RESEARCH

Factors influencing decisions by critical care physicians to withdraw life-sustaining treatments in critically ill adult patients with severe traumatic brain injury

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ABSTRACT

BACKGROUND: Most deaths in critically ill patients with severe traumatic brain injury are associated with a decision to withdraw life-sustaining treatments. We aimed to identify the behavioural determinants that influence recommendations by critical care physicians to consider the withdrawal of life-sustaining treatments in this population.

METHODS: We conducted a descriptive qualitative study based on the Theoretical Domains Framework of critical care physicians caring for patients with severe traumatic brain injury across Canada. We stratified critical care physicians by regions and used a purposive sampling strategy. We conducted semistructured phone interviews using a piloted and pre-tested interview guide. We transcribed the interviews verbatim and verified the content for accuracy. We performed the analysis using a 3-step approach: coding, generation of specific beliefs and generation of specific themes.

RESULTS: We recruited 20 critical care physicians across 4 geographic regions. After reaching saturation, we identified 7 core themes across 4 Theoretical Domains Framework domains for factors relevant to the decision to withdraw life-sustaining treatments. Four factors (i.e., clinical triggers, social triggers, interaction with families and intentions with medical decisions) were identified before the decision is made and 3 were identified during the decision-making process (i.e., considerations, priorities and knowledge needs). We identified multiple themes reflecting internal (n = 18, 8 Theoretical Domains Framework domains) and external (n = 15, 6 Theoretical Domains Framework domains) influences on the decision to withdraw life-sustaining treatments.

INTERPRETATION: We identified several core themes and domains considered by critical care physicians in Canada in the decision to withdraw life-sustaining treatments in critically ill patients with severe traumatic brain injury. Future research should aim at identifying the factors influencing surrogate decision-makers in the decision to withdraw life-sustaining treatments in these patients.

Severe traumatic brain injury is a major public health issue, and the leading cause of death and disability among people under 45 years of age.[1] Mortality rates remain high, and a substantial proportion of survivors have severe neurologic sequelae despite improved patient management and the development of evidence-based practice guidelines.[2–4] Data correlating early assessments and neurologic prognosis in this patient population are scarce, of limited clinical usefulness and variable among physicians.[2,3,5] In the absence of conclusive evidence supporting the available prognostic models, families and medical teams are faced with making life-altering, level-of-care decisions in these patients that may include the withdrawal of life-sustaining

treatments. The consequences of these decisions for the lives of patients and families are immeasurable. Concerns have been raised over the years about clinicians making decisions about withdrawal of life-sustaining treatments in the absence of appropriate prognostic information in previously healthy patients.[6–8]

We previously documented a significant variation in mortality following severe traumatic brain injury across trauma centres in Canada, including marked variation associated with the decision to withdraw life-sustaining treatments.[9] Moreover, of all deaths after withdrawal of life-sustaining treatments following traumatic brain injury, half occurred during the first 3 days of care, which many physicians consider to be premature for making such decisions.[5,9] Although critical care physicians commonly lead end-of-life discussions with caregivers based on perceived prognosis, clinicians often disagree when evaluating the prognosis of critically ill patients.[5]

Little is known about factors influencing the evaluation of prognosis and the shared decision to withdraw life-sustaining treatments made by physicians and families or surrogate decision-makers for patients with severe traumatic brain injury. The recent advent of organ donation programs after cardiac arrest following withdrawal of life-sustaining treatments that target populations with severe neurologic injuries (including traumatic brain injury) has added an ethical perspective to these difficult decisions, especially considering that the physicians involved in the care of these patients are often the same ones who are involved in the recognition and care of organ donors.[10] This phenomenon underscores the need for a better understanding of the determinants of end-of-life decisions by physicians and families of patients with severe traumatic brain injury.

The purpose of our study was to identify the behavioural determinants that influence recommendations by critical care physicians to withdraw life-sustaining treatments in patients with severe traumatic brain injury.

Methods

Study design and participants

We conducted a descriptive qualitative study using semistructured interviews with critical care physicians who care for patients with severe traumatic brain injury across Canada. To identify our study population, we developed a comprehensive list of critical care physicians working in all Canadian Level 1 trauma centres (tertiary care facilities) through critical care department or service leads and trauma directors at each centre that cared for adult patients. We stratified critical care physicians by geographic and demographic regions: Eastern Canada (provinces of Newfoundland and Labrador, Nova Scotia, New Brunswick and Prince Edward Island), Quebec, Ontario and Western Canada (provinces of Manitoba, Saskatchewan, Alberta and British Columbia).

We used a purposive sampling strategy to recruit participants. We generated a random list of potential participants for each of the 4 regions and contacted the first name on the list for each region. We selected the subsequent potential participants from these random lists according to regular intervals, known as periods. One of the investigators (A.T.) asked selected potential

participants via email about their interest in participating in the study. If a potential participant refused to participate or did not reply after 2 reminders, the next potential participant in the list corresponding to the geographic zone was solicited. Selected potential participants who were interested in participating were instructed to contact a member of our research team (K.D.).

Data collection

We conducted semistructured phone interviews with critical care physicians guided by an interview guide. The interview guide contained open-ended questions with standard prompts available to the interviewer (K.D.) when needed and was informed by the Theoretical Domains Framework[11,12] (Appendix 1, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.190154/-/DC1). The Theoretical Domains Framework is a behaviour change framework from the field of health psychology developed jointly by health psychology theorists, health services researchers and health psychologists. It comprises 14 theoretical domains derived from 128 constructs from 33 different theories of health, behavioural and social psychology that explain changes in health-related behaviour.[11,12] Considering the purpose of our study, we combined 2 Theoretical Domains Framework domains resulting in 12 domains versus 14 domains: "beliefs about capabilities" and "optimism" were combined as were "intentions" and "goals." We piloted and pretested the interview guide with 5 critical care physicians and modified it accordingly. All interviews were conducted in English and audio recorded.

Data analysis

We transcribed the interviews verbatim, and the interviewer (K.D.) verified the content for accuracy. We removed any information that could potentially identify the participant from the transcripts. We performed the analysis using a 3-step approach as follows.

Step 1: coding

Using thematic content analysis,[13] 2 study team members (K.D., J.Y.) independently coded the content of the interview transcripts into the 12 Theoretical Domains Framework domains that were proposed in the interview guide. These 2 team members met weekly to compare their coding and reach consensus on the Theoretical Domains Framework domain corresponding to each code generated. A third coder was involved to resolve disagreements (J.E.S).

Step 2: generation of specific beliefs

A specific belief refers to a collection of participant responses with a similar underlying theme that suggests a problem or influence on the target behaviour.[14] Each code was rewritten as a specific belief by 1 team member (K.D.) and verified by the second team member (J.Y.). A third coder was involved to resolve disagreements (J.E.S).

Step 3: generation of specific themes

Similar specific belief statements from step 2 were then grouped into common themes. Themes represented a higher-level categorization of the data, with each theme subsuming multiple

belief statements. The themes were our main unit of analysis; they were analyzed to identify which themes were part of the decision-making process, if they were internal or external influences on the decision, and if they affected a certain phase of the decision to withdraw life-sustaining treatments (i.e., before the decision is made or during the decision-making process).

We used NVivo software (QSR International) to code the analyses.

Sample size
Our sample size was based on the conduct of interviews within each of the 4 Canadian regions until data saturation was achieved.[15] We defined saturation as when 3 consecutive interviews were conducted with no new themes emerging. We achieved saturation after conducting 20 interviews.

Ethics approval
This study was approved by the Ottawa Hospital Research Institute Research Ethics Board (protocol 2015051701H).

Results

We approached 104 critical care physicians to recruit 20 participants between November 2015 and March 2016. The distribution of participants across the 4 Canadian geographic regions was similar through the use of our sampling strategy. Most participants were male (n = 16, 80.0%), born in Canada (n = 12, 60.0%), had 10 years of experience or less (n = 11, 55.0%), and spent between 10 and 20 weeks per year in the intensive care unit (ICU; n = 17, 85.0%) (Table 1). A total of 499 specific belief statements were generated from the 20 interviews. The number of specific beliefs varied across the 12 Theoretical Domains Framework domains, ranging from a low of 17 beliefs (intention domain) to a high of 78 beliefs (social influences domain). Beliefs were merged to create common themes that are described next.

Factors considered when deciding to withdraw life-sustaining treatments
We identified 7 core themes across 4 Theoretical Domains Framework domains for factors considered by critical care physicians to be relevant to the decision to withdraw life-sustaining treatments (Table 2) in patients with severe traumatic brain injury. Four of these themes occurred as background factors, meaning that they occurred before making the decision, whereas 3 occurred during the decision-making process itself. Important background factors that emerged included a wide variety of triggers, both clinical (e.g., clinical examination and clinical significance of the injury) and social (e.g., family request to withdraw life-sustaining treatments), as well as a variety of intentions with respect to the patient and their family (e.g., letting the patient's wishes guide the decision) and the decision to withdraw life-sustaining treatments (e.g., "take my time"). Additional factors were found to be important during the actual act of making the decision, including nature and degree of the injury, priorities (e.g., taking our time) and knowledge needs (e.g., prognosis for patients with severe traumatic brain injury).

Table 1: Demographic characteristics of the participants

Characteristic	No. (%) of participants n = 20
Region of Canada	
Eastern Canada*	4 (20.0)
Quebec	5 (25.0)
Ontario	6 (30.0)
Western Canada†	5 (25.0)
Sex	
Male	16 (80.0)
Female	4 (20.0)
Place of birth	
Canada	12 (60.0)
Europe	5 (25.0)
Africa	1 (5.0)
South America	2 (10.0)
No. of years of experience as a critical care physician	
0–5	3 (15.0)
6–10	8 (40.0)
11–15	3 (15.0)
16–20	3 (15.0)
> 20	3 (15.0)
Mean no. of weeks per year in ICU	
< 10	0 (0.0)
10–15	8 (40.0)
16–20	9 (45.0)
> 20	3 (15.0)

Note: ICU = intensive care unit.
*Comprises the provinces of Newfoundland and Labrador, Nova Scotia, New Brunswick and Prince Edward Island.
†Comprises the provinces of Manitoba, Saskatchewan, Alberta and British Columbia.

Internal and external influences
Eighteen themes across 8 Theoretical Domains Framework domains and 15 themes across 6 Theoretical Domains Framework domains emerged that reflect internal (e.g., experience in making decisions to withdraw life-sustaining treatments) and external (e.g., legislation and culture of patients in Ontario affect how decisions are made about withdrawal of life-sustaining treatments) influences, respectively, on decisions by critical care physicians to withdraw life-sustaining treatments in critically ill patients with severe traumatic brain injury. We found less consistency among physicians with respect to the external influences in comparison with the internal influences that were identified: 26.7% (4 of 15) of the external influences compared with 61.1% (11 of 18) of the internal influences were reported by 50% or more of the physicians we interviewed. Of the 15 themes with the highest frequencies, 6 (5 internal and 1 external) reflected background influences, whereas the remaining 9 reflected influences that occur during the decision-making process (Table 3, Table 4).

Table 2: Factors considered by critical care physicians in deciding to withdraw life-sustaining treatments in patients with severe traumatic brain injury

Phase of decision	Theme	No. (%) of participants* n = 20	Sample quote	TDF domain
Before or background	Clinical triggers:	**14 (70.0)**	"If the patient is brain dead or has minimal reflexes of the brain stem, …. I will propose withdrawing of care." Participant no. B04	Memory, attention and decision process
	• The clinical significance and location of the injury	5 (25.0)		
	• Imminent brain death	4 (20.0)		
	• Lack of improvement over time	4 (20.0)		
	• A poor clinical examination	3 (15.0)		
	• Catastrophic neurologic events	2 (10.0)		
	• Terminal comorbidities	1 (5.0)		
	Social triggers:	**10 (50.0)**	Q: "So how would you typically come to a decision to withdraw life-sustaining therapies?" A: "When family indicates that their loved one would not want to survive in the state that they are currently being sustained in." Participant no. C05	Memory, attention and decision process
	• The family requests WLST	9 (45.0)		
	• The patient has deficits that would not be in line with the quality of life they would want	3 (15.0)		
	Intentions with the family:	**7 (35.0)**	"I've learnt to be careful to pay attention more and allow the patient to guide the care, and to help influence and inform really that decision-making process." Participant no. B05	Intention
	• Let the patient's wishes guide my decision-making	3 (15.0)		
	• Remain empathetic and impartial	3 (15.0)		
	• Support the families	2 (10.0)		
	Intentions with medical decisions:	**6 (30.0)**	"In an 18- to 40-year-old, pretty young group, and I suppose I try to ensure that I don't start to think about withdrawal too early." Participant no. A02	Intention
	• Take my time	4 (20.0)		
	• Ensure that medical management is in line with the patient's wishes	2 (10.0)		
	• Be more aggressive when there is the opportunity to intervene	1 (5.0)		
During	Considerations:	**19 (95.0)**	"Well, there would be numerous factors that go into that decision: what the actual injury is; how they've responded or not responded to therapy; if the patient had any previous expressed wishes; what the family wishes would be; the opinions of the consultants who work with us to manage these patients." Participant no. D05	Memory, attention and decision process
	• Patient's pre-expressed wishes	13 (65.0)		
	• Collaborations with neurosurgery, neurology and radiology	8 (40.0)		
	• Allow for a prolonged period of observation	7 (35.0)		
	• Nature and degree of the injury	6 (30.0)		
	• Clinical and radiologic findings	6 (30.0)		
	Priorities:	**9 (45.0)**	"I think that we obviously have a lot of pressures in our health care system regarding resources … but I try to not allow that to influence the case by case decisions we're making with these patients." Participant no. B05	Goals
	• Taking our time	6 (30.0)		
	• Aggressive treatment	2 (10.0)		
	• Ensure that lack of resources is not part of our mindset	5 (25.0)		
	• Patient's pre-expressed wishes	3 (15.0)		
	• Engaging the patient's family in the decision-making process	2 (10.0)		
	Knowledge needs:	**7 (35.0)**	"So I think a key is understanding the long-term recovery and prognosis from this. [...] They may not return to their previous level of functioning, but that does not negate the opportunity for a good recovery." Participant no. C03	Knowledge
	• Current evidence and literature	5 (25.0)		
	• Specific anatomy and physiology of the brain	4 (20.0)		
	• Prognosis of severe TBI	1 (5.0)		

Note: TBI = traumatic brain injury, TDF = Theoretical Domains Framework, WLST = withdraw life-sustaining treatments or withdrawal of life-sustaining treatments.
*Some critical care physicians may have identified more than 1 factor within a theme; the cumulative number of participants may be greater than the total number of participants (in boldface type).

Table 3 (part 1 of 2): Themes identified as internal influences on critical care physicians when deciding to withdraw life-sustaining treatments in patients with severe traumatic brain injury

Phase of the decision	Theme	No. (%) of participants* n = 20	Sample quote	TDF domain
Before or background	I am experienced (n = 17)/not experienced (n = 3) in making decisions to WLST	**20 (100.0)**		Skills
	My role as a critical care physician concerns the WLST. My role is:	**19 (95.0)**	"I would be a facilitator of giving my medical understanding and interpretation of what possible disabilities they may be left with and that I usually explain is a spectrum. … But ultimately, the decision is with the SDM trying to make a decision about what he would want or she would want and I try to ensure the medical management at least is in line with what they want for an overall goal." Participant no. A02	Social, professional role and identity
	• To lead the discussions about WLST	13 (65.0)		
	• Make the final decision to WLST	10 (50.0)		
	• Organize all the clinical information	5 (25.0)		
	• Do the initial assessment and prognostication	3 (15.0)		
	• Ensure that we have expert support when needed	2 (10.0)		
	• Support the family	2 (10.0)		
	My past experiences influence how I approach and make decisions about the WLST for patients with severe TBI	**18 (90.0)**	Q: "Can you think of any past experiences that you've had with a patient with a severe TBI that has influenced how you make decisions now for withdrawing life-sustaining therapies?" A: "Yes, there have been 2, very young people that were in their teens, both who had very severe traumatic brain injuries. … I used to make decisions earlier in their treatment. I tend to make decisions now much later in their treatment because we just don't have really validated prediction tools." Participant no. C01	Reinforcement
	I am aware of guidelines/recommendations/literature for patients with severe TBI about:	**16 (80.0)**	"What I have read recently is some reports from the Canadian context … there was a massive variation in practice across Canada and one of the most common causes of death in severe TBI … was withdrawal of care." Participant no. B05	Knowledge
	• Prognostication	12 (50.0)		
	• The variability in practice	4 (20.0)		
	• Cause of death	2 (10.0)		
	I am aware (n = 4)/not aware (n = 12) of any guidelines or published practices regarding WLST in patients with severe TBI	**13 (65.0)**		Knowledge
	I feel uncertainty (n = 4) and anxiety (n = 3) when prognosticating patient outcomes and deciding to WLST	**6 (30.0)**	"There's an anxiety around the uncertainty of the prognosis, of the diagnosis. … But I think with the passage of time and with input of my specialist, sub-specialist colleagues, that anxiety passes." Participant no. C05	Emotion
During	When making decisions to WLST, we are influenced by the patient and their family	**20 (100.0)**	"At the end of the day, it all comes down to the patient and what their expectations out of life would be and so you're just trying to make sure that your treatment plan is in line with those wishes." Participant no. D04	Social influences
	When making decisions to WLST, I am influenced by my colleagues:	**19 (95.0)**	"So, usually these patients are admitted under a trauma service or under neurosurgery directly, and this conversation will always happen in the TBI population with either consultant, so I would say absolutely other team members influence the decisions or the recommendations that we might come to the table with." Participant no. A04	Social influences
	• Other physicians	16 (80.0)		
	• Allied health colleagues	12 (60.0)		
	• It is important to me that the entire team is in agreement with the decision	5 (25.0)		
	• I am not influenced or pressured by my colleagues when making decisions to WLST	4 (20.0)		

Table 3 (part 2 of 2): Themes identified as internal influences on critical care physicians when deciding to withdraw life-sustaining treatments in patients with severe traumatic brain injury

Phase of the decision	Theme	No. (%) of participants* n = 20	Sample quote	TDF domain
During (cont'd)	It is difficult to decide to WLST because/when:	**18 (90.0)**	"So I think it's hard for us to really fall back on any kind of hard objective assessment to know really what the evolution is going to be and the more I practise, the more experience I gain managing severe TBIs, the more I realize that I don't know how to prognosticate them very well." Participant no. B05	Beliefs about capabilities
	• The uncertainty of the prognosis	9 (45.0)		
	• We cannot rely on objective tools to aid with prognosis	6 (30.0)		
	• Patients are young	6 (30.0)		
	• Early in the patient's care	4 (20.0)		
	If I WLST, I will feel negative emotions (n = 14) or positive emotions (n = 5) depending on the situation	**18 (90.0)**	"[WLST is] one of the more difficult things that you do because it's usually a very tragic and devastating situation and so it takes an emotional toll on you." Participant no. D04	Emotion
	Interpersonal skills are needed to make decisions to WLST and to have discussions with the patient's family	**12 (60.0)**	"I think important would be the ability to communicate effectively with families." Participant no. A06	Skills
	I am confident (n = 9)/not confident (n = 1) in making decisions to WLST	**10 (50.0)**		Beliefs and capabilities
	The decision to withdraw is easier when:	**9 (45.0)**	"I think I'm very confident at the extremes. So if a patient clearly has a fairly poor neurologic result and sometimes we also get neurology involved so that they can prognosticate with the team, …. And then you can say okay, I'm very confident." Participant no. A01	Beliefs and capabilities
	• The clinical presentation is clear	7 (35.0)		
	• You allow for a prolonged period of observation	3 (15.0)		
	Experience with managing patients with severe TBI and with patient outcomes is important to be able to make decisions to WLST	**9 (45.0)**	"Knowledge of the independent factors which predict prognosis. … So I've only gotten to that from experience, so I'm very cautious now about recommending WLST given I've seen many people do better than what classically have been expected." Participant no. C03	Skills
	I feel more confident when the decision is shared with:	**7 (35.0)**	"I'm going to share the decision with someone else because I think for this kind of population, it's quite important." Participant no. B01	Beliefs and capabilities
	• My colleagues	5 (25.0)		
	• The patient's family	4 (20.0)		
	When discussing the WLST with the patient's family, I feel happy (n = 6)/ concerned (n = 1)	**7 (35.0)**	"I think it's as difficult as it is, as stressful or as sorrowful as it is to see anyone die, and no matter what, it's I think very gratifying to be able to offer a family good advice, information and support to go through that process." Participant no. B05	Emotion
	Discussions with the families are difficult	**4 (20.0)**	"[Discussion of WLST with family] is probably the most difficult thing that I have to do because in reality when an ICU physician recommends and the family agrees to withdrawal of life-sustaining therapy that means a life ends. And for me, I never want to get that wrong." Participant no. C03	Beliefs and capabilities
	There may be negative outcomes for to me as a physician, when I decide to WLST (e.g., I may be criticized for withdrawing too early)	**3 (15.0)**	"Criticizing practitioners for withdrawing too early in traumatic brain injury because we're uncertain about it and making rash decisions." Participant no. A05	Beliefs about consequences

Note: ICU = intensive care unit, SDM = surrogate decision-maker, TBI = traumatic brain injury, TDF = Theoretical Domains Framework, WLST = withdraw life-sustaining treatments or withdrawal life-sustaining treatments.
*Some critical care physicians may have identified more than 1 factor within a theme; the cumulative number of participants may be greater than the total number of participants (in boldface type).

Table 4 (Part 1 of 3): Themes identified as external influences on critical care physicians when deciding to withdraw life-sustaining treatments in patients with severe traumatic brain injury

Phase of the decision	Theme	No. (%) of participants*	Sample quote	TDF domain
Before or background	Most of my critical care physician colleagues generally follow a similar approach to making decisions about the WLST (n = 19)/there are outliers at my centre (n = 4)	19 (95.0)	"I will say that we are a team of 12 critical care physicians and I will say that in general because it's difficult to say, it is different for everybody, but in general we all agree. I think we all have the same type of practice. Clearly with some difference and I will say maybe 1 or 2 colleagues, they can be a bit different, but even if we have a different type of practice, in general, we arrive to the same conclusion." Participant no. B01	Social, professional role and identity
	The legislation and culture of our patients in our province affect how decisions are made about WLST	9 (45.0)	"I think if severe TBI goes down the line of brain death, then I think it is the only form, yes. Because yeah, I think that becomes the only form. However, I think just given current legal precedent, I'm certainly cautious around that because it would be tough to withdraw therapy without consent from a family." Participant no. C05	Environment, context and resources
	Aspects of my work structure influence the decision-making process for WLST:	7 (35.0)	Q: "What aspects of your work environment influence you in your decision to withdraw life-sustaining therapies in patients with severe TBI?"	Environment, context and resources
	• There is a lack of communication at shift changes	4 (20.0)	A: "I think it's, like I said, a continuity of the same language and it's the communication, so it may be affected by the colleague I've had the week before who has various things in a certain way and I know or I disagree and I'm going to have to spend the rest of my week trying to talk to the family to bring them in more align with the realistic expectations." Participant no. A02	
	• There is no opportunity to follow-up with patients once they leave the ICU	3 (15.0)		
	Critical care physicians are different from other disciplines:	6 (30.0)	"As a critical care physician, you don't necessarily have that perspective that the neurosurgeons do, then go on to look after these patients for months and months and then actually see them as outpatients. That's why they tend to be much more aggressive than us because they have seen those miracle cases. So they are much more cautious about saying that anything is definite." Participant no. D04	Social, professional role and identity
	• We have a limited opportunity for follow-up once the patient leaves the ICU	4 (20.0)		
	• We have specific knowledge that makes us best able to make decisions about WLST	2 (10.0)		
	• Neurosurgeons are not as interested in palliative care as we are	1 (5.0)		
	Adequate training during my fellowship has helped me to be able to make decisions to WLST (n = 4) and communicate with families (n = 2)	5 (25.0)	"It's not to say that experience doesn't play a role as in clinical working experience after training, that hopefully further hones the skills, but most people should have the necessary skills by the time they finish training. I don't think there's any other skills specific to this and the experiences should be those that are required through training." Participant no. A05	Skills
	The culture in the ICU affects our decision-making; we tend to be very conservative when making decisions to WLST	5 (25.0)	"Maybe we talk to each other, but I think that tends to be the approach at our centre to be more conservative and be more certain about outcomes before suggesting withdrawal of life support. We'll certainly be open about our concerns about disability associated with this and what that would be like for them and find that when they're young, most families wish to continue until it's clear" Participant no. C02	Environment, context and resources

Table 4 (part 2 of 3): Themes identified as external influences on critical care physicians when deciding to withdraw life-sustaining treatments in patients with severe traumatic brain injury

Phase of the decision	Theme	No. (%) of participants*	Sample quote	TDF domain
During	Having guidelines and prognostic tools, and standardization would help to facilitate making decisions about WLST	**17 (85.0)**	"I think that we do need better understanding of the evolution of these patients and some kind of guidelines because I think centres will be acting very differently based on the local preferences, culture, and different things, but I think there's a lack of data and a lot of uncertainty in these patients. So if we can gather more data, have a better idea then it's going to make decisions easier." Participant no. B03	Behavioural regulation
	Access to and quality of physical resources may or may not (*n* = 5) affect our ability to make decisions to WLST:	**14 (70.0)**	Q: "Are there any aspects of your work environment that influence your decision to withdraw life-sustaining treatment in a patient with a severe TBI?" A: "Sorry, I'm hesitating because the right answer is no. The true answer might be that we have a database of injuries and withdrawal and care and stuff like that, it's part of our ICU database. And from our ICU database, there's an increase in the number of withdrawals of life-sustaining therapy at times when the unit is full. […] I have never consciously said oh yeah, we can kind of finish off that one so that we can get another bed. I think that would be horrendous as a profession. So I believe the correct answer is no, but I'm aware of this data and I don't know how to interpret it." Participant no. C04	Environment, context and resources
	• Current prognostic models are not ideal	8 (40.0)		
	• Lack of resources and beds can influence us to decide to WLST	5 (25.0)		
	• Our institution is well supported and the resource access is not limiting	5 (25.0)		
	In our centre we have access to professional resources:	**12 (60.0)**	"So as I already mentioned, we have a lot of support around — so we have very good and very accessible ethics consultants, social work, chaplaincy, so we have a lot of people that can both support us as a team as well as the families during difficult decision-making, I would just say that the hours of availability could be better — yeah, probably just the hours." Participant no. A04	Environment, context and resources
	• Support personnel for the family, but there is not very good off-hours access	6 (30.0)		
	• Access to support from neurosurgery, neurology and nurses, but, at times, they are not available to support us	5 (25.0)		
	• At times they are not available to support us	2 (10.0)		
	Aspects of my work structure influence the decision-making process for WLST:	**7 (35.0)**	"Well, as a general rule, none of these decisions are made by 1 person in our centre." Participant no. D03	Environment, context and resources
	• Decisions to WLST require consensus	4 (20.0)		
	• There are always at least 2 critical care physicians working	4 (20.0)		
	Withdrawing life-sustaining treatments for patients with severe TBI may benefit other patients:	**7 (35.0)**	"I think there are advantages there and from a resource utilization point of view, which obviously shouldn't be part of our mindset on an individual patient, but from a resource utilization point of view, withdrawal of life support in a patient who's likely to be a high resource patient going forward, either from a dependency or a chronic ventilator bed use or things like that, if families prefer the option of withdrawal of life support if there's a resource benefit." Participant no. A04	Beliefs about consequences
	• Organ donation	5 (25.0)		
	• Free up resources	2 (10.0)		

Table 4 (part 3 of 3): Themes identified as external influences on critical care physicians when deciding to withdraw life-sustaining treatments in patients with severe traumatic brain injury

Phase of the decision	Theme	No. (%) of participants*	Sample quote	TDF domain
	WLST can have benefits for the patient	6 (30.0)	"The main positive aspect would be to prevent the patient from evolving toward severely handicapped or neurovegetative state, which typically they would not have wanted or the family doesn't want, so I think part of our role is to present that if that's not what they want, that's from a positive part." Participant no. B03	Beliefs about consequences
	Educational tools and support services are needed to help facilitate the discussions with the families and help them to make decisions about the WLST	6 (30.0)	"And so there is a real disconnect sometimes between medical team and the laypersons involved in the care of the patient. So I do think that better supports for the families, better supports for the patient in terms of education and training and comprehension around traumatic brain injuries, better understanding of outcomes. I don't know if, for example, taking people to see people who have survived a severe traumatic brain injury event, giving them more information about it." Participant no. A01	Behavioural regulation
	WLST can have positive ($n = 5$) and negative ($n = 3$) outcomes for the family	5 (25.0)	"The positives that I would see are that an individual is not left potentially institutionalized and under the care of individuals … . We prevent that outcome from happening. We potentially allow family members closure on a severe devastating injury that would alter a person's life not for the better." Participant no. C01	Beliefs and consequences
	There are negative consequences to deciding not to WLST:	5 (25.0)	"Also, the opposite is true that if you don't engage in the discussion, you may help an individual survive to a quality of life that they or their surrogate decision-maker may not be accepting of. It's a very difficult decision." Participant no. C01	Beliefs and consequences
	• We are unable to offer good end-of-life care	2 (10.0)		
	• The patient may survive to a quality of life they would not have wanted	2 (10.0)		
	• The patient may linger in the ICU	1 (5.0)		

Note: ICU = intensive care unit, TBI = traumatic brain injury, TDF = Theoretical Domains Framework, WLST = withdraw life-sustaining treatments or withdrawal life-sustaining treatments.
*Some critical care physicians may have identified more than 1 factor within a theme; the cumulative number of participants may be greater than the total number of participants (in boldface type).

Conflicting beliefs

We identified several potentially conflicting themes. We found disagreement between a clinician's desire to respect a patient's wishes and his or her need for more time to assess prognosis better, or to respect the patient's autonomy and social justice to manage resources adequately in the context of limited resources. The experience of the physician (or lack of experience) and the need for better prognostic models were also raised as important themes. Although clinicians want to lead this discussion and direct the decision (based on their experience and knowledge about the final prognosis), they also want to consider fully what the previous wishes of the patient were and make a recommendation based on their best judgment as to how to harmonize the influence of each of these factors.

Very strong beliefs that may affect behaviour or decision-making

The need for better prognostic models was identified as a very strong factor in the decision to withdraw life-sustaining treatments. Clinicians' emotions, anxiety about validity of their prognosis and making the right recommendation when

the stakes are so high (e.g., young patients and "miracle cases" from other colleagues) were also important reported factors. Diverging views among the clinical team will delay the withdrawal of life-sustaining treatments until consensus is obtained. Better prognostic models would help address these issues, as per respondents.

Overall, the main domains involved in decision-making for physicians across Canada were memory, attention and decision process; intention; goals; and knowledge. Internal influences involved in the decision were consistent among critical care physicians who identified themes reflecting background influences. The domains affected by these internal influences were skills, social and professional roles and identities, reinforcement, emotion, social influences, beliefs about capabilities and beliefs about consequences. However, the external influences involved in the decision were not consistent among participants. The domains affected by these external influences were social and professional roles and identities; environment, context and resources; skills; behavioural regulation; and beliefs about consequences.

Interpretation

We identified several core themes derived from domains of the Theoretical Domains Framework that are considered by critical care physicians in Canada in the decision to withdraw life-sustaining treatments in critically ill patients with severe traumatic brain injury. Memory, attention and decision process, intention, goals, and knowledge were the main domains involved in the decision-making for physicians across Canada. The Theoretical Domains Framework can help explain difficult decision processes such as level-of-care decisions in critically ill patients with severe traumatic brain injury.

Our study provides insight into how to improve decision-making in this very complex and emotionally charged clinical situation. The Theoretical Domains Framework commonly has been used in health care research to identify barriers and facilitators of the implementation or not of an intervention or a process of care to change behaviours.[16–19] In our study, we used this framework to identify the behavioural determinants that influence physicians' recommendations to withdraw life-sustaining treatments with the intent of identifying the targets for a future intervention to improve decision-making counselling among physicians.[20] In particular, physicians in our study seemed to point toward the need for better knowledge (e.g., prognostic evidence to help guide their recommendations), for better experience and training to make recommendations, for more time to make better prognostic estimations (including time to create consensus among involved consultants) and eventual recommendations to patients' surrogate decision-makers, and for better tools to integrate patient's values and preferences into decision-making.

Common elements of the decision-making leading to the withdrawal of life-sustaining treatments identified in our study have also been identified in other populations such as critically ill

extremely premature neonatal patients,[21] critically ill patients with stroke and frail older adults.[22,23] Critical care physicians in these fields state that poor prognosis, patient preferences and quality of life are important determinants in recommending the withdrawal of life-sustaining treatments. Similar to the extremely premature neonatal population whose premature delivery was not expected or impossible to prevent, younger patients with severe traumatic brain injury are at a time in their lives when they are for the most part free of major comorbidities and have the promise of continuing to live a high-quality life before their injury. Once their catastrophic injuries occur, the importance of adequate prognostication becomes essential in both populations. The extremely premature neonatal population risk living with multiple severe comorbidities.[21] This contrasts with decision-making for the younger population with severe traumatic brain injury: it is influenced by a different set of ethical, social and medical issues.

In the population of older adults who are critically ill, decisions are not based only on prognosis and quality of life but are also very much influenced by the quality of dying and the strong aversion to suffering at end of life.[22] In this population, where functional decline can already be occurring before admission to the ICU and most likely will be accelerated by their stay in the ICU, decision-making can be facilitated by a higher prevalence of advance directives to help guide surrogate decision-makers in decisions to withdraw life-sustaining treatments. We found that many clinicians struggle to make recommendations to withdraw life-sustaining treatments because they often face uncertainty when trying to match the preferences of the surrogate decision-makers on quality of life for the patient and how precisely physicians can predict a reliable functional prognosis. However, all respondents identified the influence of the patient and the family as an important factor in these decisions. These findings are reassuring but challenging when facing uncertainty. Most (90%) mentioned that past experiences influence how they approach and make decisions.

Overall, the lack of reliable prognostic models seems to be a substantial barrier for physicians when involved in a decision to withdraw life-sustaining treatments in patients with severe traumatic brain injury. We found an important unmet need for better prognostic models to help reduce uncertainty, and to decrease physicians' negative emotions and anxiety about making better recommendations to withdraw life-sustaining treatments. Only 1 respondent out of 4 felt that adequate training during fellowship had helped them be able to make these decisions, which suggests that the training curriculum in critical care medicine could be improved.

Limitations

Our study has some limitations. In most health care systems, as in Canadian ICUs, the decision to withdraw life-sustaining treatments is a shared decision made by bedside critical care physicians and surrogate decision-makers. In our study, we did not interview family caregivers or surrogate decision-makers involved in these decisions, nor did we consult other health

care professionals and members of the critical care team (i.e., nurses, spiritual support caregivers and social workers) who could also offer a rich perspective to the factors influencing decision-making about withdrawal of life-sustaining treatments in patients with severe traumatic brain injury. Our decision was deliberate because we chose to focus on only critical care physicians considering their pivotal role in family meetings and in these decisions.

The results of our study may not apply outside the Canadian context; critical care physicians from other countries, health care systems, societies and communities may have other perspectives with a different impact in the context of withdrawal of life-sustaining treatments.

Our interviews were not conducted in real time with physicians actually engaged in making recommendations about the withdrawal of life-sustaining treatments, which may expose our results to a potential recall bias. Respondents may have put more emphasis on exceptional situations rather than on more common ones considering that we may have a better recall of important events.

Our study was not designed to understand the determinants that influence surrogate decision-makers. Future research using direct observation of physicians and surrogate decision-makers for patients could help us deepen our understanding of the barriers and facilitators of making recommendations about the withdrawal of life-sustaining treatments and how interventions could improve the experience for surrogate decision-makers.

Conclusion

Our study identified clinically useful information about the processes surrounding level-of-care decisions for the early care of critically ill patients with severe traumatic brain injury. Identifying clear determinants involved in this process should help to improve how physicians make recommendations to withdraw life-sustaining treatments in this population. Our study has implications for the care of critically ill patients with severe traumatic brain injury and can inform policy implementation to improve our approach to the evaluation of prognosis and level-of-care decisions in this population. Future research should aim at identifying the factors influencing surrogate decision-makers in the decision to withdraw life-sustaining treatments in critically ill patients with severe traumatic brain injury.

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Data sharing: Individual participant data may not be available according to the consent obtained. However, any secondary use of the data can be submitted to the study steering committee for evaluation.

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