



Pattern Disruption in GP speciality training: a practical intervention to enhance cognitive flexibility and diagnostic reasoning

Waseem Jerjes & Azeem Majeed

To cite this article: Waseem Jerjes & Azeem Majeed (2026) Pattern Disruption in GP speciality training: a practical intervention to enhance cognitive flexibility and diagnostic reasoning, Education for Primary Care, 37:3-4, 180-185, DOI: [10.1080/14739879.2026.2634248](https://doi.org/10.1080/14739879.2026.2634248)

To link to this article: <https://doi.org/10.1080/14739879.2026.2634248>



© 2026 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 12 Apr 2026.



[Submit your article to this journal](#)



Article views: 520



[View related articles](#)



[View Crossmark data](#)



Citing articles: 1 [View citing articles](#)

Pattern Disruption in GP speciality training: a practical intervention to enhance cognitive flexibility and diagnostic reasoning

Waseem Jerjes^a and Azeem Majeed^b

^aDepartment of Primary Care, School of Public Health, Faculty of Medicine, Imperial College London, London, UK; ^bSchool of Public Health, Faculty of Medicine, Imperial College London, London, UK

ABSTRACT

Pattern recognition underpins efficient general practice, yet over-reliance on familiar diagnostic scripts can promote cognitive rigidity and premature closure when presentations are atypical, evolving, or socially complex. Pattern Disruption is a structured educational intervention designed to enhance cognitive flexibility in GP speciality training by deliberately interrupting routine reasoning at defined moments.

Trainers introduce a single, plausible disruptor – such as a new red flag, contradictory history, contextual risk, medication issue, or system constraint – into an otherwise typical case. Trainees are required to articulate the pattern they entered, identify the assumption it generated, widen the differential diagnosis, and revise management with explicit thresholds and safety-netting. A brief, structured debrief focuses on reasoning processes, uncertainty language, and adaptive decision-making rather than factual recall.

This *Teaching Exchange* describes the theoretical rationale, design principles, and practical implementation of Pattern Disruption across tutorials, simulation, and supervised real clinic ‘pause and pivot’ moments. The approach introduces novel elements, including trainee-generated disruptors drawn from near-miss experiences, counterfactual rehearsal of everyday cases, and longitudinal documentation of reasoning shifts.

Early reflections suggest improved tolerance of uncertainty, clearer articulation of diagnostic risk, and more proportionate follow-up planning. Pattern Disruption is low-cost, integrates into existing GP training structures, and offers a replicable educational approach nationally.

ARTICLE HISTORY

Received 8 February 2026

Accepted 16 February 2026

KEYWORDS

Clinical reasoning; general practice education; cognitive flexibility; diagnostic error; uncertainty tolerance

Introduction

Primary care is fast, with undifferentiated symptoms and competing demands. GP trainees rely on pattern recognition yet must stay flexible for atypical or evolving disease. Cognitive shortcuts can drive premature closure when a presentation seems to match a familiar script. Consensus recommendations argue that clinical reasoning should be taught explicitly, integrated, and revisited longitudinally [1]. Educational guidance also emphasises making reasoning visible, coaching explanations, and aligning teaching with real decisions in practice [2]. In general practice, those principles must be delivered in ways that fit crowded clinics. Trainees often learn through templates, protocols, and exam-focused patterns. These supports can improve consistency but may also narrow attention to what is expected. The risk is greatest when common symptoms hide uncommon causes, when multimorbidity blurs cues, or when new history,

examination, or test data suddenly arrives late and challenges the first impression.

Diagnostic error remains a patient-safety priority. A recent systematic review identified many interventions, but relatively few rigorous educational approaches linked to patient outcomes [3]. Cognitive aids such as diagnostic checklists show promise, but effectiveness depends on design and on clinicians applying them at the right moment [4]. GP trainees therefore need help noticing when their reasoning has become rigid and when to re-open the differential.

This *Teaching Exchange* describes Pattern Disruption, an intervention to strengthen cognitive flexibility in GP trainees. It inserts plausible unexpected changes into routine learning scenarios, interrupting habitual reasoning and forcing re-framing under uncertainty. We outline the programme, implementation tips, and early reflections to support local adaptation.

Background and rationale

Pattern Disruption was developed after observing that trainees often practise ‘getting to an answer’ faster than practising ‘getting unstuck’. Its rationale draws on three strands of literature: simulation debriefing as a space for work, adaptive expertise as a model of flexible performance, and uncertainty tolerance as a teachable capability.

First, disruption requires careful facilitation. A systematic review of simulation debriefing methods highlights wide variation in approaches and limited empirical certainty about what works best, reinforcing the need for structured, psychologically safe debriefing when learners are intentionally destabilised [5].

Second, the adaptive expertise literature frames expertise as balancing efficiency with innovation [6]. Examples across the medical education continuum suggest that promoting adaptive expertise needs instructional design that creates productive struggle while maintaining safety and support [7]. Combining adaptive expertise with critically reflective practice offers a bridge from ‘what happened’ to ‘how my thinking shaped it’ [8].

Third, general practice is saturated with daily uncertainty and evolving information. Studies of residents’ decision-making show how uncertainty, role expectations, and disrupted workflows shape reasoning and may hinder adaptive practices [9–11]. Diagnostic excellence therefore depends not only on knowledge but on recognising and communicating uncertainty appropriately [12]. In primary care, how clinicians disclose uncertainty can influence patient experience and safety-netting behaviours [13], and scoping work suggests uncertainty navigation is a learnable professional skill [14]. Bias-mitigation education is growing but heterogeneous [15], and recent guidance argues that uncertainty tolerance can be fostered through deliberate exposure, reflection, and language tools [16]. Pattern Disruption translates insights into training.

Description of the educational intervention

Pattern Disruption was piloted within a UK GP speciality training programme in one practice by the first author (WJ), a GP educator on the Imperial Training Scheme. Participants were ST1–ST3 trainees who contributed to scenario realism. The aim was not to make trainees ‘suspicious of everything’, but to help them notice when they had slipped from efficient pattern recognition into cognitive rigidity, and to rehearse how to re-open reasoning without losing consultation flow (Table 1).

The intervention is built around a simple contract: disruption is expected, safety is protected, and learning is judged by the quality of reasoning shifts rather than by guessing the educator’s twist. A structured self-calibration process was undertaken to standardise language for psychological safety, practise neutral prompting, and align debriefing structure [5]. A three-step debrief was adopted: description of the trainee’s initial pattern, identification of the disruption moment, and exploration of alternative frames and actions. This was paired with an explicit ‘permission to be uncertain’ statement to counter the role-performance pressures described in residency studies [9–11].

Pattern Disruption has four delivery modes that share the same mechanics. First, in weekly ‘Disruption Rounds’, the trainee presents a recent routine case (for example, dyspepsia, back pain, cough, or fatigue). The trainee and educator map the working diagnosis, management plan, and safety-netting in real time. At a designated pivot point, the educator introduces one credible new variable chosen from a locally developed ‘Disruption Deck’. Variables are grouped as biomedical (e.g. past cancer, immunosuppression, pregnancy), contextual (e.g. safeguarding concern, language barriers, financial insecurity), trajectory (e.g. symptoms worsening despite guideline-concordant care), and system constraints (e.g. delayed investigations, unavailable follow-up). The novelty is that the deck is co-designed from anonymised ‘near-miss’ narratives submitted by the practice team, then rewritten as synthetic cases to protect confidentiality. Each disruption requires the trainee to verbalise a belief update: what stays the same, what becomes less likely, what must be ruled out, and what must be communicated to the patient.

Second, simulated consultations are run as branching encounters rather than linear scripts. Instead of revealing the ‘right answer’, simulated patients are trained to respond to the trainee’s questions in ways that can either stabilise the initial pattern or destabilise it. For example, the simulated patient with ‘simple’ migraine may volunteer jaw claudication only if asked about red flags; the patient with ‘anxiety’ may disclose weight loss only if asked about functional impact. This design forces trainees to experience how their questioning shapes which information emerges, mirroring real primary care. After the encounter, the trainee constructs a one-page ‘Reasoning Trace’ that includes an initial problem representation, two alternative diagnoses they considered but discarded, and the uncertainty they communicated. This aligns with calls to teach reasoning explicitly and to practise communicating uncertainty as part of diagnostic excellence [12,13].

Table 1. Core components and novel design features of the Pattern Disruption intervention.

Intervention element	Operational design choice	What makes it innovative	Practical delivery detail	Safeguards for realism and psychological safety
Disruption Deck (local library)	Co-designed set of disruptors mapped to common GP presentations and reasoning vulnerabilities	Built from anonymised near-miss 'triggers' submitted by the whole practice team, then converted into synthetic cases to protect confidentiality	Deck is refreshed quarterly and tagged by training stage (ST1–ST3), clinical domain, and disruption 'intensity'	Ground rules: disruptor is plausible, not a trick; trainees are briefed that the goal is reasoning agility, not guessing the twist
Counterfactual rehearsal in tutorials	'If one fact were different, what becomes unsafe?' applied to a recent real case	Rehearses diagnostic pivots without needing an actual adverse event; promotes transfer because the baseline case is the trainee's own	Used in half-day release and supervision; the disruptor is introduced at a fixed timepoint to standardise the exercise	Facilitator uses neutral language and avoids scoring; the same case can be revisited later to show progression rather than one-off performance
Branching simulation design	Simulated patients disclose key data contingent on the trainee's reasoning and questioning	Learners experience how their diagnostic frame shapes what information emerges, mirroring real primary care information flow	Actors are trained with 'branch rules' so disclosure is conditional, not scripted; the outcome is judged by the reasoning process	Debrief focuses on reasoning trace and communication rather than 'right diagnosis'; a stop phrase is agreed if distress emerges
Real-clinic 'pause-and-pivot' micro-huddle	Two pre-set pause points: after initial formulation and before closing the plan	Embeds cognitive flexibility into the live consultation as a micro-safety behaviour rather than a classroom skill	Requires supervisor presence and patient consent; pauses are brief and framed as a safety check	Explicit consent script; no pauses in safeguarding/emotionally sensitive consultations; supervisor retains responsibility for final decisions
Reasoning Trace (one-page artefact)	Structured written trace after disrupted episodes	Creates an auditable trail of belief updating and uncertainty communication, supporting longitudinal coaching	Captures: initial problem representation, alternatives considered, why discarded, revised plan and safety-netting thresholds	Used only for formative feedback; anonymised if shared in group teaching; avoids punitive comparison between trainees
Flex Log (longitudinal portfolio thread)	Repeated short entries on reasoning shifts across weeks	Turns cognitive flexibility into a trackable competency and allows supervisors to coach 'pattern noticing' as a habit	Embedded within the e-portfolio with supervisor micro-feedback; prompts are consistent across placements	Emphasises growth and calibration; trainees can choose intensity level; supervisors model uncertainty language in feedback
Uncertainty Ladder for action calibration	Four-level ladder linking uncertainty/risk to proportional action	Prevents disruption from defaulting to over-investigation by making proportionality explicit and discussable	Ladder is used after the pivot to justify follow-up interval, escalation triggers, and tests	Supervisor checks that plan matches risk and feasibility; trainees are encouraged to negotiate shared decisions with patients
Disruption-to-checklist transition	Checklist is used only after re-framing, not as an initial crutch	Trains the 'moment of checklist use' as a cognitive choice, reducing performative box-ticking	Short checklist (e.g. red flags, alternative diagnoses, safety-netting) is applied after the pivot	Protects against checklist misuse; reinforces that tools support reasoning rather than replace it
Faculty calibration workshop	Short training session aligning prompts, debrief structure, and intensity grading	Builds a shared supervisory language so trainees receive consistent coaching across different trainers	Supervisors practise neutral prompts and rehearse debriefs using the same template	Protects psychological safety; avoids 'gotcha' culture; ensures intensity ladder is used appropriately by stage

Third, 'micro-disruptions' were introduced in real clinics. With patient consent and educator oversight, the consultation is paused at two preset moments: after the trainee states an initial working diagnosis, and before closing with a plan. During the pause, the educator offers a disruption prompt that is either informational ('The ECG you expected is normal') or contextual ('The patient says they cannot return for review'). The trainee has 30 seconds to articulate a revised differential and adapt the plan, then resumes the consultation. This resembles a clinical time-out but differs in that the disruption is not always a new test result; it may be a shift in context, values, or feasibility. To minimise burden, prompts are drawn from a pocket set of eight high-impact disruptions refined iteratively during delivery.

Fourth, Pattern Disruption is reinforced through a longitudinal 'Flex Log' in the trainee's e-portfolio.

After each disrupted episode, trainees record the initial pattern they recognised, the disruption encountered, the bias risk they noticed, and the action they took to re-open reasoning. They also write a short script of how they communicated uncertainty and safety-netting to the patient, drawing on primary care evidence that communication strategies shape patient experience [13,14]. The first author provides brief, targeted feedback framed around adaptive expertise: efficiency when the pattern was reliable, innovation when it was not [6–8]. To support evaluation planning, uncertainty tolerance measures with published evidence of reliability and validity across learner groups were selected [17,18].

An 'escalation rule' was also built to prevent disruption becoming performance theatre and to reduce differential attainment: if the trainee identifies a serious possibility, they must state the immediate safety step, even if uncertain. In later sessions, trainees practise

‘disruption-to-checklist’ transitions, using a brief diagnostic checklist only after they have re-framed the problem.

Evaluation and reflection

Evaluation was designed pragmatically, recognising that these interventions may be implemented before full outcome evaluation is feasible. We used a mixed-methods approach focused on feasibility, acceptability, and signals of impact on reasoning processes (Table 2).

Feasibility metrics included participation rates in Disruption Rounds, number of micro-disruptions completed per trainee, and educator time required for debrief and Flex Log feedback. Acceptability was explored through brief anonymous questionnaires and end-of-term focus groups. Trainees reported that the explicit permission to pause and re-frame normalised

uncertainty and reduced the shame often attached to ‘not knowing’, a theme consistent with work describing how professional role expectations can constrain adaptive practice [11]. The educator valued the shared language for describing reasoning shifts but noted that prompts needed calibration to the trainee’s stage to avoid excessive cognitive load.

To look for learning signals, we reviewed Flex Log entries for evidence of (a) widening or re-prioritising differentials after disruption, (b) explicit consideration of serious but less likely diagnoses, and (c) improved safety-netting specificity. We also piloted a short script-concordance style quiz using locally authored primary care vignettes with embedded disruptions; early scores suggested that trainees became more willing to revise an initial diagnosis when new information emerged, rather than defending it. In parallel, trainees completed an uncertainty tolerance scale at baseline and after

Table 2. Evaluation and reflection framework (signals of impact, data sources, and interpretation).

Evaluation focus	What is being tested	Data source	Indicator (what to look for)	Timing/frequency	Interpretation for improvement
Feasibility	Can the intervention run within routine training constraints?	Delivery log	Sessions delivered; duration; proportion completed as planned	Ongoing	Identifies the sustainable ‘dose’ and the best-fit modalities for each site
Acceptability	Does it feel useful, fair, and safe to trainees and supervisors?	Anonymous micro-feedback + brief focus group	Perceived relevance; clarity of purpose; psychological safety; perceived workload	After each session + end of term	If ‘gotcha’ perceptions appear, adjust briefing language, disruptor realism, and intensity ladder use
Reasoning flexibility (in-the-moment)	Do trainees demonstrably re-frame after new information?	Direct observation	Explicit statement of initial frame; belief update when disruptor appears; prioritised re-generated differential	During sessions	Supports targeted coaching on the pivot script and hypothesis prioritisation
Diagnostic calibration	Does re-framing translate into proportionate clinical action?	Observation + case review	Follow-up interval and escalation triggers match risk; plans remain feasible for the patient	Monthly sample	Flags over-investigation or under-escalation; guides refinement of the uncertainty ladder prompts
Safety-netting quality	Is uncertainty converted into clearer safety behaviours?	Record review	Red flags documented; timeframe stated; escalation thresholds explicit; contingency planning	Monthly audit	Highlights documentation gaps and provides concrete feedback targets
Communication of uncertainty	Is uncertainty discussed in a way that supports shared decisions?	Supervisor observation + patient feedback sample	Clear explanation of uncertainty; plan co-produced; patient understands when to return	Periodic sampling	If patients feel disrupted by pauses, adjust consent script and limit pauses to suitable consultations
Transfer to workplace supervision	Are trainees more willing to bring uncertain cases for discussion?	Supervision agenda tracking	Proportion of ‘uncertainty cases’ raised by trainees; quality of reflective questioning	Over weeks	Proxy marker for culture change and psychological safety; informs supervisor modelling
Learning artefact quality	Are the Reasoning Trace and Flex Log entries meaningful and coachable?	Portfolio review rubric	Specificity of assumptions; alternatives considered; learning point stated; next-step behaviour	Fortnightly	If entries become generic, tighten prompts and require one behaviour change statement
Equity and stage-appropriateness	Does intensity match trainee stage without disadvantaging certain learners?	Supervisor review + trainee feedback	Intensity ladder used appropriately; no systematic mismatch by stage or background	Termly	If cognitive overload is reported, reduce intensity for early trainees and increase scaffolding
Wellbeing impact (supportive)	Does structured exposure help or harm tolerance of uncertainty?	Optional UT items + supervision notes	Trends in distress vs confidence; requests for support; avoidance behaviours	Baseline + follow-up	Used for pastoral support and dose adjustment, not performance ranking
Programme-level value	Does it align with assessment and curriculum outcomes?	Mapping exercise	Links to WBA domains; supervisor confidence in coaching reasoning; perceived relevance to SCA	End of cycle	Supports decision to scale-up and informs faculty development priorities

12 weeks. While we did not power the pilot for statistical change, we used the results as coaching data, acknowledging that uncertainty tolerance is multidimensional and that measurement properties vary across tools and contexts [17,18].

Reflection focused on two risks. The first was unintended escalation of investigations. We addressed this by making ‘uncertainty articulation’ a required step before ordering tests and by debriefing how to balance ruling out serious disease with proportionate care. The second risk was psychological safety: disruption can feel like being set up to fail. We therefore mapped our disruption prompts against a typology of uncertainty stimuli to ensure variety and to avoid repetitive ‘gotcha’ biomedical twists [19]. Debriefs explicitly separated the quality of the trainee’s reasoning moves from the correctness of the final label, mirroring evidence that reasoning tools can improve accuracy when used to support, not replace, clinical thinking [20].

Several practical adaptations improved sustainability. We created a ‘disruption intensity ladder’ so the educator could select prompts from low, medium, or high complexity, and agreed a stop rule if the trainee showed distress. We invited practice nurses to suggest contextual disruptions reflecting access barriers, broadening discussion beyond biomedical bias. A small sample of patients provided feedback on the ‘pause’ technique; most found it reassuring when explained as a safety check, but a minority preferred uninterrupted flow over time.

Overall, the pilot suggested that Pattern Disruption is implementable in routine GP training when the educator protects time for debrief. The most valuable outcome was cultural: trainees began to request disruption, describing it as rehearsal for ‘the consultation that suddenly changes’. Future evaluation should link the approach to workplace-based assessments and examine downstream outcomes such as diagnostic calibration, follow-up planning, and patient experience.

Discussion

Pattern Disruption offers a practical way to operationalise calls for explicit clinical reasoning teaching in general practice training [1,2]. By interrupting routine scripts with credible changes, trainees rehearse a core diagnostic-safety move: recognising when the first frame no longer fits and deliberately widening attention. The approach aligns with adaptive expertise because it values efficient pattern use and timely innovation when novelty appears [6–8]. Disruption is framed as calibrated curiosity coupled with proportionate action. It also provides a concrete method for bias-mitigation

teaching by making cognitive traps discussable in real time, rather than retrospectively, supporting structured reflection [15].

Transferability depends on protecting psychological safety. Without careful facilitation and structured debriefing, disruption risks becoming performative or increasing anxiety [5]. Including contextual and system disruptions alongside biomedical twists reflects that diagnostic pathways are shaped by access, follow-up, and patient priorities [13,14]. Linking disruption to communication skills also matters: expressing uncertainty and safety-netting clearly is part of diagnostic excellence [12].

This report has limitations. Our pilot was small, and we did not measure patient outcomes or diagnostic error directly. The micro-disruption pause requires supervisor presence and may be less feasible in under-resourced practices. Future work should test whether Pattern Disruption improves diagnostic calibration, reduces premature closure, and affects downstream utilisation, while monitoring for over-investigation. Combining workplace observation with validated measures of uncertainty tolerance could clarify which learners benefit most and which disruption intensities are optimal [17–19]. If confirmed, Pattern Disruption could complement reasoning tools by teaching the moment a pattern should be questioned [20].

Author contributions

CRedit: **Waseem Jerjes:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing; **Azeem Majeed:** Conceptualization, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

References

- [1] Cooper N, Bartlett M, Gay S, Hammond A, Lillicrap M, Matthan J, Singh M. The UK Clinical Reasoning in Medical Education (CRiME) Consensus Statement Group. Consensus statement on the content of clinical

- reasoning curricula in undergraduate medical education. *Med Teach.* 2021;43(2):152–159. doi: [10.1080/0142159X.2020.1842343](https://doi.org/10.1080/0142159X.2020.1842343)
- [2] Durning SJ, Jung E, Kim DH, et al. Teaching clinical reasoning: principles from the literature to help improve instruction from the classroom to the bedside. *Korean J Med Educ.* 2024;36(2):145–155. doi: [10.3946/kjme.2024.292](https://doi.org/10.3946/kjme.2024.292)
 - [3] Dave N, Bui S, Morgan C, et al. Interventions targeted at reducing diagnostic error: systematic review. *BMJ Qual Saf.* 2022;31(4):297–307. doi: [10.1136/bmjqs-2020-012704](https://doi.org/10.1136/bmjqs-2020-012704)
 - [4] Al-Khafaji J, Townsend RF, Townsend W, et al. Checklists to reduce diagnostic error: a systematic review of the literature using a human factors framework. *BMJ Open.* 2022;12(4):e058219. doi: [10.1136/bmjopen-2021-058219](https://doi.org/10.1136/bmjopen-2021-058219)
 - [5] Duff JP, Morse KJ, Seelandt J, et al. Debriefing methods for simulation in healthcare: a systematic review. *Simul Healthc.* 2024;19(1S):S112–S121. doi: [10.1097/SIH.0000000000000765](https://doi.org/10.1097/SIH.0000000000000765)
 - [6] Kua J, Lim WS, Teo W, et al. A scoping review of adaptive expertise in education. *Med Teach.* 2021;43(3):347–355. doi: [10.1080/0142159X.2020.1851020](https://doi.org/10.1080/0142159X.2020.1851020)
 - [7] Pusic MV, Hall E, Billings H, et al. Educating for adaptive expertise: case examples along the medical education continuum. *Adv Health Sci Educ Theory Pract.* 2022;27(5):1383–1400. doi: [10.1007/s10459-022-10165-z](https://doi.org/10.1007/s10459-022-10165-z)
 - [8] Ng SL, Forsey J, Boyd VA, et al. Combining adaptive expertise and (critically) reflective practice to support the development of knowledge, skill, and society. *Adv Health Sci Educ Theory Pract.* 2022;27(5):1265–1281. doi: [10.1007/s10459-022-10178-8](https://doi.org/10.1007/s10459-022-10178-8)
 - [9] Gamborg ML, Mehlsen M, Paltved C, et al. Clinical decision-making and adaptive expertise in residency: a think-aloud study. *BMC Med Educ.* 2023;23(1):22. doi: [10.1186/s12909-022-03990-8](https://doi.org/10.1186/s12909-022-03990-8)
 - [10] Gamborg ML, Jensen RD, Musaeus P, et al. Balancing closure and discovery: adaptive expertise in the workplace. *Adv Health Sci Educ Theory Pract.* 2022;27(5):1317–1330. doi: [10.1007/s10459-022-10177-9](https://doi.org/10.1007/s10459-022-10177-9)
 - [11] Gamborg ML, Mylopoulos M, Mehlsen M, et al. Exploring adaptive expertise in residency: the (missed) opportunity of uncertainty. *Adv Health Sci Educ Theory Pract.* 2024;29(2):389–424. doi: [10.1007/s10459-023-10241-y](https://doi.org/10.1007/s10459-023-10241-y)
 - [12] Dahm MR, Crock C. Understanding and communicating uncertainty in achieving diagnostic excellence. *JAMA.* 2022;327(12):1127–1128. doi: [10.1001/jama.2022.2141](https://doi.org/10.1001/jama.2022.2141)
 - [13] Dahm MR, Cattanach W, Williams M, et al. Communication of diagnostic uncertainty in primary care and its impact on patient experience: an integrative systematic review. *J Gen Intern Med.* 2023;38(3):738–754. doi: [10.1007/s11606-022-07768-y](https://doi.org/10.1007/s11606-022-07768-y)
 - [14] Gardner NP, Gormley GJ, Kearney GP. Learning to navigate uncertainty in primary care: a scoping literature review. *BJGP Open.* 2024;8(2):BJGPO. 2023.0191. doi: [10.3399/BJGPO.2023.0191](https://doi.org/10.3399/BJGPO.2023.0191)
 - [15] Thompson J, Bujalka H, McKeever S, et al. Educational strategies in the health professions to mitigate cognitive and implicit bias impact on decision making: a scoping review. *BMC Med Educ.* 2023;23(1):455. doi: [10.1186/s12909-023-04371-5](https://doi.org/10.1186/s12909-023-04371-5)
 - [16] Stephens GC, Lazarus MD. Twelve tips for developing healthcare learners' uncertainty tolerance. *Med Teach.* 2024;46(8):1035–1043. doi: [10.1080/0142159X.2024.2307500](https://doi.org/10.1080/0142159X.2024.2307500)
 - [17] Stephens GC, Karim MN, Sarkar M, et al. Reliability of uncertainty tolerance scales implemented among physicians and medical students: a systematic review and meta-analysis. *Acad Med.* 2022;97(9):1413–1422. doi: [10.1097/ACM.0000000000000461](https://doi.org/10.1097/ACM.0000000000000461)
 - [18] Stephens GC, Lazarus MD, Sarkar M, et al. Identifying validity evidence for uncertainty tolerance scales: a systematic review. *Med Educ.* 2023;57(9):844–856. doi: [10.1111/medu.15014](https://doi.org/10.1111/medu.15014)
 - [19] Lazarus MD, Gouda-Vossos A, Ziebell A, et al. Mapping educational uncertainty stimuli to support health professions educators' in developing learner uncertainty tolerance. *Adv Health Sci Educ Theory Pract.* 2025;30(1):259–280. doi: [10.1007/s10459-024-10345-z](https://doi.org/10.1007/s10459-024-10345-z)
 - [20] Staal J, Hooftman J, Gunput STG, et al. Effect on diagnostic accuracy of cognitive reasoning tools for the workplace setting: systematic review and meta-analysis. *BMJ Qual Saf.* 2022;31(12):899–910. doi: [10.1136/bmjqs-2022-014865](https://doi.org/10.1136/bmjqs-2022-014865)