

Developing, implementing, and disseminating an adaptive clinical reasoning curriculum for healthcare students and educators

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D2.2 Curricular framework with teaching/assessment methods for the student curriculum and the train-the-trainer course

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1. Introduction

The Kern cycle of curriculum development [Kern 2015] points out recommended steps, which guide our development work (figure 1). After our initial needs assessment (WP1) and definition of goals and objectives (D2.1), we have reached a point of providing educational strategies in terms of a curriculum framework for clinical reasoning. The framework will be the basis for work packages 3 and 4 during which we will develop and implement the clinical reasoning teaching and learning activities.

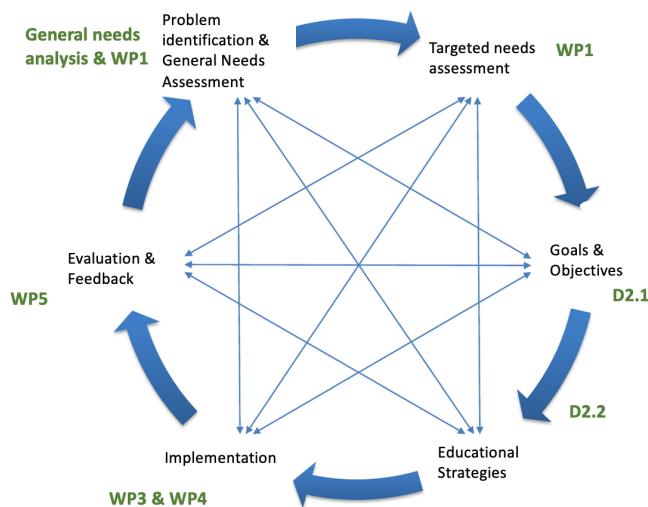


Figure 1. Kern cycle of curriculum development and DID-ACT work packages

2. Quality criteria

- Consensus workshop to discuss the clinical reasoning framework, for the student curriculum and the train-the-trainer course.
- Review clinical reasoning frameworks in relation to the need's analysis and the literature.
- A tabular representation describing aspects and dimensions of the clinical reasoning curriculum frameworks will be reviewed by associate partners.
- Constructive alignment serves as a guiding principle for the learning objectives and curricular framework development.

3. Methods

In order to provide a solid foundation, the framework is based on the need's analysis, the defined learning goals and objectives, and published research on clinical reasoning curricula. Furthermore, we connected the work process to the theory of constructive alignment of

content, teaching & learning activities and assessment. For our work, we were inspired by other work such as the Erasmus+ [TUNING project](#), the WHO framework for patient safety [WHO, 2009], and the WHO framework for interprofessional collaboration [WHO, 2010].

We followed the constructive alignment theory to ensure an optimal alignment of learning objectives, teaching, and assessment.

At the beginning of this deliverable, ORU familiarized all partners with the constructive alignment theory during an interactive webinar held by an educational developer from ORU. The constructive alignment theory emphasizes what the learner should be able to do, taking a competence-based approach. Teaching and learning activities and assessments are designed in accordance with specific learning outcomes [Biggs 2011].

Based on the identified learning objectives (see [D2.1](#)), suitable teaching, learning and assessment methods were selected to develop a framework for the student and train-the-trainer curricula. In order to secure different perspectives and overall validity, all partners were engaged in this deliverable.

In order to proceed towards teaching and learning activities we identified dimensions of curricular aspects in a consensus-process inspired by models of curricular frameworks (working document “Suggested dimensions”). These dimensions were then refined into six curricular aspects through which our curriculum will be developed. The curricular aspects are: (1) Pedagogical approach, (2) Learning objectives, (3) Teaching content, (4) Teaching and learning activities, (5) Assessment, and (6) Progression. We organized working groups who elaborated on selected parts of the clinical reasoning categories and corresponding learning objectives in relation to curricular aspects. The groups’ results were discussed in team meetings and finally merged into the exemplary tables of the framework presented below.

4. Framework

The framework consists of the learning objectives and goals, teaching and assessment methods, and module structures with online and face-to-face phases.

A theme-based approach was selected and planned to be carried out using blended-learning to ensure flexible learning schedules and an optimal match of teaching and assessment. Such methods will combine online activities, such as virtual patients and interactive videos with face-to-face methods such as bedside teaching. Matching the learning objectives, assessment methods for the learning objectives will be chosen in relation to the specific needs of the learning objectives.

4.1 Overall pedagogical approach

The pedagogical approach is based on selection of learning objectives, teaching and learning activities, and assessment methods directed towards learners' development of clinical reasoning. The various characteristics of the approach for the design of the student curriculum and the train-the-trainer course are summarized in the following table 1.

Characteristics	Description
Theme- and case-based curriculum	The DID-ACT curriculum and train-the-trainer course will be structured based on themes, which correspond to the categories

	<p>developed in D2.1, and the forthcoming learning units will be aligned with these themes. Cases and virtual patients will be core components especially of the student curriculum and most teaching, learning, and assessment activities will be based on cases. [Resor 2017]</p>
Learner-centeredness	<p>A learner-centered approach emphasizes learning as the result of a student's active engagement in learning activities. This means activities where the learners are responsible participants in the learning task. It places the learner's experiences and development of knowledge and meaning in the center of the learning process. The teacher's role is to support and facilitate the learning process and provide feedback. [Wright 2011]</p>
Blended learning	<p>Blended learning is a meaningful combination of online and face-to-face learning activities [Rowe 2012]. An example is the Flipped or Inverted classroom model, in which students prepare online and self-directed for a face-to-face learning session [Tolks 2016]. This allows teachers and learners to use the face-to-face session for discussions or knowledge application instead of instructor-led teaching of knowledge. A well-designed blended learning curriculum can be transformed into an "online only" virtual learning experience by converting the face-to-face sessions into synchronous online meetings [Tolks 2020]. Taking into account the current COVID-19 pandemic we will include suggestions for each face-to-face learning unit on how these could be modified to be conducted as a synchronous virtual session.</p>
Longitudinal	<p>The DID-ACT curriculum will be designed as a series of courses and learning activities covering several years of education based on the defined themes. It includes (spaced) repetition, progression of depth and complexity, and opportunities for deliberate practice.</p>
Adaptive	<p>The suggested learning activities of the DID-ACT curriculum and the train-the-trainer course will be adaptable to different settings, health profession curricula or resources available at the schools. We will provide a description and implementation of learning units with suggestions for alternative approaches, methods, or resources based on experiences in our partner institutions. [Quirk 2018]</p>
Focus and Border areas	<p>The DID-ACT curriculum is focusing on explicit clinical reasoning and is meant to supplement core content and experiences. However, there are areas that cannot be separated from clinical reasoning in practice and where we have to be careful on how our curriculum will fit into existing curricula without replicating</p>

	existing courses. These areas include communication skills in general, clinical examination skills, interprofessional collaboration in general, evidence-based medicine (EBM), and knowledge about clinical, biomedical, and pathological processes.
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Table 1: Overall pedagogical approach of the DID-ACT student curriculum and train-the-trainer course.

In addition to the overall pedagogical approach, we have defined several dimensions that will be used to outline the learning units of the curriculum. Table 2 describes these dimensions and some examples are provided in chapter 4.5.

Dimensions (including dimensions for the tables)

Themes/Categories	The overarching structure of the DID-ACT curriculum and train-the-trainer course will be the clinical reasoning categories defined in D2.1 . These form the basis for the themes and the development of the learning units (see 4.2)
Learning Objectives, outcomes, and prerequisites	see 4.2
Levels / Progression	see 4.3
Teaching content	This dimension includes an elaborated description of the content areas that will be covered within a category/theme. For an example, see tables 5 and 6.
Teaching and learning methods	A description of teaching and learning methods and activities will be provided for the respective teaching content. Selected teaching/learning methods and strategies for clinical reasoning are provided in chapter 4.4 .
Assessment methods	A description of assessment methods will be provided for each teaching content. Selected formative and summative and a range of workplace-based and classroom-based assessment methods for clinical reasoning aligned with the teaching/learning-activities are provided in chapter 4.4 .
Evaluation questions & activities	As indicated in the Kern cycle, the development of learning units is closely aligned with evaluation activities (WP5). To emphasize this alignment the categories/themes will include examples of related evaluation questions identified as part of D5.1. For an example see table 6 .

Table 2: Dimensions to outline the learning units of the curriculum.

4.2 Learning objectives and categories

We have defined 35 general learning objectives in [D2.1](#) and aligned them in 14 themes/categories to describe the DID-ACT student curriculum and the train-the-trainer course. Each learning unit will be mapped to at least one general learning objective and will be further specified with detailed learning outcomes. If applicable, prerequisites to participate in a learning activity will be included.

4.3 Progression

In the longitudinal DID-ACT curriculum themes, topics, and learning activities will be repeated in increasing difficulty and complexity. To facilitate this approach and align our learning units along this progression we have defined four different learner levels:

- Novice: No prior experience required, introduction into a theme
- Intermediate: Some prior experience (e.g. the beginner learning unit)
- Advanced: Requires intermediate experience
- Teacher: Advanced prior experience that enables the learner to become a teacher for peers/students in this topic/area.

Each learning unit will be assigned to one of these levels, but not all themes will necessarily implement all levels. For example, the "Theories of clinical reasoning" does not include the advanced level (see [table 5](#)), [table 6](#) does not include the teacher level, whereas [table 7](#) covers all four levels.

4.4 Teaching, learning and assessment methods

Table 3 provides a pool of suitable learning and assessment methods for clinical reasoning. This pool will feed the curriculum development in WP3 & 4. Examples of how these methods are included are highlighted in [chapter 4.5](#). In addition to the methods highlighted in table 3, almost all methods can also be used in clinical reasoning teaching and assessment. These methods include for example Problem-based learning (PBL), bedside teaching or Objective structured examinations (OSCE) (see also Trowbridge et al. for an exhaustive list).

There are numerous assessment methods that align with the clinical reasoning aspects in our categories identified in [D2.1](#). These can be aligned considering learning objectives and specific learning outcomes assessments of clinical reasoning can be implemented in various settings [Daniel 2019]: workplace-based assessment (e.g. direct observation, oral case presentation, think aloud, written notes). non-workplace-based assessment (e.g., key-feature questions, Script concordance test, patient management problems,) and assessment in simulated clinical environments (e.g. objective structured clinical examination technology-enhanced simulation) (see Table 3).

Additionally, assessment methods can be divided into formative and summative assessment. Formative assessment monitors student learning and provides continuous feedback helping students to identify strengths and weaknesses. Summative assessment aims at evaluating learners, for example at the end of the term or study program. Summative assessments can be passed or failed.

In the following table 3, selected teaching/learning and assessment strategies for clinical reasoning are described.

Method	Summary	Suitable for
Cognitive autopsy	Learner walks with teacher through his/her memories of the entire case perhaps guided by the patient's chart to stimulate the recall [Croskerry05]	Learning and (formative) assessment
Oral or written case presentation including a summary statement	In an oral or written case presentation learners are required to summarize a patient encounter focusing on the relevant aspects. [Trowbridge 2015, Smith 2016]	Learning and (formative) assessment
Concept Mapping	Concept maps can be used to let students visualize complex contexts in a graphical map. Concepts such as findings and hypotheses can be entered by students and relations between concepts can be highlighted with connections including a description. Concept maps promote critical thinking and help to understand learner's knowledge structures. [Torre 2013, Trowbridge 2015]	Learning and (formative) assessment
Extended matching	Alternative question format to MCQ with less cueing effect. The format starts with a panel of possible short options (from 6 to 25 or more). The options are e.g. a list of diagnoses or treatment methods. This is followed by a lead-in task for the student and several stems (longer case vignettes). The stems have a common theme (e.g. related to symptoms like fatigue or chest pain; anatomic sites; pathophysiologic states etc). The task of the student is to select one or more options from the panel that match each stem. Options can be selected one-time, multiple times or not at all. [Case & Swanson93]	Summative assessment
Fishbone diagram authoring in a group	A structured approach (RCA = root cause analysis) to errors. Division of complex medical errors into discrete categories in a visual display similar to a fishbone [Trowbridge 2015]	Learning and (formative) assessment
Implicit Association Tests (IATs)	A series of tests that target hidden or automatic stereotypes and prejudices related to racial, ethnic, religious, gender, sexuality groups (https://implicit.harvard.edu).	Learning
Key-feature problems/questions	Short cases vignettes followed by a few questions (MCQ, short answers, long-menu) focusing on a few decisions pivotal to the successful outcome of the case. ... [Huwendiek 2017, Trowbridge 2015]	Learning, formative or summative assessment

Mini-CEX	"A faculty member observes a trainee as he/she interacts with a patient around a focused clinical task. Afterwards, the faculty member assesses the performance and provides the trainee feedback. It is expected that trainees would be assessed several times throughout the year of training with different faculty and in different clinical situations." [Norcini]	Formative or summative assessment
Post-encounter form (PEF)	A PEF is a written exercise which is often used as part of Objective Structured Clinical Exams (OSCEs). These written exercises often take the form of multiple-choice questions and, at times, a request for next steps in diagnosis or management. [Durning 2012]	Learning, formative or summative assessment
Script concordance test	"Asking learners how new information changes the likelihood of a diagnosis and using the cumulative average of experienced clinicians to determine the most correct answer." [Lessing20]	Learning, formative or summative assessment
Situational judgment tests	Present a series of hypothetical scenarios likely to happen in practice of the profession and ask the examinee to evaluate the effectiveness or appropriateness of a series of potential responses to each scenario. [Kiessling 2016]	Learning, formative or summative assessment
Structured reflection	List most important observations, facts from history, results of tests that support or argue against the diagnosis. Could be implemented on a whiteboard [Gouzi19] or in a virtual patient environment [Hege17]	Learning, formative assessment
Think aloud	Think aloud requires learners to verbalize their thinking while performing a task and is a method to capture thought processes. Therefore, Think aloud is a way to make clinical reasoning more explicit. [Pinnock2015]	Learning, formative assessment
Virtual patients (VPs)	VPs are online clinical cases suitable to train clinical reasoning in a safe environment and also in combination with bedside teaching [Kononowicz 2019, Huwendiek 2013]	learning, formative & summative assessment
Worked examples	Erroneous examples of clinical reasoning based on worked examples of patient cases in which the protagonist makes severe errors. The learner has to detect the errors. After every wrong decision the error is corrected by the expert's feedback. [Kopp 2008]	Learning and (formative) assessment

Table 3: Selected teaching/learning and assessment strategies for clinical reasoning

4.5 Contextualizing the curricular framework with examples from selected categories

As part of our framework and starting point for the curriculum development we include four exemplary tables for selected overarching learning objectives we agreed upon in D2.1. The tables outline our joint curriculum development process at different stages.

Table 4 illustrates a first and more overarching step in developing the "Educational strategies" in the Kern cycle. It provides a collection of general ideas on, teaching & learning activities and assessment methods aligned to overarching clinical reasoning learning objectives. Based on this overarching table more granular outlines of the topics can be developed. This is shown in tables 5, 6, and 7 in which the teaching content, specific learning outcomes, and teaching & learning and assessment methods have been defined on a more specific level. Based on these tables we will further progress in WP3 and 4 and develop the corresponding learning units.

Overarching curricular outline for the categories related to clinical reasoning processes

	Novice	Intermediate	Advanced
The student will be able to accurately and efficiently collect key clinical findings needed for analysis of a patient's problem.			
Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to collect key clinical findings. 	<ul style="list-style-type: none"> Learners will be able to analyze and interpret key clinical findings and formulate a diagnosis and differential diagnoses. 	<ul style="list-style-type: none"> Learners will be able to analyze and interpret key clinical findings and formulate a diagnosis and differential diagnoses for complex patients. Learners will be able to formulate a treatment plan taking into account multiple diseases, treatments and social contexts.
Teaching & learning activities	<p>Virtual Patients: ask students for a written summary of a case highlighting the key clinical findings.</p> <p>Key points: consider that students could be cognitively overwhelmed by the complexity of the clinical situation. Provide adequate constructive feedback</p>	<p>Virtual Patients: more complex requiring a more sophisticated case summary</p> <p>Bedside teaching</p>	
Assessment (formative/summative)		<p>Oral case presentation</p> <p>Post-encounter form/Written notes</p>	
The student will be able to accurately and efficiently analyze and interpret the key clinical findings to plan patient treatment and patient care.			

Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to collect key clinical findings 	<ul style="list-style-type: none"> Learners will be able to analyze and interpret the key clinical findings and plan treatment and patient care 	<ul style="list-style-type: none"> Progressing towards a more complex patient taking into account multiple diseases, treatment and social context. Also planning how the different clinical findings can result in an interaction with other health professions for optimizing the patient care
Teaching & learning activities	<p>Virtual patients Problem-based learning, Case method</p> <p>Asking the students for discriminating and confirming features for suggested diagnoses</p>	Similar activities on more complex levels and bedside teaching	Similar activities on more complex levels
Assessment (formative/summative)	Patient management problems. OSCE, Oral exam	Same methods can be used with increased complexity and less prototypical cases	
The student will be competent in generating differential diagnoses including their defining and discriminating features			
Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to provide differential diagnoses for key symptoms and prototypical cases Learners will be able to describe differentiating and confirming features of relevant differential diagnoses 	The same leading symptom can be used with increased complexity and less prototypical cases	
Teaching & learning activities	Virtual patients, Problem-based learning, Case method	The same methods can be used with increased complexity and less prototypical cases in addition to bedside teaching.	

	<p>Blended learning: approaches combining e.g. Virtual Patients with small group teaching.</p> <p>In all instances students should be asked for discriminating and confirming features for suggested diagnoses [Bowen 2006]</p>		
Assessment (formative/summative)	Key-feature problems/questions, script concordance test, Virtual Patients	The same methods can be used with increased complexity and less prototypical cases	
The student will know about the benefits and risks of using clinical decision support systems including AI in clinical reasoning.			
Specific learning outcomes	Introduced at the intermediate level	<ul style="list-style-type: none"> Learners will be able to explain advantages and risks of decision support systems Learners will be able to identify situations in which decision-support systems can be of help. 	<ul style="list-style-type: none"> Learners will be able to describe benefits and address concerns for caution of using AI for clinical reasoning at a systems level.
Teaching & learning activities		<p>Activities that increase the awareness of how algorithms and pre-defined structures lead to increased precision and productivity in some instances but could also insert bias into the clinical reasoning process.</p> <p>Letting students work with a decision support system on a VP and then reflect and discuss their experiences in small groups?</p>	<p>Activities that look into the larger picture - systems level of using AI in healthcare settings.</p> <p>e.g. TBL activities letting students research AI and decision support systems and their application in clinical environments.</p>

Assessment (formative/summative)		Reflect in a clinical reasoning e-portfolio on consequences of using AI for CR. Based on own experiences or described cases.	Written examinations showing awareness on how AI can contribute to effective healthcare regarding the clinical reasoning process.
The student will be able to apply treatment, therapeutic and prophylactic procedures based on a holistic assessment of the patient, the diagnosis, the healthcare context, alongside with current best evidence.			
Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain the complexity of social interactions and the patient's situation in the whole context. 	<ul style="list-style-type: none"> Learners will be able to discuss ethical aspects and ethical dilemmas of their different choices. 	The learners will be able to plan treatment including therapeutic and prophylactic procedures based on a holistic assessment of the patient
Teaching & learning activities	Simulation in various modalities such as written scenario, virtual patient, mannequins and simulated patients. Bedside, Case-method	More complex scenarios in simulated and/or actual clinical settings	More complex scenarios
Assessment (formative/summative)	Formative and summative: (Interprofessional) OSCE. Patient management problems, Think aloud, Written notes Summative: Oral presentation. Formative: Mini-CEX	Can use the same assessment but with more complex scenarios	The students have to show how they can apply treatment, therapeutic and prophylactic procedures in a real clinical case
The student will know how to set treatment goals for the patient based on evidence, healthcare context, and patient's needs and preferences.			
Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to describe how treatment plans are produced and decided upon. Learners will be able to describe models of evidence-based medicine. 	<ul style="list-style-type: none"> Learners will be able to explain relations between patient needs, healthcare context and the role of evidence in this clinical reasoning process 	<ul style="list-style-type: none"> Learners will be able to formulate treatment goals based on patient's needs and preferences

Teaching & learning activities	PBL with a virtual patient on which the learners work out and discuss the different perspectives on the treatment goals for the VP. Literature on evidence- based medicine models	Case report - intermediate difficulty Virtual patient - intermediate difficulty Role-play for a more complex case in which learners can experience the different roles in this process. Alternatively, a (more complex) VP in a PBL setting also including end-of-life decisions.	Bedside teaching with actual or simulated patients
Assessment (formative/summative)	Virtual patients/Case on which students work individually and elaborate on treatment goals from different perspectives.	Formative: feedback on case report or role-play activity. Alternative: Simulated scenario in which the learner should discuss treatment options with an SP	Summative: OSCE station, mini CEX with a patient focusing on treatment goals

Table 4: Overarching curricular outline for the Processes in clinical reasoning including developing differential diagnoses and a management plan

Curricular outline for the category "Theories of clinical reasoning"

Teaching content		Novice	Intermediate	Teacher
	The student will have an understanding of key theoretical models related to clinical reasoning.			
What is clinical reasoning & why is it important	Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain clinical reasoning and related terminology in their profession. Learners will be able to explain the importance of clinical reasoning for their profession in their own words 	<ul style="list-style-type: none"> Learners will be able to explain terminologies, differences and similarities in clinical reasoning in different HP. Learners will be able to explain the importance of clinical reasoning for HPs broadly and in relation to their 	<ul style="list-style-type: none"> Learners will be able to teach about the clinical reasoning process and terminology in the different health professions. Learners will be able to point out the importance of clinical reasoning for the different health profession to

			respective discipline.	students.
	Specific teaching content	Knowing what clinical reasoning is and being able to understand the terminology and the importance of clinical reasoning for their own profession.	Knowing differences and similarities in clinical reasoning in the health professions, terminology used, and importance of clinical reasoning	Teaching students or peers on different levels about what clinical reasoning is and how important it is for all health professions and patients.
	Teaching & learning activities	Starting with a case/VP to let students in small groups (TBL or PBL) work out what clinical reasoning is and how it relates to other domains	Similar to novice level but with interprofessional student groups and cases. Interview someone in another discipline and ask for important aspects in the clinical reasoning strategies. Compare and contrast pieces of their clinical learning environment and provide thoughts on the usefulness of theories in these situations.	Discussion and exchange about teaching situations (e.g. on the ward) and developing ideas on how in these situations students can be supported in clinical reasoning. Produce teaching aids that can help clinical reasoning be implemented in different areas (examples: Check lists, thought prompts)
	Assessment (formative and/or summative)	Formative: Add to clinical reasoning e-portfolio a short reflection piece about the relevance of clinical reasoning including an example (either real or fictious).		
Dual processing	Specific learning outcomes	<ul style="list-style-type: none"> • Learners will be able to explain what dual processing is. • Learners will be able to reflect on their own dual processing in simulated and less complex situations. 	<ul style="list-style-type: none"> • Learners will be able to recognize their own dual processing in complex situations. • Learners will be able to explain the relation between dual processing and errors. 	<ul style="list-style-type: none"> • Learners will be able to explain methods of teaching dual processing for different competency levels. • Learners will be able to apply teaching methods to teach dual processing to students and peers.

	Teaching activities	Small groups working with two cases including guiding questions (an easy one in which the diagnosis/problem is obvious and a difficult one where analytical reasoning is required) and letting students experience and work out analytical reasoning and pattern recognition.	Similar to novice level but with more complex and error-prone situations (can be combined with learning activities on errors). Discussion of common heuristics and biases also outside medicine and later relation of those phenomena to medical practice. [Kahneman11]	Small (interprofessional) groups working with a think aloud approach on cases and reflect on their own (dual) reasoning process. Learners apply different tools that help for analytical reasoning (regarding different questions that should be considered depending on HP)
	Assessment (formative/summative)	Combined with assessment of the Theory into practice section.		(see assessment section of last content area)
Profession-specific theories: Illness Scripts	Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain what illness scripts are. Learners can summarize why we use illness scripts in clinical reasoning in their own words. Learners will be able to create their own basic illness scripts in less complex cases. Learners will be able to evaluate illness scripts and provide feedback. 	<ul style="list-style-type: none"> Learners will be able to create their own illness scripts in complex cases. Learners will be able to evaluate more complex illness scripts and provide feedback 	<ul style="list-style-type: none"> Learners will be able to teach what illness scripts are Learners will be able to teach how illness scripts can be created and evaluated and will demonstrate examples to students on how illness scripts can be visualized. Learners will be able to provide feedback on illness scripts.
	Specific teaching content	What are illness scripts, why they are important for the students, and how can they be developed	Similar to novice level, but more complex	Teaching about illness scripts on the ward and in other teaching situations
	Learning & Teaching	Face to face seminar or TBL to explore what illness scripts are,	Similar to novice level but with more difficult cases and with more complex	Teaching techniques that can be applied to illustrate what illness scripts are and

	activities	followed by a series of virtual patients in which learners create illness scripts in form of concept maps. Concluding face to face meeting to discuss illness scripts (peer feedback)	illness scripts including other techniques for visualizing and discussing illness scripts from other health professions	how they can help to train clinical reasoning
	Assessment (formative/summative)	Formative: Creating own illness scripts on simple cases and giving feedback for illness scripts of peers.	Similar to novice level, but for more complex and interprofessional cases	(see assessment section of last content area)
Profession-specific theories: Nursing Outcome-Present State-Test (OPT) Model	Specific learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain what the 'OPT model of clinical reasoning is' Learners will be able to compare and contrast traditional nursing process models with the OPT model Learners will be able to explain components of a patient-in-context story that are needed to create an OPT model Learners will be able to apply the OPT model of clinical reasoning. Learners will be able to describe the role of standardized terminologies in the context of clinical reasoning and nursing. 	<ul style="list-style-type: none"> Learners will be able to apply the components of the OPT model used to reason through problems, relevant nursing diagnoses, outcomes and interventions relevant in different nursing care settings. Learners will be able to summarize how the OPT model provides a guide for problem solving relevant to their roles. Learners will be able to explain knowledge and data needed to frame a patient health care situation, the process of filtering, framing and focusing to determine the present and outcome state in order to proceed with a plan of care. 	<ul style="list-style-type: none"> Learners will be able to elaborate on how the OPT model can be used to teach clinical reasoning and promote reflection in a variety of clinical and teaching contexts. Learners will be able explain how the OPT model can be used to organize the reasoning process during a simulation and promote reflection and debriefing. Learners can modify the basic tenants of the OPT model to suit their needs in a clinical teaching setting

Specific teaching content	<p>The Nursing Outcome-Present State-Test (OPT) model.</p> <p>Create a “clinical reasoning web” (a scaffold structure for concept mapping all data in a patient case, encouraging situated cognition and thus functioning as a bridge between theory and practice when learners apply knowledge and experience to new situations).</p>	<p>Applying the OPT model of clinical reasoning as a model for conceptual framework and the clinical reasoning web as a tool on more complex scenarios across life span</p>	<p>How to facilitate student's development of clinical reasoning skills using the clinical reasoning web</p>
Teaching & learning activities	<p>Face to face seminar to explore the OPT model and standardized terminologies.</p> <p>Students are individually presented to a virtual patient in which the health care issues /nursing diagnosis is obvious. They work through the scenario applying the OPT model when creating a clinical reasoning web. This is followed by a face to face seminar to discuss the case and the application of the OPT model</p>	<p>Students are working individually on several more complex virtual patients in different contexts applying the OPT model when creating a clinical reasoning web. This individual work is followed by a face to face seminar where the students discuss the case and keystone issues for the clinical reasoning in this case.</p>	<p>Face to face seminars about aspects of how to use the OPT model as a conceptual framework that supports curriculum integration and learning clinical reasoning across a nursing education program and with the potential for an interprofessional training context.</p> <p>Develop a set of teaching questions based on the OPT model of clinical reasoning that cover key issues for reflection on clinical situations to achieve desired outcomes.</p>
Assessment (formative/s ummative)	<p>Formative: Students work through a virtual patient applying the OPT model and creating a clinical reasoning web and give feedback to peers using a protocol.</p>	<p>Summative: Students work through a more complex case applying the OPT model and creating a clinical reasoning web. This is complemented with assessment of clinical reasoning skills by using Tanner’s clinical judgment model “Thinking Like a Nurse” on the</p>	<p>Formative: Discuss challenges related to teaching, learning and assessing clinical reasoning skills.</p> <p>Summative: Narrative writing (reflection essay about challenges using the OPT model).</p>

			four aspects Noticing, Interpreting, Responding and Reflecting. [Tanner, 2006]	
Profession-specific theories: Dialectical clinical reasoning in physiotherapy (PT)	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain characteristics of dialectical clinical reasoning in PT and clinical reasoning focused on behavior change. 	<ul style="list-style-type: none"> Learners will be able to explain PT's intentions behind the clinical reasoning process 	<ul style="list-style-type: none"> Learners will be able to elaborate on what influences PT's clinical reasoning in terms of <ul style="list-style-type: none"> Various PT perspectives guiding clinical reasoning The client's wishes Contextual factors
	Specific teaching content	Dialectical clinical reasoning and the Clinical Reasoning Model Focused on Client's Behavior Change in Physiotherapy (CRBC-PT) [Edwards 2004; Elvén 2015] Applying the models in cases.	Relating aspects of dialectical reasoning and the CRBC-PT model to a clinical scenario.	Proximal and distal influencing factors on PT clinical reasoning
	Teaching & Learning activities	Flipped classroom activities following literature reading. Exploring dialectical reasoning and the CRBC-PT model in online seminars by using cases representing different medical disciplines, health-problems and life-style-related behaviors.	Application of clinical reasoning on virtual patients including a rehab phase followed by a follow-up seminar (online or physical) including peer feedback.	For PT:s: Application of clinical reasoning with patients in clinical practice followed by a follow-up seminar
	Assessment (formative/s	Formative written essay on characteristics on dialectical clinical	Formative verbal assessment of a case and summative written reflection	Formative assessment in which the learner reflects in writing on own clinical

	ummative)	reasoning and the CRBC-PT model.	essay.	reasoning with a patient taking PT perspectives into account followed by a face-to face seminar in which the learners reflect with PT peers and supervisors.
Profession -specific theories: Theories of activity and clinical reasoning in occupa- tional therapy (OT)	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain characteristics of occupational therapists' clinical reasoning. 	<ul style="list-style-type: none"> Learners will be able to explain OT's intentions behind the clinical reasoning process. 	<ul style="list-style-type: none"> Learners will be able to elaborate on what influences OT's clinical reasoning in terms of: <ul style="list-style-type: none"> Various OT perspectives guiding CR The client's wishes Contextual factors
	Specific teaching content	<p>Leading theories of <i>activity</i> in different contexts</p> <p>Historical perspectives on clinical reasoning in OT [Gillette 1987, Chapparo 2008]</p> <p>Applying the models in cases.</p>	Relating aspects of an OTmode of clinical reasoning to a clinical scenario	Proximal and distal influencing factors on OT clinical reasoning
	Teaching & Learning activities	Flipped classroom activities following literature reading. Exploring different OT clinical reasoning models in online seminars by using cases.	Application of clinical reasoning on virtual patients including a rehab phase followed by a follow-up seminar (online or physical) including peer feedback.	For OT:s: Application of clinical reasoning with patients in clinical practice followed by a follow-up seminar
	Assessment (formative/s ummative)	Formative written essay on characteristics on clinical reasoning characteristics and its various	Formative verbal assessment of a case and written reflection essay.	Formative assessment in which the learner reflects in writing on own clinical reasoning with a patient taking OT

		historical developments in relation to OT core values.		perspectives into account followed by a face-to face seminar in which the learners reflect with OT peers and supervisors.
Theory into practice	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to describe the different theories with examples (illness scripts, dual processing, OPT) 	<ul style="list-style-type: none"> Learners will be able to provide examples of the different theories including theories of other professions. Learners will be able to produce examples of how clinical reasoning is and is not applied to their current place of work and learning environment 	<ul style="list-style-type: none"> Learners will be able to support students in reflecting on clinical reasoning theories Learners will be able to support students in applying clinical reasoning in clinical situations
	Specific teaching content	How clinical reasoning theories can be used/applied during bedside teaching, internships or other patient-centered situations and what theories hold as being important for the student to learn	How clinical reasoning theories can be used/applied during bedside teaching, internships or other patient-centered situations (more complex than basic level)	Supporting novices in applying theories in their learning situations with patients / on the ward
	Teaching & learning activities	Group discussion about how theories can be applied in simple cases, using virtual or simulated patients as the starting point for the discussion of clinical implications.	Group discussions about how theories can be applied in more complex and interprofessional cases and in discussion with patients.	Role plays with students, teachers and patients with the main focus on the teacher role and how students can be supported in applying clinical reasoning models. Creation of job aids to support both themselves and others in bridging the theory and practical use of clinical reasoning in teaching settings

	Assessment (formative/summative)	Formative: Adding to the clinical reasoning e-portfolio experiences made with the theories within and outside the teaching environment. Summative: Presenting an example in a seminar at the end of the term.	Formative: Assessment of the clinical reasoning practices on the ward using the theories and terminology learned and summarizing these experiences in the clinical reasoning e-portfolio.	At the end of the teaching contents 1 - 5, learners will be asked to add a piece of their choice related to theories of clinical reasoning to their teaching portfolio and present it. For example, reflections on a discussion, developed teaching material, student support they provided, job aids they developed, situations they encountered and would like to change/improve, or reflections on models applied in teaching and clinical contexts.
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Table 5: Curricular outline for the category "Theories of clinical reasoning"

Curricular outline for the category "Errors in the clinical reasoning process and strategies to avoid them"

		Novice	Intermediate	Advanced
	The student will have an understanding of how cognitive biases, system issues and emotions can influence the clinical reasoning.			
Knowledge of cognitive biases and system errors	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to give examples for cognitive errors (*) Learners will be able to acknowledge that inadequate knowledge or knowledge organization is a significant cause of cognitive error 	<ul style="list-style-type: none"> Learners will be able to explain typical system errors 	<ul style="list-style-type: none"> Learners will be able to realize the interplay between different forms of cognitive and system errors.

	Teaching & learning activities	<p>Presentation of cases provoking typical cognitive errors to recognize the existence of cognitive biases.</p> <p><u>Implicit Association Tests (IAT)</u> to learn about and discuss own hidden biases and prejudices.</p>	Construct in a group a fishbone diagram for medical errors	“Patient panels or videotaped testimonials that lead to discussing the reasons and effect of diagnostic errors” [O’Connor19]
	Assessment (formative and/or summative)	Narrative writing (reflection essays) as part of the clinical reasoning e-portfolio	Demonstration in discussion (e.g. with mentor) awareness of frequently encountered system errors.	Discuss complex interplay between cognitive and system errors.
The student will have an understanding of the benefits of an open climate that allows sharing of reasoning errors for promoting continuous learning and patient safety.				
Analysis of errors	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain methods how to systematically structure own thinking 	<ul style="list-style-type: none"> Learners will be able to detect erroneous patterns in clinical cases 	Learners will be able to value and take advantage of a psychologically safe environment to discuss errors.
	Teaching & learning activities	<u>Cognitive autopsy (*)</u>	<u>Detect flawed clinical patterns in patient cases</u>	Morbidity and mortality conferences
	Assessment (formative and/or summative)	Teacher feedback based on cognitive autopsy	Comparison with expert feedback of detected errors	Practices thinking through shared diagnostic or recounting a past personal error.
The student will be able to overcome common challenges and errors during the clinical reasoning process.				
Avoiding errors	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to explain methods of how to structure the reasoning 	<ul style="list-style-type: none"> Learners will be able to describe situations when errors may arise (e.g. handoffs, time pressure, 	<ul style="list-style-type: none"> Learners will be able to acknowledge that improvement of clinical reasoning is a lifelong task for

		process and strengthen illness scripts using analytic methods (e.g. by construction of concept maps)	fatigue, emotions)	experts and knowledge of methods how to do it despite limited time, opportunities to connect with colleagues and extrinsic rewards.
	Teaching & learning activities	Practices reduced reliance on memory by using mnemonics, checklists or other decision support / monitoring aids (pre-clinical) <u>Structured reflection</u> in a virtual patient case	Practices reduced reliance on memory in clinical settings. VP scenarios with added time pressure and triggering emotions	Mental engagement in a fraction of cases a day (critical cognitive challenge of decisions made or deliberated follow-up of patients) [Trowbridge 2015]
	Assessment (formative and/or summative)	Feedback generated by the virtual patient system	<u>Mini-CEX</u> (Work-based assessment) (*)	Follow-up of patients for which decisions were made by/in presence of the learner.
	Related evaluation questions (from D5.1)	<ul style="list-style-type: none"> I am capable of recognizing typical reasoning errors and to identify situations when they can occur. (6 - very much to 1 - not at all) [Harendza 2017] 		
The student will be able to explain the occurrence of uncertainty in the clinical reasoning				
Uncertainty	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to recognize uncertainty and the imperfect science of diagnosis (*). Learners will be able to to select tests, interpret test results (Bayes reasoning, sensitivity, specificity, positive 	<ul style="list-style-type: none"> Learners will be able to communicate about and manage uncertainty in clinical practice. 	<ul style="list-style-type: none"> Learners will be able to offer insights into the effect of uncertainty on patients (e.g. patients whose diagnoses remained elusive for an extended time are invited to discuss the effect of uncertainty on their quality of life) [O'Connor 2019]

		predictive value, etc)		
	Teaching & learning activities	Discussion of patient cases showing how incoming information about test results and patient information changes uncertainty. Discussion around solving situational judgement tests.	Present authentic cases in with unreliable data (e.g. the information presented by the patient turns out to be false, some common lab tests turned out to be misleading) or when a definitive diagnosis is not identified	Participates in panel discussion with experts from many practice settings presenting their experiences with uncertainty.
	Assessment (formative and/or summative)	Questions in written tests (e.g. MCQ) which require estimation of post-test probabilities or selection of the best diagnostic methods to reduce uncertainty Script Concordance Tests (SCT)	Role-play discussion with SPs on next steps when a clear diagnosis is missing	Mentor/Peer feedback
	Related evaluation questions (from D5.1)	<ul style="list-style-type: none"> • I lack confidence when making clinical judgments (strongly disagree; disagree; undecided; agree; strongly agree) [Alfayoumi 2019] • Regarding the outcome of proposed interventions, I try to keep an open mind. [Seif 2014] • I can function with uncertainty. [Seif 2014] 		

Table 6: Curricular outline for the category "Errors in the clinical reasoning process and strategies to avoid them"; (*) - means that activity could be repeated in several levels of the curriculum; Underlined terms are explained in table 3; (->) DID-ACT learning objectives

Curricular outline for the category "Aspects of patient participation"

Table 7 outlines curricular components for Shared decision making, which is one aspect of patient participation. Other topics not included in the table are the patient role and perspective in clinical reasoning, patient-centered care, and the integration of a patient-centered approach in clinical reasoning.

		Novice	Intermediate	Advanced	Teacher
The student will be able to involve and support the patient in a shared decision-making process about the treatment/management plan.					
Shared Decision Making (SDM) in clinical reasoning	Specific Learning outcomes	<ul style="list-style-type: none"> Learners will be able to describe models of SDM and apply these in a fictive case to make a treatment/management plan. 	<ul style="list-style-type: none"> Learners will be able to apply a model of SDM in a patient encounter and explain how the treatment/management plan has been developed through a SDM process. 	<ul style="list-style-type: none"> Learners will be able to independently involve and support the patient in a shared decision-making process about the treatment/management plan. 	<ul style="list-style-type: none"> Learners will be able to provide feedback to students on their skills in performing a SDM-process about the treatment/management plan.
	Teaching & learning activities	<p>Theory and central elements in SDM (online lectures)</p> <p>Examples of models of SDM (online lectures): The Dynamic model for SDM, the Clinical Reasoning model Focused on Clients' Behavioral Change and the 3-stage SDM process.</p> <p>Role-plays where the student practices to use a SDM model.</p>	<p>Presentation of tools and techniques that support SDM such as teach-back, MI and decision aids</p> <p>Workshop where students practice using decision coaching skills.</p> <p>More Role-plays where the student practices to use a SDM model.</p> <p>Application of SDM in patient encounters in clinical practice</p> <p>[Moore 2018]</p>	<p>Authentic practice experiences with feedback from the patient, family members and supervisors. Use e.g. The 9-item Shared Decision Making Questionnaire (SDM-Q-9)</p> <p>[Kriston 2010]</p>	<p>Presentation of key-features in SDM in clinical reasoning.</p> <p>Practice of identifying features of SDM in clinical reasoning by observing patient encounters and using an observation protocol.</p>

		[Costanzo 2019, [Elvén 2015, Legare 2018, Moore 2018, van de Pol 2016]			
	Assessment methods (formative and/or summative)	Written examination based on a case-scenario in which a SDM model should be applied.	Narrative writing (reflection essays) OSCE	OSCE Work-place based assessments e.g. direct observations of a patient encounter. Use e.g. The Shared Decision Making Questionnaire – physician version (SDM-Q-Doc) [Scholl 2012]	Observation and feedback to students on their skills in performing a SDM-process about the treatment/management plan.

Table 7: Curricular outline for the aspect of Shared decision making as part of the patient participation category.

5. Conclusions

The presented framework forms the basis for the next steps in the curriculum development process, which we will implement in WP3 and 4. As the framework was developed by a multiprofessional and international team, it reflects the needs of the different health profession curricula and also the needs of different curricula formats of the partner schools. This is of great importance for the development of a curriculum that will be applicable and adaptable to different health profession curricula across Europe.

The development of this framework required repeated and discussions between the different health professions and international partners. While developing the framework, we have noticed that the identified themes intersect in many and learning objectives (e.g. error prevention, patient-involvement, interprofessionalism) and share similarities in the use of specific learning tools (e.g. virtual patients) and assessment methods (e.g. e-portfolio, OSCE). This has a synergistic effect and enables addressing several themes in integrated learning units. Such synergistic effects will be analyzed in more detail while designing the curriculum and the train-the-trainer course in WP3 and 4 to maximize productivity of the learning experiences.

The current COVID-19 pandemic did not allow us to organize an originally planned face-to-face meeting to discuss the framework. However, we were able to organize the work in small groups across professions and contexts who worked asynchronously and met online according to their needs. In addition, we held a series of online meetings to discuss specific aspects and make decisions in consensus.

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