Virtual patient design and creation for clinical reasoning using CASUS

Course manual

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Summary

This is a train-the-trainer course manual for medical educators to learn how to design and create high-quality virtual patients on the CASUS platform to teach clinical reasoning to undergraduate medical students. The approximately-30-hour course spans several synchronous and asynchronous sessions across four weeks and contains elements of character design, storytelling, didactical and multimedia aspects, as well as technical guidance into using the CASUS platform.

Introduction

Doing clinical reasoning is hard. Teaching clinical reasoning is even harder! Clinical reasoning is a complex process of gathering information about key signs and symptoms from a patient and applying cognition and discipline-specific knowledge to reach a final diagnosis after considering several potential differential diagnoses and weighing out all the alternatives and their significance and importance for the patient at hand. Some of the tasks used in clinical reasoning by healthcare providers include "data gathering and interpretation, synthesizing information, generating hypotheses and diagnoses, developing management plans that respect the patients' perspectives, and avoiding cognitive errors" (Fąferek et al., 2023; Sudacka et al., 2021; Young et al., 2018).

Clinical reasoning has been traditionally taught in medical schools starting on the second or third year of undergraduate studies, right after learning the basics of pre-clinical sciences. Students learn how to perform a physical exam and what signs should be present in a healthy human being. Then, students slowly start seeing real-life patients and learning from their professors, instructors, and from the patients themselves, what to identify at the history taking or physical exam in a patient with a given disease. Later on, in their medical undergraduate studies, students learn about complementary tests that can help rule in or rule out some diagnoses from a wide selection of differential diagnoses.

Following the definition by the American Association of Medical Colleges, a virtual patient (VP) is "a type of computer software that simulates real-life clinical scenarios, in which the learner emulates the role of health care provider to obtain the history, conduct examination, and make diagnoses and management decisions" (Association of American Medical Colleges (AAMC), 2007; Kononowicz et al., 2010; von Zadow et al., 2013). There are several advantages to use VPs in addition to real-life patients when teaching clinical reasoning. Learning with VPs could be more efficient, would allow to have an accelerated view of how diseases change over time, are interactive and allow the use of multimedia elements that enhance realism, allow to check for additional literary sources and scientific references, allow some time to reflect on decision-making, and allow making mistakes in a safe environment. Many of these advantages make VPs attractive for teaching and learning not only clinical reasoning, but also communication skills, efficient resource utilization, acquisition of medical technical knowledge, clinical skills, and teamwork skills.

There are different types of VPs built on different platforms that serve different purposes (Kononowicz et al., 2015). First, we have the web-based interactive scenarios which present simulated VPs in a static but interactive webpage format useful for teaching and evaluating clinical reasoning and medical knowledge. The VP story evolves over a set of webpages and each page can contain different elements such as text, dialogues, hyperlinks, multimedia material (images, audio, video), and a section for system-evaluated questions. One of these platforms is CASUS (lmu.casus.net) which, in addition to the aforementioned elements, also contains a concept map section where users can document relevant findings, ordered tests or examinations, proposed differential diagnoses and treatment options. At some critical point throughout the VP story, the user will be prompted into deciding on a final diagnosis from among the list of considered differentials. The system then evaluates the degree of accuracy in selecting the correct final diagnosis. There are other VPs designed in other platforms for other purposes such as virtual worlds which are suitable for teamwork and clinical reasoning skills, high-fidelity software simulations with the use of haptic devices that make them useful to learn and practice clinical skills and medical procedures, and virtual standardized patients that are useful for developing

communication skills. The course presented in this document will focus on web-based interactive scenarios for clinical reasoning using the CASUS platform.

There is a vast body of literature done on the efficiency and efficacy of VPs in comparison to other case-based learning activities, in addition or replacement of other learning activities such as seminars or lectures, or comparing different types of VPs or platforms where VPs are developed (Edelbring et al., 2011; Ellaway et al., 2015; Fischer et al., 2008; Huwendiek et al., 2013; Menendez et al., 2015; Nascimento et al., 2021; Posel et al., 2012; Stevens et al., 2006; Tworek et al., 2010; Zary et al., 2009). However, a common complaint from medical educators is that there is a scarcity of resources to learn how to create virtual patients (Posel et al., 2012). VP authors are usually clinicians who might already have years of experience in teaching clinical reasoning in the traditional way, but when faced with the challenge of creating a virtual patient, they may lack didactical and technological deficiencies in converting that traditional format into a virtual patient format. Therefore, the main aim of this document is to provide a general guide for teachers, instructors and professors interested in learning or improving their skills on how to create high-quality virtual patients in the CASUS platform for medical students in their training years to learn and practice their clinical reasoning skills. The specific learning objectives of the course described in this document are as follows:

At the end of this course, participants will be able to

- Identify and adapt metacognition techniques to deconstruct the process of clinical reasoning
- Adapt clinical reasoning processes from clinical practice to the teaching environment
- Design a storyboard to be used in case creation
- Create a virtual patient using CASUS (final product)
- Follow didactical guidelines in the creation of cases
- Learn about platforms that offer multimedia resources (clinical images etc.)
- Make the most of the CASUS platform to convey medical knowledge and actively teach clinical reasoning
- Identify CC creative common licenses and choose among them depending on the need at hand

This course manual is based on all the materials and processes developed within the iCoViP project (2020-2023). The name iCoViP stands for “International Collection of Virtual Patients” and is a consortium of six institutions in five European countries: Germany, France, Poland, Portugal and Spain. The project’s website (www.icovip.eu) contains further relevant material that may complement this course. The main objective of the iCoViP project was to develop a collection of 200 virtual patients fitting a wide range of key symptoms, final diagnoses, and sociodemographics akin to those of the European patient population. Each VP was developed and reviewed in English and later translated into each of the official languages in the five participating countries: German, French, Polish, Portuguese and Spanish. Therefore, the full collection actually contains 1200 VPs.

This course manual is structured in the following way. Each “chapter” refers to a specific session, to be carried out on the specified day: Friday afternoon or Saturday morning. The course can be compressed or extended to fit the group’s schedule, but Friday afternoon and Saturday morning over the course of several weeks seems to be the best timeslot for clinicians to be able to assist the course and complete it. Each session starts with a “Materials needed” section, then goes into the core of what activities will

be carried out within each session, and finalizes with a “Closing” section where a recap of the current session and a sneak preview of the next is provided. Within the core of each session there may be different types of activities: Most of them are presentations to transfer knowledge to participants, but some are hands-on session to actively work on a skill or concept. Additionally, there are planned asynchronous sessions in between weeks where participants can apply the acquired knowledge and learned tools in building their own VP. In the last session, participants are expected to present their already created VP. The end product of this course is, thus, one created VP per participant.

Week 1, Friday afternoon

The first session will include welcoming the participants, going through the course overview, understanding participants' and facilitators' expectations, and agreeing on a code of conduct.

Materials needed

- Slides with the required information to convey
- A digital whiteboard or similar to record participants' and facilitators' (including tutors) expectations (optional)

Welcome

In this section, the facilitators and tutors welcome participants and we recommend doing a round of quick introductions for everybody present: Name, relevant background, role in the course (for course organizers, facilitators and tutors), motivation to join the course, and what does each person expect from the course.

Course overview

In this section, one of the facilitators should present all the relevant information of the course using slides. This information includes but may not be limited to:

Duration

Approximately 30 hours of work.

Modality

Synchronous and asynchronous: synchronous virtual sessions for knowledge transfer along with asynchronous time for independent work. Synchronous sessions are to be carried out on Friday afternoons and Saturday mornings and the independent work includes independent reading, reviewing of material, and independent work on specific parts of the VP.

Structure of the course

The course is designed to be taught in eight sessions of approximately 3 hours each session over the course of four weeks. Asynchronous work will be accomplished in between synchronous sessions. We recommend to offer the course on Friday afternoons and Saturday mornings as these are the times where most clinicians might be available. The structure of the course can be adapted to the facilitators and learner's capabilities and schedules, but should roughly look like this:

	Week 1	Asynchronous	Week 2	Asynchronous
Friday afternoon	Welcome, course expectations Course overview Code of conduct	VP design character sheet	VP design discussion and feedback Introduction to CASUS Doing a VP on CASUS Didactical guidelines	Storyboard for your VP
Saturday morning	Clinical reasoning session Contextual factors		Crash course storytelling Storyboard creation	
	Week 3	**Asynchronous**	**Week 4**	
Friday afternoon	First steps in CASUS Where to find images? Multimedia in CASUS Concept maps	Finish the VP Finish VP checklist	Individual feedback on the VP What to do with my VP once it's created?	
Saturday morning	Build VP draft on CASUS with assistance Fill out VP checklist		Final VP presentation Course feedback	

Table 1. Suggested course structure

Target group

Teachers, instructors and professors interested in learning or improving their skills on how to create high-quality virtual patients in CASUS for medical students in their training years to learn and practice their clinical reasoning skills.

Participant group size

We recommend a group size of 2 to 10 participants, depending on the number of tutors available. We recommend no more than three participants per tutor. During this first session, tutors should already be assigned to students. The method of assignment is left open to course facilitators and/or everybody present in the session.

Required background for facilitators and tutors

- Physician or clinician with practical experience in clinical reasoning
- Language level minimum B2 in English or equivalent
- Experience in designing and/or reviewing VPs for clinical reasoning
- (optional) Experience in using VPs for teaching clinical reasoning
- Being motivated to teach and communicate knowledge
- For facilitators: Relevant presentation and time management skills
- For tutors: Relevant interpersonal skills and attention to details

Required background for participants

- Physician or clinician with practical experience in clinical reasoning
- Language level minimum B2 in English or equivalent

- Technical requirements: A computer equipped with a web camera and a microphone, stable Internet access, an Internet browser compatible with CASUS, Microsoft PowerPoint or equivalent
- Other materials: pen and paper as needed, a printer (optional)

Cost

This course will be offered for free to enrolled participants through the EUGLOH channels.

Course certificate

At the end of the course, participants who successfully complete all requirements will receive a course certificate.

Platforms and materials

- For synchronous virtual sessions: Zoom, Webex or similar, depending on the local capacities.
- For storyboarding: Twine and/or Pen and paper.
- For VP creation: CASUS.

Didactical resources and techniques

- Hands-on activities
- Group activities
- Independent work
- Personalized guidance from tutors

Course code of conduct

The success of this course, as well as of any human activity or endeavor, heavily relies on a set of team or group values defined aligned with the personal values of each participant as much as possible and agreed upon by all participants at the beginning of the course. You, as a participant, are responsible for reading, knowing about, accepting and abiding to this code of conduct, as well as to any other internal rules developed within your own course cohort. We recommend the following set of rules to be honored during the whole course duration:

Time management

Time is our most valuable resource. On this manual, we provide estimated times for many activities and sessions. This estimated time can be changed as needed as the course is given. However, we ask all participants and facilitators to agree on a schedule beforehand and to stick to the time management as much as possible. This includes starting each session on time and trying to do each activity within the allocated time for it. Further, you are responsible for and commit to completing all synchronous and asynchronous activities to the best of your capabilities.

Interaction with other peers and facilitators

Only by respecting each other's experiences and listening to each other will we be able to reach an understanding and truly learn from each other. To accomplish this, please consider the following:

When to talk and when to remain silent

This course is designed to be as interactive as possible. Facilitators are free to decide whether they would like to receive questions and comments during their presentations or at the end. Participants are asked to stick to these requests. We ask all participants to please remain silent when peers are talking and avoid interruptions.

Be respectful to others

Moreover, you will be respectful to other participants' opinions and will not insult others or dismiss them in a rude manner. We welcome constructive and positive feedback during the course, as well as a productive discussion of conflicting ideas. You will not criticize others' ideas or incur in personal attacks. We will not tolerate the use of words or sharing content that is offensive, including but not limited to sexist, racist, homophobic, transphobic, anti-Semitic, Islamophobic, sexually explicit or abusive language. We will not tolerate harassment of any kind including verbal or physical during the course.

Online etiquette

Online teaching has many challenges, including that physical distance hinders proper human connection. Although not mandatory, we encourage participants to turn on their webcam as much as possible. We also ask participants to remain on mute while not talking. Further, we ask all participants and facilitators to avoid distractions as much as possible during the course. Avoid checking e-mail, social media or your mobile phone during the course. If you absolutely need to take a call or similar, please excuse yourself, turn your webcam off, and check that you're on mute.

Plagiarism

Plagiarism, also called literary theft, is defined as „The purloining or wrongful appropriation of another's ideas, writings, artistic designs, etc., and giving these forth as one's own; specifically, the offense of taking passages from another's compositions, and publishing them, either word for word or in substance, as one's own" (Morris, 1969). Plagiarism will not be tolerated in this course. Please make

sure that you compose all texts using your own words. Whenever you need to use somebody else's words, please give proper attribution and cite the original sources in the References section of the VP. If you incur in plagiarism, you will receive a warning for the first offense, and you will be expelled from the course on your second offense.

Course certificate requirements

Course certificates will only be given once all minimum requirements have been met. Participants will not receive certificates for unjustified partial completion of the course.

If you witness any course participant, tutor or facilitator violating any of these rules, please contact the course organizers. Course organizers have the collective responsibility to evaluate each report on a case-by-case basis, to emit a ruling and enforce any reached decisions, and to protect the reporter's confidentiality throughout the whole process.

However, rules work best when they're not necessarily imposed upon, but when they grow organically from the agreement among group participants. Therefore, if time allows it, participants can be given the chance to come up with their own set of rules by doing the following activity:

Hands-on activity: Participants define their own code of conduct

Full duration: Around 60 minutes.

Depending on the number of participants, the group should be split using breakout rooms or similar so that no more than 5 people work together at the time. Groups are given the opportunity to come up with and define their own rules regarding aspects such as: punctuality, time management, when to talk and when to remain silent, coffee break frequency and duration, level of participation in the course, tasks and assignments, how to interact with others, what kinds of language and behavior should be followed and what kinds will not be allowed, etc.

Participants will be given enough time to work on these topics depending on the number of aspects to discuss and the time availability. We recommend a range between 15 and 25 minutes. Each group should also designate a presenter or spokesperson. Afterwards, each group presents their preferred rules and all groups negotiate among them and with the course facilitators and tutors to come to an agreement on the final set of rules to be followed throughout the whole duration of the course. We recommend again between 15 and 25 minutes for the final agreement. These rules should be documented and sent by email or similar by a designated person as quick as possible (ideally on the same day of such session).

Closing

The first session closes with a quick recap of the topics discussed and a sneak preview of the next session, which will be about an introduction to designing VPs, clinical reasoning and VP contextual factors.

Week 1, Saturday morning

This session will be all about an introduction to designing VPs, clinical reasoning and VP contextual factors.

Materials needed

- Slides to convey the necessary materials
- VP character sheet for VP Joaquim Guerra (see below)
- Blank copies of VP character sheets for participants (via email or in the course materials)

Designing a VP

What is a Virtual Patient (VP)?

The current literature contains several definitions of virtual patients (VP) and they tend to be fuzzy and unspecific. For the purposes of this course, we will use the definition provided by the American Association of Medical Colleges (2007) that describes virtual patients as "a type of computer software that simulates real-life clinical scenarios, in which the learner emulates the role of health care provider to obtain the history, conduct examination, and make diagnoses and management decisions" (Association of American Medical Colleges (AAMC), 2007).

In other words, in this course we will create a software simulation of a patient that comes to the learner with a specific key symptom in a given healthcare setting. The learner will then obtain information from the simulation about the virtual patient and will gather and document this information as well as request specific examinations in order to reach a clinical diagnosis for the patient. After that, the learner might also have the opportunity to make management decisions. The simulation software will provide automatic feedback at specific points throughout the case. Some VPs are branched meaning that the decisions of the learner affect the course of the patient's story but in this course we will focus on linear VPs, which means that no matter what the learner's clinical decisions are, the fate of the VP will continue following only one path in the story predefined by the VP author.

Deconstructing clinical reasoning

This course assumes that the participants are all clinicians, trained to identify key signs and symptoms in real-life patients and, with the aid of complementary exams, reach a clinical diagnosis. This process usually happens at variable rates depending on the expertise of the clinician. Further, there are several cognitive processes at play during clinical reasoning. Many of these processes happen at once, overlapping e.g. considering a set of differential diagnosis and ruling in or out some of them based on newly obtained data from the patient during the patient anamnesis, while at the same time already anticipating managing options for the preferred differentials, all before even reaching a final diagnosis. This process is very messy and still not well understood.

In order to teach clinical reasoning, it is advisable to deconstruct all these processes into linear and easily digestible phases so that students can focus on one part of the process at the time. After learning clinical reasoning in a deconstructed way, and as they gain more experience in clinical reasoning, the process will become automatic with several phases overlapping. Therefore, the first step when designing a VP is to deconstruct and understand the process of clinical reasoning as best as possible so that we can then convey this information in a didactical way.

When trying to deconstruct the process of clinical reasoning, we can illustrate it in a linear way that goes from receiving a patient that comes with a key symptom, and ending in reaching a final diagnosis and deciding on management options (Figure 1).

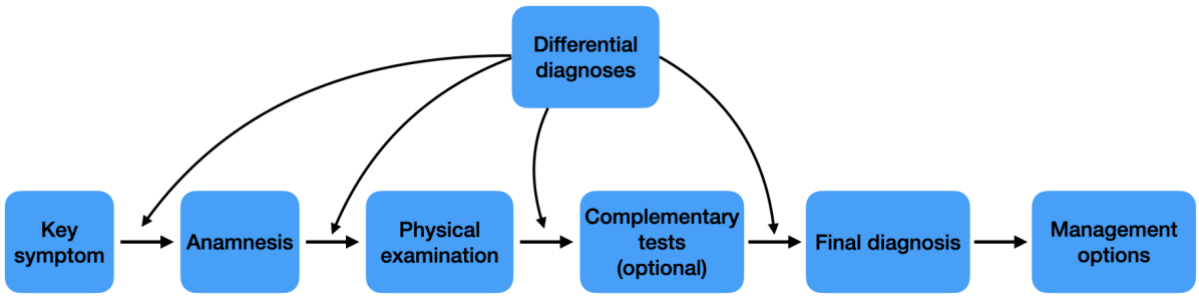

Fig 1. Schematic clinical reasoning process

From this non-exhaustive graphical representation of the clinical reasoning process we can conclude several things:

1. Each phase should be well characterized and easily distinguishable from the others.
2. Each phase has a place in the clinical reasoning process, and this order should not be altered, except in specific situations (see below). This means, for example, that treatment and management options should not be introduced before reaching and revealing a final diagnosis to the learner, even if there's already a high suspicion of what the final diagnosis and management options will be.
3. The process of thinking about and considering differential diagnoses can happen at any time, but preferably in the moments in-between each of the other phases.
4. Each phase should focus on one main objective at the time:
    a. The main objective of the key symptom phase is to receive a patient that comes with one and only one key symptom and to kick-start the clinical reasoning process. The learner can then elaborate the first set of differentials based on the key symptom.
    b. In the history taking phase, the clinician, and thus the learner, should ask all relevant questions to rule in our out the already considered differentials. Additionally, more symptoms will be discovered from the conversation, growing the list of relevant symptoms.
    c. Next, the learner should perform an oriented physical exam in order to reveal critical semiological signs that will further help ruling in or out the current list of differentials. At this point, depending on the complexity of the final diagnosis, the learner might be able to already reach a clinical diagnosis.
    d. If not, complementary exams can and should be requested until a final diagnosis is reached and revealed to the learner.
    e. After all of this, management options can be introduced and the VP story comes to an end.

As stated before, there are some specific situations where this order can be altered, namely: in emergency settings situations, if there's the need to run therapeutic tests, if the story demands calling for specialized assessment, or depending on the natural history of disease, where the diagnosis might change through time. However, we advise that these cases be considered only in exceptional situations and preferably by experienced VP designers and creators.

VP Learning objectives

Each VP might have specific learning objectives depending on the key symptom, final diagnosis, year of the medical curriculum in which the VP will be used, etc. However, they all follow more or less the same general learning objectives in clinical reasoning:

- Analyze, interpret and prioritize key clinical findings
- Identify and prioritize the most likely diagnoses based on the information provided
- Suggest an appropriate treatment, therapeutic and prophylactic procedures
- Compose a concise summary statement about the patient

Note that all these learning objectives focus on the clinical reasoning process and not on the acquisition of medical knowledge. Medical knowledge should be acquired in traditional forms of medical education (books, scientific papers, lectures, seminars, etc.). **Virtual patients are an opportunity to apply the already learned medical knowledge in a simulated setting**. Some questions about medical knowledge can be asked but they should complement the clinical reasoning process and be adapted to the specific VP at hand.

How to start?

After understanding and deconstructing the process of clinical reasoning, we can start designing our VP. This can be challenging for clinicians because, in real life, we play an active role and only "receive" patients that already come with their own background, signs, symptoms, and environmental factors. Conversely, when designing a VP, the VP author needs to play an active role in imagining and deciding on all the relevant contextual factors that surround a simulated VP. In other words, we need to create our own characters, embedding them with realistic personalities, environments, a voice, doubts, wants and needs. All these contextual factors will not only add realism to the simulation, but should also help in the process of clinical reasoning, by providing the learner with key pieces of data that will aid reach a final diagnosis.

There is no standard set of contextual factors that should be considered when designing a VP. For the purposes of this course, we will work with the set of contextual factors developed within the iCoViP project, namely:

- disease group,
- final diagnosis,
- key symptom,
- differential diagnosis,
- onset,
- age,
- sex,
- profession,
- ethnicity,
- country of origin,
- country of living,
- relevant migration background,
- addiction or substance abuse,
- allergies,
- personal medical history,

- sexual orientation,
- scenario end,
- encounter setting,
- learner's role,
- VP name,
- personality,
- complementary characters and
- family medical history.

In the next section, each of these contextual factors will be presented using a VP that was already created and is part of the iCoViP VP collection: Joaquim Guerra.

Summary: Mr. Joaquim Guerra is a 70-year-old man that comes to a local outpatient clinic in Portugal with low back pain. There is no history of recent trauma.

VP Contextual factors

- **Disease group**: Start by thinking about in which type of disease you would like to frame your virtual patient. Does this patient suffer from a cardiac disease? Or is it more an infectious disease? Options include (but are not limited to): infectious, congenital, traumatic, immunologic, neoplastic, metabolic, toxic, vascular. In our example, *Mr. Guerra's disease belongs to the orthopedics/trauma disease group.*
- **Final diagnosis**: Then, choose your VP's final diagnosis. Be as specific as possible but at the level of an undergraduate student. *Mr. Guerra's final diagnosis is disc herniation.*
- **Key symptom**: Choose one key symptom with which your VP will come to seek for medical assistance. Although many diagnoses may have several key symptoms, didactically it is better to choose and stick to only one key symptom. You will be able to include additional information about other signs and symptoms during VP development. *Mr. Guerra's key symptom is low back pain.*
- **Differential diagnoses**: Think about at least 3 other diagnosis that may be part of the differentials for your final diagnosis. The actual number will depend on the specific pathology at hand, but thinking about 3 is a good start. *Some of Mr. Guerra's differentials derived from his key symptom are: spondylosis, lumbago, herniated discs, osteoporosis, bone neoplasms, and metastatic neoplasms.*
- **Onset**: Think about your key symptom and how it starts in your VP. Does it appear suddenly? Or is it more like a non-life-threatening symptom that has been present for a while already? Think about more or less how long has your VP been suffering from this symptom. Options include: acute, subacute, chronic. *Mr. Guerra's onset is chronic.*
- **VP age**: Some diseases are more common in the youth while others are more common at an older age. Sometimes the same disease has different clinical manifestations depending on the age of the patient. Think about how old is your VP. Is it a newborn? Or is your VP already in the later stages of life? Think about life stages and then decide on an actual age: newborn, toddler, child, teen, young adult, adult, older adult. *Mr. Guerra is 70 years old.*
- **VP sex**: Similar as with age, some diseases tend to be more common in men and others in women. Some diseases are actually only applicable to people e.g. with a prostate, or with a uterus. Think about the sex of your patient and remember that sex is not binary: think beyond the traditional classification of men and women. Sex and gender are complex constructs. There

are four major categories for sex and gender: genetic sex (defined by sex gametes: XX, XY, X0, XXY, XYY, etc.), physiological sex (defined by sex hormones), psychological sex (how the person identifies and sees themselves: woman, man, non-binary, gender fluid, androgynous, etc.), and sociological sex (how society perceives this person: usually man, woman, androgynous, etc.). *Mr. Guerra identifies as a man.*

- **VP profession**: Some occupational hazards may provide a clue for occupational diseases. Additionally, the intrinsic characteristics of a given profession or job position might be risk factors for non-occupational diseases. What does your VP do for a living? Do they have hobbies or do they do voluntary or unpaid work? *Mr. Guerra used to work as a shop assistant in the past but is now retired.*
- **VP ethnicity**: Not only are some diseases that are biologically or physiologically more common in some ethnicities than in others, but race is a social determinant of health. Stigmatization due to ethnicity might improve or hinder access to healthcare. Plus, diversity is part of the human social reality and it gives dimensionality to your VP. *Mr. Guerra is of white European ethnicity.*
- **Country of origin**: A VPs country of origin could shed some light into any migration background that could be relevant for clinical reasoning (if it's different from the country of living, see below), or could just add an extra layer of personality and cultural variety to your VP. *Mr. Guerra's country of origin is Portugal.*
- **Country of living**: Although not always necessary, and sometimes even advisable to leave this out so that the simulation is more realistic to learner's around the world, sometimes it might be relevant to state the country where the story takes place and the country where the VP is living. In some exceptional cases these countries will differ (think vacations or migration cases). Additionally, clarifying the country of living, i.e. the country where the story takes place, might also be relevant for medical guidelines, procedures, and availability of certain medications. *Mr. Guerra is living in Portugal, which is also his country of origin, and the country where the story takes place.*
- **VP relevant background**: Some backgrounds are relevant for some diseases or access to healthcare. Does your VP come from a unstable country, or a country at war? Do they suffer from any physical or mental disability? These do not have to be necessarily related to the final diagnosis, but having VPs with relevant backgrounds give it more realism. *Mr. Guerra does not have any relevant migration background and he doesn't have any physical or mental disability.*
- **VP addiction or substance abuse**: Here we include all types of drugs: legal and illegal, natural and synthetic, and consumed in any way. From coffee to heroin, through smoking, alcohol, opioids, or cocaine, does your VP have any addictions or substance abuse issues? This could be relevant for specific diagnoses, but also for health promotion, diagnostic tests, etc. *Mr. Guerra does not have any problems with addictions or substance abuse.*
- **VP allergies**: Finding out about a patient's allergies should be part of the routine anamnesis for all real-life and virtual patients. It is key to ask about potential allergies to environmental factors and medication. This information could be key either to reach a final diagnosis or to plan complementary tests or management options. *Mr. Guerra doesn't have any known allergies.*
- **Personal medical history**: Some diseases appear in clusters (e.g. metabolic syndrome), while others are more likely if there's a previous medical history (e.g. fractures due to osteoporosis). Additionally, knowing about a VPs medical history can inform about current use of medication,

which might be relevant for making decisions regarding complementary tests or management options if there's a risk of pharmaceutical interaction. *Mr. Guerra has not lost any weight recently, he suffers from hypercholesterolemia treated with simvastatin and occasionally takes paracetamol. Additionally, he hasn't had any recent surgeries.*

- **VP sexual orientation**: Exploring the sexual orientation of your VP will also give it more dimensionality and realism. Are they coming with a same-sex partner seeking for medical help? Maybe they now have an opposite-sex partner, but they had children in the past with a same-sex partner. Remember that sexually transmitted diseases are more common in heterosexual people than in homosexual people! And don't forget about giving visibility to people with sexual orientations beyond heterosexual and homosexual. *Mr. Guerra is a homosexual man in a long-term committed relationship with his boyfriend.*
- **Scenario end**: Depending on the characteristics of your VP and the final diagnosis, it is possible that they are successfully discharged at the end of the case. Alternatively, some diseases require long-term treatment. Finally, death is part of life and sometimes patients die, even VPs! Some options include: successful discharge, long-term treatment, death. *At the end of the story, Mr. Guerra will continue with long-term treatment for his herniated disc.*
- **Encounter setting**: Although most encounters with VPs might happen at university hospitals or private practices, it is possible to provide healthcare in a wider variety of settings. The magnitude of the healthcare facility sometimes determines which staff and complementary exams are available for the VP at hand. The encounter setting might determine if we need to refer the VP to a more specialized setting for long-term treatment, rehabilitation, etc. Some options include: ER rural hospital, ER university hospital, ER hospital, rural hospital, university hospital, hospital, practice, outpatient clinic, other. *Mr. Guerra comes to the local outpatient clinic.*
- **Learner role**: The person learning from your VP might be an undergraduate student at the moment, but they will become residents, interns or consultants at some point. Help them feel like they are holding these positions already by stating what is their role. This also has implications for the type of decisions that they might make realistically, and it is somehow correlated with the level of difficulty of your VP (depending also on the final diagnosis). Some options include: Resident, intern, consultant, student, etc. *In this case, the learner receiving Mr. Guerra at the outpatient clinic is an intern.*
- **VP name**: Now that you have a broad overview of the characteristics of your VP, how will you name them? Feel free to assign local names depending on your VP's cultural background, where they live, and which languages they speak. Also think about making names flavorful but not overly complicated. We remember people we know mostly by name, and this is also true for VPs. Give your patient at least a first name and a last name. You may also give them a nickname. *Mr. Guerra's full name is Joaquim Guerra, which also reflects his Portuguese origins. He doesn't have any specific nicknames.*
- **Personality**: is your VP usually an active person that has been feeling rather down lately? Are they usually a very hungry child who is not eating properly? Or maybe they are an older adult living alone and having no one to talk to, so they overcompensate by talking a lot during the medical anamnesis. Or they might be in a lot of pain and thus act rather negatively. Sometimes changes in personality might give us clues about potential differential diagnoses, but most of the times they just add more dimensionality to your VP and can make the story more

interesting and engaging. *Mr. Guerra is a curious and pragmatic man who describes his illness in a concise manner.*

- **Complementary characters**: Are there other secondary characters involved in the story? Is your VP a child that is brought to you by their parent or guardian? Or is it an elder patient who depends on a caregiver? Is your VP a young adult in a committed long-term relationship and their partner is worried about their symptoms? Or would the learner need to call a different specialty to help them do more advanced diagnostic tests? Sometimes you might want to incorporate secondary characters in your story. You don't need to characterize them as well and detailed as your VP, but think about them and feel free to include them in your story as needed. Limit it to one secondary character though, or it might get too complex. *Mr. Guerra is in a long-term committed relationship with his boyfriend, with whom he lives. Apart from that, he comes alone to the outpatient clinic and there are no other relevant secondary characters.*
- **Family medical history**: Some diseases run in families and might be relevant to know if there's some sort of familial hereditary pattern. However, *in Mr. Guerra's case, there is no relevant family medical history*.

These are all relevant contextual factors that should be thought of and designed before creating a VP. Because there are so many of them, and because it might be difficult to remember all of them and even the most common options for each factor, course participants will be provided with a VP design character sheet to document all relevant aspects of their VP.

Asynchronous session: VP design character sheet

We recommend to do this activity in an asynchronous way after the first week's knowledge transfer. Participants should be instructed in the synchronous session at the end of week 1 on how to do the activity. For the activity they will use the provided VP design character sheet (See annex 1) and document in there all the desired contextual factors for their VP. Optionally, participants can draw their VP to start getting a visual idea of how their VP should look like. This initial draft will help gather further resources needed (e.g. patient images) and to plan the actual VP creation process. Participants should complete their VP design character sheet and document all their questions for a discussion at the start of week 2. Depending on the tutors' availability, participants might be given the chance of obtaining asynchronous feedback from their tutors before the session on week 2.

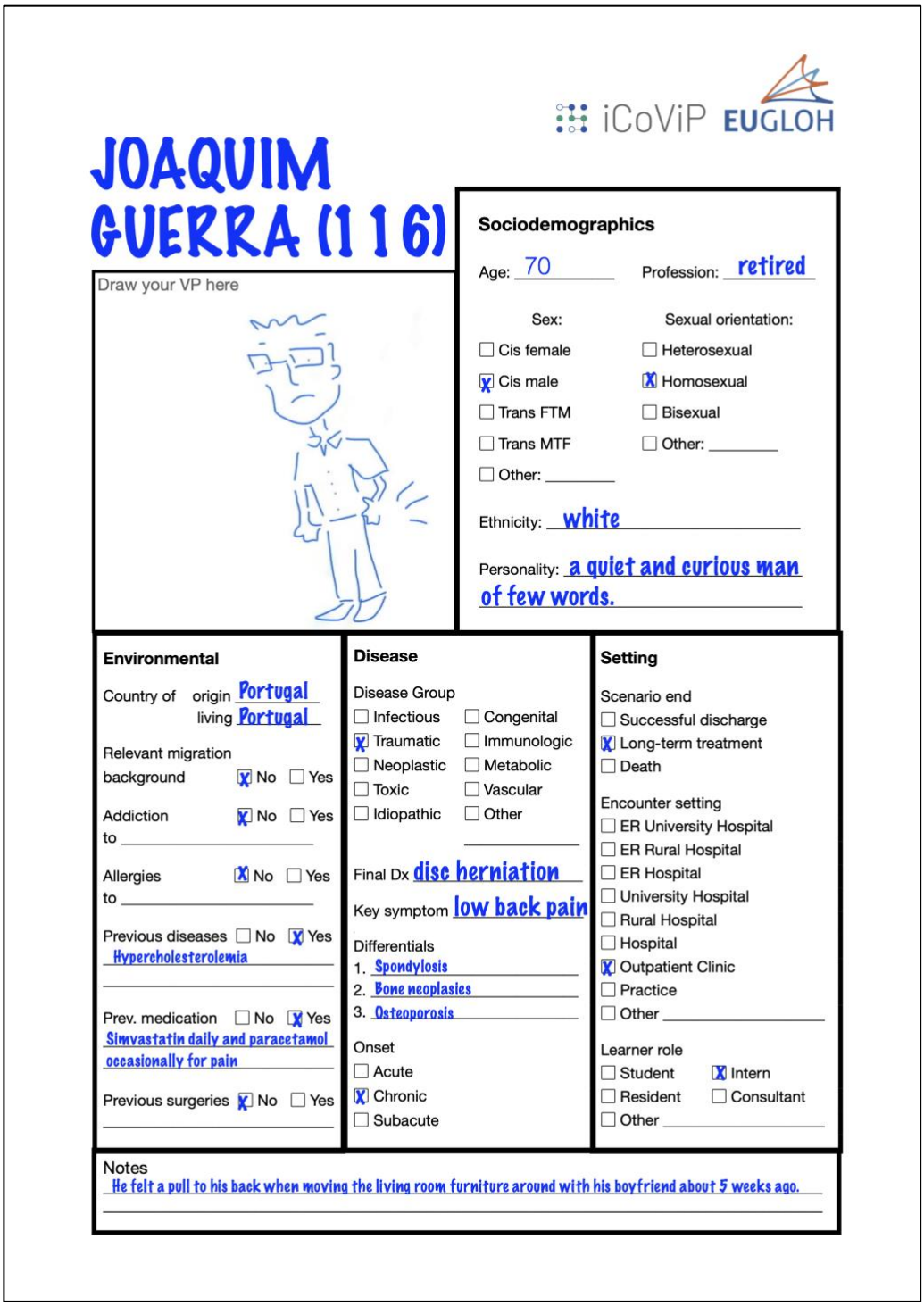

Figure 2. VP design character sheet for Mr. Joaquim Guerra

Closing

After providing instructions on how to work on the VP character sheet in a asynchronous manner, the session can come to an end by doing a short recap of the concepts learned and providing a sneak peak into next week's topics: discussing the process of asynchronously filling out the VP design character sheet and didactical guidelines for creating VPs.

Week 2, Friday afternoon

Materials needed

- Slides to convey all the necessary information
- Participants need to bring their already filled-out VP design character sheets
- Generate CASUS accounts for all participants (if they don't have one already)
- Instructions on how to access the CASUS platform

VP design character sheets: discussion and feedback

After welcoming participants to week 2, course participants will have the opportunity to share their experiences when filling out their VP design character sheets during the asynchronous session in between weeks 1 and 2. Enough time should be given to participants to share their process, ask questions, clarify unclear points or aspects, etc.

Introduction to CASUS: Anatomy of a CASUS card

Before participants can create a CASUS VP themselves, it is advised that they have at least one hands-on experience resolving a VP on their own. This section will describe to them the anatomy of a CASUS card so they know what to expect, how to navigate CASUS, and what they should focus on. Duration: 15 minutes for the presentation and instructions. The next section "Doing a VP on CASUS" should last about 45 minutes. Total duration: 60 minutes.

A slide is projected showing the components of a CASUS card, namely:

- Left navigation sidebar
- **Text**: Show actual information (text) and dialogues
- **Multimedia**: Show at least one image and its caption
- **Expert section**: if available, or at least describe it
- **Clinical reasoning tool**: Show prompts and concept map
    - **Concept map**: include parts of the concept map. Explain when to place something in which box, e.g. physical examination is a test/examination, but enlarged lymph nodes at the physical examination goes into relevant findings. Show also connections, working diagnosis (light blue), must-not-miss (red round icon with a white exclamation mark), ruled-out (grayed out), and final diagnosis (dark blue).
- **Questions**:
    - Types of questions
    - Answer comments
    - Didactical principles

The main text describing these elements is found below in the Didactical Guidelines section.

Doing a VP on CASUS

At this point, participants are still not ready to start creating their VP on CASUS, but should be given the opportunity to get familiar with the CASUS platform from the learner's perspective. This activity can be done individually or in small groups of fewer than five people. We recommend to allocate enough time for the successful completion of the VP: around 45 minutes. We also recommend to follow with the previous example of VP Joaquim Guerra.

Didactical guidelines

VPs are a learning tool for clinical reasoning. As such, they should be didactical enough so that students can actually *learn* something from them, focus on what they're learning, avoid unnecessary cognitive load, ensure that most of the clinical reasoning skills can be remembered and evoked at a later time and receive some automated feedback to know if they're on the right track or so that they can learn from their mistakes. This is why following didactical principles is so crucial. In this part of the course, we provide some didactical guidelines for VP authors to keep in mind as follow as much as possible, so as to ensure that their VPs are educational enough for undergraduate medical students.

Some of the objectives of the didactical guidelines are:

- To reduce the cognitive load and allow students to focus on learning and practice clinical reasoning
- To maintain student engagement throughout the VP
- To challenge students in their clinical reasoning knowledge at an appropriate level
- To provide students with the possibility of practicing the use of semantic qualifiers, translate or transform layperson terms into medical terms, correctly identify signs and symptoms and connect that to a set of differentials, request and interpret complementary tests to reach a final diagnosis, consider and narrow differentials, and select a correct final diagnosis
- To ensure that questions and answers are educational and engaging
- That students can learn from concept maps so that maps are correct, realistic, not overly simplified and also not unnecessarily complicated
- That students learn how to properly write a summary statement

Structure

Each VP story on CASUS develops through a set of cards. Each card should contain one relevant aspect of the story. We recommend a VP to contain between 5 and 10 cards. Each card should contain elements regarding only one step of the clinical reasoning process. In cards about complementary tests, we recommend including no more than two different types of test on one card, e.g. blood tests and X-ray images, blood tests and EKG or urinalysis and urine microscopy. Further the final diagnosis should only be revealed *after* students have to reach a decision and treatment options should ideally be introduced also *after* revealing the final diagnosis.

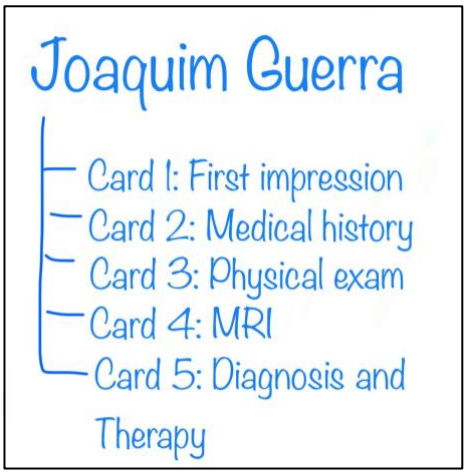

Fig 3. Sketch of the navigation bar in Mr. Guerra's case.

Multimedia material

All clinically relevant images, audios, and videos should be included. These multimedia elements should appear according to the progression of the story. The first card should contain a matching patient image in a clinical setting. Images should be of good enough resolution to appreciate all relevant structures and information in them. Images should not contain any personal identifiers from any real-life patient. Examples of multimedia material include but are not limited to EKG, X-Rays, CT, MRI, auscultation sounds, urine dipstick, blood smears, urine microscopy, etc. We encourage using multimedia elements that show normal results, as students should be exposed not only to pathological tests, but also to normal ones. Illustrative images should be avoided, as they increase cognitive load without increasing the didactical value. Each multimedia material element should contain all relevant metadata. We will learn more about the multimedia material and the elements that should go in the metadata in a further session.

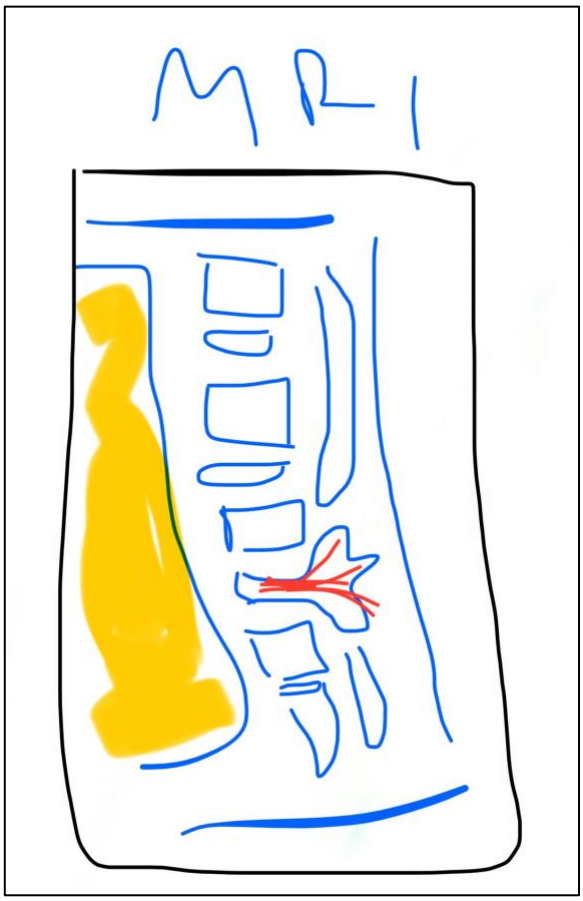

Fig 4. Sketch of the spine MRI image needed for the multimedia section in Mr. Guerra's case

Text

Text is the main way in which we will convey all the required information to the learner. There are two main sections within a CASUS card where we will be able to add text, namely, the main card body (called Text), and the Expert section. All relevant aspects of the story go in the main card body, including situational aspects, conversations in the form of a written dialogue, lab results, etc. The Expert section should be used sparingly and reserved only for occasions where there is highly technical information that should be communicated, such as an expansion of knowledge about diagnostic techniques or treatment options. Present tense should be kept throughout most of the case, as we are trying to give the illusion of the action happening in real time as the learner works on

the case. Past or future tense can be reserved for when speaking about past events (e.g. during the medical history section) or about prognosis and future treatment (during the last cards).

There should be at least two main written styles to follow depending on the progression of the story and the type of information to be communicated:

- **First impressions and medical history**: These cards should be written in **simple, layperson, everyday language in direct speech**. Passive voice should be avoided. From a didactical perspective, it is key to use this kind of language, as it gives the learner the possibility to practice key clinical reasoning skills such as transforming or translating layperson terms into technical or medical terms and the identification of keywords that lead to semantic qualifiers. Feel free to add personality to your VP and show it when they speak in the dialogue. If the patient comes accompanied by a friend, partner or another family member, feel free to add some interaction dialogue between this person and the patient, or even between this person and the healthcare provider. In emergency settings, however, and depending with whom is the healthcare provider talking to (e.g. paramedics or other healthcare providers) it might be okay to use medical terms.
- **Physical exam and complementary tests**: In these cards, the amount of text gets heavily reduced in favor of *showing* results that the student should be able to understand and interpret correctly. A table of lab results is advisable, and the use of images or other multimedia elements is preferred over a narrated text version of results. Only in cases where, because of practical or ethical reasons it is not possible to find adequate multimedia elements, is the description of the results advisable. The main objective of the information provided in these cards is that the student feels like they are actually receiving these tests in real life and they get to interpret them. The language here can be more **technical, using medical terms**. This means that passive voice is allowed, but it is still encouraged to keep it to a minimum as reading passive voice statements is cognitively more demanding. Also, keep in mind that your VP will be designed for mostly undergraduate students, so remember not to overwhelm them with a highly technical and long description of e.g. ultrasound results.
- **Diagnosis, treatment, prognosis, and end cards**: In these cards, we come back to **simple language** whenever possible. The final diagnosis is revealed in technical terms, but then it is advisable to include a dialogue where the healthcare provider clarifies the diagnosis to the VP. Further, prognosis, treatment and prophylactic options, as well as general lifestyle recommendations can be provided. The use of dialogue in these parts is encouraged, but not necessary.

> ***Card 2: Medical history – extract***
>
> ***You***: *"Mr. Guerra, can you please precisely locate the area where you feel the pain?"*
>
> *[Mr. Guerra points with his hand to the lumbar region].*
>
> ***You***: *"I see! Do you feel the pain radiating anywhere?"*
>
> ***Mr. Guerra***: *"Yes, it goes into my right, most precisely to the knee when I move and walk. Sometimes I feel like an electric shock."*
>
> ***You***: *"Had you ever felt such pain in the past?"*
>
> ***Mr. Guerra***: *"Yes, this is not the first time, but previous episodes weren't as strong or didn't last for so long as this one."*

Card 3: Physical exam – extract

At the physical examination, Mr. Guerra is in good general condition.

- ***Vitals**: Ear temperature 36.1 °C; Blood pressure: 129/81 mmHg; Heart rate 69/minute; BMI: 29.2 kg/m²*
- ***Cardio/Pulmo**: no abnormal findings*
- ***Abdomen**: soft, no pain caused by pressure or release of pressure, normal intestine sounds, liver not enlarged, spleen not palpable*
- ***Head and neck**: unremarkable*
- ***Orthopaedic exam**: pain and limitation in the mobility of the lumbar spine. Pseudoclaudication*
- ***Neurological exam**: Positive Lasègue's and Bragard's signs on the right leg. No sensory changes. Normal basic exam of the cranial nerves.*
- ***Skin**: No edema, no visible lesions. Normal hair distribution. Normal temperature of the skin, including on the extremities.*

No further abnormal findings.

Fig 5. Text sketches for cards 2 and 3 in Mr. Guerra's case. Notice the difference in language between the two cards.

Questions

The main objective of questions is for the student to aid students in the process of clinical reasoning. That means that, ideally, questions should be about stimulating learners into thinking about and narrowing down differentials as well as for interpreting signs and symptoms from the physical exam or results from complementary exams. Only in few cases is asking about actual medical knowledge advised, e.g. to maintain student engagement. It is important, though, not to ask students to repeat the cognitive process that they should do with the concept map (more about the concept map below). This means, avoid asking questions which results in students answering relevant findings, differentials, tests/examinations, or treatment options that they can document in their concept map.

The CASUS platform offers different types of questions. Each type of question has different purposes and ways of being evaluated by the system. Although multiple choice questions can become boring both for the case author and for the students, this is one of the easiest types of questions to design while maintaining didactical principles. Therefore, it is encouraged to go for this type of question. Independently of the type of question that you choose, remember to follow didactical principles such as avoiding negations, providing clear and comparable answer items, and including an enough number of discriminators. The number of discriminators (e.g. in multiple choice questions) can vary, but the general rule of thumb is to include as many or more incorrect options as correct ones. Moreover, please include a "normal" or "not pathological" option among the answer options. Remember to always add an answer comment where you explain to the student the correct and incorrect options. If you use "region of interest" or a similar type of question where images are used, you can reveal correct and incorrect options directly on a secondary identical image to the one used in the question, except that this one contains lines or arrows of different colors that explain the structures in the image. And when you write the answer comment, remember not to reveal the final diagnosis!

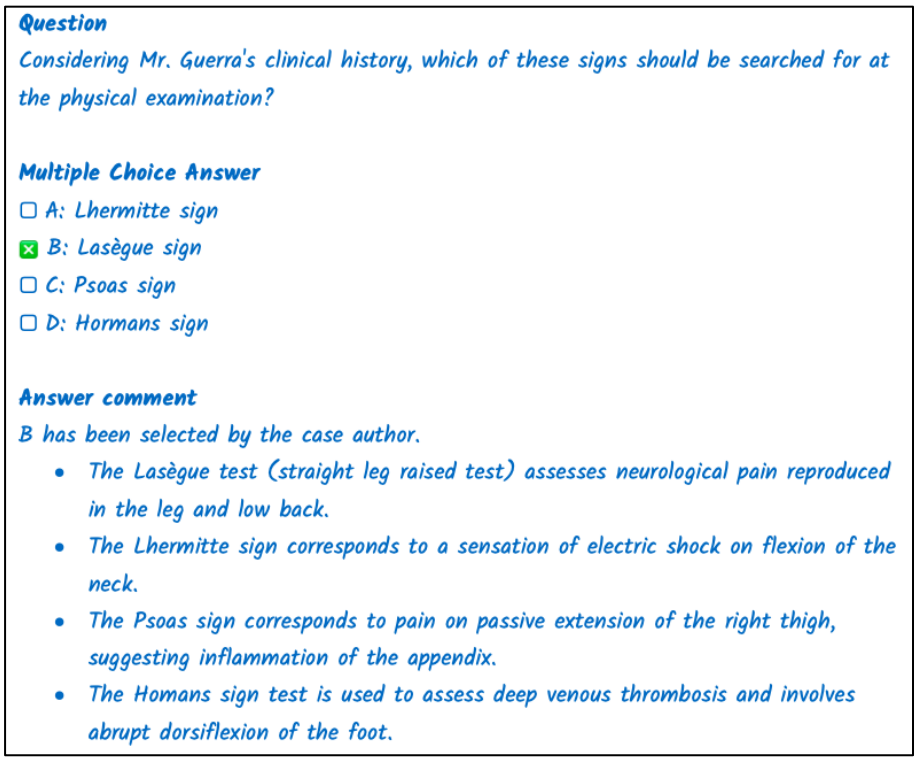

Fig 6. Sketch of a question in Mr. Guerra's case.

Concept Mapping Tool

The concept mapping tool is a feature available on the CASUS platform that allows the learner to document their relevant findings, tests or examinations, differential diagnoses and treatment options in order to reach a final diagnosis while exercising clinical reasoning. Each case author builds their version of the concept mapping tool, which learners should emulate as close as possible not only to get points from the automated evaluation system in CASUS, but also to use the concept mapping tool as a learning device. In order for the concept mapping tool to be educational enough, case authors should try to include only a "reasonable" number of findings, differentials, tests, treatment options, connections. It is hard to say what a "reasonable" number means, because this number will depend on the given case, the complexity of the case, and the necessary process involved. We recommend, however, to focus on the number of items and connections that actually make or break a final diagnosis. What is or are the pathognomonic signs? Which physical exam sign or symptom or complementary exam value actually defines or rejects a given differential? What is actually necessary to rule out the most urgent or life-threatening diagnosis and, in contrast, would actually direct the learner into making a correct final diagnosis?

Besides the concept mapping tool elements already mentioned, case authors can and should work with working diagnoses, must-not-miss, ruled-out and negation connections whenever appropriate. Blue connections speak in favor of a differential, while red connections speak against it. These elements aid in decluttering the concept mapping tool, and guiding the learner into the correct final diagnosis without actually revealing it. Case authors must also ensure that the progress of the concept mapping tool goes in-sync with the case progression, i.e. do not include elements before they are revealed in the Text or Multimedia sections.

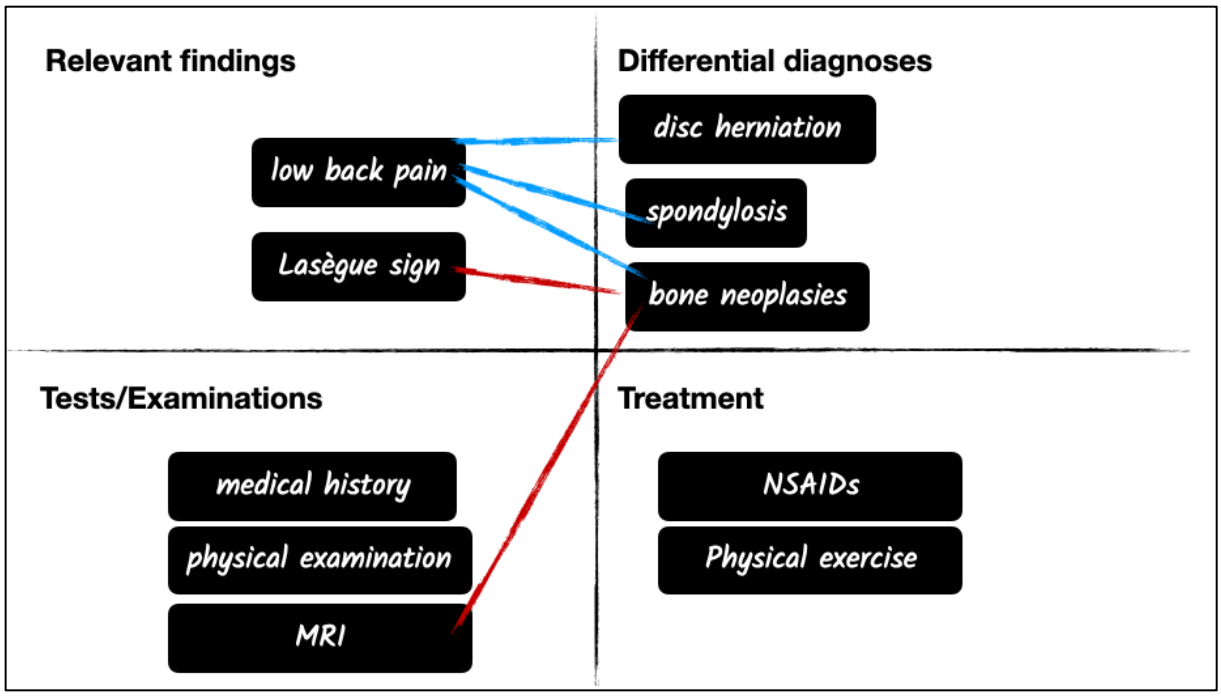

Fig 7. A sketch of Mr. Guerra's concept map

Hands-on activity: Find your VPs voice

This in-course activity helps case authors back-transform medical terms into layperson terms and speech and thus it is useful for practicing the writing style needed in the Text sections. For this activity, participants are split in pairs using the breakout rooms option or similar. Each participant should work with their own VP design character sheet. Taking turns, participants should place themselves in the role of their patient or an accompanying person and should describe the key symptom to their peer as best as possible using layperson terms. Their peer aids in calling out any use of a very technical or medical term. The peer is also allowed to ask follow-up questions to find out more about the key symptom (time of appearance, duration, intensity, character, etc.). Each partner has about 7 minutes and then they switch roles. Total duration: About 20 minutes including instructions. Afterwards, a reflection session lasting between 10 and 20 minutes is advised, where participants share their experiences, comment on their pitfalls, and reflect on possibilities for improvement, especially for when they actually write down the text of their VP.

Closing

This session ends with a recap of the concepts learned and with a preview of what will be learned the next day, namely storytelling and storyboard creation.

Week 2, Saturday morning

Materials needed

- Slides to teach this session's contents
- Projector
- Computers with internet connection and access to Twinery

Crash course storytelling

A good, engaging and memorable story has a clear structure that can be identified universally. The easiest way to structure any story is in three parts: beginning, middle and end. However, there is so much more than just that. In storytelling, the plot of a good story follows a chronological structure called the "dramatic arc". To illustrate the dramatic arc, we will use Disney's The Lion King as an example. The Lion King is in turn based on Shakespeare's Hamlet. There are six main components to the dramatic arc, namely:

1. **Exposition**: This is the introductory part of the story. The main objectives of this part are setting the scene, introducing the characters and providing relevant background information. In The Lion King, the story starts in the African savannah at Pride Rock. We get to know the main characters: Mufasa, Simba, and Sarabi (Simba's mom), as well as Rafiki and Mufasa's brother Scar. We get a glimpse of the hierarchies between all the species of animals, and of the dynamics within the lion family.

2. **Inciting incident**: This is the main event within the story that sets the plot into motion. It's a defining event for all main characters and the rest of the story develops around this key moment. This event is not something that the main character does but rather something that is done or happens to the main character, that they cannot predict or control. In The Lion King, Scar kills his brother Mufasa, exiling Simba, and scarring him for life. This will be a key moment in Simba's life that will set his future revenge in motion.

3. **Rising action**: The rising action consists of a series of events that happen right after the inciting incident and that may complement or complicate the story. The events in the rising action slowly build up the story and lead it to the climax. In The Lion King, the rising action events include Simba growing up in the jungle with his new friends Timon and Pumbaa. Further, Simba's childhood friend Nala runs into Simba in the jungle and tells him about what has happened in the savannah after his father was murdered by Scar. This newly presented information makes Simba consider returning to the savannah, although he initially refuses to do so.

4. **Climax**: The climax is another main event in the whole story. This is where the main character is ready to face their fears and deals with the main conflict of the story. In The Lion King, this is when Simba returns and faces Scar and the hyenas.

5. **Falling action**: Falling action refers to a series of events that happen as a direct consequence of the climax, where the tension is deescalated, and the story is led into its final conclusion. In The Lion King, this is when Simba finally beats Scar and the hyenas betray their master.

6. **Denouement**: This is the last part of the story, which comes at the end of the falling action and provides an end to the story. The characters, especially the main character, return to their normal life after being changed in some meaningful way after the events experienced in the story. They might become wiser from either achieving their goal or from learning from their failures. In The Lion King, this is when Simba returns as the King of Pride Rock and he and Nala introduce their newborn to all the animals in the savannah, as his father Mufasa and his mother Sarabi once did at the beginning of the story.

What makes a good story?

There are two basic things that every good story contains and that is good to keep in mind, namely action and empathy:

- **Action**: Action is what drives the story. Action is communicated and emphasized by the use of verbs: the characters *do* something. This is what grabs the audience's attention and keeps them on their feet from one scene to the next.
- **Empathy**: We communicate empathy through our story characters. Design your characters in a way that they are relatable: which clear virtues and flaws. The more human characters are, the more they will be relatable to a wider audience. Appealing to the audience's empathy is what makes them care about your story.

Activity: Tell your own story

Choose a well-known popular story and break it down into the six main parts of the dramatic arc. You may choose a story from the Bible (the myth of creation, Noah's flood, Job's story) or from popular culture, e.g. Star Wars, Lord of the Rings, Shakespeare's stories (Romeo and Juliet, A Midnight's Summer Dream, Hamlet), etc. Then, briefly present it to your peers.

Storyboard creation

Now, get ready to introduce elements of storytelling in your own VP. To organize the parts of your VP, you may use pen and paper, or a free online webtool such as Twinery. The smallest unit for organizing your story as a whole is the card. Each card should contain a specific set of elements that communicate relevant clinical aspects to the students. Remember to use verbs to drive actions and to make your VP relatable to appeal to empathy.

In the storyboard, feel free to include already as many aspects within each card as needed. You are free to decide where you'd like to include questions and of which kind, where to add multimedia elements, and when should students decide on a final diagnosis. Storyboarding is a trial-and-error process, so don't feel pressure to get it right from scratch. Instead, play around with the different elements until you find an order of events that fit your story and the clinical reasoning process.

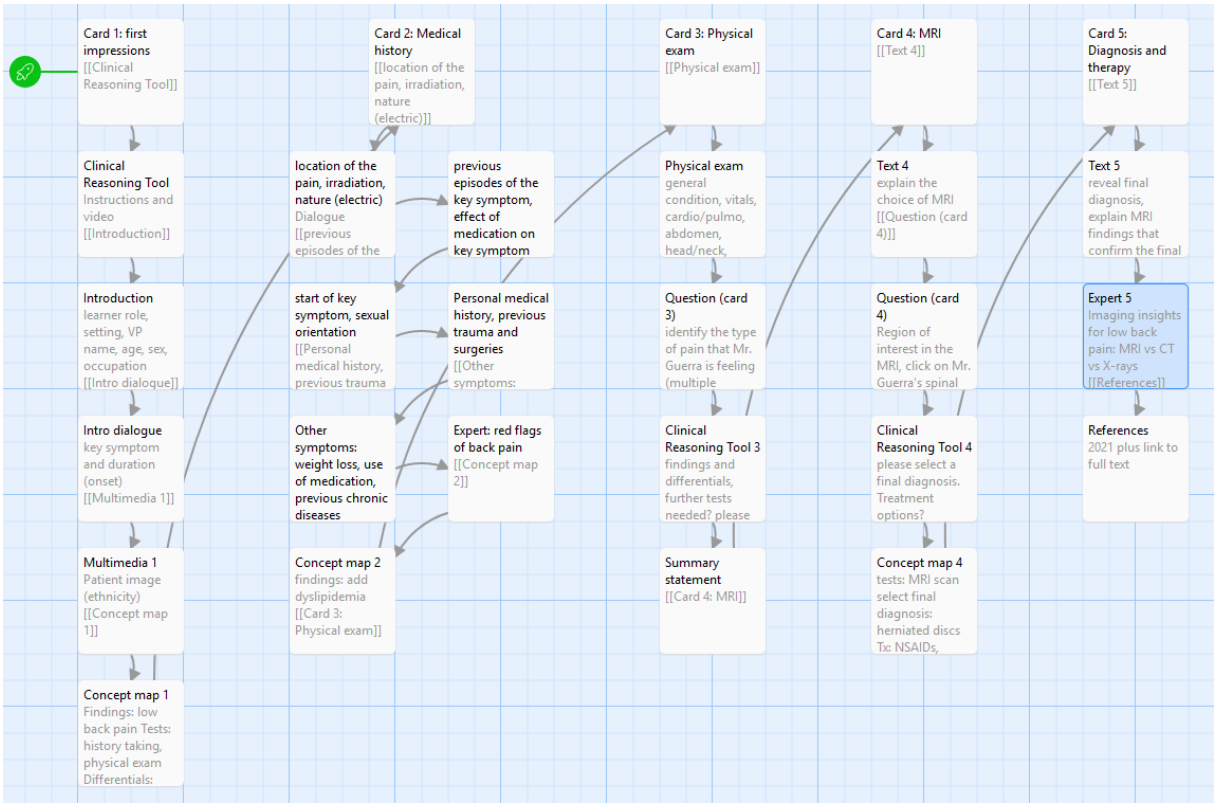

Figure 8. Example of a storyboard for Mr. Guerra's case done using the free web app Twinery (http://twinery.org/)

Asynchronous session: Storyboard for your VP

Now that you've learned in the course how to tell a good story and how to build a storyboard, work on your own VP and build a storyboard for your VP using either pen and paper or the Twinery tool. Make sure that the case follows a linear story and try to include as many necessary elements for clinical reasoning as needed without overcrowding or overcomplicating the story. Remember also to leave the medical knowledge aspects out as much as possible.

Closing

This week we've improved our understanding of how to create a VP by understanding the basic anatomy of a CASUS card, getting a hands-on experience with a CASUS VP, as well as learning how to tell good stories and how to create a storyboard for our VP. Participants are asked to build a storyboard for their VP in an asynchronous session and a sneak preview of next week's section is provided, where we'll work with CASUS in authoring mode to start building our VPs.

Week 3, Friday afternoon

Materials needed

- A CASUS account for each participant with authoring rights
- Slides for teaching the material

Discussion and feedback about the asynchronous storyboard creation activity

To start the session, participants have the chance to share their experiences in creating the VP storyboard during the asynchronous section. It is encouraged to share newly created insights as well as limitations or questions that they still may have.

First steps in CASUS: Basic anatomy of a VP on CASUS

A basic VP consists of about 5 to 10 cards on CASUS, namely: first impressions, medical history, physical exam, lab values, other complementary exams, diagnosis, treatment, follow-up. Not all VPs have exactly all these cards. Some VPs might have more, and some have fewer and sometimes cards are named a bit differently. It all depends on the way you would like to structure your story and of the nature of the final diagnosis at hand.

- **Card 1: First impression**: This is where your VP seeks healthcare assistance. Think about how you first encounter them: do they come to you or are they brought in by somebody else, including emergency services? Make sure you include in this card already many of the VP characteristics that you defined beforehand. Some of the most common characteristics to include on this card are: VP name, encounter setting, learner role, age, sex, profession, and key symptom. Sometimes you might want to include some other characteristics such as complementary characters or sexual orientation. You are free to flavor up the setting a bit more by including a time of the day, a particular season, a day of the week, weather characteristics, etc. Ideally, you would include an illustrative image of your VP on this card, so you can show already some of the VP characteristics (e.g. ethnicity) without explicitly saying so. Make sure you also include a short dialogue where the learner welcomes the patient and the VP expresses their key symptom. Include relevant key symptom aspects such as onset, duration, intensity, etc. as you see fit.

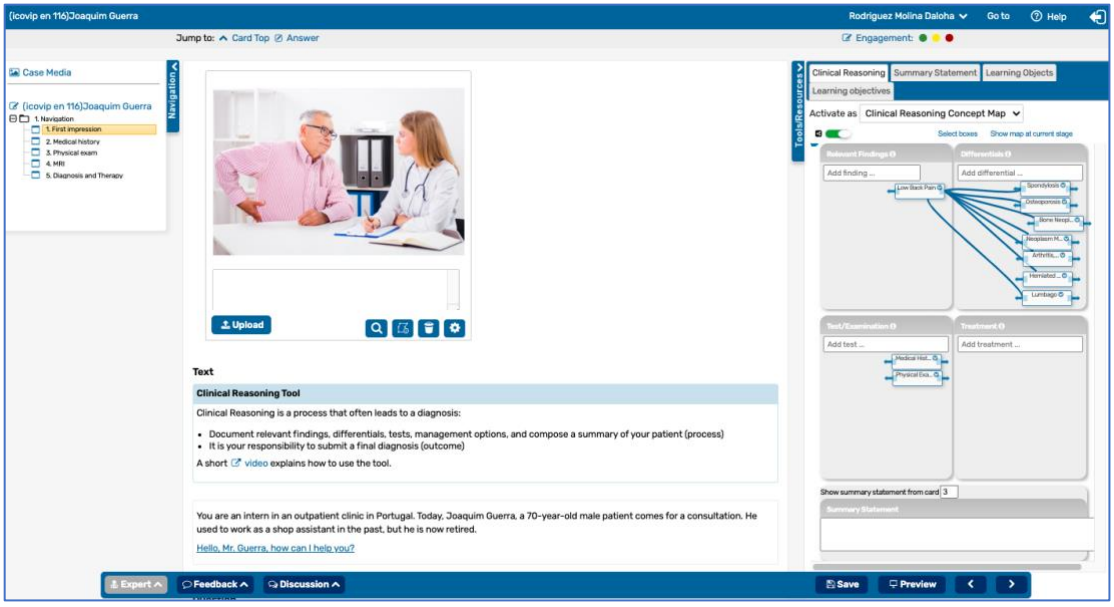

Fig 9. Card 1 of Mr. Guerra's case

- **Card 2: Medical history**: This card usually contains a longer dialogue in Q&A mode where the learner explores more about the VPs key symptom, other accompanying symptoms, habits, comorbidities, previous medication, allergies, lifestyle changes, etc. This card should be written in layperson terms, especially if it is the patient speaking. It is advised that the physician also speaks in layperson terms, but sometimes it is acceptable and it gives it more realism if the physician uses a technical term and the patient asks for further clarification.

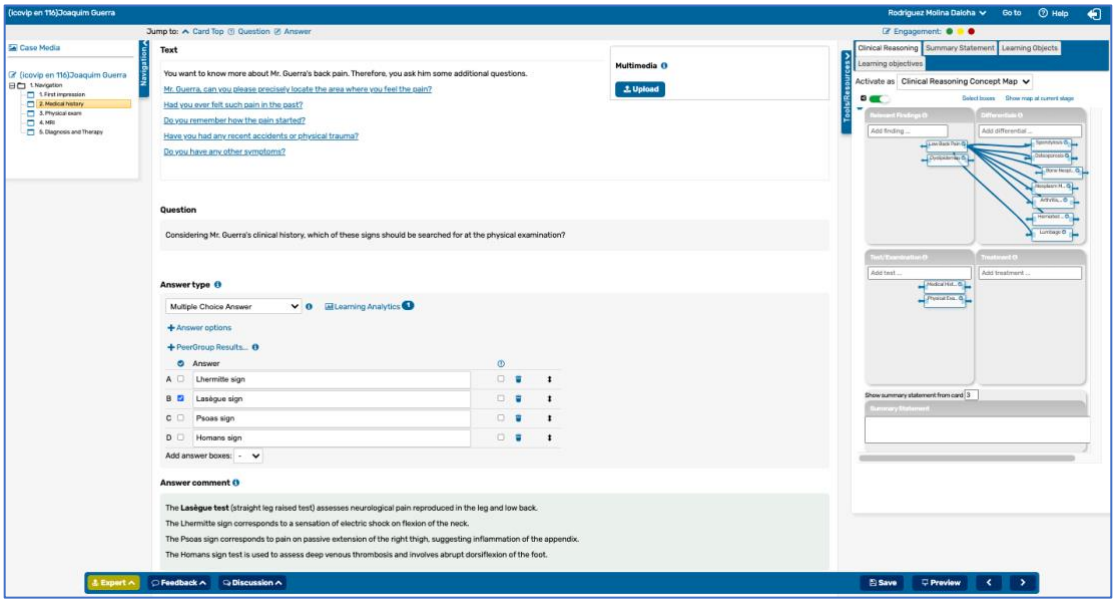

Fig 10. Card 2 of Mr. Guerra's case

- **Card 3: Physical exam**: After collecting information from the medical history in form of an medical anamnesis, the learner should think of making an oriented physical exam and document this among their tests/examinations section in the concept map. The physical exam card is fairly short and to-the-point, and it is okay to use technical and medical language. It is advised to start with vitals and general appearance of the patient and then to continue the

exam by anatomical area or system from head to toes and from medial to distal: head/neck, cardio, pulmonary, abdomen, spine (if needed), genitalia (if needed), upper and lower limbs, skin (if needed), neuro, psychiatric test (if needed). Make sure to include also normal or non-pathological elements. A sample of a normal adult physical exam can be found in annex 3.

Although not mandatory, for some final diagnoses such as skin or genital diseases, it is useful to have a clinical picture showing a key sign found at the physical examination. Make sure that you get appropriate consent from the patient and the institution that owns the image before you use it in your case. Also, make sure that patients are not identifiable in the picture and this includes not only the patient's face, but also looking out for personal marks, scars or tattoos in the picture and removing or blurring them out.

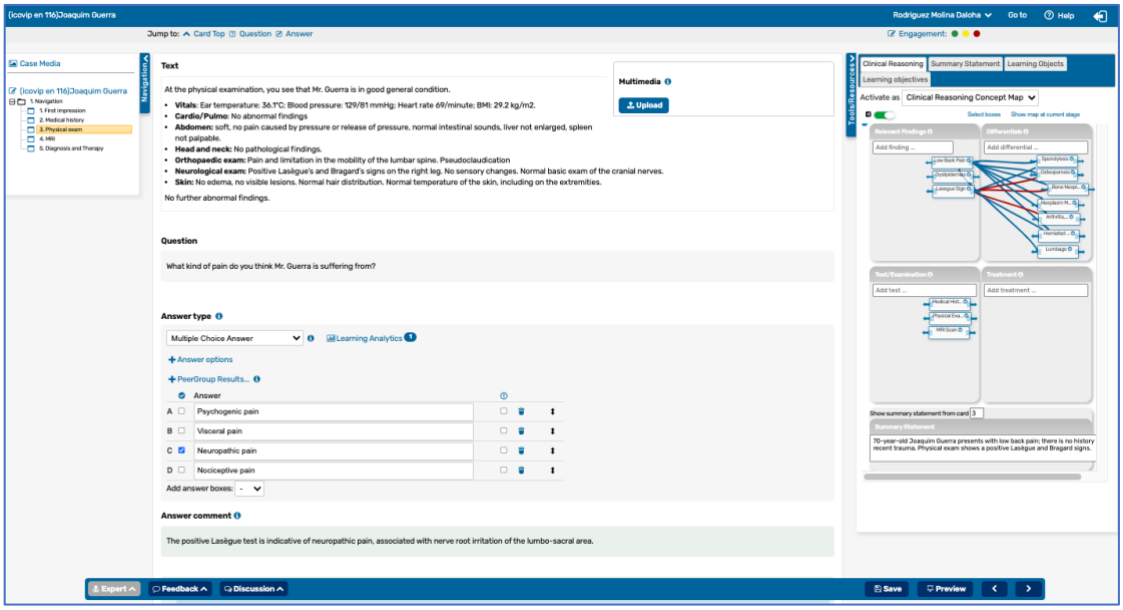

Fig 11. Card 3 of Mr. Guerra's case

- **Card 4: Lab values**: This card may contain an introductory sentence and then show blood and/or urine test results in table form. Make sure that you include reference values for all the markers measured. Work with your preferred units. In Europe and most of Latin America, the metric system is used and preferred. Do not include any specific signs or markers for normal or out-of-range values. This is part of the students' job to interpret. Finally, to make sure that the learner exercises their clinical reasoning skills, include a question at the end of the card where they have to interpret the presented results. Remember to avoid making students repeat what they do with the concept map, i.e. documenting relevant findings, tests or examinations, differentials or treatment options. Instead, make students think in terms of pathophysiology and semiology, what is going on with the patient given the presented results.

- **Cards 5-x: Other complementary exams**: Depending on the final diagnosis, some extra complementary exams might be needed, namely EKG, audio sounds, images, blood smears, urine dipstick, cultures, antigen and/or antibody tests, ultrasound videos, etc. Include any other complementary exams in these cards, grouping them by type (e.g. images) or by chronology, e.g. EKG and labs were done first so they go in one card, imaging was done later after revealing a key finding so they go in another card. Not all final diagnoses call for extra

complementary exams. Sometimes by doing a good physical exam or by receiving some basic lab results it is possible to already reach a final diagnosis. Feel free to adapt your case to your needs.

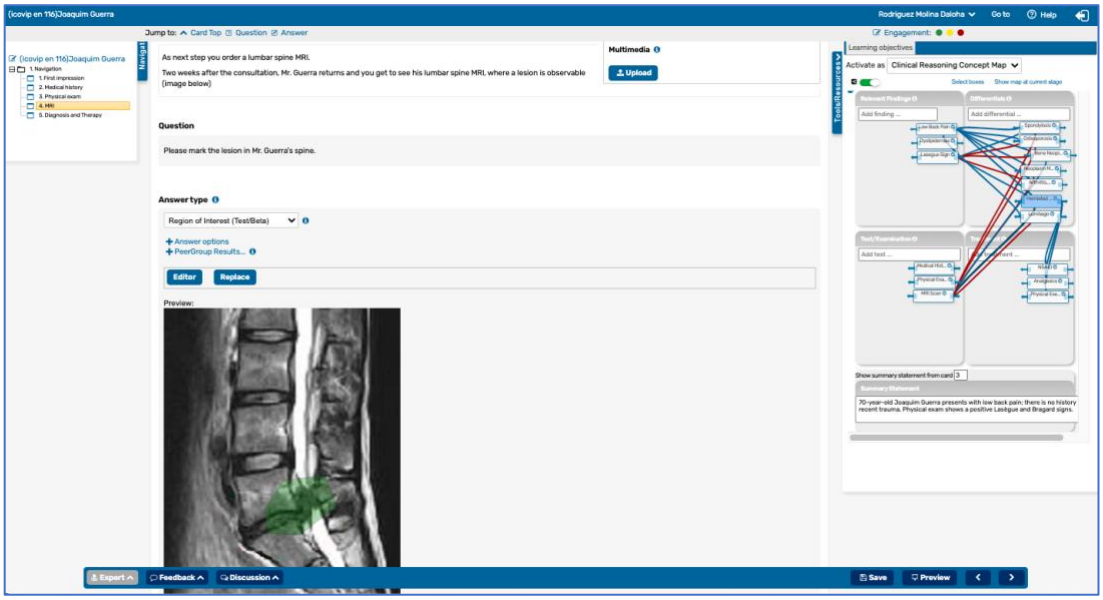

Fig 12. MRI card of Mr. Guerra's case

- **Diagnosis**: After providing all necessary information to reach a clinical diagnosis, students should be prompted to make a decision and the card right next to the one containing this prompt should reveal the final diagnosis. Make sure to reveal the final diagnosis in the first sentence of this card and to make the actual diagnosis bold. This diagnosis should match as closely as possible the final diagnosis selected by the case author in the concept map. Then, a short description of the final and secondary diagnoses (if any) in text or dialogue form should be included.

- **Treatment**: Although management and treatment are not the main focus on clinical reasoning, it is advisable to introduce the learner into treatment options that match the reached final diagnosis. Make sure to include not only pharmacological treatment, but also to mention if hospital admission is needed, as well as any lifestyle recommendations, changes and other types of therapy, e.g. food and drink consumption, physical activity, physiotherapy, etc. Make sure that you include these options in the concept map as well.

- **Last card: Follow-up**: The case ends with stating the end scenario that you planned in your VP character sheet and in your VP storyboard. Include here any relevant aspects: did the patient die? How did the family members take it? Did the patient get better? How did the patient's quality of life improve after the recommended treatment? A good description of the follow up and the fate of the VP gives a satisfactory conclusion to the learning experience.

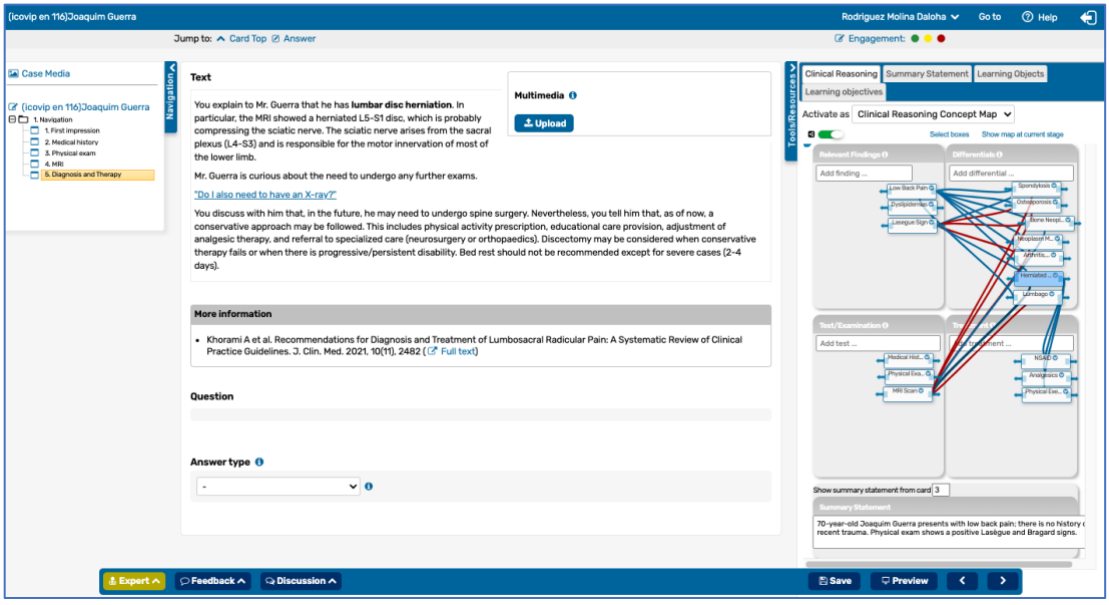

Fig 13. Last card of Mr. Guerra's case

Variations of this structure

Sometimes it is okay to deviate from this basic structure and add or remove cards as needed or to include elements in otherwise unusual places, such as in the following situations:

- Emergency settings where vital signs are evaluated on the first card and then they improve/worsen
- Complex cases where the patient is initially stable and then gets destabilized
- In cases where the patient destabilizes and needs immediate treatment before reaching a final diagnosis, e.g. oxygen

Checklist for things to include in each card:

Card 1: First impressions

- Patient image
- Full VP name, age, profession, accompanied by whom
- Scenario setting (which healthcare center)
- Key symptom
- Role of the learner: avoid using specialties so as not to limit the range and number of differentials

Card 2: Medical history

- Use focused questions in direct speech to find out more about the VP's condition. Use hyperlinks in hide-and-reveal mode to show questions and answers in dialogue form. Make sure that it is clear which character says what (the healthcare provider, the VP, or an accompanying person).

Card 3: Physical exam

- Please include a complete and full-body physical exam describing findings. Do not reach conclusions, e.g. describe all signs of heart failure instead of simply stating "heart failure signs absent." The idea is that students gather all relevant information and "translate" that into clinical terms and conclusions.

- You may use multimedia elements here, e.g. audio files for heart auscultation.
- You may include a question on this card where students have to interpret some finding from the physical exam.

Cards 4-X: Lab values and other complementary exams

- Include a table of results for any blood, urine or serology analyses. Include reference values whenever possible.
- Include multimedia material (images, videos or audios) for all relevant imaging tests, e.g. x-rays, ultrasound, CTs, MRIs, EKGs, etc. Remember to add the corresponding metadata to each multimedia element.
- On the last card of this series of complementary tests, include a prompt for students to decide what the final diagnosis is and select the final diagnosis on the concept map

Cards X: Diagnosis and treatment

- Reveal the final diagnosis and use **bold** style to highlight the final diagnosis
- Discuss treatment options with the patient

Last card: follow-up

- Provide a short description of the case scenario (death, long-term treatment, successful discharge)
- Include 1-3 main references within a References box. Please use international guidelines or general medical knowledge references that are not behind a paywall (e.g. Up-to-date or StatPearls)

How to start

Log into CASUS, click on “authoring” and click on “Create new case.” You may use a pre-exiting template or just start a VP from scratch. Enter your VP name and click on “save.” If you want to open a pre-existing case, click on the name of the VP so you can enter editing mode.

Metadata

Open the metadata box by clicking on the VP name in the upper left corner of the authoring screen. Please complete the following metadata fields:

- Case name: input the VP name
- Author(s): add your name(s)
- License: Select “CC_BY_NC_SA”. For more information about licenses, please check https://creativecommons.org/licenses/
- Language: Choose the language of the VP
- Institution: Add your institution’s name
- Click on “Save & Close”

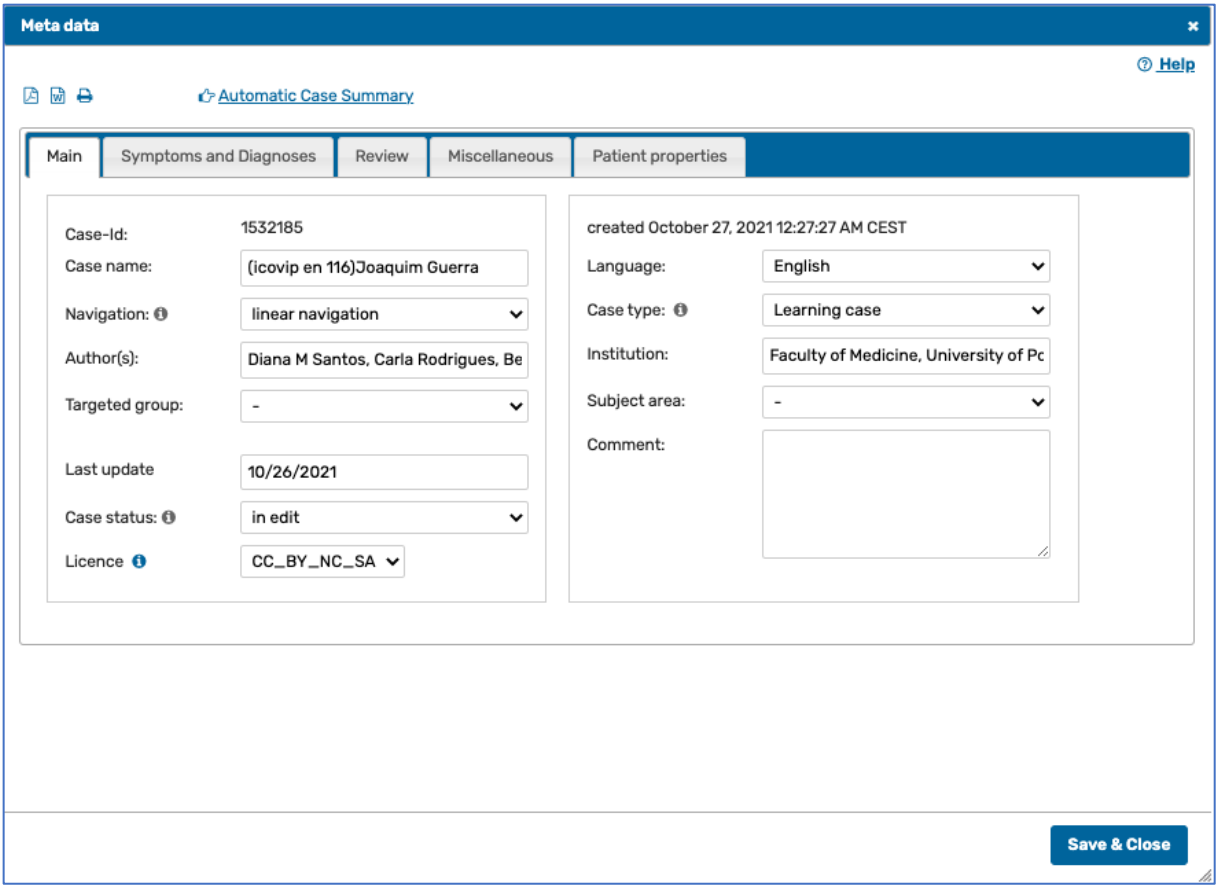

Fig 14. Mr. Guerra's metadata box

Text

If you'd like to highlight phrases or words, please use the **bold** style. Do not use the underline style, as this gets confused with active hyperlinks. You may use the *italics* style for actions embedded within the dialogues.

Questions and answers

Think about what is your objective with each question that you'd like to include in your VP. The type of question will depend on the question objective. CASUS offers a wide range of question types. The ones that we recommend are multiple choice, region of interest (for images), sorting, matrix, free text, etc. We recommend adding a question where students have to interpret some information provided in a complementary test or image.

General tips for designing questions:

- Avoid negations, e.g. "Which of the following is NOT correct"
- Avoid asking students to repeat what they should do in the concept map, e.g. avoid asking which other complementary tests they'd request, which differentials they are considering, or which treatment options should they prescribe
- Avoid questions that are too specific to the case at hand, e.g. "in which order would you request the following tests?"
- Avoid subjective questions such as those that depend on the specific set of differentials that the student should have in mind. Remember that each student or clinician might have a slightly different set of differentials

- Please always include a “normal” or “no pathological” option in questions about interpreting tests
- In multiple choice questions, make sure that each answer option contains only one element, e.g. avoid asking questions where answer options are “A and B are correct” or “EKG, x-ray and ultrasound”
- When using short free text answers, please include all potential synonyms for the correct term and only use this type of answers for short terms or phrases
- Make sure that you include an answer comment explaining the correct and incorrect answers
- For questions about images, consider including another image with the correct solutions in the answer comment where you highlight the relevant areas in the images. Alternatively, you can use the region of interest question, which does this for you

Covering COVID-19

COVID-19 is an important global event that might be medically relevant for some of your VPs. However, for sustainability reasons, please avoid mentioning any specific restrictions that might locate your VP to a specific point in time. Restrictions have changed throughout the pandemic and they also vary by geographical location, so avoid mentioning anything related to that, e.g. that an accompanying person is not allowed in the examination room **because** of COVID-19 restrictions. Instead, think of other reasons or just don’t provide any specific reason for these actions.

Also, having COVID-19 as a differential is allowed and encouraged whenever relevant, but don’t let COVID-19 dominate your case unless it is the actual final diagnosis. You may decide to treat it in a similar way as influenza.

Covering time

Also, for sustainability reasons, avoid including any specific point in time, e.g. that the VP underwent surgery in the year 2017. It is better to say “when the patient was XX years old” or “XX years ago”.

Concept maps

The concept map is the main tool in CASUS to exercise clinical reasoning. By actively using the concept map, learners can document their relevant findings, tests or examinations, differentials, and treatment options, as well as including a short summary statement. Some of these aspects are used in the daily work of a clinician when including relevant information into the patient’s medical history or electronic medical record. Therefore, learners will already be acquiring skills that they’ll use in every day of their lives as clinicians.

To add a term in the concept map, think about what is it that you want to add. For example, Mr. Guerra seeks medical assistance because of low back pain. This term is not a test or examination, it is not a differential, and it is definitely not a treatment option. Rather, low back pain is a relevant finding. Therefore, go to the concept map section and type “low back pain” in the search box. You should see suggestions for terms included in the database as you type. Once you find your term, click on it so that it can be added to the upper left quadrant of the concept mapping tool, the one corresponding to relevant findings. If you don’t find your term in the database, click on “Add your own term” and add it. However, terms that are not already in the database cannot be evaluated by the system, so students will not be able to get points for it. Sometimes, the exact term you’re looking for is not in the database, but there might be a similar one, e.g. imagine that you look for “pharyngeal swab” and you don’t find it, but “throat swab” is included. Sometimes you might find

more than one term that refers to something similar to what you mean, e.g. you find “back pain” as well as “low back pain”. In these cases, make sure that you choose the closest term to what the VP expresses: in Mr. Guerra’s case, he talks about “low back pain”.

Make sure that you build your concept map in-sync with case progression. This means that, as of card 1, you should have no more and no less than one relevant finding: the key symptom. Think and add already relevant differentials for this key symptom on card 1. Start general and narrow it down as the case progresses.

Medical history and physical exam are two terms in the test/examinations box that should always be included on card 1. Students get “easy” points for these, and it helps them build a sort of mental routine: 1. I receive a patient with a key symptom, 2. I make relevant questions to find out about more about the patient’s medical history and to increase or decrease the number of differentials, 3. I perform an oriented medical exam looking for relevant signs or symptoms that helps further in reaching a clinical diagnosis. Complementary exams might come in later.

Remember also to include the names of the examinations in the test/examinations box and the actual findings from these tests in the relevant findings box, e.g. you perform a head/neck CT which reports enlarged lymph nodes. The “head/neck CT” term goes in the test/examinations box while the “enlarged lymph nodes” term goes in the relevant findings box.

Connections are a visual aid for learners to understand which tests/examinations or relevant findings rule in or out any given differential. Make sure that you use a “reasonable” number of connections. As described in Didactical Guidelines section, it is difficult to say what is a “reasonable” number of connections. The recommendation is not to be exhaustive, but to illustrate the key positive and negative relations between findings and differentials. Remember that the main objective is to be didactical and educational for the learner, not to hold all the answers!

Clinical reasoning tool prompts

We recommend including clinical reasoning tool prompts throughout the case so that students are encouraged to do a specific clinical reasoning tool action. To add a clinical reasoning tool prompt, go to the upper right corner of the concept map on CASUS and click on “learning objects”, the click on “create new learning object”, add a title (e.g. Clinical Reasoning Tool or Summary Statement), select “clinical reasoning tool” among the categories, and input an appropriate text for your prompt.

References

The procedure for adding references is the same as for adding a clinical reasoning tool prompt, except that you have to select “References” from among the categories. Then, add in the text box all relevant references in list form.

Where to find images?

The best way to find clinical images is to look in your own healthcare center to obtain images from real patients. Make sure that the VP and the real patient are similar in age and sex. Before using any real patient images, tests, or data in your VP, make sure that you obtain all necessary consent and permissions from the patient and the healthcare center that archives the material. You may find a template for obtaining consent in annex 4. When you add a real-life patient material to a VP in CASUS, make sure that you input all relevant metadata including whether you obtained consent or not, that you select an appropriate license for releasing the image, and that you add your name and

email address in the “creator” field so you can be contacted. Also make sure that the image does not show any potential identifiers for the original real-life patient, including but not limited to names, dates of birth, tattoos, identifying scars, faces, etc.

For the patient image on card 1, you might want to consider using stock images (e.g. BigStock or iStock). Sometimes you need to buy a license to use these images. You can also check for free stock images (e.g. Pixabay or similar).

In some cases, you might not have access to a relevant clinical image from your local healthcare center. You might then want to consider using freely available clinical images from the internet (e.g. Wikipedia, Aylward, Medpix, HEAL project etc.). However, if you use these images on the internet, you need to make sure that they’ve been released with a license that allows you to use it, you might have to give appropriate credit and include a link to the original material, and thus you might break the illusion to students that such image belongs to the VP.

Multimedia in CASUS

Gather all your relevant images and get ready to upload them to CASUS. To do this, go to the card where you’d like to add the image, find the multimedia box in the text part of the card and click on the “upload” button. Follow the instructions and upload your image.

After having uploaded the image, enter the license information. To do this, click on the cogwheel symbol, enter all the information that you have about the multimedia element, including where you obtained it from and under which conditions can it be reused (license, source, comment on license). Add the creator name and email, select a license (e.g. “BY_NC_SA”), add a comment on the license if needed, and describe in “source” where is it that the image comes from (e.g. hospital, private collection, etc.).

Closing

In this session, we have reviewed how a VP looks overall, which cards it contains, what elements should go in each card, how to build a concept map, and about multimedia elements to use on CASUS. As of the next session, we will finally get a hands-on experience in building our VPs using CASUS.

Week 3, Saturday morning

Materials needed

- A CASUS account for each participant with authoring rights
- All previously presented slides in the course, for reference

Build VP draft on CASUS with assistance

Today will be mostly a hands-on session where participants have the time to start building their own VP using all the planning and resources that they have been working on and received during the past sessions. Work should be mostly individual but participants are allowed and encouraged to work in breakout rooms to get help from their peers if they want to. Tutors should monitor the work of participants without micromanaging or interrupting too much. The idea is that participants start using CASUS as a tool with in-course assistance to clarify quick questions.

In parallel: Fill out VP checklist

A VP checklist containing the most relevant aspects of the didactical review is included in annex 2. Participants can use a digital or printed out version of this checklist to make sure that they include all relevant aspects in their VP. This checklist can be filled out in parallel as they work in the case, or after completing the case to verify that their VP contains all minimum requirements for a didactical review.

Asynchronous activity: Finish the VP and the VP checklist

Participants are not expected to complete their VPs during this session. Instead, they are instructed to continue their work asynchronously until the next session. Tutors can and should provide participants with their availability during the asynchronous session for reviews, questions or general feedback. This communication is left for tutors and their guided participants to decide: via e-mail, in an online meeting, etc.

Closing

After many weeks of preliminary work, this is finally the session where participants can start bringing their VPs to life using CASUS. It is mostly a hands-on session, so slides are not required, but it is advisable to have them at hand, as well as all complementary resources (annexes, web links, etc.) in case learners have questions or need to review a specific area or procedure. In the next session, learners will receive feedback on their VP and will be given advice as to what to do with their VPs once they're created

Week 4, Friday afternoon

Materials needed

- Slides
- Computers with Internet connection and access to CASUS

Individual feedback on the VP

The hands-on session that was held in the previous session continues in breakout rooms where tutors provide personalized feedback about each participant's VP. The goal of this session is for participants to clarify any last-minute doubts that they might still have so that they can finish their VPs before the next session.

What to do with my VP once it's created?

Having a VP is key for students to learn and exercise clinical reasoning using one case example. However, for students, clinical reasoning is a skill that must be practiced in a wide variety of settings and situations in order to become adaptable and to see and experience as many aspects as possible. Therefore, one VP alone might not be enough. We recommend to have at least a set of VPs and provide students with such set. VPs can be grouped depending on the general specialty (e.g. surgery or tropical medicine), key symptoms (e.g. headache, fever, or abdominal pain), location (e.g. all VPs located in a given geographical location), language (e.g. all VPs offered in a given language), etc. We do not recommend grouping VPs based on the final diagnosis because it defeats the purpose: Students will know already what the final diagnosis is before even starting the case!

Before VPs can be added to such a collection, though, we recommend that they be reviewed by different experts focusing on different aspects at the time. Within the iCoViP project, we developed a production line for VPs and several instruments used at each stage of the evaluation. Each stage or phase has specific objectives that should be accomplished and elements that the VP should contain. We believe that running VPs through these stages greatly improves the quality of each VP. This is the lifecycle of creating a VP according to iCoViP's perspective:

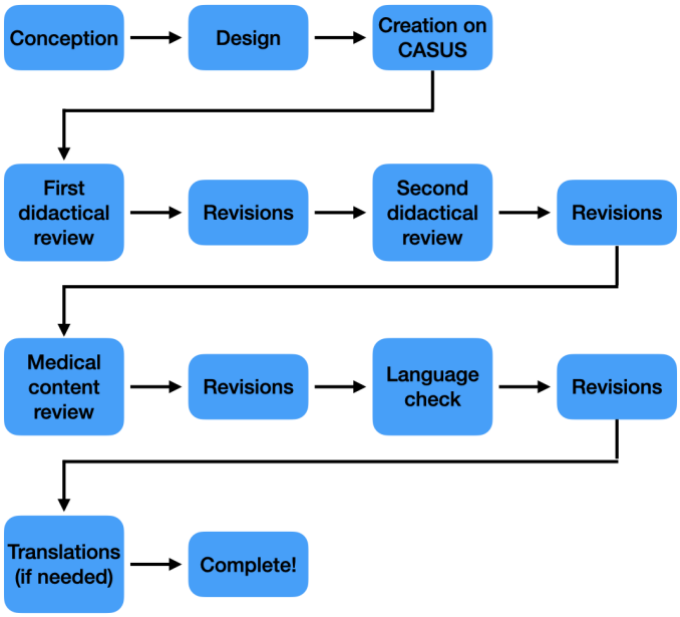

Fig 15. Production line for a creating a VP in CASUS according to iCoViP's model

Conception and design

Each VP starts with an idea. This idea can be improved, expanded and refined during the conception and design phase. The tools provided in this course aid in this phase. This is where all the relevant characteristics and contextual factors are decided beforehand, where the storyboarding occurs, and where all relevant multimedia materials are obtained.

CASUS case creation

The course described in this manual also aids in this phase. This is where you put all the conception and design aspects into a CASUS case to bring your VP to life. This manual focuses only on these two initial phases of designing and creating a VP. After this phase, the VP is ready for review stages.

Didactical review

In this phase, at least one secondary and experienced person goes through your VP and evaluates didactical aspects such as question design, text style, use of multimedia elements and their metadata, and concept map design. The didactical reviewer should provide you with appropriate feedback so you can improve your VP at this stage. We recommend at least two rounds of didactical review, each with its round of revisions. Consider using iCoViP's didactical review document (see annex 5).

Content review

In this phase, another secondary and experienced clinician should check your VP for medical content, including whether it is following up-to-date medical guidelines and protocols in terms of diagnosis and treatment. Feedback can be provided in a document or, preferably, directly on CASUS using the feedback option.

Fig 16. The Feedback button is located in the lower left corner of the CASUS system (here, in red)

Language check

In this phase, yet another reviewer should look at your case and evaluate aspects of grammar, spelling, style and any other language aspect that can be improved or corrected. The reviewer should be a native or native-equivalent (C2 level) in the language of your VP. You can decide to either give the reviewer the rights to directly make any changes that they see fit or to provide you with feedback so you can make the changes yourself.

Translations into other languages

If you'd like to reach a wider audience, you can consider translating your VP into other languages. This is an ambitious task, as you will require native speakers of the target languages that you're interested in translating into. These native speakers should also be clinicians or have some sort of clinical or scientific training so that they can properly translate relevant medical terms appropriately.

Complete!

After all these creation and review stages, your VP is complete! You can use your VP independently in your classes as it is or you can consider adding it to a larger VP collection such as iCoViP's VP collection.

Closing

In this session, a bit more time to work on the VPs with guidance and assistance from facilitators and tutors is provided. Additionally, participants learn what to do with their VP after they've created it. In the next session, the course comes to an end with the presentation of participants' VPs and a course feedback.

Week 4, Saturday morning

Materials needed

- Projector
- Computer with Internet connection
- Access to CASUS
- Course feedback survey link

Final VP presentation

Depending on the number of participants and the time at hand, all or a subset of the participants will have the chance to present their VP to their peers, as well as tutors and facilitators. A short discussion after each presentation about didactical or technical aspects can follow suit.

Course feedback

At the end of the course, it is advisable to run a course feedback. We recommend elaborating an online survey beforehand and sharing the link with participants. Participants should fill out the survey after the course in their own time and submit it within the next week. We recommend announcing the survey and sharing the link using a slide and then sending a reminder via email on the second day after the course with the survey link included in the body of the email. The survey may include quantitative and qualitative evaluations of the course, its structure, facilitators, tutors, materials used, didactical techniques used, time allocation, etc. This feedback should be used to improve future installments of the course.

Closing

The course comes to an end with (hopefully!) a satisfactory product such as a virtual patient that can be used for clinical reasoning in different settings. Additionally, participants leave the course with a collection of tools that will aid their future endeavors as VP designers, authors and creators.

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Annexes

- Annex 1: VP design character sheet
- Annex 2: iCoViP's VP checklist
- Annex 3: Normal physical exam in English
- Annex 4: iCoViP's informed consent form to obtain consent to use patient images
- Annex 5: iCoViP's didactical review document

VP NAME

Draw your VP here

Sociodemographics

Age: _____ Profession: _____

Sex:
- ☐ Cis female
- ☐ Cis male
- ☐ Trans FTM
- ☐ Trans MTF
- ☐ Other: _____

Sexual orientation:
- ☐ Heterosexual
- ☐ Homosexual
- ☐ Bisexual
- ☐ Other: _____

Ethnicity: _____

Personality: _____

_____

Environmental

Country of origin _____
living _____

Relevant migration background ☐ No ☐ Yes

Addiction ☐ No ☐ Yes
to _____

Allergies ☐ No ☐ Yes
to _____

Previous diseases ☐ No ☐ Yes
_____
_____

Prev. medication ☐ No ☐ Yes
_____
_____

Previous surgeries ☐ No ☐ Yes
_____

Disease

Disease Group
- ☐ Infectious
- ☐ Traumatic
- ☐ Neoplastic
- ☐ Toxic
- ☐ Idiopathic
- ☐ Congenital
- ☐ Immunologic
- ☐ Metabolic
- ☐ Vascular
- ☐ Other _____

Final Dx _____

Key symptom _____

Differentials
1. _____
2. _____
3. _____

Onset
- ☐ Acute
- ☐ Chronic
- ☐ Subacute

Setting

Scenario end
- ☐ Successful discharge
- ☐ Long-term treatment
- ☐ Death

Encounter setting
- ☐ ER University Hospital
- ☐ ER Rural Hospital
- ☐ ER Hospital
- ☐ University Hospital
- ☐ Rural Hospital
- ☐ Hospital
- ☐ Outpatient Clinic
- ☐ Practice
- ☐ Other _____

Learner role
- ☐ Student ☐ Intern
- ☐ Resident ☐ Consultant
- ☐ Other _____

Notes
_____
_____

VP Checklist - PLEASE MAKE A COPY OF THIS DOCUMENT BEFORE FILLING IT OUT!
Name of VP _____
Date: _____
Author(s): _____

Fill out the “complete” column with either “yes” or “no” whenever possible.
If an aspect doesn’t apply, please fill out the “complete” cell with “NA” (not applicable).
If it’s “no”, please use the “comments” column for clarification.

	Complete - If your answer is "no" please explain in the comments	**Comments**
METADATA		
Correct prefix of VP name		
Language correctly selected		
License selected		
Author’s names are in		
COMPARISON WITH BLUEPRINT		
Do VP aspects match the outline of the blueprint? (e.g. is the stated profession, sexual orientation etc. visible in the VP)		
key symptom		
final diagnosis		
onset		
disease group		
age		
sex		
profession		
ethnicity		
difficult cultural background		
disability		
addiction		
sexual orientation		
scenario end		
encounter setting		
learner role		
STRUCTURE		
Are the cards well structured (not too many aspects on one card)		
Does the VP have an appropriate length (5-10 cards)		

Is the final diagnosis only revealed **after** students have to make the decision		
Are treatment options introduced only **after** reaching a diagnosis?		
The described process (diagnostics, treatment) is based on current guidelines		
Details of the process are relevant for the clinical reasoning of students in general (and not too specific)		
MULTIMEDIA MATERIAL		
All clinically relevant images included and they show the described findings/pathologies		
Audio included (e.g. ECG, x-ray, auscultation sounds, etc.)		
License information entered		
Card 1 includes a matching patient image in a clinical setting (to be done later on)		
Patient image matches patient description in text & blueprint		
TEXT		
Direct speech is used		
Patient / accompanying person describes the key symptom and history in own words (might not be applicable in emergency settings)		
QUESTIONS		
Questions are not repeating what students should do in the concept map		
Students have to interpret images themselves and are prompted with a question to do so		
Such questions include a "normal" or "no pathological finding" option		

Appropriate question type is used		
Questions and answer options are according to didactical principles, such as avoiding negations, clear and comparable answer items, reasonable discriminators (wrong answers)		
Answer comments explain the correct & incorrect solutions (in case of image interpreting an image with illustration arrows can help)		
Questions and answers in the VP are relevant and not too specific and solutions are correct		
CONCEPT MAPPING TOOL		
Has a clear final diagnosis		
Has a "reasonable" number of findings, with the key symptom included		
Has a "reasonable" number of differentials		
Has a "reasonable" number of tests		
Has a "reasonable" number of treatment options		
Has a "reasonable" number of connections		
Working diagnosis, must-not-miss, ruled-out and negations are used (if appropriate)		
Progress is in-sync with the case progression		
References / Links		
The provided references or links are up-to-date		
References / Links are relevant for the symptoms/diagnoses at hand, are freely accessible (not behind a paywall, or accessible through educational institutions), and adapted to the student's level		

Source: https://www.soapnote.org/objective/general-adult-physical-exams/#gsc.tab=0

General Adult Physical Exam

By SOAPnote

GENERAL APPEARANCE: Well developed, well nourished, alert and cooperative, and appears to be in no acute distress.

HEAD: normocephalic.

EYES: PERRL, EOMI. Fundi normal, vision is grossly intact.

EARS: External auditory canals and tympanic membranes clear, hearing grossly intact.

NOSE: No nasal discharge.

THROAT: Oral cavity and pharynx normal. No inflammation, swelling, exudate, or lesions. Teeth and gingiva in good general condition.

NECK: Neck supple, non-tender without lymphadenopathy, masses or thyromegaly.

CARDIAC: Normal S1 and S2. No S3, S4 or murmurs. Rhythm is regular. There is no peripheral edema, cyanosis or pallor. Extremities are warm and well perfused. Capillary refill is less than 2 seconds. No carotid bruits.

LUNGS: Clear to auscultation and percussion without rales, rhonchi, wheezing or diminished breath sounds.

ABDOMEN: Positive bowel sounds. Soft, nondistended, nontender. No guarding or rebound. No masses.

MUSKULOSKELETAL: Adequately aligned spine. ROM intact spine and extremities. No joint erythema or tenderness. Normal muscular development. Normal gait.

BACK: Examination of the spine reveals normal gait and posture, no spinal deformity, symmetry of spinal muscles, without tenderness, decreased range of motion or muscular spasm.

EXTREMITIES: No significant deformity or joint abnormality. No edema. Peripheral pulses intact. No varicosities.

LOWER EXTREMITY: Examination of both feet reveals all toes to be normal in size and symmetry, normal range of motion, normal sensation with distal capillary filling of less than 2 seconds without tenderness, swelling, discoloration, nodules, weakness or deformity; examination of both ankles, knees, legs, and hips reveals normal range of motion, normal sensation without tenderness, swelling, discoloration, crepitus, weakness or deformity.

NEUROLOGICAL: CN II-XII intact. Strength and sensation symmetric and intact throughout. Reflexes 2+ throughout. Cerebellar testing normal.

SKIN: Skin normal color, texture and turgor with no lesions or eruptions.

PSYCHIATRIC: The mental examination revealed the patient was oriented to person, place, and time. The patient was able to demonstrate good judgement and reason, without hallucinations, abnormal affect or abnormal behaviors during the examination. Patient is not suicidal.

Institutional
Logo

Informed consent for the publication of patient multimedia material, such as pictures and videos on the virtual patient platform CASUS

I, (First name & last name) .....
Born:...../...../..... (dd/mm/yyyy) at ……

hereby consent to the use of the multimedia material of my person for the following purposes

- ☐ for teaching purposes in the virtual patient ..... on the CASUS platform in all translated current and future versions

- ☐ under the following Creative Commons license .....

I declare being a major and that I have the full right to make this declaration of consent. In the event that I am a minor or a protected adult, this declaration of consent will be made by the entitled parent or guardian.

I understand that I will not be entitled to receive any payment in consideration for the use of material related to my person as set forth above.

I understand that the virtual patients are worldwide accessible after registration and that registration although intended for medical students is not restricted.
I am aware that my consent is voluntary, and I can withdraw it any time by contacting … and the authors of the virtual patient will endeavour to remove my pictures and videos as quickly as possible. More information about this teaching project is available at https://icovip.eu

_____
Place, date and signature of patient (or parent/guardian, in this event please also indicate the name of the signatory)

_____
Name, place, date, stamp? and signature of explaining physician

Didactical Review

Review comments for VP _____
Reviewer _____
Date of Review _____

Metadata:
Complete and correct, (Correct prefix of VP name, Language correctly selected, License selected)

Comment(s): Suggested solution(s):

Comparison with Blueprint:
Does the VP correspond to the initial outline in the blueprint (e.g. is the stated profession, sexual orientation etc. visible in the VP)

Comment(s): Suggested solution(s):

Structure:
Are the cards well structured (not too many aspects on one card), has the VP an appropriate length (5-10 cards); is the final diagnosis only revealed after students have to make the decision

Comment(s): Suggested solution(s):

Multimedia Material:
All clinically relevant images, audio included (e.g. ECG, x-ray, auscultation sounds, etc.), license information entered, card 1 includes a matching patient image in a clinical setting added

Comment(s): Suggested solution(s):

Text:
Direct speech is used, and patient / accompanying person describes the key symptom and history in own words (might not be applicable in emergency settings)

Comment(s): Suggested solution(s):

Questions:
Questions are not repeating what students should do in the concept map, Students have to interpret images themselves and are prompted with a question to do so. Such questions include a "normal" or "no pathological finding" option. Appropriate question type is used, and questions and answer options are according to didactical principles, such as avoiding negations, clear and comparable answer items; answer comments explain the correct & incorrect solutions (in case of image interpreting an image with illustration arrows can help)

Comment(s): Suggested solution(s):

Concept Mapping Tool:
Has a clear final diagnosis and a "reasonable" number of findings, differentials, tests, treatment options, and connections; working diagnosis, must-not-miss, ruled-out and negations are used (if appropriate). Progress is in-sync with the case progression

Comment(s): Suggested solution(s):

Any other comments:

Comment(s): Suggested solution(s):