

# Initiating and integrating a personalized end of life care project in a community hospital intensive care unit: a mixed-method study of clinician and key stakeholder perspectives

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## Abstract

**Rationale** The end of life (EOL) experience in the intensive care unit (ICU) can be psychologically distressing. The 3 Wishes Project (3WP) personalizes the EOL experience by carrying out wishes for dying patients and their families. While the 3WP has been integrated in academic, tertiary care ICUs, implementing this project in a community ICU has yet to be described. **Objectives** To examine facilitators of, and barriers to, implementing the 3WP in a community ICU from the clinician and key-stakeholder perspective. **Methods** This mixed-method study evaluated the implementation of the 3WP in a 20-bed community ICU in Southern Ontario, Canada. Patients were considered for the 3WP if they had a high likelihood of imminent death or planned withdrawal of life-sustaining therapy. Quantitative data include patient demographic data and wishes implemented. Following the qualitative descriptive approach, semi-structured interviews were conducted with purposively sampled clinicians and key-stakeholders. Data from transcribed interviews were analyzed in triplicate through qualitative content analysis. **Results** During the 10-month period, 66 of 67 wishes were completed, with a median of 4.5 wishes per patient-family dyad. Interviews with 12 participants indicated that the 3WP personalized and enriched the EOL experience for patients, families and clinicians. Interviewees indicated higher intensity education strategies were needed to enable spread as the project grew. Clinicians described many physical resources for the project but required more non-clinical project support for orientation, continuing education and data collection. Instead, these roles were completed by clinicians with saturated work capacity which may have inhibited the spread of the project. **Conclusions** In this community hospital, ICU clinicians and key stakeholders reported the 3WP improved EOL care for patients, families, and clinicians. Project implementation in a community ICU requires investigators take into account project characteristics and adapt the intervention to the community hospital context.

## Initiating and integrating a personalized end of life care project in a community hospital intensive care unit: a mixed-method study of clinician and key stakeholder perspectives

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## *Abstract*

### *Rationale*

The end of life (EOL) experience in the intensive care unit (ICU) can be psychologically distressing. The 3 Wishes Project (3WP) personalizes the EOL experience by carrying out wishes for dying patients and their families. While the 3WP has been integrated in academic, tertiary care ICUs, implementing this project in a community ICU has yet to be described.

### *Objectives*

To examine facilitators of, and barriers to, implementing the 3WP in a community ICU from the clinician and key-stakeholder perspective.

### *Methods*

This mixed-method study evaluated the implementation of the 3WP in a 20-bed community ICU in Southern Ontario, Canada. Patients were considered for the 3WP if they had a high likelihood of imminent death or planned withdrawal of life-sustaining therapy. Quantitative data include patient demographic data and wishes implemented. Following the qualitative descriptive approach, semi-structured interviews were conducted with purposively sampled clinicians and key-stakeholders. Data from transcribed interviews were analyzed in triplicate through qualitative content analysis.

### *Results*

During the 10-month period, 66 of 67 wishes were completed, with a median of 4.5 wishes per patient-family dyad. Interviews with 12 participants indicated that the 3WP personalized and enriched the EOL experience for patients, families and clinicians. Interviewees indicated higher intensity education strategies were needed to enable spread as the project grew. Clinicians described many physical resources for the project but required more non-clinical project support for orientation, continuing education and data collection. Instead, these roles were completed by clinicians with saturated work capacity which may have inhibited the spread of the project.

### *Conclusions*

In this community hospital, ICU clinicians and key stakeholders reported the 3WP improved EOL care for patients, families, and clinicians. Project implementation in a community ICU requires investigators take into account project characteristics and adapt the intervention to the community hospital context.

## *Introduction and Objectives*

Advances in health care have changed the fundamental human experience of death. Though dying at home has been consistently described as the preferred location for death, more Canadians now die in an intensive care unit (ICU) than before.<sup>1,2</sup> This presents an environment replete with technology within an institutional setting that propagates the medicalization of death as the backdrop for end of life (EOL) care. This setting can obscure humanity in the dying process for patients, and perpetuate grief, anxiety, depression and post-traumatic stress disorder in bereaved family members.<sup>1,3</sup> Moreover, clinicians experience disengagement and moral distress when death is dehumanized.<sup>4-8</sup>

The 3 Wishes Project (3WP), an innovative project implemented in academic ICUs in both Canada and the United States, aims to improve EOL care by personalizing and humanizing the EOL experience through the elicitation and implementation of wishes for patients, family members and/or clinicians. It was created for the purpose of strengthening the relationships among patients, family members, and clinicians that are crucial for empathic EOL care.<sup>9</sup> The wishes implemented are classified into 11 categories: facilitating

connections with families/ friends/ pets, celebrations involving food/beverages, humanizing the ICU room, humanizing the patient, music, family care, religious rituals & spiritual ceremonies, preparations and final arrangements, keepsakes and post mortem tributes, organ & tissue donation and paying it forward for the 3WP.<sup>10</sup> A mixed-method, multi-site study conducted in an academic, tertiary level ICU demonstrated that the 3WP helped personalize the dying process through explicit integration of palliative and spiritual care into critical care practice.<sup>10</sup> Additionally, a recent study conducted by Vanstone et. al concluded that the 3WP is an affordable, transferrable and sustainable clinical project that facilitates collaborative care that honors a person's identity and preferences.<sup>9</sup>

Personalizing EOL care can take on various forms and as such, the 3WP may have unique features in different environments.<sup>9,11</sup> The adaptable nature of this EOL project may facilitate spread to community ICUs, which may not have a robustly developed EOL infrastructure.<sup>12,13</sup> Clinicians responsible for EOL care in the ICU are instrumental to 3WP implementation; therefore in order to introduce the 3WP in community ICUs and facilitate its uptake, this mixed-methods study describes the clinician and key stakeholder perspective of a 3WP implementation in a large, community ICU.

## Methods

### NH SCS ICU

#### Context

Niagara Health St. Catharines Site (NH SCS) ICU is a 509-bed community teaching hospital in Southern Ontario, Canada, which includes a 20-bed ICU. The mortality rate of the ICU is 14.5%, in line with the mortality rate at other community hospital ICUs.<sup>2,14</sup> There are 8 physicians who rotated on a 5 day, 2 night rotation, along with 100 nurses who were rostered among nine full-time staff divisions. In addition, palliative care and spiritual care staff were available by consultation Monday to Friday from 9 am to 5 pm. A multi-disciplinary team championed the project implementation and, included both clinical and non-clinical staff. The 3WP physician lead had completed part of his critical care fellowship training at St. Joseph's Healthcare Hamilton (SJHH), where the 3WP was first implemented, which inspired the implementation of the project at NH SCS with the executive support of the ICU manager. Frontline nurse champions included a senior ICU nurse, as well as a junior ICU nurse. A part-time ICU research coordinator collected quantitative data, while a research assistant collected qualitative data alongside an ICU nurse with previous qualitative research experience. Mid-way through implementation, the spiritual care staff, palliative care team, and research coordinator involved in the project implementation moved on from their positions.

#### *Project Initiation and Implementation*

The idea for this study was sparked during a national conference where the results of the 3WP in SJHH was reported. Staff at NH SCS believed it would be feasible to adopt the project in a community ICU and believed it would benefit the care of dying ICU patients. Thereafter, an environmental scan of existing EOL practices was conducted through a clinician focus group and a desire to initiate a more formalized EOL project was confirmed. Anticipated barriers included competing clinical demands on time, lack of supplies for implementing wishes, and the ICU's readiness for change.

The initial implementation plan considered patients to be candidates for the project if they had a high likelihood of imminent death as judged by the most responsible physician or planned withdrawal of life-sustaining therapy. In addition, the plan was to only enroll patients during the days where the 3WP physician lead was on service to allow the project to iteratively and organically develop in the ICU. During the first month, the frontline staff and implementation team both believed that the 3WP should consider all dying patients including when the 3WP physician lead was not on service, as the risk of patient harm was likely low, and the benefits for patients, families, and clinicians were likely to be high. The only exclusion criterion for enrollment in the 3WP was a patient or family member declining to participate.

A three-pronged strategy was used to support implementation: communication and education, collection of point-of-care resources and promotion of multidisciplinary collaboration. Communication and education

interventions included emails to staff, in-person updates about the project during rounds, champion training retreats co-hosted with the founding 3WP team from SJHH, an information binder at nursing stations with guides on how to introduce the project, a list of wish ideas as described by Cook et. al,<sup>10</sup> a list of common wishes by patients/ families/ clinicians as described by Clarke et. al<sup>15</sup> and protocols for implementing commonly used items at SCS such as music, refreshments, and keepsakes.<sup>16</sup> The 3WP physician lead and other nurse champions assisted clinicians with the implementation of the project at the bedside during care. The frontline staff and implementation team also collected point-of-care resources to facilitate wishes based on common wishes at SJHH<sup>10</sup> such as blankets, and candles. In addition, keepsakes such as EKG strips in glass vials or ink thumbprint picture frames were used to help memorialize dying patients. At the start of the project, the implementation team met with palliative care staff and spiritual care staff to promote inter-disciplinary collaboration during EOL. Patient enrolment and wishes implemented were self-reported and documented by the 3WP physician lead and clinicians enrolling patients.

## *Measurement*

### **A Mixed-Method Approach**

A mixed-method approach was used. Quantitative data described the patients enrolled in the 3WP during the times the 3WP physician lead was on service. Qualitative data described the clinician and key-stakeholder perspectives on the project initiation and implementation process. The Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines (*Appendix A*) and the Standards for Reporting Qualitative Research (SRQR) guidelines were completed.

### **Quantitative Measures**

Quantitative data was extracted from patient records which included baseline data such as age, ICU admission date, admission diagnosis, spiritual beliefs and APACHE II score. Information on advanced life supports administered during the ICU stay was also recorded along with patient final status including the location and date of death. The process of enrollment in the 3WP was collected including the reason for enrollment, project initiation and wish details (wish category, completion, costs and implementation). Wishes were classified into 11 categories.<sup>10</sup> Other consultations including spiritual care, palliative care and social work involvement was also recorded, as well as involvement of the Trillium Gift of Life for organ donation.

### **Qualitative Interviews**

A qualitative description (QD) approach was employed for the analysis of qualitative data. QD yields pragmatic and straightforward descriptions that stays close to the language of informants with minimal interpretation from investigators.<sup>17</sup> The QD approach aligns with the goals of this mixed-methods study since it is applicable for needs assessment as well as intervention development and refinement.<sup>17</sup> Individual semi-structured interviews with open-ended questions (*Appendix B*) were used for data collection focusing on the clinician and key-stakeholder experience of the implementation process. Interviewees were selected through purposively sampling clinicians and key stakeholders who had experience with project implementation and use.<sup>18,19</sup> The only exclusion criterion was if clinicians and key stakeholders declined to participate in the interviews. Interviews were conducted either in person or on the phone by both an independent research assistant who was not previously involved with project implementation, its use, or with the ICU, as well as an ICU nurse with previous qualitative research experience. Interviews were digitally recorded, transcribed verbatim and anonymized.

## *Analysis*

Quantitative data were analyzed using descriptive statistics while qualitative data was analyzed in triplicate using the qualitative content analysis, according to the QD approach.<sup>20</sup> No preconceived themes were derived prior to interviews, and codes were collected directly from the interview transcripts. These codes were updated regularly after each interview in order to determine when the saturation point in the data collection process was attained in which no new codes were identified, and new themes emerged infrequently.<sup>19</sup> Three investigators (BT, LS, EY) independently reviewed the 12 transcripts in a process of open coding. The codes

were sorted and organized into clusters and upon looking for commonalities and differences among the data, themes were derived from the various categories. After thorough reflection and analysis, the investigators came together with their own insights and discussed potential relationships in light of existing knowledge.

To enhance the trustworthiness and credibility of the analysis, data were triangulated by involving a heterogeneous sample of participants from different disciplines and varied ICU experience. In addition, member checking involved emailing the final results to interviewees and researchers to allow for comments and verification.

### *Ethics*

This study was approved by the Hamilton Integrated Research Ethics Board (HiREB Project# 4736).

## Results

### **Quantitative**

#### *Patients*

Patients were enrolled in the 3WP between January 2019 to October 2019. *Table 1* summarizes the patient characteristics. 14 eligible patients were included in the study with a mean age of 63.4 (SD, 17.1) and mean APACHE II score of 17.8 (SD, 6.8). Most patients were admitted to the ICU from the emergency department (11.0 [78.6%]) and all patients were admitted with a medical diagnosis (14.0 [100.0%]) rather than surgical issue. The mean duration between hospital admission to death was 7.5 days (IQR, 3.3-12) and enrollment duration (e.g., enrolment to death) was 0.5 days (IQR, 0-1).

#### *Wishes*

*Table 2* summarizes the wish categories including additional characteristics of the wish implementation process. Overall, 66 of 67 (98.5%) wishes were completed with at least 3 wishes for each patient-family dyad (median, 4.5 [IQR, 3.3-6.0]). The wishes were elicited by the family (32.0 [47.8%]), staff (28.0 [41.8%]) and patient (7.0 [10.4%]) with a majority implemented by staff (44.0 [65.7%]). The most common category of wishes made included facilitating connections with family, friends or pets, and keepsakes and post-mortem tributes as per the categories defined by Cook et al (Refer to *Appendix C* for examples of wishes). The wishes were inexpensive with a range from \$0 to \$30 and mean cost of wishes was \$0.87. The cost was minimized by donations from staff and community members with 19.0 (28.4%) of wishes donated.

### **Qualitative Frontline feedback**

Qualitative data from 12 clinician and key stakeholder interviews showed that the 3WP led to personalized patient and family experience at EOL, and enriched clinician experience when caring for dying patients. Participants suggested that more communication strategies were needed to scale the project and ensure its growth, describing communication strategies to consider. Finally, participants noted many physical resources to support the project (e.g., supplies, designated space for storage) but a scarcity of non-clinical support specifically in the dimensions of staff education and data collection after the project expanded to include all potential dying patients. *Table 3* summarizes the characteristics of interview participants.

#### *Personalized Patient and Family Experience at EOL*

The 3WP was perceived by clinicians and key stakeholders to improve the patient experience by personalizing EOL care, prompting important conversations, and returning some decision-making to the patient and family. Nurses and the physician indicated that the 3WP helped to individualize care in the patient's final moments. A physician shared one of the wishes where a nurse, "... got the frame and some ink and she made a thumbprint heart with the grandma's thumb and the grandchild's thumb. I just thought that was so beautiful, and it's easy to do, it's personalized." [P4] Others discussed that by eliciting wishes, they were encouraged to engage in conversations to better understand what is important to the patient. A bedside nurse commented that the 3WP, "sparks a conversation, which I think we should all have in those moments, or even before EOL... what is important to us and what is important in our care." [P1] Another nurse

observed that, “it gives decision making back to the family and the patient.” [P1] A clinician emphasized how the 3WP “gives [the family] permission to ask for [something] or gives them permission to say “Yeah, I would love that,” or “He would love that.” [P2] Eliciting wishes from families was perceived to give families a voice and seemed to help address common feelings of overwhelming helplessness through acknowledging these wishes.

### *Enriching the Clinician EOL Experience*

The implementation of the 3WP produced several benefits for clinicians as well by fostering collaboration and increasing job satisfaction. Since the 3WP incorporated multiple disciplines from spiritual care to social work, the project connected individuals who would not have originally worked together within the context of EOL care. A nurse reflected that, “what I valued the most out of it was the interdisciplinary teamwork. It’s not a project that is just for the nurses, or just for the doctors. It’s everybody who works at the hospital even beyond the ICU and the community...everybody just coming together to help the patients and the families together.” [P6] The project facilitated bonding within the unit as staff worked as a team towards a common goal of understanding what matters most to patients. Some observed an increase in nurse-physician collaboration in incorporating the 3WP in EOL care. Another nurse stated that, “I just valued the camaraderie of our unit sort of coming together and recognizing how pivotal this moment is in our patients’ lives.” [P10]

Many participants reported that the project was rewarding as it offered a larger sense of purpose. One participant explained that it “[felt] like you’re building something a bit bigger than yourself, you’re contributing to something.” [P4] The project allowed clinicians to connect and care for patients and families, when medical interventions may have become futile. A nurse shared that, “this is something tangible that you can do to give to people and feel like you are not just left without helping them in some capacity...this lets us help people but just in a different way.” [P6] Another nurse expressed, “it honestly made me feel proud to make change here in the ICU...proud of my coworkers, proud that we could get it up and running.” [P3] The adoption of this patient-centred project empowered clinicians with the resources to provide meaningful and quality EOL care, and reportedly improved job satisfaction.

### *Communication strategies need to expand with project growth*

The initial communication strategies generated immediate momentum as seen in the early staff buy-in and support for the project. A nurse explained that healthcare workers were motivated to engage in the 3WP by “seeing the wishes, and just talking about it more and hearing about other people’s experiences.” [P3]. The ICU manager further described how the ICU first bought into the project. “[The 3WP physician lead] was not expecting the level of ownership and how much it was embraced by [the] core group...[they] really blew our minds with how [they] just took over and ran with it.” [P2]

However, communication and education strategies may not have kept pace with project growth. A nurse commented that, “getting the word out there, I feel was not the greatest. There were only a handful of nurses that seemed to know a lot about it and if they weren’t working then the word wasn’t getting out there.” [P3] The research coordinator described differences in clinician buy-in, “some [were] really on board, some [were] kind of still getting a hand of remembering that 3 Wishes is an option when you have a palliative patient.” [P5]

### *Communication strategies to consider to facilitate project growth*

Participants described three strategies to promote communication as the project grew; increased dissemination of standardized protocols, clinician-centered education interventions, and constant communication. Though protocols were located in nursing stations, more deliberate dissemination was desired. A nurse suggested, “definitely more of a guideline or policy or procedure or something for people to refer to because I think a lot of the staff feel uncomfortable.” [P11] Another nurse advocated for “lunch and learns involving staff,” [P9] and more take-home material including “handing out educational material.” [P9] One common suggestion was that communication intensity should increase as the project grows. A nurse stressed

that, “there was not enough communication surrounding the whole unit and I think that was the biggest barrier.” [P12] Another participant emphasized, “there needs to be better communication to everybody in the staff.” [P2] Participants discussed the importance of “spreading it throughout the unit,” [P2] needing to, “publicize it a bit more just within our own department,” [P2] and “rolling it out to the larger group.” [P2]

### *Abundance in physical resources but lack of human resources for education and data collection*

Participants described the influence of various resources on the project’s implementation. On one hand, the project implementation was well supported by physical resources. A nurse shared, “whether it be funding so we could offer parking passes for our patient’s loved ones or funding so we could buy them something to eat that we otherwise couldn’t do so...it offered resources that allowed us to go that extra step.” [P10] Another nurse reflected, “I think that it provides us with the tools we need to better the EOL experience in the ICU.” [P11] In contrast, the human resources may have been insufficient to facilitate rapid, sustainable widespread expansion. A nurse emphasized the barrier of inadequate staffing, “[it’s] different in terms of even just like people. For example, if you are at a teaching hospital, you have medical students, residents, you have nursing students through the unit more. Perhaps if the bedside nurse has two patients, and he is busy or she is busy with next door but they need help implementing a wish, a resident could do that or they might have more time, because they are learning to talk to the patients and families and have the opportunity to find wishes.” [P6] Many clinicians also mentioned the heavy workload as an ICU staff in which they are “in and out of the room, [they’re] busy, [their] day is filled with tasks.” [P4] Given the shift based nature of the physician lead and frontline champions, there was not always someone who was there to support staff education and data collection. A nurse added that “in other centres they may have somebody that’s just dedicated to doing just 3 wishes and keeping track of this inventory, whereas we don’t have it and it’s kind of piecemeal.” [P6] The lack of mobilization of a non-clinical project support team left the scaling process to be taken up by clinicians who were already working at full capacity. A physician confirmed that, “...Part of it is also the infrastructure of our site in that we didn’t have a horizontal point of care person for a while.” [P4]

### Discussion

This mixed-method study evaluated the implementation of the 3WP in a large community ICU in Canada from the perspectives of the clinicians and key stakeholders. The 3WP was perceived to improve the EOL experience for patients and families by personalizing care and encouraging meaningful conversations. The 3WP also promotes collaboration and job satisfaction amongst the interdisciplinary healthcare team. There is a desire from frontline staff to implement this kind of project, however there needs to be careful consideration of commensurate strategies to facilitate education and delivery including consistent communication to staff as the project spreads. Finally, in a community hospital ICU setting, physical resources can be collected and donated to empower staff to support patients and families through EOL, though limited human resources may strain project implementation as frontline staff take on additional duties beyond their normal workflow.

This study confirms the previously reported benefits of the 3WP for ICU patients, families and clinicians when implemented. Literature supports the findings that this individualized approach provides opportunities for more personalized discussions with families while honouring the patient’s identity and preferences.<sup>9</sup> Similar to implementation outcomes at academic centers, the 3WP serves to make clinical work more meaningful and improves interdisciplinary team cohesion when working towards a shared purpose.<sup>9,21</sup> Moreover, our study adds to current literature by recognizing the complexities involved in implementing an EOL program in a community hospital.

Qualitative results indicate that the project spread was variable in the unit. Spread is defined as the process of communicating and implementing a project within a new environment, and can be influenced by project attributes.<sup>22</sup> Based on the customizable nature of the project whereby the main focus is personalizing care, the key characteristic of the 3WP is that the output – terminal wishes implemented – depend on the patients, families, and clinicians involved in the care. This characteristic, which allows clinicians to be creative in

the process of personalization, likely drives the sense of meaning derived from the project. Conversely, the complexity of implementing both individualized and meaningful wishes likely caps the rate of spread as clinicians are learning ‘in vivo’ a new skill set. Thus, the implementation team must plan and dedicate an additional period of time for ongoing education, practice and re-exposure for optimal retention in the case of a complex intervention.<sup>23,24</sup> Spaced learning with a broader time horizon for implementation may be necessary to integrate this type of project effectively. This may be achieved through multi-modal techniques which take into account infrastructure capability and learning preferences of the clinicians.<sup>23–26</sup>

Another characteristic of the 3WP which may influence spread is the adaptable nature of the 3WP to the setting. Though a community ICU may be able to procure physical resources to support the implementation of the 3WP, there may be a limited rate at which the project can spread given human resource constraints including research project supports. Similar studies found staffing to be an issue when implementing evidence-based projects in community hospitals. Kim et. al implemented guidelines for targeted temperature management after cardiac arrest in 21 community and tertiary care centres and the most frequently mentioned and agreed upon barrier was the lack of manpower and increased workload.<sup>27</sup> In order to facilitate implementation where human resources may be strained, the project adapted to local needs and capacities.<sup>22</sup> In our study, a majority of the completed wishes (37 [55.2%]) relied on physical resources including keepsakes, music, celebrations involving food and beverages, humanizing the ICU room and family care. Keepsakes such as a printed copy of patients electrocardiogram or a computer generated word cloud image, facilitate a personalized memory-making experience for patients, families, and clinicians.<sup>16,28</sup> Moreover, keepsakes are an intervention which are less dependent on clinicians which may facilitate spread, particularly in community-based settings. Thus, spread can be achieved in a community ICU through contextual adaptation focusing on interventions derived from more readily available physical resources, as opposed to interventions dependent on a fixed human resource.

There are several strengths of this study. First, this project explores project implementation in a Canadian community ICU where academic activity is generally less intense, given the lack of institutional mandate, financial support, research experience, and clinician workload.<sup>13</sup> Another strength is exploring the clinician and key stakeholder experience through qualitative interviewing. Understanding the clinician and key stakeholder perspective is instrumental when studying the implementation of the 3WP since they directly deliver the intervention and support the project’s growth and buy-in. Finally, this study explores a project led by frontline staff who were involved in the initiation, adaptation and activation of this project. These findings may help other centers seeking to integrate similar projects at their own sites.

In terms of limitations of this study, only wishes elicited when the 3WP physician lead was on duty were recorded. Though the 3WP operated outside of these specified time periods, data were not collected due to human resource limitations, particularly in dedicated research staff. Patient and family views were not sought since our lens was that of clinicians and key stakeholders at this stage. In addition, one of the qualitative reviewers was a frontline clinician involved directly in the 3WP implementation which may have influenced analysis and interpretation. To attenuate this risk of bias, qualitative analysis was performed in triplicate and results underwent member checking. Finally, this study is a summative description of the implementation process in early stages of spread. Given the short and sparse period of quantitative data, temporal analysis, in the form of run charts or standard process control, relating implementation interventions to project process and outcomes was not performed.

In conclusion, this study describes the implementation of the 3WP in a Canadian community hospital ICU from the perspective of clinicians and key stakeholders. The 3WP is a valuable EOL intervention for patients, families, and clinicians. When implementing the project in the community ICU, investigators will need to consider adaptations to match the nature of the project with characteristics of the environment to facilitate spread.

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### *Conflict of Interests*

Dr. Benjamin Tam and Dr. Jennifer Tsang reports grants from the PSI Foundation during the conduct of the study. Authors not named here have disclosed no conflicts of interest.

### *Authors Contribution*

KL, JT, DC, BT designed the study. KL, MC, AV, EY, ED, JT, BT participated in the implementation of the intervention. MC and EY performed quantitative data collection while EY and KL performed qualitative data collection. EY, LS and BT participated in data analysis, interpretation and drafted the manuscript. All authors have critically reviewed and approved the final manuscript.

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