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Title	Factors influencing hospital physicians' recognition of prescribing cascades: a qualitative interview study
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Publication date	2025-07-04
Original Citation	Daunt, R., Dalton, K., Curtin, D. and O'Mahony, D. (2025) 'Factors influencing hospital physicians' recognition of prescribing cascades: a qualitative interview study', Drugs & Aging. https://doi.org/10.1007/s40266-025-01222-4
Type of publication	Article (peer-reviewed);journal-article
Link to publisher's version	10.1007/s40266-025-01222-4
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Download date	2026-11-17 03:38:19
Item downloaded from	https://hdl.handle.net/10468/17751



University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Drugs & Aging
https://doi.org/10.1007/s40266-025-01222-4

ORIGINAL RESEARCH ARTICLE

Factors Influencing Hospital Physicians' Recognition of Prescribing Cascades: A Qualitative Interview Study

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Accepted: 15 June 2025
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Abstract

Introduction A prescribing cascade occurs when a medication is prescribed to manage a side effect of another medication. Prescribing cascades represent a key component of problematic prescribing and can result in harm to patients, especially older adults with multimorbidity and polypharmacy.

Objective The objective of this study was to explore factors influencing hospital physicians' recognition of prescribing cascades using the Theoretical Domains Framework (TDF), a validated theory-based qualitative methodology.

Methods Semi-structured interviews were conducted in May-July 2024 with hospital physicians of all grades. Interviews were audio-recorded and transcribed verbatim. Transcripts underwent conventional and directed content analysis to identify themes and TDF domains.

Results From 14 interviews, four predominant TDF domains were identified: (i) environmental context and resources: busy work conditions, lack of up-to-date medication lists and limited information technology (IT) infrastructure hinder prescribing cascade recognition; (ii) knowledge: physicians demonstrated limited knowledge of the term 'prescribing cascade' and highlighted education and training deficiencies at undergraduate and postgraduate level; (iii) skills: recognition skills are often developed through experiential learning while working (especially with geriatric medicine consultants) and (iv) social/professional role and identity: physicians perceived themselves as primarily responsible for recognising prescribing cascades, while pharmacists enable their recognition through medication reconciliation, medication review and ward round participation.

Conclusions This study highlights significant gaps in the knowledge and understanding of prescribing cascades among hospital physicians, as well as potential targets for future intervention. Focused education, integrated IT solutions, and a collaborative physician–pharmacist approach would likely improve prescribing cascade recognition in at-risk older people with multimorbidity and polypharmacy.

1 Introduction

A prescribing cascade occurs when a new drug is prescribed to manage an adverse effect of another drug [1]. Prescribing cascades can be either appropriate or inappropriate [2]. The latter typically occur if an adverse drug event (ADE) is misdiagnosed as a new medical condition and a second drug is inadvertently prescribed to manage it. Inappropriate prescribing cascades are clinically important as they represent an avoidable component of inappropriate prescribing and are associated with increased risk of hospitalisation, drug-related harm and, ultimately, increased morbidity and mortality [3, 4]. A prescribing cascade can be considered inappropriate when the risks associated with the combined use of the initial drug and the subsequent drug outweigh the potential benefits [5].

Older adults are particularly vulnerable to inappropriate prescribing cascades due to multimorbidity and associated polypharmacy, both of which increase the risk of inappropriate prescribing generally [6, 7]. Furthermore, this risk is increased due to age-related reduction in physiological systems reserve as well as pharmacokinetic (e.g. decreased renal and liver function) and pharmacodynamic (e.g. altered sensitivity to medications) changes that predispose patients to ADEs. The cumulative effect of multiple medications also

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Published online: 04 July 2025

Key Points

In this study, hospital physicians across all grades demonstrated limited knowledge and understanding of prescribing cascades.

Heavy workloads and understaffing limit physicians' available time to comprehensively review medications and recognise prescribing cascades.

Other important barriers to prescribing cascade recognition include lack of access to up-to-date medication lists, limited software infrastructure and prescribing education deficiencies.

increases the risk of ADEs which can result in the prescription of additional medications to manage these ADEs, thus initiating a prescribing cascade [8, 9]. Recognition of prescribing cascades in this cohort is particularly challenging as ADEs often present with non-specific symptoms such as confusion, dizziness or malaise [3, 10, 11]. These symptoms can easily be misattributed to known concurrent comorbidities or misdiagnosed as new conditions, potentially perpetuating ADEs and resulting in further inappropriate medication. Therefore, interventions to reduce inappropriate prescribing cascades should be a priority for all healthcare providers, especially those caring for older people experiencing multimorbidity and associated polypharmacy.

To date, research has focused predominantly on identifying and validating drug combinations that may represent prescribing cascades, with limited research exploring why and how prescribing cascades occur [12–14]. A recent study investigating the prevalence of potential prescribing cascades in acutely hospitalised older adults found that 39.4% of patients were prescribed potential prescribing cascades [15]. This finding suggests that the problem of prescribing cascades is under-recognised by clinicians and that opportunities to appropriately manage prescribing cascades are missed, highlighting the need for interventions to improve recognition in hospitalised patients.

For these reasons, a knowledge gap exists for research to explore the factors (facilitators and barriers) influencing recognition of prescribing cascades amongst hospital physicians. Using the Theoretical Domains Framework (TDF), a validated theory-informed framework often used in qualitative research, allows an effective method for exploring these factors [16]. The TDF has been widely used to guide data collection on factors influencing prescribing behaviours in various healthcare settings, including qualitative research on prescribing cascades [17]. It provides a valuable framework for systematically identifying these factors, which can then be targeted in behaviour-change interventions to improve practice.

Previous studies have examined perspectives and awareness of prescribing cascades amongst primary care physicians and patients [18, 19], as well as problematic polypharmacy and prescribing cascades with multiple stakeholders [20]. These studies indicate that both physicians and patients often struggle to recognise and manage prescribing cascades. This challenge arises due to difficulties in identifying new symptoms as potential drug adverse effects, limited awareness of specific prescribing cascades and the time required to address potential prescribing cascades even when recognised. No study to date has focused specifically on hospital physicians. We identified this as a key knowledge gap, as hospitalisation presents a unique and underutilised opportunity for medication reviews and recognition of inappropriate prescribing cascades. Therefore, the aim of this study was to utilise the TDF to identify the key behavioural factors influencing hospital physicians' recognition of prescribing cascades, including an evaluation of their knowledge and understanding of this aspect of inappropriate prescribing.

2 Methods

2.1 Study Approval and Reporting

Ethical approval for this study was granted by the Social Research Ethics Committee, University College Cork (reference: 2024-048). Study reporting was guided by the COREQ checklist for reporting qualitative research findings (Online Resource 1).

2.2 Study Design, Setting and Recruitment

Semi-structured interviews were undertaken as the preferred method of data collection because they are well suited to generating detailed, nuanced descriptions of participants' experiences and perspectives, especially with an under-researched phenomenon [21].

One-to-one semi-structured interviews were conducted with hospital physicians working in a large university teaching hospital in Ireland. At the time of the interviews, all physicians had clinical responsibility for patients admitted either electively or non-electively through the hospital emergency department.

The hospital medical records were primarily paper-based, including patients' prescribed medication lists which were recorded both in ward-based Kardex® prescription sheets and in discharge reports.

To obtain a range of physicians' perspectives, a sampling matrix was used to ensure that the interviews were

conducted with at least three participants from each grade of physician (intern [house officer], senior house officer [SHO or junior resident], registrar/specialist registrar [SpR or senior resident] and consultant or senior attending physician) and that at least one male and at least one female was represented within each grade. This reflects the highly organised social context and well-established hierarchical structure of clinical medicine within the Irish public hospital system [22]. In addition, previous research suggests that prescribing practices differ between grades of physician and that junior doctors often defer complex prescribing decisions to senior colleagues [23, 24]. While prescribing patterns do not differ significantly according to physician sex, it can influence patient interactions and outcomes and was therefore included in the sampling matrix [20, 25].

The inclusion criteria required that participants were registered with the Irish Medical Council and working in a recognised medical specialty in the university teaching hospital at the time of the interview. Doctors working at any grade in a surgical specialty, psychiatry, paediatrics or obstetrics/gynaecology were not included in the study, as comprehensive medication review involving larger medication lists is less of a routine task in their usual care delivery. Physicians were also excluded from the study if they worked in geriatric medicine at consultant or SpR grade or if they held an additional degree in pharmacy. Participants were recruited via convenience and snowball sampling. Potential participants were identified through the professional network of the research team, and were invited to participate via email, which included an information sheet and consent form.

2.3 Application of the TDF

The TDF provides an accessible and structured means of identifying factors that impact practice across a comprehensive range of potential behavioural determinants [17]. Compared with conducting qualitative research without theory-based approaches, using the TDF allows the generation of broader range of responses, partially due to its ability to mitigate against cognitive bias [26, 27].

In the context of the present study, the recognition of prescribing cascades was conceptualised as a behaviour. To acquire a thorough understanding of the facilitators and barriers influencing this behaviour, the development of the topic guide was informed by the 14 TDF domains and their constructs, and these domains were used as pre-determined codes during directed content analysis.

2.4 Data Collection

Immediately prior to their interviews, participants completed a short questionnaire collecting demographic information (gender, grade, years of post-qualification experience, specialty, university in which medical degree was obtained and whether they received any prior education on prescribing cascades, either formally or informally) and whether they recalled having ever identified a prescribing cascade or witnessed a colleague recognise a prescribing cascade. A topic guide was developed on the basis of reviewing relevant literature [18, 19, 28], the Theoretical Domains Framework (TDF) version 2 [29] and the authors' knowledge of prescribing cascades. At least one question was included for each of the 14 TDF domains. The topic guide (Online Resource 2) aimed to elicit factors affecting recognition of prescribing cascades based on interviewees' knowledge and experience, as well as barriers to and recommendations for improving the recognition of prescribing cascades. The topic guide was pilot tested with one physician not affiliated with the research team; this interview was not included in the data analysis (as planned a priori).

All interviews were conducted by a research physician with 8 years of postgraduate clinical experience (R.D.). All interviews were conducted in person in a private room within the hospital between May and July 2024. All participants provided written consent prior to interview and verbal consent immediately prior to the interview. Field notes were recorded by the interviewer after each interview. All interviews were audio-recorded and transcribed verbatim, with transcripts subsequently deidentified.

It was decided a priori that interviews would continue until there were at least two additional interviews where no new major themes appeared, as this would help ensure that the topic has been adequately explored [30].

2.5 Data Analysis

NVivo® software version 14 was used to facilitate analysis. Data were analysed in four phases. In the first phase, transcripts were read and re-read to ensure familiarity. In the second phase, the research physician conducted conventional content analysis, which involved open coding to create non-hierarchical codes that were then grouped into initial themes [31]. The third phase involved directed content analysis, using constructs and domains from the TDF as pre-determined codes [31]. To enhance the reliability of coding, a second researcher (K.D., pharmacist) independently identified themes and TDF domains across all transcripts. Factors considered when identifying predominant TDF domains included the frequency of beliefs, presence of conflicting beliefs, and the strength of beliefs expressed [32]. Finally, in the fourth phase, themes identified through conventional coding were categorised under the TDF domains that best reflected the themes and its associated codes [16].

2.6 Reflexivity

2.6.1 Research Team Background and Professional Experience

The research team included a research physician with specialist training in geriatric medicine (R.D.), a senior academic pharmacist with experience in qualitative methods (K.D.) and two consultant geriatricians (D.O.M. and D.C.). A total of three of the interviewees had previously worked clinically with R.D. All participants were aware that D.O.M. and D.C. were consultant colleagues working in the same hospital. K.D. had no contact with study participants. Acknowledging the influence of the researcher team's background on the study design and methods, the following steps were taken to leverage the advantages of the team's background and mitigate biases [33].

2.6.2 Topic Guide Development

The topic guide was developed using the research team's experience in prescribing cascades, along with the TDF and review of relevant literature. This approach had the advantage of creating a well-rounded guide based on current evidence and suited to the clinical context of the study.

2.6.3 Insider Positionality

As a physician with higher specialist training in geriatric medicine, R.D. recognised her 'insider position' and was aware of the need to set aside her own perspectives and try to remain neutral when interviewing physician colleagues as a researcher [34, 35]. Potential study participants were aware that R.D. had specialist training in geriatric medicine; this knowledge was beneficial in accessing potential participants within the hospital. Creating a pre-planned sampling matrix ensured diversity in participant characteristics, thus minimising the risk of selecting participants with potentially similar perspectives. During the interviews, the insider position meant that RD had the advantage of a shared clinical language and contextual understanding, facilitating rapport and easing the flow of interviews. One potential challenge of a shared language is the 'deadening effect', where shared understanding is assumed and participants do not elaborate on their views [36]. To overcome this, R.D. encouraged participants to elaborate and clarify their answers where needed.

2.6.4 Data Interpretation

It is almost inevitable that the researchers' own professional background will influence data interpretation, with views most congruent with the team's own most easily received [37]. Consequently, R.D. debriefed the team regularly throughout the analytical process to maintain openness and critical reflection among the participants. Prior to finalising the TDF codes, R.D. and K.D. met to discuss the data findings and the code development.

3 Results

A total of 15 potential hospital physician participants were contacted, of whom 14 were interviewed. These physicians had varying levels of training and experience aligned to the sampling matrix (Table 1). One physician agreed to participate but was unable to schedule an interview within the study timeframe due to other commitments. A total of seven participants were male and seven were female, with a mean of 6 years of postgraduate experience (range 10 months to 23 years). The mean interview duration was 18 minutes (range 14–35 min). At the time of the interviews, participants were practising in the following specialities: respiratory medicine ($n = 4$), rheumatology ($n = 3$), acute internal medicine ($n = 2$) and one each in cardiology, geriatric medicine, endocrinology, stroke medicine and infectious diseases.

All 14 TDF domains were identified in the transcripts, with corresponding quotations shown in Table 2, noting that some quotations are aligned to more than one TDF domain. All TDF domains are presented below, whereby the first four were identified as predominant in influencing hospital physicians' recognition of prescribing cascades: environmental context and resources, knowledge, skills and social/professional role and identity.

Table 1 Sampling matrix details of physician participants.

Physician Characteristic	Number of interviewees	Minimum number required as part of sampling strategy
Gender		
Male	7	4
Female	7	4
Grade		
Intern/house officer[a]	4	3
Senior house officer[b]	3	3
Registrar/specialist registrar[c]	4	3
Consultant	3	3

[a] < 1 year post-qualification experience

[b] ≥ 1 year post-qualification experience (typically 2 years in duration after internship).

[c] ≥ 3 years post-qualification experience (the final stage of specialist training prior to eligibility for consultancy

Table 2 Illustrative quotations.

Descriptor	Quotations
Environment	
Lack of access to up-to-date medications	'...if everybody just starts writing what this medication is indicated for and we kept it in the patient's medical records, that would be really helpful.' [SHO 1]
Staffing	'...you don't know what medications they're on…significant problem with then trying to manage their medication when they come in, because maybe you have a prescribing cascade that happens because they're on something you just don't realise they are on…' [Consultant 3]
Excessive workload	'...often, we don't know what drugs patients are on… if they come into the emergency department, you don't know what they're on, so you might start instigating some treatment, for example... you might start a diuretic but unbeknownst to you they're actually on a calcium channel blocker that was started by the GP a couple of weeks ago.' [Consultant 2]
Information technology	'If [patients] write down their medications and the dates of things were changed… can be helpful because we don't have a unified prescribing log between GPs and pharmacies and hospitals…' [SHO 2]
	'…they [patients] come in and they're not sure what medications they are on and they don't have a list… you're looking at their last list… hoping this is right.' [Registrar 4]
	'...in general, when patients are in hospital, (they) don't tend to know what they're on…' [Intern 1]
	'Like the hospital's understaffed simple as. I think if we have more staff, more time to think about things, we are more likely to identify [prescribing cascades].' [Intern 1]
	'…there's lack of staff members in the hospital because if we have more staff, we will reduce clinical workload and then hospital doctors can spend the time looking through the Kardex® and making decisions…' [SHO 1]
	'…with a busy inpatient list, you're running around the ward, you're often dealing with one or two key aspects of the patient care… we do try and look at the Kardex® each time … you have to try and keep it all in your head, where you remember the background medical history of the patient, what drugs they're on… sometimes, I think due to time constraints, you don't realise that maybe the side effect of the drug is contributing to the symptom that you're now looking at…' [Consultant 2]
	'…we just couldn't find a time to dedicate ourselves to work on that [identifying prescribing cascades] on top of our already massive clinical workload.' [SHO 3]
	'…a busy inpatient service... ideally it would be great to have a proper sit down with every patients' Kardex® to go through the medications. But the reality is, if you have 30 odd patients on an inpatient list, and you have to see all of them every day, you might overlook some of the Kardex's®…' [Registrar 2]
	'The number one barrier that jumps out to me would be time pressure… the speed at which ward rounds happen…' [SHO 3]
	'In an ideal world, if we were doing electronic prescribing, you could probably have something say, "is this medication warranted?" or "what is your reason for starting it?"' [Registrar 1]
	'We're living in a very archaic system that doesn't help with flagging when prescribing cascade might be happening… a simple intervention would be having an electronic health record prescribing system, but it's a very complex intervention to put in place unfortunately.' [Consultant 3]
	'I would just type in the name of the medication and look at the SPC and then look at the information of what side effects are common. On the computers in the hospital, they have medicines, i.e., I can get information on it as well.' [Intern 3]
	'I know that there's new ways to access it [the BNF], but it's always, in the last few years, been tricky.' [Consultant 1]
	'…if you had an app-based system where you have common prescribing cascades, for example, you click in opiates and then common co-prescribers, and then you could have a list of inappropriate common prescribing cascades.' [Consultant 2]
	'I think it'd be brilliant if everyone [patients] had…an app or something that would have their medications on it, so that … if they had swelling in their legs, you'd know they were on amlodipine or…' [Registrar 4]

3.1 Environmental Context and Resources

3.1.1 Lack of Access to Up-to-Date Medications

Interviewees highlighted difficulties accessing details of up-to-date lists of patients' medications, as well as information relating to indications for medications, initiation dates and intended duration as significant barriers to recognising prescribing cascades. This challenge was particularly evident in the emergency department outside routine working hours, when it is often impossible to access patients' full medical records or communicate with community healthcare providers.

3.1.2 Staffing

Perceived chronic staff shortages, among both medical and pharmacy teams, contributes negatively to the recognition of prescribing cascades because they reduce the time available for comprehensive medication reviews.

Table 2 (continued)

Descriptor	Quotations
Knowledge	
Recognising the term 'prescribing cascades' and its conceptual understanding Knowing examples of prescribing cascades Education and training deficiencies	'I didn't know what they [prescribing cascades] were before coming here today. And I certainly don't think a lot of the doctors in training would be familiar with the concept'. [Consultant 2] 'I think people would recognise what happened ... the laxative for constipation in the opioid patient … but they wouldn't group it together as "oh look at this interesting prescribing cascade"…' [Consultant 1] 'People are paralysed by lack of knowledge in regard to deprescribing, so they do nothing…' [Consultant 3] '…oftentimes opioids can have side effects … nausea and then people need an antiemetic to manage that … it's not something I've thought about much…' [Intern 3] '… ACE inhibitor → cough, opioid → constipation → laxative. Antihypertensive and then hypotension and then, I don't know, adding in something to raise the heart rate or something...uh, inotrope, or vasopressor…other barriers, just not being aware of them… I only know the ones I mentioned and that's not very many.' [Intern 4] '…if somebody is on a PPI like lansoprazole, and they get put on clopidogrel, or they are on omeprazole and get put onto clopidogrel and then you have to change the omeprazole to something else.' [Registrar 1] 'So I'm trying to come up with examples, but I keep thinking of contraindications as opposed to prescribing cascades…' [Registrar 2] 'I don't really remember being taught anything about it in college or … BST teaching [formal post-graduation teaching for SHOs] or anything…' [SHO 2] 'I think it's very important to have like the foundation level of education as an undergraduate, but also have constant reminders post-grad…' [Registrar 2] '...general education about "the most common inappropriate prescribing cascades that happened", "can you screen for them"' [Consultant 1] '... a medication alert system ... just to highlight that these were the inappropriate prescribing errors that have occurred… builds your awareness of it… always comes back to education, education, re-education and reminders…' [Consultant 2]
Skills	
Experiential learning Improvement with training	'...at an intern level, just a lack of experience and the lack of seeing these patterns from before and… anticipating these treatments.' [Consultant 3] 'I think as time goes on, maybe when you become a reg … you try and to take more of that in perspective and look at people's Kardex® before they go home and see do they need to be on everything.' [Registrar 4] 'In medical school, it's a bit theoretical at that point… if we had a prescribing safety course in… your first year as an intern… where you could refresh things and… talk about common drugs and common errors, that might be a bit more practical at that point. …and as an SHO as well.' [Registrar 4] 'You can start by training the young doctors so when they become consultants to keep that in mind.' [SHO 1]

3.1.3 Excessive Workload

Many participants identified excessive workload, specifically the responsibility for reviewing large numbers of patients within a limited timeframe as a key factor limiting their ability to devote time for recognising prescribing cascades. Time constraints leading to 'fast-paced' ward rounds limit the opportunity for thorough medication reviews.

3.1.4 Information Technology

Participants highlighted deficiencies in healthcare information technology (IT), including inadequate infrastructure and limited online resources. Ireland's predominantly paper-based medical records system was seen as a significant hindrance, with participants expressing a desire for electronic records systems capable of providing alerts for potential prescribing cascades.

Online resources, such as the Summary of Product Characteristics, were commonly cited as resources used to check drug side effects. Access to other resources, such as the online British National Formulary (BNF), was inconsistent and challenging for some participants. Several interviewees proposed ideas for enhancing IT resources, including the development of smartphone applications for healthcare professionals to check for common prescribing cascades and for patients as a method for maintaining up-to-date medication records.

Table 2 (continued)

Descriptor	Quotations
Social and Professional Role and Identity	
Physicians' responsibility in prescribing cascade recognition Pharmacists' role Specialty role	'It's probably everyone's responsibility to recognise prescribing cascades to the best of their ability… senior staff would probably be much more used to it and probably better at it in general.' [SHO 3] '…the medical team … the buck stops with them … you're the one prescribing, you're the one reviewing prescriptions on a regular basis…' [Consultant 1] '…the more junior, the less likely that they would be to pick it up and [more likely] to kind of give something a little bit more "blindly".' [Registrar 1] 'Being an intern, I'm not the one deciding to start the new medication, it'd be someone more senior on my team saying, "start this medication for this patient"…' [Intern 3] '…if we really want to solve this problem… having a specific team that review medication would be good, without interfering with the normal ward jobs…' [SHO 1] 'People tend to "pass the buck" to someone else when it comes to deprescribing, especially if unsure why someone is on a medication, don't know who started it, don't know when it was started, don't know why it was started – in all that uncertainty some people just pass the buck.' [Consultant 3] 'In my own experience, the pharmacist has been my primary source of flagging "this medication is inappropriate", "this adverse effect might be due to a medication"…' [SHO 1] '…if there was if a prescribing cascade or unwanted side effects from medications, more often than not the pharmacists… flag them to us.' [Registrar 2] '…if there was (a) joint ward round with the pharmacist …(and) consultants… where you sit down and go through the medications and things like that, that might be more of a structured way…' [SHO 2] 'In my previous rotation, my consultant was really good at reviewing patients' Kardex®, but partly because he was the consultant geriatrician…' [SHO 1] 'I previously worked in geriatrics … [the consultant] was really big on stopping the extra medication.' [SHO 2] '… what we see a lot is people come into hospital, with respiratory exacerbations, they're put on antibiotics, they're put on steroids… you can often end up with people who develop peripheral oedema. So they end up developing volume overload… then you're into your prescribing cascade of giving them furosemide. Now they're hypokalaemic so you're giving them potassium … that's a prescribing cascade that we'd see frequently and recognise very, very quickly …' [Consultant 3]

3.2 Knowledge

3.2.1 Recognising the Term 'Prescribing Cascade' and its Conceptual Understanding

Familiarity with the term 'prescribing cascade' varied across professional grade. Consultant physicians generally seemed unfamiliar with the term; however, they identified with the concept once provided with the definition. In contrast, all interns were able to define the term 'prescribing cascades' but admitted limited knowledge about specific prescribing cascades. During the interviews some participants had difficulties explaining precisely what a prescribing cascade entailed and mistakenly described them as drug–drug interactions and non-specific prescribing errors.

3.2.2 Knowing Examples of Prescribing Cascades

When asked, most participants had difficulty providing examples of specific prescribing cascades. When examples were provided, they were mostly 'appropriate' prescribing cascades (e.g. anti-emetic for nausea while on an antibiotic) with very few examples of inappropriate prescribing cascades provided (e.g. angiotensin-converting enzyme [ACE] inhibitor and anti-tussive).

3.2.3 Education and Training Deficiencies

All participants reported limited education on prescribing cascades. Few recalled undergraduate tuition on the topic, and none had received formal postgraduate teaching on cascades. Interviewees emphasised the need for targeted education, particularly for the most junior physicians (e.g. interns and SHOs), to improve recognition of prescribing cascades in clinical settings.

Table 2 (continued)

Descriptor	Quotations
Social influences	
Hierarchy and modelling within medical teams Support from patients Support from other healthcare professionals Reluctance to change medications prescribed by others	'… our consultants change every 2 weeks, if I don't know a consultant, I'm less likely to speak up. Whereas there are some consultants… I know them more… so I'd be more comfortable speaking up.' [Intern 4] '…it depends on the team structure and how comfortable they feel in asking for help or asking for advice or, you know, I suppose even having things explained to them…' [Consultant 3] '…you wouldn't want to challenge… someone more senior that has like prescribed… the team I'm working with at the moment, I would be very happy… to bring it up with someone. But I can't say that for every team that I've been on…it's difficult to challenge someone more senior… if you did feel that you were really challenging them… then you might not be as inclined.' [Intern 2] '… we all admire the SHO and intern who do speak up... I think we want people to be challenging us. And we want we want the status quo to be challenged all the time… Empower the nurses, empower the pharmacists, empower every level of doctor to do the same thing [speak up about medication concerns].' [Consultant 1] 'I think everyone has their preferences for the drugs they prescribe… if you're with a consultant who tends to prescribe a certain thing… you kind of copy that.' [SHO 2] 'The patients themselves can also say "I'm not feeling well since this has started. These are my symptoms"…' [Intern 3] 'Patients need to take responsibility for… their own healthcare management. I think it is their responsibility to have an up-to-date medication list that they bring to each clinical appointment and… to the hospital. They also probably need to take a role in the prompt recognition of change to their prescription and the prompt delivery of that prescription to their GP practice or their pharmacy…' [Consultant 2] '…it's unfair to ask them [patients] to read up on medications… that's not their job, that's not what they're trained for…' [Registrar 2] 'We should be empowering them to challenge us on all of these things... by giving them prompts, between printed prompts and things like that saying, "it would be in your best interest to prompt the doctors with these questions every time you see them"…'. [Consultant 1] '…any senior clinician… any pharmacists… and any senior nursing staff should have a role in that [recognising prescribing cascades] it's the whole MDT.' [Consultant 3] '…nurses… they're exquisitely positioned to do it [recognise medication side effects/ prescribing cascades] because they're giving the medicine to the patient… they have a huge amount of experience … it's more opportunistic… Although I understand that they might have less formal training in it, but they might have excellent experience… and we shouldn't discount their experience…' [Consultant 1] 'I think as well people are probably quite speciality focussed. And while I would be comfortable changing someone's diabetes medication and things like that, and I mightn't necessarily be comfortable…, you'd write to the rheumatologist and say, "does this person need to be on steroids?"… but I wouldn't necessarily stop if it's been prescribed by another specialist.' [Registrar 4]
Goals	
Focus tends to be on treating the acute issue and often a 'quick fix'	'…as a hospital doctor reviewing inpatients… we often just focus on the primary issue and try to get the patient out of hospital as soon as possible. We don't often go and review the medication, although I believe a lot of patients probably have polypharmacy issues that are caused by prescribing cascades.' [SHO 1] 'We're always quick to start someone on a medication and less quick to look at a medication we start and go "is that maybe causing that?"… we need to be looking more at deprescribing as opposed to increasing the number of drugs…' [Intern 1] '…it sounds really bad that we don't care. We, people would rather have a quick fix "oh their overloaded give them diuretics" than going back and reviewing the medications if there's any reason for them having this rather than just fixing it easily…' [Registrar 3]
Memory attention and decision processes	
A 'fresh set of eyes' can help identify potential errors Less attention given to medication reviews	'...on call [doctors] would review them [patients] and question things and a fresh set of eyes is good… sometimes reviewing the Kardex® yourself as the reg [registrar] on the ward every second day that someone has not been prescribed something completely off the charts…' [Registrar 3] 'I don't even think it would cross my mind [prescribing cascades] …' [Intern 4] '…if people have been put on medications, they [doctors] don't always wonder if they still need to be on them. Sometimes they just add rather than actually review… people are thinking more of the acute issue at hand rather than the long-term things…' [Registrar 4]

Table 2 (continued)

Descriptor	Quotations
Beliefs about consequences	
Prescribing cascades leading to patient harm Personal impact on physicians and patient disclosure	'…the risk of harm to the patient… that'd be readily avoidable if we had recognised it… longer length of stay, patient harm… more investigations, more anxiety for the patient…' [Consultant 2] 'I think both short term and long term quite significant effects to it [prescribing cascades], maybe less so short term if it's something where it's just the symptom that you're trying to get under control… but you're not thinking about the long-term outcomes.' [Intern 1] '…polypharmacy, more interactions, longer patient stay… confusion… probably leading to frustration amongst families and the patients and most GPs if things aren't made clear.' [Registrar 1] 'I'd probably wonder if I need to tell the patient [about a prescribing cascade] if I'm not 100% certain myself. I would do my best to prevent or stop this happening in future… I wouldn't be a 100% certain if I would... inform the patient exactly that this happened.' [SHO 3] 'Open disclosure is very important. It's key to making sure that patients feel safe… patients prefer open disclosure rather than finding out down the line… it's sometimes just as easy to be honest with the patient… "I made this mistake, now we've fixed it, and, it's something that we can, you know, continue to improve upon"…' [Registrar 3]
Beliefs about capabilities	
Confidence in capability to recognise prescribing cascades	'I'd actually say that it has become maybe a bit more prominent, just as I have become more experienced. Maybe in my entire intern year, I would have been happy knowing what the drug was and knowing what a drug did… I probably wouldn't have known much else about a particular drug other than the more obvious side effects, but in terms of recognising a drug that might cause a certain side effects and then recognising the negative cascade, I would not have been able to do that in the intern year and maybe only slightly picking it up at this stage.' [SHO 3] 'I don't know if I would be very confident about, for some obviously, the obvious ones that you hear about, but maybe other stuff I wouldn't really know. And then, I suppose, recognising… I'm not sure…' [Intern 2] 'It's something intuitively that we see all the time, well recognised.' [Consultant 3] 'I think people would recognise what happened [a prescribing cascade] … but they wouldn't group it together as "oh look at this interesting prescribing cascade"…' [Consultant 1]
Intentions	
Motivations are centred on symptom management	'[Prescribing cascades are] probably not recognised enough… a lot of time on ward rounds, there's a reflex just to treat rather than to think…' [Consultant 3] '…that's [prescribing cascades] not something I would have consciously been thinking of, we look at their medication list and pharmacy would do their med rec [reconciliation]…but prescribing cascades isn't something I've actively been looking for…' [Intern 3] 'On call I don't even think it [prescribing cascade] would cross my mind. I'd never change a medication on call. I'd maybe write it in the notes and say for team to review. But I'd never change it myself.' [Intern 4]
Emotion	
Fear of asking questions Emotions after a mistake	'… it's probably a knowledge and experience piece… but scared perhaps to ask questions.' [Registrar 4] 'I know other staff members would have fear of bringing up a question that they'd have and they would just choose not to bring it up… for fear of looking silly or inappropriate or unintelligent and fear of that being known…' [SHO 3] 'If I was the one that made the mistake, I would feel terrible.' [SHO 1] 'I'd feel reasonably okay if it was the first experience of it, making sure I actually made an effort to learn from it and not make the same mistake again.' [SHO 3]
Behavioural regulation	
Desire to learn from errors	'…if I didn't recognise it, then I won't recognise the next time if it hasn't been pointed out, you know that sort of way. So that's just like, uh, not learning from it then…' [Intern 2] '…in previous institutions where I've worked there used to be a medication alert system that went around maybe once a month, just to highlight that these were the inappropriate prescribing errors that have occurred… builds your awareness of it…' [Consultant 2]
Optimism	
Potentially 'benign' consequences of prescribing cascades Pessimism about recognition	'Usually they would be benign [consequences of prescribing cascades] …' [Registrar 1] '…we probably miss opportunities in clinic to do a reconciliation or something of someone's drugs.' [Registrar 4] 'I'm not sure if they're [prescribing cascades] recognised…' [Intern 1] '…in my limited experience, I have probably seen… less than five… think there's a lot more of them [prescribing cascades] that go on, that are missed…' [SHO 3]

Table 2 (continued)

Descriptor	Quotations
Reinforcement	
Rapport with patients influences response	'It depends on… prior interactions with the patient… they're just some patients that seem to find an issue with everything, so when they say stuff, it's like the boy who cried wolf, you're less likely to take it on board… other patients it's just the way they say things …it's the rapport you have with [them]…' [Intern 4]
Learning opportunity is an incentive to report	'…people are less likely to own up to errors that are made because … [of] … what would happen if they did own up. So, they need to be reassured that you're not going to give out to them. No one's going to lose their job over it, but it's very important that we have discussed it, so we all learn from it.' [Consultant 2]

Kardex® (medication prescription and administration record); BST (hospital-based training programme completed by senior house officers)

ACE inhibitor angiotensin converting enzyme inhibitor, *app* smartphone applications, *BST* basic specialist training, *GP*, general practitioner (primary care physician), *MDT* multidisciplinary team, *PPI* proton-pump inhibitor, *SHO* senior house office, *SPC* summary of product characteristics

3.3 Skills

3.3.1 Experiential Learning

Several participants noted that most of their knowledge about prescribing and deprescribing—including prescribing cascades—developed informally during postgraduate training, often through experiential learning while working with geriatric medicine consultants.

3.3.2 Improvement with Training

Participants reported that their ability to recognise prescribing cascades improved with experience. Intern physicians in particular reported challenges with recognising cascades due to limited exposure. Participants suggested that case-based learning and early career training (during intern/SHO years) could enhance skills.

3.4 Social/Professional Role and Identity

3.4.1 Physicians' Responsibility in Prescribing Cascade Recognition

All interviewees stated that recognising prescribing cascades is primarily the responsibility of the prescriber, with ultimate accountability resting with the most senior attending physicians, i.e. consultants. Some junior physicians felt less responsible, as they reported prescribing most medications under the direction of more senior colleagues. This perspective contrasted with that of senior physicians, who noted that junior physicians can sometimes prescribe without complete understanding of the clinical context, increasing the risk of prescribing cascades. This leads to senior physicians feeling responsible for monitoring and overseeing the prescribing practices of junior colleagues.

3.4.2 Pharmacists' Roles

Pharmacists were identified as crucial for recognising prescribing cascades through routinely performing an accurate medication reconciliation and review, identifying side effects and highlighting potentially inappropriate medications to the attending physicians. Several participants also suggested that a combined pharmacist–physician ward round would be an effective method to monitor and review patients' medications for potential prescribing cascades.

3.4.3 Specialty Role

Geriatricians were frequently mentioned for their expertise in deprescribing inappropriate medications and greater capacity to recognise prescribing cascades. Several participants indicated that they were more confident recognising prescribing cascades within their own specialty.

3.5 Social Influences

3.5.1 Hierarchy and Modelling within Medical Teams

Junior physicians, particularly interns/SHOs, described hesitancy with discussing medications with senior colleagues, influenced by relationships and team culture. They also reported that they tended to imitate the prescribing and deprescribing practices of their senior colleagues and would hesitate to question the prescribing decisions of senior colleagues. In contrast, consultants indicated that they welcomed junior physician input on patients' medications (e.g. if they were to highlight potential adverse effects and/or potential prescribing cascades).

3.5.2 Support from Patients

Participants expressed mixed views on patients' roles in supporting physicians to recognise prescribing cascades. Several

expected patients to maintain an accurate medication list and to report any suspected adverse symptoms to their doctor, while others perceived that it was 'unfair' to expect patients to do this, particularly older adults and those with limited knowledge about their medications.

3.5.3 Support from Other Healthcare Professionals

Many interviewees emphasised the possibly beneficial supportive role of other healthcare professionals in recognising prescribing cascades, including nurses, occupational therapists and physiotherapists. Nursing staff in particular were noted to be well positioned to identify adverse effects following medication changes. One participant commented that all healthcare professionals should be 'empowered' to speak up regarding any medication-related concerns which could help prescribing cascade recognition.

3.5.4 Reluctance to Change Medications Prescribed by Others

Participants reported reluctance with discontinuing medications initiated by other physicians, particularly when the physician had expertise in the relevant area, even when they suspected a prescribing cascade had occurred.

3.6 Goals

Interviewees reported that the focus during hospital admissions tends to be primarily on acute issues rather than reviewing longstanding medications which may be contributing to prescribing cascades. Even when a patient presents with a new symptom or change of clinical status, the goal is usually to address the acute problem by prescribing a symptom-relieving drug rather than a more thorough medication review to identify a potential side effect.

3.7 Memory, Attention and Decision Processes

Interviewees noted challenges with distinguishing between side effects and new medical conditions, highlighting that a 'fresh set of eyes' can help in identifying side effects and potential prescribing cascades.

Participants noted that the focus in the acute hospitalization context is primarily on the acute problem that led to admission. Therefore, less attention is given to reviewing medications (especially long-term medications), limiting the opportunity to recognise pre-existing prescribing cascades.

3.8 Beliefs about Consequences

3.8.1 Prescribing Cascades Leading to Patient Harm

Participants commented on the potential for harm associated with unrecognised prescribing cascades (polypharmacy, pill burden and increased hospitalisation). However, several participants appeared to downplay the consequences, viewing certain prescribing cascades as 'benign', and had an acceptance that side effects and associated prescribing mistakes happen frequently.

3.8.2 Personal Impact on Physicians and Patient Disclosure

Interviewees perceived low personal consequences for failing to recognise prescribing cascades. Several indicated they would only inform the patient if severe consequences occurred.

3.9 Beliefs about Capabilities

Junior physicians, particularly interns/SHOs, expressed low confidence in recognising prescribing cascades, despite familiarity with the term. By contrast, other participants, particularly consultants, expressed confidence in recognising prescribing cascades even if they were not familiar with the term prior to the interview.

3.10 Intentions

When new symptoms appear, hospital physicians' primary motivations are centred on symptom management and not actively inclined to identify potential prescribing cascades.

3.11 Emotion

Several participants highlighted that they would avoid asking questions of senior colleagues regarding potential prescribing cascades for fear of appearing 'silly' or 'unintelligent'.

In the theoretical setting of recognising that they had caused an inappropriate prescribing cascade, some participants described that they would feel 'horrible', whereas others described that they would feel 'okay' about this.

3.12 Behavioural Regulation

Participants expressed a desire for external mechanisms, either through feedback from colleagues or from alert

systems, to learn from prescribing errors and recognise prescribing cascades more easily in the future.

3.13 Optimism

Several participants seemed less concerned about the consequences of prescribing cascades, describing them as 'benign' consequences.

Additionally, participants were generally pessimistic regarding the frequency of inappropriate prescribing cascade recognition, stating that 'most are not recognised' and opportunities to recognize prescribing cascades are frequently missed.

3.14 Reinforcement

One interviewee noted that the rapport they developed with patients reinforced their response to patients reporting side effects (e.g. less likely to recognise if lower rapport or high level of complaints in general).

Several participants suggested that junior doctors could be incentivised to report errors related to suspected prescribing cascades by framing it as a learning opportunity and reassuring them that reporting would not result in punitive consequences.

4 Discussion

This research has uniquely identified key factors that impact hospital physicians' recognition of prescribing cascades using the TDF, which served as the theoretical model to gain comprehensive insights into the clinical behaviour of recognising of prescribing cascades [16].

In essence, our findings indicate that knowledge about prescribing cascades is very limited among hospital physicians. While more junior physicians recalled being taught about prescribing cascades during their medical education, senior physicians were generally unfamiliar with the term. This suggests that the topic of prescribing cascades has only relatively recently been incorporated into medical education and that, as a therapeutics concept, it has yet to integrate into routine clinical practice. This is emphasised by the fact that no participant recalled hearing the term 'prescribing cascade' mentioned in the clinical setting. Although in the three decades since prescribing cascades were first described, considerable research has been conducted in the topic, further efforts are needed to ensure that all physicians are familiar with prescribing cascades as a clinical term and concept to increase awareness and recognition in practice [38]. Participants in this study were generally unable to name more than a few examples of specific prescribing cascades, most of which are classified as appropriate (e.g. opioid → constipation → laxative) rather than inappropriate (e.g. ACE-inhibitor → cough → anti-tussive). A recently published explicit cascades list, called 'ThinkCascades', includes only nine inappropriate prescribing cascades in older adults, significantly underrepresenting their number [39]. A more comprehensive, validated list could serve as a resource for physicians, improving awareness, which has been identified in previous research as a key priority to improve recognition of prescribing cascades [18, 20].

In addition to limited knowledge of prescribing cascades, participants also demonstrated uncertainty distinguishing between polypharmacy, prescribing errors, prescribing cascades and drug–drug interactions during the interviews. For example, physicians sometimes provided examples of drug–drug interactions when asked for prescribing cascade examples. While previous research on deprescribing interventions has largely focused on reducing inappropriate or unnecessary medications, recognising prescribing cascades requires an additional layer of complexity, i.e. identifying when a drug has been prescribed to treat the side effect of another drug [40]. The conceptual overlap and confusion around the terminology is likely to further hinder efforts to recognise prescribing cascades.

Participants indicated that the primary responsibility for recognising prescribing cascades lies with them as prescribers. However, despite this acknowledgement, recognising cascades was seemingly not a priority. One possible explanation is that participants often perceived the consequences of failing to recognise prescribing cascades in hospital as 'benign' or inconsequential to the patient's acute hospitalisation episode. Previous research has highlighted that the absence of clear evidence of patient harm can result in 'deprescribing inertia' [20]. Similarly, the present study displays 'recognition failure'. Additionally, participants did not perceive any personal negative consequences for failing to recognise and correct inappropriate prescribing cascades, with several suggesting that side effects and prescribing errors are an inherent and to some extent unavoidable part of clinical practice [20].

This attitude may reflect a broader view that failing to recognise prescribing cascades is an acceptable deficiency driven by systemic challenges and the day-to-day realities of busy clinical practice. The lack of a well-established clinical focus on prescribing cascades, combined with the consensus from interviews that 'most are not recognised' emphasises the low priority placed on their detection and management. Furthermore, errors related to unrecognised prescribing cascades are rarely the sole responsibility of one physician [18]. More often, they result from a combination of systemic and environmental challenges within the healthcare environment that influence the decision-making process. These challenges, frequently highlighted by interviewees, contribute to

a culture wherein the relative lack of concern may stem from an acceptance of working in a flawed healthcare system.

Several prominent environmental challenges repeatedly highlighted by participants included lack of accurate information regarding patients' medications, insufficient staffing and time constraints. A key issue identified was the lack of basic information during medication reviews, such as accurate medication lists, the original prescribing indications and medications' intended duration. The Irish public hospital system remains predominantly paper-based, with no widespread integrated electronic platform between community healthcare settings and hospital settings. This fragmentation often results in incomplete access to documentation, including medication changes made in other clinical settings.

A recent study by Jennings et al. reported that communication failures and a lack of prescribing stewardship during healthcare transitions added to the degree of risk when making prescribing decisions in such settings [20]. In line with this finding, interviewees in the present study emphasised that this issue was particularly problematic in the emergency department, where they described medication decision-making as 'hoping it is right'. In addition, physicians often make prescribing decisions in the context of limited, or at times inaccurate, information due to what one interviewee described as an 'archaic' health record system. This lack of comprehensive transfer of accurate information is a significant barrier to recognising prescribing cascades and increases the risk of medication-related harm to patients. It is unsurprising, therefore, that medication safety in transitions of care has been identified as a priority in the World Health Organisation's 'Medication Without Harm' challenge [41].

Physicians in this study also stressed the need for improved documentation, noting that medications are very often prescribed without clearly documented indication, a similar finding to previous research which noted that patients' health records often contain insufficient information to support decisions on prescribing and deprescribing [5, 24]. Research on deprescribing has similarly reported that clearer documentation of drug indications and long-term plans of each medication, as well as records of previously prescribed medications, in tandem with the reasons for their discontinuation, could facilitate easier recognition of prescribing cascades [42].

To improve recognition of inappropriate prescribing cascades, participants in this study suggested implementation of integrated IT solutions, aligning with previous research on prescribing cascades [28]. Such systems could support screening for prescribing cascades by improving documentation around prescribing and ensuring that all healthcare providers have access to all current medication information. Several participants suggested software-based systems such as electronic alerts. For electronic alerts to be effective, they must capture users' attention whilst minimising 'alert fatigue', a challenge highlighted in the present study and previous studies [28, 43]. Other considerations for electronic alert systems include grading the priority of alerts, choosing appropriate timing, avoiding excessive number of alerts and cognitive overload and ensuring that they do not undermine clinical autonomy [43, 44]. A critical factor highlighted in a previous study is the importance of accurate information in generating alerts, without which the alerts may be misleading [45]. In well-organized and fully resourced hospital systems, physicians could decide to refer patients with suspected potentially inappropriate prescribing cascades to polypharmacy clinics for assessment, if such clinics are available. However, in most hospitals, physicians will need to assess and decide on deprescribing when they receive electronic alerts to potential cascades, or to refer to specialists for advice. Furthermore, as suggested by participants, IT solutions could incorporate the development of smart phone applications both for patients and healthcare professionals. For patients, an application could help them maintain a personal record of their medication regimen and identify potential side effects, empowering them to have an active role in medication management and prescribing cascade recognition [18, 46]. For physicians, an application with a searchable database of common prescribing cascades capability could be clinically valuable.

During inpatient admissions and ward rounds, staffing shortages, time constraints and acute issue prioritisation were frequently cited as obstacles to comprehensive medication reviews, with the cumulative effect of these factors limiting opportunities for identifying prescribing cascades [19]. Routine tasks, such as rewriting medication charts, are often delegated to the most junior members on the team due to time pressures, possibly representing a missed opportunity for prescribing cascade recognition [24].

Interviewees highlighted several challenges related to recognising prescribing cascades in older adults particularly. Hospitalised patients are increasingly older, frailer people who live with polypharmacy and multimorbidity, in line in global demographic trends [47]. Identifying and classifying a prescribing cascade as appropriate or inappropriate in this cohort of patients, often with complex polypharmacy, has previously been described as 'unfeasible' [20]. One strategy proposed by the present study's participants to address these challenges was the implementation of routine expert medication reviews through a collaborative, interdisciplinary model including pharmacists and physicians. Such a model aligns with existing pharmacotherapy optimisation recommendations and could be integrated within a polypharmacy stewardship programme. Effective management of prescribing cascades involves several key steps: identifying the cascade, determining the indication for the original medication, assessing whether this indication remains and deprescribing

the original and/or subsequent medications where appropriate [48]. This model is likely to be more effective than simply increasing staff without ensuring the additional staff have the required training and skills to effectively recognise and manage prescribing cascades.

In the present study, participants also commented that many older adults had difficulty managing their medications, identifying side effects and communicating concerns regarding side effects to their physician, making the detection of prescribing cascades more challenging. These challenges are exacerbated by the organisation of modern medicine around a single-disease framework, in which each condition is treated in isolation [49]. This framework is evident in hospital settings, where patients' assessments focus primarily on immediate presenting problems. Interviewees generally agreed with this, commenting that hospitalisation is usually focused on the acute presenting problem. Many participants also discussed the reluctance among doctors to modify or discontinue long-standing medications, especially those prescribed by other specialists expressing concerns about overstepping professional boundaries, even when they suspected that an inappropriate prescribing cascade had occurred.

This present study highlighted that the hierarchal structure in hospital medical teams influences both the initiation and discontinuation of inappropriate prescribing cascades. More senior physicians commonly direct prescribing adjustments, with more junior physicians unlikely to question instructions from their senior colleagues [23]. This reduces the opportunity to scrutinise whether a prescription might create an inappropriate prescribing cascade [38]. More junior physicians also reported lower self-confidence in identification of prescribing cascades, often perceiving their prescribing patterns as lower risk. These findings highlight the need for targeted education to enhance junior physicians' knowledge and confidence in recognising medication side effects and prescribing cascades. While formal educational programmes are essential, informal learning remains invaluable [23]. Many physicians in this study reported that they gained much of their knowledge on prescribing and deprescribing through working with consultants, especially geriatricians, because of their expertise with routine management of multimorbid patients who experience polypharmacy. They also suggested that leveraging teachable moments when prescribing cascades are identified and using these cases as direct learning opportunities may be valuable.

4.1 Potential Behaviour-Change Interventions

The findings from this study highlight multiple opportunities for behaviour change interventions aimed at improving the recognition of prescribing cascades. One key value of using the TDF is its ability to provide a validated, structured, theory-based approach to understanding current practice-related challenges and supporting intervention design [16]. Previous research has indicated that theory-based behaviour change interventions are more effective than those without a theoretical foundation [50]. The TDF is often applied with the behaviour change wheel (BCW) to systematically design targeted, theory-based interventions [51]. A key strength of identifying all 14 TDF domains is that it allows for a multi-faceted intervention to be designed. While the results of this study were not specifically analysed according to the BCW, the BCW may be applied in a number of ways. For example, in this study, 'knowledge' was identified as a key domain influencing physicians' recognition of prescribing cascades. According to the BCW model, knowledge maps onto 'capability', which can be addressed through intervention functions such as modelling, education and enablement [51]. A potential intervention could involve interactive, case-based learning sessions for junior doctors, where prescribing cascade scenarios are discussed. Additionally, while 'beliefs about consequences' was identified as a less influential domain, it could still be integrated into the intervention as 'motivation' and 'education' components. Incorporating discussions on the potential harm to patients and the clinical responsibility to recognise and deprescribe prescribing cascades could enhance the effectiveness of the intervention.

Ultimately, the integration of IT resources, a collaborative approach with specialists in pharmacotherapy (both physicians and pharmacists) and medication educational initiatives for both healthcare providers and patients would likely empower all parties to recognise and address prescribing cascades effectively, improving medication safety across healthcare settings.

4.2 Strengths and Limitations

All interviews in this study were conducted by the same interviewer, ensuring consistency in data collection and data analysis. Reflexivity was considered throughout, enhancing the study's rigour by accounting for potential biases in data interpretation. The TDF was utilised both in topic guide development and content analysis. This framework is beneficial as it provides a structured approach to exploring behaviours, and it has been shown to reveal additional themes that may not be generated through other approaches [26, 27]. Furthermore, TDF domains can be mapped to the BCW, which can be utilised to identify and design suitable interventions to address the barriers identified [51]. However, while an example of how the BCW can be utilised is provided in the discussion, a limitation of this study is that the results were not specifically analysed according to the BCW.

The main limitation of the present study is the potentially low degree of transferability of the results, as this study was conducted in a single hospital in Ireland. This

hospital operates within a particular social and environmental context, where health records are predominantly primarily paper-based. Consequently, the findings may be less generalisable to other healthcare settings, particularly those with different systems, resources and cultures.

5 Conclusions

This study highlights the barriers that hospital physicians encounter in recognising inappropriate prescribing cascades, including gaps in knowledge, systemic and environmental challenges and cultural attitudes. Limited awareness of prescribing cascades, combined with fragmented healthcare information systems and often inadequate documentation of medication indication and duration, contribute to unrecognised prescribing cascades increasing the risk of harm to patients, particularly multimorbid older adults with polypharmacy. Addressing these challenges requires targeted behaviour-change interventions informed from these findings. These interventions could include integrated IT solutions, improved documentation of diagnoses and medications prescribed, interdisciplinary expert medication reviews and enhanced education and training opportunities. Such interventions could empower physicians to recognise inappropriate prescribing cascades more effectively, thus facilitating their minimisation—ultimately reducing medication-related harm and improving patient safety.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40266-025-01222-4.

Declarations

Funding Open Access funding provided by the IReL Consortium.

Conflict of interest Denis O'Mahony is an Editorial Board member Drugs and Aging. Denis O'Mahony was not involved in the selection of peer reviewers for the manuscript nor any of the subsequent editorial decisions. The authors Ruth Daunt, Kieran Dalton and Denis Curtin have no competing interests to declare that are relevant to the content of this article.

Availability of data and material The datasets generated in this study are available from the corresponding author on reasonable request.

Ethical approval Ethical approval for this study was granted by the Social Research Ethics Committee, University College Cork (reference: 2024-048).

Consent to participate Written informed consent was obtained prior to enrolment from all participants.

Consent for publication Not applicable

Code availability Not applicable

Author contributions: All authors contributed to the study conception and design. Material preparation was performed by Ruth Daunt. Analysis was performed by Ruth Daunt and Kieran Dalton. The first draft of the manuscript was written by Ruth Daunt and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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References

1. Rochon PA, Gurwitz JH. The prescribing cascade revisited. Lancet. 2017;389:1778–80.
2. Sternberg SA, Gurwitz JH, Rochon PA, et al. Prescribing cascades. In: Cherubini A, Mangoni AA, O'Mahony D, et al., editors. Optimizing pharmacotherapy in older patients: an interdisciplinary approach. Cham: Springer International Publishing; 2023. p. 59–68.
3. Rochon PA, Gurwitz JH. Optimising drug treatment for elderly people: the prescribing cascade. BMJ. 1997;315:1096.
4. Kalisch LM, Caughey GE, Roughead EE, et al. The prescribing cascade. Australian Prescriber 2011;34.
5. McCarthy LM, Visentin JD, Rochon PA. Assessing the scope and appropriateness of prescribing cascades. J Am Geriatr Soc. 2019;67:1023–6.
6. Hanlon P, Nicholl BI, Jani BD, et al. Frailty and pre-frailty in middle-aged and older adults and its association with multimorbidity and mortality: a prospective analysis of 493,737 UK Biobank participants. Lancet Public Health. 2018;3:e323–32.
7. Davies LE, Spiers G, Kingston A, et al. Adverse outcomes of polypharmacy in older people: systematic review of reviews. J Am Med Dir Assoc. 2020;21:181–7.
8. Stevenson JM, Davies JG, Martin FC. Medication-related harm: a geriatric syndrome. Age Ageing. 2020;49:7–11.
9. Khezrian M, McNeil CJ, Murray AD, et al. An overview of prevalence, determinants and health outcomes of polypharmacy. Ther Adv Drug Saf. 2020;11:2042098620933741.
10. Lavan AH, Gallagher P. Predicting risk of adverse drug reactions in older adults. Ther Adv Drug Saf. 2016;7:11–22.
11. Petrovic M, van der Cammen T, Onder G. Adverse drug reactions in older people. Drugs Aging. 2012;29:453–62.
12. Shahid F, Doherty A, Wallace E, et al. Prescribing cascades in ambulatory care: a structured synthesis of evidence. Pharmacotherapy. 2024;44:87–96.
13. Doherty AS, Shahid F, Moriarty F, et al. Prescribing cascades in community-dwelling adults: a systematic review. Pharmacol Res Perspect. 2022;10: e01008.

14. Chen Z, Liu Z, Zeng L, et al. Research on prescribing cascades: a scoping review. Front Pharmacol. 2023;14.
15. Daunt R, McGettigan S, Kelly L, et al. Detection of potential prescribing cascades in multimorbid older patients hospitalised with acute illness—an observational prospective prevalence study. Drugs Aging. 2025. https://doi.org/10.1007/s40266-025-01201-9.
16. Atkins L, Francis J, Islam R, et al. A guide to using the theoretical domains framework of behaviour change to investigate implementation problems. Implement Sci. 2017;12:77.
17. Dyson J, Cowdell F. How is the theoretical domains framework applied in designing interventions to support healthcare practitioner behaviour change? A systematic review. Int J Qual Health Care. 2021;33: mzab106.
18. Farrell B, Galley E, Jeffs L, et al. "Kind of blurry": deciphering clues to prevent, investigate and manage prescribing cascades. PLoS ONE. 2022;17: e0272418.
19. Farrell BJ, Jeffs L, Irving H, et al. Patient and provider perspectives on the development and resolution of prescribing cascades: a qualitative study. BMC Geriatr. 2020;20:368.
20. Jennings AA, Doherty AS, Clyne B, et al. Stakeholder perceptions of and attitudes towards problematic polypharmacy and prescribing cascades: a qualitative study. Age Ageing. 2024;53: afae116.
21. DeJonckheere M, Vaughn LM. Semistructured interviewing in primary care research: a balance of relationship and rigour. Family Med Community Health. 2019;7.
22. Vanstone M, Grierson L. Thinking about social power and hierarchy in medical education. Med Educ. 2022;56:91–7.
23. Noble C, Billett S. Learning to prescribe through co-working: junior doctors, pharmacists and consultants. Med Educ. 2017;51:442–51.
24. Dalton K, O'Mahony D, Cullinan S, et al. Factors affecting prescriber implementation of computer-generated medication recommendations in the SENATOR trial: a qualitative study. Drugs Aging. 2020;37:703–13.
25. Kthupi A, Rochon PA, Santini S, et al. Exploring sex, gender, and gender-related sociocultural factors in clinical decision-making for older adults using a prescribing cascade vignette: a transnational qualitative study. Drugs Aging. 2024. https://doi.org/10.1007/s40266-024-01158-1.
26. Dyson J, Lawton R, Jackson C, et al. Does the use of a theoretical approach tell us more about hand hygiene behaviour? The barriers and levers to hand hygiene. J Infect Prev. 2011;12:17–24.
27. Birken SA, Presseau J, Ellis SD, et al. Potential determinants of health-care professionals' use of survivorship care plans: a qualitative study using the theoretical domains framework. Implement Sci. 2014;9:167.
28. Dalton K, Callaghan R, O'Sullivan N, et al. Community pharmacists' awareness, identification, and management of prescribing cascades: a cross-sectional survey. Res Soc Adm Pharm. 2024;20:102–12.
29. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implement Sci. 2012;7:37.
30. Francis JJ, Johnston M, Robertson C, et al. What is an adequate sample size? Operationalising data saturation for theory-based interview studies. Psychol Health. 2010;25:1229–45.
31. Hsieh H-F, Shannon SE. Three approaches to qualitative content analysis. Qual Health Res. 2005;15:1277–88.
32. Patey AM, Islam R, Francis JJ, et al. Anesthesiologists' and surgeons' perceptions about routine pre-operative testing in low-risk patients: application of the theoretical domains framework (TDF) to identify factors that influence physicians' decisions to order pre-operative tests. Implement Sci. 2012;7:52.
33. Olmos-Vega FM, Stalmeijer RE, Varpio L, et al. A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. Med Teach. 2023;45:241–51.
34. Warner BE. Clinical colleague and clinical academic: a physician's autoethnographical reflexive account of opportunities and challenges as an 'insider' researcher. Int J Qual Methods. 2024;23:16094069241256278.
35. Folkes L. Moving beyond 'shopping list' positionality: using kitchen table reflexivity and in/visible tools to develop reflexive qualitative research. Qual Res. 2023;23:1301–18.
36. Mannay D. Making the familiar strange: can visual research methods render the familiar setting more perceptible? Qual Res. 2010;10:91–111.
37. Jamieson MK, Govaart GH, Pownall M. Reflexivity in quantitative research: a rationale and beginner's guide. Soc Pers Psychol Compass. 2023;17: e12735.
38. O'Mahony D, Rochon PA. Prescribing cascades: we see only what we look for, we look for only what we know. Age Ageing. 2022;51: afac138.
39. McCarthy LM, Savage R, Dalton K, et al. ThinkCascades: a tool for identifying clinically important prescribing cascades affecting older people. Drugs Aging. 2022;39:829–40.
40. Sawan M, Reeve E, Turner J, et al. A systems approach to identifying the challenges of implementing deprescribing in older adults across different health-care settings and countries: a narrative review. Expert Rev Clin Pharmacol. 2020;13:233–45.
41. World Health Organization. Medication without harm: WHO global patient safety challenge. 2017. http://apps.who.int/iris/bitstream/10665/255263/1/WHO-HIS-SDS-2017.6-eng.pdf?ua=1&ua=1. Accessed 24 Jan 2025.
42. Linsky A, Zimmerman KM. Provider and system-level barriers to deprescribing: interconnected problems and solutions. Public Policy Aging Report. 2018;28:129–33.
43. Marcilly R, Ammenwerth E, Vasseur F, et al. Usability flaws of medication-related alerting functions: a systematic qualitative review. J Biomed Inform. 2015;55:260–71.
44. Ancker JS, Edwards A, Nosal S, et al. Effects of workload, work complexity, and repeated alerts on alert fatigue in a clinical decision support system. BMC Med Inform Decis Mak. 2017;17:36.
45. Tamblyn R, Huang A, Perreault R, et al. The medical office of the 21st century (MOXXI): effectiveness of computerized decision-making support in reducing inappropriate prescribing in primary care. CMAJ. 2003;169:549.
46. Grindrod KA, Li M, Gates A. Evaluating user perceptions of mobile medication management applications with older adults: a usability study. JMIR mHealth uHealth. 2014;2: e11.
47. World Health Organization. Ageing and health. 2024. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health. Accessed 24 Jan 2025.
48. Daunt R, Curtin D, O'Mahony D. Polypharmacy stewardship: a novel approach to tackle a major public health crisis. Lancet Healthy Longev. 2023;4:e228–35.
49. Schoen C, Osborn R, Huynh PT et al. Taking the pulse of health care systems: experiences of patients with health problems in six countries. Health Aff (Millwood) 2005;Suppl Web Exclusives:W5-509-25.
50. Glanz K, Bishop DB. The role of behavioral science theory in development and implementation of public health interventions. Annu Rev Public Health. 2010;31:399–418.
51. Michie S, Atkins L, West R. The behaviour change wheel. A guide to designing interventions. 2014;1:1003–10.