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Alternative Digital Credentials: UAE's First Adopters' Design, Development, and Implementation Part (1)

El-Farra Samar
Higher Colleges of Technology
Emirates Medical Association-Radiographers Society of Emirates,
United Arab Emirates (UAE)

Abstract. The global skills gap and lack of a verified volunteering capacity for pandemics and catastrophes, amongst other factors, have compelled higher education to consider validated alternative credentials. However, alternative credentials are in the infancy stage, so universities are tailoring frameworks and curricula in the absence of a global standardization. Recently, calls to develop "soft"/non-technical skills like empathy among healthcare students are increasing. However, the current healthcare non-technical skills curricula do not account for the clinical aspects as they have originated from aviation programs adopted since the 1970s after high-profile plane crashes were mainly attributed to errors in non-technical skills. The aim of this paper is to address all these gaps by performing curriculum analysis, design, development, and implementation to lay the foundation for subsequent research to evaluate the outcomes. The developed curriculum was offered in an alternative credential format for a pilot group of seven undergraduate medical imaging students. This paper describes the development and implementation of five pedagogical interventions, and the subsequent paper shall review seven assessment and evaluation tools and requirements related to competency within entrustable medical imaging professional tasks. This paper is unique as we are unaware of any publications on deployed or awarded alternative credentials combining technical and non-technical skills within entrustable professional tasks. As such, the work presented can provide educators with practical curriculum development approaches to address the educational paradigm shifts.

Keywords: alternative digital credentials; health sciences education; non-technical skills; medical imaging; entrustable professional tasks

1. Introduction

Due to disruptions like the declined interest in full and lengthy credentials and the gap between graduation and employment rates, higher education institutions are expected to offer quality Alternative Digital Credentials (ADC), including micro-credentials and digital badges (International Council for Open and Distance Education, 2019; Kato et al., 2020). In our previous work on the ADC provisions within higher education institutions as the heartland of academia, the model of provision accounted for the suitable representation of competency-based work placement-related training in a digital badge format with linked students' artifacts as evidence of attainment. In comparison, campus-related didactic and laboratory Simulation-Based Training (lab-SBT) were branded as micro-credentials. This reported pilot implements an ADC composed of a Micro-credential and two digital badges in the medical imaging of the human thorax and extremities. Despite the wealth of literature on the ADC technological aspects, to our knowledge, no case pilot studies with a focus on the educational part of implementation have been published (El-Farra et al., 2022).

In healthcare systems, COVID-19 has revealed a severe lack of qualified volunteers in catastrophes or pandemics. Verified undergraduate capacity can positively impact the recruitment of verified students to volunteer in supporting the frontline human resources. However, ADC offered by universities can reasonably address issues like verified competencies in undergraduates or adult lifelong learners returning for reskilling/upskilling. The concept of ADC is challenged by the lack of trust of employers and learners (El-Farra et al., 2022; Chakroun & Keevy, 2018). Our framework addressed significant risks of ADC offerings through an outcome-focused quality assurance model. It was reviewed in conjunction with a case study which is the focus of this pilot. The designed case study was within an undergraduate radiography / Medical Imaging (MI) context, suitable for a low-risk, low-cost pilot. The model was intended to lead the nationwide application and constitutes a blueprint for the future of the ADC landscape. The piloted ADC reviewed in this paper comprises didactic and lab-SBT micro-credentials, integrated with an implemented clinical preceptorship digital badge. The program was delivered over two consecutive academic semesters.

This research is unique as we are unaware of any MI-specific ADC offerings. Also, combining "soft skills" or "Non-Technical Skills" (NTS) in the healthcare lingua franca (Thomas, 2018) with technical skills within an integrated credential is unfamiliar. Furthermore, we are unaware of any MI application of the "Entrustable Professional Activities" (EPA) concept. An entrustable professional activity is an essential task that an individual can be trusted to perform without direct supervision within the health care context (Englander et al., 2017). Besides, existing NTS Training programs (NTSTs) came out after high-profile air crashes in the 1970s, which were attributed directly to human errors like teamwork (Prineas et al., 2021). Also, 70% of high-profile flight accidents stemmed from communication failures. In response, aviation NTST "Crew Resource Management" was developed by the aviation industry to enhance NTS (Thomas,

2018). Within the healthcare context, NTSTs were derived from aviation with minor adjustments to reflect the specifics of clinical settings (Thomas, 2018). To our knowledge, no NTSTs are published to address MI-specific performance tasks.

In high-risk industries such as health care or aviation, NTS are directly related to safety. Goldman and Wong (2020) emphasize the importance of core NTS in quality improvement and patient safety, which promotes the rapport between health care professionals and the patient (Pollard et al., 2019). Further, NTS are a constellation of cognitive and social skills needed to reduce error and improve human performance in complex systems (Prineas et al., 2021). The NTS list varies across domains, and so does the terminology. In the designing phase of the pilot, three main NTS were identified as the focus of this ADC pilot provision: communication, collaboration, and empathy. The complexity of patient care depends heavily on the quality of communication (Blackmore et al., 2018, Kaplonyi et al., 2017). Failure to communicate sparks patient dissatisfaction (Gude et al., 2020). In a systematic review of 59 studies analyzing 88,069 patient complaints, the most common complaints were communication-related (Reader et al., 2014). Correspondingly, the World Health Organization (WHO) reported a high proportion of patient safety incidents directly linked to miscommunication between health care professionals. Hence, improving communication between health care professionals and patients is crucial for preventing millions of adverse events (WHO, 2021). Finally, communication is a vessel for expressing other NTS like social awareness and empathy (Kwee & Kwee, 2021). Moreover, collaboration across clinical settings is essential in high-acuity time-critical emergencies and stressful environments. Effective collaboration and communication are critical for safe patient care
(Amaniyan et al., 2020; Kenwright & Wilkinson, 2019).

In healthcare, empathy is principally a cognitive attribute that originates from an understanding of the suffering of an individual patient and being able to communicate this understanding to help a patient (Hojat, 2016). Patients' outcomes and experience in more sophisticated MI procedures like CT scans are heavily affected by NTS, such as empathy and effective communication (Bwanga & Kayembe, 2022).Empathy is an essential emotional and cognitive resource that can directly affect patients' well-being beyond the effects of prescribed drugs or treatments and interventions (Decety, 2020) Also, patients report that communication and empathy are the most important skills used to judge radiologists (Kwee & Kwee, 2021). Problems in communication and empathy counted for 29.1% of 88069 patient complaints, and 33.7% of complaint issues were related to the safety and quality of clinical care, including collaboration deficiencies (Reader et al., 2014).

Academics are socially accountable for meticulously training and validating their graduates' skills and professional values to care for society's most vulnerable individuals (Kenwright & Wilkinson, 2019). Furthermore, it is critical for MI professionals to ensure the patient is treated compassionately and not objectified in a process that is primarily focused on the production of a medical

image (Bolderston, 2016). Yet, severe gaps in NTS capacity are evident. For example, medical students scored similar or less social-emotional skills than the average population (Meirovich et al., 2016). Therefore, NTS evaluation and/or training systems are increasingly incorporated within undergraduate curricula (Prineas et al., 2021). Integrating NTS within curricula places the rather abstract NTS into a more meaningful context (Gude et al., 2020). Ostensibly, students who completed an embedded NTST in the pre-clinical curriculum reported the relevance of NTST content to their careers and desired more similar experiences (Kaplan-Liss et al., 2018). Furthermore, in a cross-sectional study performed 12 years apart, students who attended communication training reported higher levels of a tendency toward acquiring communication skills (Gude et al., 2020). Yet, research examining the effectiveness of NTSTs has only surfaced within the last few decades, rendering a lack of a single 'best-practice' with only a few studies being validated. Also, high-risk industries NTSTs are designed with aviation context dependencies that lack MI-specific adjustments (Thomas, 2018). Accordingly, the need to deploy an NTST specifically targeting the ADC learning outcomes and EPTs is evident. The participants enrolled in the pilot belong to the existing undergraduate program designed to explicitly focus on MI technical skills with an implicit NTS focus. In response to those challenges, we reviewed the relevant literature that best informs the design, development, and implementation of a previously analyzed dedicated NTST in an ADC offering based on the ADDIE model. This work will lay the foundation for the subsequent work on evaluation and assessment by providing a road map for MI-specific ADC curriculum development and implementation. Figure 1 lists the acronyms used in this paper.

ADC	Alternative Digital Credentials (that are not full credentials)
ADDIE	Analyze, Design, Develop, Implement, and Evaluate (Curricula development model)
lab-SBT	Lab Simulation-Based Training using an X-ray digital machine
MI	Medical Imaging (Radiography)
NTS	Non-Technical Skills (soft skills)
NTST	Non-Technical Skills Training (programs)
PPS	Professional Practice Standards
PPS-modified	PPS Modified checklist
VRSVAS	Value, Resources, Standards, Validation, Accessibility, Support (Quality assurance model)

Figure 1: Glossary

2. Methods

The method is carried out to lay the foundation for the subsequent work on evaluating and assessing the proposed ADC. We investigated and implemented adult and NTS theories, relevant frameworks, and approaches to ADC curriculum development within the EPT context to provide a roadmap of the main factors to consider when analyzing, designing, developing, and implementing ACD based on the ADDIE (Analyze, Design, Develop,

Implement, and Evaluate) model as one of the most fundamental instruction design models (Snell et al., 2019). The developed ADC was implemented on a cohort of seven undergraduate MI students as a pilot study. In response to the scarcity of similar work in MI, this work is intended to present a guide for ADC development in healthcare professions for educators and curriculum planners.

3. Analysis and Design- ADDIE

The analysis process was initiated and published as a framework under quality assurance, scope identification, and integration with the existing undergraduate curriculum. Finally, the NTST standards were identified to form the cornerstone linking the pedogeological components.

3.1. Quality assurance- background

The proposed model was designed to address learners' and employers' scepticism over the quality and value of ADC. The ***Value, Resources, Standards, Validation, Accessibility, Support*** (VRSVAS) model provides an outcome-focused dynamic ADC provision that can mitigate the reluctance to accept ADC in general (El-Farra et al., 2022). The alignment of the pilot with the VRSVAS model was achieved as follows:

1- The piloted ADC ***value*** was directly relevant to an employment opportunity. This was achieved through the endorsement of the Radiographers Society of Emirates and the alignment with the International Standards Classification of Occupations (ISCO-08) (El-Farra, 2021).

2. ***Resources*** availability was accomplished by recruiting a faculty subject matter and curriculum developer expert to develop and execute the program while tapping into the existing laboratory and clinical sites with no extra costs.

3. ***Standards*** for ADC were identified and made available for all stakeholders, including students, assessors, and potential employers.

4. Life-long documented ***validation*** processes involved assessments verified by faculty and clinical sites while maintaining evidence artifacts under student records at the institutional learning management system.

5. Incorporating individualized ***accessibility*** and offering learner ***support*** are more prominent in upskilling/reskilling. However, students had the flexibility to change class hours to fit into their schedules and other assessments. Moreover, online sessions were offered whenever pedagogically warranted. Also, due to the unfamiliarity with ADC, extensive orientation and consultation/mentoring sessions were provided at the beginning of the semester and as needed.

3.2. Scope and integration

The scope of any NTS training should be balanced so the overall extent of the generic principles and skills can be applied to a range of specific scenarios. Principally, broad scopes impose difficulties in making meaningful training and inferences in particular situations. Contrary to this, excessively narrow scopes render inferences and training outputs challenging to transfer to other conditions (Thomas, 2018). To identify a balanced NTS scope, two MI faculty members who maintain licensures of practicing MI in Canada and the United Kingdom with ten and eighteen years of clinical and academic experience, respectively, have reviewed the academic/professional profile using the ISCO-

08. Faculty agreed on a list of highly relevant NTS within the EPA. Cimatti (2016) emphasized the critical role of industrial engagement in determining the most pertinent NTS. As such, the list was surveyed in industrial focus group discussions for the NTS list for the top three NTS priorities to be established. The final top listed NTS were communication, collaboration, and empathy.

The ADC is a novel offering with an existing "parent" curriculum that incorporates NTS that are embedded but not isolated in assessment and/or training. Consequently, the exact NTS scope identification and precise "dissection" was performed during the analysis and design phases to best inform the subsequent development, implementation, and evaluation. A mapping schema was developed to link the accredited MI curriculum with the ADC constituents while maintaining the embedded alignments with courses on MI positioning and procedures and patient care in MI. The concept of EPAs is common in competency-based education in medicine, but we are unaware of any straightforward MI application of EPA. However, we debate that an entrustable professional task, defined as an essential task of a specialty or subspecialty that an individual can be trusted to clinically perform without direct supervision (Englander et al., 2017), is relevant to the ADC in MI as "entrusting" a student to perform MI specific tasks under no supervision and satisfies the quality assurance expectations. Performing an entrustable task requires integrating knowledge, skills, and attitudes to independently execute an activity with observable and measurable outputs within a given time frame (Englander et al., 2017). The ADC was conceptually broken down into EPA that are aligned with the course learning outcomes of both didactic courses and verified by the two digital badges aligned with the clinical preceptorship I course in the subsequent semester, and those are:
EPA 1: Practice effective and safe communication and collaboration while demonstrating empathy in performing extremities MI accurately and independently.
EPA 2: Practice effective and safe communication and collaboration while demonstrating empathy in performing thorax MI accurately and independently.
Both EPAs incorporate MI-specific knowledge and skills, competencies like pathology, emergencies, and patient care.
Finally, the weekly implementation plan was designed to integrate with the "parent" curriculum, so the concurrent courses are synchronized with the NTST learning events. Thus, students are first exposed to the prerequisite technical/clinical knowledge before being exposed to the NTST components. Figure 2 depicts the overall ADDIE summary of the ADC offering.

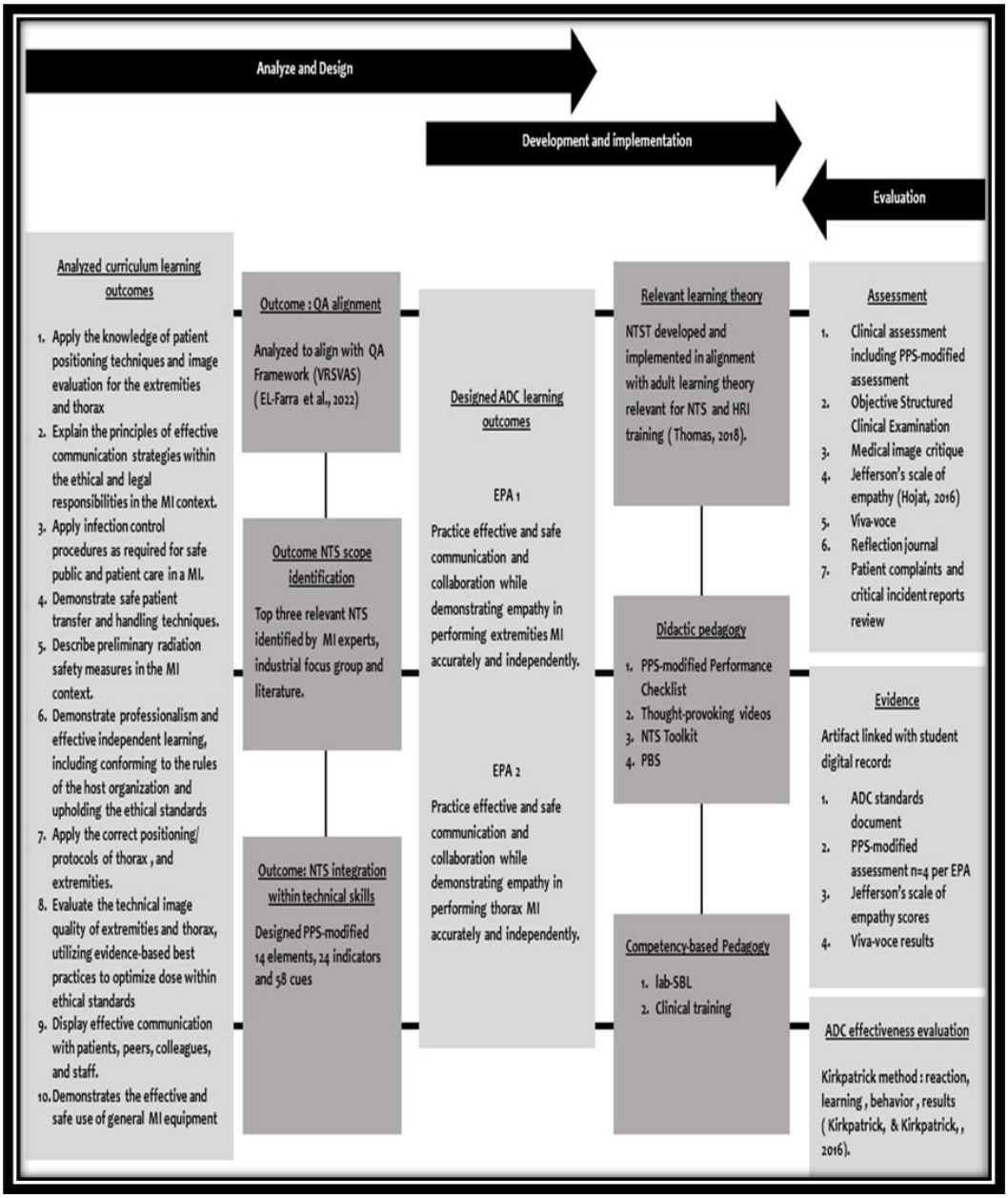

Figure 2: The overall ADDIE summary of the ADC offering.

3.3. Standards

To develop an NTST, standards are required to translate the EPA expectations into measurable and describable achievement elements. However, a standard setting for healthcare curricula is unavailable (De Champlain, 2019). For example, while MI faculty value and understand constituents of empathy like caring, they remain unclear about the implications on the MI curricula and the applications within the MI-specific professional practice. Consequently, consensus on competence standard requirements for caring is important to clarify the meaning and identify caring behaviors as an integral part of MI practice and education (Kammies & Archer, 2022). Further, there is an urgent need to investigate and to develop a healthcare explicit definition of NTS like

healthcare compassion to facilitate implementation into practice (Taylor et al., 2017).

Standards are intended to guide the learning activities and the assessment processes, yet, setting standards is controversial, especially in assessments (Schuwirth & Vleuten, 2019). Subsequently, we used the Australian Society of Medical Imaging and Radiation Therapy (ASMIRT) Professional Practice Standards (PPS) as a reference. The relevancy of those PPS is attributed to many aspects. Firstly, when the MI curriculum was revamped for accreditation, it was mapped against those PPS. Also, PPS are relevant in academia because they have been developed by incorporating academic, clinical, and professional elements that support the principles of practice (ASMIRT, 2018). Moreover, the PPS review precise professional activity requirements to be demonstrated in the clinical setting, which can be expressed as an EPT. Finally, if PPS were modified to address the purpose of the ADC, they could constitute a reliable checklist that can be used to train and assess students as they perform both EPTs.

However, when the curricular mapping was completed in 2017, it only had the NTS covertly implied and embedded. Another challenge was that although the PPS was intended to provide a resource for students, they were conversely 1) lengthy and intended to have elements of repetition, so extracting a practical checklist was a challenge, and 2) developed to be suitable in the context of a graduate practitioner rather than an undergraduate stackable ADC. To overcome those challenges, we performed a top-down extraction process through the relevant PPS elements, indicators, and cues to produce the PPS modified checklist (PPS-modified) following the below steps:

1) An example is the exclusion of PPS that require high dependencies on high-order NTS like decision-making and critical thinking.
2) Inclusion of PPS suitable for sophomores.
3) Reduction of repetitions when possible.

The PPS-modified has fourteen elements of relevancy to the three NTS translating into twenty-four indicators. Fifty-eight possible cues were identified to provide additional clarification on performance indicators. To accommodate the complexity that might arise at the clinical sites, we considered cues as flexible and non-extensive. Considering the overlap across different NTS, for example, the dependency of empathy on communication skills (Hojat, 2016), segregating some of the NTS like decision-making and critical thinking was not entirely possible without compromising the context of practice in real life. Consequently, we accepted six of the twenty-four cues that were beyond the three NTS but with an interdependency with patient safety. For example, the indicator "respond effectively to emergent needs" might require elements of decision-making and critical thinking in addition to communication, collaboration, and empathy. A summary of the PPS-modified used to integrate PPS with NTS for scope identification is in table 1. It is noteworthy that this PPS-modified was equally used for training and assessment, as described in the following sections.

Table 1: PPS-modified used to integrate PPS with NTS for ADC scope identification

Elements (*n*) = 14	Indicators *n*=24
1. Uses sound communication methods 2. Adjusts communication technique to suit the situation 3. Provides effective communication throughout a procedure 4. Ensures documentation is accurate 5. Demonstrates respect for colleagues and other members of the interprofessional team 6. Ability to work collaboratively within the organization 7. Evaluation of the appropriateness of the clinical information provided 8. Demonstrates empathy 9. Applies strategies to support patients and support persons. 10. Demonstrates appropriate skills for managing conflict within the workplace 11. Advises colleagues and members of the healthcare team about individual patient needs 12. Collaborative approach to decision making 13. Applies reasoning and problem-solving skills to determine appropriate clinical decisions 14. Identifies problems and applies systematic and logical approaches to their resolution	**Communication *(n)*=17** **Collaboration *(n)*=10** **Empathy (*n*)= 9** Decision Making *(n)=3* Critical Thinking *(n)=3*

4. Development and Implementation - ADDIE

The development of the NTST events was completed before the beginning of the semester, and implementation was conducted over two consecutive semesters. Instruction adjustments were applied for an individualized student-centered approach. For example, the intended one-on-one mentoring sessions were impractical and time demanding, so consultations replaced pre-scheduled bi-weekly mentoring.

Considering the cohort's characteristics, curricular design theories for technical and NTS overlap; nonetheless, the adult learning theory is the most relevant to the design of NTST within the high-risk industries' context (Thomas, 2018). Moreover, within an English medium instruction environment, students' capacities to perform NTS tasks overlap to a certain extent with the level of English language mastery. To minimize this effect, native and English conversations were equally acceptable in the lab-SBT and clinical training. Many clinically encountered patients speak the native language of students, so this bi-lingual communication freedom catered for an authentic NTS learning experience.

In the first week of the semester, seven eligible students were voluntarily enrolled based on individually expressed written interest after attending an

awareness session with faculty and employer. In the first semester of delivering the micro-credential components, the average extra student engagement time was 2-3 hours per week, and grades set or homework assignments were avoided. Finally, the timeline was based on sequential delivery so that NTST activities would relate to the previously gained technical knowledge from both curricular courses of the ADC. At the same time, the second semester involved top-up requirements with extra contact hours to obtain both digital badges.

The NTST was categorized into didactic pedagogy and clinical competency-based pedagogy. Putting the adult learning theory checklist described by Thomas (2018) into practice, the pedogeological activities were designed to:

1) motivate the students; for example, an early on-set meeting with the potential employers was conducted, so the learners could recognize their need for developing NTS.
2) be authentic competency-based training with pre-determined taxonomy of competencies and criterion-referenced assessment as evident in Problem-Based Scenarios (PBS) and clinical training, for example.
3) consider individual needs and development requirements. For example, in the early weeks, one-on-one coaching sessions were offered, and weak points were identified halfway through the semester to inform personalized laboratory training sessions.
4) diversify the activities to have both didactic and competency-based activities catering to pedogeological experiences within and outside learners' preferred learning styles.
5) plan activities that fit the purpose. For instance, knowledge was developed through discussions and videos, skills acquired through lab-SBT and clinical training, and attitudes were developed through facilitated discussions and reflection.
6) maintain a reasonable cognitive load by carefully monitoring contact hours, assignments, and assessments.
7) expose students to good versus poor NTS performances, errors, and near-misses so those NTS can be modeled or avoided in PBS, lab-SBT, and clinical training activities.

4.1. Didactic Pedagogy- the micro-credential components

The first week was allocated to orienting, coaching, and allowing for the material of the domain-specific knowledge in the curricular courses to pave the way for the NTST components to be delivered effectively. The NTST has four didactic micro-credential activities: a performance checklist, thought-provoking videos, an NTS toolkit, and fourteen different PBS. Examples of the activities and more information can be reviewed in the appendix.

4.1.1. Performance checklist

Checklists were initially developed within the WHO's global patient safety challenge (WHO, 2021). Moreover, performance checklists are the most frequently used assessment method, as they provide an operational definition of the goal for learning and the satisfactory level of performance expected. Also, the heterogeneity in measurement instruments used to assess NTS limits their reliability across different examination settings. Consequently, using similar

rubrics for training and assessment allows the observation of individual progress across academic years (Setyonugroho et al., 2015). The specific criteria stipulated in a checklist help to reduce observation biases and they can increase reliability among different trainers (Schmutz et al., 2014) Finally, the unified checklist was used for lab-SBT, clinical training, and assessment, serving as an alignment reference between goals for learning, content, and review, enhancing faculty confidence in teaching and evaluating NTS.

Consequently, the same PPS-modified previously used to anchor the alignment across the constituents of the curriculum was also utilized as the checklist provided for the students in the third week of the first semester. An initial orientation and explanation of the PPS-modified components were delivered. Afterward, the PPS-modified was used as a training reference tool for learners to understand the expectations and be better informed about their progress during lab-SBT discussions and clinical assessment.

4.1.2. Thought-provoking videos

Videos followed by reflective questions are reportedly beneficial in developing NTS (Dolev et al., 2021). In general, multimedia is invaluable in modeling high-risk industries' complex systems as it extends the flexibility of repetitive own-pace learning. Critical reflection, reasoning, and behavioral modeling through observing expert performance are also benefits of multimedia (Thomas, 2018).

To lay the foundation for the subsequent activities, thought-provoking videos displaying a set of technical and NTS were carefully selected as discussion starters. For example, the story circle and interviews of COVID-19 survivors were used to enhance empathy. Videos of critical COVID-19 survivors who posted their experiences were played for this activity, followed by a "flash-back" activity in groups. Students took turns sharing a five-minute story from their own personal or close COVID-19 experiences. To monitor the effectiveness of those videos, discussions were initiated using an audience response system to establish the baseline and post video students' conception of the NTS in question.

4.1.3. Toolkit

To provide a quick cheat sheet for students during their clinical experience, an NTS toolkit was developed describing seven different tactics that can be used in real-life. The toolkit trains the student to address communication and collaboration through five tactics described by Prineas et al. (2021): situation awareness; specific communication; direct communication; loop-closure of communication; assertive communication when a patient/individual is in danger. Further, the following three tactics were incorporated for empathy: standing in someone's shoes (Hojat, 2016); handling disagreement by the "yes and" rule (Kaplan-Liss et al., 2018); and aggressive patient communication strategies in reference to the Schulz von Thun's communication square model (Altabbaa et al., 2019). Serving as a "mental cue," students used the toolkit during the PBS, lab-SBT, and clinical training activities and assessment. Figure 1 depicts the toolkit.

4.1.4. Problem-based scenarios

In conjunction with lab-SBT activities, which will be discussed in the following section, PBS that mimic situational context are powerful NTS training tools (Cimatti, 2016). Introduced to health sciences education in the 1980s (McMillan & Dwyer, 1989), PBS facilitates learning from understanding a problem or working towards resolving one (Barrows & Tamblyn, 1980). We also introduce foreseeing a protentional problem and pre-emptive actions as an additional value of learning through PBS. Also, NTS like empathy can be better trained through realistic, relevant scenarios which reflect the reality of the clinical environment (Naidoo et al., 2020). For example, MI academics facilitate a culture of empathy by utilizing empathy-specific diverse learning opportunities (Kammies & Archer, 2022) such as authentic pedagogy simulation-based teaching, role-playing, reflective learning, and peer discussion (Naidoo et al., 2020). Additionally, when students practice deep and high-level group discussions, their communication and collaboration skills tend to improve (Deep et al., 2019, Latif et al., 2018). Similarly, feedback exchange and the application of previous knowledge are added values of group PBS discussions (McCrorie, 2019).

The PBS applied for the pilot was purposefully designed to be fit for the subsequent lab-SBT. To ensure standardization, the PPS-modified was used to guide the scenario discussions, so all standards have been addressed. A weekly scenario discussion covering the key issues was conducted to address the scenario aspects, the challenges and risks foreseen, and the proposed management of the scenarios. The fourteen PBS were developed to address both MI and patient perspectives to perform both EPTs accurately and safely.

To improve the fidelity of the PBS, they were designed to have concealed problems and challenges caused by suboptimal NTS like language barriers, awareness of patients' implicit special needs, and addressing aggressive/uncooperative patients or staff.

The PBS implementation was a three-stage progressive release process, as follows:

Stage 1:

- Trigger of an MI request descriptive of a hypothetical patient's encounter (including patient's data and clinical history).
- Interaction narrative (including non-verbal cues description) between the hypothetical radiographer, patient, teams, etc.
- The resulting radiographic image and documentation.
- A blinded error outcome (to be released in the subsequent session).

Stage 2: Groups review the information and identify room for improvement, pitfalls, errors, risks, and a better dialogue/action. Discussions are facilitated to appreciate different perspectives. To offset language barriers, discussions in the mother tongue were allowed. Once completed, each group presented a better dialogue/action scenario applying the toolkit.

Stage 3: Progressive release - the second version of PBS is shared, including the exposed pitfall, and the scenario had to be re-written based on the new information.

Stage 4: This stage is a duplicate of stage 2 with the PPS-modified to verify the standards/cues behind the error/pitfall shared.
It is noteworthy that only towards the end of the semester, only in one out of fourteen scenarios was the exact blinded outcome correctly predicted by a group, which indicated a reliable collection of PBS.

4.2. Competency-Based Pedagogy
Competency-based education focuses on graduate competencies and can be translated into an EPT (Carraccio et al., 2017). Two activities utilized as competency-based pedagogy are lab-SBT and clinical training.

4.2.1. Lab simulation
Sessions of lab-SBT were held in the first semester before joining the clinical practicum course in the subsequent semester. To address the numerous clinical training limitations, lab-SBT has gained popularity across the healthcare professions as an instructional strategy. This is primarily attributed to the capacity of lab-SBT events to authentically replicate situations that prompt learners to practice their relevant technical and NTS within a simulated real-life event (Thomas, 2018). Moreover, lab-SBT facilitates are reliable, scalable, and offer safe learning opportunities. Also, well-structured lab-SBT events reflect the social context within realistic environments, attitudes, and values that contribute to safe and efficient patient care. Similarly, lab-SBT can be designed to portray how experts manage challenging real-world problems, facilitating NTS development (McCrorie, 2019) through reflective practice (Thomas, 2018).

Implementing lab-SBT through students alternately playing the patient's and health care professionals' roles is a cost-effective method that can improve students' communication skills (Dalwood et al., 2020, Gelis et al., 2020). Role-play allows students to practice safely while correcting mistakes (Kaplonyi et al., 2017) within unusual scenarios (Xu et al., 2016). Moreover, playing different roles invokes reflection on one's own and other people's perspectives (Dalwood et al., 2020; Xu et al., 2016). When video recorded, learners playing the health care professional role get the opportunity to observe their body language and interaction and improve future encounters (McCrorie, 2019). Further, lab-SBT discussions promote NTS like critical thinking and communication (Latif et al., 2018). Those findings that promote Lab-SBT are also confirmed in MI settings. In an MI-specific literature review, Lab-SBT were reportedly linked to consistency in enabling building students' confidence in a safe environment. Also, NTS like communication, collaboration and decision-making can be practiced without consequences. Further benefits are relevant to feedback and improvement while reflecting on learning from mistakes (Hazell et al., 2020).

While designing the lab-SBT activities, a balance between the method, modality, and assessment of student learning should be maintained. High-fidelity lab-SBT is relevant in NTST as it represents the complexities of clinical practice (Battista & Nestel 2019). The previously designed PBS was suitable for lab-SBT training as it was designed with fidelity and relevant problem-oriented constituents. We employed simulated participants as a compatible modality, allowing the students to practice the different roles, improve their NTS, and model the

experts as they perform in complex situations. Also, this modality has cost-effectiveness considerations. Finally, students' learning was formatively assessed with non-grade bearing assessments including self-reflection, peer feedback, and expert feedback discussions using the PPS-modified for consistency. Sessions of lab-SBT were four-stage consecutive events as follows:
Stage 1: students are assigned alternate roleplay of patient, radiographer, or observer video shooting the encounter while using the student's device playing the role of a patient for privacy considerations.
Stage 2: the EPT was carried out in the laboratory using the MI equipment while performing the accurate and safe position and procedure as prescribed in the requisition form.
Stage 3: To establish empathy importance, the student in the patient's role is the first to reflect on the encounter from a patient's standpoint, followed by feedback by the student in the observer's role.
Stage 4: Debriefing is the final stage commonly regarded as the most critical learning step (Keskitalo, 2022). Group structured feedback debriefing and a hands-on demonstration by faculty on how experts might address challenging situations are utilized to conclude the activity.
Table 1 summarizes the NTST pedagogical interventions compared to the "parent" curriculum.

Table 1: Summary of the NTST pedagogical interventions

Pedagogy	Parent Curriculum	Micro-credential enhancements
Direct contact hours per semester	60	36 extra (total = 96 hours)
Performance rubric/criteria	None used for NTS	PPS-modified derived from (ASMIRT, 2018)
Thought-provoking videos.	None used for NTS	NTS – clinically specific videos were used with pre/post polls that confirmed students' mind shifts.
NTS Toolkit	None used	A practical seven tactics "mental-cue" was used for PBS discussions, lab-SBT, and clinical training.
PBS	None used	14 different PBS using the most common NTS-related errors in real clinical MI situations.
lab-SBT.	Demonstration /training sessions	Dedicated lab-SBT of the role-played PBS with structured feedback using the PPS-modified toolkit to inform individual training plans.

4.2.2. Clinical training- digital badge components. Extending communication training into work experience can potentially promote NTS (Cimatti, 2016). Clinical training constitutes the foundation of competency-based education, which supports evidence for EPA attainment while enhancing reflective practice and self-efficacy. Also, clinical training motivates students and facilitates

indirect learning by modeling the expert's performance as they perform in real-clinical situations (Morris, 2019). Although students frequently perceive interactions with health care professionals as an influencing factor in the development of their skills, modeling can either reinforce theoretical learning, or it can influence convincing students to avoid unprofessional practices.

The existing clinical preceptorship credit of 160 contact hours over 15 weeks was maintained with adjustments to accommodate the ADC requirements by introducing the below:

1) The original clinical site rotation over the average of 12 different clinical sites was fixed to one hospital to increase the reliability of the assessment and training opportunities.
2) The quota of MI patient exams per BD was increased from 28 to 70 per EPT.

The clinical implementation was a three-stage process.
Stage 1: Students were offered an orientation and assigned to work on the clinical site. Concurrently, students received feedback from the clinical tutors and attended follow-up discussion sessions with the faculty.
Stage 2: Extra laboratory training was offered based on individual performance.
Stage 3: Five different assessments were conducted by faculty, the clinical instructor, and clinical tutors**.**

5. Evaluation

The evaluation step was conducted at the individual student assessment level and at the ADC's program level. From a curricular standpoint, the ADC assessments and requirements were divided into three main categories based on the deviations from the parent curriculum. The first category was the unchanged course requirements. The second was replaced or waived as an ADC requirement due to lack of relevancy or compatibility. Finally, the last category included added and/or altered assessment tools or requirements and those are:

1. Patient training quota was doubled from 34 to 70 per EPT.
2. Four clinical assessments per EPT
3. A summative structured viva-voce.
4. Two reflection journals
5. Empathy score using Jefferson's Scale of Empathy (JSE) test (Hojat, 2016)
6. Patient satisfaction and critical incident report reviews
7. E-portfolio

Finally, the program was evaluated using the Kirkpatrick method: reaction, learning, behavior, and results (Kirkpatrick & Kirkpatrick, 2016).
Part 2 of this paper will delve more deeply into the assessment, evaluation, and evidence of attainment.

6. Discussion

Due to the novelty of the concept, an abundance of caution has limited our pilot project to a small cohort, leaving statistical inferences inapplicable. However, many assumptions were valid and informative for future piloting and complete fledge plans in other divisions in our institution. Human resourcing is essential

for ADC offerings, yet, identifying academics with curricular and clinical expertise could be challenging. The ADC pilot faculty who performed the ADDIE steps is an academic expert who leads MI programs accreditation and maintains clinical licensures of practicing clinical MI. Secondly, language is a substantial barrier to NTS pedagogy, so consideration of this at the early designing stages is imperative. Since the graduates that will serve the population are native language speakers, allowing bi-lingual training was an acceptable and efficient tactic that eliminated possible language rather than NTS deficiencies. Third, many ethical considerations arose around the detrimental grade effects on students, so we applied the following mitigation approaches:

1. Institutional ethical approval permission to conduct the research was granted by our institutional Research Ethics and Integrity Committee (REIC2-113)
2. Informed consent which included an explanation of the study was voluntarily obtained from each student. Also, the participants had the choice to withdraw at any point in time without penalty.
3. Faculty co-teaching the parent curriculum components were blinded to the measurement tools and the teaching material to minimize biases that might affect students' graded tasks that contribute to the Grade Point Average (GPA).
4. Cognizant of the extra time demands and cognitive load, only undergraduates with a minimum of 2.8 GPA were eligible to enrol.

Lastly, we conclude that the role of industry and clinical partners is unequivocally essential for ADC offerings as per our suggested framework and taxonomy.

7. Limitations

Due to the novelty of ADC offerings and the subsequent lack of employability or possible job promotion linkage, no upskilling/reskilling seekers were enrolled, limiting our findings and recommendations to undergraduates within small group dynamics. Also, the scarcity of research on ADC and NTST within MI and the lack of a single 'best-practice' imposed the need for vigilant and extensive MI-specific adjustments throughout the ADDIE steps.

8. Conclusion

All healthcare professions, including MI-specific NTST and verified attainment of NTS like effective communication, collaboration, and empathy, are paramount for employment prospects and patient safety considerations within high-risk clinical conditions. In combination with the adult learning theory, the ADDIE model is a plausible match to deliver a range of dedicated NTSTs within the MI context with reasonable confidence of applicability across healthcare higher education. Using existing PPS and articulating competency/clinical-based EPTs to guide NTST development is a practical approach to provide alignment between existing full graduate higher education curricula and an intended NTST. Furthermore, when considering ADC for upskilling, it is advised to pilot it on undergraduates to assess low impact on employability prospects and cost considerations. Finally, ADC for undergraduate students as

they proceed with full credential academic progression is potentially valuable in building volunteering working forces in cases of pandemics and catastrophes per the EPT scope described in this framework. Nonetheless, an evaluation of the intervention suggested in this work is required. Transparent and trustworthy research is needed to identify the employability outcomes, long-term comparative retained competencies, and MI stakeholders' acceptance and involvement worldwide.

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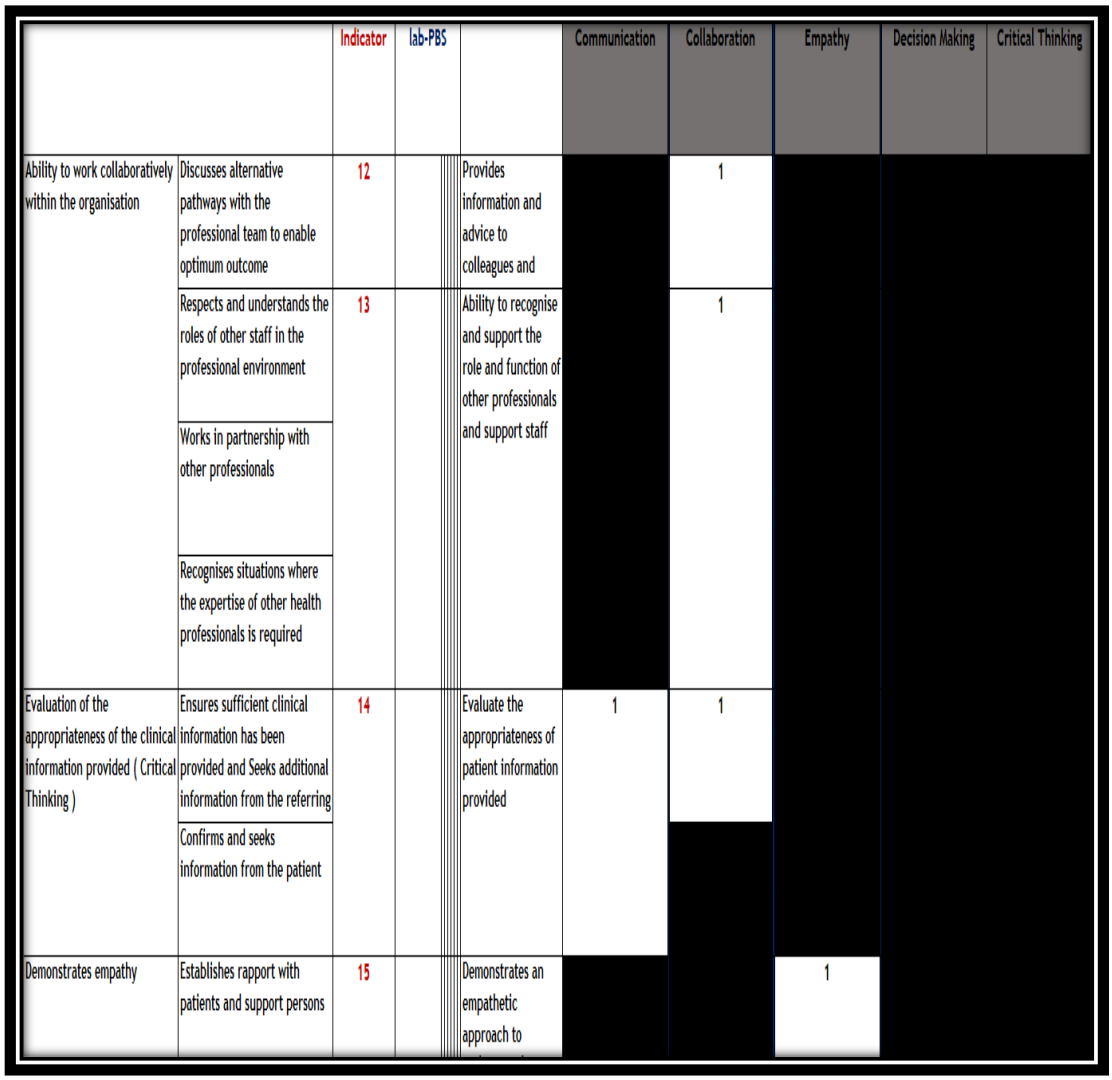
Appendix

1. PPS-modified performance checklist sample

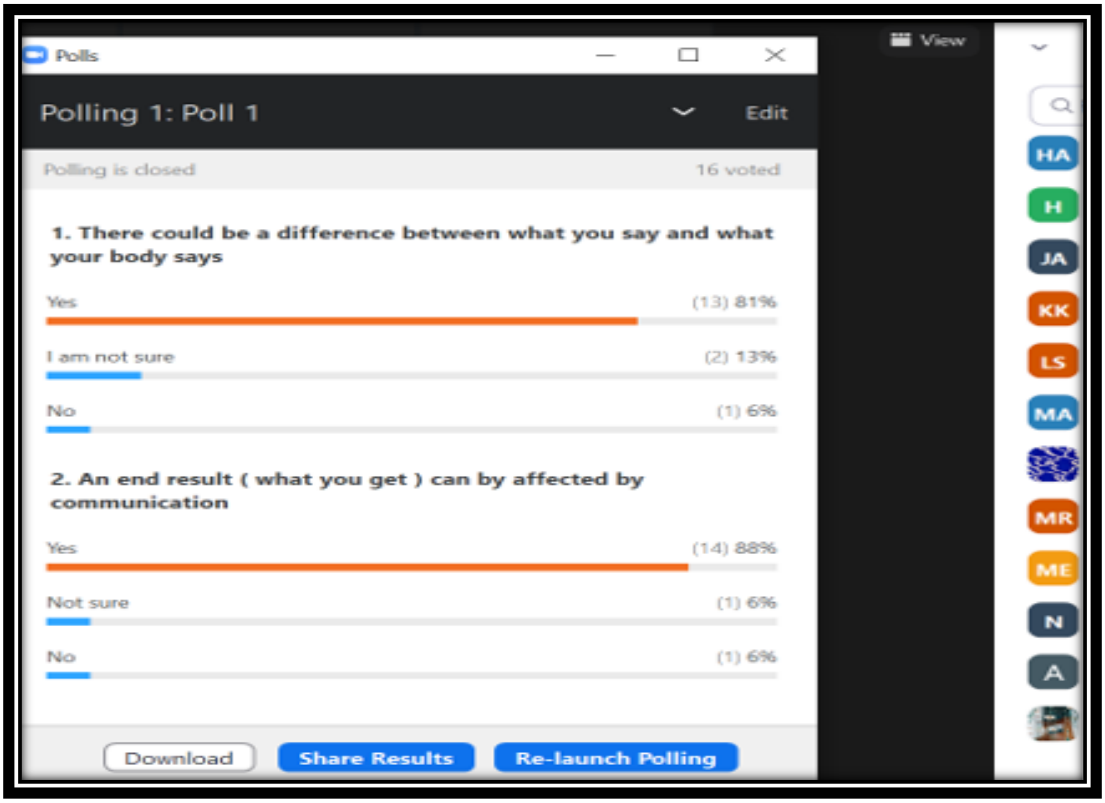
Used for

1. Standards identification and mapping
2. Training checklist
3. Evaluation and assessment.



		Indicator	lab-PBS		Communication	Collaboration	Empathy	Decision Making	Critical Thinking
Ability to work collaboratively within the organisation	Discusses alternative pathways with the professional team to enable optimum outcome	12		Provides information and advice to colleagues and		1			
	Respects and understands the roles of other staff in the professional environment	13		Ability to recognise and support the role and function of other professionals and support staff		1			
	Works in partnership with other professionals								
	Recognises situations where the expertise of other health professionals is required								
Evaluation of the appropriateness of the clinical information provided (Critical Thinking)	Ensures sufficient clinical information has been provided and Seeks additional information from the referring	14		Evaluate the appropriateness of patient information provided	1	1			
	Confirms and seeks information from the patient								
Demonstrates empathy	Establishes rapport with patients and support persons	15		Demonstrates an empathetic approach to			1		

2. **Thought-provoking videos.** Polls samples and analysis for the whole class



Unstrapping a patient decision based on patient's disposition and attitude

Poll before intervention

	Baseline		
	I will unstrap	Not sure	I will not unstrap
Polite patient	8/12 **(67%)**	4/12 **(33%)**	0
Angry Patient	5/12 **(42%)**	4/12 **(33%)**	4/12 **(33%)**

Intervention: Video and discussions

Poll after intervention

Question	Agree	Not sure	Disagree
The way patients communicate might influence a radiographer's performance and judgment.	19/19 **(100%)**	0	0
Common sense and how the patient communicates are not enough, I also need technical knowledge to be able to apply patient's safety using health care specific communication skills	17/19 **(89%)**	2/19 **(11%)**	0
Being polite warrants unstrapping a patient.	0	0	19/19 **(100%)**

3. **Toolkit example**

SSDCA communication/collaboration/critical thinking (Situation – Specific- Direct- Close the loop- Assertive)

1. **Situation awareness**
   - Recognise that 'meaning' is different to 'information' or 'knowledge', and effective communication depends t on the existing level of situation awareness.
   - Listen actively and observe body language.
   - Have an awareness of the signs of physical and mental deterioration and call for emergency.
   - Recognise when to call for assistance when you are feeling unwell or overwhelmed.
2. **Specific**

- Speak clearly using a 'controlled vocabulary' with the medical teams and simple "everyday language" with patients (have an interpreter if the patient is unable to speak in English/Arabic)
- Avoid using the word 'right' only to mean chirality (as in 'left' or 'right') and avoid its use to mean 'Ok' or 'correct'
- Use numbers rather than vague terms e.g., "SID is 180" rather than "long SID"
- Avoid non-standard clinical abbreviations and acronyms (e.g., Bucky)

4. **Example of problem-based scenarios triggering a progressive release outcome** (also used for lab-SBT).

A) <u>Trigger</u>

Ext(1) Date
Student Radiographer
Student simulated patient
Evaluator student:
Mins- pause for patient transfer

Time allocation 5

Imaging Request
MRN 12458937
Patient name: Fatma Ahmed
DOB: / / Age: 26
sex: F weight: 180 KG
Start date of last Menstrual Period (if applicable): / /

Patient arrival
☐ Walking
☐ Wheelchair
☐ Bed/trolly

Patient precautions
☐ Contact
☐ Droplet
☐ Airborne
☐ Standard

Examination requested and clinical data

Pt had a fall
Trauma to Rt. Foot , R/O #
Rt. Foot x-ray

B) Progressive release outcome

- Radiographer calls porters to transfer the patient and observes them as they transfer her to the table and back to the bed.
- Patient snaps at her saying are you implying that I can't do that on my own because of my weight?
- Finally the radiographer convinces the patient to move to the table with aid. The radiographer notes that the wheelchair was moving as the patient was moved so the radiographer holds and supports the wheelchair with her body while standing on spread legs for a stable position
- Patient refuses/unable to turn to her side for a lateral so radiographer goes to the reception area calls the doctor so the patient doesn't feel bad saying that I have a 180 kg patient Fatma Ahmed you sent for foot x-ray she is angry about her weight and is snapping at me, will we be able to help her without the lateral view? I don't want to embarrass her.

5. **Lab simulation.** Role play of the previous PBS feedback example

1. Peer Evaluation: Observer

Communication: she was explaining the procedure in simple words to the patient
Empathy: she was gentle with the patient
Safety : she wore gloves later
Technical : good but not use lead protection
Other: she was confused about how to transfer the patient in the right way and smile maybe patient will shy

2. Self-reflection

Communication: I didn't ask the patient about the area of injury, and I didn't identify myself for the patient.
Empathy: I was gentle with the patient
Cultural awareness: I give the patient her space
Safety: I start without wearing gloves I didn't use the marker
Technical : I use the wrong collimation, I didn't use the marker, In the AP foot, I understood that I forgot to angle the tube after I told the patient that I would take the image.
Other: I was confused about how to transfer the patient from the bed to the x-ray table.

3. Faculty comments and training: I demonstrated the ways to safely transfer of the patient to the table and students rehearsed the same technique

To improve
Apply 10-28 days rule as applicable
Patient is a bariatric , must request for help to support off and on , consider using the mobile machine. We must exhaust all options before suggesting cancelling an important standard view.
Use eye contact when you explain the procedure.
Ask patient if she can move and what she can do , autonomy is important
You breached patient privacy by speaking over the phone in the reception
Observe the patient while exposing
Use lead protection