IPE Module (147).
	• **Existing characteristics/proficiencies/practices** As they transition to the clinical clerkship phase, fifth-year medical students and third-year nursing students are prepared to apply their pre-clinical knowledge in real-world settings. The clinical clerkship phase immerses them in the day-to-day activities of healthcare providers, allowing them to work directly with patients under the supervision of experienced clinicians. This phase is characterized by rotations through various medical specialties, including internal medicine, surgery, pediatrics, obstetrics and gynecology, psychiatry, and primary care (147).
	• **Different learning strategies** In recent years, HueUMP has innovated its teaching methods by incorporating E-Learning, U-Learning, Problem-Based Learning (PBL), Team-Based Learning (TBL), Simulations, and Case-Based Learning (9). These approaches allow students to access learning materials flexibly online and on mobile devices, encouraging collaborative problem-solving and real-world application of knowledge. These innovations supplement traditional teaching,

	offering students more engaging and interactive learning experiences.
Resources	• **Personnel** **- Curriculum Heads/ Module Heads** At HueUMP, the highest authority is held by the School Council, followed by the Board of Directors. Similar to other public medical universities in Vietnam currently undergoing the transformation of medical education, a Curriculum Core Group has been established to oversee the development of an integrated CBE curriculum and manage academic activities. This group aims to facilitate joint planning and foster a culture of critical inquiry. Within the Clinical and Preclinical phases, there are heads for each study year, who closely collaborate with Module/Department Heads to contribute to the development of the new curriculum. The specific development of each module is conducted by the respective module head and its multidisciplinary working group (149). **- Faculty Members** The faculty team at HueUMP totals 452 members, with the Department of Medicine having the highest representation at 125 members (147). In addition to teaching responsibilities, there are faculty members dedicated to overseeing student learning, extracurricular activities, and addressing student issues on a class-by-class basis for each discipline. **- Standardized Patients** The Standardized Patient Team comprises of 6 individuals who are trained to portray various medical conditions and clinical scenarios. This team undergoes regular training based on clinical content and situations to support students before they enter clinical clerkship.
	• **Facilities** We plan to conduct Simulation-Based IPE at the Skill-Lab Center, which also serves as the center for teaching clinical skills to students. The center consists of 9 classrooms, 1 administrative room, and 1 storage room. All 9 classrooms are equipped with

teaching facilities such as projectors, sound systems, and medical models for practicing various subjects including Internal Medicine, Surgery, Obstetrics, Pediatrics and Family Medicine.

- **Funding/costs**

The budget of HueUMP comes from various sources, including:

State budget: The university receive a portion of its budget from the state budget of the Vietnamese Government. This is the primary source of funding for public universities.

Tuition fees and other student revenues: Students at HueUMP are required to pay tuition fees and other fees such as training fees, laboratory fees, library fees, and other charges. These revenues can play an important role in the university's budget.

Scholarships and sponsorships from organizations, businesses: The university receive support from organizations, businesses, or individuals through scholarship funds, research projects, or other collaborations.

Revenue from services or products: The university generate some revenue from providing services or products such as medical services, education services.

Funding from international organizations: HueUMP receives funding from international organizations through collaborative projects, scholarship programs, or development projects.

Skills-Lab Center has only been established and operational for 5 years, so the budget is still constrained. Additionally, the broader financial landscape of the university may also influence the budgetary constraints faced by the Skills-Lab Center.

2. Design and Development

a) What are the needs in relation to the product of the training programme?

The AAMC EPAs are currently being implemented at HueUMP for medical students from their fourth to sixth years during their clinical clerkship. All AAMC EPAs are intrinsically linked to interprofessional communication and collaboration, which are crucial for enhancing patient safety and minimizing medical errors. Consequently, IPE has also been integrated into the curriculum at HueUMP since 2022 (12).

The current pedagogical methods employed for IPE at HueUMP include group discussions, communication exercises with standardized patients, practical experiences at primary healthcare facilities, and home visits to develop interdisciplinary healthcare plans (12). These methods aim to foster teamwork, improve communication skills, and promote a holistic understanding of patient care among healthcare students. However, while these approaches have their merits, there are instances of medical errors that necessitate hands-on practice using simulation models to ensure comprehensive learning and skill development (15, 19).

Medical errors often arise from a lack of experience or inadequate practice in handling real-life scenarios, especially those requiring immediate and effective interprofessional collaboration (97). To address this gap, this study focuses on testing a new teaching methodology, SBE using LF and HF Simulations that replicate complex clinical situations where errors are likely to occur. Through these simulations, students can practice and refine their skills in a controlled environment, receive immediate feedback, and learn from their mistakes without posing any risk to actual patients.

b) What are the aims and objectives? What content should be included? How should the content be organized? What educational strategies should be adopted? What teaching methods should be used? and How should assessment be carried out?

The instructional goal of enhancing patient safety by addressing communication and collaboration across healthcare professionals is crucial in the context of reducing medical errors. This goal aligns with recognized standards such as those outlined by AAMC (47) and HueUMP outcome standards, emphasizing competencies essential for effective healthcare delivery (Figure 8).

Figure 6. Class Outcomes Development Process

In designing the outcomes for IPE class, it's essential to consider various domains of learning to ensure comprehensive development among students. These domains typically include cognitive, psychomotor, and affective aspects (150), each playing a significant role in preparing future healthcare professionals to mitigate medical errors and enhance patient safety (Table 15).

- Cognitive Domain: In the cognitive domain, students are expected to acquire knowledge and understanding related to effective communication strategies, teamwork dynamics, and the impact of interdisciplinary collaboration on patient outcomes. These outcomes are designed based on level 3 of Bloom's Taxonomy (151) to ensure that students not only grasp theoretical concepts but also develop critical thinking skills necessary for identifying and addressing communication challenges that contribute to medical errors.

- Psychomotor Domain: In the psychomotor domain, the focus shifts to developing practical skills and competencies that enable effective teamwork and communication using ISBAR on presenting clinical cases. These outcomes ensure that students not only understand the importance of teamwork but also gain hands-on experience in applying communication strategies in realistic healthcare settings.

- Affective Domain: In the affective domain, outcomes aim to shape students' attitudes, values, and professional behaviors towards collaborative practice.

Table 15. Outcomes, Educational, and Assessment Methods

Class Outcomes
• **Cognitive (3rd Level of Bloom' s Taxonomy)** - Apply ISBAR framework in presenting clinical cases - Demonstrate the roles and responsibilities of team members for solving health problems • **Psychomotor** - Perform a clear and concise introduction by stating who you are, your role, where you are, and why you are communicating among team members. - Perform an accurate presentation of the current situation, detailing what is happening at the moment with the patient. - Perform a comprehensive summary of the background information, explaining the issues that led up to the current situation. - Perform a detailed clinical assessment, articulating what you believe the problem is based on your findings. - Perform clear and actionable recommendations for correcting the situation, outlining the next steps for patient management • **Affective** Show mutual respect for team members during their presentation
Educational Methods
- Lectures - LF Simulation - HF Simulation

Assessment Methods
- Satisfaction Survey - Pre and Post-Test - Reflection Essay

The teaching methods employed include lectures, role-playing, HF simulation, assessment and evaluation based on the Kirkpatrick model (146) (Figure 9). This model encompasses four levels of assessment to ensure the effectiveness of medical education.

Level 1 (Reaction): A satisfaction survey was developed by reviewing and modifying a previous study (152) to gather feedback from learners (146). This assesses their perceptions and satisfaction regarding the content and teaching methods.

Level 2 (Learning): Pre and post-tests were reviewed, modified, and created based on Student Perception of Interprofessional Clinical Education Revised (SPICE-R) (153) and ISBAR framework (154) to evaluate learners' progress in clinical understanding and medical problem-solving. This evaluates the ability of learners to apply theoretical knowledge into practical skills effectively.

Level 3 (Behavior): Using open-ended reflection essays (146) (152) for learners to reflect and summarize their learning experiences and application of knowledge in practice. This provides an opportunity for learners to contemplate on the lessons learned and how they can apply them in real-life situations.

Level 4 (Results): To assess this level is very challenging because the participation rate of students in IPE at HueUMP is relatively low compared to the total student body. During hospital internships, there are not only graduates from HueUMP but also students from other medical schools. Therefore, evaluating the effectiveness of the class requires a follow-up plan to track students who participated in the IPE class and their subsequent experiences during hospital internships. Some studies have utilized 360-Degree Evaluations conducted by nurses for assessment purposes (155).

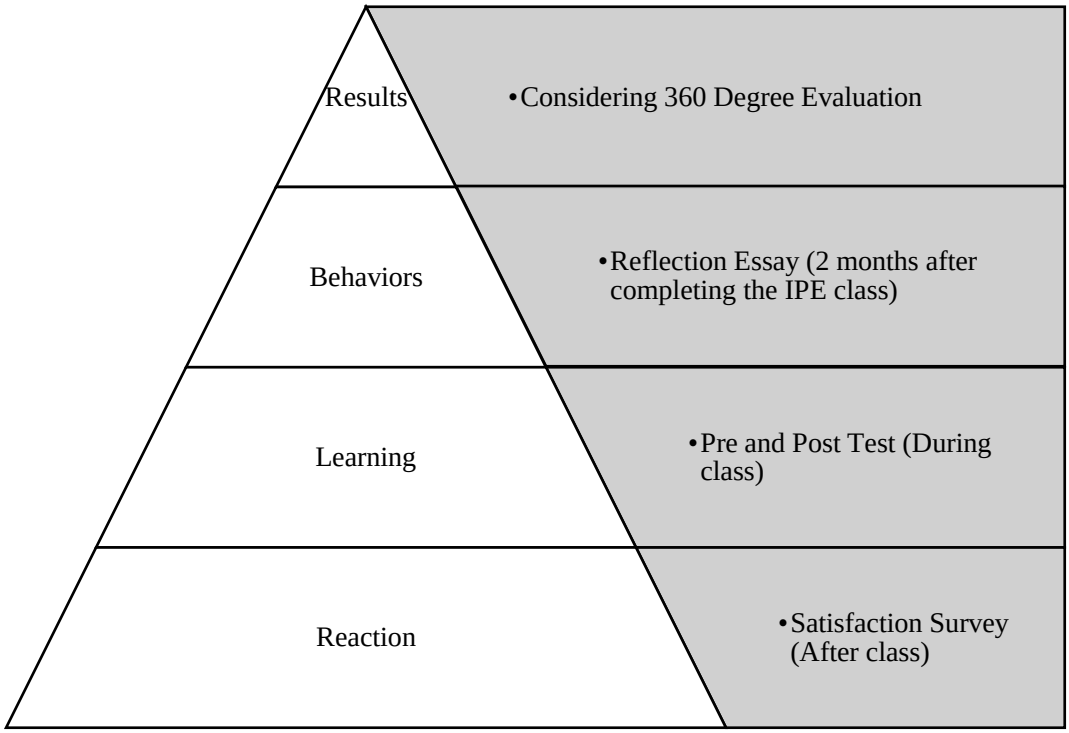

Figure 7. Assessment and Evaluation Methods based on Kirkpatrick's Model

In this Simulation-Based IPE class, the structure is designed to comprehensively prepare students for addressing medical errors through effective interprofessional communication (IPC). Before the class begins, study materials are distributed via HueUMP LMS one week in advance. During the class session, the activities are structured as follows (Table 16):

Table 16. Structure of Simulation-Based IPE Class

Structure of Simulation-Based IPE Class				
Phase	**Process**	**Time**	**Activities**	**Delivering methods**
Before class	Study materials (Presentation- Interprofessional Communication on Presenting Clinical Cases) will be sent to students via HueUMP LMS one week before starting class			
In class	Assessing student knowledge and attitude on IPC in solving the medical erros before studying	10 mins	Pre-test	
	Ice breaking	10 mins	Introducing students to each other	
	Briefing	10 mins	Setting clear expectations and learning objectives; providing orientation to roles, environment, and equipment; creating a safe and effective learning environment	
	Lecture	15-20 mins	Interprofessional Communication on Presenting Clinical Cases	Presentation

	Simulation	15 mins	Students will practice on simulated patient models based on clinical scenarios	Practicing on LF simulators (Groups 1 and 2 perform. Groups 3 and 4 observe and provide feedback, then switch roles)
	Debriefing	20 mins	Debriefing of case scenario	
	Simulation	15 mins	Students will practice on simulated patient models based on clinical scenarios	Practicing on HF simulators (Groups 3 and 4 perform. Groups 1 and 2 observe and provide feedback, then switch roles)
	Debriefing	20 mins	Debriefing case scenario	
	Assessing student knowledge and attitude on IPC in solving the medical erros after studying	10 mins	Post-test	
Closing	Conclusion and recap	30 mins	Summarize main keypoints of presenting personally gathered and verified information, acknowledging areas of uncertainty	
	Student satisfaction	10 mins	Student satisfaction survey	
2 months later	Reflection essay			

Before the class, study materials will be sent to students via HueUMP LMS one week prior to the start of the class. These study materials are developed in the form of a presentation on the topic of "Interprofessional Communication in Presenting Clinical Cases." The content is curated from lectures , researchs (27, 156), and videos available on the online platform YouTube.

During the class, the session will begin with a 10-minute pre-test to assess students' knowledge and attitudes on IPC in solving medical errors before studying.

Next, there will be a 10-minute ice-breaking activity, introducing the course outcomes and the roles of doctors and nurses, conducted through a presentation. This will be followed by a 20 to 30-minute lecture on interprofessional communication in presenting clinical cases.

The class will then proceed with a 10-minute briefing to set clear expectations and learning objectives, provide orientation to roles, environment, and equipment, and create a safe and effective learning environment. Students will engage in a 15-minute LF Simulation where they will take on the roles of doctors and nurses and communicate and collaborate with each other with groups 1 and 2 performing while groups 3 and 4 observe and provide feedback, then switching roles. Following the LF Simulation, there will be a 20-minute debriefing session to discuss the case scenario using role-playing. Students will then practice on HF Simulation based on clinical scenarios for 15 minutes, with groups 3 and 4 performing while groups 1 and 2 observe and provide feedback, then switching roles. This will be followed by another 20-minute debriefing session to discuss the case scenario. Students' knowledge and attitudes on IPC in solving medical errors will be reassessed with a 10-minute post-test.

The GAS Model (Gather, Analyze, Summarize) was chosen for its simplicity, clarity, and adaptability, making it particularly effective for addressing communication and procedural issues in healthcare settings (157). Its straightforward three-step process helps participants systematically reflect on specific events, analyze contributing factors, and formulate actionable takeaways without being overwhelmed. This focus on reflective learning and critical thinking aligns with the goals of improving communication and procedural adherence. In contrast, models like PEARLS, TeamGAINS can be more complex and require extensive training, while Debriefing with Good Judgment (DWGJ) may not provide the same structured clarity as GAS for quick yet thorough debriefs (142).

At the end of the class, there will be a 30-minute conclusion and recap session to summarize the main key points, present personally gathered and verified information, and acknowledge areas of uncertainty. Finally, students will complete a 10-minute student satisfaction survey. Two months later, students will submit a reflection essay on what they have learned and experienced during the class.

In collaboration with a surgeon and a faculty member from the Department of Nursing at HueUMP, I embarked on a comprehensive project to enhance interprofessional communication and collaboration skills among healthcare professionals. Initially, I conducted an extensive review of common medical errors using databases such as PubMed and Google Scholar. Additionally, I analyzed the functionality of various models available at the Skills-Lab Center. Based on this analysis, we engaged in thorough discussions to select and modify two scenarios that best align with current practices and the capabilities of our existing models (Figure 10). The chosen scenarios include ineffective communication leads to medical errors (urinary retention) and ineffective communication leads to medical errors (insulin dosing).

After selecting these case scenarios, I developed detailed cases and sought reviews from two experts: one emergency physician and one internal medicine physician. These scenarios were meticulously chosen to facilitate focused educational simulations that address critical issues in healthcare settings.

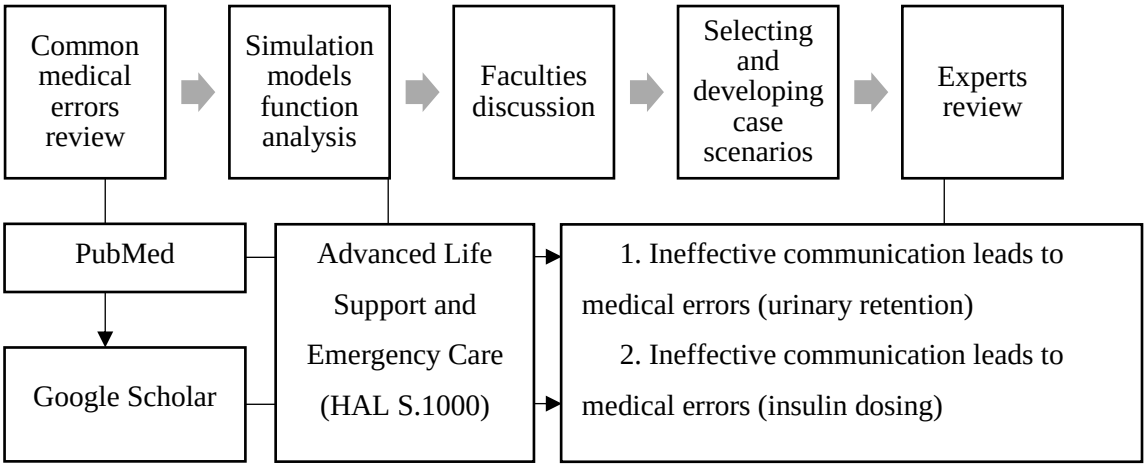

Figure 8. Case Scenarios Development

c) How should details of the curriculum be communicated?

The syllabus will be used to communicate the details of the class (158) (Table 17) and each content will be matched with different educational methods The class is held at the Skills-lab Center and employs a mix of teaching methods: Lectures (40%), and Simulation (60%). Assessment is equally divided among pre and post-tests, and reflection essays (each 50%). Utilizing simulators and resources available at the Skills-Lab Center, the course aims to teach medical and nursing students skills to avoid medical errors through practical and interactive methods. The learning objectives include demonstrating effective communication and collaboration (cognitive), performing error-free communication and collaboration (psychomotor), and expressing respect for diverse professional roles (affective). Attendance is mandatory, with makeup sessions required for legitimate absences.

Table 17. Class Syllabus

Class Syllabus		
Course Title	Simulation-Based IPE for Medical and Nursing Students	
Classroom	Skills-Lab Center	
Teaching Methods	Lecture	Simulation
	40%	60%
Assessment Methods	Pre and Post-test	Reflection essay
	50%	50%
Resources	Simulators, classrooms and available resources at Skills-Lab Center	
Course Description	This class is designed for medical and nursing students to engage in role-playing and practice simulation models, through which they can learn skills to prevent medical errors related to presenting clinical cases	

Learning Objectives	• **Cognitive** - Apply ISBAR framework in presenting clinical cases - Demonstrate the roles and responsibilities of team members for solving health problems • **Psychomotor** - Perform a clear and concise introduction by stating who you are, your role, where you are, and why you are communicating among team members. - Perform an accurate presentation of the current situation, detailing what is happening at the moment with the patient. - Perform a comprehensive summary of the background information, explaining the issues that led up to the current situation. - Perform a detailed clinical assessment, articulating what you believe the problem is based on your findings. - Perform clear and actionable recommendations for correcting the situation, outlining the next steps for patient management • **Affective** Listen and show mutual respect for team members during their presentation
Attendance Obligation	Students are not allowed to be absent from this class unless for legitimate reasons. Those who are absent must register for makeup sessions with subsequent groups

d) What educational environment should be fostered?

To foster effective communication skills within a clinical setting, an educational environment will be cultivated that prioritizes psychological safety, active engagement, teamwork, feedback, and professionalism (159-163) (Figure 11). Within this environment, open communication, collaboration, and mutual respect among students and instructors will be encouraged. By promoting a culture of continuous learning, reflection, and growth, the aim is to empower students to develop the communication skills necessary for successful clinical practice while embracing diversity, promoting inclusivity, and upholding the highest standards of professionalism and ethical conduct.

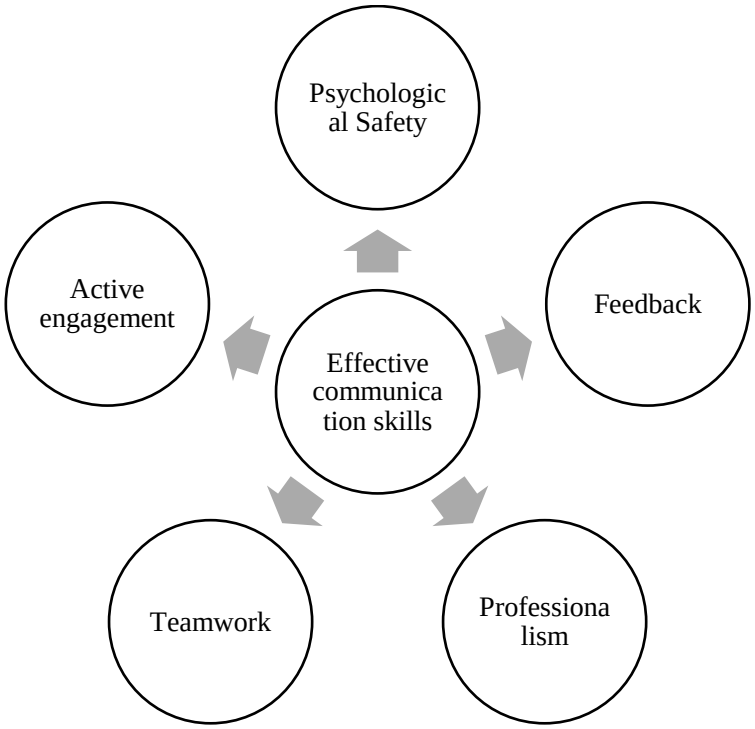

Figure 9. Educational Environment

e) How should the process be managed?

The implementation of the IPE Module at HueUMP, overseen by the Family Medicine Center (12), involves considering the integration of SBE using LF and HF Simulation. This approach has garnered positive feedback from both students and instructors, demonstrating effective outcomes. It aims to supplement current teaching methods by addressing medical errors that are challenging to simulate through traditional approaches.

The process of integrating SBE into the IPE module requires careful planning and collaboration. It involves designing relevant scenarios, training faculty in simulation techniques, and ensuring adequate resources for simulation facilities. This initiative aims to better prepare students for real-world healthcare challenges, ultimately enhancing patient care quality and safety.

3. Plan for Implementation, Assessment and Evaluation

a) Implementation

The piloting Simulation-Based IPE class is scheduled to launch in 8th January 2025. The program will include sixteen selected students, two instructors - a physician and a nursing faculty member and one operator (Table 18). Before the commencement of the class, a faculty meeting will be held to review the learning outcomes, study materials, and assessment methods. Following this meeting, the student selection process will take place.

Table 18. Date, Number of Instructors, Operators, and Students

Date	Instructors	Operator	Number of students	
January 2025	1 Faculty from Department of Surgery	Nguyen Hoang Minh and 1 Operator	4 groups (2 Medical and 2 Nursing Students/ group)	8 Medical Students
	1 Faculty from Department of Nursing			8 Nursing Students

Student selection criteria: 5th Year Medical Students and 3rd Year Nursing Students who have not previously participated in the IPE Module

The selection criteria for students are as follows: eligible participants are 5th Year Medical Students and 3rd Year Nursing Students who have not previously participated in the IPE Module. Students with prior experience in the IPE Module will be excluded to ensure the accuracy and validity of the module's effectiveness assessment, thereby avoiding potential biases. Subsequent steps include scheduling time slots, preparing participant lists, and conducting a rehearsal session (Figure 12).

This meeting aims to ensure thorough preparation and alignment with the outlined program as detailed in the Design and Development Results. Study materials will be uploaded onto the HueUMP Learning Management System one week before the class begins to facilitate access and preparation.

During the class sessions, students will engage in ice-breaking activities to foster a conducive learning environment. They will participate in HF and LF Simulation to apply theoretical knowledge in practical settings. The class will culminate with students completing a satisfaction survey to provide feedback on their learning experience immediately after the session. Additionally, students will be required to write a reflection essay two months later to evaluate the long-term impact of the IPE class on their understanding of medical errors and interprofessional collaboration.

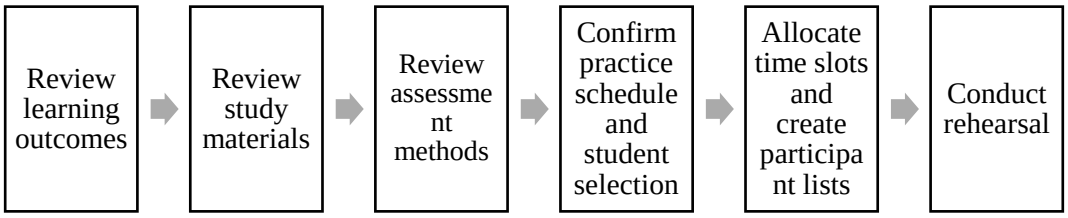

Figure 10. Faculties Meeting Process

b) Assessment and Evaluation

The evaluation process will begin on January 8, 2025, with the administration of a satisfaction survey (Level 1) and a pre-post test (Level 2), and will continue after that (Figure 13). Data collected from these surveys will be quantitatively analyzed to assess students' perceptions of the course and to determine any changes in their knowledge and attitudes toward interprofessional communication in clinical case presentations. Additionally, the reflection essays (Level 3) will undergo qualitative analysis using content analysis. Based on the analyzed data, a detailed report will be prepared for the institution to evaluate the effectiveness of the Simulation-Based IPE program. It will present a comparative analysis of pre-and post-test results to highlight improvements in knowledge and attitudes toward interprofessional communication in clinical scenarios. Furthermore, qualitative insights from reflection essays will be discussed to provide a deeper understanding of the student's personal and professional growth, highlighting specific instances of behavioral change and application of learned skills in real-world settings. The report aims to offer comprehensive feedback on the program's impact, identifying strengths, areas for improvement, and potential implications for future curriculum development and implementation.

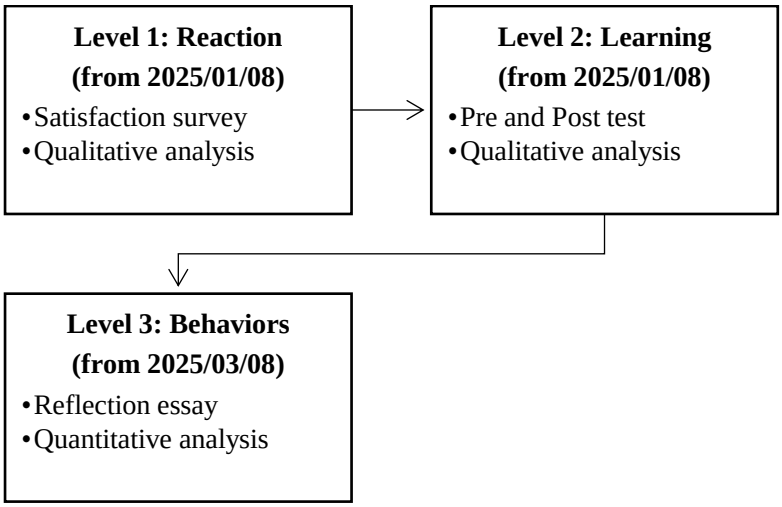

Figure 11. Assessment and Evaluation Process

V. Discussion

Simulation-Based IPE class utilizing LF and HF Simulation, such as the one developed at HueUMP, Vietnam is increasingly recognized for their effectiveness in enhancing clinical skills and teamwork among healthcare students (164). Behaviourism, Cognitivism, and Constructivism play significant roles in developing this Simulation-Based IPE. Each theory contributes uniquely to the teaching and learning process for healthcare students, addressing different aspects of learning and skill development.

Behaviourism focuses on shaping behavior through stimuli and reinforcement. In IPE, it can be applied through simulated scenarios to reinforce basic skills such as effective communication and professional responses (165).

Cognitivism provides theoretical foundations on internal cognitive processes such as thinking, remembering, and problem-solving. In IPE, Cognitivism helps students analyze and apply knowledge from simulations, improving deep understanding and problem-solving abilities in healthcare contexts (166).

Constructivism emphasizes the learner's active role in constructing knowledge through experience and interaction with the learning environment. In IPE, Constructivism creates a motivational learning environment, encouraging active participation in simulation activities and fostering teamwork skills (167).

The integration of these theories creates a comprehensive learning environment where students not only hone clinical skills but also develop teamwork, critical thinking, and self-directed learning abilities. Flexibly applying these theories meets diverse learning needs and prepares students for real-world challenges in community healthcare. Furthermore, outcomes and assessment methods are carefully designed to reflect the effectiveness of the learning process. Bloom’s Taxonomy is chosen to ensure that learning objectives are clear and aligned with the cognitive levels expected of healthcare students. This taxonomy helps in structuring objectives from lower-order thinking skills (such as knowledge and comprehension) to higher-order skills (such as application, analysis, synthesis, and evaluation), thereby facilitating a comprehensive assessment of students’ learning outcomes. Additionally, Kirkpatrick’s model is employed as an evaluation method to assess the impact of Simulation-Based IPE on students. This method has been widely chosen in many studies to evaluate the effectiveness of IPE (152, 155). By utilizing these assessment frameworks, educators at HueUMP ensure a rigorous evaluation process that validates the educational effectiveness of Simulation-Based IPE in preparing healthcare students for diverse and challenging healthcare environments.

On the other hand, the adoption of the ADDIE Model in designing this class ensures a systematic approach to curriculum development, addressing the diverse learning needs of medical and nursing students. Simulation-based learning environments provide a safe space for students to practice clinical encounters and communication skills, fostering interdisciplinary collaboration (19). Evaluating the educational outcomes, particularly through competency-based assessments for EPA 6, allows for a comprehensive understanding of student performance and skill acquisition (168). These methodologies contribute significantly to the ongoing improvement of interprofessional education initiatives worldwide (19, 46, 99).

1. Key Components and Specifications for Developing Simulation-Based IPE

The study identified critical components and specifications essential for designing an effective Simulation-Based IPE class. Key findings highlighted the importance of realistic clinical scenarios, team work, structured debriefing sessions, and the integration of advanced simulation technologies to enhance learning outcomes (Figure 14). These results align with earlier studies emphasizing the value of realism and interprofessional collaboration in SBE. For instance, Reeves et al. (2016) (97) found that realistic scenarios and team work significantly improve students' clinical competencies and communication skills. The effectiveness of these components can be attributed to several underlying mechanisms. Realistic scenarios provide a safe yet challenging environment for students to apply theoretical knowledge practically (19, 112). Team work foster essential collaboration and communication skills, aligning with the competencies required in real healthcare settings (97). Structured debriefing sessions allow for critical reflection and continuous improvement, enhancing the overall learning experience (169).

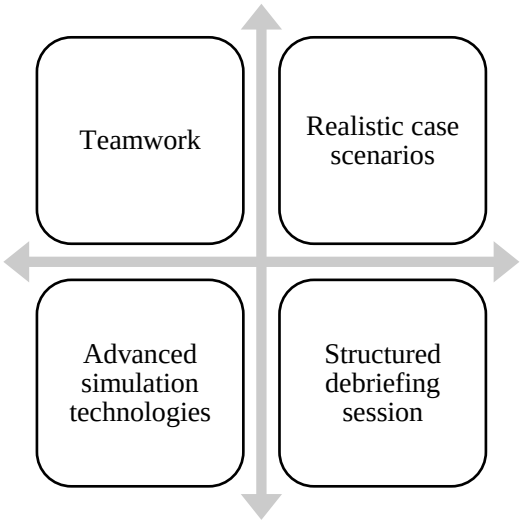

Figure 12. Key Components of Simulation-Based IPE

The unique aspect of this IPE class, distinguishing it from other IPE classes, is the development of case scenarios tailored to the Vietnamese context. Specifically, two medical error scenarios were created based on the use of paper-based health records.

These scenarios are meticulously designed to reflect the common practices and challenges faced in Vietnam's healthcare system, where the transition to digital records is still ongoing, and paper-based health records remain prevalent (170). By incorporating such context-specific elements, the simulation provides a more realistic and relevant learning experience for the students.

Through these scenarios, students not only practice their clinical skills but also develop problem-solving strategies to address system-level issues inherent in a paper-based record system. This approach underscores the importance of effective communication and teamwork in mitigating errors and ensuring patient safety.

Additionally, these scenarios serve as a catalyst for structured debriefing sessions, where students can critically reflect on their performance, discuss the impact of the paper-based system on patient care, and explore potential improvements. This continuous feedback loop enhances their learning experience, preparing them for real-world challenges specific to the Vietnamese healthcare context.

2. How can Simulation-Based IPE be effectively integrated within the existing IPE module of HueUMP?

Educational Methods utilized IPE courses across various institutions globally have demonstrated the efficacy of innovative and immersive learning techniques and simulation has been documented extensively in the literature as highly effective for enhancing interprofessional collaboration and clinical skills (171).

At HueUMP, the current IPE Module managed by the Family Medicine Center using team-building exercises, group discussions, communication with Standardized Patients (SPs), visits to primary healthcare facilities, home visits, and presentations of interprofessional healthcare plans. While these methods are effective, integrating LF and HF Simulation can further enhance learning experiences and outcomes (Figure 15). LF and HF Simulation can substitute for SPs in certain clinical scenarios that SPs cannot accurately replicate and replace group discussions by providing a more dynamic and interactive learning environment. The reasons for this will be explained in detail in Section 3.

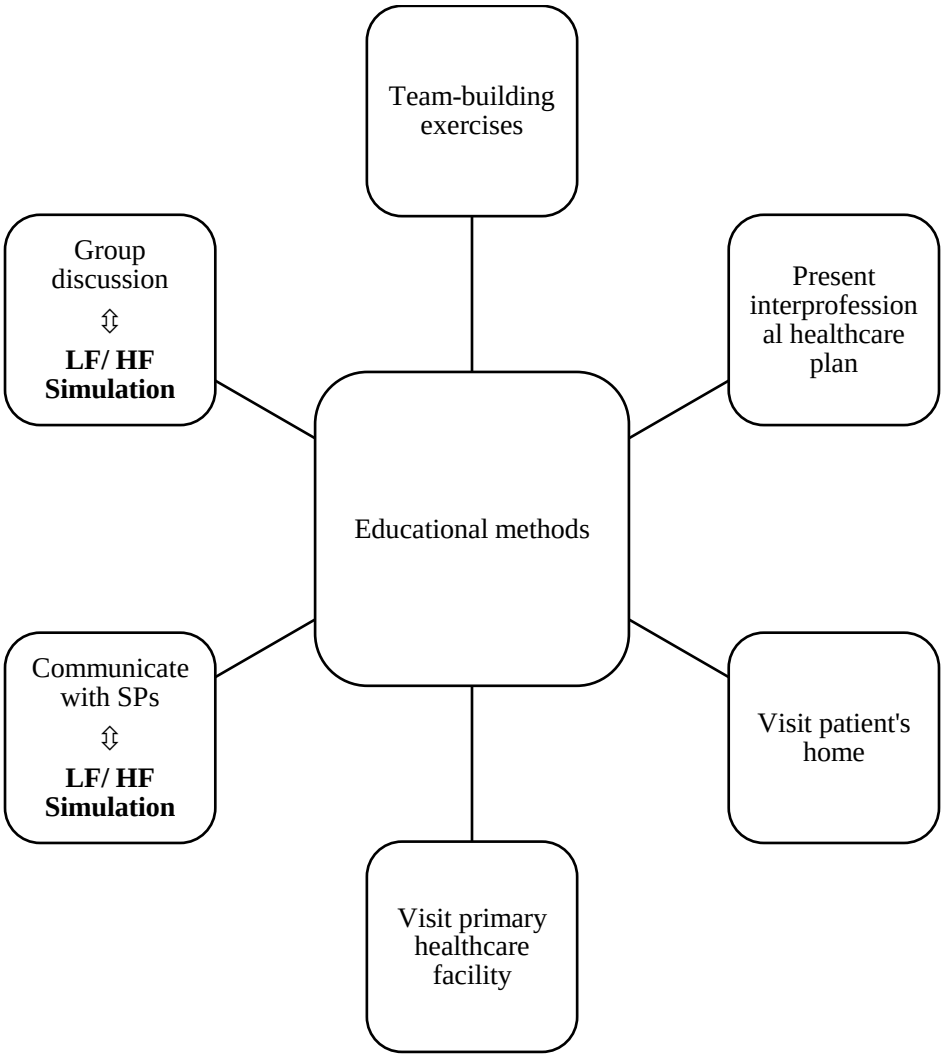

Figure 13. Integration of LF and HF Simulation Methods into IPE Module

3. Effectiveness of Simulation-Based IPE and compared to other educational methods

Simulation-based IPE has been increasingly recognized as a superior approach in preparing healthcare students for real-world clinical practice (171). LF and HF Simulation provides a realistic and controlled environment where students can practice clinical skills and manage critical scenarios, which enhances their readiness for real-life situations and improves interprofessional teamwork (112) (Table 19).

One of the primary advantages of using LF and HF Simulation is the creation of a safe and controlled learning environment (172). In high-stakes fields such as healthcare, aviation, and the military, making mistakes during training can have severe real-world consequences (172, 173). Simulations mitigate this risk by allowing trainees to practice in a risk-free setting. This controlled environment also enables trainers to design specific scenarios to test and improve the skills of the trainees without the interference of external factors.

Simulations offer the capability of providing immediate and detailed feedback, which is essential for effective learning. LF and HF Simulations are equipped with software and monitoring systems that can track the actions of the trainees in real-time (172). This allows for instant feedback, helping trainees to recognize and correct their errors swiftly. Moreover, the data collected from these simulations is accurate and quantifiable, providing a solid basis for performance analysis and improvement.

Another significant advantage is the flexibility and customizability of simulations. LF and HF Simulations can be tailored to suit a wide range of scenarios, from common situations to rare and complex cases (172). This adaptability ensures that trainees are well-prepared for various circumstances they might encounter in their professional roles. Additionally, simulations can be conducted at any time and place, making them more convenient compared to the logistical constraints of organizing group discussions or coordinating with service providers.

While the initial investment for setting up LF and HF Simulations may be high, they are cost-effective in the long run (172). The expenses associated with ongoing training sessions, travel, and coordination with service providers are significantly reduced. Furthermore, simulations save time by allowing trainees to practice independently without the need to align schedules with group discussions or service provider availability.

LF and HF Simulations are particularly effective in enhancing practical skills and decision-making abilities (172). HF Simulations, which are designed to mimic real-world conditions closely, help trainees develop and refine their technical skills. On the other hand, LF Simulations, which are simpler and more focused on cognitive processes, aid in improving decision-making in complex situations. This dual approach ensures a comprehensive development of both practical and cognitive competencies.

Table 19. LF and HF Simulation Compared with Other Educational Methods

Group Discussion	**Communicate with SPs**	**Using LF Simulation**	**Using HF Simulation**
Enhancing teamwork and communication skills in a collaborative environment			
		• Focuses on technical and clinical skills that SPs cannot fully simulate • Allows students to practice in emergency or complex scenarios that are challenging to reproduce with SPs	

4. Challenges

Despite the positive results observed in Simulation-Based IPE, it is essential to acknowledge several limitations that could impact its effectiveness (Figure 16) (174-176). Technological challenges, such as equipment malfunctions, software bugs, and the ongoing need for updates and maintenance of simulation tools, pose significant hurdles (174). These issues have the potential to disrupt the learning process and diminish the overall impact of simulation-based training. Additionally, resistance to change among students and faculty represents another critical barriers (174). This resistance may stem from a preference for traditional teaching methods, unfamiliarity with new technologies, or doubts regarding the efficacy of SBE in IPE (Smith et al., 2023). Overcoming these challenges is crucial for the successful implementation and sustainability of simulation-based IPE programs.

Furthermore, high initial setup costs, limited availability of simulation resources, and logistical constraints also present formidable challenges to the widespread adoption of simulation-based methods (175, 176). These factors can restrict access to simulation facilities and limit the frequency or scope of simulation exercises. Addressing these barriers is imperative to fully leverage the potential of SBE in preparing healthcare professionals who are competent and confident in delivering high-quality care across diverse clinical settings. By addressing technological issues, overcoming resistance to change, and mitigating logistical challenges, institutions can enhance the effectiveness and accessibility of simulation-based IPE, thereby ensuring its long-term success in healthcare education.

Another significant challenge is assessing the effectiveness of the class based on level 4 of the Kirkpatrick model. The low participation rate of students in IPE at HueUMP relative to the total student body complicates this assessment. During hospital internships, there is a diverse mix of interns not only from HueUMP but also from other medical schools, further complicating the evaluation process. To accurately gauge the effectiveness of the IPE class, a comprehensive follow-up plan is essential. This plan should track the progress of students who participated in the class and monitor their subsequent experiences during hospital internships. This longitudinal approach is crucial for understanding how the knowledge and skills gained in the IPE class translate into real-world healthcare settings. By integrating multiple evaluation approaches and ensuring a longitudinal follow-up, educators and healthcare institutions can gain a holistic view of the impact of IPE training on students' readiness and competence in interprofessional collaboration and patient care. This comprehensive understanding is essential for continuously improving and refining IPE curricula to better prepare future healthcare professionals.

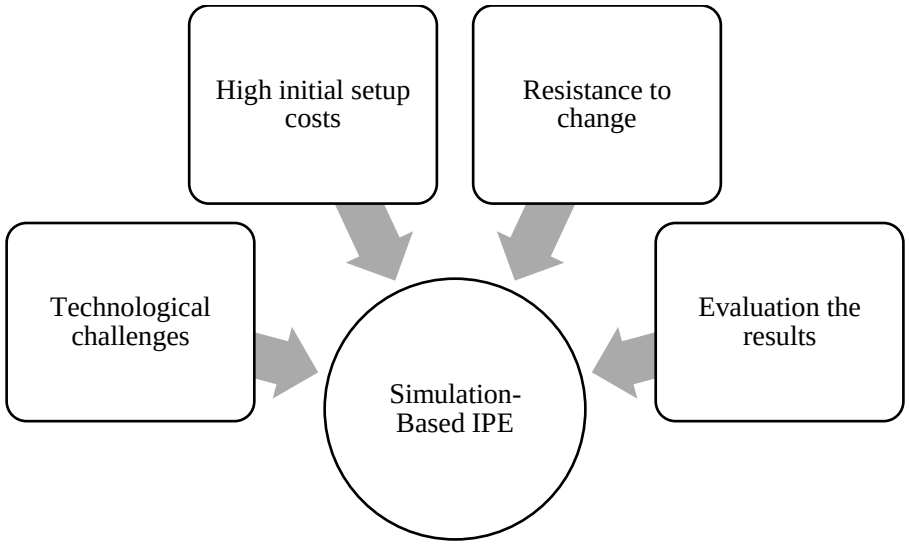

Figure 14. Challenges of Simulation-Based IPE

VI. Conclusion

Simulation-Based IPE represents a pivotal advancement in healthcare education, offering substantial benefits for medical and nursing students. This approach, supported by robust evidence, enhances critical skills such as communication, clinical decision-making, and teamwork through immersive, scenario-based learning. By simulating realistic clinical situation, Simulation-Based IPE using LF and HF simulations at HueUMP can replace the current educational methods used in the IPE module and equip students with practical experience to improve patient safety and healthcare outcomes.

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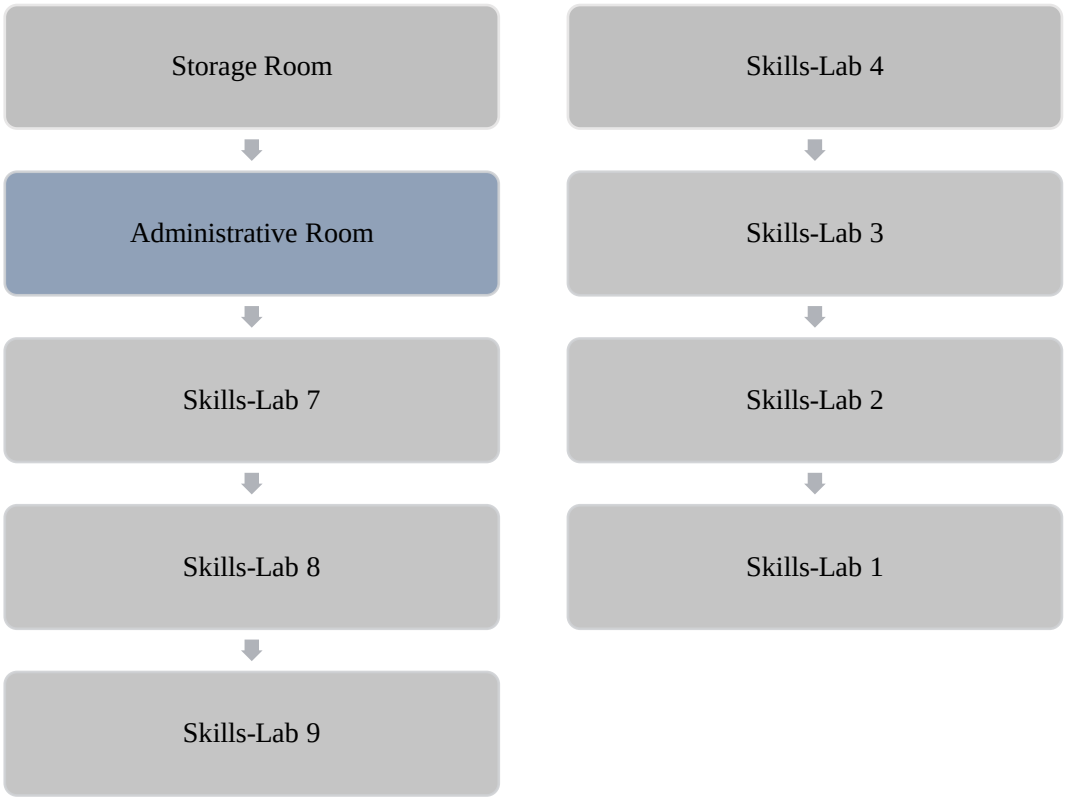
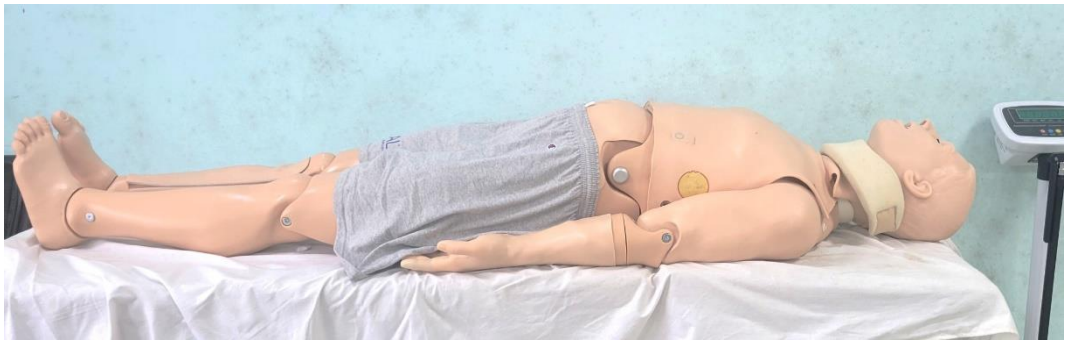
Appendices

Appendix 1: Skills-Lab Center



Appendix 2: Skills-Lab Room

Appendix 3: Storage Room and HAL S1000 used for piloting SBE



Appendix 4: Class Syllabus

Class Syllabus		
Course Title	Simulation-Based IPE for Medical and Nursing Students	
Classroom	Skills-Lab Center	
Teaching Methods	Lecture	Simulation
	40%	60%
Assessment Methods	Pre and Post-test	Reflection essay
	50%	50%
Resources	Simulators, classrooms and available resources at Skills-Lab Center	
Course Description	This class is designed for medical and nursing students to engage in role-playing and practice simulation models, through which they can learn skills to prevent medical errors related to presenting clinical cases	
Learning Objectives	• **Cognitive** - Apply ISBAR framework in presenting clinical cases - Demonstrate the roles and responsibilities of team members for solving health problems • **Psychomotor** - Perform a clear and concise introduction by stating who you are, your role, where you are, and why you are communicating among team members. - Perform an accurate presentation of the current situation, detailing what is happening at the moment with the patient. - Perform a comprehensive summary of the background information, explaining the issues that led up to the current situation. - Perform a detailed clinical assessment, articulating what you believe the problem is based on your findings.	

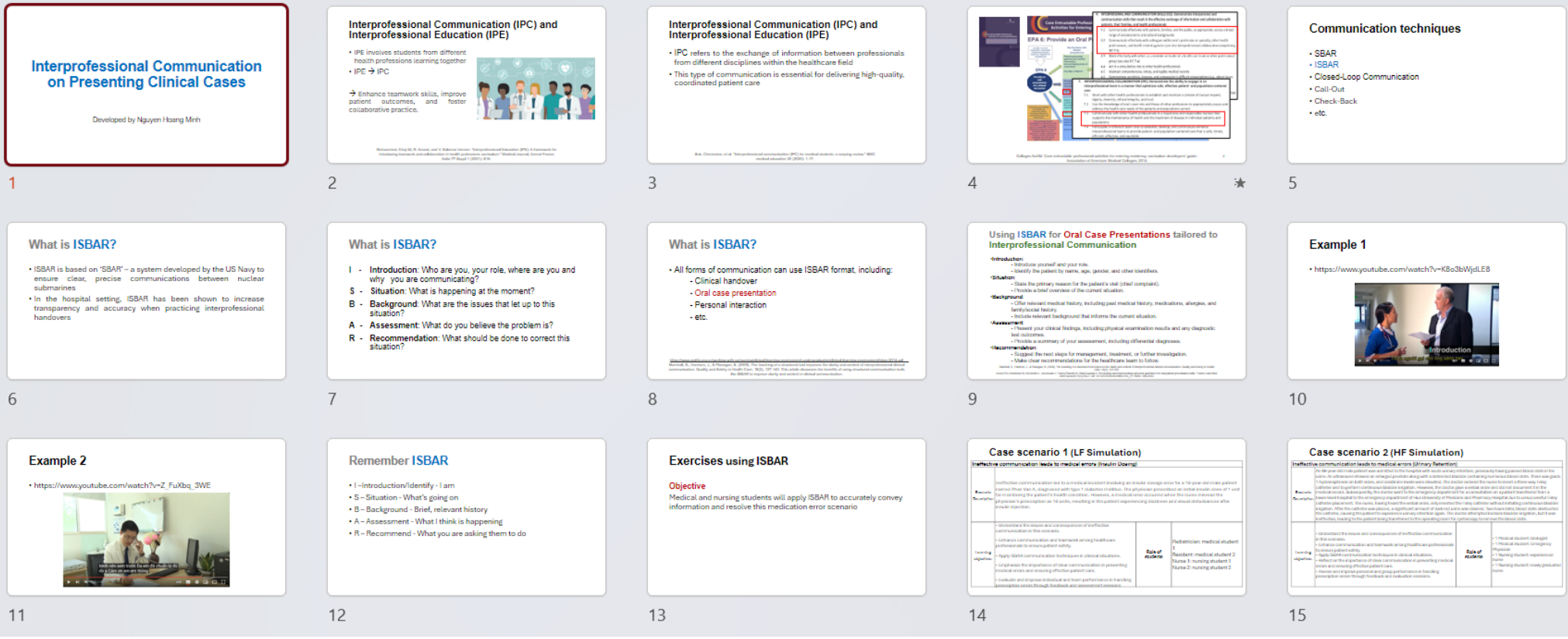
	- Perform clear and actionable recommendations for correcting the situation, outlining the next steps for patient management • **Affective** Listen and show mutual respect for team members during their presentation
Attendance Obligation	Students are not allowed to be absent from this class unless for legitimate reasons. Those who are absent must register for makeup sessions with subsequent groups

Appendix 5: Class Structure

Structure of Simulation-Based IPE Class				
Phase	**Process**	**Time**	**Activities**	**Delivering methods**
Before class	Study materials (Presentation- Interprofessional Communication on Presenting Clinical Cases) will be sent to students via HueUMP LMS one week before starting class			
In class	Assessing student knowledge and attitude on IPC in solving the medical erros before studying	10 mins	Pre-test	
	Ice breaking	10 mins	Introducing students to each other	
	Briefing	10 mins	Setting clear expectations and learning objectives; providing orientation to roles, environment, and equipment; creating a safe and effective learning environment	
	Lecture	15-20 mins	Interprofessional Communication on Presenting Clinical Cases	Presentation

	Simulation	15 mins	Students will practice on simulated patient models based on clinical scenarios	Practicing on LF simulators (Groups 1 and 2 perform. Groups 3 and 4 observe and provide feedback, then switch roles)
	Debriefing	20 mins	Debriefing of case scenario	
	Simulation	15 mins	Students will practice on simulated patient models based on clinical scenarios	Practicing on HF simulators (Groups 3 and 4 perform. Groups 1 and 2 observe and provide feedback, then switch roles)
	Debriefing	20 mins	Debriefing case scenario	
	Assessing student knowledge and attitude on IPC in solving the medical erros after studying	10 mins	Post-test	
Closing	Conclusion and recap	30 mins	Summarize main keypoints of presenting personally gathered and verified information, acknowledging areas of uncertainty	
	Student satisfaction	10 mins	Student satisfaction survey	
2 months later	Reflection essay			

Appendix 6: Study Material (Presentation)



Appendix 7: 1st Case Scenario using LF Simulation

Ineffective communication leads to medical errors (Insulin Dosing)

1. Learning Objectives

- Understand the issues and consequences of ineffective communication in this scenario.

- Enhance communication and teamwork among healthcare professionals to ensure patient safety.

- Apply ISBAR communication techniques in clinical situations.

- Emphasize the importance of clear communication in preventing medical errors and ensuring effective patient care.

- Evaluate and improve individual and team performance in handling prescription errors through feedback and assessment sessions.

2. Student Orientation

- Each group will be assigned specific roles as follows: one medical student will play the role of the pediatrician, another medical student will act as the resident, and two nursing students will assume the roles of nurse 1 and nurse 2.

- Each group will have 15 minutes to perform their roles, followed by a 20-minute debriefing session.

3. Role of instructors

- Pre-Briefing:

- Introduce the scenario and objectives to the students.
- Explain the roles and emphasize the importance of accurate medication administration and clear communication.
- Provide an overview of expected outcomes and learning points.

- Observation During Simulation: Monitor students' performance, focusing on adherence to medication administration protocols.
- Debriefing using GAS Model

- Gather:

Question: "Let's start by sharing what happened during the medication administration process. What did you observe?"

Encourage each student to share their perspective and note down key events and observations on a whiteboard or flip chart.

- Analyze
Questions:
+ "Reflecting on the medication administration process, what improvements could be made?"
+ "What should the nurse have done before administering insulin to the patient?"
+ "What actions could the nurse have taken to verify the unclear medication order?"

Discuss aspects such as procedure, communication, and teamwork and highlight the importance of verifying patient identity, cross-checking medication orders, and consulting with the healthcare team if there are uncertainties.

- Summarize
Questions:
+ "Based on our discussion, what are the key best practices we should follow to prevent medication errors in the future?"
+ "Why is accurate documentation and clear communication crucial in preventing medical errors?"

Consolidate the points discussed during the analysis phase and discuss real-world implications and the impact on patient safety.

4. Case Scenario

Medical Error	Ineffective communication leads to medical errors (Insulin Dosing)
Situation Summary	Ineffective communication led to a medical incident involving an insulin dosage error for a 10-year-old male patient named Phan Van A, diagnosed with type 1 diabetes mellitus. The physician prescribed an initial insulin dose of 1 unit for monitoring the patient's health condition. However, a medical error occurred when the nurse misread the physician's prescription as 10 units, resulting in the patient experiencing dizziness and visual disturbances after insulin injection.

5. Preparation

Simulators and equipments	- Pediatric patient simulation model - Blood pressure cuff - Insulin injection pen - Physician's written prescription
Roles	- Operator: patient's family member - Pediatrician: medical student 1 - Resident: medical student 2 - Nurse 1: nursing student 1 - Nurse 2: nursing student 2

6. Process

The instructor will observe the process and proceed to deliver the narration for each dialogue

Process Stage	Role of student	Role of Operator		Expected Student Response
		Operator (Patient's father)	**Simulator and Model**	
Beginning (2 minutes)	**Narration**: Pediatrician informs the patient's condition and treatment plan. Pediatrician: "Based on the tests, your child has been diagnosed with Type 1 Diabetes. He will need to receive 1 unit of Insulin to maintain blood sugar levels." Pediatrician: "No, shortly Nurse will come to count the injection for him and instruct you on how to administer it at home."	Patient's Father: "Yes, doctor." Patient's Father: "Does my child need to come to the hospital daily for injections?" Patient's Father: "Okay, thank you, doctor."		The medical student playing the role of the Pediatrician will proceed to communicate the patient's condition and treatment plan

	Narration: Pediatrician meets Nurse 1 and hands over the prescription while requesting to administer insulin to patient Phan Van A in Room 1. Pediatrician hands over the prescription and says: "Nurse 1, please administer insulin to patient Phan Van A in Room 1." **→ Solution approach: Using ISBAR** Nurse 1: "Yes, doctor."			The medical student portraying the Pediatrician and Nurse 1 will deliver the lines.
Proceeding (10 minutes)	**Narration**: Nurse 1 reads the doctor's order, unclear whether it's 1 or 10 units, with Nurse 2 standing nearby. Nurse 1: "Sister, is this number 1 or 10?" Nurse 2: "It seems like 10." Nurse 1: "I think so too."			The two nursing students portraying Nurse 1 and Nurse 2 deliver the lines
	Narration: Nurse 1 enters room 1 to administer insulin to patient A.	Patient's father: "Yes, please."	Proceeding with the simulation of insulin injection on the pediatric patient model	

	Nurse 1 talks to the patient's father: "I'm here to give your child the insulin injection."			
	Narration: One moment later, the patient complains of dizziness to his father, who immediately seeks out Nurse 1. Nurse 1: "Yes, I'm coming right away." After checking, the patient's blood pressure is found to have dropped to 80/50 mmHg. Nurse 1: "I'll get the doctor right away."	Patient's father: "My child suddenly feels very dizzy. Please come and check." Patient's father: "Yes, please help."	Proceeding with simulating the process of measuring blood pressure on the pediatric patient model	The nursing students portraying Nurse 1 deliver the lines
	Narration: Nurse 1 goes to find the resident and encounters them. Nurse 1: "Doctor, patient in Room 1 is showing signs of dizziness, blood pressure dropped to 80/50 mmHg after insulin injection." Resident Doctor: "Yes, I'm coming right away."			Student portraying the Resident and Nurse 1 perform their dialogue accordingly

Completion (3 minutes)	**Narration**: After arriving, the resident doctor checks the patient's condition and asks Nurse 1 about the doctor's order. Resident: "Did you administer 1 unit or 10 units of insulin to the patient?" Nurse 1: "I administered 10 units because that's what was written in the doctor's order." Resident: "This is actually 1 unit. I will check the patient's blood sugar level to determine the appropriate course of action." Nurse 1: "Yes, doctor. I apologize for the mistake."	Patient's father: "Thank you, doctor."	The student portraying the Resident and Nurse 1 perform their dialogue accordingly.

Appendix 8: 2nd Case Scenario using HF Simulation

Ineffective communication leads to medical errors (Urinary Retention)

1. Learning Objectives

- Understand the issues and consequences of ineffective communication in this scenario.

- Enhance communication and teamwork among healthcare professionals to ensure patient safety.

- Apply ISBAR communication techniques in clinical situations.

- Reflect on the importance of clear communication in preventing medical errors and ensuring effective patient care.

- Assess and improve personal and group performance in handling prescription errors through feedback and evaluation sessions.

2. Instructions for Students

- Each group will be assigned specific roles as follows: one medical student will play the role of a urologist, one medical student will act as an emergency physician, one nursing student will act as an experienced nurse and one nursing student will play the role of a newly graduated nurse.

- Each group will have 15 minutes to perform their roles, followed by 20 minutes of feedback.

3. Instructor's Role

- Pre-Briefing:

- Introduce the scenario and objectives to the students.

- Explain the roles and the importance of clear communication.

- Provide an overview of expected outcomes and learning points.

- Observation During Simulation:

- Monitor the role-playing process of the students.

- Debriefing using GAS Model:

- Gather:

Question: "Let's start by sharing what happened with the patient who experienced urinary retention. What did you observe during the situation?"

Encourage each participant to share their perspective and recount the sequence of events.

Note down key events and observations on a whiteboard or flip chart.

- Analyze:

Questions:

+ "Reflecting on the incident, what improvements could be made in the communication?"
+ "What should have been done to ensure continuous bladder irrigation was initiated along with the Foley catheter insertion?"

Highlight the importance of verifying patient orders, clear communication between healthcare professionals, and proper documentation.

- Summarize:

Questions:

+ "Based on our discussion, what are the key best practices we should follow to prevent similar incidents in the future?"
+ "Why is accurate documentation and clear communication crucial in preventing medical errors?"

Discuss real-world implications and the impact on patient safety.

4. Case Scenario

Medical Error	Ineffective communication led to a medical incident resulting in urinary retention for the patient.
Situation Summary	An 86-year-old male patient was admitted to the hospital with acute urinary retention, previously having passed blood clots in his urine. An ultrasound showed an enlarged prostate along with a distended bladder containing numerous blood clots. There was grade 1 hydronephrosis on both sides, and creatinine levels were elevated. The doctor ordered the nurse to insert a three-way Foley catheter and to perform continuous bladder irrigation. However, the doctor gave a verbal order and did not document it in the medical record. Subsequently, the doctor went to the emergency department for a consultation on a patient transferred from a lower-level hospital to the emergency department of Hue University of Medicine and Pharmacy Hospital due to unsuccessful Foley catheter placement. The nurse, having heard the verbal order, only inserted the Foley catheter without initiating continuous bladder irrigation. After the catheter was placed, a significant amount of dark red urine was drained. Two hours later, blood clots obstructed the catheter, causing the patient to experience urinary retention again. The doctor attempted bedside bladder irrigation, but it was ineffective, leading to the patient being transferred to the operating room for cystoscopy to remove the blood clots.

5. Preparation

Script	**Simulators**	- Adult Patient Simulation - Male Reproductive System Model - Urethral Catheterization Model
	Equipments	- X-ray film, ultrasound - Creatinine test result - Sterile drape with a hole - Blood clots - Sterile gloves - Antiseptic solution - Cotton swab, gauze or medical sponge - Xylocaine lubricating gel - Male urinary catheterization set: Foley catheter 2-way and 3-way - 10ml sterile water-filled syringe for catheter balloon inflation - Urinary collection bag
	Roles	- Operators (voiceover for patient model) - 1 Medical student: Urologist - 1 Medical student: Emergency Physician - 1 Nursing student: experienced nurse - 1 Nursing student: newly graduated nurse
Props Preparation	- Hospital bed - Patient name tag - Patient Monitoring or blood pressure monitor	

6. Process

The instructor will observe the process and proceed to deliver the narration for each dialogue

Process Stage	Role of student	Role of Operator		Expected Student Response
		Operator (Voiceover)	Simulator and Model	
Beginning (3 minutes)	**Narration**: The Urologist observes the test results and X-ray, ultrasound images, and informs the patient. Urologist: "The patient is currently experiencing acute urinary retention with significant blood clots in the bladder, possibly due to enlargement of the prostate gland causing urinary blockage with bleeding. Shortly, nursing staff will proceed with placing a urinary catheter followed by continuous bladder irrigation. Please wait."	"I've been unable to urinate doctor." "Yes, doctor."		Observes the test results and X-ray, ultrasound images
Proceeding (10 minutes)	**Narration**: The Urologist instructs the newly graduated nurse to insert a 3-way urinary catheter with			The student playing the Urologist gives verbal

	continuous bladder irrigation. However, he only gives verbal orders and then proceeds to the Emergency Department to consult on a case transferred from the lower urinary tract due to an unsuccessful catheterization attempt. Urologist: "Nurse A, please proceed to insert a 3-way urinary catheter with continuous bladder irrigation for the patient. Now, I need to go to the Emergency Department for a consultation with another patient." **→ Solution approach: Using ISBAR** Nurse A (Newly graduated nurse): "Yes, doctor." -	orders and moves to the emergency room. The nursing student newly graduated listens to the doctor's orders
	Narration: After arriving at the emergency department, Emergency Physician: "A patient transferred from the local hospital to the Emergency Department of HueUMP Hospital,	The two students playing the roles of Urologist and Emergency Physician proceed to conduct a consultation.

	failed attempt to insert a urinary catheter." Urologist: "Yes, I know." (Then both move to another location)		
	Narration: Although not remembering the doctor's orders, the newly graduated nurse proceeded to insert a urinary catheter for the patient because of fear of causing inconvenience. Nurse A: “Excuse me, I'd like to proceed with inserting the urinary catheter."	“Yes, please."	The nurse proceed with simulating the process of inserting a urinary catheter on a male genital model
	Narration: Two hours later, the patient complained of inability to urinate. The experienced graduated nurse noticed this while passing by, promptly checked the patient's condition, and reported to the doctor, discovering that the newly graduated nurse had forgotten to perform bladder irrigation, causing a blood clot to block the urinary tract and	Voiceover: The patient complains about not being able to urinate "I've already had the urinary catheter inserted, why can't I urinate?"	The experienced nurse checked the patient's vital signs on the model BP = 150/90 mmHg

	leading to urinary retention for the patient The experienced nurse: "What seems to be the problem?" The experienced nurse: "Please wait a moment, I'll call the doctor right away." The experienced nurse: "Doctor, patient Nguyen Van A in room 1 is complaining of inability to urinate." Urologist: “ I asked Nurse A to insert a urinary catheter and irrigate to remove blood clots. Please ask Nurse A to come see me." Nurse A: "Yes, doctor?" Urologist: "Did you irrigate the blood clot for patient A in room 1?"	"Please quickly inform the doctor, I'm very uncomfortable not being able to urinate."	HR = 96 beats per minute RR = 18 breaths per minute

	Nurse A: "I forgot, I couldn't hear clearly at that time, and I didn't dare to ask again because you were busy with consultation. I'm sorry." Urologist: "Go inform the patient and transfer them to the operating room for cystoscopy to remove the blood clot and reinsert the urinary catheter!"	
Finish **(2 minutes)**	**Narration**: The patient was transferred to the operating room for cystoscopy to remove the blood clot and reinsert the urinary catheter.	The newly graduated nurse and the experienced nurse moved the patient to the operating room

Appendix 9: Satisfaction Survey (Level 1 of Kirkpatrick Model)

	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
How satisfied are you after completing the IPE class?					
Describe your opinion after completing the class					
What are the most valuable aspects of this class?					
What could be improved?					
What can you do based on what you have learned?					

Appendix 10: Pre and Post-Test (Level 2 of Kirkpatrick Model)

1 – Strongly Disagree

2 – Disagree

3 – Neutral

4 – Agree

5 – Strongly Agree

Interprofessional Collaboration and Communication					
Working with students from different disciplines enhances my education	1	2	3	4	5
My role within an interprofessional team is clearly defined	1	2	3	4	5
Patient/client satisfaction is improved when care is delivered by an interprofessional team	1	2	3	4	5
Participating in educational experiences with students from different disciplines enhances my ability to work on an interprofessional team	1	2	3	4	5
I have an understanding of the courses taken by, and training requirements of, other health professionals	1	2	3	4	5
Healthcare costs are reduced when patients/clients are treated by an interprofessional team	1	2	3	4	5

Health professional students from different disciplines should be educated to establish collaborative relationships with one another	1	2	3	4	5
I understand the roles of other health professionals within an interprofessional team	1	2	3	4	5
Patient/client-centeredness increases when care is delivered by an interprofessional team	1	2	3	4	5
During their education, health professional students should be involved in teamwork with students from different disciplines in order to understand their respective roles	1	2	3	4	5
Presenting Clinical Cases using ISBAR					
Do you think it is necessary for the healthcare provider to introduce themselves and their role when presenting clinical cases?	1	2	3	4	5
Is it important for the healthcare provider to clearly state the patient's primary reason for the visit (chief complaint) when presenting clinical cases?	1	2	3	4	5
Providing a brief overview of the current situation when presenting clinical cases is necessary	1	2	3	4	5

Healthcare providers should offer relevant medical history, including past medical history, medications, allergies, and family/social history, when presenting clinical cases	1	2	3	4	5
Is it necessary for the healthcare provider to clearly present their clinical findings, including physical examination results and diagnostic test outcomes, when presenting clinical cases?	1	2	3	4	5
Healthcare provider should provide clear recommendations for the healthcare team to follow when presenting clinical cases.	1	2	3	4	5

Appendix 11: Reflection Essay (Level 3 of Kirkpatrick Model)

How did you apply what you learned in the IPE class? Describe how you avoid medical errors related to presenting clinical cases during clinical clerkship in a short essay.

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Abstract in Korean

위임가능전문직무를 위한 시뮬레이션 기반 전문직 간 교육 모듈 개발: 임상 사례를 바탕으로

Nguyen Hoang Minh

The Graduate School

Yonsei University

Department of Medical Education

Background: 후에 의학 및 약학 대학교(HueUMP)는 위임가능전문직무(EPAs)를 시범 도입 후 2022 년부터 공식 교육 과정으로 적용하고 있다. 또한 2022 년에 다양한 의료 분야의 학생들이 참여하는 전문직 간 교육(IPE) 모듈이 시범적으로 도입되었고, 그룹 토의, 표준화 환자와의 의사소통, 가정 방문, 일차 의료 기관 방문 등의 방법을 통해 팀워크와 환자 돌봄을 강조하였다. 본 연구에서는 술기교육센터를 활용하여 저충실도(LF) 및 고충실도(HF) 시뮬레이션 바탕의 새로운 교수 방법을 통한 IPE 를 HueUMP 의 시도하고자 한다. 이 논문의 IPE 는 기존 교육 방식으로는 효과적으로 다룰 수 없었던 의료 오류 시나리오를 사용하여 임상 사례 보고하기를 가르치는 데 중점을 두고 있다.

Methods: 시범 교육 모듈 개발을 위해 ADDIE 모델을 사용하였다. 우선적으로 기존 교육과정 분석, 대상 학습자, 이용 가능한 자원 분석 등을 시행 하였으며 다음으로 설계 및 개발 단계는 Harden 의 교육과정 개발을 위한 10 가지 질문을 토대로 개발하였다.

Results: 수업의 성과는 두 가지 의료 오류 시나리오를 바탕으로 개발하고 설계되었다: 첫 번째는 요로폐색 환자 처치의 인수인계에서 있을 수 있는 비효율적인 의사소통을 주제로 개발되었고 두번째는 인슐린 투여와 관련된 비효율적 의사소통 사례를 주제로 개발되었다. 프로그램의 평가 방법은 Kirkpatrick 모델을 기반으로 만족도 조사, 교육 전후 시험, 성찰 에세이 작성으로 설계하였다. 수업 정보는 HueUMP 학습 관리 시스템에 업로드할 예정이며,

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Conclusion: 저충실도 및 고충실도 모형을 활용한 시뮬레이션 기반 전문직간 교육은 시나리오 사례에 따라 현재 HueUMP 의 교육 방법을 대체 할 수 있으며, 이를 통해 학생들은 더욱 효과적으로 EPAs 를 달성할 수 있다.

Keywords: 전문직 간 교육, 시뮬레이션 기반 교육, 위임가능전문직무, 의사소통, 환자 안전