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3 **Facilitators and Barriers to Adopting a Restrictive Red Blood Cell Transfusion Practice:**  
4 **A Survey of Intensive Care Physicians**  
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## ABSTRACT

**Background:** To explore the perceptions of red blood cell transfusion (RBC) practices among intensive care physicians and to determine facilitators and/or barriers to practicing a restrictive transfusion strategy using the theoretical domains framework (TDF).

**Methods:** An online population-based, cross-sectional survey of intensive care physicians in one healthcare system was completed. Survey questions were based on key theoretical domains of the TDF and pre- and pilot-testing were completed. Descriptive statistics (demographic and Likert scale data) and conventional content analysis (open-ended responses) were conducted.

**Results:** Forty-two intensive care physicians completed the survey (56% response rate). Respondents' knowledge of published evidence, use of guidelines, improved outcomes, physician autonomy, and perceived culture of acceptance and collegial support were identified as facilitators to practicing a restrictive transfusion strategy. Identified barriers included potential impact on and cost to other clinical goals, conflicting practices and beliefs of physicians in other clinical specialties, deficits in medical trainees' skills and knowledge, and attitudinal barriers related to denial.

**Interpretation:** Nine key, self-reported facilitators and barriers to intensive care physicians' transfusion behaviour using the TDF were identified. Understanding these determinants will inform development and implementation of interventions to encourage optimal use of RBC transfusion practices for stable, non-bleeding hospitalized patients.

## INTRODUCTION

Allogeneic red blood cell (RBC) transfusions are common medical procedures used to treat anemia among hospitalized patients.<sup>1,2</sup> Guidelines in clinical settings such as the intensive care unit (ICU) recommend RBC transfusions for most stable, non-hemorrhagic patients with a hemoglobin concentration below 70 g/L; above this restrictive threshold, RBC transfusions may be clinically inappropriate.<sup>3</sup> Despite these evidence-based recommendations, observational studies continue to report variation and sub-optimal RBC transfusions practices worldwide.<sup>4,5</sup>

Variations in clinical practice may indicate that guidelines alone are insufficient for promoting and sustaining restrictive RBC transfusions among physicians; still it remains unclear why deviations from recommended best practice continue to persist and what can be done to support behavior change? Previous studies investigating clinical behaviour change suggest that determinants at both the individual and institutional levels underlie physician behaviours.<sup>6</sup> Theory-based approaches are being increasingly used to investigate behavioural determinants in various clinical practices as a lens to understand mechanisms and/or mediators for change.<sup>7-9</sup>

In two parallel studies exploring determinants of physician transfusion practices, the theoretical domains framework (TDF) was used to guide and examine qualitative findings from interviews with 28 intensive care and neonatology physicians in Canada and the United Kingdom.<sup>10,11</sup> The TDF is a validated tool, composed of 14 theoretically-derived domains, used to assess healthcare professionals' behaviours and inform development of techniques for behaviour change.<sup>6,12,13</sup> For local contexts seeking to promote restrictive RBC transfusion practice, the TDF offers a reproducible means to understand facilitators and barriers, and to tailor interventional techniques.

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3 The objectives of this study are, therefore, to explore the perceptions of RBC transfusion  
4 practices among intensive care physicians and to determine the key facilitators and barriers to  
5 practicing restrictive RBC transfusion strategy using the TDF.  
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## 11 12 **METHODS**

### 13 14 *Study Design and Target Population*

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17 A population-based, cross-sectional survey of all intensive care physicians in the  
18 province of Alberta, Canada was completed. Eligible participants were identified through the  
19 Intensive Care Section of the Alberta Medical Association and the Alberta Health Services  
20 Critical Care Strategic Clinical Network, both of whom maintain lists of intensive care  
21 physicians practicing in the province (an estimated 75 intensivists).  
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### 28 29 *Ethical Approval*

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31 Research ethics approval was obtained from the Conjoint Health Research Ethics Board  
32 (CHREB) of the University of Calgary (Ethics ID: REB17-0307).  
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### 35 36 *Survey Development*

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38 A literature review of studies exploring facilitators and barriers to transfusion behaviour  
39 informed questionnaire item development. Among identified studies, the TDF was used to  
40 identify relevant behavioural determinants within the theoretical domains of knowledge,  
41 social/professional role and identity, beliefs about capabilities, beliefs about consequences,  
42 motivation and goals, and social influences.<sup>11,14</sup> Questionnaire items were then developed to  
43 explore facilitators or barriers to practicing a restrictive RBC transfusion practice within these 6  
44 domains. The final survey questions were designed to ensure a) sufficient and non-redundant  
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3 representation of items,<sup>15</sup> and b) relevance to the care of the ICU context. Response options  
4 included a combination of 5-level Likert scale, open-ended text, and multiple choice.  
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### 7 8 *Survey Pilot Testing* 9

10 A convenience sample of 6 intensive care physicians evaluated the survey for clinical  
11 sensibility, face validity, and content validity.<sup>15</sup> Each reviewer was asked to assess the relevance  
12 and quality of each item, to identify unnecessary or ambiguous questions (including clarity,  
13 relevance, flow, and wording),<sup>15</sup> and to report the length of time required to complete the  
14 questionnaire. After 2-weeks, reviewers were asked to complete the survey again to assess test-  
15 retest reliability. Given that the study objective was to elucidate the facilitators and barriers to  
16 adopting a change in transfusion practice, rather than to compute a score or index, the stability or  
17 the extent to which a measure is reproducible was important.<sup>15</sup>  
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### 20 21 22 23 24 25 26 27 28 *Survey Instrument* 29

30 The final survey was composed of 13 questions (presented over 7 online screens; see  
31 description of survey administration) designed to understand potential determinants to physicians  
32 practicing a restrictive RBC transfusion strategy (i.e., restrictive hemoglobin threshold of 70g/L)  
33 (Box 1). Information concerning respondents' primary location of practice, number years  
34 practicing in critical care, primary specialization leading to critical care, and experience treating  
35 the relevant patient population were also assessed. Limited demographic information was  
36 collected to decrease the likelihood of individual respondent identification.  
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### 46 47 *Survey Administration* 48

49 The survey was administered online using services from Survey Monkey<sup>16</sup> between July  
50 27, 2017 and October 6, 2017. Email invitations to participate in the study were sent directly  
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3 Strategic Clinical Network to all eligible participants on their mailing lists. No physician contact  
4 information was shared with the research team. The invitation email included a personalized  
5 message informing participants of the purpose of the study, estimated time to complete the  
6 questionnaire, description of implied consent upon survey completion, data storage and  
7 confidentiality agreement, and link to the open online survey. Two reminder emails were sent  
8 within 3-week intervals after the original invitation.  
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17 Potential participants were informed that the survey was voluntary and was designed to  
18 understand barriers and facilitators in aggregate rather than at the individual-level; therefore, this  
19 research is not intended to evaluate individual participants' knowledge or competence.<sup>17</sup>  
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22 Completion of all survey questions, excluding those regarding demographic information, was  
23 required to submit the survey. In addition, participants were able to review and change answers  
24 (i.e., through back buttons) prior to submission. The Survey Monkey platform tracked potential  
25 duplicate entries through IP addresses of computers used to access the survey, with no more than  
26 1 entry ever permitted from a single address.<sup>16</sup> However, survey responses were anonymous: IP  
27 information was not available to the research team and no connections were made between  
28 respondent data and IP addresses.  
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#### 39 *Data Analysis*

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42 Responses from completed surveys were analyzed using descriptive statistics. For  
43 questions with Likert scale response options, the proportions of responses within each response  
44 category (i.e., strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree)  
45 were depicted graphically and organized by theoretical domain. Open-ended responses were  
46 analyzed using conventional qualitative content analysis to identify key themes for why  
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3 respondents perceived their ICU contexts to be (or not be) amenable to practicing a restrictive  
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5 transfusion strategy.  
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## 10 **RESULTS**

### 11 *Characteristics of Survey Respondents*

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14 Forty-two eligible intensive care physicians completed the survey (56% response rate).  
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16 Most respondents identified a large urban hospital as their primary location of practice (54.7%;  
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18 n=21 of 39 respondents), had over 15 years of experience practicing in critical care (56.1%; n=23  
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20 of 41 respondents), and reported medicine as the clinical specialty that led them to critical care  
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22 medicine (60.0%; n=24 of 40 respondents) (Table 1). The majority also reported that they  
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24 commonly encounter patients with borderline hemoglobin levels (between 70 and 90 g/L) for  
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26 whom a restrictive transfusion strategy could apply (88.1% strongly agree; 9.5% agree).  
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### 31 *Determinants to practicing a restrictive RBC transfusion strategy*

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33 A summary of responses to the Likert scale survey questions evaluating facilitators and  
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35 barriers to practice change (Q1 to Q13), grouped by theoretical domains of the TDF, is provided  
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37 in Figure 1.  
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#### 40 *Identified facilitators*

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42 Two major facilitators were respondents' knowledge of the evidence in support of  
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44 restrictive RBC transfusions and use of transfusion guidelines. Almost all respondents reported  
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46 being aware of the evidence (87.8% strongly agree; 9.8% agree) and over 90% reported that it  
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48 was strong and sufficient (Q1 and Q2). Most respondents reported using the evidence to guide  
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50 their practice (73.8% strongly agree; 23.8% agree) (Q3). Moreover, 86% of respondents felt that  
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52 guidelines are important to the quality of care and over 75% did not feel constrained by  
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3 transfusion guidelines (Q4). Respondents' perceptions that a restrictive transfusion practice  
4 would lead to improvements in both patient and health system outcomes were also identified as  
5 key facilitators. Ninety-five percent of respondents agreed that a restrictive RBC transfusion  
6 strategy could reduce the risk of patient harm, reduce costs, and save resources in the ICU  
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8 (45.2% agreed; 45.2% strongly agreed) (Q11 and Q12).  
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15 Most respondents' reported that their ICUs were amenable to practicing a restrictive RBC  
16 transfusion strategy (50% agreed and 35.7% strongly agreed). Based on open-ended text  
17 elaboration of these responses, two facilitators centered on the dynamics between healthcare  
18 providers within the ICU were identified (Table 2). These included physician autonomy with  
19 regards to clinical decision-making and a culture of acceptance (i.e., of restrictive RBC  
20 transfusion strategy) and collegial support. As described by one respondent: "*The md group has*  
21 *pretty consistent practices so if [an] approach is adopted it tends to be followed*" [R40].  
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31 Other facilitators described by respondents included implementation of strategies and  
32 approaches to encourage uptake of a restrictive transfusion strategy, including the use of  
33 transfusion practice guidelines as well as a multidisciplinary approach to healthcare provider  
34 education. One respondent remarked that: "*Multidisciplinary education surrounding guidelines*  
35 *for transfusion have diminished requests for transfusion when not indicated*" [R6] (Table 2).  
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### 43 *Identified barriers*

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45 For a smaller proportion of respondents, the potential impacts on other areas of practice  
46 or goals were identified as barriers to practicing a restrictive transfusion strategy. Twelve percent  
47 of respondents agreed that adopting a restrictive RBC transfusion strategy could come at the cost  
48 of other clinical and/or patient goals (e.g., slowing time to recovery or discharge from the ICU),  
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55 21.4% neither agreed nor disagreed.  
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3           Approximately 14% of respondents did not perceive or were indifferent to whether their  
4 ICU was amenable to practicing a restrictive transfusion strategy (Q13). Thematic analysis of  
5 open-ended responses elaborating on these responses identified 3 additional barriers (Table 2).  
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7 The first related to a perceived conflict between ICU healthcare providers and other clinical  
8 specialties with regards to the appropriateness of RBC transfusions. One respondent remarked of  
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10 “No significant barriers among intensivists, but consulting services at times at odds” [R29].  
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17           Another barrier related to the nascent skills and knowledge of medical trainees and how  
18 this may hinder their ability to consistently adhere to a restrictive transfusion practice. Such  
19 issues were perceived to occur predominantly during evening shifts, as noted by one respondent  
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21 “Our ICU is staffed by residents at night and they don't always adhere to restrictive transfusion  
22 strategies” [R12].  
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29           A final attitudinal barrier that emerged was the perception that inappropriate RBC  
30 transfusion practices did not occur and, as such, there were no issues to address. This barrier was  
31 exemplified by one respondent who commented that “This [is] really NOT a problem, so why  
32 bother expanding on an answer to a question that did not need to be asked?” [R11] (Table 2).  
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### 38 *Non-influential Domains*

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41           Determinants to practicing a restrictive transfusion practice were not identified in the  
42 social influences domain. Roughly half reported that they were not influenced by or were  
43 indifferent to their ICU physician colleagues with respect to RBC transfusion practices (Q8)  
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45 (Figure 1). Approximately 69% disagreed or strongly disagreed that their patients’ families  
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47 influence their RBC transfusion practice and 14.3% neither agreed nor disagreed (Q10).  
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## 55 **INTERPRETATION**

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3 This study reports on how intensive care physicians perceive current RBC transfusion  
4 practices in the ICU as well as the factors that influence restrictive RBC transfusion practices for  
5 stable, non-bleeding adult ICU patients. Among key facilitators identified included respondents'  
6 perceived knowledge of the evidence in support of a restrictive RBC transfusion strategy,  
7 reported use of transfusion guidelines, potential improvements in patient and system outcomes,  
8 physician autonomy, and a perceived culture of acceptance and collegial support in the ICU.  
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10 Factors impeding restrictive transfusion practices included the potential impact on and cost to  
11 other clinical goals, conflicting practices and beliefs of physicians in other clinical specialties,  
12 deficiencies in residents' skills and knowledge, and attitudinal barriers related to perceived  
13 optimism of practice.  
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27 To our knowledge, this is the first population-based, cross-sectional survey of intensive  
28 care physicians' transfusion behaviours using the TDF. We found that key determinants to  
29 practicing a restrictive RBC transfusion strategy in 5 out of the 6 TDF domains explored. The  
30 social influences domain was not deemed relevant, as most respondents reported that neither  
31 their physician colleagues nor patients' families influenced their transfusion decisions. The lack  
32 of social influences for this behaviour may not be surprising given the reported autonomy for  
33 clinical decision-making and collegial support for such autonomy. Interestingly, when  
34 respondents did not feel that their ICUs were amenable to practicing restrictive transfusions,  
35 conflicts with healthcare providers in clinical specialties outside of the ICU (e.g., surgery) were  
36 described. This highlights a potential barrier to implementing evidence-based transfusion  
37 recommendations given the interdisciplinary nature of care in the ICU. While RBC transfusion  
38 thresholds have been well studied in several patient populations, including the critically ill,  
39 evidence of efficacy and/or safety of restrictive transfusions has not been demonstrated in all  
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3 hospital contexts and patient subpopulations.<sup>3</sup> Therefore, when hospitalized patients receive care  
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5 from varying provider groups,<sup>18</sup> differences in inter-specialty practice patterns may arise.  
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8 One barrier identified from one respondent was the disbelief of variability in RBC  
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10 transfusion practices in their ICU and that exploration into this area was unwarranted. These  
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12 findings may represent a significant attitudinal barrier to practice change, particularly if  
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14 expressed by physicians in an influential or leadership role. Conversely, one of the most  
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16 prevalent barriers identified from the open-ended responses related to the nascent knowledge and  
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18 skills of medical trainees. This echoes findings from a survey study by Kasraian *et al.* (2014) that  
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20 reported of insufficient knowledge and training in transfusion medicine among medical  
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22 residents.<sup>19</sup> Taken together, such observations may indicate broader deficiencies in medical  
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24 education with respect to transfusion practices and opportunities for further transfusion medicine  
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26 training at the medical school level.<sup>19</sup>  
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### 31 *Implications for Policy and Practice*

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34 Relative to previous survey studies that have explored physician perceptions of their  
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36 transfusion practices,<sup>20,21</sup> the use of the TDF was a particular unique strength to our study. We  
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38 are able employ a tailored, theory-based approach to link the identified facilitators and barriers to  
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40 relevant techniques for behaviour change.<sup>6,9,13</sup> For example, facilitators identified in the beliefs  
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42 about consequences domain (i.e., restrictive transfusions perceived to improve patient and health  
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44 system outcomes), behaviour change may be promoted through personal feedback of  
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46 performance, persuasive communication, and social processes of encouragement, pressure and  
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48 support.<sup>13</sup> Similarly, techniques that involve rewards and incentives, rehearsal of the behaviour,  
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50 and modelling/demonstration of the behaviour by others may help overcome the barriers related  
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52 to medical trainees.<sup>13</sup>  
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### *Study Limitations*

We were unable to determine the true denominator of eligible intensive care physicians in our population; instead, we had to assume that all eligible intensive care physicians were on either of the provincial mailing lists we were able to access. By extending invitations to those on both lists, we anticipate that our approach captured the majority of intensive care physicians in the province. Also, we did not pursue other recruitment methods, such as through conventional paper mail or fax, due to limited study resources. This may have led to selection bias through under-coverage or voluntary response bias.<sup>22,23</sup> Non-response bias may have also been introduced.<sup>24</sup> However, the observed response rate was 56% and is considered reasonable for surveys administered electronically.<sup>15</sup> It would have been ideal to compare the demographics of respondents and non-respondents; unfortunately, this was not possible as we were unable to collect information for the latter. Lastly, the cross-sectional nature of the study only permitted us to understand physician perceptions at one point in time. Given that the findings will inform design of behaviour change techniques, it is important to acknowledge that physician perceptions could evolve over time.

### **CONCLUSIONS**

The results of this survey study identified key facilitators and/or barriers to adopting a restrictive RBC transfusion practice among intensive care physicians. However, we hypothesize that a number of behavioural determinants could be shared across different medical specialties. This theory-based, methodological approach for soliciting behavioural determinants to transfusion behaviours may also apply broadly in other clinical contexts. Ultimately, the key determinants identified in this study will be mapped to feasible and acceptable behavior change

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techniques that may be implemented to ensure sustainable uptake of restrictive RBC transfusions practices.

Confidential

**Authors' contributions:**

Design of the study (LJJS, TWN, HTS, DAZ, FMC); management of data (LJJS, FMC), analysis of data (LJJS); interpretation of the data (LJJS, TWN, HTS, DAZ, FMC); preparation of manuscript (LJJS, FMC); review of manuscript (LJJS, TWN, HTS, DAZ, FMC); approval of final manuscript (LJJS, TWN, HTS, DAZ, FMC).

**Funding:**

LJJS is supported by an Alberta Innovates-Health Solutions (AIHS) Graduate Studentship Award (Record Number: 201500076). This research received no other grants from any funding agencies in the public, commercial, or not-for-profit sectors.

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Confidential

**Box 1. Final Survey Questions**

Select one of the following responses for each question:

a) Strongly agree; b) Agree; c) Neither agree nor disagree; d) Disagree; e) Strongly disagree.

**KNOWLEDGE**

1. I am aware of the evidence in support of a restrictive RBC transfusion strategy for hemodynamically stable non-bleeding adult patients in the ICU
2. The evidence base in support of a restrictive RBC transfusion strategy for hemodynamically stable non-bleeding adult patients is strong and sufficient
3. Evidence in support of a restrictive RBC transfusion strategy guides my approach to RBC transfusions

**SOCIAL/PROFESSIONAL ROLE & IDENTITY**

4. In general, adhering to guidelines is important to the quality of care I deliver
5. I feel constrained by the recommendations in transfusion guidelines

**MOTIVATION AND GOALS**

6. Adopting a restrictive RBC transfusion strategy can come at the cost of other goals or improving other patient outcomes (e.g. slowing time to recovery or discharge)
7. A restrictive RBC transfusion strategy is important to my clinical practice

**SOCIAL INFLUENCES**

8. I am influenced by my physician colleagues with respect to RBC transfusion practices
9. In our ICU, my physician colleagues and I tend to practice in a similar fashion and make decisions that are consistent with the general way of agreement
10. Patients' families have an influence on my RBC transfusion practice

**BELIEFS ABOUT CONSEQUENCES**

11. A restrictive RBC transfusion strategy can reduce the risk of harm (e.g. transfusion-related reactions or infections) to the patient
12. A restrictive RBC transfusion strategy can reduce costs and save resources in the ICU

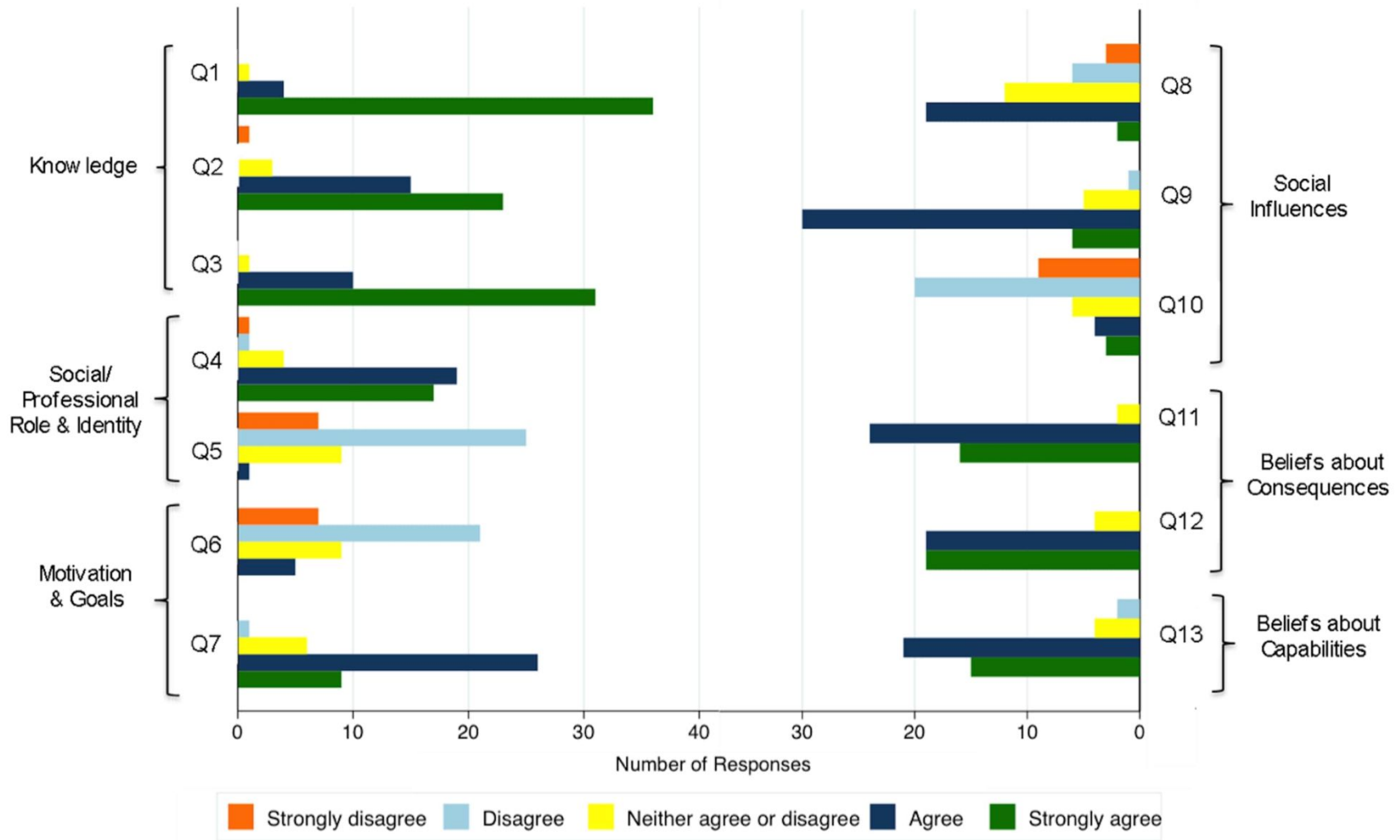
**BELIEFS ABOUT CAPABILITIES**

13. The conditions in my ICU are amenable to practicing a restrictive RBC transfusion strategy
14. Please elaborate on your response to question 13: \_\_\_\_\_

**Table 1.** Characteristics of Survey Respondents

<b>Characteristic</b>	<b>Frequency</b>
<b>Total Respondents</b>	42
<b>Primary Location of Practice, n=39 (%)</b>	
Teaching Hospital	18 (45.3)
Large Urban Hospital	21 (54.7)
<b>Years Practicing in Critical Care, n=41 (%)</b>	
0-5 years	2 (4.9)
5-10 years	7 (17.1)
10-15 years	9 (21.9)
≥ 15 years	23 (56.1)
<b>Clinical Specialty Leading to Critical Care, n=40 (%)</b>	
Medicine	24 (60.0)
Surgery	6 (15.0)
Anaesthesia	5 (12.5)
Other	5 (12.5)
<b>Commonly encounter patients with borderline hemoglobin levels (i.e., between 70 and 90 g/L), n=42 (%)</b>	
Strongly agree	37 (88.1)
Agree	4 (9.5)
Neither agree nor disagree	1 (2.4)
Disagree	0
Strongly disagree	0

**Figure 1.** Summary of Likert Scale Survey Responses



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**Table 2.** Thematic analysis of respondents’ open-ended text responses elaborating on amenability of ICU to practicing a restrictive transfusion strategy

Themes	Sample Quote
<b>Facilitators</b>	
• Physician autonomy	<i>“There is relative freedom in decision-making” [R5]</i>
• Culture of acceptance and collegial support	<i>“The md group has pretty consistent practices so if [an] approach adopted it tends to be followed” [R40]</i> <i>“Culture that accepts restrictive transfusion strategy” [R15]</i>
• Multidisciplinary approach to education	<i>“Multidisciplinary education surrounding guidelines for transfusion have diminished requests for transfusion when not indicated” [R6]</i>
• Use of clinical guidelines	<i>“We have a local guideline supporting restrictive RBC transfusion practices” [R26]</i>
<b>Barriers</b>	
• Conflict between clinical specialties	<i>“No significant barriers among Intensivists but consulting services at time at odds” [R29]</i>
• Knowledge and skills of medical trainees	<i>“Our ICU is staffed by residents at night and they don't always adhere to restrictive transfusion strategies” [R12]</i>
• Perceived non-issue	<i>“This [is] really NOT a problem, so why bother expanding on an answer to a question that did not need to be asked?” [R11]</i>