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

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D1.1 (b) Report on specific needs, preoccupations of stakeholders, and barriers: interviews

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Table of contents

Introduction

The aim of the specific needs analysis was to gain detailed knowledge on the specific needs and barriers for explicit, structured teaching and assessment of clinical reasoning (CR). The specific needs of multiple stakeholder groups were investigated. By including different stakeholders we wanted to ensure that different perspectives are represented and that the curriculum can be adopted by different schools. The needs analysis described in the following was built on the results of the general needs analysis that was conducted by the consortium prior to this project.

Quality criteria

- Interview guideline for implementation and analysis provided
- Survey and interview questions reviewed and agreed upon by all partners
- Diverse range of participants (faculty, students, educators,...) for the interviews and survey
- Conduction of as many interviews as necessary for clear understanding of current practices and barriers.
- >= 35 interview participants

Methods

In addition to the survey, the DID-ACT consortium conducted interviews with faculty and students in order to identify needs and barriers for teaching and assessing clinical reasoning in healthcare education. To obtain results that could easily be compared and integrated with the survey results, the interview questions were constructed analogously to the surveys. The final interview guides for both stakeholder groups were structured as displayed in Fig. 1.

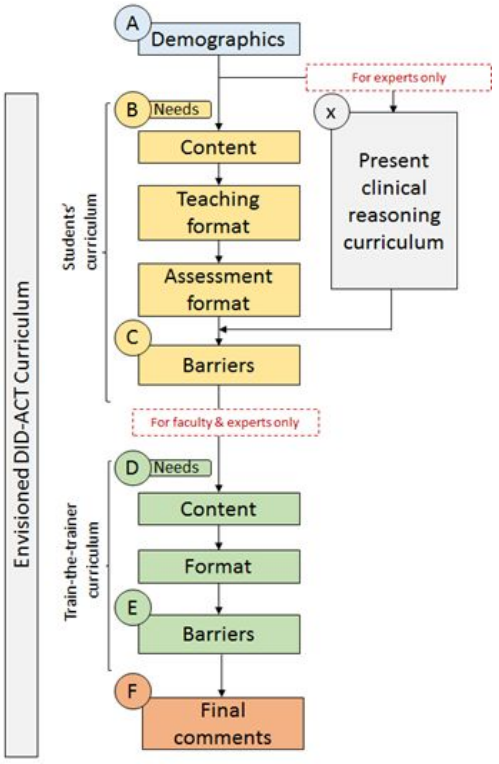

Figure 1. Structure of the DID-ACT Specific Needs Assessment interview guide

The sections contained questions about:

- Section A: the background, affiliation and clinical reasoning experience of survey participants. In total: 5 questions;
- Sections B, C: needs for an envisioned longitudinal clinical reasoning for students. This included needs regarding content and teaching / assessment format (part B, 7 question) and perceived barriers of implementing the students' curriculum (part C, 2 questions);
- Section x: included questions as in section B but regarding the current status of the implemented clinical reasoning curriculum at the respondents' institution (6 questions) and not just the needs expressed for the envisioned curriculum;
- Sections D, E: envisioned train-the-trainer course. This comprised of content and teaching format (part D, 5 questions) and perceived barriers for implementing the train-the-trainer course (part E, 3 questions);
- Section F contained one final open-ended question with general comments regarding all aspects of the questionnaire.

Detailed interview guides with instructions were prepared to ensure that the interviews were conducted in a comparable manner at all locations. The interviews were audio-recorded to help with the analysis and for documentation reasons. All participants gave their informed consent prior to the interview. Most of the interviews were conducted via online meeting platforms such as Zoom or Skype because of the restrictions due to the Corona pandemic that began soon after data collection had started.

Because of the different languages, all consortium partners analyzed the interviews conducted at their location and provided the results in English for an overarching qualitative (content) analysis. In this overarching analysis, common themes related to the respective questions were identified and are described in the following sections.

Results

A total of 41 interviews with faculty and students was conducted. The following table shows the number of interviews per stakeholder group and partner institution that were included in the following analyses. The interviews were mainly conducted with members from partner and associate partner institutions. However, in a few cases, also stakeholders from other institutions were interviewed.

Institution	**Faculty**	**Students**	**Total**
EDU	1	6	7
INSTRUCT	3	--	3
ORU	9	--	9
UAU	5	2	7
UBERN	3	1	4
UJ	5	1	6
UM	2	3	5
Total	**28**	**13**	**41**

Table 1: Overview of conducted interviews

1. Needs

- How should clinical reasoning be taught?
- From which year on should CR be taught?
- How should clinical reasoning be assessed?
- What are incentives for the train-the-trainer?

1.1 Needs for the student curriculum

In the following chapters, the results of the interview analysis of the specific needs analysis of faculty and students are summarized. The open-ended questions from the web-survey did not add any new information to the survey results and are therefore not mentioned. In the text, example comments from the interviews are presented to illustrate the results.

1.1.1 Contents of the clinical reasoning curriculum

Faculty

The desired contents of a clinical reasoning curriculum according to faculty are shown in the table below. For each category it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	Frequency	Subcategories
Aspects of patient participation in clinical reasoning	f	Culture Patient communication Shared decision making
Collaborative aspects of clinical reasoning	f	Communication of risks Communication skills Hierarchical collaboration System-based decisions
Developing a treatment/management plan	f	Nursing plan
Errors in the clinical reasoning process and strategies to avoid them	f	Identify risks
Gathering, interpreting, and synthesizing patient information	f	--
Interprofessional aspects of clinical reasoning	f	Communication Communication & change of perspectives Conflicts & shared goal Interprofessional collaboration Learning from each other Professional identity Respect
Self-reflection on clinical reasoning performance and strategies for future improvement	f	Balance between self-reflection and objective reflection Reflection of clinical practice Self-reflection after other activities
Theories of clinical reasoning	f	Definition of clinical reasoning Illness Scripts Narrative reasoning Probabilities Theoretical knowledge (what are hypotheses etc.) Type 1 and type 2 thinking
Developing a problem formulation/hypothesis	m	--
Differences regarding clinical reasoning between professions	m	--
Ethical aspects	m	--
Generating differential diagnoses including defining and discriminating features	m	--

Meaning of factual knowledge for clinical reasoning	m	Application of factual knowledge
Order of teaching the contents / what content should be taught in which year of study	m	--
Strategies to learn clinical reasoning	m	Heuristics Metacognition
Systematic approach to clinical reasoning	m	--
Unclear situations / ambiguity	m	--
All aspects important / cannot be seen in isolation	r	--
Ambulatory context	r	--
Basic/ simple procedures must first be mastered	r	Emergency procedures Step-by-step approach
Case-reflections	r	--
Clinical reasoning also needed in prevention / information of healthy people	r	--
Clinical reasoning & communication together	r	--
Clinical reasoning not important in teaching	r	--
Dealing with information sources	r	Guidelines
Define levels of needed competence	r	--
Developing a diagnostic plan	r	--
Importance of argumentation and reasoning	r	--
Metacognitive decision making	r	--
Need for good concept of interprofessional teaching	r	--
Quality/evaluation of clinical reasoning	r	--

Table 2: Content for a clinical reasoning curriculum (faculty)

Students

The desired contents of a clinical reasoning curriculum according to the students are shown in the table below. For each category it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	**Frequency**	**Subcategories**
Collaborative aspects of clinical reasoning	f	--
Developing a diagnostic plan	f	--
Developing a treatment/management plan	f	Forward planning

Gathering, interpreting, and synthesizing patient information	f	--
Generating differential diagnoses including defining and discriminating features	f	Guidelines
Interprofessional aspects of clinical reasoning	f	--
Self-reflection on clinical reasoning performance and strategies for future improvement	f	--
Aspects of patient participation in clinical reasoning	m	--
Developing a problem formulation/hypothesis	m	--
Errors in the clinical reasoning process and strategies to avoid them	m	Communication Error management Feedback culture
Strategies to learn clinical reasoning	m	--
Theories of clinical reasoning	m	--
Economic aspects	r	--
Necessary steps	r	--
Situational thinking	r	--

Table 3: Content for a clinical reasoning curriculum (students)

1.1.2 How clinical reasoning should be taught

Faculty

According to the interview participants, clinical reasoning should be taught using the following formats. For each category in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	**Frequency**	**Subcategories**
Case-based learning	f	Practical and social experiences
Clinical setting	f	Block internships Clinical work Elective study year Internships Interprofessional bedside teaching
Lectures	f	Enriched by video examples, stories, metaphors
Simulations	f	High fidelity simulation (mannequins) Human simulated patients Interprofessional simulations Simulation of first working day Virtual reality
Virtual patients (interactive online cases)	f	--

All / combinations of formats can be used	m	--
Blended learning	m	Combinations of team-based learning and virtual patients Spiral blended learning curriculum & simulation (general)
Problem based learning	m	--
Team-based learning (TBL)	m	Interprofessional TBL
Peer-teaching	r	--
Self-study	r	--
Small groups	r	--
Video examples	r	--

Table 4: Teaching format of clinical reasoning (faculty)

The results for the question how clinical reasoning should be taught show that there is not one best format to teach all aspects of clinical reasoning, but that ideally multiple formats are used to teach different aspects of clinical reasoning, which should be predefined (which method to use for which aspect of clinical reasoning). Some comments also point to a blended learning approach, e.g. combining face-to-face sessions with Virtual Patients.

Case-based learning, simulations, Virtual Patients, lectures, and clinical settings have been mentioned most often as formats that should be used to teach clinical reasoning.

- *"It would be good to have multiple cases over a longer period of time based on concrete patient cases in different settings which not only cover prototypical cases but also non-typical scenarios, not rare cases but non standard course of diseases where you have to think more about it."*
- *"A basic lecture would be part of it for me. One could use video examples here to show how it [CR] works, and teach the theories of this process."*
- *"Initially, it [clinical reasoning] can be trained for example with VPs, however later it is important to train it in a clinical setting."*

Lectures have been described to be useful to provide the students with the basic knowledge they need for clinical reasoning and could be enriched with videos and self-study. The actual reasoning process can be trained with cases while Virtual Patients or other (different types of) simulations provide a safe environment for the students to gather experience with clinical reasoning.

Also problem-based learning and team-based learning are suitable formats for teaching clinical reasoning as they foster reflection and critical thinking. Team based learning has been mentioned as a useful format for teaching of interprofessional aspects. Finally, clinical reasoning teaching should also be taught in clinical practice.

- *"Team-based learning in the classical way (big room and all together) can help if it is not stereotypic in the decisions that should be made. I could also imagine this with the different professions but it needs to be very well structured and prepared."*

- *“Direct every-day experiences are always the most educational ones. I also think it would be possible to integrate it [clinical reasoning] here (...)”*

Also sequencing aspects have been named, meaning e.g. first lectures, other basic knowledge input or self study, then Virtual Patients or other simulations for practicing in a safe environment, then teaching of clinical reasoning in clinical practice.

- *"Each of these methods has its place in a certain order. Because each of them reaches a slightly different goal. And it's hard to say which one is less and which one is more important, because it's about arranging them in such a sequence that each of them fulfils its role."*
- *“For different topics I would organize a kick-off then let the students in a self-directed way and then come together to clarify questions before going into simulated situations with standardized patients and video-taping with a follow-up discussion. From there they can go into real situations with patients.."*

Students

In the following, desired teaching formats according to the students are shown. For each category in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	**Frequency**	**Subcategories**
Case-based Learning	f	--
Problem Based Learning (PBL)	f	--
Team-based Learning	f	--
High fidelity simulation (mannequins)	m	--
Human simulated patients	m	--
Lectures	m	Flipped classroom Interprofessional lectures
Small groups	m	Interprofessional groups Peer-teaching Role-Play in small groups Seminars
Virtual Patients	m	--
Importance of Feedback/Formative assessment	r	--
Interprofessional settings	r	--

Table 5: Teaching format of clinical reasoning (students)

The students can imagine several formats to work well for the teaching of clinical reasoning, such as team-based learning, problem-based learning, case-based learning, or Virtual Patients. Similar to faculty, also sequencing aspects have been mentioned, e.g. first practising clinical reasoning with Virtual Patients and then with real patients.

- *"I think this [team-based learning] is most effective, because together you can make the best decisions [...] and include all competencies"*
- *“I consider it [case-based learning] suitable for teaching CR. CR is not necessarily about knowledge, but about complex thought processes. These are most likely to be anchored if you can link them to current cases.”*
- *“Perfect for a start [Virtual Patients]. No harm can be done to patients and wrong decisions can be corrected. Very large selection of possible patients and cases. Must later be converted into real patients. In real life other factors like emotions and fatigue play a huge role.”*
- *“I find problem-based learning a good format that is already implemented at our institution. You get an outlook how to think about differential diagnosis”*

More critically seen are high fidelity simulations and also human simulated patients (SP). When the SPs are not well-trained, this kind of simulation is not as useful, while high fidelity simulations are seen as more useful for practical skills training.

- *“Could be used for clinical reasoning [High fidelity simulations], but it might not be so process-oriented. Clinical reasoning might not be so much in the foreground, but rather the processing of an algorithm.”*
- *“They [Human simulated patients] must be well trained. Then it works very well. The question is whether you can reach a certain complexity. I don't know if it's much better than reviewing cases with real patients.”*

Many students see classical lectures as a less suitable format for the teaching of clinical reasoning, as they can mainly be used for factual knowledge and there is often not much interaction.

- *“I think the use of lectures is very limited. Only knowledge transfer, learning facts, no interaction.”*
- *“Not useful. Because it [lectures] is a format for the entire auditorium and learning clinical reasoning is a very individual process.”*

1.1.3 In which study year clinical reasoning instruction should begin

Faculty

The majority of the participants believe that clinical reasoning should be taught from the first study year on. Also where it is currently explicitly taught, in the majority of cases, the teaching of clinical reasoning starts in year 1.

Students

Also the majority of the students advocate to start teaching clinical reasoning in the first year of medical study.

1.1.4 How clinical reasoning should be assessed

Faculty

According to the interview participants, clinical reasoning should be assessed using the following formats. For each category in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	Frequency	Subcategories
Assessment using Virtual Patients	m	--
Clinical examinations	m	OSCE
General Aspects	m	Formative assessment Grades/summative assessment Objective assessment
Oral examination	m	--
Workplace-based assessments	m	--
Written test	m	(electronic) MCQ Key feature cases Script concordance test Situational judgement test Video examples
All / combinations of formats should be used	r	--
Assessment of group work	r	--
E-Portfolio	r	--
Patient care (under supervision)	r	Longitudinal patient care
Progress Test	r	--
Written case reflection	r	--

Table 6: Assessment format of clinical reasoning (faculty)

The results to the question how clinical reasoning should be assessed show that there is not one best format to assess all aspects of clinical reasoning, but that several formats can be used depending on what aspect of clinical reasoning is to be assessed.

To assess the clinical reasoning *process*, the students should be given an opportunity to explain why they arrive at a certain diagnosis or conclusion e.g. in a clinical or oral exam.

- *"Any type of oral examination is suitable because if a student does not explain enough you can always ask for explanations. The learning objectives can be on factual knowledge but you can also assess clinical reasoning."*

To evaluate the students' performance, clear criteria have to be established beforehand so that clinical reasoning can be objectively assessed.

- *"The ideal scenario would be a discussion with an expert, but clear evaluation criteria have to be defined beforehand."*

To assess more the outcome of clinical reasoning (but not the clinical reasoning process itself), written tests like Multiple Choice Questions or Key Feature cases (see for example Bordage & Page, 2018) could be used according to the interview participants.

- *"In the beginning such aspects could also be assessed as part of MC tests, especially in electronic MC assessment there are suitable formats, such as the situational judgement test or key features and also video examples can be included."*

Formative assessment is also seen as important, because feedback is helpful for the learning process of the students; however this could be also classified as teaching format (rather than assessment format).

- *"What we would need is much more formative assessment with direct feedback if something goes in a certain way."*

Further, virtual patients and workplace-based assessments have been named as assessment formats.

- *"Assessment with the use of virtual patients is a thing that could be quite cool in the future, because it gives the opportunity to conduct a relatively standardised assessment of students using relatively small workforces and resources for this."*
- *"I can well imagine a scenario in which after examining the patient by medical students at the clinic, the assistant asks the question: so what do you think, what's wrong with the patient? And this is also some kind of assessment of whether they are coping with or not."*

Written case reflections as a homework assignment, where students present a case and explain their reasoning, have also been mentioned.

Students

The desired assessment formats for clinical reasoning are described below. For each category in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	**Frequency**	**Subcategories**
Oral examination	f	Case-based oral examination
Assessment using virtual patients	m	--
Clinical examination	m	OSCE
Feedback as important component of assessment	m	--

Workplace-based assessments	m	--
Written test	m	Key feature approach MCQ
All methods can be useful	r	--
Case-based assessment	r	--
Simulation-based (interprofessional) assessment	r	--
Video questions	r	--

Table 7: Assessment format of clinical reasoning (students)

The students most often commented on oral examinations and assessment using Virtual Patients. However, the most positive overall evaluation from the students received workplace-based assessments, mainly because it is the most realistic format.

- *"This (workplace-based assessments) is the closest to reality and the best way to assess."*

The students find written tests not very useful for the assessment of clinical reasoning. Clinical examinations are seen as more useful, but many students associate them with clinical skills and not clinical reasoning.

- *"No. Not useful. I don't think you can assess such a complex topic with MC questions."*
- *"Unsuitable. It is not factual knowledge that can be queried. Here it is about thought structures that have to be queried and MC questions are not very suitable to represent their own thought structure. I do not know Script Concordance Test."*
- *"In the current OSCE format, it is not ideally assessed whether someone is good at clinical reasoning. OSCEs are more about clinical skills and less about clinical reasoning."*

The opinions on oral examinations are rather divided. Some students find them suitable for clinical reasoning, others question their objectivity.

- *"Better than written assessments. The examiner might differ in objectivity. Dialogue with the student possible.Still not the ideal format as the CR process should be dealt with by the student on his own and not by answering CR related questions of the examiner."*
- *"With examiner training, this can certainly work. There is a danger that factual knowledge will be tested again. Structured oral examination."*

Overall, the importance of feedback has repeatedly been mentioned as an important component of assessment.

1.2 Needs for the train-the-trainer course

Do you think the DID-ACT train-the-trainer course is necessary for healthcare educators at your institution?

Yes	20	*"it is not only a couple of powerpoint bullets, it is attitude and a change of approach within a hierarchical setting"* *"Because everyone has different knowledge and thinking about clinical reasoning"*
Maybe	2	*"I do not consider it realistic to train the management staff of the clinics"* *"Maybe, but medicine cannot be the only perspective"*
No	0	

Table 8: Necessity of a train-the-trainer course for clinical reasoning

An experienced faculty development person mentioned several times the challenge of providing a course about the "skill" clinical reasoning, since usually train-the-trainer courses do not cover skills or topics, but general methods, like problem-based learning or bedside teaching:

- *"If you have a separate course for clinical reasoning and there are other courses for bedside teaching or online teaching you have to carefully plan what should be included in such a course."*

How much time (e.g. days/hours) would you be willing to spend on a train-the-trainer course?

Most answers favored a **few days spreaded over a longer period of time**, others mentioned that it depends on the purpose and the local situation and that such a course should be part of the local faculty development program. There were also suggestions to offer different course versions for more and less experienced educators and also depending on their teaching obligations.

- *"A shorter or extended version for very interested educators might be an option."*
- *"I mean, it depends on the purpose, right?"*
- *"realistically a 2-year program and from time to time refresher courses"*

What should the DID-ACT train-the-trainer course on clinical reasoning cover?
In your opinion, what is the <u>best</u> format for the DID-ACT train the trainer course?

The following model has been developed based on the responses to these two questions to represent the categories and themes identified in the interviews.

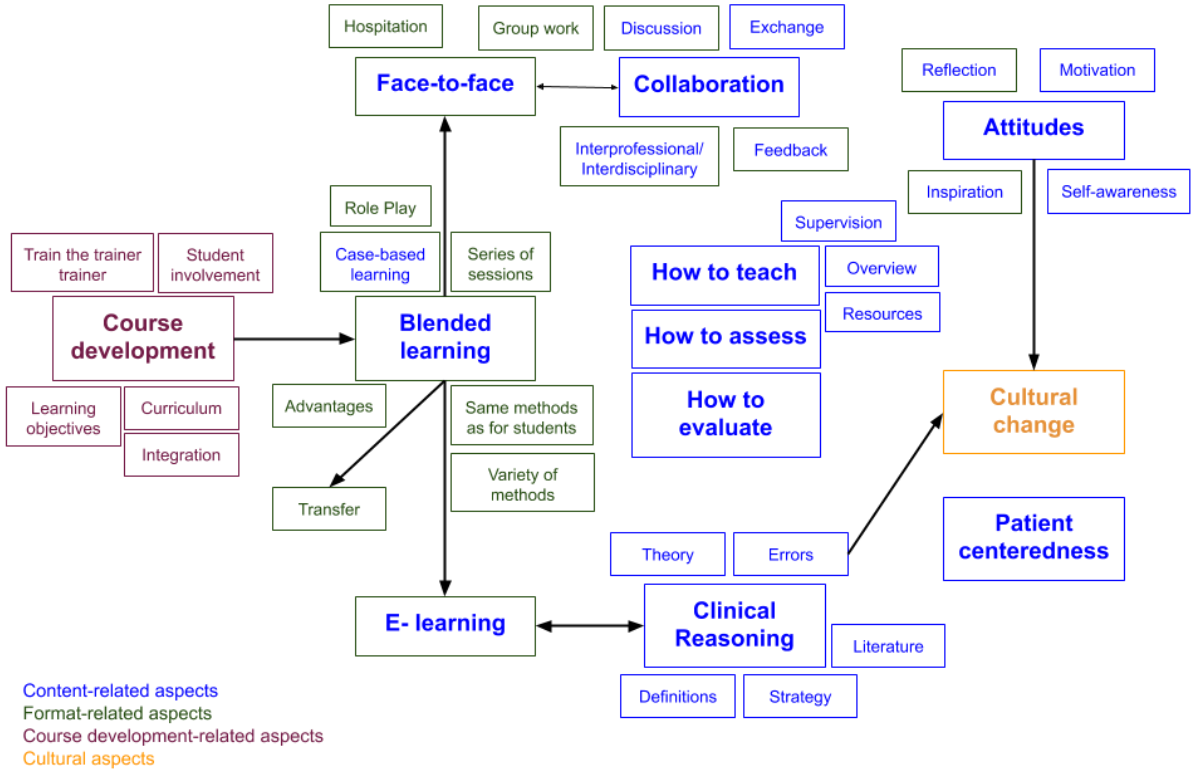

Figure 2: Identified categories (in bold) and themes from the interviews grouped according to the categories they belong to.

There is an overlap of four main area participants covered:

- content-related (blue)
- format-related (green)
- aspects related to course development (red)
- culture (yellow)

Aspects related to **Course development** were mentioned by more experienced faculty development participants. They emphasized the need to train the trainer how to teach the faculty course and also suggested involving students in developing the train-the-trainer course. Other important aspects were to define learning objectives as part of a curricular outline and integrate the course into the local faculty development program.

- *"If you teach the trainer you need a curriculum with the specific learning objectives."*
- *"Invite and discuss train-the-trainer program with students - They are smart and often know what is missing"*

Blended learning was the main format participants considered as suitable for a train-the-trainer course and they also thought educators should learn in the course how to implement it themselves. They emphasized the advantages of the online and face-to-face

phases and mostly recommended offering a series of sessions over a longer period of time. Only two specific teaching methods have been mentioned - case-based learning for teaching and assessment and role plays for simulating teaching situations with students. Additionally, participants suggested to use a variety of methods and, importantly, to use the same teaching methods for the train-the-trainer course as for the student curriculum on clinical reasoning.
In addition to the online and face-to-face teaching sessions, hospitations and transfer sessions were recommended.

- *"First literature (theories and studies regarding clinical reasoning…) then face-to-face. The course should start with reading the same literature/studies. It is important to have some sort of common starting point."*
- *"I would let them experience the same process as students."*
- *"[...] for example the presentation in the class, such a case based learning."*
- *"A training on digital learning, e-learning, because this provides many opportunities, and also eases many aspects."*

Collaboration clearly evolved from the interviews related to content but also format - participants mentioned the face-to-face teaching sessions of the blended learning approach, such as group work as suitable to enable collaboration in form of discussion, exchange of experiences, and feedback. They emphasized the need to have courses with interprofessional and interdisciplinary participants, but also cover differences and similarities among professions as course content.

- *"What clinical reasoning should embrace and to share your experience.To discuss the differences and similarities in various occupations."*
- *"Learning together with other disciplines is an added value, being able to exchange ideas."*

Teaching, assessment, & evaluation methods were mentioned as important content to cover in a train-the-trainer course. This includes providing an overview about available methods and resources and also techniques to supervise and support students.

- *"The supervisors - how the supervisors can convey what they have in themselves regarding clinical reasoning"*
- *"The second thing I would add is as a part of this, to ensure that everyone knows what tools are available"*

Clinical reasoning including theories, strategies, available literature, cognitive errors, and definitions was mainly seen as teaching content for the online learning phases in which educators could study the material on their own. Especially for teaching and discussing errors related to clinical reasoning participants saw a need for a **cultural change** in institutions.

- *"No error culture at all is present."*

The need for a cultural change is also related to the category **Attitudes**. Participants mentioned that aspects like inspiration and motivation to explicitly teach clinical reasoning,

reflection, and self-awareness among educators should be raised by a train-the-trainer course. By increasing the number of motivated and engaged educators a cultural change can be achieved.

- *"Important to reflect individually and thereafter in a group"*
- *"Raise their self-awareness for clinical reasoning"*

Finally, the need for more **patient-centeredness** was raised, but not further elaborated.

- *"How to enhance patient participation"*

The number of terms mentioned by the participants are reflected in the following word cloud

Figure 3: Word cloud of interview responses

2. Barriers & preoccupations

In this section we present themes identified when asking open-ended questions regarding barriers to introducing a longitudinal clinical reasoning curriculum both in the interviews and web-survey. The question asked were:

- What, in your opinion, are the main barriers/challenges for introducing such a longitudinal curriculum on clinical reasoning at your institution?
- What critical aspects/barriers/challenges do you see in implementing the DID-ACT train-the-trainer course at your institution?

We used as the initial coding frame for the qualitative analysis the list of response items in barrier questions from the web survey reported in D1.1a.

Using this coding frame we coded the transcriptions of interviews in local languages (project partners did it in their native languages) and translated the coded segments. Using this strategy we identified 86 segments for the students curriculum (cSTU) and 51 segments for the train-the-trainer course (cTTT). As the category "Other" was used quite frequently, we decided to modify the coding frame in a team of three researchers to better fit the results of the interviews. In addition, as we saw many similar patterns when it came to the barriers for the students and train-the-trainer courses, we decided to merge the coding frames into one schema. The newly developed coding frame consisted of 9 main categories including in total 24 subcategories (table 2.1). Another round of coding the segment by the group of 3 researchers led to acceptable agreement with discrepancies solved by consensus. The relative frequency of segments in the cSTU and cTTT curricula are presented as separate columns in table 2.1. The list of categories and subcategories is ordered by frequency of occurrence.

2.1 Barriers identified in interviews

For each category in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Table 2.1. Major thematic categories of barriers in the new coding frame

Category	**F_{cSTU}**	**F_{cTTT}**	**Subcategories**
Culture-related	f	f	Communication issues Lack of collaboration clinical vs academic community Lack of culture of reflection Lack of error culture & feedback culture Non-invented here syndrome Resistance to change Strong hierarchy Social inertia Others
Teaching process	f	f	Lack of awareness it can be taught / learned Lack of guidance how to teach Lack of qualified faculty Lack of standards Perception it cannot be taught Others
Time-related	f	f	Faculty as learners Faculty as teachers Lack of time in the curriculum Others
Motivation/support	m	f	Financial Higher clinical priorities Political/Top-Down Others
Content-related	f	m	Lack of awareness of clinical reasoning Lack of agreement what clinical reasoning is

			Lack of agreement between professions what clinical reasoning is
No challenges	m	r	
Assessment process	r	r	Lack of good assessment methods
Logistics	r	r	Lack of technical infrastructure, lack of rooms or difficulties in coordination when many involved
Other	none		

Table 9: Barriers; F_{cSTU} - Frequency of comments regarding barriers to introducing students' curriculum; F_{cTTT} - Frequency of comments regarding barriers to introducing train-the-trainer course; Frequency categories: frequently (f), moderately (m) or rarely (r).

2.2 Barriers described in open-ended questions in the web survey

We have received just a handful of open-ended responses (n=6) in web-survey and they did not introduce new, significant themes or citations to the discussion on the barriers.

2.3 Summary of identified barriers

The two most information-rich categories explaining barriers encountered in introduction of clinical reasoning teaching were culture- and teaching process-related.

In the **culture** category we grouped utterances describing different forms of resistance to change. Staff members are often satisfied with the current status of teaching and unwilling to put extra effort in introducing new methods with outcomes that are in their opinion uncertain. There is a strong avoidance of reflection based on error. Clinical teachers are unwilling to pause their actions to share their way of thinking because they believe it is ineffective, may show limitations in their way of thinking or simply are not used to doing it because it was not done as they were students. There were voiced concerns that content developed in other contexts might not be applicable or were regarded not good enough to be included in the local curriculum.

- *"(...) we could come to the conclusion that everything we've done so far, and what we've achieved, can be questioned, right? And that's why I think there's so much, so much resistance(...)*
- *"They think that it [reflection] takes too much time. It is difficult to convince superiors and colleagues that it is worthwhile to invest 15 mins/day to think because it will save time many hours later on. [...] And they do not have the time for that [being taught about thinking] [...] Those teaching reflection on the ward to the students have to be given time to do that and be freed from their clinical duties."*
- *"If the curriculum is too general, if the plan isn't coherent with the Swedish context.Team [skills practice] could be difficult to practice in Universities that lack for example physicians. International differences"*

The **teaching process** related barriers were divided into subcategories which formed a spectrum of mindsets ranging from complete rejection of the idea clinical reasoning can be taught or ignorance of availability of such methods, through concerns of missing parts in for the teaching process as adequate learning objectives in educational standards or guidance

on concrete aspect of teaching clinical reasoning, up until clear acceptance of the teaching methodology around clinical reasoning but inability of finding enough people to implement those methods in practice.

- *“And he [senior doctor] has residents who present cases to him and they are all over the place. He doesn’t understand why they have not organized their presentations, organized the way they examine, spoken to interview and examine the patient, using heuristics, so the scripts that he has. And he has been doing it for 40 years! So it is very, you know he can make assumptions and say, you know, this is not the way to do it. But he does not know that it is not something… it is something you have to learn.”*
- *“We need guidelines, recommendations for CR: the recommendations would enhance our understanding. So what are the standards of clinical history taking, what are the guidelines of teaching clinical skills. And how do we measure the outcomes: is this something that will help us to diagnose heart murmurs earlier? This is probably part of the DID-ACT project to unify and create a consensus of the evidence how to conduct CR teaching”*
- *"Who can teach clinical reasoning and is experienced enough to develop such a trainer curriculum?"*

Another frequently encountered category of concers regarded **time-related** barriers. These can be divided into problems related to business of clinical staff more focused on hospital duties than teaching; no time for activities related to personal development in teaching skills and finally a full-packed students' curriculum.

- *"There is always the problem, how many hours for classes can a teaching assistant devote and get out of work, right?"*
- *“Challenge to implement changes in such a short time…”*
- *“Battle for time in teaching; Once people realize that they may lose time for other things, it may be difficult. If something new is added, something else may no longer be possible.”*

There were also opinions that a barrier form lack of adequate **motivation** to implement changes. The missed incentives included financial compensation or acknowledgment for extra effort, lack of support from the top (including team leaders, deans, accreditation bodies or health ministry) and pressures to prioritise higher clinical care.

- *"I see a challenge in the lack of resources. .. You need money for administrative staff (organization) for the tutorial for the trainer training.”*
- *“Nothing can be changed without the dean of study affairs.”*
- *"Where will such a clinical reasoning course be attached to, if such a course is led by someone non-medical it will not be taken seriously but if it is led by one of the department heads it might just because of this not be accepted by other departments or department heads. This is a political issue.”*

Content-related issues were reported mainly regarding students’ curriculum and revolved around the fact that there is still lack of awareness and disagreement about what clinical reasoning is.

- *“most educators think that main thing is knowledge”*
- *“Important to make CR more concrete. It is complex and important to continue working with it.”*
- *“Some people don't perceive [clinical reasoning] as a separate subject, but just like something you*

teach like that and it is not difficult after all"

Other barriers were mentioned just sporadically and included lack of awareness of adequate clinical reasoning **assessment** methods and non-critical problems with **logistics** (as lack of room or technical infrastructure).

- *"The challenge is that it's a skill that you can never learn enough. Student frustration because of this. Hard to find any frame of reference since there is no actual knowledge."*
- *"You need an infrastructure to show the importance of the topic."*

3. Current situation (at partner institutions)

3.1 How clinical reasoning is taught

Faculty

Currently, clinical reasoning is most often taught using the following formats. For each format in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	Frequency	Subcategories
Bedside-teaching	f	Cognitive task analysis Internships Teaching ward rounds
Case-based learning	f	Active guided learning Based on and compare with student experiences Brainstorming Clinical case discussion
Lectures	f	--
Problem-based learning	f	--
Virtual Patients (interactive online cases)	f	Formative and self-assessment Writing a case
Clinical work	m	Elective study year
High fidelity simulation (mannequins)	m	Emergency training
Human simulated patients	m	Role play
Seminars	m	--
Blended learning	r	--
Clinical skills training	r	--
Depends on teacher	r	--
Interprofessional teaching	r	--
Learning by role models	r	--

Other simulations	r	--
Peer consulting	r	--
Small groups	r	--
Spiral curriculum	r	--
Team-based learning	r	--

Table 10: Current teaching of clinical reasoning (faculty)

Students

Only a few students answered this question. The following teaching formats were mentioned. For each format in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	**Frequency**	**Subcategories**
Problem-based learning	m	--
Case-based learning	r	--
Clinical skills training	r	--
High fidelity simulation (mannequins)	r	--
Human simulated patients	r	--
Lectures	r	--

Table 11: Current teaching of clinical reasoning (students)

3.2 Study year in which the teaching of clinical reasonings starts

In the majority of the reported cases, the teaching of clinical reasoning starts in the first year of study.

3.3 How clinical reasoning is assessed

Faculty

Currently, clinical reasoning is most often assessed with the following formats. For each format in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	Frequency	Subcategories
Clinical examinations	f	During rounds OSCE
Oral examinations	f	--
Workplace-based assessments	f	Patient care
Written tests	f	MCQ-single best answer questions
Assessment using Virtual Patients	m	--
Case examples	r	--
No assessment of clinical reasoning	r	--
Self-assessment	r	--

Table 12: How clinical reasoning should be taught (faculty)

Some people further stated that there is currently no explicit assessment of clinical reasoning at their institution.

Students

Only very few students talked about current assessment formats for clinical reasoning. The following two formats were mentioned. For each format in the following table it is indicated whether it has been mentioned frequently (f, ≥ 8 mentions), moderately (m, 3-7 mentions) or rarely (r, 1-2 mentions). The categories and subcategories are presented in alphabetical order within a frequency range.

Category	Frequency	Subcategories
Clinical examinations	r	OSCE
Workplace-based assessments	r	--

Table 13: How clinical reasoning should be taught (students)

3.4 Constructive alignment of teaching and assessment

The participants (faculty) were asked whether there is constructive alignment of teaching and assessment in their current curricula (16 comments in total):

- In 6 comments, constructive alignment was reported
- In 5 comments, no constructive alignment was reported
- In 5 comments, it was not clear from the answers if constructive alignment is present or not

3.5 Train-the-trainer course

Do you have a train-the-trainer course on clinical reasoning at your institution?

Yes	0
No	18

None of the respondents indicated that they have a course on clinical reasoning for their faculty and educators.

4. Summary of the interviews and survey questions

Regarding the desired **contents** of the DID-ACT students curriculum, there is some agreement between the interview and survey results. A difference exists between interprofessional aspects and aspects of patient participation in clinical reasoning, which were rated higher in the interviews than in the surveys. On the other hand, generating a differential diagnosis, developing a problem formulation and a diagnostic plan were rated higher in the survey.

Concerning ideal **teaching formats** for clinical reasoning, there is high agreement between the results from the interviews and the survey regarding which teaching formats are the most suitable for clinical reasoning, with case-based learning and simulations being the most favored ones. Lectures on the other hand are seen as less useful. Problem-based learning and Team-based learning were more frequently chosen in the survey and student interviews than in the interviews with faculty/teachers.

Also regarding ideal **assessment formats** for clinical reasoning, there is wide agreement between the interviews and the surveys. Clinical examinations and oral examinations are seen as the most useful formats to assess clinical reasoning. Written tests were rated more favorable in the interviews, for certain aspects of clinical reasoning at least.

Concerning the **train-the-trainer course,** the preferred format in the survey and interviews was blended learning. The content such a course should cover was also similar in the

interviews and the survey. However, the interview participants provided additional content the course should include such as aspects related to interprofessionality or providing opportunities for communication and collaboration. From the interviews we also gained a better understanding about the course structure, which should cover the more theoretical aspects (such as theories of clinical reasoning) in an online course and make use of the face-to-face sessions to foster collaboration and discussion.

Existing **barriers** were identified quite frequently in the section we identified as *cultural issues* within interviews, but these do not explicitly show up as survey questions, so it is hard to compare. Even though we agreed that cultural barriers are also part of some of the survey questions, the cultural barriers had such an important role in the interviews, that these issues stand out and are a very important additional outcome of the interviews and have to be discussed carefully.

5. Literature review of clinical reasoning frameworks and course concepts

Educating for development of clinical reasoning (CR) involves many aspects of teaching methods, assessment and patient experiences. A multi-professional and multi-cultural group within DID-ACT initiated a literature review aiming to provide a basis for developing a clinical reasoning curriculum for health professions students. Thirty-five full-texts have been analysed from a search yielding knowledge of aspects and ways to integrate them into health professions curricula. A summary of the analysis is presented here.

Clinical reasoning is at the core of any health professions practice. It is about applying knowledge, skills, and experience to a patient situation in a timely fashion. Because it is a multi-faceted competence, definitions vary from a very broad perspective of encompassing "… *the sum of the thinking and decision-making processes associated with clinical practice*" (Higgs & Jones, 2008), to descriptions of what e.g. a physicians do in patient encounters: "*… data gathering, interpreting, and synthesising information as well as generating hypotheses and diagnoses, developing management plans, avoiding cognitive errors and ensuring patient safety* (Goldszmidt, Minda, & Bordage, 2013).

Clinical reasoning (CR) has been integrated for a long time in rehabilitation oriented professions such as occupational therapy and physiotherapy (Gillette & Mattingly, 1987). In these professions, a longitudinal interaction with the patient is emphasized. The diagnostic aspects of clinical reasoning dominate in the medical oriented literature (e.g. R. Pinnock & Welch, 2014). In recent years, Clinical reasoning has also been used to explain nursing practice, focusing on the analytic process which guides the nurse to therapeutic actions, and helps determine patient care (Holder AG, 2018). Consequently, there are differences between professions in how clinical reasoning is viewed, but has a common core which is central for future professionals.

Despite clinical reasoning (CR) being a core competence, authors and surveys state that it is scarcely taught or assessed explicitly (Dowding et al., 2012; Harendza, Krenz, Klinge, Wendt, & Janneck, 2017; Homberg, Oberhauser, & Kaap-Frohlich, 2019; Kelekar & Afonso, 2020; Kononowicz et al. 2020; Kuiper, 2013; R. Pinnock & Welch, 2014; Rencic, Trowbridge, Fagan, Szauter, & Durning, 2017). An exception seems to be physiotherapy in which most programme directors state that they teach CR more outspokenly (Christensen et al., 2017). There are educational challenges with CR which is "… *notoriously difficult for students to grasp and teachers to nurture."* (Charlin et al., 2012), also illustrated by Pinnock et al.: *"It is central to our clinical practice, yet it remains an enigma and continues to present a challenge to teachers and learners"* (R. Pinnock & Welch, 2014) and, as Rencic et al. add*: "clinical reasoning ability is often "caught" by learners as opposed to being explicitly "taught" to them"* (Rencic et al., 2017).

Different thinking strategies are at play in clinical reasoning development which can largely be dichotomized into analytic and non-analytic (or system1 & 2) thinking. A general view is that students need to train both kinds in their education (Charlin et al., 2012; Marcum, 2012). Moreover, recent development has turned both thinking processes into "dual process thinking" (Nafea & Dennick, 2018; Ruedinger, Olson, Yee, Borman-Shoap, & Olson, 2017). A clinical reasoning teaching strategy needs to involve activities in which students critically observe and reflect on their own thinking, and develop meta-cognitive and self-regulated learning abilities (Dalton, Gee, & Levett-Jones, 2015; Elven, Hochwalder, Dean, & Soderlund, 2019; Kuiper, 2013; Stickley, 2018).

The overarching curricular strategy has implications for clinical reasoning in which the problem-based curriculum integrates reasoning strategies within all core activities whereas organ-/system-based curricula need stand-alone activities to apply knowledge in integrated cases (R. Pinnock & Welch, 2014; Rochmawati & Wiechula, 2010). However, regardless of the overarching curricular strategy, clinical cases stand at the core of clinical reasoning teaching, addressing both analytic and non-analytic reasoning strategies. There are many variations to how cases are used to engage students in . Problem-based learning, scenarios, case vignettes (Iyer, Goss, Browder, Paccione, & Arnsten, 2019), case seminars (Orban et al., 2017), and Virtual Patients (Khin-Htun & Kushairi, 2019; Posel, McGee, & Fleiszer, 2015) are some examples. With digital technology advances, artificial intelligence (AI) becomes integrated in clinical decisions, which means finding new ways to integrate AI into reasoning processes is needed. Pinnock et al. (2020) present ways to incorporate AI into a clinical reasoning curriculum.

Several authors stress the importance of a longitudinal progress of clinical reasoning development throughout the curriculum (Homberg et al., 2019; Kuiper, 2013; Ruedinger et al., 2017). The bridging activities form a bridge between academic and clinical areas which requires collaboration between teaching staff from both fields in order to coach students (Dowding et al., 2012).

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