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HOW DO I DO IT

TRANSFUSION

How do we leverage implementation science to support and accelerate uptake of clinical practice guidelines in transfusion medicine

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Abstract

Background: Developing and disseminating clinical practice guidelines is a common strategy used to inform practice and address evidence-to-practice gaps that are prominent in transfusion medicine. Despite a highly systematic method for synthesizing evidence into guideline recommendations, comparatively little attention is paid to the real-world implementation of the recommendations in routine practice. A more scientific approach drawing on learnings from the field of implementation science is therefore warranted.

Study Design and Methods: In this article, we propose a methodological roadmap to embed implementation science principles, frameworks, and methods to facilitate the development and uptake of transfusion medicine guidelines. We draw upon research undertaken in partnership with the International Collaboration of Transfusion Medicine Guidelines (ICTMG) to illustrate the roadmap in action.

Abbreviations: AGREE, appraisal of guidelines for research and evaluation; COM-B, capability, opportunity, motivation-behaviour; ERIC, expert recommendations for implementing change; GuiDiR, guide to disseminating research; ICTMG, International Collaboration for Transfusion Medicine Guidelines; KT, knowledge translation; PICO, population, intervention, comparator, outcome; TDF, theoretical domains framework; TIDieR, template for intervention description and replication.

Results: The methodological roadmap constitutes five steps which have been matched to existing processes for developing and implementing clinical practice guidelines: (1) environmental scan; (2) detailing who needs to do what differently, per guideline recommendation; (3) barriers and enablers assessment; (4) tailoring implementation strategies to identified barriers and enablers; and (5) implementation and evaluation of implementation strategies. For each step, we define the key concepts and methods involved, and share examples from work done with ICTMG to support transfusion medicine guideline implementation.

Discussion: We intend this methodological roadmap for clinicians, researchers, and organizations involved in supporting clinical practice guideline use. Informed by principles, frameworks, and methods from implementation science, the roadmap can provide a more structured, transparent, and replicable approach to improve the implementation of guideline recommendations in transfusion medicine.

KEYWORDS

clinical practice guidelines, implementation science, knowledge mobilization, knowledge translation, transfusion medicine

1 | BACKGROUND

Evidence-to-practice gaps are widespread in medicine. It has been suggested that on average, it takes 17 years for evidence to diffuse into practice[1] and that only one in seven evidence-based interventions is fully implemented.[2] This creates unnecessary delays in the speed at which the best evidence identified in published studies and clinical practice guidelines can be incorporated into current standards of care. Several systematic reviews have highlighted the extent of the problem[3–5] which contributes to suboptimal care for patients and significant waste in spending among health systems globally.[6] The picture within the field of transfusion medicine is equally concerning. It has now been over 10 years since the publication of an Editorial in *Transfusion* calling for the use of multidisciplinary and evidence-based approaches to bridge evidence-to-practice gaps in transfusion medicine.[7] While some progress has been made in this endeavor, studies continue to find gaps in transfusion practices[8]; thus, a redoubled focus on solutions is warranted.

The development and dissemination of clinical practice guidelines is one common approach to address evidence-to-practice gaps in healthcare and more specifically in transfusion medicine.[9] The development of guidelines typically includes several highly systematized steps including selecting a topic of interest, synthesizing available evidence, and generating recommendations based on the evidence.[10] Multiple transfusion guidelines have been developed and published, with initiatives from organizations such as the Association for the Advancement of Blood and Biotherapies and the British Society for Hematology, and the International Collaboration for Transfusion Medicine Guidelines (ICTMG) leading the way.[11–13] However, multiple studies show continued high rates of unnecessary transfusions and incorrect dosing when judged against available evidence and guideline recommendations.[14–18] This issue impacts patient outcomes and blood systems by increasing demand and waste among blood components that are a scarce resource.

Despite a highly systematic approach toward synthesizing evidence into guideline statements (e.g., AGREE II[19]) comparatively little attention is paid to the real-world implementation of the statements in actual clinical practice, which limits the utility of the information in the guidelines themselves.[20] Unsurprisingly, evidence suggests a modest impact of guidelines in changing clinical practice and that mere publication of guidelines is insufficient to meaningfully change practice.[21] Thus, there is a need for a more scientific approach to improve and accelerate the uptake of clinical practice guidelines in medicine and transfusion medicine specifically.

Knowledge translation (KT) is one such scientific approach that focuses on the synthesis, dissemination, exchange, and application of knowledge to improve health and healthcare.[22,23] KT activities might include

synthesizing evidence and creating guidelines or developing key messages to help disseminate academic publications. The term KT is often used synonymously with other fields dedicated to improving healthcare.[24] Implementation science is an interdisciplinary field of study with close ties to KT that aims to close the gap between what is known (evidence) and what must be done to support behavior change (practice). Implementation science draws upon principles, models, theories, frameworks, and methods from several disciplines such as behavioral science, health services and policy research, change management, improvement science, and health economics.[25,26] The field of behavioral science is particularly complementary in this context given its focus on understanding factors that drive behavior change (e.g., a recommendation in a guideline informing a healthcare provider to change their practice). Moreover, the fields of change management (see Kotter's eight-step model[27]) and improvement science exist on a continuum (see Donabedian's model[28]) and offer complementary perspectives to help unpack underlying change processes to ensure success and select outcomes to measure success (see Proctor's implementation outcome set[29]).

Implementation science thinking may be employed both a priori during the guideline development process, or once a guideline has been developed and disseminated (i.e., "starting with the end in mind" and/or adopting an integrated KT approach).[30–33] A good example of an implementation project launched after a transfusion medicine guideline had been developed comes from Choosing Wisely Canada's "Why Give Two When One Will Do?" toolkit which sought to reduce unnecessary red blood cell transfusions in hospitals.[34] Another useful example comes from the European Commission guideline on implementing evidence-based patient blood management in hospitals.[35]

Implementing recommendations from clinical practice guidelines typically requires someone to do something differently in their behavior. This can mean doing a new practice, doing more of an existing practice, or less of an existing practice/stopping something entirely, and may include a number of different "actors" doing something different.[36] When considering the notion of doing less of something or stopping it entirely, we can draw upon the field of de-implementation that is concerned with the reduction, replacement, and elimination of existing clinical practices that are ineffective, outdated, or potentially harmful.[37] When implementation (or de-implementation) challenges are framed in behavioral terms, we can draw upon evidence from behavioral science (introduced above) to unpack the factors influencing behavior change among patients, healthcare providers, and decision-makers and inform strategies to increase the uptake of guideline recommendations to close evidence-to-practice gaps.[38] Few studies to date within transfusion medicine have drawn upon concepts and methods from behavioral science to identify and categorize factors impacting transfusion practices[39] and to inform the development of behavior change interventions targeting practice change among transfusion healthcare providers.[40] As such, there are opportunities for current research to draw upon these ideas and methods to enhance the design of studies targeting clinical practices in transfusion.

This "how do we" paper aims to develop and describe a methodological roadmap to embed implementation science principles, frameworks, and methods to facilitate the development and uptake of transfusion medicine guidelines.

2 | METHODOLOGICAL ROADMAP SUMMARY

We intend this methodological roadmap for clinicians, researchers, and organizations involved in guideline development, dissemination, and other activities to support the uptake of guidelines in clinical practice. The roadmap has been developed in conjunction with the ICTMG, an independent collaborative of international volunteers with expertise in transfusion medicine and related clinical disciplines, guideline development methodology, and implementation research. To date, the ICTMG has published guidelines for platelet transfusion,[12] fetal and neonatal alloimmune thrombocytopenia,[41] red blood cells for patients with hemoglobinopathies,[42] hemolytic disease of the newborn,[43] and, most recently, intravenous albumin.[44] When outlining steps in the roadmap, we will include examples of work undertaken with the ICTMG to embed implementation science principles, frameworks, and methods into their guideline development and dissemination processes.

Figure 1 depicts our proposed five-step roadmap matched to existing steps in guideline development and dissemination ("lifespan of a guideline"), summarized from an checklist for guideline development and rollout.[10] These existing steps include: (i) topic selection; (ii) guideline development; (iii) guideline reporting; (iv) guideline dissemination and implementation; and (v) tracking ongoing use and periodic guideline update/replacement. Traditionally, implementation science thinking may be applied once guidelines have been developed and are ready for dissemination, to support their implementation. However, there is growing recognition around the need to bring this thinking earlier in the

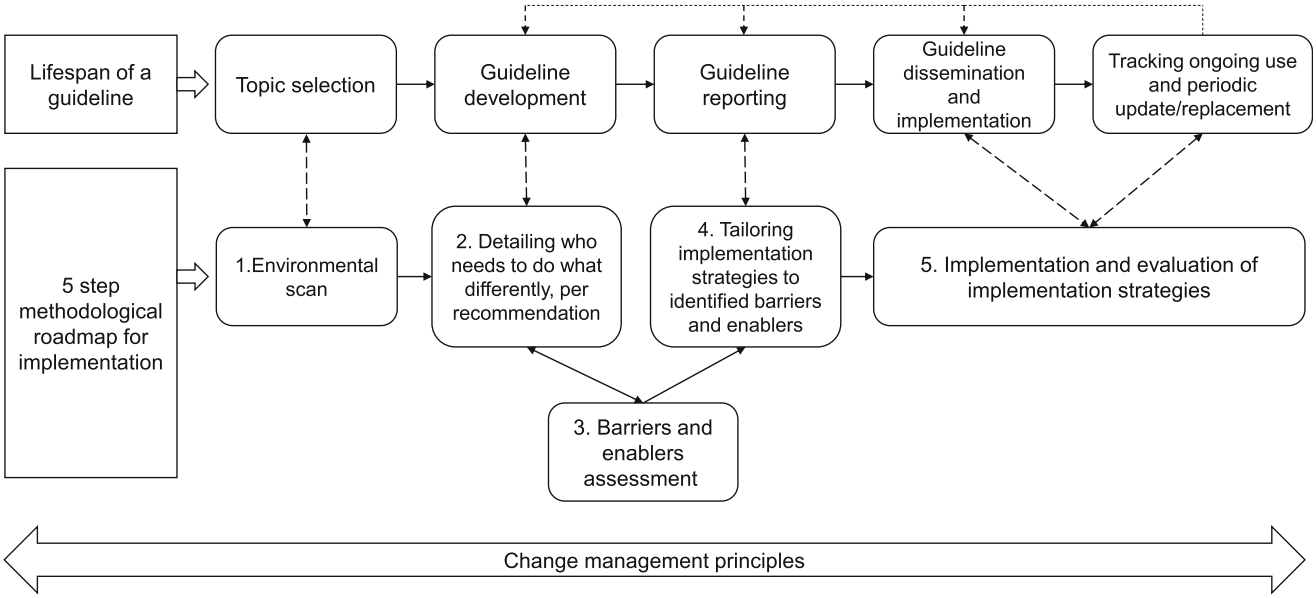


FIGURE 1 A methodological roadmap to embed implementation science principles, frameworks, and methods to support the development and uptake of clinical practice guidelines.

process when guideline development groups are being formed and topics are being selected (i.e., upstream implementation planning),[45] which has been reflected in the roadmap. The following sections, including Table 1, will summarize each of the five steps in the roadmap.

2.1 | Step 1: Environmental scan

At the earliest point during guideline development (e.g., topic selection), there is a need to gather information to inform decision-making and organizational learning around implementation.[46] In the context of the ICTMG, this was an important step to help identify and specify activities and learnings from previous guideline development and dissemination projects to inform the move to embed implementation science into their ways of working. This step allows teams to learn from previous activities, avoid duplication, and provides a "birds-eye" perspective on current implementation efforts.

An environmental scan can involve introspection at an organization and/or health system-level to identify relevant gaps/variation in care, data availability to assess variation in care, and current interventions and quality improvement initiatives to promote existing guidelines and support engagement among knowledge users (herein referred to as an implementation strategy). Implementation strategies can be specified and categorized using existing implementation science frameworks, such as the Behavior Change Wheel,[47] the Expert Recommendations for Implementing Change (ERIC) taxonomy,[48] or the Effective Practice and Organisation of Care taxonomy,[49] to help specify what has already been done, highlight gaps in current approaches, and identify opportunities for improvement. Environmental scanning requires close linkages with the guideline development group because understanding the current landscape and possible "go-to" implementation strategies can inform early steps in topic selection and guideline development (e.g., selecting Population, Intervention, Comparator, Outcome (PICO) criteria).

For example, as part of an ICTMG implementation research project for a recent guideline on the use of intravenous albumin,[44] our team undertook an environmental scan of existing implementation strategies used by the ICTMG to support the uptake of previous ICTMG clinical practice guidelines. Data were categorized using the Behavior Change Wheel and ERIC taxonomy and is summarized in Box 1. The benefit of this step was two-fold. First, it provided a common language to specify what had been done to support implementation of previous guidelines and allowed comparisons across them in order to see whether any implementation strategies beyond education and training (typical "go-to" strategies) had been used. Second, when it comes to future steps in the roadmap (Steps 3 and 4), the environmental scan provided a foundation to build upon to assess whether the existing types of intervention strategies were targeting the barriers and enablers within different theoretical domains, and where the gaps/missed opportunities are for new strategies to be used.[50] This "internal" environmental scan outlined above can additionally be supplemented with "external" scanning from other organizations or the

TABLE 1 Summary of a methodological roadmap to embed implementation science principles, frameworks, and methods into existing steps for developing and promoting uptake of clinical practice guidelines.

Lifespan of a guideline	Key activities informed by Schünemann et al. (2014) guidelines 2.0 checklist	Methodological roadmap step	Summary	Key questions to ask
Topic selection	**Priority setting** *The process of identifying, balancing, and ranking stakeholder priorities* **Target audience and topic selection** *Identifies guideline users and defines covered topics* **Question generation** *Defines key guideline questions using the PICO framework, specifying the population, intervention, comparison, and outcomes for decision-making*	1. Environmental scan	During early guideline development, assess care gaps, data availability, and existing quality improvement efforts to learn iteratively and prevent duplication. Supplement this with external scans from other organizations or literature to identify relevant gaps, data sources, and interventions. Understanding data availability early helps prioritize clinical behaviors and evaluate implementation strategies later	What is current clinical practice? What is the extent of variation in care—where are there gaps with existing recommendations and where is there the greatest need and scope for improvement? What data are available to assess variations in care? What existing quality improvement initiatives have been put into place to try and improve practice in this clinical area, and/or to support uptake of other clinical practice guidelines in transfusion? How successful were they? What is known about existing barriers and enablers or factors influencing clinical practice in this clinical area?
Guideline development	**Summarizing evidence and considering additional information** *Organizes evidence to support recommendation development and includes relevant additional information* **Judging quality, strength, or certainty of body of evidence** *Evaluates confidence in research findings using structured approaches, considering factors like disease burden, outcome importance, interventions, values, costs, and diagnostic accuracy* **Developing recommendations and determining their strength** *Uses a structured, transparent process to integrate key factors that influence a recommendation. Strength is determined by the panel's confidence that benefits outweigh harms*	2. Detailing who needs to do what differently, per guideline recommendation	During guideline development, identify key 'actors' (the who) and 'actions' (the what) for each recommendation to clarify who needs to change their behavior to maximize actionability.[36] This process can also inform the creation or refinement of recommendations to enhance actionability. Consider whether actors and actions apply across different regions and adapt recommendations as needed for broader relevance	Who is the actor(s) that the guideline recommendation is targeting? What is the action(s) that the guideline recommendation is targeting? Are there linkages between actors and/or actions across guideline recommendations? What is the likelihood that recommendations will be generalizable across transfusion contexts? Have any of the actors or actions been identified/targeted before as part of existing quality improvement initiatives identified in Step 1?
		3. Barriers and enablers assessment	After identifying key actors and actions for each recommendation, assess barriers and enablers to implementation in clinical practice. Doing this before finalizing the guideline helps shape implementation strategies and feasibility considerations. If new barriers or enablers emerge, revisit recommendations as needed	What are the things that may get in the way (barrier) of implementing the information in a guideline recommendation? What are the things that may help support (enabler) implementing the information in a guideline recommendation? Are there any key actors, actions, or contextual issues identified at this step which

(Continues)

TABLE 1 (Continued)

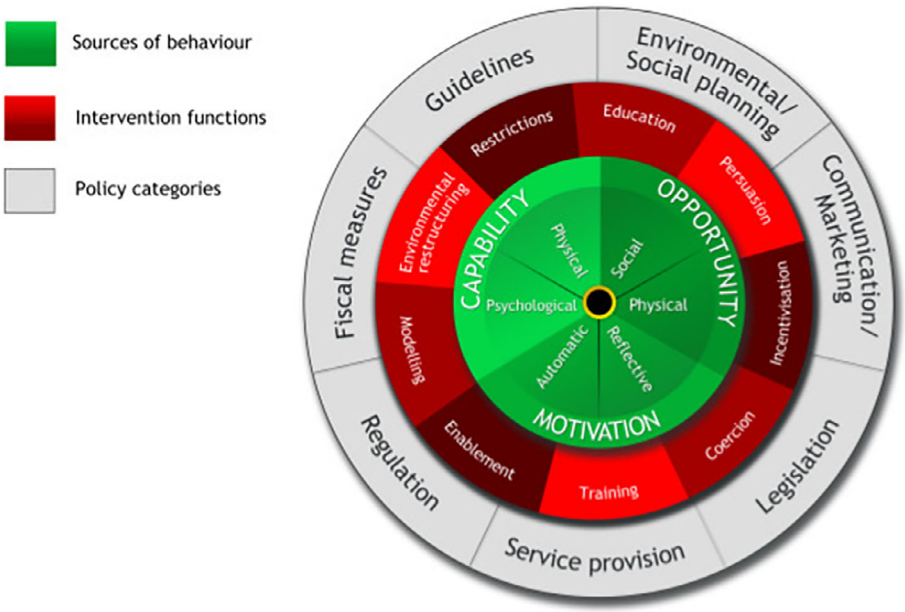
Lifespan of a guideline	Key activities informed by Schünemann et al. (2014) guidelines 2.0 checklist	Methodological roadmap step	Summary	Key questions to ask
				have not been considered in the guideline recommendations? Have any of the barriers and been identified/targeted before as part of existing quality improvement initiatives identified in Step 1?
Guideline reporting	**Reporting and peer review** *Covers guideline publication methods and pre-publication review by internal and external stakeholders to ensure accuracy and quality*	4. Tailoring implementation strategies to identified barriers and enablers	Once barriers and enablers are identified, tailor implementation strategies accordingly. Strategies from earlier steps may be refined rather than created from scratch. Ideally, select strategies before or near guideline publication to ensure timely, targeted, and impactful implementation during guideline roll-out	Which barriers and enablers will be most important to address? Which framework can I use to help select my implementation strategies? How acceptable is my proposed implementation strategy? How practical is deliver is my proposed implementation strategy? What is the likelihood that my proposed implementation strategy will be effective? How affordable is my proposed implementation strategy? Will there be any side-effects of my proposed implementation strategy? What are the equity considerations for my proposed implementation strategy?
Guideline dissemination and implementation Tracking ongoing use and periodic guideline update/ replacement	**Dissemination and implementation** *Focuses on strategies to make relevant groups aware of the guidelines and to enhance their uptake* **Evaluation and use** *Involves assessing the guideline process, uptake, and impact on health outcomes or other effects* **Updating/replacing** *Determines when a guideline needs revision or replacement due to new evidence or other influencing factor that influence the recommendations*	5. Implementation and evaluation of implementation strategies	After selecting implementation strategies, begin roll-out with a clear implementation and evaluation plan. Choose distinct implementation outcomes (e.g., acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, sustainability) to measure success over time.[29] Where possible, use existing data sources (potentially identified in Step 1) or incorporate new data to track recommendation uptake and behavior changes	How can I measure change as a result of my implementation strategy? What data are already available to measure change? What is the timeline for measuring change? How do I make sure my intervention strategy is delivered as designed (e.g., fidelity)?

published literature to identify care gaps, data sources/ indicators, and interventions/initiatives relevant to the guideline topic(s) being considered. Environmental scanning should also enable the selection of key indicators and/or data sources which will provide information about implementation progress, and ultimately support evaluation of the impact of implementation strategies, as outlined later in the roadmap.

BOX 1 Example of an environmental scan of implementation strategies across the ICTMG to support guideline dissemination and implementation

In April 2024, we conducted an environmental scan of the ICTMG website and the organization's annual reports to pull out 31 implementation strategies across five ICTMG guideline projects between 2013 and 2024: platelet transfusion,[12] fetal and neonatal alloimmune thrombocytopenia,[41] RBCs for patients with hemoglobinopathies,[42] hemolytic disease of the newborn,[43] and, most recently, intravenous albumin.[44] Several systematic reviews were also published across these areas to support evidence building for the guidelines.

Data were classified according to the Behavior Change Wheel[47] and the ERIC taxonomy.[48] The Behavior Change Wheel has three layers. At its center is the Capability, Opportunity, Motivation - Behaviour (COM-B) model, which summarizes influences on behavior (and potential mechanisms of action of interventions). The other two layers—Intervention types and Policy categories—represent a range of broad types of ways to change behavior, some of which are more relevant to addressing Capability, Opportunity, or Motivation. By classifying in this way, it enables us to see what our identified implementation strategies are targeting. The ERIC taxonomy is a compendium of 73 expert-consensus-generated implementation strategies. The taxonomy adds value by offering a common language to specify what had been done to support implementation and to help build out/tailor implementation programs to address key barriers and enablers to implementation.



[Color figure can be viewed at wileyonlinelibrary.com]

The 31 implementation strategies identified in our scan included: decision-making tools ($n = 4$), blog posts ($n = 1$), case study reports ($n = 1$), podcasts for healthcare providers ($n = 3$), "train-the-trainer" presentation slide decks ($n = 4$), educational webinars ($n = 3$), project specific webpages ($n = 5$), endorsements from other organizations ($n = 6$), pamphlets ($n = 3$), and podcasts for patients ($n = 1$). The scan revealed that strategies were mainly focused on increasing knowledge and skill (Capability) with some educational and persuasive strategies (Opportunity). According to the ERIC taxonomy, these strategies were mainly classified under two implementation strategies: *develop educational materials* (definition: develop and format manuals, toolkits, and other supporting materials in ways that make it easier for stakeholders to learn about the innovation and for clinicians to learn how to deliver the clinical innovation) and *distribute educational materials* (definition: distribute educational materials, including guidelines, manuals, and toolkits, in person, by mail, and/or electronically). This means that there are likely gaps in addressing other types of barriers beyond knowledge deficits, and also using a wider array of intervention approaches.

2.2 | Step 2: Detailing who needs to do what differently, per guideline recommendation

During guideline development and recommendation formulation, it is crucial to specify key "actors" (who) and "actions" (what) for each recommendation. Clinical practice guidelines often lack clarity about whose behavior needs to change, what actions are required and under what circumstances (e.g., start something new (implementing), do more of something already being done, do less of something or stop it entirely (de-implementing), replace something), which can limit their practical application.[36]

Michie and Johnston demonstrate this issue using the following example from a heart failure guideline—"Heart failure care should be delivered by a multidisciplinary team with an integrated approach across the healthcare community." How this recommendation is written leaves unanswered questions about which specific disciplines are involved (the who) and what specific behaviors demonstrate integration (the what). Addressing specificity in wording can enhance actionability and support decision-making, including about the tailoring of strategies to best address varying influences on behavior among subsets of the target actor group. The Action, Actor, Context, Target, Time framework provides a user-friendly implementation science-focused framework to support this step of the roadmap by enabling more focused and actionable recommendations.[51]

As an illustration, our work on the ICTMG guideline on the use of intravenous albumin[44] included a "who needs to do what differently" mapping exercise by a multidisciplinary team to match each guideline recommendation with the most appropriate knowledge users by clinical role or specialty. Across 14 recommendations in the albumin guideline, we identified more than 24 types of healthcare provider roles for which at least one of the recommendations could be relevant to their scope of practice. A selection of these roles included: critical care physicians, dialysis nurses, nephrologists, neonatologists, perfusionists, gastroenterologists, cardiac surgeons, and general surgeons. This exercise highlighted the need identify—with specificity—the key actors for which guideline dissemination efforts must be targeted.

Identifying specific key actors can range from simplistic or informal methods, such as in this case with the mapping exercise, to more rigorous or formal methods, such as a Delphi or e-Delphi approach, if resources/capacity allow. These formal methods leverage expert opinion for the purposes of ranking recommendations according to their importance and relevance and may be particularly advantageous when a deeper dive into barriers and enablers to implementation is warranted.

2.3 | Step 3: Barriers and enablers assessment

Once the key actors and actions have been matched to each guideline recommendation and prioritized, identifying barriers (things that may get in the way of) and enablers (things that may help) to implementing the practice-change information in each recommendation is required. For example, accessing, reading, and using a guideline are behaviors in their own right, so there will likely be barriers and enablers to engaging with the guideline in the first place (e.g., knowing it exists, having time, believing it applies to their role). Then there will be barriers and enablers to actually doing what is recommended in the guideline (e.g., transfusing red cells at a certain hemoglobin threshold which might depend on having the hemoglobin results available and be influenced by normative practice in their team). In this roadmap, we acknowledge the benefit of surfacing these barriers and enablers as early as possible, ideally during the guideline development process itself,[19,38] to ensure that by the time a guideline is ready to be implemented, the selection of implementation strategies can reflect these factors. Moreover, there may be some bidirectionality at this step if there are barriers and/or enablers relating to key actors and actions that have not been considered in the recommendations, which may require going back to earlier steps in the roadmap.

Standard practice in implementation science draws upon frameworks of factors that we already know are likely to influence behavior,[52] some of which have been widely applied to guideline implementation. The use of a framework enables drawing from, and contributing to the wider literature in a replicable way on what influences practice change.[53] The most useful frameworks also link those factors to fit-for-purpose strategies so that interventions can be developed to address barriers and enablers to guideline uptake. One such framework is the Theoretical Domains Framework (TDF),[53,54] which synthesizes constructs from 33 behavior change theories into 14 domains. These represent motivational (e.g., knowledge, intention, emotions, beliefs about consequences, capabilities, skills), interpersonal (e.g., professional role/identity, social norms, pressure, team working), and environmental (e.g. available resources, time, costs) influences on behavior. The TDF has been used to structure interview and survey questions[55] to explore factors influencing a clinical practice behavior, and for analyzing and categorizing themes in the data around different types of barriers and enablers.[56] Previous applications within transfusion include exploring barriers and enablers to transfusion practice in intensive care units[57] and audit and feedback of transfusion practice.[39] An example of this step in action

TABLE 2 Example qualitative barriers and enablers assessment focused on the implementation of blood transfusion guidelines in a sample of UK healthcare providers.

Domains from the theoretical domain framework (TDF)	Question from interview guide	Barriers/enablers reflecting each TDF domain	Example quote from interviews with healthcare providers
Knowledge *What people know about a topic*	In general, to what extent do you agree with the guidelines?	Clinicians need to know how to access the guidelines	"The expectation would be that they'd have the working knowledge to seek out or know where to seek out the relevant information if needed"
Skills *The abilities people need to perform a task well*	How easy or difficult are the guidelines to understand?	Guidelines are a core part of clinicians' training	"Those guidelines are drilled into our trainees and those drills and those processes are really established into our trainees from an early age"
Memory, attention, and decision processes *How well people can remember, focus, and make decisions*	Do you ever get distracted when you are intending to check or implement the guideline recommendations?	I deviate from guideline because I have to individualize a decision based on how the patient presents	"In terms of deciding when to transfuse a person the guidelines are certainly kept in mind but clinically, erm.... The individual circumstance of the patient would probably take precedent"
Behavioral regulation *The strategies people use to stay on track*	Do you ever check the guidelines before carry out a transfusion?	Clinicians find it difficult to change existing practice habits to become consistent with new guideline recommendations	"People tend to stick to what they know rather than moving across to the new recommendation"
Environmental context and resources *Everything around a person that affects their ability to act*	To what extent do you feel you have the resources to implement recommendations in transfusion guidelines?	There is ambiguity in the interpretation of some guideline recommendations	"I have to say those, that some of the guidelines the wording can be interpreted in more than one way sometimes"
Social Influences *How other people encourage or discourage a behavior*	Do you ever discuss guidelines with colleagues?	In general, I perceive my peers as supportive of guidelines	"So we tend to be quite adherent as a group I would say to transfusion practices. So there's no sort of descent among the ranks, we are very much in agreement"
Beliefs about capabilities *A person's confidence in their ability to perform a task*	How easy or difficult is it to implement guideline recommendations in day-today practice?	Guidelines do increase my confidence in my transfusion decisions	"If you're sort of, if it's supporting what you think should happen then I think it's going to influence your confidence in your decision"
Intention *A person's plans and commitment to do something*	How important do you think it is to follow guidelines	It is not important to strictly stick to the recommendations in guidelines	"It's a guideline so you don't actually have to stick to it you just have to know that's what the guidance is and then apply it as it's appropriate"
Goals *The long-term objectives people are working toward*	Do you set personal goals for your practice based on guidelines?	Guidelines should not be followed more strictly	"I don't agree that guidelines should be much stronger. I mean guidelines have a place in life but they're not there to determine practice"
Social/professional role and identity *How people see themselves in their job or role*	To what extent do you think transfusion guidelines are applicable to your professional role?	Part of being a good doctor is knowing when not to use the guideline	"I think the art of becoming a good doctor is to know when not to use the guideline – to know what the limitations are and when you need to go outside of it"

(Continues)

TABLE 2 (Continued)

Domains from the theoretical domain framework (TDF)	Question from interview guide	Barriers/enablers reflecting each TDF domain	Example quote from interviews with healthcare providers
Beliefs about consequences *What people think will happen as a result of their actions*	Are there any disadvantages to using guidelines to manage transfusion?	Guidelines may prevent people from applying their clinical judgment	"Yes I think that one issue can be that it might take away clinician's own clinical judgment and we do see this one especially in obstetrics ... I don't find the guidelines as useful is gray areas"
Reinforcement *Rewards or punishments that influence behavior*	Are there any incentives to following guidelines in your daily practice?	Personal satisfaction that you've treated the patient well is an incentive to follow guidelines	"There's always personal satisfaction when you've treated a patient well but nothing else"
Emotion *How feelings impact behavior*	Do you have any concerns or anxieties about not adhering or deviating from guidelines?	Deviating from guidelines is a source of anxiety	"My only concern is that I think things are getting more litigious and my only concern is ... guidelines being used against you in a litigious situation"
Optimism *General positivity or negativity about outcomes*	To what extent do you believe clinical guidelines have the potential to improve transfusion practice?	Guidelines have the potential to improve transfusion practice	"I do think they have help to filter down and change what people do and people's attitudes towards blood transfusion"

can be found in Table 2, which summarizes a barriers and enablers assessment of the use of blood transfusion guidelines in clinical practice. These were identified from a qualitative interview study by our author team with healthcare providers (hematologists, obstetricians, surgeons, specialist transfusion nurses, anesthetists, transfusion laboratory managers) in two UK hospitals.

2.4 | Step 4: Tailoring implementation strategies to identified barriers and enablers

Following identification of the barriers and enablers associated with a guideline's recommendations, selecting and tailoring implementation strategies can occur. In this context, an implementation strategy is designed to support those whose behavior is being targeted to change as part of a guideline recommendation (it can target initial engagement with the guideline and/or subsequent practice change). Examples from the transfusion literature synthesized by Delaforce et al.[58] are reported in Table 3. Other useful examples from Australia, Canada, and Austria can be found in the European Commission guideline on the implementation of evidence-based patient blood management in hospitals.[35] By identifying specific actions and actors (Step 2) and what influences them (Step 3), we can design more focused, targeted, and tailored implementation strategies. Ideally, this should build on what is already in place and learn from existing strategies in an iterative way (Step 1). Taking this type of approach allows us to contribute back to the wider evidence base and draw upon wider evidence around interventions targeting practice change and better understand what works and in what circumstances.[62,63] While it can be tempting to rush to this step of generating solutions and strategies, it is important for this step to be informed by a thorough analysis of barriers and enablers to inform implementation strategies.

Selecting implementation strategies that can be executed along with (or in swift succession to) guideline publication helps to close the gap between when actors become aware of the recommendations and when they can access supports to align their actions accordingly. In practice, this amounts to a move from often post hoc approaches (after guidelines may already be "in the wild") into a more deliberate and prospective a priori approach. Within implementation science, there are several frameworks that can support this step in the roadmap such the Behavior Change Wheel[47] or ERIC taxonomy,[48] as outlined in the Step 1. Moreover, to assess such viability of proposed implementation strategies, the Acceptability, Practicability, Effectiveness, Affordability, Side-effects, and Equity framework offers as useful guide in order to maximize the likelihood that they can be rolled-out and received as intended.[64] Powell et al. have also published practical guidance on methods for selecting implementation strategies,[65] which is a valuable resource to support successful execution of Step 4.

TABLE 3 Examples of barriers to the implementation and utilization of the transfusion guidelines matched to implementation strategies, adapted from Delaforce and colleagues.[58]

Study aim	Barriers to implementation identified	Implementation strategies taken from the Expert Recommendations for Implementing Change (ERIC) taxonomy
Evaluate a multifaceted approach to reduce unnecessary red blood cell utilization[59]	Access to knowledge and information, knowledge and beliefs about the intervention, evidence strength and quality, structural characteristics, culture	Alter incentive/allowance structures, audit and provide feedback, conduct educational meetings, involve executive boards, remind clinicians
Evaluate a multifaceted approach to reduce blood transfusion in cardiac surgery[60]	Culture, knowledge and beliefs about the intervention, tension for change	Capture and share local knowledge, remind clinicians, conduct educational meetings, identify and prepare champions, develop a formal implementation blueprint, develop educational materials, audit and provide feedback
Evaluate multifaceted patient blood management programs to optimize the utilization of blood components[61]	Evidence strength and quality, knowledge and beliefs about the intervention, culture, peer pressure, relative advantage	Audit and provide feedback, start a dissemination organization, develop educational materials, use data experts, conduct local consensus discussions, conduct educational outreach visits, involve executive boards

2.5 | Step 5: Implementation and evaluation of implementation strategies

The two final stages of the lifespan of a guideline are: (i) guideline dissemination and implementation and (ii) tracking ongoing use and periodic guideline update/replacement. The final step in the methodological roadmap spans both these stages and focuses on the implementation (roll-out) and evaluation of implementation strategies. Ideally, questions about evaluation should be considered during earlier steps of the roadmap (how would we measure change?). Thus, the identification of a set of implementation outcomes that are behaviorally specific and are distinct from service outcomes and patient outcomes is recommended for evaluation.[29] For this step, we can once again leverage existing frameworks from implementation science such as the Consolidated Framework for Implementation Outcomes Addendum[66] or the Reach, Effectiveness, Adoption, Implementation, and Maintenance framework[67,68] to guide the selection of key implementation outcomes. Proctor and colleagues also suggested several implementation outcomes for consideration: acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, and sustainability.[29] The evidence base for Proctor's outcome set has been effectively summarized in recent scoping and systematic reviews.[69,70] Additionally, where possible, it is advised to utilize existing routinely collected data sources/indicators (potentially identified during environmental scanning) or ensure that process and outcome data are added where possible to enable evaluation of uptake and variation in care. In terms of study designs, methods are available to evaluate implementation interventions beyond randomized-controlled trials.[71] These include process evaluations targeting guideline development and tools to specify and classify dissemination activities using tools such as TIDeR[72] or GuiDiR.[73]

3 | DISCUSSION

There is a need for a more structured, transparent, and replicable approach to improve the implementation of recommendations made within clinical practice guidelines in medicine and transfusion medicine. We have proposed a five-step methodological roadmap to embed implementation science principles and activities in the development and dissemination of clinical practice guidelines, using examples from transfusion medicine. We sought to match the roadmap to existing steps involved in developing and disseminating guidelines, from start to finish, to encourage integration of the information in the roadmap into existing processes.

To maximize the utility of the roadmap, it is important to think about implementation as early as possible when developing transfusion guidelines and to leverage knowledge users through the process. Practically speaking, this could be enacted in a number of ways. Key actors and actions are identified when writing guideline recommendations, so that they can be as specific as possible rather than being somewhat vague and difficult to use among their target audience. Additionally, while the purpose of a guideline is to summarize the state of medical evidence, one needs to think about what is feasible to

enact "on the ground" in routine practice (i.e., actionability). Recommendations may be based on the best available medical evidence; however, they may be impossible to enact in practice. As such, there may even be opportunities to conduct barriers and enablers assessments when writing recommendations and selecting them. While this does not mean discarding recommendations that are considered challenging to implement, rather moving toward possible refinement (a bidirectional approach) and selection/tailoring of specific implementation strategies to complement guideline recommendations, as per Step 4 in the roadmap.

We have attempted to ground concepts and suggested activities into current practices among guideline developers, based on experiences of the ICTMG. It is acknowledged that certain limitations (e.g., expertise, time, resources, etc.) may hinder the speed at which clinicians, researchers, and organizations involved in guideline development are able to embed implementation science principles into existing processes. In such cases, leaning on familiar quality improvement strategies such as audit and feedback, educational meetings, and engaging decision makers (see Table 3) may be feasible activities to support the integration of implementation science principles can be scaled and optimized over time. Moreover, we recognize that groups "on the ground" may be doing aspects of the roadmap already to support uptake of transfusion guidelines, although there is likely variability in how this is done which hinders evidence-building and replication efforts. This speaks to opportunities to broker further partnerships in this interdisciplinary space which requires continued focus on building mutual understanding across disciplines,[22,24,74] ensuring a shared language/jargon, and the ability to find champions to support implementation efforts. We suggest that there may be a mutual benefit in terms of how transfusion medicine could also help advance models, theories, frameworks, and methods in implementation science, and given the complexity of transfusion medicine and variability in practice, this area should be of interest to implementation science researchers.[7]

Implementation science and improvement science share a common goal of enhancing healthcare delivery but differ in scope in that implementation science focuses on generalizable strategies for adopting evidence-based interventions, while improvement science and quality improvement emphasize iterative, context-specific changes. Given that most healthcare institutions have dedicated quality improvement departments, aligning implementation science with familiar improvement frameworks may facilitate its practical application.[75] Change management frameworks, such as Kotter's eight-step model,[27] also offer a structured approach to bridging these disciplines by embedding change within organizational culture. Integrating such complimentary perspectives can strengthen the uptake of evidence-based practices while allowing for necessary local adaptations.[74]

Much of the thinking about this roadmap as it applies to transfusion medicine has been done in partnership with the ICTMG with examples from the roadmap "in action" presented in this paper (e.g., Box 1). It will be of interest to understand how the roadmap relates to the work undertaken by other guideline organizations and we encourage collaboration in this area. Current activities in the partnership with the ICTMG will include enacting Steps 3–5 of the roadmap as applied to the recent guideline on albumin use,[44] and leverage the entire roadmap for transfusion medicine guidelines in the pipeline. Essentially, further empirical testing of the steps outlined in the roadmap is warranted.

4 | CONCLUSION

Uptake of clinical practice guidelines in transfusion medicine is needed to address known evidence-to-practice gaps. We propose that by integrating an interdisciplinary approach which draws on knowledge from implementation science, this uptake can be accelerated to ultimately improve patient care, reduce evidence-to-action time gaps, and promote efficiencies within health systems. We have developed a five-step methodological roadmap to support those working in guideline development and implementation to integrate implementation science principles into their workflow. Although exemplified in the field of transfusion medicine, the roadmap has the potential to inform clinical guideline development and dissemination more generally, and we welcome plans for empirical testing in other clinical areas.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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