

Implementing routine glucocorticoid toxicity monitoring: a multilevel, theory informed qualitative study with three pillars of behaviour changes recommendations for clinical teams

Vasilis S. Vasiliou

vasilis.vasiliou@rhul.ac.uk

Royal Holloway University of London

Callum Ewing

Royal Holloway University of London

Joana Martins-Martinho

Hospital de Santa Maria

Ana Rita Lopes

Hospital de Santa Maria

Sarah Louise Mackie

University of Leeds

Cristina Ponte

Hospital de Santa Maria

Raashid Ahmed Luqmani

University of Oxford

Research Article

Keywords: Methods, Glucocorticoids, Toxicity, Rheumatologists, Vasculitis, Implementation problem, Assessment, Tracking, Theoretical Domain Framework, Semi-structured interviews, Behavioural change

Posted Date: October 13th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10606185/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

1
2
3
4
5
6
7
8
9
10
11
12
13

**Implementing routine glucocorticoid toxicity monitoring: a multilevel, theory informed
qualitative study with three pillars of behaviour changes recommendations for clinical
teams**

Vasilis S. Vasiliou Ph.D, FHEA*.,

Royal Holloway, University of London, Department of Psychology, Egham, United Kingdom,

University of Oxford, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, Oxford, United Kingdom,

vasilis.vasiliou@rhul.ac.uk

Orcid: 0000-0003-3501-4093

Callum Ewing, MSc,

Royal Holloway, University of London, Department of Psychology, Egham, United Kingdom,

Joana Martins-Martinho, MD

Rheumatology Department, ULS de Santa Maria, Centro Académico de Medicina de Lisboa, Lisbon, Portugal; Faculdade de Medicina, Universidade de Lisboa, Centro Académico de Medicina de Lisboa, Lisbon, Portugal.

Ana Rita Lopes, MD

Rheumatology Department, ULS de Santa Maria, Centro Académico de Medicina de Lisboa, Lisbon, Portugal

Sarah Louise Mackie, BM BCh PhD

Leeds Institute for Rheumatic and Musculoskeletal Medicine, University of Leeds, Leeds, United Kingdom; and Leeds Biomedical Research Centre, Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom

Cristina Ponte, MD, PhD

Rheumatology, Department, ULS de Santa Maria, Centro Académico de Medicina de Lisboa, Lisbon, Portugal; Faculdade de Medicina, Universidade de Lisboa, Centro Académico de Medicina de Lisboa, Lisbon, Portugal

Raashid Ahmed Luqmani, D.M. FRCP, FRCP (Ed)

University of Oxford, Nuffield Department of Orthopaedics, Rheumatology and

Musculoskeletal Sciences, Oxford, United Kingdom,

***Corresponding author: Vasilis S. Vasiliou, Ph.D, FHEA**, Department of Psychology,

Bowyer Building, Office 0.12, Royal Holloway, University of London, Egham, Surrey,

TW20 0EX, +44 01784 91 1679, vasilis.vasiliou@rhul.ac.uk | academic

website <https://pure.royalholloway.ac.uk/en/persons/vasilis-s-vasiliou>

55

56

Abstract

57

58

59

60

61

62

63

64

65

Background: Glucocorticoid (GC) therapy is central to the management of vasculitis and other inflammatory conditions, but prolonged medium- to high-dose use substantially impacts physical and psychological health. Despite the availability of methods to assess GC-related side effects, GC toxicity is not routinely or consistently monitored in clinical trials and practice. This implementation gap persists across settings and contributes to preventable morbidity. This study aimed to identify clinician-reported barriers and facilitators, understand preferred assessment methods for the new OMERACT glucocorticoid domains core domains, and develop data-driven, multilevel behavioural change recommendations to support implementation in clinical practice.

66

67

68

69

70

71

72

73

74

75

Methods: As part of the X (Mask for blind review) multi-method, multi-level research programme we employed a multimethod qualitative design to examine clinicians' perspectives in the UK and Portugal. Using hospital-based snowball (peer referrals) and purposive sampling, clinicians ($n=15$) who prescribe medium- to high-dose GCs (≥ 7.5 mg prednisone equivalent/day) attended participatory qualitative interviews. Analysis combined reflexive thematic analysis, content analysis, and deductive mapping. Behavioural determinants were identified using the Theoretical Domains Framework (TDF) and mapped onto the Behaviour Change Technique Ontology (BCTO) to specify three pillars with behavioural change implementation recommendations. Interdisciplinary consensus meetings refined recommendations and developed exemplar actions.

76

77

78

79

Results: Clinicians reported a wide variation in awareness and use of GC-toxicity assessment methods. Confidence varied by years of experience, with clear gaps in assessing psychological and cumulative harms observed across seniority. Routine monitoring is often deprioritised in favour of disease control, driven by barriers such as time pressure, workflow

constraints, limited access to tools, and uncertainty about responsibility. Facilitators included brief tools, clear guidance, team-based routines, leadership, and system-level supports. Preferred methods included diaries, laboratory tests, and patient-reported outcomes. TDF analysis identified nine relevant domains and generated 11 belief-based targets. With further BCTO mapping, we then generated 15 data and theory-driven recommendations across three pillars: individual clinician, professional/team, and clinic/organisational system, supported by 80 practical exemplars.

Conclusions: Routine GC toxicity assessment requires coordination beyond individual clinicians. This study provides actionable recommendations to embed toxicity monitoring into routine care while accommodating clinical priorities, addressing systemic barriers, and supporting local adaptations. The findings have implications for safer long-term GC management across Rheumatology and other glucocorticoid-prescribing specialties.

Key words: Methods, Glucocorticoids, Toxicity, Rheumatologists, Vasculitis, Implementation problem, Assessment, Tracking, Theoretical Domain Framework, Semi-structured interviews, Behavioural change

Contribution to the literature

- 97 ▪ The study explored why GC side effects are often not routinely monitored in clinical
98 practice, despite clinicians acknowledging their importance.
- 99 ▪ We highlight practical barriers such as lack of time, unclear responsibility, and difficulty
100 fitting assessments into busy clinics.
- 101 ▪ We propose 15 clear, behavioural change practices mapped across 80 workable
102 exemplars, to change how the monitoring and assessment of GC toxicity occurs, at
103 clinician, team, and organisational levels, making the task easier and more consistent.
- 104 ▪ We present a transferable, theory- and data-informed practice model that can be used
105 within and beyond Rheumatology, to support safer medication monitoring in healthcare.

1. Background

Glucocorticoids (GC) are among the most widely prescribed class of immunosuppressive and anti-inflammatory medications globally and remain the standard first-line treatment for systemic vasculitis (1), a group of rheumatic diseases characterised by inflammation of blood vessels (2). Many individuals with vasculitis and other long-term rheumatic conditions require prolonged medium-to-high GC doses (e.g., >7.5 mg to ≤100 mg prednisone equivalent daily, as per EULAR guidance (3)). However, long-term GC use is associated with a wide range of dose- and duration-dependent adverse effects spanning psychological, behavioural, physical, and cognitive effects (4,5). Collectively, these are recognised as GC toxicity or GC side effects (6–8).

Patients and clinicians can struggle sometimes to identify both the direct physiological effects of GCs and the secondary downstream impacts these effects have on patients' day-to-day lives (9). Additionally, concerns about GC side effects remain widespread (7,10–12) in terms of adverse effects on daily functioning and psychological well-being, despite their potential benefit in terms of disease progression (10,12). In response, the OMERACT Glucocorticoid Impact Working Group (<https://omeract.org/working-groups/glucocorticoids/>) has undertaken extensive work to establish a standardised core domain set for the assessment of the GC toxicity with the aim to support a more integrative assessment of CG toxicity in clinical trials and routine care (13). Through a multi-stakeholder consensus process, the Working Group developed and defined 14 core domains capturing both physiological toxicity (e.g., recurrent infections, bone fragility, hypertension, mood disturbance) and life-impact outcomes (e.g., sleep disruption, changes in appearance, effects on interpersonal relationships and work functioning), as well as withdrawal symptoms (14,15). This work has been indirectly prompted by the development of various instruments and other methods, including validated clinician-assessed instruments (e.g. the Glucocorticoid Toxicity Index (16)), and validated patient-reported outcome

measures (PROMs), (e.g., the GC PRO (17)), that track and assess various GC side effects. Despite these new instruments, routine assessment of GC side effects remains limited in real-world practice (3,18).

Existing research has typically examined either patients' experiences, attitudes, and preferences regarding GC-related adverse effects (9,12,19–21), or clinicians' perspective on GC prescribing, focusing on risk perception, attentional processes, and personal decision-making parameters (22,23). However, this work has not closed the implementation gap (24,25). Clinicians continue to report uncertainty about which instruments to use, lack confidence in interpreting available tools, and experience insufficient organisational support for routine GC toxicity monitoring (26). Importantly, we still lack a comprehensive understanding of the behavioural determinants that would support clinicians in routinely using methods to assess and track GC side effects (24,27).

This fragmented nature of existing research risks impeding translation into routine care. Without a systematic understanding of determinants likely to influence clinicians' behaviours, passive dissemination of guidelines and recommendations is unlikely to improve monitoring practices or optimize patient outcomes (28,29). Additionally, failure to address the multilevel determinants that could prompt changing behaviours can undermine adherence to guidelines, and weaken efforts to implement evidence-based recommendations effectively (30). In this context, a more integrated, theory-driven, multilevel, and multimethod approach is, therefore, proposed to identify, organise, and address the full range of determinants influencing clinicians' ability to routinely assess GC toxicity.

Understanding determinants supporting clinicians' behaviours in complex clinical environments requires attention to both individual-level determinants (e.g. knowledge, skills, beliefs, cognitive processes) and contextual determinants (e.g. team norms, organisational processes, organisational culture and resources) (31). Given this complexity,

reliance on a single behavioural theory is unlikely to capture the breadth of relevant influences because it can only provide uninformative insights about what needs to change (32). To address this challenge, behavioural scientists developed the Theoretical Domain Framework (TDF) (33,34) through a structured consensus process, synthesising 33 behavioural theories and 128 constructs into 14 distinct domains (33). The TDF is now widely used in implementation science to identify barriers, facilitators, and determinants influencing clinicians' behaviours, particularly through qualitative mapping approaches (35–39). Coupled with TDF, the Behaviour Change Technique Ontology (BCTO) (35) has recently proposed as a framework that can further enhanced the capacity to translate identified TDF-determinants into precise, theory-informed implementation strategies (38). The BCTO is an open-access, machine learning-readable taxonomy which provides a standardised and theory-informed terminology for specifying behaviour change techniques (BCTs)-the smallest active components capable of influencing behaviour (37). Together, the TDF and BCTO provide coherent, systematic methods for developing context-specific recommendations, aligned with the multilevel nature of implementation challenges.

In this context, we established the X Project (Masked for Blind Review) to develop theory and data driven recommendations, to support clinicians in the routine use of methods for tracking and assessing GC toxicity. The current study had five specific aims: (1) to explore clinicians' perspective on the use of methods for assessing GC side effects; (2) to identify barriers and facilitators influencing assessment practices; (3) to examine which assessment methods best align with some of the key OMERACT core domains for GC toxicity and why; (4) to map clinicians' beliefs onto the TDF domains; and (5) to develop data-driven behavioural change implementation recommendations, linking identified determinants to specific BCTs (implementation suggestions).

2. Methods

2.1. Methodology

We conducted a qualitative participatory, multi-method, multilevel study, exploring UK and Portuguese clinicians' perspectives on using GCs to treat systemic vasculitis or polymyalgia rheumatica. Guided by an interpretivist paradigm, the study recognised researchers' active involvement in knowledge production (39), while aiming to generate data-driven implementation recommendations. Reporting follows COREQ (40) guidelines to ensure transparency in qualitative methods, alongside SQUIRE 2.0 guidance to align reporting with healthcare improvement and implementation research.

2.2. Recruitment & Participants

Clinicians were recruited using snowball and purposive sampling within hospital networks, supported by invitations circulated through UKIVAS and GCA clinical meetings, to identify clinicians with experience or interest in GC toxicity. Eligible participants had ≥ 2 years' experience prescribing GCs for ANCA-associated vasculitis, polymyalgia rheumatica, or giant cell arteritis. Following a brief online screening questionnaire to help contextualise their responses (39), participants received study information, provided e-consent, and completed a short clinician profile questionnaire capturing demographics, clinical background, and current practices for assessing GC-related toxicity.

2.3. Materials

The study's material included the clinician profile questionnaire and a semi-structured interview guide (Supplementary Material SM1). The guide was developed to address the study's five aims. To ensure conceptual clarity, interviewers used the AACTT framework (41) to define the targeted behaviour ("using methods to assess GC toxicity"), specifying *who* performs the behaviour, *what* it entails, and *in what context*¹. The term

¹ The focal behaviour of interest we identified was the following: physicians (Actor) to routinely use methods to assess GC toxicity (Action) during consultation meetings (Context) with patients diagnosed with vasculitis (Target) when prescribing or adjusting medium to high doses of glucocorticoids (Time).

“Methods” was explicitly mentioned at the outset and reiterated during the interview, defined as clinical actions assessing GC impact on health and daily living (e.g., vital monitoring, clinical observations, dose-related tracking, questionnaires).

The guide consisted of four sections. The first two sections explored current GC toxicity assessment practices—usefulness and confidence, including perceived barriers and facilitators. The third section involved a two-stage card-sorting task, using some of the 14 OMERACT domains (14). In the first stage, clinicians chose which of eight assessment methods they would use for each domain and provided justifications. In the second stage, they then categorised each domain by perceived importance (more important for clinicians, more important for patients, or equally important). The fourth section explored the 14 TDF domains (33), to identify behavioural determinants that were subsequently used to develop the recommendation.

Materials were designed collaboratively with Rheumatologists, Clinical Health Psychologists, and Information Specialists. Procedures and materials were piloted with the local X vasculitis group, two senior co-authors (X), and two trainee Rheumatologists (x), to ensure clarity and content validity.

2.4. Procedures

A study flyer containing a QR code and the study website link (X) was circulated across the team’s networks (e.g., X). After screening and consent, participants completed the clinician profile questionnaire and scheduled an online interview (approximately 60 minutes).

The semi-structured interviews comprised four sections, to address the five main study aims. The first section involved discussions about clinicians’ current practices for assessing GC toxicity (aim 1). The second section explored perceived barriers and facilitators to routine practice (aim 2). The third section involved the two-stage card-sorting

exercise, ranking preferred methods for each of the selected OMERACT GC domains, and sorting domains by perceived importance categories (aim 3). Next, participants engaged in an open discussion about TDF-domains that could support routine assessment of GC toxicity in clinical practice (aim 4). Finally, we used the beliefs that we generated by mapping participants' data onto the TDF domains to link determinants to specific BCTs (aim 5).

Interviews were flexible, allowing pauses and breaks, and transcripts were anonymised. The researchers used prompts when necessary to encourage further elaboration. All the interviews were conducted on-line via Microsoft Teams, and audio recorded using Audacity (Version 3.6). Automatic transcripts were generated and checked manually for accuracy. Interviews with Portuguese clinicians followed identical procedures. Portuguese transcripts were translated via Teams AI translation and verified by two bilingual interviewers who compared the translations against original recordings (x). Interviewers were experienced clinicians who received >6 hours of qualitative interviewing training and the X study protocol instructions. Data collected occurred between 20/03/2024 and 16/05/2024. The study received ethics from both the X research ethics committee (Ref n: X) in the UK and the X in Portugal. All the data were stored centrally within the X cloud (MRP), provided by X IT secured network.

2.5. Analyses

A multilevel, multimethod analytic strategy, integrating inductive and deductive approaches (42) was used, to address the five study aims. The research team collaborated with clinicians as lay advisory partners to ensure contextual relevance (43). For the first two aims, we coded the data using NVivo (Version 14), and analysed using inductive reflexive thematic analysis (44). Codes were developed inductively, and refined iteratively, to identify patterns relating to clinicians' current practices and perceived barriers/facilitators.

For the third aim, we analysed the data using content analysis (45). Frequency counts of preferred assessment methods and importance rankings were tabulated in Excel along with qualitative justifications. Two authors independently reviewed and horizontally coded the data to identify semantic hierarchies (levels of importance) and alignment of methods with the OMERACT domains.

For the fourth aim, two coders (XX & XX) independently mapped transcripts to the 14 TDF domains, using formal TDF construct definitions (33). After mapping the first two interviews, discrepancies were resolved through discussion. Next, belief statements were generated within each domain, capturing shared meanings relevant to using methods to assess GC-toxicity (46). Then, three co-authors (XX,XX,XX) ranked each belief on a 0-4 Likert scale based on: (a) the number of coded data and mean frequency of reporting each of the beliefs (low-medium-high); (b) the presence of conflicting beliefs within each domain that would signal high heterogeneity (variation); and (c) perceived strength of influence on behaviour. Afterwards, an interdisciplinary meeting defined the domains and beliefs (determinants) that were used to develop the behavioural change recommendations.

For the fifth aim, we linked the identified determinants to behaviour change techniques (BCTs), using the BCTO (36). We first distilled the identified determinants (beliefs about what needs to change) into concise, data-driven implementation suggestions. We then mapped each suggestions to the BCTO higher-level group class definitions of the taxonomy (e.g., presenting a broad conceptual strategy about what kind of change is being targeted), and then to relevant Level-2 BCTs definitions and examples, using the ontology definitions from the latest BCTO repository of the Human Behaviour-Change Project 2025. Finally, for each BCT, we developed context-specific exemplar actions, tailored to GC toxicity assessment, each explicitly linking TDF domains, BCTO classes, Level-2 BCTs,

and clinical exemplars. These were refined through interdisciplinary meetings and clinicians feedback to enhance clinical relevance and feasibility.

2.6. Methods to Maximize Trustworthiness

Trustworthiness was enhanced through strategies supporting credibility, dependability, confirmability, and transferability (47). Credibility was supported via interdisciplinary reflexive discussions with different prior clinical and research experiences in GC toxicity management, and oversight by an experienced Clinical Health Psychologist researcher (x). Transferability was promoted through detailed documentation, thick illustrative quotes, and clinician feedback. Dependability and confirmability were strengthened through consistent application of the TDF and BCTO frameworks and maintenance of a transparent audit trail.

1. Results

Participants

One hundred and twelve clinicians expressed an interest and $n=15$ clinicians (10 males and 5 females; mean age 42 years) fulfilled the criteria to participate in the semi-structured interviews. Years of clinical working experience varied across participants, with the majority being specialists. The number of years working with patients with different forms of vasculitis conditions ranged in years from 4 to 30. All clinicians reported prescribing glucocorticoids. Table 1 presents the demographics and other characteristics of the sample.

Table 1. Demographics and other Characteristics of the sample.

Variable	
Demographics	
<i>Years of clinical practice, mean years (range)</i>	
Resident	$2.5 \pm (2-5)$
Medical specialist	$1.12 \pm (1-5)$
Years of experience in treating patients with different forms of vasculitis	$7.92 \pm (1-12)$
<i>Medical Specialty, n (%)</i>	

Rheumatology	10/15 (64)
Nephrology	3/15 (21)
Respiratory	1/15 (7)
Internal medicine	1/15 (7)

Participants' behaviours related to glucocorticoid use and monitoring

Average glucocorticoid prescription/month, n (%)

0-1	1/15 (7.7)
2-5	12/15 (76.9)
6-10	2/15 (15.4)

Average medium to high doses (>7.5 mg/day) of GC prescription/month, n (%)

0-1	1/15 (7.7)
2-5	14/15 (92.3)

Use of methods/tools to assess GC Toxicity**, n(%)*

Yes	14/15 (100)
No	0

Use one of the following methods, n (%)

GTI	1/15 (7.1)
BVAS	5/15 (35.71)
VDI	3/15 (21.43)
Questionnaire assessing mood	0
Questionnaire assessing QoL	1/15 (7.14)
Questionnaire assessing disability	0
Questionnaire assessing fatigue or/sleep	2/15 (14.29)
Other not referred above	3/15 (21.43)

* "Methods" refers to anything a clinician would do to assess the impact of GCs. These include things like: (a) monitoring how an increased dose of GCs affects patients' body and daily living; (b) using questionnaires to assess patients' mood or daily activities; (c) checking patients' vitals, etc.;

** In patients with PMR, GCA, ANCA-associated or other vasculitis who receive medium to high monthly doses of glucocorticoids;

*** "GC PRO" "I don't use any of the above" "Direct questioning"

BVAS: The Birmingham Vasculitis Activity; GC: glucocorticoid, GTI: The Glucocorticoid Toxicity Index; VDI: The Vasculitis Damage Index.

Aim 1: Clinicians' attitudes towards methods used to address GC side effects

Inductive thematic analysis identified four themes highlighting clinicians' attitudes about methods assessing GC side effects. Below and on Table 2, we present illustrative data extracts. Firstly, some clinicians reported using tools such as the Glucocorticoid Toxicity Index (GTI), DEXA scans, and the GC Patient-Reported Outcome measure (PROM), noting PROMs' value in capturing patient experiences, related to mood, sleep, and appearance (IntUK_0093... *they seemed to pick up a lot about the sleep and appearance and impact of weight and impact on mood as well*). However, awareness and use varied; some were familiar only through literature rather than practice (IntPG_0013: *"I don't have my own*

experience to apply, because my contact with this is only from the studies in which they are used"). Secondly, attitudes toward method selection were influenced by clinical context, patient needs, and resources: structured tools were seen as systematic by some clinicians, whereas others preferred more flexible, symptom-based questioning systems as being more practical (IntUK_0006: *"It also depends a little bit on how it is done which method we are talking about, but it can somehow really help to be more systematic and save time, or if the method is too long it can steal more time"*). Thirdly, time constraints often relegated toxicity assessment to a secondary priority, behind disease control (e.g., IntUK_011: *"We're so focused on controlling symptoms and controlling this activity that you sometimes just entirely run out of time to think about the consequences of this"*). Finally, confidence varied, with some clinicians expressing uncertainty about the adequacy of current tools and their own knowledge in capturing the full scope of GC toxicity.

TABLE 2 ABOUT HERE

Aim 2: Clinicians' barriers and facilitators in using methods to assess toxicity

Clinicians reported several barriers to using assessment methods, mainly contextual. As Table 3 shows below, limited access to diagnostic tools and equipment, especially in resource-constrained settings, was a key challenge (IntUK_0044: *"We do not have available, to my knowledge, any standardized and rigorous way of making this evaluation. Therefore, I think this is also an obstacle"*). Time constraints during consultations often led clinicians to prioritize disease control over toxicity monitoring (IntPG_0016: *"access to a scale, access to a blood pressure monitor, which we have, but it's in the nurses' room and we can send the patients there, but we have to talk to the nurses first, which still takes a lot of work, patients come here."*). Lack of knowledge and confidence also emerged, with less experienced clinicians finding assessments complex, while experienced ones viewed them as routine but effortful.

On the other hand, clinicians identified important facilitators showing a strong preference for tools that are simple, quick, and easily integrated into practice (IntPG_0012: “something simple, easy to put into practice and easy to access as well”). Streamlined formats, such as tick lists, were valued for tracking adverse effects and reducing reliance on memory. Notably, clinicians emphasized the need for credible, systematic tools to ensure reliable detection and support decision-making. Overall, findings highlight the importance of practical, accessible, and evidence-based solutions for GC toxicity monitoring.

TABLE 3 ABOUT HERE

Aim 3 – Matching clinicians preferred methods to address GC side effects: A face validity exercise of the OMERACT glucocorticoid impact core domain set

Following the development of the thirteen OMERACT core domain set to measure the impact of GCs on patients living with rheumatic conditions (Lyne et al., 2024) this face validity exercise explored clinicians’ preferred methods for assessing some of the 13 OMERACT domains of GC impact in rheumatic conditions. Figure 1 below shows the most frequently reported preferred methods, including diaries, PROMs, vital sign checks, laboratory tests, and doctor/emergency department visits for monitoring and managing various GC side effects, including mood changes, changes in appearance or sleep, impact on relationships or daily activities, and symptoms during tapering.

FIGURE 1 ABOUT HERE

Content analysis revealed distinct methods for assessing the selected OMERACT core domain set, examined. As table 4 shows, objective measures (e.g., lab tests) were favoured for infections and blood sugar, while fractures and withdrawal symptoms were managed through consultations and A&E visits. Also, checking vitals was the most frequent method used for blood pressure. Eye problems are promptly managed via doctor visits. Mood changes, fatigue, and weight gain were often tracked via diaries or questionnaires to

compare against disease activity; appearance, sleep, and daily functioning were assessed through PROMs.

TABLE 4 ABOUT HERE

Clinicians also ranked their perceptions about the importance of assessing each of the thirteen OMERACT core domains, sorting their preferences into three levels: “*important for clinicians*,” “*important for patients*,” and “*equally important*”. As figure 1 illustrates, six of the fourteen domains were considered equally important for clinicians and patients, seven primarily for patients, and only blood pressure monitoring was rated as clinician-focused. Findings underscore the need for practical, patient-centered tools aligned with clinical priorities. Table 5 summarizes the findings from clinicians’ preference, following a card-sorting task.

TABLE 5 ABOUT HERE

Aim 4 –TDF derived behavioural determinants (beliefs)

From 15 interviews, 367 utterances were coded into 14 TDF domains, generating 18 beliefs related to changes needed to increase the use of methods for assessing GC toxicity. Three study Rheumatologists independently rated the relevance of each domain. Inter-rater reliability was low (Fleiss’s Kappa = -0.054 , 95% CI -0.162 to 0.055), indicating agreement no better than chance. Exact agreement across all three raters was low (11.1%), while partial agreement between at least two raters was observed in 50% of cases, suggesting some convergence despite skewed rating distributions, a known limitation of kappa statistics. Disagreements were resolved through a consensus meeting. Nine domains were judged relevant to supporting routine GC toxicity assessment: knowledge, skills, beliefs about capabilities and consequences, goals, memory/attention/decision processes, environmental context/resources, social influences, and behavioural regulation. Five domains (e.g., role identity, optimism, reinforcement, intention, emotions) were not relevant. From the nine

domains, we identified 11 specific beliefs (behavioural determinants) to inform good clinical practice and implementation recommendations. Below, we report the findings with illustrative quotes presented on Table 6, grouped in beliefs “*likely to increase the use of methods to routinely assess GC side effect*”. In the Supplementary Material S2, we present the ranking exercise which led to the selection of the TDF, as well as extensive summaries with direct quotes for each one of the TDF domain.

TABLE 6 ABOUT HERE

Within the *Knowledge* domain, we highlighted the need for clear, evidence-based and standardised guidance to support systematic assessment of GC toxicity. A major gap identified was limited awareness of the full range of glucocorticoid-related harms, including when and how different toxicities emerge over time. Clinicians viewed such knowledge as foundational for early recognition and appropriate management, emphasising that awareness can and should be developed through training and clinical experience rather than assumed.

When asked about the *Skills* domain, clinicians emphasized the need to develop practical skills for recognizing, interpreting, and managing GC side effects, noting that these skills are acquired through experience and repeated patient care. Junior clinicians were seen as particularly vulnerable to overlooking toxicity, underscoring the importance of structured training and decision support. Clinicians highlighted the importance of reliance on guidelines and scoring systems to support decision-making, accessing resources (guidelines, decision tools, training modules, etc.), and clinical reasoning skills to distinguish GC toxicity from disease activity- capabilities viewed as learnable but not automatic.

Clinicians’ *beliefs about capabilities* domain focused on confidence in assessment which can be gained by using supportive tools. While some felt comfortable with certain aspects, many noted gaps in evaluating complex domains like psychological effects and impact of GC toxicity. Confidence improves when assessments are routine, supported by

training, or tools such as toxicity indices, highlighting the perceived importance of using standardised methods.

The *Beliefs about Consequence* domain was judged to be highly relevant. Clinicians viewed monitoring GC toxicity as critical for early intervention, tailored treatment, and preventing long-term harms. Early detection of emerging toxicity supports timely actions such as dose adjustments or alternative therapies, while structured tools help balance treatment with disease control. Monitoring was also seen as preventative and ethical, reducing risks of complications (e.g. diabetes, fractures) and addressing patient-related concerns, such as psychological impact.

With regards to *Goals*, clinicians view GC toxicity assessment as important for patient safety, yet often a task competing with priorities like diagnosis and disease monitoring. Its importance has grown with GC-sparing options and awareness of serious risks such as fractures and their medicolegal implications. To prevent deprioritization, clinicians could support the implementation of toxicity assessment in guidelines and routine clinical systems.

Considering the *Memory, Attention, and Decision Process* domain, clinicians described reliance on memory as unreliable due to time pressures and competing demands. Automated prompts, electronic templates, and task delegation (e.g., pre-consultation questionnaires or nurse-led assessments) were viewed as essential strategies to reduce cognitive load and ensure consistency.

The *Environmental Context and Resources* domain proposed structural barriers, including variable access to infrastructure, time pressure, and resources, lack of privacy and space constraints. Standardization across settings through frameworks, technology, and delegated tasks was seen as essential to ensure that patients receive the same quality of GC side effect monitoring care. Clinicians believed that structural adjustments, such as longer

consultations, dedicated spaces, and supportive resources, are needed to enable thorough, patient-centred assessment.

The *Social Influence* domain identified the role of senior colleagues, consultants, and professional or national guidelines (e.g., EULAR, ACR, KDIGO) in supporting practice change. Finally, within the domain of *Behavioural Regulation*, clinicians emphasized the need for role modelling, shared expectations, and embedding assessment into routine workflows and protocols as essential to regulate behaviour towards the main task, hence, move toxicity assessment from ad-hoc practice to standard care.

Aim 5 – A Three wide- level Behavioural change recommendation

Following the identification of the nine selected TDF behavioural domains, and the generation of eleven belief-based behavioural targets, we mapped the targets onto the BCTO which finally resulted in $n=15$ data-driven implementation recommendations. The recommendations are organised in three levels of influence as shown in the Sankey diagram on Figure 2: (1) the individual clinician (knowledge, skills, beliefs, attention/decision processes); (2) the profession/team level (shared routines, peer support, leadership, prompts), and (3) the local organisational level (workflow integration, access to diagnostics, documentation pathways). Each recommendation specifies the BCTO higher-level group class and Level-2 BCTs, along with practical exemplars ($n=80$). The recommendations are presented in our open access repository x.

At the *individual clinician level*, three implementation recommendations mapped onto ten Behaviour Change Techniques (BCTs), focus on increasing awareness of the full spectrum of GC toxicity, developing assessment skills through direct patient care, and strengthening confidence via standardised methods. These strategies aim to support clinicians in recognising, distinguishing, and consistently assessing GC-related toxicity during routine consultations.

At the *professional level*, six implementation recommendations, mapped onto 17 BCTs, emphasising structured learning, practical decision aids, and leadership actions. These strategies target shared professional beliefs about the value of routine toxicity monitoring, address cognitive limitations, and promote senior role-modelling. These practices can help embed a glucocorticoid side effect assessment, normalising the task as a collective professional responsibility that promotes an equitable safe care practice across settings.

Finally, at the *local organisational level*, six recommendations, mapped onto 16 BCTs, focusing on repeated exposure to assessment methods, integration of a centralised workflow with prompts and templates, delegation of tasks across multidisciplinary teams, and provision of protected time and space for patient-centred assessment.

FIGURE 2 ABOUT HERE

4. Discussion

The widespread recognition of the risks associated with prolonged medium- to high-dose glucocorticoid (GC) use (6), alongside the evidence linking cumulative GC exposure to be associated patient outcomes (48), have highlighted persistent concerns that GC toxicity is not assessed consistently in routine care (3), and remains neglected in everyday clinical practice (24,27,49–51). We set up the X multilevel, multimethod qualitative study to address this implementation gap. In a departure from previous applications of the TDF in areas such as health risk management and communication (52), or adherence to clinical guidelines (53), this study is the first in the field of Rheumatology that employs the Behaviour Change Technique Ontology (BCTO; <https://www.bciosearch.org/>), to identify key behavioural determinants to support the clinical team with actionable implementation suggestions. This ontology-based approach enabled the development of 15 theory-informed recommendations, mapped to 43 specific

behaviour change techniques. Together, these recommendations provide more than 80 practical exemplars, specifying what needs to change, by whom (54), and in which settings, offering a structural approach for scalable implementation. Below, we discuss these findings in relation to the broader implementation science and clinical literature, and we invite clinical teams to employ the recommendations by adapting the proposed exemplars to their local and regional clinical contexts (55).

Barriers and facilitators to routine GC-toxicity assessment

Clinicians described substantial variability in how GC toxicity is assessed, largely driven by differences in clinical settings, access to resources, and reliance on ad-hoc or individualised use of methods. Time pressure and limited diagnostic tools were prominent barriers, consistent with previous findings (56). Confidence in assessment varied by experience: senior clinicians felt more assured, yet many expressed concerns about the adequacy of existing assessment approaches, echoing earlier findings (57). Routine assessment was further constrained by limited specialist knowledge and insufficient access to validated tools (17) (56). Across the data, clinicians identified ongoing education, access to structured assessment tools, and clear guidance as facilitators.

Behavioural determinants supporting GC-toxicity assessment

Knowledge, skills, beliefs about capabilities and consequences, goals, memory/attention/decision processes, environmental context/resources, social influences, and behavioural regulation were ranked as the most relevant TDF, to support the development of the recommendations. Collectively, these determinants indicate recommendations focusing on knowledge and skills, priorities and decision-making, and the contextual structures.

Pillar 1: Individual clinician-level implementation

The findings suggest that routine GC toxicity assessment is most likely to be adopted when the behaviour is simplified, structured, and cognitively supported. Clinicians emphasised the need for clearer guidance on what to assess and how to assess it, to ensure all clinicians, especially junior staff, have the knowledge and skills needed to distinguish GC toxicity from disease activity (59). These findings reflect broader challenges in GC toxicity assessment (60), including limited use of existing tools, such as the Glucocorticoid Toxicity Index (GTI-MD) (16) or validated PROMs, such as the GC PRO (17) which were developed because routine practice lacks reliable methods for recognising metabolic, psychological, and physical harms at an early stage (61). Despite their availability, awareness and routine use of these tools remain low, often due to limited confidence, access, or time.

Clinician confidence increases when toxicity assessment becomes routine rather than an ad-hoc (62). This can be supported through regular training, pre-visit PROMs, and brief micro-checklists that reduce reliance on memory and support decision-making under time pressures. Embedding reminders, prompts, and decision rules into clinical systems can also engage patients in monitoring subjective toxicities such as mood, sleep, and fatigue-domains. These adjustments are strongly supported by cognitive load theory (65), which proposes that externalising key steps and embedding prompts into workflows improves consistency of safety-critical behaviours (66,67). Making these adjustments can reduce clinicians' tendencies to overlook domains which are both central to patients' well-being (6,63) and highly relevant to clinical trials (64).

Importantly, GC toxicity assessment should not be a sole clinician's responsibility but engage the MDT team, with senior members protecting time (68,69) and space (70,71), for the assessment that will happen from other MDT members. These tactics align with evidence indicating that team-based approaches improve sustainability in practice.

Consistent with the implementation literature, passive dissemination of guidelines alone is unlikely to change behaviour (72); instead, combining behavioural diagnosis (via the TDF) with actionable strategies (via the BCTO) helps clarify what needs to change, by whom, in which settings, and why (73).

Pillar 2: Wider professional-level implementation

Beyond individual behaviour, routine GC toxicity assessment requires coordinated action at the level of the wider profession (74). Even where validated tools are available, uptake remains slow, reflecting persistent evidence–practice gaps (3,18). A key professional task is therefore to agree on the common minimum package for GC-toxicity assessment and promote a degree of standardisation across services (75). Reducing unwarranted variation is critical, as variability is associated with poorer outcomes and health inequities (76).

Leadership from recognised experts in GC toxicity and endorsement by professional bodies (e.g., EULAR, ACR, ARA) play a central role in shaping professional norms.

Embedding GC toxicity assessment within guidelines, training curricula, and audit-and-feedback systems signals that monitoring is a core component of high-quality care (e.g., “prevent avoidable harms”) (77) rather than an optional add-on.

Audit-and-feedback processes, particularly when paired with clear targets and practical suggestions for improvement, can support a successful implementation (78). However, our findings also align with literature that cautions against rigid standardisation (79).

Professional guidance should define a clear minimum standard, while allowing flexibility to tailor assessment to individual patient needs and clinical contexts, supporting consistency without undermining clinical judgement (80).

Pillar 3: Local/Regional Organisational-level implementation

At the local organisational level, sustainable implementation depends on systems that embed GC toxicity assessment into everyday clinical work rather than relying on clinician

memory or motivation. Implementation science shows that complex and safety-critical practices are more likely to be sustained when clinicians are repeatedly exposed to them, see them modelled by senior staff, and practise them routinely (81). Our recommendations emphasise clear standard operating procedures, routine documentation of toxicity assessment in clinic letters, and visible modelling by senior clinicians during case discussions, underscoring the importance of integrating assessment into existing computerised workflows (82,83).

Electronic prompts, templates, and role-appropriate delegation support consistent practice by reducing cognitive burden and omission. Additionally, organisational systems must allow flexibility, including clinical override, to balance toxicity monitoring with urgent patient needs (84–86). This approach reinforces that standardisation should support, rather than constrain, clinical judgement by creating the time, tools, and structures needed for consistent GC-toxicity assessment without adding unnecessary burden (84,85).

Strengths and limitations

This study has several limitations. First, the inter-rater agreement in prioritising TDF beliefs was low, indicating differences in how interdisciplinary team members interpreted ranking criteria. Second, limited variations in clinicians' responses may reflect a rather narrow pool of clinicians, potentially inflating self-selection bias. Third, because there are no established guidelines for glucocorticoid toxicity assessment, we were not able to make behaviourally informed predictions (e.g., using the TDF), especially in contexts where the evidence remains unclear (86). Fourth, the qualitative design limited quantification of how feasible the recommendations can be in practice (e.g., time required for assessment). Finally, while BCTO mapping clarifies implementation actions, it did not directly demonstrate real-world impact, which requires further evaluation using process evaluation or systems

dynamic-based designs, to identify network feedback loops and influential drivers of change (87).

Despite these limitations, the study has notable strengths. First, it applies a theory-informed implementation science, clarifying semantic entities, data-driven behavioural pathways (89), and decision making pathways that can support scalable yet flexible standardisation across Rheumatology and other specialties prescribing GCs. Second, the participatory design and stakeholder involvement strengthen relevance and equity (90,91), and consistent findings across two national contexts enhance ecological validity (92). Fourth, extensive use of verbatim quotations supports transparency (93), linking preferred assessment methods to specific OMERACT core domains, enhancing clinical utility (94) by aligning recommendations of using patients-driven vs expert-generated validated tools (95).

In conclusion, this study applies a theory-informed behaviour change approach, grounded in the TDF and operationalised through BCT mapping, to generate multilevel implementation recommendations for routine GC toxicity assessment. By addressing key systemic barriers and enhancing clinician training, organisational support, and embedding assessment into routine workflows, our recommendations provide a structured pathway that can improve monitoring practices. Given the diversity of clinical contexts in which GCs are prescribed, implementation should be locally adapted rather than ad-hoc. Integrating GC-toxicity assessment into care pathways should now be a priority.

613 **Declarations**

614 **Ethics approval and consent to participate**

615 Informed consent was obtained from all the clinicians who participated in the study. All
616 procedures performed in studies involving human participants were in accordance with the
617 ethical standards of the institutional and/or national research committee and with the 1964
618 Helsinki declaration and its later amendments or comparable ethical standards. The study was
619 approved by the following ethical committees: for the UK: X ; For Portugal: X

620 **Consent for publication**

621 All participants consented to having their fully anonymized quotes/data published.

622 **Availability of data and materials**

623 De-identified data from this study are available in the OSF public archive repository here (X).
624 Also the OSF contains the three wide level recommendations booklet. The analytic codes
625 used to conduct the analyses presented in this study are available by emailing the
626 corresponding author.

627 **Competing interests:**

628 x

629 **Funding**

630 The study received funding from X

631 **Authors' contributions**

632 All authors conceived and approved the manuscript. VSV participated in the planning of the
633 project, led the analyses and writing up of the manuscript, and drafted the introduction,
634 methods, and discussion. CE assisted in the analyses and write-up. JMM & ARL collected
635 data, participated in the TDF ranking exercise, and revised the manuscript. SM contributed to
636 the write up of the recommendations, participated in the TDF ranking exercise, organised the
637 external interdisciplinary meetings, and revised the manuscript. CP participated in the TDF

638 ranking exercise, and revised the manuscript. RL obtained the funding of this project,
639 participated in the planning of the project, edited and reviewed the manuscript, and provided
640 overall supervision of the project. All authors read and approved the final manuscript.

641 **Acknowledgements**

642 The authors would like to X Local Vasculitis group.

643

644

645

646 **References**

- 647 1. Iglesias-Gamarra A, Penaranda E, Espinoza LR. Vasculitides Throughout History and
648 Their Clinical Treatment Today. *Curr Rheumatol Rep*. 2011 Dec;13(6):465–72.
649 doi:10.1007/s11926-011-0210-x
- 650 2. Jennette JC. Overview of the 2012 revised International Chapel Hill Consensus
651 Conference nomenclature of vasculitides. *Clin Exp Nephrol*. 2013 Oct;17(5):603–6.
652 doi:10.1007/s10157-013-0869-6
- 653 3. Duru N, van der Goes MC, Jacobs JWG, Andrews T, Boers M, Buttgereit F, et al.
654 EULAR evidence-based and consensus-based recommendations on the management of
655 medium to high-dose glucocorticoid therapy in rheumatic diseases. *Ann Rheum Dis*.
656 2013 Dec;72(12):1905–13. doi:10.1136/annrheumdis-2013-203249
- 657 4. Huscher D, Thiele K, Gromnica-Ihle E, Hein G, Demary W, Dreher R, et al. Dose-
658 related patterns of glucocorticoid-induced side effects. *Annals of the Rheumatic*
659 *Diseases*. 2009 Jul;68(7):1119–24. doi:10.1136/ard.2008.092163
- 660 5. Judd LL, Schettler PJ, Brown ES, Wolkowitz OM, Sternberg EM, Bender BG, et al.
661 Adverse Consequences of Glucocorticoid Medication: Psychological, Cognitive, and
662 Behavioural Effects. *AJP*. 2014 Oct;171(10):1045–51.
663 doi:10.1176/appi.ajp.2014.13091264
- 664 6. Harris E, Tiganescu A, Tubeuf S, Mackie SL. The Prediction and Monitoring of
665 Toxicity Associated with Long-Term Systemic Glucocorticoid Therapy. *Curr*
666 *Rheumatol Rep*. 2015 Jun;17(6):38. doi:10.1007/s11926-015-0513-4
- 667 7. Robson JC, Dawson J, Cronholm PF, Ashdown S, Easley E, Kellom KS, et al. Patient
668 perceptions of glucocorticoids in anti-neutrophil cytoplasmic antibody-associated
669 vasculitis. *Rheumatol Int*. 2018 Apr;38(4):675–82. doi:10.1007/s00296-017-3855-6
- 670 8. Oray M, Abu Samra K, Ebrahimiadib N, Meese H, Foster CS. Long-term side effects of
671 glucocorticoids. *Expert Opinion on Drug Safety*. 2016 Apr 2;15(4):457–65.
672 doi:10.1517/14740338.2016.1140743
- 673 9. Venter G, Tieu J, Black R, Lester S, Leonardo N, Whittle SL, et al. Perspectives of
674 Glucocorticoid Use in Patients with Rheumatoid Arthritis. *ACR Open Rheumatology*.
675 2021 Apr;3(4):231–8. doi:10.1002/acr2.11234
- 676 10. Cheah JTL, Robson JC, Black RJ, Goodman SM, Lester S, Mackie SL, et al. The
677 patient's perspective of the adverse effects of glucocorticoid use: A systematic review of
678 quantitative and qualitative studies. From an OMERACT working group. *Seminars in*
679 *Arthritis and Rheumatism*. 2020 Oct;50(5):996–1005.
680 doi:10.1016/j.semarthrit.2020.06.019
- 681 11. Yardimci GK, Pagnoux C, Stewart J. A Canadian vasculitis patient-driven survey to
682 highlight which prednisone-related side effects matter the most. *Clinical and*
683 *Experimental Rheumatology*. 2023 Feb 15. doi:10.55563/clinexprheumatol/ef9nda
- 684 12. Black R, Goodman susan, Ruediger C, Lester S, Mackie SL, Hill CL. A Survey of
685 Glucocorticoid Adverse Effects and Benefits in Rheumatic Diseases The Patient

686 Perspective [Internet]. Vol. 23. 2017;23(8):416–20.
687 doi:10.1097/RHU.0000000000000585

688 13. Black RJ, Robson JC, Goodman SM, Hoon E, Lai LYH, Simon LS, et al. A Patient-
689 reported Outcome Measure for Effect of Glucocorticoid Therapy in Adults with
690 Inflammatory Diseases Is Needed: Report from the OMERACT 2016 Special Interest
691 Group. *J Rheumatol*. 2017 Nov;44(11):1754–8. doi:10.3899/jrheum.161083

692 14. Lyne SA, Yip K, Vasiliou VS, Katz DA, Richards P, Tieu J, et al. Consensus of the
693 definitions of the OMERACT glucocorticoid impact core domain set for people with
694 rheumatic and musculoskeletal diseases. *Seminars in Arthritis and Rheumatism*. 2024
695 Feb;64:152338. doi:10.1016/j.semarthrit.2023.152338

696 15. Tieu J, Cheah JT, Black RJ, Christensen R, Ghosh N, Richards P, et al. Improving
697 benefit-harm assessment of glucocorticoid therapy incorporating the patient perspective:
698 The OMERACT glucocorticoid core domain set. *Seminars in Arthritis and Rheumatism*.
699 2021 Oct;51(5):1139–45. doi:10.1016/j.semarthrit.2021.06.010

700 16. Stone JH, McDowell PJ, Jayne DRW, Merkel PA, Robson J, Patel NJ, et al. The
701 glucocorticoid toxicity index: Measuring change in glucocorticoid toxicity over time.
702 *Seminars in Arthritis and Rheumatism*. 2022 Aug;55:152010.
703 doi:10.1016/j.semarthrit.2022.152010

704 17. Bridgewater S, Ndosi M, Dawson J, Richards P, Silverthorne C, Dures E, et al.
705 Validation of a new glucocorticoid-specific Patient-Reported Outcome Questionnaire
706 (the GC PRO). *Annals of the Rheumatic Diseases*. 2024 Mar;83(3):394–400.
707 doi:10.1136/ard-2023-224946

708 18. Davison SN, Levin A, Moss AH, Jha V, Brown EA, Brennan F, et al. Executive
709 summary of the KDIGO Controversies Conference on Supportive Care in Chronic
710 Kidney Disease: developing a roadmap to improving quality care. *Kidney International*.
711 2015 Sep;88(3):447–59. doi:10.1038/ki.2015.110

712 19. Ng X, dosReis S, Beardsley R, Magder L, Mullins CD, Petri M. Understanding systemic
713 lupus erythematosus patients’ desired outcomes and their perceptions of the risks and
714 benefits of using corticoGCs. *Lupus*. 2018 Mar;27(3):475–83.
715 doi:10.1177/0961203317726375

716 20. Morin C, Fardet L. Systemic glucocorticoid therapy: risk factors for reported adverse
717 events and beliefs about the drug. A cross-sectional online survey of 820 patients. *Clin*
718 *Rheumatol*. 2015 Dec;34(12):2119–26. doi:10.1007/s10067-015-2953-7

719 21. Wilson JC, Sarsour K, Gale S, Pethö-Schramm A, Jick SS, Meier CR. Incidence and
720 Risk of Glucocorticoid-Associated Adverse Effects in Patients With Rheumatoid
721 Arthritis. *Arthritis Care & Research*. 2019 Apr;71(4):498–511.
722 doi:10.1002/acr.23611

723 22. Hazlewood GS, Loyola-Sanchez A, Bykerk V, Hull PM, Marshall D, Pham T, et al.
724 Patient and rheumatologist perspectives on tapering DMARDs in rheumatoid arthritis: a
725 qualitative study. *Rheumatology*. 2022 Feb 2;61(2):606–16.
726 doi:10.1093/rheumatology/keab330

- 727 23. Kuijper TM, Folmer R, Stolk EA, Hazes JMW, Luime JJ. Doctors' preferences in de-
728 escalating DMARDs in rheumatoid arthritis: a discrete choice experiment. *Arthritis Res*
729 *Ther.* 2017 Dec;19(1):78. doi:10.1186/s13075-017-1287-z
- 730 24. Theocharous V. Identifying Behavioural Health Determinants of GC Toxicity
731 Assessment in Vasculitis.
- 732 25. Alten R, Mischkewitz M. New concepts to reduce glucocorticoid toxicity. *Joint Bone*
733 *Spine.* 2019 Nov;86(6):715–23. doi:10.1016/j.jbspin.2018.11.006
- 734 26. Raj R, Ahuja KD, Frandsen M, Jose M. Symptoms and their recognition in adult
735 haemodialysis patients: Interactions with quality of life. *Nephrology.* 2017
736 Mar;22(3):228–33. doi:10.1111/nep.12754
- 737 27. Gvozdenović E, Allaart CF, Van Der Heijde D, Ferraccioli G, Smolen JS, Huizinga
738 TWJ, et al. When rheumatologists report that they agree with a guideline, does this mean
739 that they practise the guideline in clinical practice? Results of the International
740 Recommendation Implementation Study (IRIS). *RMD Open.* 2016 Apr;2(1):e000221.
741 doi:10.1136/rmdopen-2015-000221
- 742 28. Grimshaw J, Thomas R, MacLennan G, Fraser C, Ramsay C, Vale L, et al. Effectiveness
743 and efficiency of guideline dissemination and implementation strategies. *Health Technol*
744 *Assess.* 2004 Feb;8(6). doi:10.3310/hta8060
- 745 29. Grudniewicz A, Kealy R, Rodseth RN, Hamid J, Rudoler D, Straus SE. What is the
746 effectiveness of printed educational materials on primary care physician knowledge,
747 behaviour, and patient outcomes: a systematic review and meta-analyses.
748 *Implementation Sci.* 2015 Dec;10(1):164. doi:10.1186/s13012-015-0347-5
- 749 30. Rapport F, Smith J, Hutchinson K, Clay-Williams R, Churrua K, Bierbaum M, et al.
750 Too much theory and not enough practice? The challenge of implementation science
751 application in healthcare practice. *Evaluation Clinical Practice.* 2022 Dec;28(6):991–
752 1002. doi:10.1111/jep.13600
- 753 31. Pronovost PJ. Enhancing Physicians' Use of Clinical Guidelines. *JAMA.* 2013 Dec
754 18;310(23):2501. doi:10.1001/jama.2013.281334
- 755 32. Francis JJ, Stockton C, Eccles MP, Johnston M, Cuthbertson BH, Grimshaw JM, et al.
756 Evidence-based selection of theories for designing behaviour change interventions:
757 Using methods based on theoretical construct domains to understand clinicians' blood
758 transfusion behaviour. *British J Health Psychol.* 2009 Nov;14(4):625–46.
759 doi:10.1348/135910708X397025
- 760 33. Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, et al. A guide to using the
761 Theoretical Domains Framework of behaviour change to investigate implementation
762 problems. *Implementation Sci.* 2017 Dec;12(1):77. doi:10.1186/s13012-017-0605-9
- 763 34. Michie S. Making psychological theory useful for implementing evidence based
764 practice: a consensus approach. *Quality and Safety in Health Care.* 2005 Feb
765 1;14(1):26–33. doi:10.1136/qshc.2004.011155

- 766 35. Michie S, Thomas J, Johnston M, Aonghusa PM, Shawe-Taylor J, Kelly MP, et al. The
767 Human Behaviour-Change Project: harnessing the power of artificial intelligence and
768 machine learning for evidence synthesis and interpretation. *Implementation Sci.* 2017
769 Dec;12(1):121. doi:10.1186/s13012-017-0641-5
- 770 36. Marques MM, Wright AJ, Corker E, Johnston M, West R, Hastings J, et al. The
771 Behaviour Change Technique Ontology: Transforming the Behaviour Change
772 Technique Taxonomy v1 [version 2; peer review: 4 approved]. *Wellcome Open*
773 *Research.* 2024.
- 774 37. Michie S, West R, Hastings J. Creating ontological definitions for use in science
775 [Internet]. 2019 [cited 2026 May 1]. Available from:
776 <https://www.qeios.com/read/YGIF9B> doi:10.32388/YGIF9B
- 777 38. Michie S, Johnston M, Rothman AJ, De Bruin M, Kelly MP, Carey RN, et al.
778 Developing an evidence-based online method of linking behaviour change techniques
779 and theoretical mechanisms of action: a multiple methods study. *Health Serv Deliv Res.*
780 2021 Jan;9(1):1–168. doi:10.3310/hsdr09010
- 781 39. Pope C, Mays N, editors. *Qualitative research in health care.* Fourth edition. Hoboken:
782 Wiley-Blackwell; 2020.
- 783 40. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research
784 (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for*
785 *Quality in Health Care.* 2007 Sep 16;19(6):349–57. doi:10.1093/intqhc/mzm042
- 786 41. Presseau J, McCleary N, Lorencatto F, Patey AM, Grimshaw JM, Francis JJ. Action,
787 actor, context, target, time (A ACTT): a framework for specifying behaviour.
788 *Implementation Sci.* 2019 Dec;14(1):102. doi:10.1186/s13012-019-0951-x
- 789 42. Proudfoot K. Inductive/Deductive Hybrid Thematic Analysis in Mixed Methods
790 Research. *Journal of Mixed Methods Research.* 2023 Jul;17(3):308–26.
791 doi:10.1177/15586898221126816
- 792 43. Locock L, Kirkpatrick S, Brading L, Sturmey G, Cornwell J, Churchill N, et al.
793 Involving service users in the qualitative analysis of patient narratives to support
794 healthcare quality improvement. *Res Involv Engagem.* 2019 Dec;5(1):1.
795 doi:10.1186/s40900-018-0133-z
- 796 44. Braun V, Clarke V. One size fits all? What counts as quality practice in (reflexive)
797 thematic analysis? *Qualitative Research in Psychology.* 2021 Jul 3;18(3):328–52.
798 doi:10.1080/14780887.2020.1769238
- 799 45. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. *African Journal*
800 *of Emergency Medicine.* 2017 Sep;7(3):93–9. doi:10.1016/j.afjem.2017.08.001
- 801 46. Alhamad H, Donyai P. The Validity of the Theory of Planned Behaviour for
802 Understanding People's Beliefs and Intentions toward Reusing Medicines. *Pharmacy.*
803 2021 Mar 9;9(1):58. doi:10.3390/pharmacy9010058

- 804 47. Polit DF, Beck CT. Generalization in quantitative and qualitative research: Myths and
805 strategies. *International Journal of Nursing Studies*. 2010 Nov;47(11):1451–8.
806 doi:10.1016/j.ijnurstu.2010.06.004
- 807 48. Rice JB, White AG, Scarpatti LM, Wan G, Nelson WW. Long-term Systemic CorticoGC
808 Exposure: A Systematic Literature Review. *Clinical Therapeutics*. 2017
809 Nov;39(11):2216–29. doi:10.1016/j.clinthera.2017.09.011
- 810 49. Implementation of Change in Healthcare A Complex Problem. In. Available from:
811 [https://onlinelibrary.wiley.com/doi/chapter-](https://onlinelibrary.wiley.com/doi/chapter-epub/10.1002/9781119488620.ch1#accessDenialLayout)
812 [epub/10.1002/9781119488620.ch1#accessDenialLayout](https://onlinelibrary.wiley.com/doi/chapter-epub/10.1002/9781119488620.ch1#accessDenialLayout)
813 doi:<https://doi.org/10.1002/9781119488620.ch1>
- 814 50. Baker R, Camosso-Stefinovic J, Gillies C, Shaw EJ, Cheater F, Flottorp S, et al.
815 Tailored interventions to overcome identified barriers to change: effects on professional
816 practice and health care outcomes. In: The Cochrane Collaboration, editor. *Cochrane*
817 *Database of Systematic Reviews* [Internet]. Chichester, UK: John Wiley & Sons, Ltd;
818 2010 [cited 2026 May 1]. p. CD005470.pub2. Available from:
819 <https://doi.wiley.com/10.1002/14651858.CD005470.pub2>
820 doi:10.1002/14651858.CD005470.pub2
- 821 51. Quartuccio L, Treppo E, Urso L, Del Frate G, Mescia F, Alberici F, et al. Unmet needs
822 in ANCA-associated vasculitis: Physicians’ and patients’ perspectives. *Front Immunol*.
823 2023 Feb 23;14:1112899. doi:10.3389/fimmu.2023.1112899
- 824 52. Kumar N, Mohammadnezhad M. “Patients would probably be more compliant to
825 therapy if encouraged by those around them”: a qualitative study exploring primary care
826 physicians’ perceptions on barriers to CVD risk management. *BMC Prim Care*. 2022
827 Dec;23(1):61. doi:10.1186/s12875-022-01668-0
- 828 53. Abboud J, Rahman AA, Shaikh N, Dempster M, Adair P. Physicians’ perceptions and
829 preferences for implementing venous thromboembolism (VTE) clinical practice
830 guidelines: a qualitative study using the Theoretical Domains Framework (TDF). *Arch*
831 *Public Health*. 2022 Dec;80(1):52. doi:10.1186/s13690-022-00820-7
- 832 54. Michie S, Thomas J, Johnston M, Aonghusa PM, Shawe-Taylor J, Kelly MP, et al. The
833 Human Behaviour-Change Project: harnessing the power of artificial intelligence and
834 machine learning for evidence synthesis and interpretation. *Implementation Sci*. 2017
835 Dec;12(1):121. doi:10.1186/s13012-017-0641-5
- 836 55. Boaz A, Baeza J, Fraser A, Persson E. ‘It depends’: what 86 systematic reviews tell us
837 about what strategies to use to support the use of research in clinical practice.
838 *Implementation Sci*. 2024 Feb 19;19(1):15. doi:10.1186/s13012-024-01337-z
- 839 56. McDonough AK, Curtin J, Saag K. The epidemiology of glucocorticoid-associated
840 adverse events. 2008. 2008;20(2):131–7. doi:10.1097/BOR.0b013e3282f51031
- 841 57. Fardet L, Petersen I, Nazareth I. Prevalence of long-term oral glucocorticoid
842 prescriptions in the UK over the past 20 years. *Rheumatology*. 2011 Nov
843 1;50(11):1982–90. doi:10.1093/rheumatology/ker017

- 844 59. Harrison C, Fortin M, Van Den Akker M, Mair F, Calderon-Larranaga A, Boland F, et
845 al. Comorbidity versus multimorbidity: Why it matters. *Journal of Multimorbidity and*
846 *Comorbidity*. 2021 Jan 1;11:2633556521993993. doi:10.1177/2633556521993993
- 847 60. Zong JY, Leese J, Klemm A, Sayre EC, Memetovic J, Esdaile JM, et al.
848 Rheumatologists' Views and Perceived Barriers to Using Patient Decision Aids in
849 Clinical Practice. *Arthritis Care & Research*. 2015 Oct;67(10):1463–70.
850 doi:10.1002/acr.22605
- 851 61. Bridgewater S, Shepherd MA, Dawson J, Richards P, Silverthorne C, Ndosi M, et al.
852 Measuring the impact of GC therapy on health-related quality of life in patients with
853 rheumatic diseases: international development of a glucocorticoid treatment-specific
854 patient-reported outcome measure. *Rheumatology*. 2023 Nov 2;62(11):3565–75.
855 doi:10.1093/rheumatology/kead081
- 856 62. Vliet Vlieland TPM, Van Den Ende CHM, Alliot-Launois F, Beauvais C, Gobbo M,
857 Iagnocco A, et al. Educational needs of health professionals working in rheumatology in
858 Europe. *RMD Open*. 2016 Nov;2(2):e000337. doi:10.1136/rmdopen-2016-000337
- 859 63. Costello R, Patel R, Humphreys J, McBeth J, Dixon WG. Patient perceptions of
860 glucocorticoid side effects: a cross-sectional survey of users in an online health
861 community. *BMJ Open*. 2017 Apr;7(4):e014603. doi:10.1136/bmjopen-2016-014603
- 862 64. Cheah JTL, Robson JC, Black RJ, Goodman SM, Lester S, Mackie SL, et al. The
863 patient's perspective of the adverse effects of glucocorticoid use: A systematic review of
864 quantitative and qualitative studies. From an OMERACT working group. *Seminars in*
865 *Arthritis and Rheumatism*. 2020 Oct;50(5):996–1005.
866 doi:10.1016/j.semarthrit.2020.06.019
- 867 65. Green LA, Nease D, Klinkman MS. Clinical Reminders Designed and Implemented
868 Using Cognitive and Organizational Science Principles Decrease Reminder Fatigue. *The*
869 *Journal of the American Board of Family Medicine*. 2015 May 1;28(3):351–9.
870 doi:10.3122/jabfm.2015.03.140243
- 871 66. Master of Science in Industrial Management, University of Central Missouri, Missouri,
872 USA, Mojumder MU, Ruddro RA, MSc. in Industrial Engineering, Lamar University,
873 Texas, USA. HUMAN-MACHINE INTERFACES IN INDUSTRIAL SYSTEMS:
874 ENHANCING SAFETY AND THROUGHPUT IN SEMI-AUTOMATED
875 FACILITIES. *ajis*. 2023 Mar 1;04(01):01–26. doi:10.63125/s2qa0125
- 876 67. Laprime A, Kanaley R, Keller A, Stephen SJ, Schrieffer J, Fallon A, et al. Improving
877 Employee Safety Through a Comprehensive Patient Behavioural Program. *Hospital*
878 *Pediatrics*. 2024 May 1;14(5):356–63. doi:10.1542/hpeds.2023-007714
- 879 68. Pattyn N, Van Cutsem J, Dessy E, Mairesse O. Bridging Exercise Science, Cognitive
880 Psychology, and Medical Practice: Is “Cognitive Fatigue” a Remake of “The Emperor’s
881 New Clothes”? *Front Psychol*. 2018 Sep 10;9:1246. doi:10.3389/fpsyg.2018.01246
- 882 69. Bennett SE, Zangi HA, Larsson I, Beauvais C, Boström C, Domján A, et al. Assessing
883 acceptability and identifying barriers and facilitators to implementation of the EULAR
884 recommendations for patient education in inflammatory arthritis: a mixed-methods study

- 885 with rheumatology professionals in 23 European and Asian countries. *Annals of the*
886 *Rheumatic Diseases*. 2022 Oct;81(10):1348–57. doi:10.1136/annrheumdis-2022-222253
- 887 70. Knudsen LR, Lomborg K, Hauge EM, De Thurah A. Facilitators and challenges of
888 implementing a digital patient education programme for rheumatoid arthritis into clinical
889 practice. *BMC Health Serv Res*. 2024 Sep 20;24(1):1104. doi:10.1186/s12913-024-
890 11597-6
- 891 71. Sraka G, Ladak Z, Laur C, To D, Oliva L, Barnes C, et al. “It’s Like a One-Stop-Shop”:
892 A Qualitative Study Exploring Patient Experiences With Interdisciplinary Team–Based
893 Rheumatology Care. *J Rheumatol*. 2026 Feb;53(2):206–12. doi:10.3899/jrheum.2025-
894 0768
- 895 72. Flodgren G, Hall AM, Goulding L, Eccles MP, Grimshaw JM, Leng GC, et al. Tools
896 developed and disseminated by guideline producers to promote the uptake of their
897 guidelines. Cochrane Effective Practice and Organisation of Care Group, editor.
898 *Cochrane Database of Systematic Reviews*. 2016 Aug 22;2016(8).
899 doi:10.1002/14651858.CD010669.pub2
- 900 73. West R. Human Behaviour-Change Project [Internet]. OSF; 2024. Available from:
901 <https://osf.io/efp4x/overview>
- 902 74. Kien C, Daxenbichler J, Titscher V, Baenziger J, Klingenstein P, Naef R, et al.
903 Effectiveness of de-implementation of low-value healthcare practices: an overview of
904 systematic reviews. *Implementation Sci*. 2024 Aug 5;19(1):56. doi:10.1186/s13012-024-
905 01384-6
- 906 75. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of
907 change in patients’ care. *The Lancet*. 2003 Oct;362(9391):1225–30. doi:10.1016/S0140-
908 6736(03)14546-1
- 909 76. Soni SM, Giboney P, Yee HF. Development and Implementation of Expected Practices
910 to Reduce Inappropriate Variations in Clinical Practice. *JAMA*. 2016 May
911 24;315(20):2163. doi:10.1001/jama.2016.4255
- 912 77. Ivers NM, Grimshaw JM, Jamtvedt G, Flottorp S, O’Brien MA, French SD, et al.
913 Growing Literature, Stagnant Science? Systematic Review, Meta-Regression and
914 Cumulative Analysis of Audit and Feedback Interventions in Health Care. *J GEN*
915 *INTERN MED*. 2014 Nov;29(11):1534–41. doi:10.1007/s11606-014-2913-y
- 916 78. O’Brien M, Oxman A, Haynes R, Davis D, Freemantle N, Harvey E. Local opinion
917 leaders: effects on professional practice and health care outcomes. In: *The Cochrane*
918 *Collaboration*, editor. *The Cochrane Database of Systematic Reviews* [Internet].
919 Chichester, UK: John Wiley & Sons, Ltd; 1999 [cited 2026 May 1]. p. CD000125.
920 Available from: <https://doi.wiley.com/10.1002/14651858.CD000125>
921 doi:10.1002/14651858.CD000125
- 922 79. Samarasinghe BSW, Millar R, Exworthy M. Bridging the divide? Why the integration of
923 standardisation and individualisation of care remains paramount during turbulent times.
924 *leader*. 2025 Sep;9(3):292–4. doi:10.1136/leader-2023-000920

- 925 80. Bartels EA, Meijboom BR, Nahar-van Venrooij LMW, De Vries E. How service
926 modularity can provide the flexibility to support person-centered care and shared
927 decision-making. *BMC Health Serv Res.* 2021 Dec;21(1):1245. doi:10.1186/s12913-
928 021-07267-6
- 929 81. Dornan T, Lee C, Findlay-White F, Gillespie H, Conn R. Acting wisely in complex
930 clinical situations: ‘Mutual safety’ for clinicians as well as patients. *Medical Teacher.*
931 2021 Dec 2;43(12):1419–29. doi:10.1080/0142159X.2021.1951693
- 932 82. Derksen C, Walter FM, Akbar AB, Parmar AVE, Saunders TS, Round T, et al. The
933 implementation challenge of computerised clinical decision support systems for the
934 detection of disease in primary care: systematic review and recommendations.
935 *Implementation Sci.* 2025 Jul 17;20(1):33. doi:10.1186/s13012-025-01445-4
- 936 83. Van De Velde S, Heselmans A, Delvaux N, Brandt L, Marco-Ruiz L, Spitaels D, et al. A
937 systematic review of trials evaluating success factors of interventions with computerised
938 clinical decision support. *Implementation Sci.* 2018 Dec;13(1):114. doi:10.1186/s13012-
939 018-0790-1
- 940 84. Laureiro-Martínez D, Brusoni S. Cognitive flexibility and adaptive decision-making:
941 Evidence from a laboratory study of expert decision makers. *Strategic Management*
942 *Journal.* 2018 Apr;39(4):1031–58. doi:10.1002/smj.2774
- 943 85. Raine T, Gkini MA, Irving PM, Kaul A, Korendowych E, Laws P, et al. Maintaining
944 Clinical Freedom Whilst Achieving Value in Biologics Prescribing: An Integrated
945 Cross-Specialty Consensus of UK Dermatologists, Rheumatologists and
946 Gastroenterologists. *BioDrugs.* 2021 Mar;35(2):187–99. doi:10.1007/s40259-020-
947 00464-5
- 948 86. Francis JJ, Stockton C, Eccles MP, Johnston M, Cuthbertson BH, Grimshaw JM, et al.
949 Evidence-based selection of theories for designing behaviour change interventions:
950 Using methods based on theoretical construct domains to understand clinicians’ blood
951 transfusion behaviour. *British J Health Psychol.* 2009 Nov;14(4):625–46.
952 doi:10.1348/135910708X397025
- 953 87. Vasiliou VS, Meany L, Belluci C, Dockray S, Linehan C, Dick S, et al. Capturing the
954 context of drug use for college students: A contextual behavioural science informed
955 qualitative analysis of harm reduction practices using network feedback loops simulation
956 modelling. *Journal of Contextual Behavioural Science.* 2024 Oct;34:100844.
957 doi:10.1016/j.jcbs.2024.100844
- 958 88. Taylor N, McKay S, Long JC, Gaff C, North K, Braithwaite J, et al. Aligning intuition
959 and theory: a novel approach to identifying the determinants of behaviours necessary to
960 support implementation of evidence into practice. *Implementation Sci.* 2023 Jul
961 20;18(1):29. doi:10.1186/s13012-023-01284-1
- 962 89. Michie S, West R, Hastings J, Hogan W, Marques MM, Johnston M, et al. The Human
963 Behaviour-Change Project Phase 2: Advancing behavioural and social sciences through
964 ontology tools. *Wellcome Open Res.* 2024 Dec 19;9:730.
965 doi:10.12688/wellcomeopenres.23520.1

90. Gustafson P, Abdul Aziz Y, Lambert M, Bartholomew K, Rankin N, Fusheini A, et al. A scoping review of equity-focused implementation theories, models and frameworks in healthcare and their application in addressing ethnicity-related health inequities. *Implementation Sci.* 2023 Oct 16;18(1):51. doi:10.1186/s13012-023-01304-0
91. Baumann AA, Cabassa LJ. Reframing implementation science to address inequities in healthcare delivery. *BMC Health Serv Res.* 2020 Dec;20(1):190. doi:10.1186/s12913-020-4975-3
92. Subramanian S, De Moor K, Fiedler M, Koniuch K, Janowski L. Towards enhancing ecological validity in user studies: a systematic review of guidelines and implications for QoE research. *Qual User Exp.* 2023 Dec;8(1):6. doi:10.1007/s41233-023-00059-2
93. Tuval-Mashiach R. Raising the Curtain: The Importance of Transparency in Qualitative Research.
94. Tieu J, Cheah JT, Black RJ, Christensen R, Ghosh N, Richards P, et al. Improving benefit-harm assessment of glucocorticoid therapy incorporating the patient perspective: The OMERACT glucocorticoid core domain set. *Seminars in Arthritis and Rheumatism.* 2021 Oct;51(5):1139–45. doi:10.1016/j.semarthrit.2021.06.010
95. McArthur C, Bai Y, Hewston P, Giangregorio L, Straus S, Papaioannou A. Barriers and facilitators to implementing evidence-based guidelines in long-term care: a qualitative evidence synthesis. *Implementation Sci.* 2021 Dec;16(1):70. doi:10.1186/s13012-021-01140-0

Table 2. Summary of themes for the Aim 1: Clinicians' attitudes of methods used to access GC side effect

Theme	Extract Data
Knowledge about Methods of GC Toxicity	▪ "We've tested the GC PROM in patients in cognitive interviews and that seemed to pick up a lot about the sleep and appearance and impact of weight and impact on mood as well" ▪ "There is an index, which is the Glucocorticoid Toxicity Index." ▪ "I think they are quite practical because they are part of the normal profile of the consultation and they are very useful, because they allow me to validate, to have feedback on what I am doing, that bad feedback of get up and go."
Methods in Use	▪ "I think it makes us not forget to evaluate anything. Let a slightly more systematized way be made. ▪ "Well, this is the part that I give more primacy. I give priority to what is practical and, therefore, standardized scores or methods of that kind I do not tend to use in clinical practice, because I do not think they are practical. Therefore, the methods I use today I think are practical." ▪ "It is really detecting, if they exist almost completely, what are the signs of toxicity that this patient has and that may lead to a different approach, that is, a faster reduction, eventually, of corticosteroids therapy" ▪ "Sometimes it varies a little according to the dose and the type of patient and disease I have in front of me." ▪ "In terms of cost, because of the local reality that we only have one densitometer in the X hospital, the cost is not very reasonable. Patients have to be transported to X to do so and this adds a cost." ▪ "we ask the general and then either they spontaneously say something else that we think ok, this may be a side effect of the corticosteroids, or there are certainly things that are left out." ▪ "I think it is above all to detect symptoms or signs that are associated with corticosteroids therapy that may escape us on a day-to-day basis in a routine consultation."
The attitude of controlling the Disease over Toxicity	▪ "essentially in the consultation I do (limitations) in pathologies" ▪ "because the truth is that we evaluate toxicity, but these diseases are diseases that are very important and that medication is very essential and often, despite noticing toxicity, our room for manoeuvre for reduction is very small"
Confidence in Practice	▪ "There are always things that patients surprise us by reporting on and how this there is have impacted them on that front." ▪ "I would recommend, I think so. If you can maintain a systematic method, now it depends on the person, right? Each one has their own systematic method of evaluating, yes." ▪ "I don't think it covers everyone, and I think it's fallible in not being very systematic. I think it should be more systematic. And I don't think it covers everything." ▪ "No, I think they evaluate it well, but I don't have my own experience to apply, because my contact with this is only from the studies in which they are used. So, after the application I don't know, but it seems to me that it is, from the parameters they use that it's good." ▪ "No, I am not fully satisfied. I always think that we can always improve. There are always things that I had not evaluated." ▪ "Yes. They are the ones that make sense to me, so I believe they make sense to others."

Table 3. Summary of themes, and extract data for aim 2: Clinicians' barriers and facilitators in using methods to assess toxicity

Theme	Sub Themes	Extract Data
Barriers		
Barriers to Use GC side effect Assessment Methods, effectively	Resource Limitations Time Constraints Prioritisation of Disease Control Absence of Standardisation Patient Education Deficits	▪ “So, the biggest and easiest one would essentially be time” ▪ “Patients know their time frame, they will sometimes be reserved unless you brought specifically for certain things and they may not easily volunteer things that might be bothering them, but they're always a bit hesitant” ▪ “There it is, it has more to do with the patients' response to questions and the fact that I am a little limited in what I can do about toxicity.” ▪ “Lack of time, obstacle number 1 for most things in our clinical practice.” ▪ “Secondly, until recently, now you can't complain so much, but lack of resources, such as, for example, we don't have a sphingometer, we don't have a blood pressure measuring device, sometimes it doesn't work. It was a regular thing, at the moment we can't complain so much.” ▪ “Third, the patient's lack of sensitivity or knowledge of the adverse effects of corticoGCs” ▪ “Sometimes there are circumstances of consultation time,” ▪ “Imagine, the difficulty I find is the absence of standardization. That is, I think I can detect some adverse events, but others may eventually escape me if I forget to do one thing or another that day. But I think they're easy to apply.”
Knowledge and Confidence as a cognitive barrier	Challenge Due to Specialised Knowledge Experience and Confidence Impact of Barriers	▪ “Confidence instilled by repeated exposure to these scenarios hundreds of times.” ▪ “The routine stuff. Yeah, that's quite easy to have a look at and look back” ▪ “and fourth, lack of medical knowledge. That is, it is not present, not to be aware of the subject as much as a person should be.” ▪ “It's easy, as it's part of the routine assessment I do.” ▪ “It's quite easy because these are things I've been doing for many years, practically since I've had contact with Rheumatology.” ▪ “Easy. It's not difficult, if a person remembers I don't think it's difficult. It's a person willing to do it, so it's easy.”
Facilitators		

Facilitators and Motivation	Ongoing Education and Specialized Training Improved Access to Resources Structured Clinical Guidelines Patient Involvement Ease of Implementation	▪ “Having an updated a system that's able to track various ways of how the toxicity can happen and the way it affects various systems” ▪ Training on the subject. More training and more awareness and an evaluation tool. But it could be a tool that was first widespread ▪ “Something very simple like a tick list might be helpful for clinical practise in terms of the adverse events if people weren't using it already” ▪ “Evidence. Therefore, having a method that demonstrates that it can effectively detect adverse events, and ideally that can then have changes in practice that reduce those same side events, that would be ideal.” ▪ “That it was a method that was faster and more effective.” ▪ “If it were really something more systematized, less empirical, I could eventually really improve my care, so that I never forget to ask anything, to try to systematize.” ▪ “It had to be an effective and simple method, quick to use.”
------------------------------------	--	--

Table 4. Methods clinicians would use to assess OMERACT glucocorticoid impact core domain set, frequency, and exemplar response

OMERACT Criteria	Assessment Method	Frequency*	Exemplar response
[I-OMER_P]: Getting frequent Infections	Order a lab test or visit doctor/A&E	8	▪ <i>“something objective to be able to tell the difference of what is causing it”</i>
[II-OMER_P] Having fractures frequently	Visit doctor or A&E	8	▪ <i>“if it is a symptomatic fracture, it should naturally be observed in an emergency department”</i>
[III-OMER_P] Feeling low or high (Mood changes)	Diary	13	▪ <i>“Track it against disease activity, and see if they are related to the other”</i>
[IV-OMER_P] Noticing changes in blood pressure	Check vitals	12	▪ <i>“Important to assess for their treatment course”</i>
[V-OMER_P] Increase blood sugar levels	Order lab test	10	▪ <i>“Consequences are long term damage”</i>
[VI-OMER_P] Gain Weight	Diary	10	▪ <i>“The person can measure weight at home.”</i>
[VII-OMER_P] Feeling constantly tired (fatigue)	Diary or Questionnaire/PROM	11	▪ <i>“See if it is drugs causing this”</i>

[IX-OMER_P] Pain in the bones	Order lab test	9	▪ <i>"Investigate the cause to see if it is GC related"</i>
[X-OMER_P] Eye problems and/or changes in vision	Visit doctor or A&E	12	▪ <i>"Objective test at optician that will help"</i>
[XI-OMER_P] Changes in appearance	Questionnaire or PROM (Patient Reported Outcomes)	13	▪ <i>"Patient will know better than anyone else"</i>
[XII-OMER_P] Sleep disturbances	Questionnaire or PROM (Patient Reported Outcomes)	13	▪ <i>"Easiest getting that information from the patient"</i>
[XIII-OMER_P] Impact on relationship	Questionnaire or PROM (Patient Reported Outcomes)	12	▪ <i>"I can see that it is a retrospective evaluation on all parameters."</i>
[XV-OMER_P] Impact on my daily work (or activities)	Questionnaire or PROM (Patient Reported Outcomes)	13	▪ <i>"Hard to say it was GC and not disease"</i>
[XVII-OMER_P] Symptoms occurred after lowering the treatment (withdrawal symptoms)	Visit Doctor or A&E	12	▪ <i>"Rheumatologist able to tell pt this is a withdrawal period and expected, but needs to be able to tell on how severe the symptoms are"</i>

*The frequency corresponds to the preferred methods (e.g., how many participants selected the method as their preference). The presented methods represent the most frequently reported ones.

Table 5. Level of Importance of OMERACT criteria, frequency, and exemplar response

OMERACT Criteria	Level of Importance (For clinician, patient, or equal)	Frequency	Exemplar response
Getting frequent Infections	Equal	12	▪ <i>"Relatively easy sign that GCs are putting them at risk of infections, similarly infections are affecting patients' lives"</i>
Having fractures frequently	Equal	14	▪ <i>"Is a bad side effect, and impacts their ability to walk, function, do their day-to-day life"</i>
Feeling low or high (Mood changes)	Patient	10	▪ <i>"Time constraints of a clinic, I think clinicians are poor at assessing mood changes"</i>

Noticing changes in blood pressure	Clinician	8	▪ <i>“Typically, asymptomatic”</i>
Increase blood sugar levels	Equal	8	▪ <i>“So it's important to me and it's important to the patient. It is important for the patient because it is a cardiovascular risk factor, which interferes with his health. And it is important to me that I am the one who has to manage this problem.”</i>
Weight Gain	Patient and Equal	7	▪ <i>“I think this is the one patient dread”</i>
Feeling constantly tired (fatigue)	Patient	10	▪ <i>“As clinician relatively small understanding of symptom thus difficult understanding of what to do”</i>
Pain in the bones	Equal	8	▪ <i>“It is something that should be valued by the patient, who should make him come to the doctor and that should be approached by the doctor to try to understand if there is no underlying fracture and how this is limiting the patient and has to be treated, even if it is with analgesia. And it may justify making an adjustment in therapy.”</i>
Eye problems and/or changes in vision	Equal	11	▪ <i>“Everybody wouldn't want another organ to be affected”</i>
Changes in appearance	Patient	12	▪ <i>“I don't think it would bother me”</i>
Sleep disturbances	Patient	9	▪ <i>“For the patient because of the quality of life and also because of other complaints that may be associated during the day, namely fatigue, which sometimes may not be because of corticoGCs, but may be because of sleep deprivation.”</i>
Impact on relationship	Patient	11	▪ <i>“Part of their external life and not their medical life, and we tend to be focused more on their medical life”</i>
Impact on my daily work (or activities)	Patient	8	▪ <i>“It is more important for patient as you have got to do your work, and I do not. Not necessarily uninterested in it, it just is not as important for me”</i>

Symptoms occurred after lowering the treatment (withdrawal symptoms)	Equal	10	▪ <i>“Don't want to develop adrenal deficiency coming off GCs”</i>
--	-------	----	--

Table 6: Generated beliefs likely to support clinicians in using methods to assess GC side effect

Domains	Specific beliefs (n=1)	Frequency (out of 15 interviews)	Coded data (Sample code)
Knowledge	[1b] I need greater awareness and understanding of the breadth, timing, and risks of glucocorticoid toxicity	11/15	▪ (IntUK_0093): “It’s just an awareness of the breadth of the toxicity and side effects that can happen... knowledge that can be learned.” ▪ (IntPG_0012): “More awareness is needed in relation to the subject... by repetition there will be much more information.” ▪ (IntPG_0013): “Almost being more aware of the need to reduce them... I can pay more attention to the associated prophylaxis.” ▪ (IntUK_0119): “If I was asked of the 3000 people in our service, how many are on GCs? Nobody would know.”
2. Skills	[2a] Skilfully managing glucocorticoid side effects requires clinical experience and prolonged exposure to real cases.	9/15	▪ (IntUK_0006): “You have to be fairly experienced to be able to safely and adequately manage and mitigate GC-related side effects.” ▪ (IntUK_0119): “You certainly get better at it the more patients you treat.” ▪ (IntUK_0042): “Inexperienced people will often forget to evaluate bone health... until the patient gets a fracture, by which point it’s too late.” ▪ (IntPG_0015): “The main skill is to distinguish what is an adverse effect of glucocorticoid vs. disease activity.” ▪ IntPG_0017): “You need good knowledge of pain... to understand if joint or muscle pain is due to withdrawal or masked pathology.”

	[2b] I need access to clear guidelines, assessment methods, and training modules to identify and manage side effects.	9/15	▪ (IntUK_0006): “Offering resources... There is room for upskilling and I think that works for everyone.” ▪ (IntUK_0119): “I think we're really poorly trained in thinking about the longer-term consequences and also thinking about how to minimise GC exposure.” ▪ (IntUK_0093): “I think it's something that can be quite guideline driven or scoring system driven.” ▪ (IntUK_0042): “Having checklists of what to do is really helpful.” ▪ (IntPG_0012): “Decision guidelines... standardization of what is supposed to be done.”
4. Beliefs about capabilities	[4a] When I use standardised methods that are familiar and integrated into my routine practice, I have confidence in assessing glucocorticoid toxicity well	13/15	▪ (IntPG_0016): “The difficulty I find is the absence of standardization... others may eventually escape me if I forget...” ▪ (IntUK_0013): “There are probably things that might not be fully assessed by my approach at the moment.” ▪ (IntUK_0006): “Confidence instilled by repeated exposure to these scenarios hundreds of times.” ▪ IntUK_0044): “If you’re trained in it, if it’s convenient, and that’s the way to do this.” ▪ (IntPG_0016) the difficulty I find is the absence of standardization. That is, I think I can detect some adverse events, but others may eventually escape me if I forget to do one thing or another that day. But I think they're easy to apply. ▪ (IntUK_0011): “Doctors can find it harder to talk to patients about psychological impact and side effects.” ▪ (IntPG_0015): “Weight changes can also be difficult... I don’t know if it’s from glucocorticoids or a sedentary lifestyle.”
6. Beliefs about consequences	[6a] Routine monitoring of glucocorticoid toxicity support timely and tailored	13/15	▪ (IntUK_0093) I mean just yesterday then on in negotiation with two patients. Then I opted for a lower GC dose because

	treatment decisions that prevents avoidable harm		actually they'd have significant side effects on what I would consider fairly modest doses, but they were quite sensitive to the side effects. So we made a combined decision to reduce it. ▪ (IntUK_0006) If we don't use any methods, yeah. A significant impact on morbidity, mortality, general well-being. ▪ (IntUK_0013) I think it would impact their outcomes subjectively, massively. Don't feel like their symptoms and concerns are being addressed and then they would feel like they had explanations potentially for things that have been troubling them after starting treatment that might not have been expected or thought of as being toxic effects of their medications. I also think it would allow us to give interventions potentially reduce doses or investigate. ▪ (IntUK_0093) it can impact it very positively, both from reducing the sort of unpleasant side effects in the immediate term like insomnia, but also long term, you're potentially looking at, you know, prolongation of life expectancy and things if you can get it right.
9. Goals	[9a] Assessing glucocorticoid toxicity is a priority but it must be balanced with other priorities in the consultation	10/15	▪ (IntUK_0011) I think it should be always included as part of the assessment, because it's obviously just the other side of the coin to how active their disease is and and it will impact on treatment changes and also things that could impact their quality of life as well. ▪ (IntUK_0013) So I think there's there's a number of priorities to address within each consultation. So. I think that that's part of the. The balance that needs to be struck, and I think that it's important you assessment and clinical cortical toxicity, but it's not more important than the rest of the consultation.

			▪ (IntUK_0119) It would certainly be one of the highest priorities I would have thought, because the clinical risk of not doing it in terms of premature mortality, morbidity seems high. ▪ (IntPG_0013) It is really if there are tools, that there is really a kind of online questionnaire, a quick to use tool ends up facilitating the evaluation in a really systematic way and we do not get distracted in the middle of the things we are evaluating, because sometimes there are interruptions in the middle of the consultation, the patient or external, and that can distract us a little from our goal and here we are faster and more effective.
10. Memory, attention and decision processes	[10a] Glucocorticoid toxicity assessment should become more routine, when supported by prompts or delegated, rather than relying on my memory	11/15	▪ (IntUK_0006) a section on the clinic list or clinic letter on the electronic trackers that. Has a list of GCs related. Side effects and toxicity symptoms and signs. Etcetera and. It prompts you to review these with. The patient. And then you can choose to go through that list for the patient and address issues as they occur. ▪ (IntUK_0011) My routine assessment, and that's difficult because I don't use a specific score or anything setting and then it would be difficult to remind myself. ▪ (IntUK_0119) But I think that we need to use the technology we have already in place with electronic records to make this so that it doesn't rely on the doctor remembering to do it. I think this needs to be more automated ▪ (IntPG_0012) For some things it is automatic, for some things it is conscious. That is, some things that clearly have to be a little more conscious. Weight is automatic, blood pressure in this subgroup of patients is automatic. Lipid profile is automatic to tend towards the conscious, because it sometimes fails, and densitometry and fracture risk is

			half-half, that is, sometimes it fails because it does not apply to all patients. And infectious risk is what is perhaps a little more conscious. ▪ (IntUK_0044) I think if it was embedded, maybe in electronic systems or something, so the patient records maybe if the patients were aware of it as well, then I think those kinds of reminders help.
11. Environmental context/resources	[11a] We need standardisation of assessment across practice environments to reduce inequalities	11/15	▪ (IntUK_0006): “Variation in practice across these is the biggest problem in the way the services are set up. Some have gone to greater lengths than others.” ▪ (IntPG_0015): In the private sector, evaluation may incur costs, whereas in public hospitals it is free, affecting feasibility and consistency. ▪ (IntUK_0119): “We need a framework... so that it doesn’t matter which doctor you see... to have that sort of standardisation.” ▪ (IntUK_0119) I suppose there's the availability of things, so like having a blood pressure cuffing clinic. Not all clinics do, so you haven't got one you can't assess for hypertension. I suppose that. ▪ (IntPG_0013) In the consultation I think I do it in a slightly more systematized way, because they are my records, they are the way I usually write and there are fewer interruptions. In hospitalization, there are acute complications and there are also more interruptions. Sometimes it can be done in a slightly less systematic way. ▪ (IntUK_0119) I think this is where technology may have some role, but I think the problem with any technology approach is that it relies on patients being able to play a part in it and a lot of the population I see. They're older and are more fearful of using technology, so I think for example, in an ideal world we would send some information and tasks

			for the patient to do before they came to the clinic, so that that assessment then didn't take up all the time in clinic.
	[11b] I need more time and privacy in consultations, to fully assess glucocorticoid toxicity	8/15	▪ (IntUK_0042) You know, if you have more time, you can do more. You can ask more. You can be more satisfied with what you're doing. You can go into more detail. You can perhaps give people more complete answers. So I think time is the is the major obstacle to to many of these things. ▪ (IntPG_0015) More time to evaluate. We have nurses who routinely measure vital signs. Therefore, as a rule, there is more time than an appointment in a public hospital. And in the private sector, maybe there is even less time to do that and maybe there is less support. ▪ ntPG_0013) It is really if there are tools, that there is really a kind of online questionnaire, a quick to use tool ends up facilitating the evaluation in a really systematic way and we do not get distracted in the middle of the things we are evaluating. ▪ (IntPG_0015) Maybe I would evaluate more often if I could, if I had time, the impact on a psychic level, on a fatigue level. Therefore, these things that end up being more important for the patient than for us. The appearance, the sex life, that kind of impacts.
12. Social influences	[12a] I need influence of experts and peers on adopting best practices and standardised methods for managing GC toxicity	11/15	▪ (IntUK_0013) My consultant would influence my decision, so if they had said in this clinic we used this specific method, then I would do that. ▪ (IntUK_0042) So if you had kind of an expert stand up and say, look, we do this in all of our patients and it's this easy and we've found these outcomes and actually we've been able to change care and prevent damage, then I think you know that that is where you kind of demonstrate. ▪ (IntUK_0044) I think if we were beginning to see improvements or if it was embedded in research and trials.

			▪ (IntPG_0012) there must be a guiding figure for the internship or training period. This can be an important figure, especially in the early years when, even if you don't teach actively, seeing yourself doing it is an influence on what the doctor will do in the future. ▪ (IntPG_0018) If I had a EULAR guideline, it could eventually influence my method, so to speak.
14. Behavioural regulation	[14a] I need system-level standardisation procedures into the workflow to regulate and sustain routine glucocorticoid toxicity assessment	10/15	▪ (IntPG_0013) I think that maybe what I have to do is to evaluate if there are really specific guidelines that have emerged some specific evaluation methods in a more routine way and try to incorporate them into my clinical practice. ▪ (IntUK_0042) So I think you know if the toxicity index is low, you could be relatively reassured that. You can accept a higher dose of GCs for now if the toxicity index is high, then it does get a little bit tricky because if you need the patient. To have high doses of GCs, you're almost proving to yourself that they're they're always going to cause damage, and if you don't have anything you can give them other than GCs, you're almost in a position where you're going. I know that GCs are gonna make you sick. ▪ (IntPG_0015) I think this was possible if there was, for example, a nurse in a pre- or post-consultation who could apply scales or scores to assess toxicity. Therefore, do this in a routine way. We in the consultation have other things, which may be more important and that sometimes we can value more. But if this were a systematic thing, always having a nurse, I think it would be the ideal way to do this.

Note1: We used the v2 of the theoretical domain framework (Atkins et al. 2017) to complete the analyses.

Note2: Only the final agreed domains and beliefs are presented. See the Supplementary Material SM2 for the comprehensive list of the 14 domains and beliefs, including the ones that were excluded.

Figure 1: Rate of Preference importance of the OMERACT core domain set

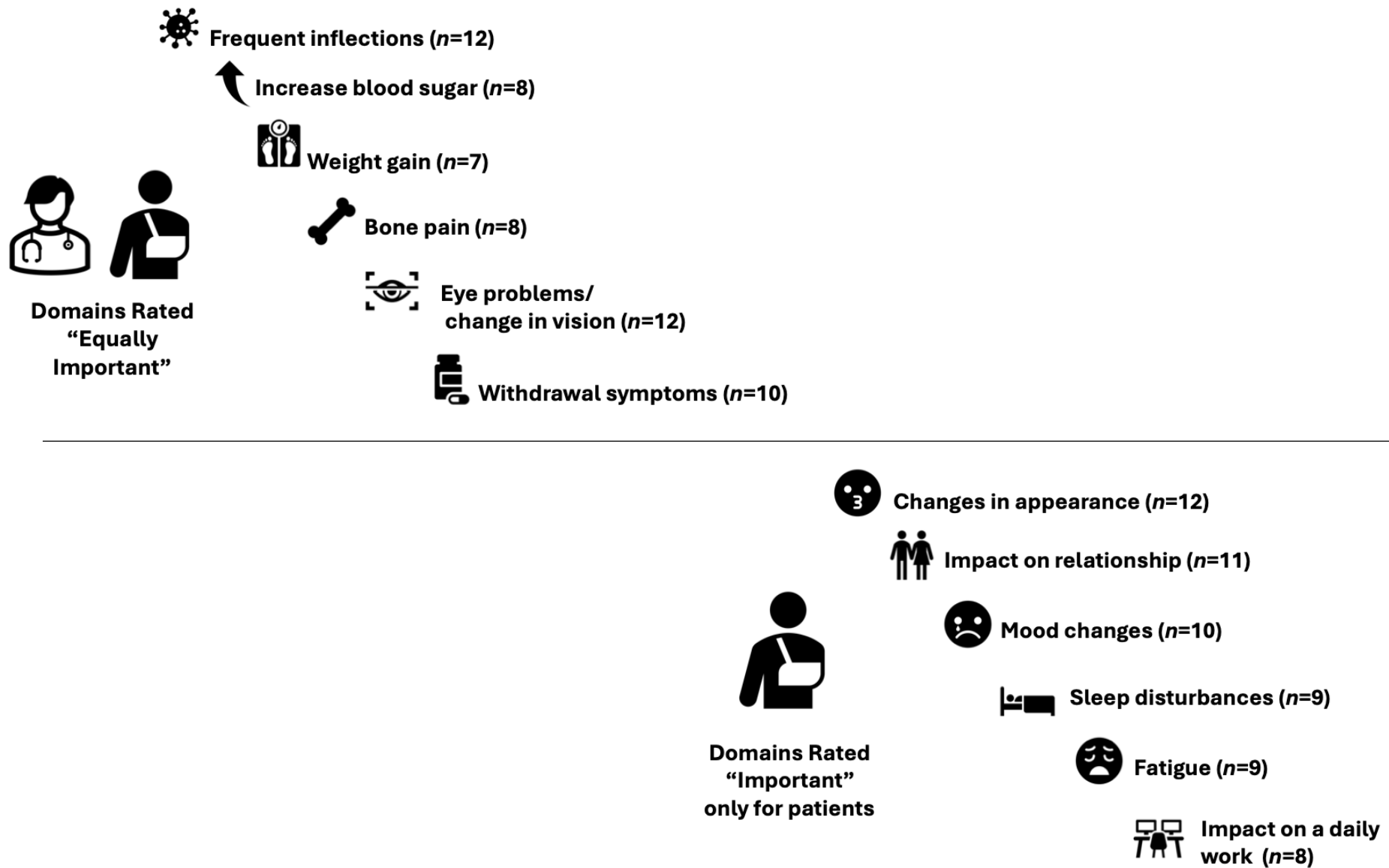
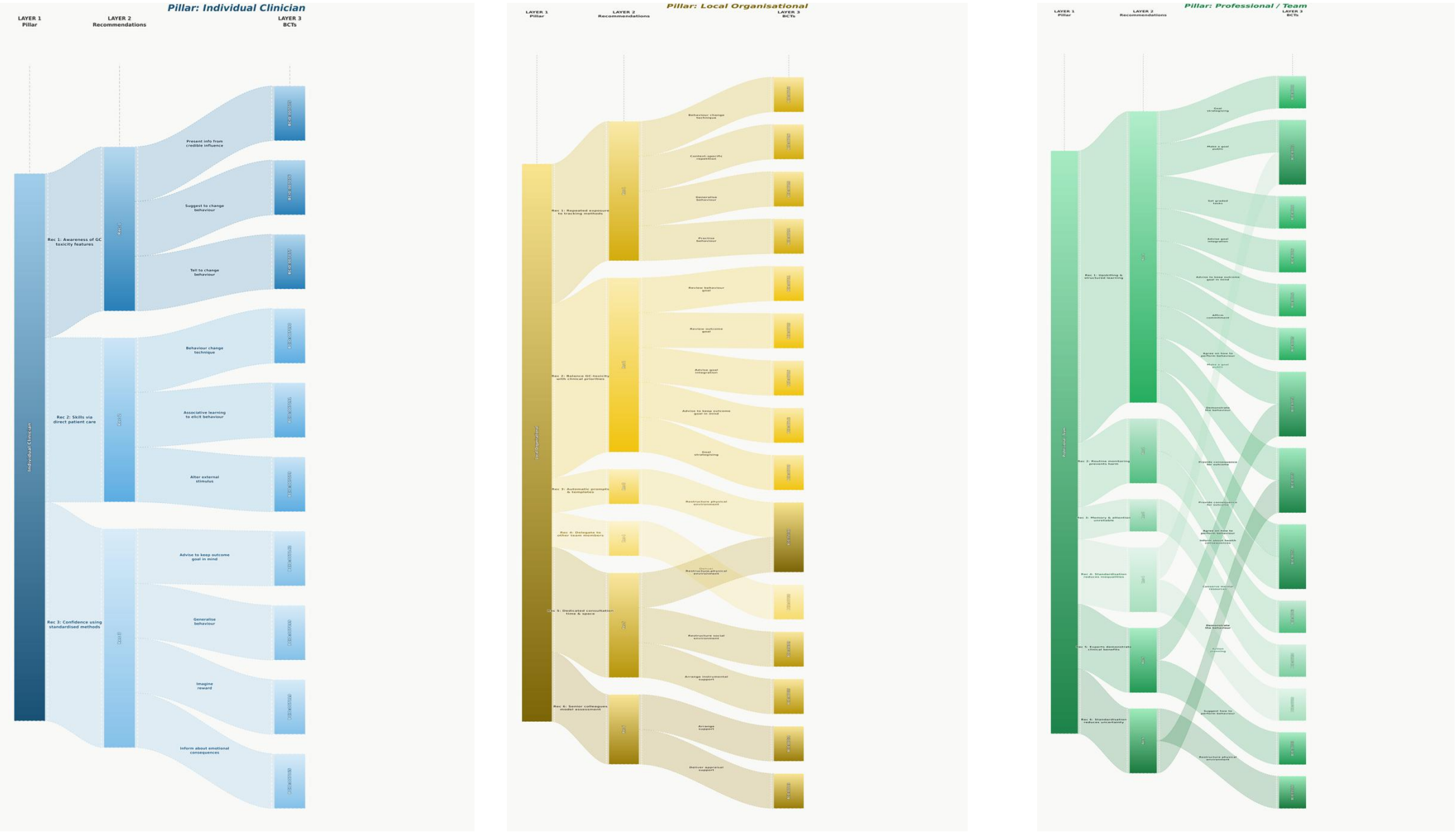


Figure 2: A Sankey diagram with the three level behavioural change recommendations



Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryMaterialSM1.docx](#)
- [SupplementaryMaterialSM2.docx](#)