Using Technology to Create a More Humanistic Approach to Integrating Palliative Care into the Intensive Care Unit

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Abstract

A decade ago, the major obstacles to integration of palliative care into the intensive care unit (ICU) were the limited number of providers trained in palliative care, an immature evidence base, and a lack of appreciation for the importance of palliative care in the ICU. In 2016, the palliative care workforce has expanded markedly and there is growing appreciation of the benefits of palliative care, whether provided by a generalist (intensivist, nurse, social worker) or palliative care specialist. However, there is evidence that the quality of ICU-based palliative care is often suboptimal. A major barrier to more broadly addressing this quality problem is the lack of scalable ICU-based palliative care models that use technology to deliver efficient, collaborative palliative care in the ICU setting to the right patient at the right time. To address these challenges, we first review strengths and limitations of current care models as the basis for our novel conceptual framework that uses the electronic health record as a platform on which external innovations can be built, including: (1) screening for patients at risk for poor outcomes, (2) integrating patient- and family-reported needs, (3) personalizing care, and (4) directing generalist versus specialist triage algorithms. In the approaches considered, we describe current challenges and propose specific solutions that use technology to improve the quality of the human interaction in a stressful, complex environment.

Keywords: critical illness; palliative care; patient-reported outcomes; patient centeredness

Why Is It Important to Improve the Current State of Intensive Care Unit–based Palliative Care?

An Essential Component of High-Quality ICU Care

The definition of palliative care articulates its relevance to intensive care unit (ICU) practice: “an approach that improves the quality of life of patients and their families facing problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual” (1, 2). Although the American Thoracic Society and the Society of Critical Care Medicine have published statements promoting palliative care for patients with critical illness, there are limited details on how best to deliver high-quality ICU-based palliative care (3, 4). Recent work has reviewed evidence for the impact of specialist palliative care in an ICU setting (5–8). The purpose of this article is to examine the strengths and limitations of current ICU-based palliative care models as the basis for discussing two innovative, scalable, technology-based strategies with potential to improve the humanistic delivery of high-quality palliative care in the ICU.

Unmet Patient, Family, and Clinician Needs Exist

Many hundreds of thousands of deaths occur in the ICU or just after ICU-based care in the United States and Europe every year—a number that continues to increase despite the growing use of hospice and palliative care (9–11). In addition to high mortality rates, many critically ill patients suffer from symptoms including pain, breathlessness, and anxiety while in ICUs (12). Family members...
often report poor communication, unsupported decision making, and conflict over end-of-life care (13). Our increasingly shiftwork-driven ICUs are staffed with time-stressed clinicians who are often uncomfortable discussing goals of care and end-of-life care and who commonly report that barriers to discussions about end-of-life care are primarily related to families’ difficulty accepting poor prognoses or the limitations of life support rather than their own communication skills (14). Therefore, it is not surprising that patients and families experience long-term psychological distress (15, 16), clinicians struggle with moral distress and an epidemic of burnout (17, 18), and discordance between patients’ preferred and prescribed goals of care remain similar to that reported 2 decades ago (19). Importantly, patients who ultimately survive the ICU stay and their families may also have important palliative care needs. For example, psychological distress is common among survivors of critical illness and among family members of both survivors and patients who die in the ICU (20). Family members of critically ill patients who survive the ICU are actually less satisfied with clinician communication than family members of patients who die in the ICU (21).

Evidences of Palliative Care Effect—But Room for Improvement in Its Delivery
A growing evidence base that shows ICU-based palliative care interventions can reduce length of stay, the use of low-value care, and psychological distress among family members (5, 6, 22, 23). So, it should be simple: identify those with the greatest needs, and then provide needs-targeted palliative care. Yet in reality, the ICU is a complex system where palliative care specialty consultation is provided to a small number of critically ill patients (<5%) late in their course through a variety of difficult-to-scale models (24–30). Although there has been increasing attention to the importance of palliative care in the ICU, improvement in the delivery of high-quality care in this setting has been limited (31, 32).

**What Are the Barriers to Operationalizing a Scalable ICU-based Palliative Care System?**

It is instructive to evaluate the current quality of ICU-based palliative care through a Donabedian model. This model evaluates the quality of health care through structure (resources, staffing, support), process (stakeholder interaction, clinician–electronic health record [EHR] interaction, eligibility ascertainment), and outcome (quality domains and indicators).

**Structure**
Epidemiological studies estimate that a staggering 19 to 35% of ICU patients could be eligible for a specialty palliative care consultation on the basis of published clinical criteria associated with poor outcomes, also known as “triggers” (see columns 1 and 2 of Table 1) (33, 34). Based on the assumption that an expected poor outcome is a marker of a significant burden of unmet need, trigger-promoted specialist palliative care aims to improve quality of life by using advanced communication techniques to establish goals of care or reduce conflict, helping to manage complex physical or psychological symptoms, providing psychosocial or spiritual support, or assisting those who could not navigate complex systems of care alone (35). Although the number of palliative care specialists in the United States has expanded over the past decade to nearly 4,500 providers, there are far fewer palliative care specialists to patient ratios (1:1,200) than in other specialties (e.g., 1:71 for cardiologists and patients with myocardial infarctions) (36). Furthermore, there is dramatic geographic variation in palliative care access, with around one-third of hospitals lacking this service (36). Also, the palliative care field’s ability to increase its current workforce is limited, because only about 250 palliative care specialists enter the workforce annually (37). Therefore, it would be difficult for many palliative care consult services to manage even a modest-sized subgroup that many would consider appropriate for palliative care consultation, such as those with chronic critical illness (~400,000/yr in the United States alone) (38, 39).

**Process**
Clinicians often practice in poor collaborative care models. Current ICU-based palliative care delivery strategies include consultative, integrative, and mixed models (7). Consultative models generally rely on physician judgment to activate the palliative care consultation. Although this model maximizes intensivist autonomy, variability in physician behavior and attitudes can lead to systematic under- or overutilization of palliative care services (40, 41). There are also complexities associated with “ownership” of medical decision making and 30-day mortality reporting for surgeons that can reduce the proactive use of palliative care services (42, 43). Another potential limitation of consultative models is that palliative care providers often enter the clinical picture late during a time of conflict, may have less knowledge about prognosis and therapeutic choices in comparison to intensivists, and may be uncomfortable in an ICU environment in which their role in the team is unclear. Integrative models include ICU clinicians who have acquired sufficient skills to provide palliative care. In reality, ICU clinicians vary widely in communication and palliative care skills, perhaps in part because current training remains inconsistent (44). ICU staffing is also increasingly shiftwork driven and time conscious, creating a hectic multiprovider environment that may limit explorations of patient values and thoughtful consideration of whether specialist or primary palliative care would be most efficient. The most feasible approach is a collaborative mixed model that directs specialist care to the difficult cases in collaboration with the ICU team yet encourages intensivists and ICU nurses to manage cases independently that are within their comfort and skill level. However, relatively few examples of scalable models of this mixed model have been well described, and none have been documented to improve patient and family outcomes. As a result, in many U.S. hospitals, intensivist–palliative care specialist interactions are often marked by a lack of shared understanding and inadequate interdisciplinary communication (8).

It is difficult to efficiently identify patients most likely to benefit from palliative care services. Most studies exploring routine or proactive palliative care consultation have been activated through clinical screening criteria called triggers (see columns 1 and 2 of Table 1) (5, 45). Parsimonious sets of as few as five triggers can identify more than 85% of ICU patients with poor outcomes, such as early death (33). Because EHRs are used by more than 70% of hospitals, they have unmatched potential as a platform for trigger-prompted interventions. However,
<table>
<thead>
<tr>
<th>Published Trigger Criteria</th>
<th>Problems with Trigger</th>
<th>Published Clinical Characteristic-based Triggers for Palliative Care Specialist Consultation and Proposed Approaches to Their Challenges</th>
<th>Proposed Poor Outcome Phenotype</th>
<th>Proposed Trigger Definition for Phenotype</th>
<th>Advantages of Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU stay &gt; 1 mo (63)</td>
<td>Too uncommon and late in course</td>
<td>Chronic critical illness (38)</td>
<td>ICU for &gt;7 d plus &gt;1 of these: &gt;96 h of ventilation Tracheotomy Sepsis Severe wounds ICH/stroke/TBI</td>
<td>Common</td>
<td>High mortality and cost Prolonged debilitation Multiple readmissions Caregiver burden</td>
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<td>ICU stay &gt; 50% above average (52)</td>
<td>Lacks illness severity/course context</td>
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<td>“Global ischemia” or “anoxia” after cardiac arrest (24, 34, 53)</td>
<td>“Global ischemia” difficult to define</td>
<td>Acute, extremely severe illness (24)</td>
<td>Ventilation &gt;2 d plus &gt;1 of these: Status-post cardiac arrest or... ICH or... Predicted mortality &gt;50% or... Multisystem organ failure (&gt;3 of these): PaO2/FIO2 &lt; 300 Platelet count &lt;100,000/µl Increase in creatinine &gt;2 mg/dl Increase in bilirubin &gt;2 mg/dl Use of vasopressors Brain dysfunction (GCS, RASS)</td>
<td></td>
<td>Common</td>
</tr>
<tr>
<td>Multiple system organ failure (&gt;3 organs) (62)</td>
<td>Complex programmatic algorithm needed</td>
<td></td>
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<td>Large ICH with &gt;5 d of ventilation; ICH on ventilator with anoxia (24, 34)</td>
<td>“Anoxia” hard to define</td>
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<td>Full code with poor prognosis (51)</td>
<td>“Poor prognosis” is ill defined</td>
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<tr>
<td>Active stage 4 cancer (24, 34)</td>
<td>“Active” hard to define</td>
<td>Elderly with poor functional status (33, 34)</td>
<td>Admit from SNF or LTAC or... Ventilation + dementia or... Age &gt;75 + mechanical ventilation</td>
<td></td>
<td>High mortality Continuity of care is generally poor Complex family talks involving other clinicians often needed</td>
</tr>
<tr>
<td>Advanced age with preexisting functional dependence/ comorbidities (24)</td>
<td>Staging of cancer often poorly documented and if so is done in text form</td>
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<tr>
<td>Dementia (34, 55)</td>
<td>Extracting comorbidities during hospitalization is difficult</td>
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<td>Nursing facility resident (34)</td>
<td>Could use EHR problem list, although they are often not updated</td>
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<td>ICU admission after 10 hospital days (24)</td>
<td>Not well defined in EHR typically</td>
<td>Progressive illness trajectory (24, 62)</td>
<td>&gt;3 Hospital readmissions in 6 mo</td>
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<td>High mortality</td>
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<td>Multiple recent ICU admissions (62)</td>
<td>If documented, in text format</td>
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Definition of abbreviations: EHR = electronic health record; GCS = Glasgow Coma Scale; ICH = intracranial hemorrhage; ICU = intensive care unit; LTAC = long-term acute care facility; RASS = Richmond Agitation and Sedation Scale; SNF = skilled nursing facility; TBI = traumatic brain injury.
Challenges to Electronic Health Record–based Trigger Identification of Patients Who Could Potentially Benefit from Palliative Care Consultation and Implications for Building Solutions

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Solutions</th>
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<tbody>
<tr>
<td>EHR-based triggers</td>
<td>Consensus-based, EHR-compatible triggers based on poor outcome phenotypes (e.g., chronic critical illness, severe acute illness, high-morbidity elderly patient); see Table 1</td>
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<tr>
<td>Reliance on unidimensional, arbitrary factors that lack consensus-based acceptance (e.g., ventilation &gt; 1 wk)</td>
<td>Novel technologies such as SMART (63) and FHIR (57) to allow app integration with EHR data and interoperability</td>
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<td>Difficulty extracting from EHRs (e.g., &quot;disparate advanced treatment goals,&quot; &quot;unrealistic goals of care&quot;)</td>
<td>Share strategies and EHR data registry templates using the power of professional organizations (e.g., American Thoracic Society) to unify approach</td>
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<tr>
<td>External electronic tools (e.g., apps) require specialized programmatic interfaces to use EHR data</td>
<td>Bedside digital patient-reported outcomes systems to both perform an initial needs assessment and track outcomes</td>
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<td>Intra-EHR solutions are not interoperable across health systems</td>
<td>Incorporate informational content, question coaches, communication prompts, and other tools</td>
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<td>Governance and collaboration</td>
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<td>Requirement for specialized programming expertise to build digital solutions within or external to EHRs</td>
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<td>Risk of overlap and redundancy in an environment of rapid innovation but siloed system</td>
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<td>Patient and family focus</td>
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<td>Patient/family voice is not incorporated in current trigger-based systems</td>
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<td>Palliative care approach using arbitrary triggers omits many domains of palliative care quality</td>
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<tr>
<td>Patient-centered outcomes are difficult to measure in the context of end-of-life care</td>
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<tr>
<td>Informational deficits about the purpose and potential benefits are common among patients, families, and clinicians alike</td>
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Definition of abbreviations: EHR = electronic health record; FHIR = Fast Healthcare Interoperability Resources; SMART = Substitutable Medical Applications, Reusable Technologies.

Table 2.

Few hospitals are using EHR-based triggers to automate screening, because such “e-triggers” do not yet exist in an optimal format (Table 2). Many triggers are difficult to extract from EHRs because of their subjective nature (e.g., "disparate treatment goals"), whereas others are challenging to ascertain in real time for proactive screening because they rely on information that is not codified until after discharge (i.e., International Classification of Diseases, 10th revision diagnosis codes). A lack of special programmatic expertise or resources necessary to operationalize triggers within a hospital’s EHR environment may be rate limiting as well. In current practice, therefore, trigger-based screening usually requires either active clinician-driven medical record searches or a daily ICU team query—a process that is time intensive and difficult to scale.

Prognosis used as a proxy for palliative care needs may not fully capture actual needs. Triggers based on clinical characteristics can identify patients with poor prognoses. However, these cannot specify the actual presence, amount, or type of palliative care need that may exist. Furthermore, it is not clear that ICU patients and families who meet specific trigger criteria have a greater burden of need than those with other diagnoses, such as acute stroke, trauma, or severe respiratory failure (46). Yet investigating need seems to be an uncommon practice among clinicians, as family members report that they are rarely asked about patient values or their emotional, spiritual, and caregiving needs (13, 14, 31, 47). In the absence of well-characterized need, patients cannot be optimally triaged to either palliative care specialists or primary palliative care by ICU clinicians—a threat to the patient-centeredness of the entire process of care delivery. Furthermore, patients and families may be less likely to accept palliative care specialist presence unless common informational needs, such as addressing misperceptions about the purpose of palliative care (e.g., equating it with end of life or “giving up”), are identified (8, 36). Although there are few efforts to directly assess palliative care needs among critically ill patients and their families, a recent pilot program has begun to assess palliative care needs during daily interdisciplinary rounds (46).

Outcome

A key limitation of ICU-based palliative care, where survival may not be possible and traditional cost-effectiveness analyses may be inappropriate, is the absence of dominant, conceptually strong, and widely accepted patient-centered outcome measures (48). Some have measured concepts clearly important to patient-centered palliative care principles, such as the quality of communication between patients/families and clinicians, the quality of dying and death, family member psychological distress, satisfaction with care, the use of ineffective life-sustaining care interventions, resolution of conflict, and the concordance of known with experienced end-of-life care wishes (49). Given family members’ grief and distress in the weeks to months after the death of a loved one, many drop out during follow up after hospital-based interventions, further complicating outcome assessment. Therefore, ICU length of stay has persisted as a common outcome because of its ease in collection, although it is neither patient centered nor a core palliative care quality metric.

What Are Possible Solutions to Better Operationalizing a Scalable Approach to Targeted, Collaborative Palliative Care in the ICU?

Leaders in palliative care have rightly highlighted the importance of focusing on...
developing “interventions and care models that match existing availability of personnel and are broadly scalable” (50). We would add that a successful system should incorporate elements of sensitivity (i.e., reliably identifying all potentially eligible patients), specificity (i.e., allowing a focus on those who have the greatest unmet needs), and enhancing collaborative ICU–palliative care teamwork. Importantly, we believe that the key attribute of an ideal ICU-based palliative care delivery system necessary to overcome the structure, process, and outcome challenges highlighted above will be the capability to use the EHR (1) to automate the identification of patients at high risk of a poor outcome, (2) to ascertain patient/family-reported needs and outcomes, and (3) to efficiently triage the patient–family unit to the appropriate level of primary (i.e., intensivists, ICU nurses, ICU-based social workers) or specialist palliative care.

**Practical Clinical Examples of Tradeoffs Related to EHR Triggers**

When considering candidate EHR-based processes to operationalize palliative care delivery, it is useful to consider the implications of using different clinical characteristics in light of tradeoffs related to the likelihood of a poor outcome (the traditional trigger criterion), the likelihood of actually needing specialist-level palliative care attention (vs. ICU team–only care), and the feasibility of EHR integration. Specific examples of published triggers may help to elucidate these tradeoffs (Figure 1).

Example 1 represents “unrealistic goals of care” (51). Although this example may describe at least a moderate likelihood of needing specialist care to navigate conflict, it has questionable specificity for certainty of a poor outcome, cannot be feasibly extracted from the EHR, and is neither patient nor family centered. Example 2, ventilation for longer than 1 week (52), is much easier to ascertain in real time from EHRs, although it is not a specific indicator of either palliative care specialist need or certainty of a poor outcome; its ubiquity would present a time burden for specialist consultants as well. Both “global ischemia after cardiac arrest” (example 3) and high likelihood of death based on an ICU-based prediction model (example 4) are highly specific markers of poor outcome (53). Yet, neither trigger is reliably related to palliative care specialist need, and global ischemia is difficult to identify using real-time EHR data. In fact, even identifying the occurrence of an in-hospital cardiac arrest in near-real time in an EHR can be challenging, as it may depend on searching either physician billing documentation or a “code blue” note title; out-of-hospital arrests would likely be omitted. Perhaps a better strategy is illustrated in example 5, in which we identify an elderly patient with chronic critical illness whose family reports conflict with the ICU team. This scenario reflects a strategy that aims to optimize sensitivity, specificity, and patient volume. It does so by first focusing on a clinically intuitive and recognizable patient phenotype (or “profile”) rather than just an arbitrary time period of care. Second, it incorporates an assessment of patient/family need by using patient-/family-reported outcome data (PRO) measures. PROs are patient/family-completed questionnaires that ascertain symptoms, functional status, quality of life, and experiences—that is, they can assess needs as well as outcomes (54). We will expand on this dual EHR- and PRO-based strategy below.

**Operationalizing an Approach to Care for High-Need, Poor-Outcome Patients/Families**

We propose conceptualizing three main strategies for delivering ICU-based palliative care as shown separately in Figure 2: (1) triggers based on prognosis or diagnosis, (2) poor outcome phenotypes plus a palliative care needs assessment, or (3) a needs assessment alone. We examine each strategy by discussing functionalities including screening, intervention personalization, and outcomes assessment.

Strategy 1, the use of prognostic or diagnostic triggers alone to initiate a consultative model of palliative care, reflects the general current state of trigger-based palliative care and also serves as the basis for most of the existing literature examining the benefit of palliative care consultation in the ICU (24, 53, 55). Unfortunately, this typically paper-based strategy poorly leverages EHRs to automate the “heavy lifting” of palliative care eligibility screening because of triggers that may be highly subjective, somewhat arbitrary, and lacking clinical context. Because the voices of patients and family members are not incorporated in the trigger, a process is promoted in which sensitivity likely outstrips accuracy and length of stay generally serves as the chief metric of success.

Figure 1. Examples of palliative care triggers. Axes reflect certainty of need for palliative care specialist, certainty of poor outcome, and feasibility of electronic health record integration. The volume of the box approximates the relative number of patients who likely meet the trigger. Of note, example 5 would require both electronic health record and patient-reported outcome data.
To address the conceptual weaknesses and logistical inefficiencies of strategy 1, we propose two novel approaches (strategies 2 and 3) that use digital solutions to provide a more humanistic, scalable ICU-based palliative care system with smarter screening, collaborative and targeted interventions, and patient-centered outcomes.

First, the nature of the triggers for Strategies 2 and 3 would be based in more clinically recognizable concepts. For strategy 2, triggers are based on poor outcome phenotypes derived from EHR data elements, with “risk stratification” performed through a palliative care needs assessment conducted with a bedside mobile device-based PRO system (Figure 2). A further conceptual advance is that the EHR is used not as a solution itself, but rather as a platform on top of which an external app could be integrated that can display lists of patients meeting these phenotypes along with their patient/family-reported needs as framed by the National Quality Forum’s eight domains of palliative care quality (56). By using novel open-source programmatic approaches both to define poor outcomes phenotypes (Table 1) (57) and to connect EHR data to the app itself, cross-EHR interoperability would be...
possible—and scalability enhanced (58). Strategy 3’s trigger for palliative care delivery would consist solely of a needs assessment gathered electronically at the bedside from patients, families, or even ICU teams. The rationale for such a system is the recognition that deploying palliative care—a discipline focused on symptoms and needs—based instead on a specific diagnosis or prognosis has conceptual and logistical limitations, as discussed above. The simplicity, low cost, optimization of specificity, and requirement for only a mobile device with no EHR component are attractive elements of strategy 3.

Systems 2 and 3 are designed to promote a model of “smart triage” to either generalist or specialist palliative care intervention based on either the quantity or complexity of reported needs—the most feasible approach in light of the specialist workforce concerns described earlier. Simpler informational or decision-making needs could be addressed initially with a portfolio of web-based educational resources curated by the bedside nurse, delivered on the same tablet computer used to measure the need, and reinforced in a family meeting with the ICU team. More complex needs (e.g., conflict resolution, difficult end-of-life decision making) or needs that most ICU teams feel less confident addressing (e.g., spiritual support, psychological distress, anticipatory bereavement, hospice queries) would proactively prompt a palliative care consultation—although one conducted collaboratively with the ICU team’s introduction to the family. The ICU team could also opt out of palliative care consultation if desired for specific cases, though hospitals could monitor performance on provider palliative care quality metrics. Extending the system one step further, the needs assessment data could be imported into the team’s progress note both to document the need and the plan for addressing it.

Strategies 2 and 3 could also represent novel solutions to the challenge of collecting outcomes. The PRO system used to assess in-hospital needs could be used to automate the longitudinal collection of patient- and family-centered outcomes beyond just the standard hospital-centric length of stay and cost metrics, including symptoms, psychological distress, satisfaction, quality of communication, therapeutic alliance, quality of dying and death, and perceived quality of care.

There are a number of potential advantages to Strategies 2 and 3. First, they would attempt to substantially enhance the specificity of a trigger-based palliative care model and also efficiently target personalized care toward reported, not assumed, need. Second, by applying app-based technology, future iterations would be simpler to build and share than within-EHR solutions, and the open source nature of the programmatic approach would encourage innovation from an international audience—rather than limiting it to a small group of developers with specific EHR vendor allegiances. Third, these systems could include a patient- and family-facing digital hub that includes resources known to be effective (information, navigators, question coaches, support groups) (23, 59). Last, a peripheral cultural benefit would be the promotion of a common language of need rather than the disparate parlance of ICU teams (“the APACHE II score is 30”), palliative care providers (“the Palliative Performance Status score is 50%”), and patients and families (“I need help to resolve the conflict between my brother and sister about the life support decision for our father”).

**Limitations and Concerns about These Proposed Systems**

First, an important barrier to success for this approach could be resistance from ICU clinicians, who often have strong negative or positive feelings about the role of palliative care specialists. Resistance from family members who may object to yet another clinician’s involvement could be problematic as well. However, we believe that these attitudinal barriers are decreasing with the expansion of primary and specialty palliative care in our health care system and the growing public acceptance of palliative care principles (36, 60). Second, a current barrier for many health systems is lack of quality EHR, a reality that also required manual screening to conduct nearly all of the existing ICU-based palliative care trigger research. Third, the success of new approaches to electronically triggered palliative care delivery will depend on the demonstration that they can promote more collaborative generalist and specialist care—and that they improve patient and family outcomes. The framework proposed in this article articulates feasible strategies that can be evaluated for effectiveness. Fourth, a danger of any technology-based tool or intervention is rapid obsolescence. Although European EHR vendors have not finalized the specifics of the programmatic approach we describe, the Centers for Medicare and Medicaid Services, the Veterans Administration, and various United States–based EHR vendors support the platform, suggesting that it is a sustainable direction (61). Furthermore, the current strategy of open source build encourages users to iteratively improve it with time. Fifth, we recognize that relying exclusively on patient- or family-reported need, absent the contextual framing of clinical factors like prognosis, could unnecessarily trigger a palliative care consultation for temporary reactions to a stressful situation. These concerns could be allayed to some extent by application of the needs assessment after 2 to 3 days of ICU care. Last, digital security is always a concern. However, these tools and technologies can be successfully hosted behind institutional firewalls and link family reports to patient data with one-way data flow and identifier-free login.

**Conclusions**

This is a time of great opportunity for ICU-based palliative care. There is an increasing awareness of the importance of integrating palliative care into the ICU setting. However, there is also evidence that many opportunities for providing it are missed—in part because of a lack of well-described delivery models that are easily scalable, efficient, patient-centered, and collaborative. Given the limitations of the palliative care specialist workforce along with most ICU clinicians’ continued interest in providing primary palliative care, it will be essential to develop automated systems that identify patients at risk for poor outcomes, ascertain patient- and family-reported need, and facilitate mixed models of collaborative patient-centered care.

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