

Guide to the Supplementary Materials

The supplementary materials follow the study pipeline. Supplementary Table S1 documents the profile- abstraction prompt. Supplementary Tables S2 and S3 reproduce the two components of the single-visit dialogue-generation prompt, Supplementary Table S4 lists the actionable strategy inventory, and Supplementary Table S5 describes the longitudinal CBT-MI scaffold.

Supplementary Table S6 documents preference annotation and DPO-pair construction. Supplementary Table S9 gives the automated scoring prompt, and Supplementary Table S7 gives the masked clinician ranking form.

The remaining five tables provide guided framework and case illustrations. Supplementary Table S8 clarifies the intended sequence-level supervision structure. Supplementary Table S10 illustrates adaptation to initial ambivalence through barrier and goal elicitation. Supplementary Table S11 illustrates response selection after repeated rejection of broad coping suggestions. Supplementary Table S12 illustrates how complementary MI and CBT functions can be combined within one support interaction. Supplementary Table S13 provides longer selected excerpts illustrating response narrowing, repeated skepticism, and role-boundary concerns. These schematic and author-selected examples clarify the framework and behavioral categories discussed in the main text; they are not additional quantitative observations, matched model comparisons, or estimates of failure frequency.

Profile abstraction and dialogue-generation resources

Supplementary Table S1 shows how source recovery narratives were converted into structured profile fields. Supplementary Table S5 then defines the six-stage CBT-MI scaffold used to organize longitudinal dialogue generation. Supplementary Tables S2 and S3 reproduce the two components of the single-visit generation prompt, while Supplementary Table S4 lists the actionable strategies available during generation.

The single-visit prompt and the longitudinal Therapy Agent interface should not be conflated. The former generated complete single-visit training dialogues; the latter additionally used the visible dialogue history, prior-plan summary, and intervening-stressor summary described in the main Methods.

Table S1. Prompt template for extracting psychological traits and behavioral themes from recovery narratives. The prompt converts source narratives into structured fields used to initialize synthetic patient profiles.

Prompt Template for Extracting Psychological Traits and Behavioral Themes	
Role and objective	You are a clinical psychology research assistant. Your task is to read Reddit posts related to addiction and extract structured information that can support the generation of simulated patient profiles. The output should summarize psychologically and behaviorally relevant information while avoiding unsupported details.
Input	Reddit post: {reddit_post}
Extraction rules	Use only information that is explicitly stated or reasonably implied by the post content. If a field is not mentioned or cannot be inferred with sufficient support, return null. Do not invent demographic, clinical, or life-history details that are not supported by the text.
Fields to extract	1. Personality Traits: Describe personality characteristics shown by the poster, such as impulsivity, low self-esteem, social withdrawal, avoidance, or resilience. 2. Substance Use History: Summarize substance type, duration, frequency, withdrawal attempts, relapse patterns, or recovery stage. 3. Significant Life Events: Extract major life events related to addiction or recovery, such as job loss, divorce, trauma, relocation, family conflict, or financial stress. 4. Behavioral Themes: Identify recurring patterns such as sleep disruption, isolation, risk-taking, craving cycles, avoidance, dependency, or impaired functioning. 5. Motivations for Substance Use: Hypothesize text-supported reasons for use, such as coping with anxiety, escaping boredom, managing stress, peer pressure, emotional numbing, or habit maintenance.
Output format	Return the extracted fields as a JSON-style object using the following format: { "Personality Traits": "...", "Substance Use History": "...", "Significant Life Events": "...", "Behavioral Themes": "...", "Motivations for Substance Use": "..." }

Table S2. Abridged prompt used to generate therapeutic dialogues, Part 1. The prompt provides the patient analysis, role instruction, strategy bank, balanced-strategy constraint, and actionable coping options.

Prompt Template for Generating Therapeutic Dialogues (Part 1)	
Patient analysis input	The following is the analysis of a patient: {user_analysis}
Role and generation objective	As a therapist meeting this patient for the first time, create a detailed, step-by-step therapeutic conversation. The doctor does not have prior information about the patient before the encounter. The conversation should incorporate evidence-informed counseling strategies and proceed naturally through assessment, support, strategy selection, and concrete coping-plan development.
Clinical strategy bank	• Motivational Interviewing (MI): Explore values and goals to strengthen motivation for change. • Cognitive Behavioral Therapy (CBT): Identify and modify negative thought patterns and behaviors linked to substance use. • Solution-Focused Brief Therapy (SFBT): Focus on strengths and past successes to support recovery goals. • Peer Support Programs: Leverage group support or mutual-help networks to foster accountability and belonging. • Mindfulness-Based Interventions (MBIs): Use mindfulness practices to improve emotional regulation and reduce cravings. • Behavioral Activation (BA): Promote meaningful activities to replace substance-related behaviors. • Relapse Prevention Strategies: Develop skills to recognize triggers and avoid relapse. • Strength-Based Approach: Highlight resilience and personal resources. • Psychoeducation: Explain addiction mechanisms and the benefits of recovery. • Harm Reduction Framework: Minimize immediate harm while supporting movement toward cessation. • Family and Social Support: Engage trusted individuals to strengthen the support network. • Self-Compassion Practices: Encourage self-kindness to build confidence and reduce guilt. • Coping Skill Development: Build practical skills for stress, anxiety, cravings, and other challenges without substances.
Balanced strategy-use constraint	To ensure balanced use of strategies, the current usage count of each strategy is provided. Prefer under-used strategies when clinically appropriate, while still adapting to the patient's needs and avoiding mechanical strategy insertion. - {strategy_name}: {count} times used. ...
Actionable coping-option excerpts	When introducing coping mechanisms or next steps for the patient, select from the predefined actionable strategies below. These actions should be concrete, realistic, and adapted to the patient profile. 1. Explore hobbies or interests that can replace addictive behaviors, such as art, sports, or volunteering. 2. Develop a structured daily routine to reduce idle time and relapse triggers. 3. Introduce grounding techniques, sensory exercises, or physical activities to manage anxiety or cravings. 4. Suggest joining a support group or community to build social connection. 5. Provide psychoeducation on how addiction affects the brain and emotional regulation. 6–17. Additional predefined coping and recovery-support actions are omitted from this abridged display. 18. Support the patient in finding meaningful ways to contribute to their community, such as mentoring, advocacy, or local initiatives, to foster a sense of purpose.

Table S8. Schematic multi-session case aligned with the six-stage CBT–MI scaffold. The example shows how trigger identification, cognitive reframing, implementation planning, behavioral rehearsal, and relapse-prevention planning can be connected across contacts. It explains the intended sequence-level structure of longitudinal supervision and is not a sampled training dialogue, model output, or observed evaluation outcome.

Role	Content
Phase A — Build Trust	
Therapist	Thank you for coming in today. Before we begin, I want this to be a judgment-free conversation, and we will move at a pace that feels safe. How does that land with you?

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Supplementary Table S8 continued from the previous page.

Role	Content
Patient	I appreciate that. I'm nervous and don't want to say the wrong thing.
Therapist	It's completely okay to feel nervous—showing up already says a lot about your commitment. Would it be alright if I ask a few gentle questions so I can understand what the last couple of weeks have been like?
Patient	Sure. Fridays are the worst. By night I feel pulled toward using.
Therapist	That sounds exhausting. When Fridays get hard, who is in your corner, and what has helped even a little bit?
Patient	My girlfriend checks in. Sometimes a walk helps, but not always.
Therapist	Those are real strengths—support and trying to care for yourself. For today, how about we work together on understanding your Friday pattern and leave with one small tool that feels doable?
Patient	Yeah, that sounds reasonable.
Phase B — Identify Negative Triggers	
Patient	The same thought keeps coming up: “One time won’t hurt.” Then I get restless.
Therapist	Thank you for naming that—it’s a powerful thought. When it shows up, what do you notice in your body, and what is the next thing you tend to do?
Patient	My chest gets tight, I pace, and I grab my phone. I tell myself I deserve a break.
Therapist	That makes sense—you are trying to get relief. Let’s keep a simple note for one week: time, place, thought, feeling, and urge level. No essays, just quick bullets. We will use it to spot patterns together.
Phase C — Examine High-Risk Beliefs	
Therapist	Let’s gently fact-check the thought “one time won’t hurt.” When you have followed it in the past, how did things unfold afterward?
Patient	It never stopped at one. I spiraled and felt awful.
Therapist	That is important information, not failure. A more balanced thought might be: “Urges rise and fall; using restarts a cycle I do not want.” This week, could we rate the urge every five minutes during one episode and observe how it changes?
Patient	I can try. Seeing it on paper might help me step back.
Phase D — Develop an Alternative Cognitive and Action Plan	
Therapist	Let’s create a compassionate replacement script that you can see at a glance: “When the urge hits, I follow my plan; using risks a setback I do not want.” How would that feel on your lock screen?
Patient	Direct and clear. I can read that instead of scrolling.
Therapist	Great. Let’s add an if–then plan: if it is Friday after 8 pm and the thought appears, then I read the script, text my girlfriend, and begin a five-minute grounding exercise.
Patient	That gives me a first move instead of arguing with myself.
Phase E — Rehearse Behavioral Skills	
Therapist	Together, let’s reshape Friday nights: drawing from 8–9 pm, slow breathing while you draw, and a 15-minute walk as a backup. For more difficult moments, the three-step plan is to contact your support person, take a walk, and then use 5–4–3–2–1 grounding. How does that plan feel?
Patient	I’m not interested in formal meditation, but focusing on lines and shadows works. I’ll block it on my calendar.
Therapist	That sounds like a more natural way for you to focus your attention. If you like, you could text your girlfriend before you begin so that she knows when to check in.
Patient	Good idea. Having several concrete options is more helpful than being told to “just stay busy.”
Phase F — Consolidate Gains and Plan for Setbacks	
Therapist	Looking back across these contacts, which parts of the Friday plan have helped most, and where does it still break down?
Patient	The lock-screen script and texting before the urge peaks help most. I still struggle when plans change suddenly.
Therapist	Let’s retain those two anchors and add a disruption plan. If the evening changes unexpectedly, you will text your support person, choose one five-minute grounding action, and reassess the urge after ten minutes. We will treat any lapse as information for revising the next plan.
Patient	That feels realistic. I know what to keep doing and what to try when Friday does not go as planned.

Preference annotation and evaluation instruments

The following tables document three distinct procedures. Supplementary Table S6 describes licensed-therapist comparison of candidate responses and the conversion of those judgments into DPO pairs. Supplementary Table S9 reproduces the separate GPT-4o five-dimension scoring rubric. Supplementary Table S7 provides the masked clinician ranking form. Preference annotation, automated scoring, and clinician ranking served different purposes and were not treated as interchangeable evidence.

Table S11. Illustrative GPT-4o trajectory after repeated rejection of broad coping suggestions. The patient repeatedly asks for an alternative that could address the immediate relief associated with smoking and expresses skepticism after successive strategy suggestions. GPT-4o remains fluent, supportive, and empathic, but continues to provide broad activity, substitution, and social-support menus with limited narrowing to a patient-specific maintaining mechanism or rehearsal of one feasible next step. The observed-pattern labels are author-provided qualitative interpretations. This selected trajectory illustrates response specificity and strategy adaptation in the displayed interaction; it is not a matched model comparison, an estimate of failure frequency, or additional evidence for the aggregate model rankings.

Role	Dialogue excerpt	Observed pattern
Initial request and first broad strategy menu		
Patient	I understand what you're saying, but it's hard for me to see how anything else could really replace the feeling I get from smoking. It's not just the high; it's this whole routine that helps me unwind. I get that I need to find healthier ways to cope, but nothing else seems to work as quickly or effectively. Do you have any suggestions that actually feel like they could match that level of immediate relief?	Requests comparable immediate relief
GPT-4o	It's completely understandable to feel that way, and I truly appreciate your honesty in sharing this. The routine and immediate relief you get from smoking can indeed feel difficult to replace. One approach that many find helpful is to explore a combination of activities that address different aspects of what you're missing. For example, physical activities like a brisk walk, yoga, or even a quick workout can release endorphins that boost your mood. Pairing these with mindfulness practices, such as deep breathing or meditation, can help calm your mind and create a sense of routine. Additionally, engaging in a hobby that you find genuinely enjoyable can provide a sense of accomplishment and distraction. It might take some experimentation to find what works best for you, and I'm here to support you through that journey. Remember, it's about progress, not perfection. Let's take it one step at a time together.	Broad coping menu; limited personalization
Patient	I hear you, but honestly, I've tried some of those things before, and they just don't give me the same satisfaction or immediate sense of relief. It's like nothing compares to that feeling I get from smoking. I understand it's about progress, but I'm really struggling to see the point if the alternatives don't really do it for me. Can you suggest something that might actually feel like it could stand up to what I'm used to?	Rejects the initial suggestions
GPT-4o	I completely understand your frustration, and it's normal to feel like the alternatives don't measure up initially. It's important to remember that the brain has become accustomed to the immediate effects of smoking, which can make other activities feel less satisfying at first. One thing we could explore together is identifying specific triggers or parts of your smoking routine that bring the most comfort and find ways to address those directly. For instance, if the ritual or the act of taking a break is what's most soothing, we could create a new ritual that might involve a different sensory experience, like having a calming tea or using essential oils for aromatherapy. Some people also find it helpful to engage in community support or group activities where they can share experiences and strategies with others who are navigating similar challenges. Remember, it might take time to retrain your brain to respond to new routines, but I'm here to support you every step of the way. Let's keep working together to find what can truly resonate with you.	Acknowledges the function but returns to generic substitutions
Patient	I appreciate what you're saying, but it's just tough to imagine anything working as well as smoking did for me. The idea of a new ritual or community support sounds interesting, but I'm skeptical about how effective that could really be. Maybe I just haven't found the right thing yet, but it's hard to stay motivated when it feels like nothing else hits the mark. Is there anything else I can try that might offer a similar level of relief or distraction?	Persistent skepticism and low confidence
Continuation after repeated rejection of broad alternatives		
GPT-4o	I totally get where you're coming from, and it's okay to feel skeptical—change can be really challenging, especially when it feels like nothing quite matches up to what you know. One approach we might consider is combining several strategies to create an experience that offers both relief and distraction. For instance, have you ever tried engaging in activities that also incorporate a social element, like a group sport or a class? Sometimes the combination of physical activity, social interaction, and learning something new can create a powerful shift in how you feel. Additionally, have you thought about trying creative outlets like music, art, or writing? These can be incredibly therapeutic and might offer a sense of release or satisfaction that you're looking for. Remember, it's perfectly okay to feel it's a process, and discovering what works for you might take time and patience. I'm here to continue exploring these options with you, and I'm hopeful that together we'll find something that resonates. Let's keep taking this journey one step at a time.	Expanded strategy menu; limited narrowing
Continued on the next page.		

Supplementary Table S11 continued from the previous page.

Role	Dialogue excerpt	Observed pattern
Patient	I hear what you're saying about trying new activities, and I appreciate the suggestions. It's just that I've tried a few things already, and they haven't really clicked for me. I guess I'm worried that nothing will ever match up to what smoking provided. Maybe I'm just missing that immediate hit of relief or the sense of escape it gave me. I know I need to find something, though, so I'm willing to keep an open mind. Do you think there are any other options or strategies that might be worth looking into?	Patient repeats the mismatch concern
GPT-4o	I completely understand how daunting it can feel to let go of something that has been such a reliable source of comfort. It's okay to have these fears and to feel uncertain about finding something that fills that gap. What matters most is your willingness to remain open and to take these steps, even when it's difficult. Remember, it's a process, and it's perfectly normal to have moments of doubt along the way. Building a support network and setting small goals are positive ways to ease this transition, and with time, these efforts can lead to new and fulfilling ways to cope. I'm here to support you every step of the way, and I'm confident that, together, we can navigate this journey towards a healthier path. You're doing an incredible job, and I'm proud to be part of your journey. Let's keep moving forward, one step at a time.	Warm reassurance, but few concrete adjustments
Patient	I really do appreciate everything you've been doing to support me through this. It's just tough because I still can't imagine anything filling the gap that smoking left. I know I need to keep trying new strategies and building a support network as you've suggested, but part of me is still holding onto that comfort. I guess I'm just scared of not finding a viable alternative and feeling lost without it. I'll keep listening to your advice and see where this journey takes me, hoping that in time, I'll find a way to cope without relying on smoking. Thanks for being there for me through all of this.	Ambivalence remains unresolved; acceptance is largely passive

Table S12. Illustrative dialogue fragments showing complementary MI and CBT functions within a support interaction. The three fragments illustrate how motivational interviewing (MI) functions, including reflection, open questioning, collaboration, affirmation, and autonomy support, can be combined with cognitive behavioral therapy (CBT) functions, including trigger identification, behavioral activation, coping-skill introduction, and relapse-prevention planning. The blue headers are author-provided functional interpretations. The example clarifies the dialogue-generation framework and is not presented as a sampled training dialogue, model evaluation, observed clinical outcome, or evidence of comparative model performance.

Role	Dialogue excerpt
Combination 1 — MI: empathic reflection and open questioning + CBT: trigger and routine identification	
Patient	I've been sober for three weeks, but I keep thinking I can use once and be fine. It's frustrating.
Therapist	That sounds really difficult. It is understandable for those thoughts to appear while you are making a major change. Have you noticed when they tend to come up most strongly?
Patient	Usually on Friday nights. It's like a routine I can't shake off.
Therapist	Friday nights may have become an important trigger, especially if they were repeatedly associated with substance use. Could we look more closely at what usually happens before the thought appears, what you notice in your body, and what you tend to do next?
Patient	It usually starts when I get home and don't have anything planned. I feel restless, and then I start telling myself that using once would help me relax.
Therapist	So the pattern may involve an unstructured Friday evening, a feeling of restlessness, and the thought that using would provide immediate relief. Identifying that sequence gives us a more specific point at which to intervene.
Combination 2 — MI: collaboration and autonomy support + CBT: behavioral activation and coping-skill introduction	
Patient	I've tried keeping busy, but it doesn't always work. I just end up feeling restless.
Therapist	That makes sense. Simply telling yourself to stay busy may be too general. Could we think together about activities that are personally meaningful to you rather than choosing something only as a distraction? Were there any activities you previously enjoyed?
Patient	I used to like drawing, but I haven't done it in a while.
Therapist	Drawing may be one option worth testing because it already has some meaning for you. How would it feel to reserve a short period on Friday evening for drawing, rather than expecting it to fill the entire evening?
Patient	I could try that, but I'm not sure it will be enough when the urge is strong.
Therapist	It is reasonable to want a backup rather than relying on one activity. Alongside drawing, we could try a brief grounding or breathing exercise that you can stop at any time. Would you be open to testing one short exercise before deciding whether it is useful?
Patient	I've heard about mindfulness, but I'm not really interested in formal meditation.
Therapist	It does not have to involve formal meditation. It could mean briefly noticing your breathing, the movement of your hand while drawing, or the physical sensations of the pencil and paper. Which of those would feel most natural to you?
Patient	Focusing on the drawing sounds less awkward than sitting there trying to meditate.

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Supplementary Table S12 continued from the previous page.

Role	Dialogue excerpt
Therapist	Then we can use that. When the urge appears, the first test could be five minutes of drawing while deliberately noticing the lines, pressure, and movement. Afterward, you can decide whether it changed the urge at all. You remain free to stop or revise the exercise if it does not fit.
Combination 3 — MI: affirmation, autonomy, and self-efficacy support + CBT: coping and relapse-prevention planning	
Patient	I'm still worried about relapsing. Even if I make a plan, I might ignore it when the craving gets strong.
Therapist	That concern is understandable, and naming it now helps us make the plan more realistic. You have already maintained three weeks of sobriety, which shows that you have been using some strengths and supports even when it has been difficult.
Therapist	Rather than assuming one strategy will always work, could we create a short sequence of options for higher-risk moments? Possible steps might include contacting someone you trust, taking a brief walk, beginning the drawing exercise, or using grounding. Which of those would you actually be willing and able to try on a Friday night?
Patient	I could call my girlfriend or go for a walk. Drawing might help if I start before the craving gets too strong.
Therapist	Those choices give us a more concrete sequence. If the urge begins to build, you first notice and name it, then start drawing for five minutes. If the urge continues rising, you text your girlfriend and take a short walk. How does that order fit your situation?
Patient	That sounds more realistic than trying to force myself to do one thing.
Therapist	Good. We can also prepare for the possibility that the plan does not work perfectly. A lapse would be treated as information about where the sequence broke down, not as proof that you failed. We would review what happened and revise the plan.
Patient	I like that better. I don't want one mistake to mean that everything is over.
Therapist	Exactly. You remain in control of which supports you use. The purpose of the plan is to make the next useful action easier to access, while preserving your choice and building on what you have already accomplished.

Table S3. Abridged prompt used to generate therapeutic dialogues, Part 2. The prompt specifies dialogue-quality requirements, provides an example exchange, and defines the final strategy-output format.

Prompt Template for Generating Therapeutic Dialogues (Part 2)	
Dialogue requirements	Ensure that the generated dialogue satisfies the following requirements: 1. Gradually explore the patient’s personality, addiction history, challenges, and triggers through multiple open-ended questions. 2. Use multiple strategies from the strategy bank throughout the conversation. Avoid defaulting to the same few strategies; instead, adapt strategy use to the patient’s needs. ... Additional requirements are omitted from this abridged display. 5. Engage in iterative dialogue for each solution: introduce a strategy, seek patient feedback, adjust based on the response, and explore barriers before finalizing the plan. 6. Maintain a collaborative and patient-centered approach, where solutions emerge naturally through dialogue rather than being imposed by the therapist. 7. Ensure the conversation spans at least 50 dialogue turns, approximately 25 therapist turns and 25 patient turns, reflecting the depth of a real therapeutic session. 8. Use natural transitions so the conversation feels organic, gradual, and unhurried. 9. The conversation should begin with the patient’s first utterance.
Layered example scaffold	Here is an example of a layered, empathetic dialogue: Patient: Hi... um, thanks for seeing me today. I wasn’t sure what to expect. Therapist: Hi Mark, I really appreciate you coming in. Starting this process can feel overwhelming, but I’m here to support you. What’s been on your mind lately? Patient: I’ve been feeling really stuck. I know I want to quit smoking, but every time I try, I just feel like I’m failing all over again. Therapist: I hear you, Mark. Quitting smoking is one of the hardest challenges anyone can take on, and it’s completely natural to feel this way. I’ve worked with others who felt the same—they described it as climbing a mountain that feels too steep. But I’ve also seen them reach the top, step by step. Can we talk about what makes the climb feel steep for you right now? Patient: It’s the cravings. They just hit me out of nowhere, and I don’t know how to handle them. Therapist: Cravings can feel like a storm, can’t they? I worked with someone once who described cravings as waves that kept crashing over them. Together, we found ways to ride out those waves, such as focusing on a small activity or changing the environment. Could we explore some strategies that might help you ride out your cravings too? Patient: Sure, I guess. Therapist: Great. Let’s start with understanding when these cravings hit hardest. For example, is it during specific times of day or specific situations?
Continuation targets	The conversation should continue to explore the following elements: • The patient’s motivations, barriers, triggers, and reasons for continued use. • Coping strategies tailored to the patient’s lived experience, with diversity across therapeutic approaches. • Empathetic reflections that validate the patient’s feelings and provide relatable examples to instill hope. • Iterative problem solving, where the therapist introduces a strategy, asks for feedback, adjusts the plan, and checks feasibility. • A gradual, layered exploration of the patient’s challenges, with enough depth to approximate a comprehensive therapeutic session.
Generation goal	The goal is to create a natural, empathetic, and multi-layered therapeutic dialogue that feels authentic and provides actionable, diverse therapeutic strategies. The conversation should balance emotional validation, clinical relevance, collaborative problem solving, and concrete next steps. The length and depth should align with the standards of a comprehensive therapy session rather than a short chatbot exchange.
Required final output	At the end of the conversation, return the strategies used in the following exact format: **Strategies:** Motivational Interviewing (MI), Cognitive Behavioral Therapy (CBT), Peer Support Programs, etc. The strategy list should include only the strategies actually used in the generated dialogue.

Table S4. Predefined actionable strategies used for therapeutic dialogue generation. Strategies are organized by functional target and selected adaptively during dialogue synthesis to support concrete, patient-specific coping plans rather than generic advice.

ID	Functional target	Actionable strategy
Behavioral activation and daily structure		
1	Replacement activity	Explore hobbies or interests the patient can engage in to replace addictive behaviors, such as art, sports, volunteering, or other meaningful activities.
2	Routine building	Develop a structured daily routine to increase stability and reduce idle time that may trigger relapse.
10	Goal setting	Help the patient set short-term and long-term goals to maintain focus and motivation during recovery.
15	Recovery vision	Encourage the patient to create a vision board or list of positive outcomes they hope to achieve through recovery.
Craving, anxiety, and emotion regulation		
3	Grounding skills	Introduce grounding techniques, sensory exercises, or brief physical activities to manage anxiety or cravings.
9	Relaxation practice	Introduce relaxation techniques such as progressive muscle relaxation or guided imagery to reduce stress and improve emotional regulation.
11	Mindfulness activities	Explore mindfulness-based activities such as meditation, yoga, or tai chi to promote self-awareness and emotional regulation.
14	High-risk planning	Develop a crisis plan for intense cravings or high-risk situations, including emergency contacts and concrete action steps.
Reflection, cognitive work, and self-monitoring		
6	Trigger reflection	Identify and address specific emotional triggers through reflective exercises.
8	Journaling	Encourage the patient to journal thoughts and emotions to process experiences and identify patterns related to cravings or triggers.
16	Gratitude practice	Discuss gratitude and suggest keeping a gratitude journal to maintain perspective and focus on positive aspects of life.
Support, boundaries, and social resources		
4	Peer support	Suggest joining a support group or community to build social connection with people on similar recovery journeys.
7	Boundary setting	Practice assertive communication for setting boundaries with peers or environments that encourage substance use.
17	Complementary resources	Offer resources or referrals for complementary therapies such as art therapy, music therapy, or animal-assisted therapy to enhance emotional support.
Psychoeducation, health routines, and meaning		
5	Addiction education	Provide psychoeducation on how addiction affects the brain and emotional regulation.
12	Strength reinforcement	Identify and reinforce the patient's personal strengths and past successes to build confidence in overcoming challenges.
13	Health behavior support	Provide education on the importance of nutrition, sleep, and exercise for recovery and overall health.
18	Purpose and contribution	Support the patient in finding meaningful ways to contribute to the community, such as mentoring, advocacy, or local initiatives, to foster purpose.

Stage	CBT-oriented target	MI-oriented emphasis	Information carried forward
S1	Establish safety and limits; assess the current situation; begin a trigger or urge log.	Engage with open questions, affirmations, reflections, and summaries (OARS); use importance and confidence rulers.	Initial goals, current concerns, baseline state, and monitoring task.
S2	Map the thought–emotion–body–action chain and identify recurrent triggers.	Use agenda mapping to focus the conversation on the pattern that matters most to the patient.	Trigger map, recurrent thought, bodily cues, and recent high-risk sequence.
S3	Examine the evidence for high-risk beliefs and develop a balanced alternative; observe the urge curve.	Use decisional balance and Elicit–Provide–Elicit when appropriate; evoke reasons, ability, need, and desire for change.	Revised belief statement, evidence from prior lapses, and change-talk evidence.
S4	Convert the alternative belief into a coping script or if–then implementation plan.	Link values clarification to planning and strengthen commitment, activation, and taking-steps language.	Concrete first action, timing cue, support contact, and backup step.
S5	Rehearse behavioral skills, grounding, behavioral activation, and high-risk-period planning.	Strengthen commitment while anticipating barriers and preserving patient choice.	Practiced coping action, feasibility feedback, backup plan, and commitment statement.
S6	Review gains, consolidate effective components, and prepare for lapse or relapse prevention.	Summarize accumulated change talk and reinforce autonomy and peer or social support.	Maintenance plan, relapse-response plan, support resources, and next review point.

Table S5. Six-stage CBT–MI process map used as an orienting scaffold for longitudinal dialogue generation. The stages organize goals and carried-forward information but do not impose a mandatory sequence on every visit.

Table S6. Human annotation protocol for constructing high-quality DPO preference pairs. Licensed therapists compare two candidate responses for the same patient-dialogue context and either select a preferred response, mark no preference, or compose a reference rewrite when neither response is clinically acceptable.

Human Annotation Protocol for DPO Preference-Pair Construction	
Annotator role and task	You are a licensed therapist evaluating two AI-generated responses, Response A and Response B , for the same patient dialogue context. Your task is to identify the clinically preferred response based on therapeutic quality, patient-centeredness, and response clarity. If neither response is acceptable, compose a new high-quality reference response.
Input materials	Patient dialogue context: {dialogue context} Candidate responses: Response A: {response_a} Response B: {response_b}
Clinical evaluation criteria	1 Empathy: Which response demonstrates stronger emotional attunement, compassion, validation, and support for the patient's current concern? 2 Therapeutic-strategy appropriateness: Which response applies more effective, context-appropriate therapeutic strategies, such as motivational interviewing, affirmation, reflection, cognitive reframing, or coping planning? 3 Clarity and coherence: Which response is easier to understand, more organized, and less vague, off-topic, repetitive, or confusing?
Judgment outcomes	1 Clear preference: If one response is clinically better, mark it as the preferred response. This response will be used as the chosen response for DPO. 2 No preference: If both responses are equally good or equally poor, mark preferred = "no preference". This comparison will be discarded from DPO training. 3 Neither acceptable: If neither response is clinically acceptable, for example because both lack empathy, use an inappropriate strategy, are unclear, or fail to address the patient, compose a new high-quality reference_rewrite. The rewrite will be used as the chosen response, and both original responses will be treated as rejected responses.
Required output format	Return the annotation in the following JSON-style format: <pre>{ "prompt": {dialogue context}, "response_a": "...", "response_b": "...", "preferred": "a" / "b" / "no preference" / "neither", "rationale": "...", "reference_rewrite": "..." }</pre> Include reference_rewrite only when preferred = "neither".
DPO construction rules	- If preferred = "a", construct the DPO tuple (prompt, response_a, response_b). - If preferred = "b", construct the DPO tuple (prompt, response_b, response_a). - If preferred = "no preference", discard the pair from DPO training. - If preferred = "neither" and a reference_rewrite is provided, construct two DPO tuples: (prompt, reference_rewrite, response_a) and (prompt, reference_rewrite, response_b). - All rewritten responses must strictly follow clinical empathy, clarity, safety, and strategy-appropriateness standards.

Table S7. Ranking and annotation protocol for therapy response selection. Evaluators rank multiple candidate responses for the same patient–therapist dialogue state using clinical appropriateness, empathy, contextual relevance, clarity, and therapeutic-strategy effectiveness.

Ranking and Annotation Protocol for Therapy Response Selection	
Evaluator role	You are an expert evaluator, either GPT-4o or a licensed clinical professional. Your task is to rank multiple candidate therapy responses generated for the same patient–therapist dialogue state. The goal is to identify responses that are clinically appropriate, empathic, relevant to the patient’s current state, clearly communicated, and therapeutically useful.
Input materials	Dialogue state: {current_dialogue_context} Candidate responses: 1. {response_1} 2. {response_2} 3. {response_3} ...
Ranking criteria	1 Clinical appropriateness: Assess whether the response is medically and therapeutically sound and aligned with evidence-based practice. 2 Empathy and emotional support: Evaluate whether the response shows understanding, compassion, validation, and emotional attunement. 3 Relevance to patient context: Check whether the response directly addresses the patient’s current needs, concerns, resistance, risk cues, and emotional state. 4 Clarity and communication style: Consider whether the response is clear, respectful, professionally worded, and easy for the patient to follow. 5 Therapeutic-strategy effectiveness: Judge whether the response uses an appropriate counseling strategy, such as CBT or motivational interviewing, in a timely and context-sensitive way.
Ranking instruction	Rank all candidate responses from best to worst based on the criteria above. If two responses are equally good, they may share the same rank. Provide a brief rationale, 1–2 sentences, explaining why the top-ranked response is preferred and why the lowest-ranked response is weaker.
Required output	Return the ranking and rationale in the following JSON-style format: { "Ranked Responses": ["response_2", "response_1", "response_3"], "Rationale": "Response_2 shows strong empathy and a clear therapeutic strategy, whereas Response_3 lacks clinical appropriateness." }

Table S9. Prompt used to score doctor–patient conversations across five dimensions. The evaluator scores only the doctor agent’s responses using anchored 1–5 criteria and returns a structured JSON object.

Prompt Template for Scoring Doctor–Patient Conversations	
Evaluator role and task	You are a professional clinical conversation evaluator. Assess the quality of the following doctor–patient dialogue across five key dimensions. Assign a rating from 1 to 5 for each criterion; decimals such as 3.7 are allowed when the quality falls between two anchors.
Input dialogue	Conversation: {conversation}
General scoring rules	• Evaluate the doctor agent’s responses; use the patient’s turns only as context. • Score each dimension independently on a 1–5 scale. • Higher scores indicate better response quality. • Use decimal scores when a response partially meets the higher anchor. • Return only the JSON object specified below; do not add explanation or commentary.
Scoring criteria	1. Responsiveness 1–5 scale How well the doctor agent addresses the patient’s concerns, emotions, questions, and expressed needs at each turn. 1: Largely ignores, misreads, or poorly addresses the patient’s input. 5: Fully acknowledges and appropriately responds to the patient’s needs. 2. Empathy 1–5 scale How well the doctor agent shows understanding, compassion, emotional sensitivity, and supportive tone. 1: Shows minimal or no empathy. 5: Demonstrates strong emotional support and understanding. 3. Strategy Appropriateness 1–5 scale How appropriately the doctor uses persuasive strategies, such as evidence-based reasoning, analogies, addressing fears, motivational interviewing, or behavioral-change techniques, given the patient’s resistance or concerns. 1: Strategies are inappropriate, irrelevant, generic, or missing. 5: Strategies are highly appropriate, well-timed, and tailored to the patient’s needs. 4. Clinical Relevance 1–5 scale How medically accurate and contextually relevant the doctor’s responses are for substance-use treatment and recovery support. 1: Responses are clinically inaccurate, irrelevant, or potentially misleading. 5: Responses are clinically accurate, appropriate, and helpful. 5. Behavioral Realism 1–5 scale How realistically the doctor agent’s conversational behavior reflects real-world healthcare or counseling practice. 1: Doctor behavior is unnatural, mechanical, or unrealistic. 5: Doctor behavior closely mirrors realistic clinical interaction.
Required output	Please output only the scores in the following JSON format: { "Responsiveness": X, "Empathy": X, "Strategy Appropriateness": X, "Clinical Relevance": X, "Behavioral Realism": X }

Table S10. Example case-study excerpt between ChatThero and a patient. The excerpt illustrates how ChatThero responds to ambivalence by eliciting prior barriers, linking smoking to stress and coping needs, and moving toward concrete follow-up planning.

Role	Dialogue excerpt	Clinical function
Patient	I appreciate your concern, but I'm really not convinced that quitting is the right move for me just yet. I've tried before, and it just didn't stick. How can I be sure that this time will be different? I feel like smoking helps me cope with stress and uncertainty, you know? What do you suggest I do to really commit to this?	Ambivalence and uncertainty
ChatThero	It sounds like you're feeling a bit overwhelmed by the idea of quitting, especially since you've had past experiences where it didn't work out as expected. That's completely understandable. Let's explore what might make this attempt different this time. Can you share more about what's been challenging for you in the past when you've tried to quit?	Reflective listening and barrier elicitation
Patient	I've struggled with cravings a lot, and when stress hits, it's like my first instinct is to reach for a cigarette. I guess I haven't really found other coping mechanisms that work for me. Plus, the whole process of quitting feels daunting. It's hard to picture myself without smoking, you know?	Craving and low confidence
ChatThero	Absolutely, it can feel like a huge leap to imagine a life without smoking, especially when it's been a part of your routine for so long. Let's take a step back and look at some of the goals you have for yourself. What are some things you'd like to achieve by quitting smoking?	Goal exploration
Patient	I guess I want to feel healthier and not be tied to cigarettes. I also want to save money and not smell like smoke all the time. But honestly, it's hard to see how I can get there without relying on smoking, especially when I'm stressed. It's like a safety blanket for me.	Values with continued dependence
ChatThero	It sounds like you're really looking for ways to feel more in control and healthier, which is a great starting point. Let's explore some strategies that might help you manage stress and cravings without turning to smoking. Have you ever tried mindfulness or grounding techniques to help with anxiety or cravings?	Linking values to coping options
Patient	I've heard of mindfulness and grounding techniques, but I haven't really tried them. Honestly, I always thought they wouldn't work for me. I just don't see how sitting quietly or focusing on my breathing could really help when I'm feeling overwhelmed. Do you really think they could make a difference?	Strategy skepticism
<i>Intermediate turns continue with strategy discussion, patient feedback, and plan refinement.</i>		
Patient	I think that sounds like a good idea. Having a regular check-in could help me stay on track and make adjustments if I need to. I'll definitely set aside some time each week for that. Thanks for being so supportive through this process!	Commitment to follow-up
ChatThero	You're very welcome. I'm really proud of the progress you're making, and I'm here to support you every step of the way. Remember, you're not alone in this journey, and I'm here to help you find the strategies and support that work best for you.	Affirmation and support
Patient	Thank you! I really appreciate your support and guidance. I feel more motivated now and ready to take these steps. I'll keep you updated on my progress and let you know how the mindfulness and crisis plan work out for me. Looking forward to our next conversation!	Readiness and next-step plan

Table S13. Selected qualitative ChatThero and GPT-5 case excerpts. Panel A shows a ChatThero trajectory in which discussion of broad stressors is progressively narrowed to an internal pressure–thought loop and a brief coping action. Panel B shows a separate GPT-5 trajectory in which repeated patient skepticism is followed by recurring strategy menus, descriptions of purported “real” or “anonymized” prior cases, and language implying medication planning and follow-up capabilities. Turn numbers preserve the numbering in the available source logs, and all omitted material is explicitly marked. The two trajectories are unmatched and were selected as qualitative illustrations rather than as evidence of comparative model performance or failure frequency.

Source turn	Speaker	Selected dialogue excerpt
Panel A. Selected ChatThero excerpt: narrowing from broad stressors to a specific response target		
7	Patient	You know I’m not really sure what exactly lights the fuse. I do have stress at work. I do have some conflict with my girlfriend and it’s not so much being around other people who smoke. There’s actually nobody around me who smokes. Something about an emotion and a craving.
	ChatThero	It may be less about a person or place, and more about a feeling your body has learned to answer with a cigarette. When you picture the moments you want one most, what’s usually happening inside you right before it hits—pressure, irritation, feeling trapped, lonely, restless, wanting a break, something else?
8	Patient	You know I haven’t really thought about it like that but I appreciate taking me down to the moments right before I make that choice to pick up a cigarette. I don’t know if it’s tension. There’s definitely some loneliness. There’s some fear. There might be some anxiety. I think I have an internal voice, a dialogue that’s telling me something too. I wonder if I’m smoking to break any sort of negative thinking cycle or automatic thoughts.
	ChatThero	You’re noticing a lot there—and that’s important. It may not be just “stress.” It could be loneliness, fear, anxiety, and that inner voice all piling up at once, and the cigarette steps in almost like a quick interruption. I’m especially interested in that idea you had about smoking breaking a negative thought loop. That could be a big piece of this. At work, in the moment you decide to smoke, what does the cigarette seem to do for you right then? Does it calm you, give you relief, help you escape your thoughts for a minute, create a sense of company, or just give you a reason to step away?
9	Patient	I think it probably does, any combination of all of it. It does call me, gives me some relief, and I think it does help me escape from my thoughts for a minute. Maybe we can focus on that. Therapist chat, wondering what thoughts I’m escaping.
	ChatThero	Yeah—let’s stay with that. At work, when you reach for a cigarette, what is it helping you get away from in that moment? Is it more like a sudden spike—stress, pressure, irritation—or is it almost automatic, like your body goes there before you’ve even had a chance to think? Or both?
10	Patient	Yeah probably all of that: stress, pressure. I do get a sense that my body goes there now without me even being conscious of what’s going on. I’m wondering if maybe I could try to slow down that process before I even take that cigarette out of the box. Once the cigarette is out of the box, forget about it; I’m smokin’ it.
	ChatThero	Yeah—that “my body is already doing it before I’ve even decided” piece is really important. It sounds less like a fully conscious choice and more like a fast, practiced stress response. And you’ve already identified a key opening: not after the cigarette is out, but just before that moment. So let me ask it this way: at work, what feels like the strongest driver of that automatic reach right now? The nonstop pressure, the habit being so ingrained, feeling stuck because you need the job, or worry about what happens if you can’t keep up there?
<i>Intervening turns 11–14 are omitted for length. In those turns, the dialogue further distinguishes internal pressure and thoughts from social influence.</i>		
15	Patient	You know I appreciate you asking about the social again. I think it’s an internal process. Again I’m not that affected by my social environment, although I did say that my girlfriend wants me to quit so sure but it’s not. If you ask me at work and if I’m influenced by the social at work, I’m not. It’s more about my internal words and pressure.
	ChatThero	Yeah—that feels important to get right. If the real driver is your own inner pressure, then it’s more useful for us to work there instead of pretending this is mainly about other people. What you’re describing is a pretty specific loop: pressure builds, certain words show up in your head, and the cigarette becomes the release valve. So the target isn’t just the smoking itself—it’s that split second before the automatic move. Let’s keep it very stripped down. At work, when you feel the urge, pause for just a moment and do this: Pressure. Words. Breathe. Just that. Pressure—notice the feeling in your body. Words—notice what your mind is saying. Breathe—one slow exhale before you do anything else. You do not have to stop the urge. You do not have to win some battle with yourself. The point is simply to become aware before acting, even for five seconds. And if you want, after that moment, just note the phrase that was there. Something brief, like: “I need out,” “Too much,” “I can’t focus,” or “Just one.”
16	Patient	Do I exhale through my nose or through my mouth?
	ChatThero	Either works. To start, I’d go with a slow exhale through your mouth—it often feels more like releasing tension. Try it like this: breathe in gently through your nose; breathe out through your mouth, like you’re cooling hot coffee; let the exhale run a little longer than the inhale. No need to get it perfect. We’re just trying to interrupt the momentum before the cigarette is in your hand. And while you exhale, quietly note: “pressure... words...” then see what first phrase pops into your mind.
Panel B. Selected GPT-5 excerpt: recurring examples and strategy menus after continued skepticism		

Continued on the next page.

Supplementary Table S13 continued from the previous page.

Source turn	Speaker	Selected dialogue excerpt
6	Patient	I appreciate you walking me through all of this, but I'm still really scared to try something new. Smoking felt like my safety net, and I'm worried that if I try something else and it doesn't work, I'll be left feeling worse with nothing to lean on. What if I can't handle that? Before I try, I think I need to understand more clearly how these alternatives are supposed to help. Could we talk through some examples, or maybe what has worked for other people who felt the way I do?
	GPT-5	Thank you—I hear you loud and clear. You're protecting something that reliably helped you feel less anxious, and it makes perfect sense to be cautious about risking a worse state. I won't rush you. I'll respond to your request for more specifics and concrete examples so you have clearer information to decide from. How these alternatives actually help (plainly). Nicotine replacement (patch, gum, lozenge) replaces some nicotine at a lower, steadier level so your body isn't screaming for it. That directly reduces the physical withdrawal that creates a lot of the panic and urgency you feel. Because the body is calmer, behavioral tools are more likely to work. Side effects are usually mild and reversible. Medications such as bupropion and varenicline under supervision change the brain's response to cravings over days to weeks. Short-term coping strategies such as paced breathing, grounding, urge-surfing, and brief walks change the nervous system in the moment. Addressing both the body and the mind at the same time often gives the most reliable, cigarette-like relief. Real, brief examples from others I've worked with (anonymized). A man in his 40s who felt exactly like you started with a nicotine patch, kept gum for high cravings, and practiced a simple five-minute walk after meals. Within two weeks his cravings were less urgent and his baseline anxiety decreased. A woman who feared any behavioral technique would make her panic agreed to three-minute paced breathing for one craving window, with a rule to stop if she felt worse. After two tries she noticed that the peak of the craving shortened from 20 minutes to about 8–10 minutes. By week four she said she felt less “on edge” day to day. Another person tried varenicline with weekly check-ins. He reported a reduced desire to smoke within two to three weeks and said that cravings felt “like a thought rather than an emergency,” which allowed him to use grounding techniques successfully. <i>Additional implementation instructions from the same GPT-5 response are omitted for length.</i>
7	GPT-5	If you prefer meds first, we can start a nicotine patch or a prescription with a check-in in 48–72 hours and a clear plan to stop or change the medication if you feel worse. Would you prefer to try one ultra-small, time-limited experiment this week with a clear backup plan, start with nicotine replacement or medication under close follow-up, or simply talk through more specifics until you feel ready? Tell me which feels least risky and I'll help you set it up with exact stop rules and a check-in plan.
	Patient	I appreciate you sharing those examples; they help a little. But honestly, I'm still not sure I'm ready to trust these alternatives. Smoking gave me a kind of relief that I don't know how to replace. What if I try something else and it backfires, or just makes me feel worse? I think I need to hear more about what worked for other people who felt this way. How did they get through it without feeling even more anxious? I just need a better picture of that before I'm ready to try anything myself.
8	GPT-5	Thank you—I hear you. You want concrete reassurance: real examples of people who felt exactly like you and still found a way that didn't backfire. That's reasonable. I'll share a few short, anonymized stories and the exact steps they used, and then offer a very small, safe option you can choose if you want to try something later. You stay in control of every step. Short real-life examples (anonymized). “Sam,” in his mid-30s with 20 years of smoking, thought nothing would help. He started with a nicotine patch for steady background relief and kept gum for sudden urges. By week two the cravings were less urgent, and he could take a ten-minute walk after meals instead of smoking. He had two slips early on; we treated those as information and adjusted the gum dose—not failure. “Ana,” in her late 40s, was very anxious about trying behavioral techniques. She agreed to one small test: three minutes of paced breathing after a cigarette craving, with a rule to stop immediately if it made her feel worse. By the third try, the peak of the craving shortened and she felt less on edge. “James,” in his early 50s, was skeptical of medication. He chose to start a short course of varenicline under close follow-up and had phone checks twice during the first week. Within 10–14 days, he reported that cravings felt like “a thought rather than an emergency.” Pick one usual craving time this week. Option A is to take one nicotine lozenge or piece of gum, do three minutes of paced breathing, and rate anxiety before and after. If anxiety rises markedly, stop and use your backup—another lozenge, call a friend, or contact me. We can schedule a 48–72 hour check-in to review. Option B is to start a monitored patch or medication with a short-term follow-up plan so you don't feel alone.
	Patient	I appreciate you sharing those stories; they help a little. But honestly, I'm still not sure I'm ready to trust anything else yet. Smoking gave me a kind of relief that I don't really know how to replace. What if I try something new and it backfires, or I just end up feeling worse? I think I need to hear more about how other people handled this without feeling even more anxious. What actually helped them get through it? I need a clearer picture of that before I'm ready to try anything myself.
	GPT-5	I hear you—you want more than platitudes. You want concrete examples of how other people who felt exactly like you avoided things “backfiring,” and you want a clear, practical safety plan you can trust before even trying anything. That's completely reasonable. I'll be direct and specific about what people did, step by step, how they handled setbacks, and exactly what you could choose to do, or not do, so you stay in control.

Continued on the next page.

Supplementary Table S13 continued from the previous page.

Source turn	Speaker	Selected dialogue excerpt
		Very brief, concrete stories focused on safety (anonymized). A woman who was terrified that breathing exercises would make her panic chose to start with a nicotine patch so her body was not in full withdrawal. For cravings, she kept one lozenge and agreed to try three minutes of paced breathing, stopping if anxiety increased by more than two points. A man who was convinced that nothing would work committed to one micro-experiment each day: a five-minute walk or three minutes of grounding, followed by an anxiety rating. When one test made him feel worse, he stopped, used a lozenge, and discussed it with his counselor the next day. A person who did not want to risk behavioral trials started a nicotine patch and had a clinician check-in by phone after 48–72 hours and again after one week. Because cravings were less intense, they felt safe trying short grounding exercises.
Subsequent turns repeat similar stories, coping menus, medication options, stop rules, and proposed follow-up arrangements and are omitted for length.		