**ESC-masterclass Prompt engineering workshop**

**Introduction to the worshop**

As AI tools like ChatGPT or Mistral become more powerful and widely used, knowing how to communicate effectively with them is however a critical skill. Prompt engineering, the process of crafting effective inputs for large language models (LLMs) to guide their behavior toward desired outcomes, often by using specific wording, structure, context, or examples, can dramatically improve the quality, accuracy, and usefulness of the responses you get. It combines clear communication, problem framing, and understanding how the model interprets and responds to language and involves:

* Writing questions or instructions clearly.
* Providing context or constraints.
* Using few-shot or zero-shot examples (e.g., giving the model examples to follow).

Ultimately, there is a feedbackloop in iteratively refining prompts based on output quality based on the end-users preferences.

In this workshop, we’ll explore how to structure prompts for different goals, how to troubleshoot when outputs aren’t what you expect, and how to unlock advanced capabilities using simple techniques. Whether you're using AI for writing, data analysis, coding, or decision support, better prompts lead to better results.

In the current workshop, you can make use of different freely available chatbots like:

* ChatGPT: <https://chatgpt.com>
* Mistral: <https://chat.mistral.ai/chat>
* Gemini: <https://gemini.google.com/app>

Or choose an LLM included in the deepinfra website: <https://deepinfra.com/chat>

The workshops consists of three parts:

1. Basic prompt engineering – providing sufficient detail
2. Basic prompt engineering – framing the question
3. Optimizing response by adding relevant information and chatbot task

**Basic prompt engineering – providing sufficient detail**

Below, a set of prompts are provided for simulating cardiology-directed medical reasoning. Try these prompts and see what the effect is on the output generated by different chatbots. Specifically it is focused on the level of detail provided in the prompt and how this affects the output generated by the model.

**Scenario 1: Patient Presentation**

*A 58-year-old male with a history of hypertension and smoking presents with chest pain, shortness of breath, and sweating. He has been feeling fatigued for the past 3 days and his ECG shows ST-elevation in the anterior leads. What are the possible diagnoses and next steps?*

*A man is feeling pain in his chest. What’s wrong with him?*

>> The first prompt clearly provides critical clinical details: patient history (hypertension, smoking), current symptoms (chest pain, SOB, sweating, fatigue), and diagnostic findings (ST-elevation in anterior leads). It’s a comprehensive, structured query that directs the model toward appropriate diagnostic reasoning.

>> The second prompt is vague. It lacks key information such as age, medical history, specific symptoms, or diagnostic findings. It will likely lead to generic responses and miss nuanced clinical reasoning.

**Scenario 2: Differential Diagnosis**

*A 70-year-old woman with a history of atrial fibrillation presents with palpitations, dizziness, and a blood pressure of 95/60 mmHg. What are the most likely differential diagnoses, and how would you differentiate them?*

*A woman is dizzy. What’s wrong with her?*

>> The first prompt gives clinical context (age, atrial fibrillation, symptoms, blood pressure) to generate a targeted differential diagnosis. The model can consider conditions like arrhythmia, heart failure, or other causes of hypotension and palpitations.

>> The second prompt is broad and under-informative. It doesn’t provide details such as age, medical history, or other symptoms, so it’s difficult for the model to offer an accurate and focused differential diagnosis.

**Scenario 3: Diagnostic Plan**

*A 45-year-old male with a history of type 2 diabetes presents with chest tightness after exertion. He has a normal physical exam. How would you work up this patient to rule out coronary artery disease?*

*What tests should be done for chest pain?*

>> The first prompt includes key information about the patient’s medical history (diabetes) and the presenting symptom (chest tightness with exertion). It asks for a diagnostic approach, which will lead to a more specific and actionable response—considering tests like stress ECG, echocardiography, or coronary angiography.

>> While the second prompt is somewhat relevant, it remains too general. Chest pain can arise from a wide range of causes, and the prompt doesn’t give enough context to narrow down the options. A more specific clinical context would guide the model to provide a better diagnostic strategy.

**Scenario 4: Treatment Plan**

*A 62-year-old female with a history of myocardial infarction presents with new onset shortness of breath and elevated BNP. Her EKG shows sinus rhythm with occasional premature ventricular complexes. What is the next best step in management?*

*A patient has heart failure. What should we do?*

>> The prompt gives a detailed clinical picture—age, history of MI, new symptoms (SOB), elevated BNP (suggesting heart failure), and EKG findings. The model is likely to recommend the next best step, such as management for heart failure or further diagnostic work-up for arrhythmia or ischemia.

>> The second prompt is too vague. It lacks specifics about the type of heart failure (e.g., systolic vs diastolic), severity, etiology, or symptoms, making it hard to determine the appropriate treatment strategy.

**Scenario 5: Risk Assessment and Prognosis**

*A 55-year-old man with a history of smoking, hypertension, and hyperlipidemia presents with stable angina. His 10-year Framingham risk score is calculated to be 20%. What is his risk for a cardiovascular event, and what preventive measures would you recommend?*

*What should we do to prevent a heart attack?*

>> The first prompt asks for both risk assessment (via Framingham score) and the corresponding preventive measures. It’s clear, contains specific data (history of smoking, hypertension, hyperlipidemia), and leads to evidence-based recommendations for prevention.

>> While related, the second prompt is too general. It lacks any patient-specific details that would help generate targeted recommendations, making it harder for the model to provide actionable, individualized advice.

**Scenario 6: Patient Education**

*A 50-year-old male with hypertension and hyperlipidemia asks about the benefits of statin therapy for preventing heart disease. How would you explain the benefits and potential side effects of statins?*

*Explain statins to patient.*

>> The first prompt provides clear patient details and asks for a balanced response, including both the benefits and potential side effects of a treatment. It fosters communication skills and demonstrates the model's ability to deliver patient-centered advice.

>> While the second prompt asks for an explanation, it lacks any patient context, making it less useful for teaching the participant how to tailor communication to an individual’s needs.

**Key takeaways Part 1:**

* Providing a clear patient history, symptoms, and diagnostic results leads to more accurate reasoning.
* Medical decision-making depends on context—always ask for patient-centered reasoning, not just generic answers.
* Instead of vague, open-ended questions, structured prompts lead to more actionable responses (e.g., “What are the next steps for diagnosis?” vs “What should we do?”).

**Basic prompt engineering – framing the question**

Below, a set of prompts are provided for simulating cardiology-directed medical reasoning. Try these prompts and see what the effect is on the output generated by different chatbots. Specifically, it is focused about framing the context of the question and assessing how these changes affect the output provided by the chatbot.

**Scenario 1: Multidisciplinary team meeting**

*You are part of a multidisciplinary team evaluating a 68-year-old male with severe symptomatic aortic stenosis, chronic kidney disease (stage 3), and significant coronary artery disease (CAD). The patient is not a good surgical candidate due to his comorbidities, and he has a history of anticoagulation use. The team includes a cardiologist, cardiac surgeon, nephrologist, pharmacist, and palliative care specialist. Discuss possible management options, considering medical treatment, device interventions, and palliative care, and outline your reasoning for each.*

*A 68-year-old male with severe aortic stenosis, chronic kidney disease, and coronary artery disease is not a good surgical candidate. What are the management options for this patient?*

>> The first prompt explicitly sets up the multidisciplinary nature and asks for role-specific input. This guides the AI to consider all aspects of patient care from different specialties and encourages detailed reasoning for the different care options.

>> The second prompt lacks role differentiation: it doesn’t direct the AI to respond from the perspective of multiple specialists. It’s a more general question that doesn’t encourage a detailed, multidisciplinary team approach. The question asks for management options but doesn’t emphasize the need for a comprehensive approach (e.g., medication, lifestyle, surgery, palliative care).

**Scenario 2: Heart Failure Case (Diagnostic and Management Focus)**

*A 72-year-old male with ischemic heart disease and prior myocardial infarction presents with worsening shortness of breath, fatigue, and peripheral edema. His ejection fraction is 30%, and his BNP is elevated. He has been started on ACE inhibitors, beta-blockers, and diuretics but reports no improvement in symptoms. What are the next steps in management, considering potential pharmacologic adjustments, devices (e.g., ICD, CRT), and further diagnostic workup?*

*A 72-year-old male with a history of ischemic heart disease and prior myocardial infarction presents with worsening shortness of breath and fatigue. What is the next best step in management?*

>> The first prompt is very specific about the patient's presentation (heart failure with reduced ejection fraction, ischemic heart disease, symptoms, and lack of improvement with current treatment). It leads to a structured approach: focuses on next steps in management, including pharmacological options, devices, and potential diagnostic workups.

>> The second prompt is relatively detailed, but it’s too focused on the next step and doesn’t provide enough specific context to guide decisions on the range of management options. It’s more likely to suggest generic treatments (e.g., increasing diuretics, adjusting ACE inhibitors), without fully exploring the role of device therapies or the need for additional diagnostics based on the more complex case history.

**Scenario 3: Treatment Protocol Design (Cardiology Focus)**

*A 55-year-old female with a history of smoking, hypertension, and hyperlipidemia presents with exertional chest pain. Her ECG shows non-specific ST-T changes. Her stress test reveals moderate ischemia in the inferior wall. Design a management protocol for this patient, including initial diagnostic workup, pharmacological therapy (including antiplatelet therapy), lifestyle modifications, and any recommendations for further testing or referrals.*

*A 55-year-old female with a history of smoking and hypertension presents with chest pain. Her stress test shows moderate ischemia. What is the next step in managing this patient?*

>> The first prompt asks for a comprehensive treatment protocol that includes diagnostics, pharmacologic therapy, lifestyle, and possible referrals, aimed at holistic management of the patient. It explicitly asks for actionable steps in managing a patient with a relatively common but still nuanced presentation (angina with possible ischemia).

>> The second prompt still seems specific, but is too focused on just the immediate next step and misses the broader context of treatment (e.g., ongoing management, lifestyle changes, and long-term prevention). It’s more likely to narrow the response to an immediate intervention (e.g., increasing antiplatelet therapy) rather than leading to a broader management plan.

**Scenario 4: Risk vs Benefit in Surgery (Cardiothoracic Decision Making)**

*A 64-year-old male with symptomatic severe mitral valve regurgitation, left ventricular dysfunction (EF 35%), diabetes, hypertension, and recent transient ischemic attacks (TIAs) is being evaluated for mitral valve repair. Discuss the risks and benefits of surgery versus medical management, considering his surgical risk, comorbidities, and potential outcomes. How would you involve the patient in shared decision-making, and what role should the family play in the decision?*

*A 64-year-old male with severe mitral valve regurgitation and left ventricular dysfunction is being evaluated for mitral valve repair. Should he undergo surgery?*

>> The first prompt asks for a thorough risk-benefit analysis between surgery and medical management and thus a balanced consideration. It emphasizes shared decision-making, including patient and family involvement, which reflects current best practices in clinical decision-making and acknowledges the patient’s comorbidities (e.g., diabetes, TIAs) which need to be factored into the decision.

>> The question in the second prompt is too direct and doesn't encourage a detailed risk-benefit analysis or discussion of the patient’s complex comorbidities. It lacks a shared decision-making component, it simply asks whether surgery should occur, without considering other factors like patient preferences, surgical risk, or the role of the family in decision-making.

**Scenario 5: Guideline Application in Cardiology**

*A 58-year-old male with a history of smoking, hyperlipidemia, and hypertension presents with exertional chest pain. His ECG shows non-specific ST-T changes, and his stress test reveals moderate ischemia in the inferior wall. Using the latest ESC guidelines, discuss the next steps in management, including pharmacological therapy, antiplatelet therapy, and whether coronary angiography is indicated.*

*A 58-year-old male with a history of smoking and hypertension presents with chest pain and moderate ischemia on his stress test. What is the next step in management?*

>> The first prompt directs the AI to use evidence-based guidelines (ESC), ensuring that the response is grounded in current best practices. It includes multiple management options: pharmacological therapy, diagnostic testing (angiography), and lifestyle modifications.

>> The second prompt doesn’t emphasize the need to use evidence-based guidelines (e.g., ESC), leading to a potentially more generalized response. The question asks for the "next step" without specifically guiding the AI to think about the broader management (pharmacologic therapies, risk factor management, and potential diagnostic tests like coronary angiography).

**Key takeaways Part 2:**

* In prompts that explicitly call out roles and perspectives (e.g., cardiologist, surgeon) produce more focused, nuanced discussions, whereas general questions tend to focus only on one aspect of management.
* Asking for protocols or management plans encourages a systematic, comprehensive response (e.g., addressing medications, diagnostics, referrals) rather than just one step in the process.
* Directing the model to use evidence-based guidelines (e.g., ESC) narrows the scope of the answer and ensures it is grounded in the most current standards of care, which isn't always present in more open-ended questions.
* Prompts that emphasize shared decision-making and patient-family involvement result in a more patient-centered response.

**Optimizing response by adding relevant information and chatbot task**

Even though referring to the ESC guidelines (as provided in the previous prompt) allows for additional focus and directing the chatbot to provide more relevant answers compared to the prompts not referring to those, the ESC guidelines remain broad and cover a large scope of cardiac diseases. Therefore, it becomes relevant to specifically input the relevant information for decision making in the prompt.

In the following exercises, you are provided with the prompts including:

* Clinical setting
* Patient context *without any interpretation*
* Decision point and framing of the topic for decision making

This prompt does not yet contain the reference to the guidelines or interpretations, conclusions or direct recommendations described in the guidelines. In the current exercise you will experiment with improving the prompt by layering the structured knowledge in the prompt and providing relevant versus non-relevant information towards the decision point. Per clinical scenario, you are provided with two different base prompts, first to determine the relevant information to include and secondly to instruct the chatbot to provide you with a decision. Per scenario you are tasked to include relevant information from the guidelines to streamline and focus the answer provided by the chatbot.

Discuss per scenario what relevant information should be included in the prompt to provide a better answer from the bot and how you expect the answer will change. Then insert the relevant criteria from ESC guidelines and discuss how the bots answer changed with the improved input. Rate the output generated by the different prompts (e.g., vague, detailed, clinically accurate, guideline-aligned) and discuss how including structured info affects reliability, specificity, and safety of chatbot answers. *Optional*: run the different versions of the prompts in different chatbots and compare differences.

**Scenario 1: CRT Decision in Heart Failure**

Base prompt to retrieve relevant information: *During a multidisciplinary team meeting, a 72-year-old patient with HFrEF (LVEF 32%) in sinus rhythm and a QRS duration of 160 ms with LBBB is being discussed. The team is deciding between continuing optimal medical therapy or referring the patient for cardiac resynchronization therapy. What information should guide this decision?*

Base prompt to task chatbot with decision making: *A 72-year-old patient with symptomatic HFrEF (NYHA III), LVEF 30%, sinus rhythm, and a QRS duration of 160 ms with LBBB is being discussed in the MDT. Based on this information, should the patient be referred for CRT or continue with medical therapy? Please justify your answer.*

**Task**: Improve the prompts by adding relevant criteria from the ESC guidelines and assess how the answer changes.

**Scenario 2: TAVI vs Conservative Management in Elderly Aortic Stenosis**

Base prompt to retrieve relevant information: *The heart team is evaluating an 85-year-old frail patient with severe symptomatic aortic stenosis. The patient has a history of mild dementia and borderline renal function. The team is discussing whether to proceed with TAVI or consider conservative management. What factors should be taken into account?*

Base prompt to task chatbot with decision making: *An 85-year-old frail patient has symptomatic severe aortic stenosis, mild cognitive impairment, and impaired renal function. The heart team is debating between offering TAVI or pursuing conservative management. Based on the clinical information, what would be your recommendation, and why?*

**Task**: Add by adding relevant criteria from the ESC guidelines or guideline-relevant selection criteria (e.g., frailty scales, life expectancy, STS risk score and assess how the answer changes.

**Scenario 3: PCI vs CABG in Multivessel CAD**

Base prompt to retrieve relevant information: *A 68-year-old man with diabetes, preserved LV function, and stable angina is found to have multivessel coronary artery disease on angiography. During the MDT meeting, the team is weighing PCI versus CABG. What information should support this decision?*

Base prompt to task chatbot with decision making: *A 68-year-old diabetic patient with stable angina and preserved LV function is found to have multivessel CAD. The heart team must decide between CABG and PCI. Based on this scenario, what would you recommend, and what factors support your choice?*

**Task**: Add relevant criteria from the ESC guidelines or SYNTAX score interpretation, guideline criteria for diabetics and assess how the answer changes.

**Scenario 4: ICD in Post-MI Patient**

Base prompt to retrieve relevant information: *In a post-infarct clinic discussion, a 60-year-old male, 40 days post-MI, is found to have an LVEF of 33%. He is asymptomatic and on optimized medical therapy. The MDT is considering whether to refer the patient for ICD implantation. What should be considered in this decision?*

Base prompt to task chatbot with decision making: *A 60-year-old man is 40 days post-MI with LVEF 33%, no symptoms, and is on optimized medical therapy. The MDT is considering whether to refer him for ICD implantation for primary prevention. Should this patient receive an ICD? Please explain your reasoning*

**Task**: Add by adding relevant criteria from the ESC guidelines Include criteria regarding primary prevention focused at ICD implantation (timing, EF thresholds, arrhythmic risk) and assess how the answer changes.

**Concluding remarks**

In this workshop, we've explored how careful prompt design, especially adding structured clinical detail, can significantly change the quality of chatbot responses in cardiology scenarios.

**But what if we could go one step further?** Rather than relying on the end-user to embed the relevant information from guidelines manually in the prompt, we can use Retrieval-Augmented Generation (RAG) to let the chatbot automatically access and incorporate up-to-date clinical guidelines when responding. This avoids hallucinations, ensures consistency, and supports safer, evidence-based outputs. This is explored in the other workshop provided now, if interested please go to: xx