Barriers to Implementing Internist Recommendations for Perioperative Anticoagulation Management by Surgical Teams: A Qualitative Study

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Abstract

Introduction: In our center, half of all recommendations made by an internist about perioperative anticoagulation management are not followed by surgical team members. We aimed to understand the barriers to implementing perioperative anticoagulation recommendations.

Methods: This was a prespecified analysis of interviews with surgical team members about individual- and systems-level drivers of missed perioperative anticoagulation recommendations. Interviews and analysis were guided by the Theoretical Domains Framework and the Consolidation Framework for Implementation Research.

Results: We interviewed 16 surgical team members and 2 internists. Surgical team members intentionally did not follow recommendations about perioperative anticoagulation management when they felt that the bleeding risk outweighed the risk of thrombosis. This assessment of risk was driven by emotion and previous experience, even among participants who were familiar with perioperative literature.

Conclusions: Development of study outcomes and guideline recommendations for perioperative anticoagulation management should include surgical team members in order to address the acceptability of these recommendations and increase adoption.

Résumé

Introduction : Dans notre centre, la moitié des recommandations formulées par un interniste concernant la prise en charge de l’anticoagulation périopératoire ne sont pas suivies par les membres de l’équipe chirurgicale. Nous avons cherché à comprendre les obstacles à l’application des recommandations relatives à l’anticoagulation périopératoire.
Introduction

There have been advances in perioperative anticoagulation management over the previous decade, in part due to the introduction of direct oral anticoagulants (DOACs) and additional evidence for perioperative management of vitamin K antagonists (VKAs) in patients with atrial fibrillation and venous thromboembolism (VTE). However, this expansion of agents and indications for anticoagulation have not been matched with high-quality evidence to guide perioperative management. Implementation of best practices for perioperative anticoagulation management has been challenging for perioperative physicians to synthesize, with low reported rates of adherence. Further, the paucity of high-quality evidence to guide perioperative anticoagulation decision-making has led to a lack of clear recommendations from major society guidelines, particularly for intermediate-risk patients, in turn contributing to wide practice variation among thrombosis experts. While previous studies have identified barriers to implement best practices among perioperative medicine physicians, there is little known about the barriers to best practices for surgical teams. Studies of surgical teams have focused on knowledge of perioperative anticoagulation guidelines and assessment of bleeding risk rather than comprehensively examining barriers and facilitators to evidence-based perioperative anticoagulation management.

A previous quality improvement study performed in our center examining preoperative internal medicine consult note recommendations found that approximately one-half of recommendations made by an internist were not followed by the surgical team (“missed recommendations”). Recommendations relating to pre- and postoperative anticoagulation management were only followed for 61.5% (n = 64/103) and 45.2% (n = 28/62) of patients, respectively. Interview data found that missed recommendations may be unintentional or intentional, and that surgical team members were aware of postoperative anticoagulation recommendations and intentionally did not follow most postoperative anticoagulation orders.

To further explore this gap between recommendations by internists and management of patients by surgeons, we report the results of a qualitative interview study aimed at understanding why surgical teams may intentionally not fully implement recommendations made by internal medicine specialists regarding perioperative anticoagulation management, with the objective of informing the development of interventions that may improve the quality and safety of perioperative care.

Methods

Our current study reports data collected during the qualitative strand of a sequential explanatory mixed methods study performed by our study team to understand the drivers of missed perioperative recommendations. The primary study used a chart audit to characterize the number and types of missed recommendations, followed by semistructured interviews to explore the reasons for missing these recommendations. The chart audit strand identified that...
Barriers to implementing internist recommendations

Perioperative anticoagulation recommendations were most common among missed recommendations and the interview guide was therefore developed to ask about anticoagulation separately from other types of recommendations. This additional study question was developed prior to data collection and analysis of the qualitative strand. We focused on the perceptions of the recommendations and the management by surgeons rather than on the type and details of perioperative anticoagulation management recommended by internists.

This study was approved by the University of Calgary Conjoint Faculties Research Ethics Board (CHREB) and is reported according to the Consolidated criteria for Reporting Qualitative Research (COREQ) guidelines.11

Setting

The Foothills Medical Center is a quaternary care hospital in Calgary, Alberta, Canada. Patients with medical comorbidities who are scheduled for elective, semiurgent, or urgent surgeries at the Foothills Medical Center are referred to the Preadmission Clinic (PAC) before surgery to be seen by an internist. The internist makes recommendations regarding the patient’s home medications, medical diagnosis, and pre- and postoperative management of medical issues, which include anticoagulation management recommendations for patients with atrial fibrillation, VTE, and mechanical valves. These recommendations are communicated to the surgical team by a dictated consult note (the “PAC visit note”) which is available on the electronic health record (EHR).

Interview guide

The interview guide was developed using the Theoretical Domains Framework (TDF) and the Consolidated Framework for Implementation Research (CFIR). The TDF and CFIR may be combined to understand multilevel implementation.12 The TDF is a conceptual framework for understanding influences of behavior and has been commonly used to understand implementation of interventions or to design more effective interventions in healthcare.13 We used the TDF to understand determinants of surgical team member behavior related to perioperative anticoagulation management. The CFIR is a conceptual framework that examines reasons for the success or failure of implementation of interventions.14 The Intervention Characteristics Domain of the CFIR was used in our interview guide to understand how characteristics of the intervention (in this study, the PAC visit note recommendations) were related to whether surgical teams implemented PAC recommendations. The interview guide was pilot tested with two surgical residents and adapted based on the role of the participant. The full interview guides are available in Appendix A–D.

Study participants

We recruited surgical residents, nurse practitioners to inpatient surgical units, and staff surgeons through purposive sampling from the disciplines who have the most patients seen in PAC: general surgery, gynecology, gynecologic oncology, spine surgery, and neurosurgery. Surgical residents were invited to interview through emails sent by chief residents to all residents in their surgical training program, and all nurse practitioners working in inpatient surgical units were invited via email. Snowball sampling of interview participants was then used to recruit additional residents and nurse practitioners. The surgical disciplines of participating nurse practitioners are not reported because there is often only one nurse practitioner per discipline and this would allow identification of study participants. Staff surgeons were invited through convenience sampling of surgeons who have expressed interest in perioperative processes. We also interviewed PAC internists, who were selected based on PAC scheduling. Participation was voluntary for all participants, and all participants provided informed consent. Residents and nurse practitioners were reimbursed for their time, and staff surgeons and internists were not.

Data collection

Interviews were one-on-one, lasted between 30 and 60 min, and held in-person. They were conducted by a member of the study team with experience in interviewing (K.F.) who does not work clinically with any of the participants. All interviews were audio recorded, transcribed verbatim, and manually cleaned by the interviewer. Identifying information was removed. Participants did not review their individual transcripts.

Interview transcripts were coded by two study team members with experience in qualitative data analysis: an internal medicine physician who works in PAC (S.M.R.) and the interviewer (K.F.). Codes were assigned independently using a coding framework based on the TDF, and codes were reconciled between the two coders. Additional codes were developed inductively through discussion between the two coders when predefined codes were not applicable. Data were managed in NVivo version 12.3.0 (QSR International, Inc., Doncaster, Australia). A surgical resident participant and study team member (G.M.) reviewed the results and final manuscript for agreement with the interpretation and analysis.
Results

Eighteen interviews were conducted and included eight residents (44.4%), two nurse practitioners (11.1%), two internal medicine physicians (11.1%), and eight staff surgeons (44.4%). The disciplines and faculty status of participants are reported in Table 1. The final codebook included 31 codes (Appendix D). Of these, 25 were predefined using the TDF and CFIR constructs and 6 were developed inductively. The new codes covered specific medical topics (e.g., diabetes, anticoagulation), critiques and suggestions, and the intended purpose of the PAC visit note. Relevant constructs are indicated in brackets, where applicable. We identified five predominant themes.

The major themes that surgical team members provided for intentionally not following PAC visit note recommendations about perioperative anticoagulation management were beliefs about consequences, knowledge, evidence strength and quality, emotion, and reinforcement. These themes were overlapping, with beliefs about consequences acting as a unifying construct that most consistently impacted decision-making (Figure 1). In addition, surgical team members felt that if there was a conflict between internal medicine recommendations and the surgical team planned course of action, decisions about perioperative anticoagulation management should be made by the surgical team (Social or Professional Role and Identity) and that internists may not understand surgical factors well enough to make acceptable recommendations (Intervention Source). While themes were similar across surgical disciplines, participants often highlighted how perceptions of perioperative anticoagulation may differ between disciplines, in particular neurosurgery (Surgical Context). Themes were similar for preoperative and postoperative management of anticoagulation, and so we did not differentiate these time periods in our analysis.

Beliefs about consequences

Beliefs about consequences was most proximal to decision-making about perioperative anticoagulation management.

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Table 1. Characteristics of interview participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number (%)</th>
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<tbody>
<tr>
<td>Faculty status</td>
<td></td>
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<tr>
<td>Nurse practitioners</td>
<td>2 (11.1)</td>
</tr>
<tr>
<td>Residents</td>
<td>8 (44.4)</td>
</tr>
<tr>
<td>Staff physicians</td>
<td>8 (44.4)</td>
</tr>
<tr>
<td>Discipline of practice</td>
<td></td>
</tr>
<tr>
<td>General surgery</td>
<td>3 (16.7)</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
<td>1 (5.6)</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>4 (22.2)</td>
</tr>
<tr>
<td>ENT surgery</td>
<td>1 (5.6)</td>
</tr>
<tr>
<td>Gynecology</td>
<td>4 (22.2)</td>
</tr>
<tr>
<td>Spine surgery</td>
<td>2 (11.1)</td>
</tr>
<tr>
<td>Thoracic surgery</td>
<td>1 (5.6)</td>
</tr>
<tr>
<td>Internal medicine</td>
<td>2 (11.1)</td>
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</table>

ENT, ear, nose, and throat.

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Figure 1. Interaction of barriers to implementing perioperative anticoagulation recommendations.
Surgical team members did not follow PAC visit note recommendations when they felt that the risk of bleeding was greater than the risk of thrombosis. One resident stated, “If we feel their risk of bleeding is higher than the risk of a complication of anticoagulation, then always err on the side of not giving” (P10, general surgery resident). Surgical team members perceived that the risk of withholding anticoagulation was quite low: “I think [of] the risk of stroke as a single digit number versus the risk of a patient slowly getting a big hematoma and dropping his hemoglobin and needing a transfusion and a second OR” (P01, general surgery resident). This was echoed by staff surgeons and nurse practitioners, all of whom who felt that the risk of an adverse event of holding anticoagulation was very low and reported that intraoperative and postoperative surgical bleeding were critical outcomes (Table 2). Neurosurgical and spine surgery team members emphasized that the consequences of bleeding were particularly serious in their discipline.

Knowledge and rating of evidence
Many surgical team members reported a lack of peer-reviewed data or guidelines that could support decision-making about perioperative anticoagulation management. Some respondents were not aware of the evidence base (low Knowledge), while others were aware of evidence or guidelines but rated this as inadequate to support decision-making (high Knowledge with low rating of Evidence Strength and Quality) (Figure 1; Table 2). The overall effect was that most respondents did not use evidence or guidelines to make decisions about perioperative anticoagulation management.

One general surgery resident stated “Anecdotally we tend to hold those DOACs [for] 2 or 3 days and they still tend to be the more oozy cases. I don’t have any data to back that up, and I don’t know if anybody does … it’s super subjective” (P02). Staff surgeons responded similarly, stating “There aren’t any solid recommendations … there aren’t evidence-based guidelines to go by … it’s all kind of gosh-golly, what do most people do?” (P13, neurosurgery) and “It’s always a guess … we’ll just [restart anticoagulation] when we felt like it. There’s no science, it makes it a little awkward” (P14, spine surgery). In contrast, one resident with high knowledge of the evidence and guidelines stated, “there’s a lack of evidence for a lot of the things we do in neurosurgery … because [some surgeries] are not that common … we extrapolate [evidence] from other data sets, from other operations in other areas of the body … but its challenging to extrapolate everything to your specific patient in that type of situation” (P04).

Use of emotion and experience to guide decision-making
Without guidelines or evidence, many surgical team members reported using emotion or previous experience to make decisions about perioperative anticoagulation (Emotion and Reinforcement, respectively); citing “a sense of control” as being more important than “evidence [of] better outcomes” (P04, neurosurgery resident). Many surgical team members relayed a specific patient or experience that prompted them to be more cautious when following internal medicine recommendations about anticoagulation; one staff spine surgeon reported “I can’t say for sure … but the experience has been that [patients who take DOACs with 3 days of surgery bleed more] … I tell patients different instructions than internal medicine simply based on experience, not evidence” (P14, spine surgery). Similarly, a nurse practitioner shared that “We do recognize the risk [of holding anticoagulation but] … I have yet to see somebody have a stroke because they haven’t been on their warfarin for history of [atrial fibrillation], and maybe it’s more emotional that I don’t want to start an anticoagulant that I know could really cause a bleed versus how risky is it for them to actually develop a stroke” (P05).

Surgeon evaluation of internists’ recommendations
Surgical team members generally trusted internal medicine recommendations to be safe, though some participants felt that internists did not know enough about surgery to make safe recommendations about perioperative anticoagulation management (Intervention Source; Table 2). This was common among neurosurgery team members. Internist participants agreed, stating “I don’t know anything about the operative characteristics of taking out this mass or fixing this bone, I don’t know how much those bleed … I don’t have years of experiencing in cutting someone” (P15). Some surgical team members reported that internal medicine recommendations focused on medical indications for anticoagulation and did not adequately consider surgical risks of bleeding; for example, one general surgery resident stated, “Sometimes the internist … is making a suggestion based on whatever guidelines around when to restart [anticoagulation], keeping in mind like the reason that they were anticoagulated in the first place, but some of the surgeons feel that they don’t fully understand like the risk of bleeding in certain procedures immediately postoperatively. [There are] routine procedure[s] where just we know the postoperative bleeding risk is high versus like a technically challenging operation where there [were] steps in the surgery where it was maybe more difficult to control bleeding, and so sometimes if you
Table 2. Exemplar quotes of surgical team member perspectives on perioperative anticoagulation management for each major theme

<table>
<thead>
<tr>
<th>Construct (Framework)</th>
<th>Exemplar quote</th>
<th>Participant</th>
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<tbody>
<tr>
<td><strong>Belief about consequences (TDF)</strong></td>
<td>“There’s occasionally recommendations about anticoagulation that are definitely not followed by us because of the bleeding risk postoperatively … that’s really case specific, like if the case goes poorly you’re like oh yeah an extra day without their heparin … [especially] if the reason for anticoagulation is something relatively minor, like a low CHAD score for [atrial fibrillation] or something”</td>
<td>P02, general surgery resident</td>
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<td>“We see the complications of anticoagulation, we don’t see the complications of not anticoagulating”</td>
<td>P04, neurosurgery resident</td>
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<td>“As you might imagine we have a risk skewed view of anticoagulation because everybody that shows up that’s on anticoagulants, has a hematoma, those are the ones that we get to see, don’t get to see all the people that are [on] anticoagulation and doing fine”</td>
<td>P13, staff neurosurgery</td>
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<td><strong>Knowledge (TDF)</strong></td>
<td>“If somebody told me [to hold DOACs for] 3 days [before surgery] my understanding I would be like oh that’s the new evidence, like I would defer to this always … [internal medicine physicians] might not know that they’re teaching the surgeons this too”</td>
<td>P17, gynecologic oncology</td>
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<td>“[Managing anticoagulation] is not particularly evidence based, it’s more kind of what we’re comfortable, what we usually do, what the postoperative imaging looks like, if there’s a lot of blood, what the reason for them being on the blood thinners is in the first place”</td>
<td>P07, neurosurgery resident</td>
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<td><strong>Evidence strength &amp; quality (CFIR)</strong></td>
<td>“The evidence, which I do know reasonably well for [DOACs], the guidelines are based on what anesthesiologists use when they do spinal anesthetics, and … there is no data for spine surgery to tell us what they’re safe”</td>
<td>P14, staff spine surgeon</td>
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<td><strong>Emotion (TDF)</strong></td>
<td>“[Postoperative bleeding is] a different risk, a different hurt than having a patient on the floor that gets a PE. You know you feel bad about that, but when it was your knife that did the cutting that caused the bleed, and they deteriorate because of that, that’s tough. And the other thing with neurosurgery is, is where we work we can do worse than kill people.”</td>
<td>P04, neurosurgery resident</td>
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<td><strong>Reinforcement (TDF)</strong></td>
<td>“It’s a hemangioblastoma, that’s a very bloody tumor, maybe the surgeons like no, I know there’s no evidence but just because there’s no numbers, but I know if I go in there, and the patient’s only been off anticoagulation for a couple days then it’s gonna be a bloody mess, because it’s a bloody tumor”</td>
<td>P04, neurosurgery resident</td>
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<td></td>
<td>“No, it is, it’s purely subjective … [for] these other blood thinners, I tell patients different instructions than internal medicine simply based on experience not evidence”</td>
<td>P14, staff spine surgeon</td>
</tr>
<tr>
<td><strong>Social or Professional Role and Identity (TDF)</strong></td>
<td>“If someone comes in on blood thinners … and generally [the PAC visit note will] tell us when to start them, but I think we know that, like it’s within our … opinion, jurisdiction”</td>
<td>P06, nurse practitioner</td>
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<td>“Restart[ing anticoagulation] has to be done at the surgeons discretion, right like it’s, it’s just, it’s not fully my decision, it’s a shared decision making between the surgeon and myself”</td>
<td>P15, internal medicine physician</td>
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<td><strong>Intervention Source (CFIR)</strong></td>
<td>“I feel confident that internal medicine knows the pharmacokinetics and dynamics of these medications way better than I do, so if they say 3 day wash out is all that’s needed to be safe for surgery I trust that, so I would personally never say oh it’s gotta be a week I don’t feel comfortable cutting in that setting”</td>
<td>P11, staff urologynecologist</td>
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<td>I: Do internists know enough about surgery to make safe recommendations about anticoagulation? P: Surgeries are different, you know like we’ll do carotid endarterectomy with dual antiplatelet therapy but we would never take out a brain tumor on dual antiplatelet therapy. It’s a huge difference, and that’s one of those things that you, that is everything, anticoagulation it’s all about location, it’s like real estate location, location, where we’re working.</td>
<td>P04, neurosurgery resident</td>
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TDF, Transtheoretical Domains Framework; CFIR, Consolidated Framework for Implementation Research; CHAD, congestive heart failure, hypertension, age greater than 65 years, diabetes mellitus; DOAC, direct oral anticoagulant; PE, pulmonary embolism.
follow the instructions just like they’ve outlined then the patient could certainly get into trouble with bleeding” (P10).

**The surgical team ultimately decides**

While all participants agreed that though decisions about anticoagulation could be informed by internal medicine recommendations, ultimately the surgical team must make the final decision about starting or holding anticoagulation (Social Role). For example, a neurosurgery resident stated, “Ultimately … you have to respect the risk of the person doing the cutting, that they wear the risk, they feel the weight of the risk, and when patients have a poor outcome … from something you’ve done to somebody … that’s tough” (P04).

**Discussion**

This qualitative study used implementation frameworks to explore barriers to following internal medicine recommendations about perioperative anticoagulation by surgical teams and led to novel insights that can improve perioperative quality of care. Notably, surgical team members reported intentionally not following PAC visit note recommendations before and after surgery primarily due to beliefs about consequences; surgical team members consistently weighed the risks of bleeding as greater than the risks of holding anticoagulation. Surgical team members often reported using previous experience and emotion to make decisions about perioperative anticoagulation management and focused on adverse outcomes related to postoperative bleeding rather than thrombotic events. This relationship between risks and benefits of perioperative anticoagulation held whether the surgical team member was familiar with guidelines or evidence. Importantly, no surgical team members commented on whether the internists’ recommendations adhered to evidence or guidelines as an important consideration when deciding to implement these recommendations; instead, several participants stated that they felt that the guidelines and evidence did not apply to their specialty. Internists felt that their lack of understanding of surgical considerations limited their ability to tailor recommendations about anticoagulation to specific scenarios. Altogether, these results suggest that altering internal medicine recommendations alone would not reduce the number of missed recommendations; instead, surgical teams must be actively engaged in the guideline development process, including evidence generation, in a way that considers their perspectives on risks and benefits. These findings may inform design and implementation of perioperative anticoagulation management pathways, including guidelines and major society recommendations.

Variations in practice patterns for anticoagulation management based on different weighing of risks of anticoagulation have been seen in other studies; for example, one study found that internists and cardiologists tend to prioritize thromboembolic complications of withholding anticoagulation, and proceduralists emphasize bleeding complications of administering anticoagulation. This variation is reflected in different society guideline recommendations. For example, Thrombosis Canada recommends withholding DOACs for 2 days before surgery in patients with normal renal function, while the American Society of Regional Anesthesia and Pain Medicine guidelines recommend a longer duration of withholding anticoagulation due to concern for increased risk of bleeding.

In addition, several surgical team members in our study felt that existing guidelines and evidence were too broad to apply to specific surgical scenarios. Review articles published in surgical specialty journals often report a lack of evidence about perioperative anticoagulation management in their specific discipline, suggesting that surgeons in other centers also feel that major society guidelines on perioperative anticoagulation management need to be adapted to individual surgery types. For example, an attempt to synthesize evidence for postoperative anticoagulation management in neurosurgical patients was limited by lack of data in this population; of the five studies with a total of 47 participants included in this review, three were retrospective analyses of fewer than 20 patients and two were animal studies. This was reflected in our results; neurosurgeons were much more cautious about implementing internal medicine recommendations than other specialties.

Regardless of their awareness of guidelines, our data show that all surgical team members primarily used their own experience and judgment when weighing the risks and benefits of perioperative anticoagulation management decisions. This is commonly reported in the literature; studies performed in ophthalmologists and spine surgeons found that the majority of individual surgeons make decisions about perioperative anticoagulation management based on their own assessment of the risk of bleeding complications, rather than using national guidelines. Similarly, a study of spine surgeons found that those who estimate the risk of postoperative epidural hematoma as greater tended to hold off of postoperative thromboprophylaxis for longer than those who estimated lower risk, suggesting that that the surgeon’s assessment of risk is strongly related to
perioperative anticoagulation decisions. An international survey of orthopedic surgeons found that most respondents had a broader definition of a major bleeding event than what is currently used in most trials of perioperative anticoagulation, suggesting a disconnect between what surgeons perceive as important bleeding and how major research societies define major bleeding. Validation of surgeon risk estimation of bleeding may be important to inform future perioperative anticoagulation management guidelines. At minimum, researchers and authors of major society guidelines working in perioperative anticoagulation should include surgical team members from different disciplines as stakeholders to define important clinical outcomes to increase the acceptability of their recommendations or study outcomes. Different perioperative anticoagulant protocols, co-developed with surgical team members, should be tested in different surgical populations using bleeding outcomes that are meaningful to these teams.

Altogether with the results of our study, this suggests that many surgeons perceive that the current body of evidence that informs perioperative anticoagulation management recommendations is not strong enough to inform their clinical decisions. This should caution investigators who aim to reduce variation in perioperative anticoagulation management by developing interventions that translate current evidence and guidelines into practice algorithms; education alone will not increase the uptake of recommendations that are unacceptable to surgical team members due to perceptions of risk.

Finally, our result suggests that a lack of understanding of the consequences of bleeding for certain surgeries is a limitation in internists’ knowledge that influences uptake of perioperative anticoagulation recommendations. This is a potential area for intervention, especially with the emergence of perioperative training fellowships for internists in Canada.

In addition, due to the multiple intraoperative factors that contribute to perioperative anticoagulation decisions by surgical teams, it may be more reasonable to adopt a model of multidisciplinary shared care, with real-time discussion between care providers rather than siloed, preoperative decision-making by internists.

Our study is a single center qualitative study with a focus on only some of the surgical groups, and the results may not be generalizable to other centers or every surgical specialty. However, our findings are in keeping with survey studies in other settings. In addition, we did not assess whether the perioperative anticoagulation recommendations made by internal medicine physicians were in keeping with best practices; rather, our results focus on surgical team member’s perspectives, which provide insight into their decision-making. In addition, we anticipate response bias in participants who have an interest in perioperative medical management. It is possible that other surgical team members who did not respond to our invitation are not following recommendations for different reasons, such as because they are not interested or aware of them.

**Conclusion**

Many surgical team members are unaware of current evidence and existing guidelines that inform perioperative anticoagulation management. Even when aware of published best practices, surgical teams are unlikely to follow recommendations that they perceive as unsafe, especially when supporting evidence is limited or does not come from within their surgical population. In the absence of perceived adequate recommendations, surgical team members use experience and subjective assessment of risk that emphasizes bleeding to make decisions about anticoagulation. Altogether, our results highlight that a multidisciplinary panel of experts, including surgeons, anesthesiologists, thrombosis experts, and internists, is needed to unify guidelines across Canada to ensure that they are acceptable to all stakeholders. Research on perioperative anticoagulation management should be co-designed with surgeons to ensure that the protocols and outcomes are acceptable. These barriers to adherence to anticoagulation recommendations should be considered in trial design, writing of guidelines, and making recommendations for individual patients.

**Authorship**

K. Flemons contributed to study design, data collection and analysis, writing and revising the manuscript, and approval of the final manuscript for publication. M. Bosch contributed to study design, data collection, revising the manuscript and approval of the final manuscript for publication. G. Marcil contributed to study design, analysis of the data, revising the manuscript, and approval of the final manuscript for publication. R. Kachra contributed to study design, data collection and analysis, revising the manuscript, and approval of the final manuscript for publication. K. Zarnke contributed to study design, analysis of the data, revising the manuscript, and approval of the final manuscript for publication.
L. Skeith contributed to analysis of the data, writing and revising the manuscript, and approval of the final manuscript for publication.

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Competing Interests

S.M.R., R.K., K.Z., M.G., and M.B., have no competing interests to declare. L.S. received honoraria from LEO Pharma and research funding from CSL Behring. Dr. Skeith is a member of the CanVECTOR Canadian Thrombosis Research Network.

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References


Appendices

Appendix A: PAC Note Interview Guide – Feb 12, 2020

1. Tell us a little bit about yourself! Your role, your year, experience, specialties?
2. How often do you encounter the PAC note?
   2.1. When/how were you first introduced to it? By whom/what setting? (Curriculum, attending, other resident, what context, etc?)
3. Can you describe your workflow when planning a surgery for me? [I.E. patient comorbidities, post-op care, entering medications, etc] [Medical planning; meeting patient; med recs, netcare/chart, etc]
   3.1. [At what point(s)] Are you accessing/referring to the PAC note?
      3.1.1. Which team member(s)?
         3.1.1.1. Who looks at/records/orders contents of PAC recommendations?
         3.1.1.2. Who reviews? Anyone? Is the staff surgeon going over your work/double checking?
         3.1.1.3. Whose job is it to review note, put in medications, etc? Whose job do you think it should be? Is it the surgeon's job to review this work? (Tucking in patients, etc?)
      3.1.2. In what forms do you review the PAC note? (paper chart, netcare, etc?)
      3.1.3. How do you know which patients have Internal Medicine recommendations? Is it clear why you would or would not send a person to PAC?
3.2. Is there a process to ensure that the recommendations are implemented?
   3.2.1. Do you double check? When would you return to the note?
      3.2.1.1. After surgery? If there are symptoms (chest pain, blood sugar?). An unrecognized medication? An emergency?
4. How valuable are the contents of the note to you?
   4.1. What is your process of going over the note? What parts, what are you looking for, etc? Are there areas that are more/less helpful? (i.e. past medical history, medications, review of systems, physical exam, investigations, impression, and plan.)
   4.2. Do you have any thoughts about the evidence base the recommendations draw on? For instance, regarding diabetes management, anticoagulant management?
      4.2.1. Do they differ from recommendations in your field/specialty? How do you navigate the differences? (do you know if the recommendations conflict?)
5. Is the note one of the resources you would return to in complicated situations?
   5.1. Is it important to implement recommendations completely? What factors might change how you would implement recommendations?
6. Do you feel that…
   6.1. Are recommendations made by internists in preadmission clinic notes adaptable for changing patient status?
   6.2. Do you think internists who work in PAC understand enough about surgery to make useful recommendations for management of complex medical patients before and after surgery?
   6.3. Are the recommendations realistic? Have you seen examples of unrealistic recommendations?
   6.4. Are the recommendations easy to find and understand? To implement?
   6.5. Do you have enough time/energy to read and implement the PAC notes? Are notes too short/too long?
   6.6. Other strengths and weaknesses of the note? Any suggestions or requests?
7. In the absence of the note…
   7.1. Should surgeons be able to manage patients with comorbidities/complex medical illnesses w/o help from internists? PROMPTS: blood sugar levels, etc
      7.1.1. What targets would you be aiming for (specifically)/when would you worry?
   7.1.1. When would you use the internal med consult service? What's your threshold for reaching out to internal med?
   7.2. How confident would you be in such medical management? Areas that you do or do not need help or recommendations?
   7.3. What things would you be most/least worried about in managing comorbidities/medically complex patients?
8. How do you think your peers use and view the note?
   8.1. Is there a common expectation about how the note will be read and implemented?
   8.2. Do you feel any pressure to implement the PAC recommendations because they were made by a colleague? Peer pressure?
   8.3. Would you say there is a common opinion or feeling about the PAC note system amongst your colleagues?
Appendix B: PAC Note Surgeon & Nurse Practitioner Interview Guide –March 5, 2020

1. Tell us a little bit about yourself! Your role, experience, specialty?

2. How often do you encounter the PAC note?
   2.1. When/how were you first introduced to it? By whom/what setting? (As a resident, other staff, what context, etc?)

3. Can you describe your workflow when planning a surgery for me? [I.E. patient comorbidities, post-op care, entering medications, etc] [Medical planning; meeting patient; medical records, netcare/chart, etc]
   3.1. [At what point(s)] Are you accessing/referring to the PAC note?
      3.1.1. Which team member(s)?
         3.1.1.1. Who looks at/records/orders contents of PAC recommendations?
         3.1.1.1. How often would you review the patient orders after they are entered by a resident?
         3.1.1.1. Whose job is it to review note, put in medications, etc? Whose job do you think it should be?
      3.1.1. In what forms do you review the PAC note? (paper chart, netcare, etc?)
      3.1.1. How do you know which patients have Internal Medicine recommendations? Is it clear why you would or would not send a person to PAC?
         3.1.1.1. Do you always know when one of your patients has been sent to PAC, or are you sometimes surprised to see that they have been to PAC?

3.2. Is there a process to ensure that the recommendations are implemented?
   3.2.1. Do you double check? When would you return to the note?
      3.2.1.1. After surgery? If there are symptoms (chest pain, blood sugar?). An unrecognized medication? An emergency?

4. How valuable are the contents of the note to you?
   4.1. What is your process of going over the note? What parts, what are you looking for, etc? Are there areas that are more/less helpful? (i.e. past medical history, medications, review of systems, physical exam, investigations, impression, and plan.)
   4.2. Do you have any thoughts about the evidence base the recommendations draw on? For instance, regarding diabetes management, anticoagulant management?
   4.2.1. Do they differ from recommendations in your field/specialty? How do you navigate the differences? (do you know if the recommendations conflict?)

5. Is the note one of the resources you would return to in complicated situations?
   5.1. Is it important to implement recommendations completely? What factors might change how you would implement recommendations?

6. Do you feel that…
   6.1. Are recommendations made by internists in preadmission clinic notes adaptable for changing patient status?
   6.2. Do you think internists who work in PAC understand enough about surgery to make useful recommendations for management of complex medical patients before and after surgery?
   6.3. Are the recommendations realistic? Have you seen examples of unrealistic recommendations?
   6.4. Are the recommendations easy to find and understand? To implement?
   6.5. Do you have enough time/energy to read and implement the PAC notes? Are notes too short/too long?
   6.6. Other strengths and weaknesses of the note? Any suggestions or requests?

7. In the absence of the note…
   7.1. To what degree should surgeons be able to manage patients with comorbidities/complex medical illnesses w/o help from internists? PROMPTS: blood sugar levels, etc
      7.1.1. What targets would you be aiming for (specifically)/when would you worry?
      7.1.1. When would you use the internal med consult service? What’s your threshold for reaching out to internal med?
   7.2. How confident would you be in such medical management? Areas that you do or do not need help or recommendations?
   7.3. What things would you be most/least worried about in managing comorbidities/medically complex patients?

8. How do you think your peers use and view the note?
   8.1. Is there a common expectation about how the note will be read and implemented?
   8.2. Do you feel any pressure to implement the PAC recommendations because they were made by a colleague? Peer pressure?
   8.3. Would you say there is a common opinion or feeling about the PAC note system amongst your colleagues?
Appendix C: PAC Note Internist Interview Guide – Feb 27, 2020

1. Tell us a little bit about yourself! Your role, experience, specialties?
2. Can you describe your workflow when dictating the PAC note for me? [I.E. things you would include for everyone, how your plan the note]
   a. Do you have certain things you focus on for before surgery in most patients?
   b. Do you have certain things you focus on for after surgery in most patients?
3. Who is the intended audience for your note? [who reads it? Multiple people?]
   a. Who looks at/records/orders contents of PAC recommendations?
   b. Who is usually responsible for implementing or not implementing the recommendations that you make in a PAC note?
   c. Who is most responsible for implementing or not implementing the recommendations that you make in a PAC note?
4. Is there any process (in Internal Medicine/Surgery) to ensure that the recommendations are implemented?
   a. If you recommend something in the PAC note that you feel is very important, do you check to ensure that it is implemented?
   b. Do you think the surgical team has a process?
5. What aspects of the PAC note do you feel are most helpful? [to patients, to surgeons, to family doctors…]
   a. Are there areas that are more/less helpful? (i.e. past medical history, medications, review of systems, physical exam, investigations, impression, and plan.)
   b. Are there medical comorbidities that are more/less important to provide recommendations on? (i.e. diabetes, anti-coagulation, DVT prophylaxis, troponins, etc)
6. Have you encountered differences in the evidence base/guidelines between internal medicine and surgery? For instance, regarding diabetes management, anticoagulant management?
   a. Do you try to highlight guidelines as part of your recommendations? [for anti-coagulation management, for diabetes, for troponins?]
   b. Encountered resistance/pushback on anything?
   c. Controversial items?
7. Is it possible/realistic to provide recommendations for management of patients after surgery?
   a. Is the post-operative period too complex to make recommendations about diabetes or anti-coagulation management in the PAC note?
   b. Should internists working in PAC be making recommendations about management of diabetes after surgery? [why. Why not?] 
   c. Do you think your peers working in PAC make recommendations about management of anticoagulation after surgery? [why don't they,]
   d. Should internists working in PAC be making recommendations about management of anti-coagulation after surgery? [why. Why not?]
      i. Do you think your peers working in PAC make recommendations about management of diabetes after surgery? [why don't they,]
8. Is it important that the surgical teams implement your recommendations completely?
   a. Is it possible to provide a range of recommendations, or is it too complex?
9. Are recommendations made by internists in preadmission clinic notes adaptable for changing patient status? 
   a. Do you ever feel that your knowledge of surgery and post-operative care limits your ability to make recommendations that are appropriate for post-operative care? [anti-coagulation, diabetes…]
10. Does the surgical team know enough about medicine to manage medical issues in the post-operative period? [diabetes, anti-coagulation]
   a. What medical issues should surgeons be able to manage, and what issues require an internist?
   b. Do surgeons try to manage too much on their own, without help from specialists?
11. What barriers do you think the surgical team experiences in implementing our recommendations?
   a. Do you have strategies or techniques to reduce these barriers?
12. What would you say the general feeling is about the PAC note system amongst your colleagues?
   a. Is there a common expectation about how the note will be read and implemented?
# Appendix D: Final Codebook

<table>
<thead>
<tr>
<th>Domain</th>
<th>Definition</th>
<th>Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. PAC Note Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Source</td>
<td>Perception of key stakeholders about whether the intervention is externally or internally developed.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Evidence Strength &amp; Quality</td>
<td>Stakeholders’ perceptions of the quality and validity of evidence supporting the belief that the intervention will have desired outcomes.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Value Added (previously: Relative Advantage)</td>
<td>Stakeholders’ perception of the advantage of implementing the intervention versus an alternative solution.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Adaptability</td>
<td>The degree to which an intervention can be adapted, tailored, refined, or reinvented to meet local needs.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Complexity</td>
<td>Perceived difficulty of implementation, reflected by duration, scope, radicalness, disruptiveness, centrality, and intricacy and number of steps required to implement.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Design Quality &amp; Packaging</td>
<td>Perceived excellence in how the intervention is bundled, presented, and assembled. Ease of use, User Interface (netcare, paper chart, etc)</td>
<td>CFIR</td>
</tr>
<tr>
<td><strong>2. ENVIRONMENTAL CONTEXT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural Characteristics</td>
<td>The social architecture, age, maturity, and size of an organization.</td>
<td></td>
</tr>
<tr>
<td>Networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External networks</td>
<td>Communication and understanding of relationship between different services at foothills. I.E. Outpatient to Inpatient, Internal med &amp; surgical service, etc</td>
<td>CFIR</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>Social networks and formal/informal communication within a surgical service or unit at Foothills</td>
<td>CFIR</td>
</tr>
<tr>
<td>Patient Needs &amp; Resources</td>
<td>The extent to which patient needs, as well as barriers and facilitators to meet those needs, are accurately known and prioritized by the organization.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Relative Priority</td>
<td>Individuals’ shared perception of the importance of the implementation within the organization.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Available Resources</td>
<td>The level of resources dedicated for implementation and on-going operations, including money, training, education, physical space, and time.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Access to Knowledge &amp; Information</td>
<td>Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks.</td>
<td>CFIR</td>
</tr>
<tr>
<td>Reinforcement</td>
<td>Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus. Rewards, Incentives, Punishment, Consequences, Reinforcement, Contingencies, Sanctions</td>
<td>TDF</td>
</tr>
<tr>
<td><strong>3. SOCIAL CONTEXT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Influences/Culture</td>
<td>Group identity; Social pressure; Social norms; Group conformity; Social comparisons; Social support; Power; Conflict; Alienation</td>
<td>TDF / CFIR</td>
</tr>
<tr>
<td>Peer Pressure</td>
<td>Mimetic or competitive pressure to implement an intervention; typically because most or other key peer or competing organizations have already implemented or are in a bid for a competitive edge.</td>
<td>CFIR</td>
</tr>
<tr>
<td><strong>4. CHARACTERISTICS OF INDIVIDUALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>An awareness of the existence of something. Individuals’ attitudes toward and value placed on the intervention as well as familiarity with facts, truths, and principles related to the intervention. Knowledge (including knowledge of condition/scientific rationale); Procedural knowledge; Knowledge of task environment; Schemas + mindsets + illness representations; Procedural knowledge</td>
<td>CFIR / TDF</td>
</tr>
<tr>
<td>Skills</td>
<td>An ability or proficiency acquired through practice. Skills, Skills development, Competence, Ability, Interpersonal skills, Practice, Skill assessment</td>
<td>TDF</td>
</tr>
<tr>
<td>Social/professional role and identity</td>
<td>A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting. Professional identity; Professional role; Social identity; Identity; Professional boundaries; Professional confidence; Group identity; Leadership; Organisational commitment</td>
<td>TDF</td>
</tr>
</tbody>
</table>
### Domain Definition Framework

<table>
<thead>
<tr>
<th>Domain</th>
<th>Definition</th>
<th>Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beliefs about capabilities</td>
<td>Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use. Self-confidence; Perceived competence; Self-efficacy; Beliefs; Self-esteem; Empowerment; Professional confidence</td>
<td>TDF</td>
</tr>
<tr>
<td>Beliefs about consequences</td>
<td>Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation. Beliefs; Outcome expectancies; Characteristics of outcome expectancies; Anticipated regret; Consequences; Appraisal/evaluation/review; Salient events/sensitisation/critical incidents</td>
<td>TDF</td>
</tr>
<tr>
<td>Motivation and goals</td>
<td>Mental representations of outcomes or end states that an individual wants to achieve. Goals (distal/proximal); Goal priority Goal/target setting; Goals (autonomous/controlled); Action planning; Implementation intention; Intention; stability of intention/certainty of intention</td>
<td>TDF</td>
</tr>
<tr>
<td>Memory, attention and decision processes</td>
<td>The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives. Memory; Attention; Attention control; Decision making; Cognitive overload/tiredness</td>
<td>TDF</td>
</tr>
<tr>
<td>Emotion</td>
<td>A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event. Fear; Anxiety; Affect; Stress; Depression; Positive/negative affect; Burn-out</td>
<td>TDF</td>
</tr>
<tr>
<td>Behavioural Regulation</td>
<td>Workflow; anything aimed at managing or changing objectively observed or measured actions; Behaviour that is automatic, conditioned, not consciously recognized, etc. Self-monitoring; Breaking habit; Action planning; Routine/automatic/habit; Direct experience/past behaviour; Representation of tasks; Stages of change model</td>
<td>TDF</td>
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</tbody>
</table>

### 5. INDUCTIVE CODES

<table>
<thead>
<tr>
<th>Specific Medical Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-Coagulation</td>
</tr>
<tr>
<td>Diabetes</td>
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<tr>
<td>DVT</td>
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<tr>
<td>Fitness for surgery</td>
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<tr>
<td>Troponin Monitoring</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Estimation</th>
<th>Processes by which risk of various treatment pathways is estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose of PAC recommendations (philosophy of note)</td>
<td>Individual perspectives on the role of the PAC recommendations and how they ought to operate</td>
</tr>
<tr>
<td>Communication Pathways</td>
<td>Ways in which different units or entities within the hospital do or do not communicate; flows of information; communication breakdowns</td>
</tr>
<tr>
<td>Suggestions</td>
<td>Suggestions to improve usefulness of PAC recommendations or recommendation process</td>
</tr>
<tr>
<td>Critiques</td>
<td>Identification of problems with the PAC note recommendations or process</td>
</tr>
</tbody>
</table>