Official Title: Operationalizing PCplanner, a Needs-focused Palliative Care for Older Adults in Intensive Care Units: a Randomized Clinical Trial

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Study Title: Operationalizing Needs-Focused Palliative Care for Older Adults in Intensive Care Units (ICU)

Short Title: PCplanner

Study Design: Randomized Controlled Trial (RCT)

Version 5.1 dated 13 June 2022

Study Site(s):

Duke University Hospital
2301 Erwin Road
Durham, NC 27710

Duke Regional Hospital
3643 N Roxboro St
Durham, NC 27704

Duke Raleigh Hospital
3400 Wake Forest Rd.
Raleigh, NC 27609

Principal Investigators
Christopher E. Cox, MD, MPH
Division of Pulmonary Allergy & Critical Care
Box 102043
Durham, NC 27710
Phone: 919-681-7232
Email: christopher.cox@duke.edu

Sharron Docherty, Ph.D.
School of Nursing
BOX 3322
Durham, NC 27710
Phone: 919-668-3836
Email: sharron.docherty@duke.edu

Study Sponsor: National Institute of Aging (R01)

IRB Number: Pro00101745

Table of Contents

Abbreviations and Definitions

- Adverse Event (AE)
  - Any untoward medical occurrence associated with or observed in the context of a study procedure. For this study and patient population, an AE will be considered any suicidal ideation. No other events will be considered AEs as this patient population is ill and it is expected that other untoward medical occurrences will occur.
- Clinical Trial Management System (CTMS)
  - For this study, a CTMS known as OnCore will be utilized to manage the study's administrative responsibilities and subject level documentation.
- Duke Raleigh Hospital (DRaH)
  - Study site in which eligible patients will be enrolled.
- Duke Regional Hospital (DRH)
  - Study site in which eligible patients will be enrolled.
- Duke University Hospital (DUH)
  - Study site in which eligible patients will be enrolled.
- Electronic Data Capture (EDC)
  - For this study, the EDC will be REDCap, which is a secure, Duke approved EDC platform in which relevant study data, such as screening, enrollment, and clinical variables will be documented.
- Electronic Health Record (EHR)
  - Used interchangeably with EMR; the EHR is the patient-specific medical record located in the secure MaestroCare (aka: EPIC).
- Electronic Medical Record (EMR)
  - Used interchangeably with EHR; the EMR is the patient-specific medical record located in the secure MaestroCare (aka: EPIC).
- Electronic Patient Reported Outcomes (ePRO)
  - ePRO can be used to describe study source, such as the patient-completed surveys (e.g., PTSS), or can refer to the system that houses patient-derived data. For this study, ePRO may refer to the surveys OR it may refer to the system which houses the patient-derived data, which is the web application known as "PCplanner."
- General Anxiety Disorder-7 (GAD-7)
  - Anxiety symptoms
- Intensive Care Unit (ICU)
  - Defined as any medical, surgical, trauma, neurological, cardiac, or cardio-thoracic unit in which a patient is receiving cardiac or respiratory support for survival means.
- Institutional Review Board (IRB)
  - Ethical and regulatory committee who provides approval and oversight of clinical trial at study site.
- Manual of Operating Procedures (MOP)
  - A document detailing instructions for a specific task or set of tasks; often used to ensure consistency and accuracy among the study team.
- National Institute of Aging (NIA)
  - Study Sponsor, branch of the National Institute of Health (NIH)
- NEST (Needs at the End of life Screening Tool)
  - Needs assessment.
- PCplanner
  - A novel web application developed by DHTS and external vendor, One Cow Standing, LLC (Durham, NC) that interfaces with the EMR on a daily basis, pulling relevant clinical data from patients admitted to an ICU setting that meet general study criteria. The web

application serves as the technological platform by which the study is to be conducted and the primary data (e.g., surveys) are completed by enrolled subjects.

- Patient Health Questionnaire-9 (PHQ-9)
    - Depression symptoms
- Post-Traumatic Stress Scale survey (PTSS)
    - PTSD symptoms
- Protocol Deviation (PD)
    - An inadvertent event or event this is out of the control of the study team and/or the subject that occurs outside of the study protocol design and/or procedures.
- Protocol Violation
    - An act of intentionality that is committed by the study team and/or the subject that occurs outside of the study protocol design and/or procedures.
- System Usability Scale (SUS)
    - Usability scale used to measure usability of web-application.
- Serious Adverse Event (SAE)
    - Defined as an adverse event that is both serious and expected in nature; the event may have a reasonable possibility that it is related to a study. SAEs for this study are defined as a suicide attempt, a hospitalization, or death.
- Suicide Ideation (SI)
    - The idea of committing self-harm and/or the intent to act on the idea of committing self-harm.
- Unanticipated Problem (UP)
    - Any other event, not meeting the definition of PD, UP, AE or SAE that, in the opinion of the principal investigator, merits documentation as it occurred outside the expected design of the study and/or study procedures. These events, like PDs, UPs, AEs, or SAEs, may be reported to the IRB and/or the study sponsor, as applicable.

Clinical Protocol Synopsis

1. Title
PCplanner: operationalizing needs-focused palliative care for older adults in intensive care units

2. Background
The number of older adults who receive life support in an ICU (currently 2 million per year) is increasing while survival remains unchanged. Yet the quality of ICU-based palliative care is highly variable across clinicians and hospitals. Namely, older adults often suffer from untreated symptoms in a technology-focused setting; many caregivers (i.e., family members) report poor quality communication and decision making, and clinicians struggle to connect with each other in a shiftwork environment. Additionally, there are process barriers to improving the delivery of high quality palliative care which include difficulties in efficiently identifying older adult patients and family caregivers with the greatest burden of unmet palliative care needs, engaging family decision makers, and coordinating care by ICU teams and palliative care specialists.

To address these barriers, a mobile app platform prototype called PCplanner (Palliative Care planner) has been developed for patients, their family members, and clinicians. PCplanner directly captures EHR data to automate the identification of older adults with palliative care needs based on clinical characteristics such as dementia and declining health status. The app engages families as partners in their loved one's care by facilitating in a self-report of actual needs. Additionally, the app provides a scalable digital infrastructure for coordinating needs-targeted care from collaborating ICU teams and palliative care specialists. In pilot work, PCplanner reduced unmet needs, psychological distress, and length of stay while increasing goal concordant care, communication, and hospice utilization. While these data are promising, the intervention requires a rigorous evaluation of efficacy.[1]

3. Study Design
This is a 5-year, randomized controlled trial (RCT) that aims to test a native, novel web application called "PCplanner" developed by an external technology vendor, One Cow Standing. PCplanner directly captures EHR data to automate the identification of older adults with palliative care needs based on clinical characteristics such as dementia and declining health status. The app engages families as partners in their loved one's care by facilitating in a self-report of actual needs. Additionally, the app provides a scalable digital infrastructure for coordinating needs-targeted care from collaborating ICU teams and palliative care specialists. The project specifically intends to randomize 150 older patients aged ≥50years, their 150 self-described family members, plus their ICU clinicians to determine if the intervention can improve family-reported unmet palliative care needs compared to standard of care.

Study Aims
The project will operationalize this goal by completing three specific aims, which are described below:

- ***Aim 1:*** Optimize the usability of the PCplanner mobile app, specifically for older adults. *Approach and goal:* To optimize the PCplanner mobile app platform before Aim 2's clinical trial, key features will be added, based on user testing feedback, compatible for older adult caregivers and clinicians. Iterative revisions based on usability participant feedback will be performed until the app platform achieves 'excellent' usability (i.e., mean Systems Usability Scale (SUS) score >60).
- ***Aim 2***: Test the PCplanner intervention's efficacy vs. usual care in a randomized clinical trial (RCT). *Hypotheses:* Compared to usual care at 8 days post-randomization, PCplanner-augmented care will improve family-reported unmet palliative care needs. It will also improve short-term and long-term (3-month) secondary outcomes among family caregivers

(psychological distress symptoms, quality of communication), patients (receipt of goal concordant treatment), and health systems (length of stay). *Approach and goal:* In academic and community medical center settings, the study team will test these hypotheses among the family caregivers of medical and surgical ICU patients with dementia, declining health status, poor functioning, and other characteristics common to the aging experience.

- ***Aim 3:*** Explore family caregiver and clinician RCT experiences to characterize how these participants may have been impacted by intervention components in a variety of implementation contexts, with a goal of understanding intervention mechanisms and barriers to future implementation and dissemination. *Approach and goal:* Using a mixed methods approach, we will integrate findings from both qualitative analysis of semi-structured interviews via telephone with family caregivers and clinicians as well as quantitative family caregiver, patient, and care process outcomes. This will provide insight into mechanisms of action and highlight methods for future intervention optimization through enhanced personalization, replicability, and scalability—all factors that are critical to successful implementation and dissemination of the intervention.

Primary and Secondary Outcomes

All outcomes have been piloted by the Duke University study team and chosen based on the conceptual model, expert recommendations, and psychometrics (Table 1).[2-4] Response burden will be minimized with short instruments and online data entry via ePRO.[5] Pilot testing confirmed completion in 15-20 minutes and demonstrated that all outcomes were responsive at levels of clinical significance.[1] Data will be collected at pre-randomization baseline (T1 Data Collection) as well as 4 days (T2 Data Collection), 8 days (T3 Data Collection), and 3 months (T4 Data Collection) post-randomization.

Primary Outcomes

For Aim 1, usability will be assessed with the SUS [6] and analysis of semi-structured interview transcriptions, while acceptability will be measured with the Client Satisfaction Questionnaire (CSQ-8).[7]

For Aim 2, the primary RCT outcome will be unmet palliative care needs at T3 (8 days post-randomization) as reported by family caregivers using the Needs; Existential concerns; Symptoms; and Therapeutic interaction (NEST) scale.[1,8,9] The NEST, which assesses palliative care needs among both critically ill older adult patients and their family caregivers (and is completed by family caregivers), is the primary trial outcome and T3 is the primary timing of its measurement.[9] The NEST's 13 items (score range 0-130) sample each of the National Consensus Project's eight domains of palliative care quality.[10] The main patient-level outcome will be the receipt of goal concordant care at T2.[11,12]

Secondary Outcomes

Secondary outcomes will include family caregiver psychological distress symptoms measured with the PHQ-9 (depression),[13] the GAD-7 (anxiety),[14] and the PTSS (PTSD) at survey 3 (T3) (1 week post-randomization) and survey 4 (T4) (3 months). Systems outcomes will include post-randomization length of stay (LOS), use of aggressive care, discharge disposition, and hospice use.[15,16] Clinicians will complete a brief palliative care attitudes scale at the time of consent.[17] Aim 3's analysis of facilitators, barriers, and mechanisms will be based on transcribed semi-structured family and clinician interviews.

Study Overview

Aim 1

The previous pilot showed compelling results, but also identified targets that could substantially improve app functionality. However, changes in an app's user interface or function, regardless of intention, can influence intervention delivery, data validity (e.g., ePRO system), as well as *usability*—the quality of the user's experience across domains of ease of use, efficiency, memorability, error rate, and

satisfaction.[18-20] Usability testing is a critical procedure because it can identify any problems proactively, using lessons learned to improve the software before its introduction in a clinical trial setting.[1,19,21] Therefore, Aim 1, a cross-sectional refinement (*not* developmental) study involving 10-15 participants, will aim to improve efficiency, memorability, satisfaction, and overall decrease error rate. Participants eligible for this portion of the study will be healthy volunteers, specifically Duke employees, at least 18 years of age or older. Aim 1, completed concurrently with Aim 2 startup tasks, will target three key areas:

1. Engagement and personalization: the study team will enable a 'Recommender System' to improve user experience including reminders and notifications, dashboard views unique to study role (e.g., CRC vs. clinical teams), enhanced visualization of needs data, single-click ICU team approval for study team members to approach families, and hovering box feedback in response to user-completed tasks.
2. Security: The Duke Health Technology Support team will ensure that the app system's security adheres to current standards throughout the course of the trial.
3. Interoperability: Standards will be used for EHR triggers with the assistance of DHTS ACE team programmers.

Aim 2

The primary focus of the project is Aim 2, the RCT. Therefore, the majority of study activity will center on this particular aim. The study workflow is shown in Appendix 1.

As noted above, patients' self-described family members will be enrolled in this project. The family members are the primary research subject of focus in that they will be asked to sign and date the informed consent for this study, undergo app registration, and complete a baseline survey (T1) for eligibility and subsequent randomization. If deemed eligible to continue in the study, as determined by their NEST score, each family member will be randomized to one of two study arms:

- ***Arm 1—PCplanner intervention***: individuals randomized to this arm are considered to be "intervention". All individuals who are randomized to this arm will have their survey 1 (T1), survey 2 (T2), and survey 3 (T3) results shared with the attending ICU clinician (and possibly palliative care clinician for non-responder intervention participants) on service at the time of consent via an automatic, electronic notification from the web application. After the receipt of survey 1 (T1) results, the ICU clinician will conduct a one-on-one family meeting prior to survey 2 (T2) completion by the family member. The purpose of this meeting is to discuss and attempt to address the needs reported by the family member. Should the family member continue to report high needs at the completion of survey 2 (T2), defined as a NEST score of ≥25 or T2 NEST score > T1 NEST score, a formal Palliative Care team consult will be sought by the clinical team for the family member in an attempt to discuss and address the reported needs.
- ***Arm 2—usual care control***: Control family caregivers will receive usual ICU care that does not include a protocolized palliative care consult. Data collection will be identical to the intervention group (email/text links with unique URLs integrated with the trial data system), though data reported by family members will not be visible in the PCplanner dashboard or otherwise available to clinicians. Each usual care participant will be provided with telephone and email contacts for study staff to answer questions or address urgent distress. A palliative care specialist consult is allowed for any control patient or family caregiver if ICU clinicians believe it is needed. All such crossovers will be recorded (as will the total number of palliative care-family interactions).

Randomization will be stratified by three variables:

- Department location at the time of ICU admission and informed consent (i.e., Medical versus Surgical)
- Palliative Care Trigger type (i.e., Acute versus Chronic; see Appendix 2)
- Baseline NEST score (i.e., ≥25 vs. <25 but ≥10)

All family members, regardless of their randomization arm will be asked to complete a total of four surveys, as listed below (see Appendix 3 for survey timeline):

- T1: to be completed within 72 hours of informed consent; study day 1
- T2: to be completed on study day 4
- T3: to be completed on study day 8
- T4: to be completed on study day 90

Surveys are completed remotely and electronically via the web application by the enrolled family member. Reminders are automatically provided by the PCplanner platform to the family members via email and/or text alerts to complete the surveys (Appendix 4).

Patients enrolled into this study, at the consent of their legally authorized representative (LAR), will passively participate in the study. Passive participation includes allowing the study team to access and abstract relevant clinical data from the patient's EMR. The clinical data abstracted for the purposes of this research project will be housed in the secure, EDC (REDCap).

Clinicians, whether ICU attending or Palliative Care, will be asked to complete a baseline survey at the time in which informed consent is obtained. The baseline survey will collect relevant information from the clinician, such as sociodemographic and professional information, as well a contact information (e.g., email address and cell phone number). Clinicians, who are assigned to an intervention family, will receive automatic text and/or email alerts via the web application informing them of the completed survey(s), reported needs, and the need to complete a family meeting.

Aim 3

Each month during Aim 2's RCT, we will purposefully sample up to 30 patient cases; a patient case being defined as 1 family caregiver and the associated clinician(s) from the intervention group.[22,23] The sampling will be stratified to ensure variability in factors that may influence experiences relevant to patients (e.g., trigger type), family caregivers (i.e., gender, race, age, confidence with technology, baseline NEST), and clinicians (i.e., medical vs. surgical). Each patient case selected will be asked to undergo a single 30-minute semi-structured interview with each case participant conducted at T2 that focuses on exploring the participant's experiences with core intervention components and palliative care processes.[24,25]

4. Study Population

Eligibility apply to participants in all study Aims with the exception of Aim 1 in which healthy volunteers will be asked to test the usability of the web application. Healthy volunteers for Aim 1 will be recruited Duke employees. Briefly, inclusion criteria for *patients* and *family caregivers*, defined as the individual (related or unrelated) who provides the most support and with whom the patient has a significant relationship. Although only one family caregiver per patient is eligible, other family can participate in family meetings if they wish. Patients' bedside *ICU clinicians* on the day of family consent are eligible. P*atient* exclusions include previous palliative care consult. *Family caregiver* exclusions are low need burden (NEST <10) and lack of English fluency (the app is not validated in other languages).

Patients

Inclusion Criteria (pre-consent, patients)

1. ≥50 years of age.
2. Receiving care in an adult ICU for >24 hours.
3. Meets >1 of 9 high risk phenotypes listed below:
    a. Dementia (e.g., Alzheimer's, multi-infarct, other dementia etiology)
    b. Declining health status defined as EITHER:
        i. > 2 hospital admissions in 3 months preceding current admission
        OR
        ii. > 1 ICU admission in 3 months preceding current admission
    c. Poor functional status defined by EITHER:
        i. Admission from a skilled nursing facility (SNF) or long-term acute care (LTAC) facility.
        OR
        ii. > 3 activities of daily living (ADL) limitations at admission.
    d. Severe acute illness defined by EITHER:
        i. Cardiac arrest
        ii. Multi-system organ failure (> 3 of: lung, kidney, hematological, brain, cardiac, or liver) that has worsened over 48 hours (i.e., Sequential Organ Failure Assessment [SOFA] score increased during this time period)
    e. Severe acute stroke (e.g., acute intracranial hemorrhage, ischemic stroke, or traumatic brain injury).
    f. Acute respiratory failure, defined as any of the following:
        i. Mechanical ventilation $\geq$ 24 hours
        ii. Any single use of O2 device, listed below, or combination of O2 devices used in $\geq$ 24 hours from time of ICU admission:
            1. Nasal cannula with O2 flow $\geq$ 6 liters per minute (LPM)
            2. Facemask oxygen (e.g., partial re-breather, non-rebreather)
            3. Non-invasive ventilation (BiPAP or CPAP)
            4. High flow nasal cannula
    g. Acute renal failure (new hemodialysis or continuous venovenous hemodiafiltration for > 1 hour)
    h. Advanced cancer (Advanced/metastatic cancer diagnosis)
    i. Shock (use of vasopressor or inotrope for > 4 hours)

Exclusion Criteria (pre-consent, patients)

1. Palliative care consultation performed during the hospitalization before eligibility determination.
2. Current admission to the ICU at the index hospital is >8 days.
3. Patient is imprisoned.
4. Patient has no known family or surrogate decision maker.
5. Death is expected to occur within 24 hours.

Exclusion Criteria (post-consent, patients)

1. Patient dies before T1 completion.

Family members

Inclusion Criteria (pre-consent, family member)

1. Family member is > 18 years of age.
2. Self-described as the individual (related or unrelated) who provides the most support and with whom the patient has a significant relationship (per definition of 'family' described in the Society of Critical Care Medicine 2016 Guidelines for Family-Centered Care in the Neonatal, Pediatric, and Adult ICU).

Exclusion Criteria (pre-consent, family member)

1. Lack of English fluency such that the potential participant and/or study team is not confident that they could complete study tasks (app viewing, surveys).
2. Family member is imprisoned.
3. Family member is unable to complete study surveys for any reason.

Exclusion Criteria (post-consent, family member)

1. Low need burden (NEST score < 10) at the completion of survey 1 (T1).

Clinicians

Inclusion Criteria (ICU Physicians)

1. ≥18 years of age.
2. Physician must be the attending or fellow physician of the eligible patient in the given study ICU.

Exclusion Criteria (ICU Physicians)

1. Not applicable; there are no factors excluding an ICU physician from participation.

For aim 3, individuals who participated in aim 2 will be eligible for participation should they denote on their informed consent they are willing to be contacted for future research.

5. Study Procedures

As noted above, this study is centered on Aim 2, therefore, study procedures detailed below are focused on Aim 2 of the project. However, for Aims 1 and 3; the study team will be expected to maintain screening and enrollment logs, complete informed consent, and also required to maintain relevant study documentation, as outlined in the study MOP(s).

Screening, Recruitment and Informed Consent

Screening for eligible patients will occur daily via the native web application, PCplanner by delegated study team members. PCplanner was developed to integrate with the EMR, MaestroCare, by “calling” to the EMR via an application programming interface (API) which retrieves patients’ clinical information that preliminarily meet study eligibility criteria. The study team will maintain a robust screening log of all patients reviewed and document the following (at a minimum):

1. Date screening occurred.
2. Whether or not the individual was eligible for the study.
    a. Reason for ineligibility, if applicable.
3. If the individual was approached for consent.
    a. Reason not approached for consent, if applicable.
4. Outcome of consent.
    a. Declined, reason for decline, and date of decline.
    b. Consent, date of consent, and consent version number.

For those patients who are eligible to consent, the study team will either 1) release the patients, via the web application, to the attending ICU clinician (note: if the ICU clinician is not consented, the study team will be required to consent the ICU clinician prior to any further study activity) or 2) automatically approach the eligible patient/family dyad for consent if the clinician has opted out of reviewing the patient/family dyad prior to approach. If scenario 1 is being utilized, the ICU clinician will be asked to review the patient via the web application and determine if they are eligible for recruitment. If the ICU clinician denies the patient, the study team will not approach the patient’s family member for consent (unless otherwise discussed by the study team and the clinical care team). If the ICU clinician approves the patient, the study team will recruit the family member in-person using the traditional method of informed consent or remotely using an approved telephone script. If scenario 2 is utilized the study

team will mark the family automatically mark the family as “approved” and approach the patient/family dyad for consent. Regarding of the scenario for recruitment, all family members will be approached at the time of their loved one’s ICU admission. Also, physicians will be texted by the study team noting that they will approach a patient allowing them to say ‘no’ if they choose.. If a patient has decision-making capacity at the time of recruitment, he/she will be approached for consent, in addition to the family member. All individuals approached for consent to the study will be informed at the time of recruitment that research is voluntary and they do not have to participate if they do not want to. Furthermore, they will be informed that participation will not affect their loved one’s care positively or negatively. If a family member chooses to not participate, he/she will be documented as a ‘declined’ individual and the date of decline, as well as reason (if available) will be documented. Should a family member be approached and opt to consent, they will be asked to complete the app registration and survey 1 (T1) within 72 hours of consent. Eligibility to continue study participation will be determined automatically via an automated, electronic scoring system built within the web application. Additionally, if the individual is eligible to continue study participation, randomization to one of the two study arms will occur automatically and simultaneously. The study team and the family member will be alerted of the family member’s study status and randomization arm assignment. As with screening, the study team will be required to maintain a robust enrollment log includes the following information (at a minimum):

1. Patient Information (i.e., name, MRN, location of enrollment, race, gender, ethnicity) and Family Member Information (i.e., name, DOB, race, gender, ethnicity).
2. Consent, date of consent, and consent version number.
3. Study status (including randomization arm, assigned clinician, withdraw, lost to follow-up, study completion)
4. Death (Patient and/or Family Member), including date

It is important to note that for this study, there are several statuses a family member (and thus patient) can have. They are listed below:

- **Screened (in screening or screened):** defined as any patient who’s EMR has been reviewed against protocol for eligibility purposes. Individuals who are assigned this status must be noted on the screening log.
- **Excluded**: defined as any patient’s who’s EMR has been reviewed against protocol for eligibility purposes, but is found to not meet eligibility criteria, as determined by the study team. Individuals who are assigned this status must be noted on the screening log.
- **Released:** defined as any patient’s who’s EMR has been reviewed against protocol for eligibility purposes and is determined to meet eligibility criteria, as determined by the study team. These individuals are sent to the ICU attending clinician to review and either APPROVE or DENY. Individuals who are assigned this status must be noted on the screening log.
- **Approved:** defined as any patient who is RELEASED by the study team for clinician review and is ultimately determined to meet eligibility criteria and is appropriate for recruitment, as determined by the ICU attending clinician. Individuals who are assigned this status must be noted on the screening log.
    - Note: should the ICU attending opt out of approving each patient/family dyad for recruitment within the web application the study team will automatically “approve” the patient/family dyad and attempt consent.
- **Denied:** defined as any patient who is RELEASED by the study team for clinician review and is ultimately determined to not meet eligibility criteria and is not appropriate for recruitment, as determined by the ICU attending clinician. Individuals who are assigned this status must be noted on the screening log.
- **Consented**: defined as any patient who is both RELEASED and APPROVED, their family member is approached for consent, and voluntarily chooses to consent to the study, the

procedures, risks and benefits with the understanding that they may withdraw at any time. A signed/dated informed consent must be on record to account for this individual. Family members who reach this status will be required to complete survey 1 (T1) within 72 hours of informed consent. Individuals who are assigned this status must be noted on the enrollment log.

- **Refused**: defined as any patient who is both RELEASED and APPROVED, their family member was approached for consent, but opted to not consent and therefore participate in the study. Patients who are assigned this status must be noted on the screening log.
- **Randomized**: defined as any family member who's loved one has the statuses of RELEASED, APPROVED, and CONSENTED, the family member completes T1 survey, and continues to meet all eligibility criteria. Family members who reach this status will be required to interact with the app three additional times (i.e., completion of T2, T3, and T4). Additionally, if the family is randomized to Arm 1, they will be required to participate in at least one family meeting conducted by the ICU attending. Patients and family members who are assigned this status must be maintained on the enrollment log.
    - **Responder:** defined as any family member who is randomized to the intervention arm and upon completing survey 2 (T2) received a NEST score of <25 and their survey 2 (T2) score is less than their survey 1 (T1) score. Individuals who are assigned this study status will not receive a Palliative Care consult by the Palliative Care clinician. Only the ICU attending will be able to view the survey results.
    - **Non-responder:** defined as any family member who is randomized to the intervention arm and upon completing survey 2 (T2) received a NEST score of >25 or their survey 2 (T2) score is greater than their survey 1 (T1) score. Individuals who are assigned this study status are to receive a Palliative Care consult by the Palliative Care clinician. The family member's survey results will be viewed by both the ICU attending and the Palliative Care clinician.
- **Screen Failed:** defined as any family member who was consented to the study, completes survey 1 (T1), but DOES NOT receive a NEST score of ≥ 10 on completion of survey 1 (T1). Patients and their family members who are assigned this status must be maintained on the enrollment log.
- **Withdraw by PI or Self:** defined as any family member who voluntarily consents to participate in the study, but is then withdrawn from the study. The PI may withdraw a participate at any time without their consent if the PI deems it is in their best interest to no longer participate OR the individual demonstrates lack of compliance with study protocol and study procedures. Family members who reach this status have no additional follow-ups or study requirements; no further clinical data will be abstracted from the patient's EMR. Patients and family members who are assigned this status must be maintained on the enrollment log.
- **Lost to Follow-Up (LTF):** defined as any family member who voluntarily consents to participate in the study but after non-compliance and at least 3 documented, attempted contacts appropriately spaced 1-5 days apart, the family member will be considered LTF. Patients and family members who reach this status have no additional follow-ups or study requirements. Patients and family members who are assigned this status must be maintained on the enrollment log.
    - A family member who returns the study team's contacts within 1 week of last attempted contact may resume study participation.
    - A family member who has completed at least T1, T2, and T3 will be included in the overall target enrollment, even if deemed LTF for T4.
- **Completed:** defined as any family member who both consented and randomized to the study and completed T1-T4 (or at least 75% of the surveys). Family members and patients who reach this status have no additional follow-up or study requirements. Family members and patients who are assigned this status must be maintained on the enrollment log.

Study data collection
Each consented family member will be asked to complete four surveys, as well as up to two meetings (for intervention group participants). Appendix 4 shows the timeline and acceptable time frames within which survey responses are allowed. Note that some latitude is provided given the possibility for weekends, etc.

- **Baseline, Survey 1 (Day 1; up to 3 days allowed post-consent):** this will occur generally on the day of consent. At this time, the following will occur:
    - App Registration
    - Survey 1 (T1) Completion
    - Randomization (if eligible)
- **ICU Family Meeting for intervention group:** The ICU attending will initiate a one-on-one family meeting to discuss the reported family needs. This is to occur prior to the completion of Survey 2 (T2).
- **Survey 2: (Day 4; up to 4 days allowed post-randomization)**
- **Need-focused Palliative Care Family Meeting for intervention group:** As noted above, this meeting will be triggered by a family member's T2 NEST score that is either ≥25 or higher than their T1 NEST score. The ICU attending and the Palliative Care team will meet with the family member together if at all possible to discuss the reported family needs. This meeting is to occur prior to the completion of Survey 3 (T3).
- **Survey 3: (Day 8 up to 4 days allowed)**
- **Survey 4: (Day 90; up to 28 days allowed)**

At each specified time point above, the study team will abstract, as needed, relevant clinical data, as defined in the study EDC manual of procedures (MOP) and enter into the EDC, REDCap.

Compensation
Compensation for study participation will be provided to each family member via Greenphire. Participants may receive up to a total of $60 for study completion:

- T1: $15.00
- T2: $15.00
- T3: $15.00
- T4: $15.00

Compensation for study participants in aims 1 and 3 will also be provided. Participants who partake in aim 1 or 3 will receive a one-time payment of $15.00 for the completion of the single study visit.

6. Subject Participation Duration: For those subjects enrolled in Aims 1 and 3, we anticipate their study participation consisting of only one study survey, which will last for 30-60 minutes. For the RCT (Aim 2), it will require 3 months for participants to complete the entire study from the time of randomization, including the intervention and all the follow up surveys.

7. Enrollment sites
This study will be conducted at Duke University Health (DUH), Duke Regional Hospital (DRH), and Duke Raleigh Hospital—all sites within the Duke University Health System.

8. Statistical Design, Analyses, Sample Size and Power
Statistical Design and Analyses Plan
Aim 1

After programming is complete, the study team will determine PCplanner usability using a 'system-user-task-environment' mixed-methods approach.[1,5,19,26-28] The study team will interviews with healthy volunteers to determine app usability. During the single 30-minute sessions participants will complete: a 'think aloud' protocol in which CRCs record comments as PCplanner is used;[30] a semi-structured interview, and the 10-item (0 [lowest] to 100 [highest]) industry-standard Systems Usability Scale (SUS).[31] App revisions that address the needs of all users.[32] The study team anticipate 2-3 cycles of 5-10 users each will achieve our testable hypothesis that PCplanner will attain a mean SUS score >60 ('excellent' usability). [33,34]

Aim 2

We will test the primary study hypothesis that the NEST score is lower (i.e., fewer unmet needs) for intervention family caregivers compared to usual care at T3 (~1-week post-randomization). All participants will be analyzed as part of the group they were assigned, regardless of adherence or crossover status (i.e., intention to treat). We will use a general linear model to estimate mean NEST changes and corresponding confidence intervals over time using SAS PROC MIXED (SAS Institute, Cary NC). Different correlation structures will be examined (e.g., unstructured, autoregressive) and model fit indices will be used to guide the choice of the final model's structure.

Analyses similar to those conducted for the NEST (primary outcome analyses) above will be performed for the secondary family caregiver hypotheses involving PHQ-9, GAD-7, and PTSS scores at T3 and T4. While family caregivers will be interviewed at T4 regardless of patient survival, patient death could complicate the analyses in two key ways: (1) Presence of missing data due to family loss to follow up (i.e., non-random missing data) and (2) differences in family caregiver distress by patient survival status (i.e., heterogeneous effect).[35] To address the impact of patient death on outcomes, after first exploring reasons for and predictors of dropout, we will conduct a 2-step supplemental analysis. In Step 1, missing T4 data due to loss to follow up among family caregivers of survivors will be multiply imputed via SAS PROC MI. In Step 2, we will account for T4 outcomes that are missing due to death via composite endpoint and principal stratification methods to estimate the causal effects of the intervention in the presence of these unidentified outcomes and complicated missing data patterns.[36,37] For the key patient outcome, receipt of goal concordant care, we will use logistic regression models adjusting for the stratification variables, to examine if rates at T3 differ by treatment group. The key healthcare systems outcome, post-randomization hospital length of stay (LOS), provides a unique challenge due to the high expected mortality rate (40-50%). In addition to descriptive analyses, steps to examine treatment group LOS differences will include: (1) a proportional hazards model with death treated as a censoring event; (2) a chi-square test of mortality rate differences; and (3) a Brunner-Manzel rank test for the composite death-LOS outcome. This last step implements a recently developed methodology of a composite outcome that incorporates a numerical value for death (i.e., coded as the worst possible outcome or the longest possible stay) in the observed LOS distribution.[38,39]

Aim 3

Transcribed interviews will be analyzed using a content analysis technique that combines *structural* (e.g., intervention component, palliative care process barriers) and *magnitude coding* (e.g., theme intensity) with *inductive coding* (e.g., variations in outcomes not captured by instruments).[40] The study team will separately code 10 interviews, discuss the generated codes, and create an initial code book by consensus. The code book will then be used by the study team for the next 10 transcribed interviews (with the PI coding each 5th interview). The final code book will be organized into categories used to generate themes of mechanistic and process elements. Narrative case summaries will be constructed and matrixed by patient case using *qualitative* analytic themes and *quantitative* data (e.g., triggers, needs, psychological distress, app use analytics). Across-case comparisons will be made using meta-matrices to search for patterns in intervention mechanisms of action common across theoretically- and empirically-derived categories of cases.[41] Next, *process tracing* will be used to

explore how particular outcomes (e.g., needs, distress, goal concordance) may have been related to intervention components and their effect on process barriers in our conceptual model.[42,43]

Sample Size and Power

Calculations were conducted via the mixed models with the differences in slopes option in PASS 2020 (Kayesville, UT). With a total of 130 participants at 8 days (n=65 per treatment arm), we will have 80% power to detect a differential NEST improvement between treatment groups of 8.80 units at 8 days (SD=21.1, ρ=0.64 between baseline and 8 days based on pilot data and an additional ongoing trial [NCT03506438]). To account for 10% dropout by 8 days, we plan to consent and randomize 150 participants (n=75 per treatment arm). This sample size will also provide a power of 80% (Type-I error of 5%, dropout rates as noted above) to detect a 2.33-unit PHQ-9 change (SD=5.3, ρ =0.6) at 8 days—far smaller even that it's 5.0-unit MCID. These estimates are based on our pilot work as well as an ongoing RCT (NCT03506438) we are conducting that uses the NEST

9. Study Duration: As this project is centered around Aim 2, it is anticipated that from the time the clinical trial opens to enrollment it will require ~41 months to complete data collection (~36 months for cumulative enrollment with 4-5 months to complete all long-term follow up; this time does not include start up and analyses) and 4-6 months to perform all final data analyses for all Aims.

10. Risk-Benefit Assessment

Potential risks

Overall, this project is minimal risk. However, it is possible that participants could experience a breach of confidentiality should their records be accessed unlawfully by an outside party. Also, it is possible that participants may experience mild anxiety when answering survey questions, though this has not been observed in similar interventions including the multiple pilot studies on which this trial is based. It is believed that involvement in this study will present no significant physical, psychological, financial, legal, or other risks. Additionally, there is always the potential of a breach of data security given that this project involves the use of a web application developed by external vendors, One Cow Standing, LLC located in Durham, NC.

Adequacy of protection against risks

Recruitment and informed consent procedures.

First, the Duke Institutional Review Board (IRB) will review and approve the study protocol before study initiation. Informed consent (e-consent or written) will be required from all participants, including content experts. Second, we will use a novel, Duke Health Technology Services (DHTS) and Office of Information Technology (OIT) developed, secured screening method that integrates the EMR and the novel web application. The API developed respects participant privacy and rights. The study team will only approach those family members that are deemed appropriate for the study, which will be determined by individual patient EMR review and subsequent approval by the ICU clinician via the web application. The approach of family members, will be aided by a short IRB-approved recruitment video found at PCplanner.duke.edu. The study team will then ask the family member to read and sign the study consent form at the time of enrollment. Potential subjects will be given as much time as they need to consider study participation. A copy of the consent form will be given to participant and the original maintained in a secure location at the study site.

Protections against risk

General oversight

There are several ongoing mechanisms for monitoring the occurrence of adverse events and other unanticipated problems related to research activity. The PI or delegated study team member will perform day-to-day monitoring of the study activities. Careful monitoring of all persons entering the study will minimize attrition and will ensure the clinical safety of these patients. This monitoring is facilitated by a telephone

number for the study team and an email address (pcplanner@duke.edu) provided to participants upon entry into the study to report concerns related to study participation.

Plans to prevent coercion of patients and to ensure voluntary participation
The study team will strive to create an environment free of any coercive practices for patients, the family members and the participating clinicians. The study team will stress that study involvement is absolutely voluntary and that choosing to participate or not participate will not affect their care in anyway. In addition, the study team will utilize the standardized 2-minute informational video, which has been used successfully in past trials describe treatment groups and ensure a similar approach across sites.

Specific longitudinal participant oversight plans for severe psychological distress (including suicidal ideation)
Given the difficult situations faced by family members who have loved ones in an ICU environment, it is recognized that there is a slight risk that some participants may become distressed completing questionnaires or viewing study materials, as mentioned above. Additionally, given the extreme stresses of the critical illness experience, participants may even endorse suicidal ideation (SI).

The study team will take the following measures to effectively manage any serious distress that occurs:

(1) All of the in-person and telephone-based data collection sessions will be conducted by trained study team members who are sensitive to the issues that arise.

(2) Study team members will emphasize to participants that any interviews or other study interactions are participant-controlled. Thus, participants will be instructed that they are in control over what they share and generally how long they discuss any topic that is addressed.

(3) Participants will be told that they can discontinue an interview or telephone session at any time and that they are also free to reschedule an interview or treatment session at any time within the week.

(4) There is also a potential risk for identifying underlying mental health issues through the survey responses. For issues such as passive suicidal ideation or symptoms of depression, anxiety, or PTSD, an informational sheet will be provided with contact numbers for additional mental health services.

(5) As a safety measure, used in past and current ICU-based clinical research, the study team will monitor participants closely beyond just the parameters of questionnaire scores. The study staff will monitor participants closely during any interviews performed and will refer those with any concerning level of emotional distress and/or relationship distress to the PIs to evaluate by phone or in person. This will be done immediately, particularly if there is staff concern about a participant who indicates suicidality.

All study participants will be informed of the suicidality response plan prior to signing the informed consent for their participation in the study. The PI or study team delegate(s) will complete the online Columbia Suicide Severity Rating Scale (C-SSRS) training, a 30-minute interactive slide presentation followed by a question-answer session. The C-SSRS is a scale that can delineate high, moderate, and low-risk levels.

Suicidality Response Plan
The Suicidality Response Plan can be activated if the study team have in-person or telephone interactions that concern them, deeming the participant as ‘high risk.’ Additionally, ‘high risk’ participants are defined as those who reply to the PHQ-9’s question #9 regarding suicidal ideation with any response indicating a frequency of such ideation measured in days other than ‘never’ PLUS responding ‘yes’ to a branching logic item that follows any such ‘positive’ response to item #9 that determines if the individual has an active suicidality plan.

If the participant is deemed to be at high risk of active suicidality, the app system will send an alert email and/or text message in real time to the study manager, the study coordinator(s) and the PIs (no PHI included, only study ID).

One of these study staff will then contact the participant. Contact is to occur as soon as possible (and definitely within 24 hours of learning of the event). Using the full C-SSRS, the trained staff will then help to assess the participant to determine if they endorse active suicidal ideation. The trained staff will also determine if the participant is currently being treated by a mental health professional.

If the participant is considered to be *actively suicidal* then at least one of the following plans will be followed depending on the location of the participant for each of the following situations:

- Situation 1
    - If the participant is with one of the study personnel, the study personnel will notify the PIs immediately.
    - The study personnel will either physically walk the subject to the emergency department, or call a Psychiatric Emergency services number relevant to the site as described above.

- Situation 2
    - If the participant is on the telephone:
        - The study personnel will notify the PIs immediately
        - The study personnel will stay on the telephone with the subject participant.
        - The study personnel will immediately contact 911 to initiate an on-site rescue if such action is clinically indicated.
    - The study personnel will stay on the telephone with the subject until EMS services have contacted the participant.

- Situation 3:
    - If there are any active suicidal concerns in any of the surveys (e.g., PHQ-9 above), an email, or in a text message:
        - The study data system will notify the PIs and Study Manager in real time of any PHQ-9 suicidality item positively endorsed.
        - The study personnel will then contact the honest broker to de-identify the participant information.
        - Next, the study personnel (or a PI; whoever is able first) will contact the participant by telephone.
        - The study personnel or PI will stay on the telephone with the subject participant
        - The study personnel or PI will use a different telephone line to immediately contact 911 to initiate an on-site rescue if action is clinically indicated.
        - The study personnel or PI will stay on the telephone with the subject until EMS services have contacted the participant.

If the participant if determined to be actively suicidal and require immediate medical therapy, they will be withdrawn from the study.

If the family member is deemed not to be actively suicidal, they will be given a list of local mental health resources within the app platform's screen as follows:

- Duke: Call Emergency Psychiatry at (919) 681-4410 or (919) 681-1316, available 24 hours a day, 7 days a week.

- The National Suicide Prevention Lifeline - 1-800-273-TALK (8255) is a free, 24-hour hotline available to anyone in suicidal crisis or emotional distress.

As described above, all concerns about participant safety will be discussed immediately with the PIs - including concerning severe distress that does not involve suicidality.

For these situations, once an "alert situation" is known, the PIs will refer the participant if needed (based on a PI-led phone call) to local psychological resources. The study team will also make urgent and emergency referrals as needed based on information learned.

To date, in previously completed similar studies, analysis has found that <5% of participants will require a call from the study team during some point in the study period. Of those, none have required referral to acute psychiatric care after a detailed interview from the study team. After a disposition/solution has been made, both the resolution (and follow up) will be documented in the 'contact log' section of the data system for reporting to the DSMB.

Patient Death While in Study

Finally, it is recognized that this project targets patients who are critically ill and elderly, therefore, there is a risk of death. The study team will review the EMR to look for records of death, halting all study procedures, if applicable, and noting the date of death. Additionally, on phoning any family member, the study team will initiate a conversation to tactfully ascertain the patient's vital status. If the patient has died, we will provide brief support. If a family member states that they wish to drop out, the study team will respect that as well. A follow-up question may be asked to ascertain the reason for withdraw; however, this is for documentation purposes only.

Vulnerable Populations

The study team not enroll patients from vulnerable populations (e.g., imprisoned persons, minors). However, elderly patients will be targeted for enrollment into this project, and therefore, there is a potential risk of death due to their age and critical illness in < 3 months.

Potential Benefits

This randomized clinical trial will compare PCplanner to a usual care control condition. The PCplanner intervention may reduce unmet needs and psychological distress, increase goal concordance, and reduce length of stay. Therefore, this intervention could hold great promise for helping many others in similar situations in the future. However, this is not certain. In fact, subjects in the usual care control condition may experience similar or even greater benefits to those described for PCplanner. Then again, they may receive no particular benefit. Nonetheless, study involvement puts subjects at low risk for any adverse physical or psychological risk. Therefore, the potential benefits for participation justify the minimal risk to those enrolled in the proposed study. Financial compensation will not be emphasized as a benefit of participation in research.

11. Adverse Events (AEs), Serious Adverse Events, (SAEs), Protocol Deviations (PDs) and Unanticipated Problems (UPs).

As noted above, this is considered a minimal risk study. Since the project intends to enroll critically ill patients who are elderly, and therefore, at risk of multiple and significant comorbidities, hospitalizations, and even death, adverse and serious adverse events will be limited to events that directly affect the overall well-being and safety of the family member (research subject). Additionally, given that this is a self-directed, survey based study, it is anticipated that compliance of research subjects (family member or clinician) will be less than 100% and/or completed within the protocol window. As such, events related to incomplete or missed study procedures will not be considered a protocol deviation and therefore will not be reported to the institutional or

sponsor officials. Rather, events occurring outside of the study protocol will be documented and recorded by the study team in the web application, EDC, and/or study source documents as applicable.

All participants will have access to the principal investigator's contact information 24 hours a day (shown in the consent form). If a telephone interview is required, it will be conducted by a trained study team member who has been trained to be sensitive to the nature of these issues.

Adverse Events (AEs) and Serious Adverse Events (SAEs)
Adverse events (AEs) generally would include extremely high distress levels (PHQ-9 score >25, GAD-7 score >20, PTSS score >34) or active suicidal ideation (i.e., endorsement of PHQ-9 suicidal ideation item plus a positive response to a branching logic item signifying active planning that would follow inquiring about a plan). A serious adverse event (SAE) would be a suicide attempt, a hospitalization, or death.

It is anticipated, in this study, for AEs to be extremely uncommon as it is a behavioral study. However, it is possible that participants could exhibit signs of and/or experience suicidal ideations with intent or thoughts of intent to act on such ideations. No other event, outside of suicidal ideation with intent or thoughts of intent to act on ideations will be considered an AE for this trial.

Like, AEs, it is not anticipated that SAEs will occur. However, for this study, an SAE would include a suicide attempt, a hospitalization (of family member), or death (of family member). All serious adverse events will be reported within the standard timelines required to the IRB, study sponsor, and/or DSMB, as appropriate and when applicable.

Protocol Deviations (PDs) and Unanticipated Problems (UPs)
Protocol deviations are errors made by study staff or deviations from plan made by study clinicians such as failure to conduct a family meeting. Unanticipated problems could consist of issues such as failure of the study staff to respond in a timely manner to suicidal ideation reported by a participant.

Given the nature of this study, it is anticipated that most enrolled family members will not complete their study surveys within the assigned protocol window. Additionally, it is expected that surveys may be missed as these are self-reported outcomes. As such, these will not be considered protocol deviations. Should other protocol deviations or unanticipated problems occur, they will be discussed with the PI, documented, and reported to the IRB, study sponsor, and/or DSMB, as appropriate and when applicable.

Period and Frequency for Event Assessment and Follow-Up
Protocol deviations and other unanticipated problems, as well as AEs and SAEs, will be recorded in the data collection system throughout the study.

The study team will record all reportable events with start dates occurring any time after informed consent is obtained until 7 days after the last day of study participation. At each study survey, the study team will inquire by way of verbal or written request and/or EMR review, of the occurrence of AE/SAEs since the last survey. Events will be followed for outcome information until resolution or stabilization.

Characteristics of an Adverse or Serious Adverse Event
Relationship to Study Intervention
To assess relationship of an event to study intervention, the following guidelines are used:

- ***Definitely Related****:* The definition of an AE/SAE that is definitely related would include episodic distress triggered by either a study survey or some study material (e.g., a video).

- ***Possibly Related****:* The definition of an AE/SAE that is possibly related would include simply experiencing high levels of distress during the trial period. That is, this could follow a reasonable temporal sequence from administration of the study intervention, but that could readily have been produced by a number of other factors.
- ***Not Related****:* An AE/SAE that is not related would include a hospitalization for a car accident, etc. That is, it would be an adverse event that is clearly not related to the investigational agent/procedure - i.e. another cause of the event is most plausible; and/or a clinically plausible temporal sequence is inconsistent with the onset of the event and the study intervention and/or a causal relationship is considered biologically implausible.

Expectedness

- ***Unexpected*** – The definition of an unexpected AE/SAE will be one whose nature or severity of the event is not consistent with information about the condition under study or intervention in the protocol, consent form, product brochure, or investigator brochure.
- ***Expected*** - There are no events known to be associated with the intervention. Psychological distress is expected given the severity of patients' illnesses and their family members' involvement in decision making about a life-threatening illness.

Severity

The following scale will be used to grade adverse events:

1. Mild: no intervention required; no impact on activities of daily living (ADL). For example, elevated distress levels (e.g., PHQ-9 score >25, GAD-7 score >20, PTSS score >34).
2. Moderate: minimal, local, or non-invasive intervention indicated; moderate impact on ADL. For example, suicidal ideation endorsed (i.e., PHQ-9 item #9), though no plan endorsed.
3. Severe: significant symptoms requiring invasive intervention; subject seeks medical attention, needs major assistance with ADL. For example, suicide attempt, hospitalization due to distress symptoms, or death.

Reporting Procedures

Adverse and Serious Adverse Events

We have a strong plan for AE/SAE reporting and follow up. First, we have a very robust monitoring system for psychiatric and emotional symptoms. We will know 'alert' values of depression, anxiety, and PTSD symptoms the second a questionnaire is completed via the mobile app. For symptoms that are either great in total burden (i.e., total score is high), we will call the participant to check in. For specific symptoms such as the suicidal ideation item in the PHQ-9 depression questionnaire, we will also call the participant and assess the severity of the situation, triaging them as appropriate to psychiatric support. Last, we have broadly placed our email addresses and phone numbers in all study materials and will encourage people to contact us regarding any issues.

Since this is a psychosocial intervention, we do not expect study related physical issues to occur. Furthermore, there is no lab work involved.

All deaths will be reported to NIA Program Officer, the DSMB Chair, and the central IRB within 72 hours of study's knowledge of death. For each patient who dies, a brief report containing the following variables will be provided:

Age
Principal diagnosis
Number of comorbidities
Admission APACHE II score
Days since enrollment

Brief description of circumstances surrounding death including expected or unexpected.

All **adverse events that are both serious** (SAE) **and unexpected** (i.e., have not been previously reported for the study's intervention) will be reported to the IRB, NIA PO, and to the independent data and safety monitoring body according to the timeframe displayed in appendix 6. The summary of all other SAEs should be reported to NIA PO and to the DSMB or a Safety Officer, if either is appointed, quarterly, unless otherwise requested by the DSMB or a Safety Officer.

Serious (fatal or life-threatening) SAEs that are unanticipated (i.e., not listed in the Data and Safety Monitoring Plan) and that are related to the intervention will be reported to the NIH Program Officer and to the DSMB Chair according to the timeframe displayed in appendix 6.

The summary of all other SAEs will be reported to NIH Program Officer and to the DSMB quarterly, unless otherwise requested by the DSMB. Additionally, for SAEs, we will hold an all-investigator teleconference within 7 days. The PIs will draft a description of the SAE and an action plan. This will be passed on to the IRB, the NIH, and DSMB within 72 hours of the teleconference. See appendix 6 for identifying and reporting structure.

Table	
Information	Timing
Study operations: Enrollment rate, refusals, dropouts	Reviewed on a weekly basis
Intervention adherence: Total app logins, number of pages viewed per use, surveys completed, total time spent per login	Numerous dimensions via software analytics
Distress: -Suicidal ideation -Psychological distress symptoms	 -Real-time monitoring with automated email alert sent to all study staff if suicidal ideation present -Every 6 months by DSMB and every year by IRB
Unanticipated Problems, Adverse Events, and Serious Adverse Events: hospitalizations, life-threatening events, death	Reviewed by PI and study staff immediately on discovery.

Protocol Deviations and Other Unanticipated Problem Reporting
Incidents or events that meet the reporting criteria, as outlined by the Duke IRB, will be reported to the Duke IRB as needed.

The following will be included, at a minimum:

- A detailed description of the event, incident, experience, or outcome;
- A description of any changes to the protocol or other corrective actions that have been taken or are proposed in response to the unanticipated problem.

12. Data & Safety Monitoring Plan

Overall framework for safety monitoring and what information will be monitored
The proposed trial will be monitored for safety using both automated / electronic means, as well as by human oversight. The study data system will allow real-time monitoring of study participant distress levels, alerting study staff immediately with any participant report of suicidal ideation. Human safeguards will include the study team, led by the experienced PIs, the Duke Institutional Review Board, and the study Data Safety Monitoring Board (DSMB). All of these components are discussed in greater detail below. The trial information monitored is shown in the Table.

Plans for assurance of compliance regarding adverse event reporting.
The study team will be required to document and report adverse events (including serious adverse events) to the Institutional Review Board (IRB), as appropriate and in line with institutional reporting criteria. Also, all adverse events are reported as part of NIH Progress Reports in the non-competitive and competitive renewals.

Plans for assuring data accuracy and protocol compliance.

The PIs will supervise the study, including data management, data accuracy, and protocol compliance. The study biostatistician and Study Manager will be the chief data managers and will adhere to established federal and institutional patient safety and protection guidelines. To assure data accuracy, the Study Manager will review data system reports on a routine basis. These reports will show enrollment, missing data, and other values. Additionally, the Study Manager will process detailed reports to search for errors and generate basic reports for dissemination for regular staff meetings.

Data Safety Monitoring Board (DSMB)

This trial will be supervised by a single independent DSMB composed of professionals with significant experience in clinical trials, palliative care interventions, epidemiology, and biostatistics who are not directly involved in the study, its interpretation, or in current collaborative research with a study team member.

The main responsibilities of the DSMB will be to (a) assess for the presence of potential harms and unintended consequences of the PCplanner intervention and usual care control, (b) ensure the validity and integrity of the data, and (c) make recommendations to the investigators and to the NIH about whether the trial should be continued without modification, continued with modification, or terminated.

The initial DSMB meeting will occur before the initiation of subject enrollment for the purpose of updating members on the study, ensuring agreement on the review process, establishing the review methodology and procedures, ensuring all conflicts of interest are disclosed (to be reviewed by NIH staff), reviewing the protocol, and codifying a written DSMB charter. The NIH's Data Safety Monitoring Plan (DSMP) Template will be used to guide the drafting of the charter. This document will specify procedures for protocol amendments, ensuring participant confidentiality and privacy, ensuring database protection, coordinating center responsibilities, creating adverse outcome definitions (adverse events, unanticipated problems, and serious adverse events), protocol for reporting and responding to adverse events while also maintaining subject confidentiality, justifying sample size, assessing accrual and compliance, halting and stopping rules (drafted with the assistance of the DSMB chair and the DSMB lead statistician), approving informed consent documents, and guidelines for quality control and quality assurance. Before enrollment begins, the DSMB charter will be approved by both the DSMB and the NIH; additionally, ClinicalTrials.gov registration will be finalized.

The first DSMB data review will occur either after the first 50 participants have been enrolled—representing approximately 25% of randomization target—or enrollment has occurred for 6 months, whichever is observed first. Thereafter, the DSMB will review cleaned data reports (provided by the Study Manager 2 weeks before the DSMB meeting) every 6 months during enrollment and follow up and will prepare a report with any recommendations within 2 weeks following their review. The specific study metrics that the DSMB will review at each meeting include: enrollment rate (noting race & ethnicity of those enrolled), retention rate (noting race & ethnicity of those who drop out), PHQ-9 scores, GAD-7 scores, PTSS scores, and Adverse Events. The primary safety measures will be Adverse Events reports and PHQ-9's suicidal ideation item. Other items reviewed by the DSMB at each meeting will include: (a) data quality, completeness, and timeliness; (b) performance of the individual sites; (c) adequacy of compliance with goals for recruitment and retention, including women and minorities; (d) protocol adherence; and (e) presence of factors that could adversely affect study outcome or compromise data confidentiality. Study patients will be recovering from life-threatening illnesses managed in intensive care units which increase the likelihood of death overtime in comparison to healthy individuals. As such, any patient deaths and their cause during the follow up period will be recorded, discussed, and highly scrutinized.

The Study Manager, will provide written reports to DSMB members that do not name the treatment group. The study biostatistician, will oversee any DSMB statistical requests and interpretations. During

the review process, formal statistical tests may be performed under DSMB supervision if requested (e.g., examining the differences in Adverse Event or outcome rates between factor-based groups). Additionally, the DSMB may request a formal statistical assessment if a suspicious increase in PHQ-9 score is observed in any treatment group. We do not plan interim analyses given the sample size of this trial. If a specific group is found to have a statistically or clinically significant increase in mortality or PHQ-9 score, the DSMB scope of action may include recommendation for stopping the trial (see next paragraph). For differences in study dropout rates, appropriate changes to the protocol will be made by PI consensus after DSMB member input. Any protocol changes, as well as any adverse events, will also be immediately reported to the Duke Institutional Review Board as well as to the project's NIH Program Officer.

As noted above, the DSMB will have the power to stop the trial at their discretion. The following is a possible stopping plan that could be adapted by the study DSMB for inclusion in the final DSMB Charter. Because this is an early phase trial, we will not have formal stopping rules based on efficacy or futility. Criteria for intervention discontinuation and stopping based on safety concerns will be determined in partnership with the study DSMB and codified in the DSMB charter before enrollment begins. We propose a strategy similar to that included in our past ICU-based RCTs that included family caregivers (e.g., R01 HL109823, PI: Cox). Three-month all-cause mortality will be the primary adverse event for the patients in study. We will examine the distribution of deaths by treatment arm three times during the trial: at 15, 25, and 50 deaths. At each of these interim looks, we will examine the distribution of deaths by study group and conducted either a non-parametric sign test or Wilcoxon signed-rank test to test the difference in median number of deaths between the arms. We will use Haybittle-Peto guidelines and stringently set the p-value at 0.001 to flag a significant difference between arms at each of these interim looks. If this difference is observed, this would then indicate a closer examination of related constructs, as well as proximate causes and circumstances surrounding death (e.g., timing and location of death, withdrawal of life support or not, comorbidities and illness severity, clinician expectations of survival). We will use the Patient-Centeredness of Care Scale to provide additional information on the alignment of patient treatment and values at the time of death. Although past end of life interventions have not increased mortality, it is possible that by better focusing decision makers' attention on patients' values, higher mortality could be observed in the intervention group by identifying patients for whom prolonged life support would be a state worse than death (Patrick DL, et al. Ann Int Med. 139:410-415, 2003; Holloway RG, et al. JAMA. 298:802-804, 2007). Yet if PCplanner—a non-directive intervention—led to more decisions to forego life support, this would be ethically permissible if the treatments received reflected patient-centered care as assessed by the PCCS (Institute of Medicine, 2001; Lin GA, et al. Arch Intern Med. 169:1551-1553, 2009; Holloway RG, et al. 2007). The primary adverse event for family caregivers will be symptoms of psychological distress as measured by the PHQ-9 and PTSS at T2 and T3. We propose to examine the distribution of scores by treatment arm three times during the trial: at 25, 75, and 100 caregivers. Using methods similar to those above, we could examine circumstances more closely as per DSMB guidelines.

Frequency of Data and Safety Monitoring

The proposed trial will be monitored extensively. In real-time, all study staff will be made aware of any study participant who reports any suicidal ideation. Routine reports on enrollment, adherence, dropout, and study progress will be generated by the study data system and then reviewed by the study team. All primary outcomes will be reviewed as well in a summary view (for the PI; group-based data will not be included) and a group-based view (for the DSMB; treatment group name will be removed). The study DSMB will view data every 6 months. Interim analyses, though not planned, will be conducted at the behest of the DSMB. Our approach to stopping rules is discussed below in the context of the DSMB.

Safety Review Plan
Study progress and safety will be reviewed routinely. Progress reports, including recruitment, retention and attrition, and AEs will be provided to the DSMB semi-annually. An Annual Report will be compiled and will include a list and summary of AEs. In addition, the Annual Report will address (1) whether AE rates are consistent with pre-study assumptions; (2) reason for dropouts from the study; (3) whether all participants met entry criteria; (4) whether continuation of the study is justified on the basis that additional data are needed to accomplish the stated aims of the study; and (5) conditions whereby the study might be terminated prematurely. The Annual Report will be sent to the Independent Monitors and will be forwarded to the IRB and the study sponsor. The IRB and other applicable recipients will review progress of this study on an annual basis.

Quality Assurance and Confidentiality
First, the PCplanner electronic data platform "forces" responses to key questionnaire items (e.g., primary outcomes surveys) before allowing progression through the particular interview's template, thereby minimizing missing data. For less critical items, delayed data entry is possible (though these data elements are non-essential to primary aims analyses). However, each time the study team logs into the secure data entry system, prompts appear on the welcome screen that show what data elements remain incomplete (as well as the time frame within which they must be entered) for all site participants.

The study PI will ensure the validity of the data system by examining electronic summary case report forms within the data system to ensure adequacy and accuracy of data collection as well as transcription to the database itself after enrollment of the first 5 participants. Agreement will be reviewed and discrepancies will be discussed.

Safety Monitoring
The proposed trial will be monitored for safety using both automated and electronic means, as well as by human oversight. The study data system will allow real-time monitoring of study participant distress levels, alerting study staff immediately with any participant report of suicidal ideation. Human safeguards will include the study team, led by the experienced PIs, the Duke Institutional Review Board, and the study Data Safety Monitoring Board (DSMB), as applicable per reporting criteria.

Frequency of monitoring, including plans for interim analysis and stopping rules
The proposed trial will be monitored extensively. In real-time, all study staff will be made aware of any study participant who reports any suicidal ideation. Routine reports on enrollment, adherence, dropout, and study progress will be generated by the study data system and then reviewed by the study team. All primary outcomes will be reviewed as well in a summary view (for the PI; group-based data will not be included) and a group-based view (for the DSMB; treatment group name will be removed). The study DSMB will view data every 6 months.

Safety Review Plan
Study progress and safety will be reviewed monthly (and more frequently if needed). Progress reports, including patient recruitment, retention/attrition, and AEs will be provided to the Independent Monitor(s) semi-annually. An Annual Report will be compiled and will include a list and summary of AEs. In addition, the Annual Report will address (1) whether AE rates are consistent with pre-study assumptions; (2) reason for dropouts from the study; (3) whether all participants met entry criteria; (4) whether continuation of the study is justified on the basis that additional data are needed to accomplish the stated aims of the study; and (5) conditions whereby the study might be terminated prematurely. The Annual Report will be sent to the Independent Monitors and will be forwarded to the IRB and NIA. The IRB and other applicable recipients will review progress of this study on an annual basis.

Study Report Outline for the Independent Monitors(s) (Interim or Annual Reports)
The study team will generate Study Reports for the Independent Monitor and will provide information on the following study parameters: NEST, PHQ-9, GAD-7, and PTSS scores; enrollment success; rate of consent; rate of successful randomization; retention rates; and AE/SAEs. Study Report tables will be generated only from aggregate (not by group assignment) baseline and aggregate safety data for the study population.

Submission of On-Site Monitoring/Audit and Inspection Reports
The IRB, IMC, and NIA Program Officials will receive copies of all study monitoring/audit or inspection reports within 14 day of PI receipt.

Table A

Data type	Frequency of review	Reviewer
Subject accrual (including compliance with protocol enrollment criteria)	Monthly	PI, Internal QA Reviewer
	Semi-annually	Independent Monitor(s)
Status of all enrolled subjects, as of date of reporting	Monthly	PI, Internal QA Reviewer
	Semi-annually	Independent Monitor(s)
Data entry quality control checks on 5% of charts	Weekly	QA Reviewer
Adherence data regarding study visits and intervention	Monthly	PIs, Internal QA Reviewer
	Semi-annually	Independent Monitor(s)
AEs and rates (including out-of-range lab values)	Monthly	PIs, Internal QA Reviewer
	Semi-annually	Independent Monitor(s)
	Annually	NIA FDA (If Applicable)
SAEs (unexpected and related)	Per occurrence	PIs, Independent Monitor (s) NIA, FDA (if applicable)
SAEs (expected or unrelated)	Per Occurrence	PIs, Internal QA Reviewer
	Annually	Independent Monitor (s), NIH/NIA
Unanticipated Problems	Monthly	PIs, Internal QA Reviewer
	Per Policy	IRB, FDA (if applicable)

Data management plan
All study data will be entered by participants and delegated study team members via the PCplanner app and the REDCap data system, as applicable. Participant data entry will primarily utilize our tested, highly secure ePRO system linked to the web application. The study team will abstract relevant clinical data from the EMR and input into the secure REDCap. The PCplanner mobile app backend will reside on a Duke University RHEL Server fronted by a ProxyPass pass through server within Apache HTTPD. The central REDCap database will run on a mirrored Duke University server system with automatic fail-over features and transaction logs. Data will be backed up hourly on the Duke University server and archived four times daily on a mirror server managed by Duke Health Technology System (DHTS). The app and data system will be built to security standards set by both the Duke Information Technology Security Office (ITSO) as well as DHTS; our programmatic partners, Duke ORI, have experience using this paradigm. These standards enforce strict scheduled security patching of all digital resources. Weekly summative (i.e., not group-based) reports will be generated and reviewed by the study team to

monitor enrollment and retention, safety indices, and missing data.

Study Report Outline for the Independent Monitors(s) (Interim or Annual Reports)
The study team will generate Study Reports for the DSMB and will provide information on the following study parameters: NEST, PHQ-9, GAD-7, and PTSS scores; enrollment success; rate of consent; rate of successful randomization; retention rates; and AE/SAEs. Study Report tables will be generated for baseline and aggregate safety data for the study population.

Data handling and Record Keeping
The study team is responsible for ensuring the accuracy, completeness, legibility, and timeliness of the data reported. All source documents should be completed in a neat, legible manner to ensure accurate interpretation of data. The study team will maintain adequate case histories of study subjects, including accurate case report forms (CRFs), and source documentation. The principal investigator will maintain overall oversight and responsibility of these activities.

Personal identifiers, such as name, date of birth, MRN, diagnoses, dates of admission and discharge, and other relevant clinical information for both patients, family members and the clinicians may be stored in the REDCap study data system. Data will be backed up hourly on the server and archived four times daily on a mirror server managed by the Duke Health Technology Solutions team.

13. Data management
All study data will be input by participants and CRCs via the PCplanner app (noting that the usual control group will do the same via the private study webpage, directly linked to the study RedCAP data system, without access to the PCplanner content). Participant data entry will primarily utilize our tested, highly secure ePRO system linked to our data system. The PCplanner mobile app Ansible backend and the RedCAP study data system will reside on a Duke University RHEL Server fronted by a ProxyPass pass through server within Apache HTTPD. The central RedCAP database will run on a mirrored Duke University server system with automatic fail-over features and transaction logs. Data will be backed up hourly on the Duke University server and archived four times daily on a mirror server managed by Duke Health Technology System (DHTS), a technical partner in this R01 project. The app and data system will be built to security standards set by both the Duke Information Technology Security Office (ITSO) as well as DHTS; our programmatic partners, Duke ORI, have experience using this paradigm. These standards enforce strict scheduled security patching of all digital resources. Routine summative (i.e., not group-based) reports will be generated and reviewed by the study team to monitor enrollment and retention, safety indices, and missing data.

14. Privacy, Data Storage & Confidentiality
Privacy
We believe that risks to privacy associated with study participation will be low based on the steps we plan to take closely safeguard participant privacy, protected health information (PHI; see also next section), and personal information. Study ID numbers, generated randomly at the time of enrollment, and are linked in a separate RedCAP subsystem patient names and medical record numbers. Further, names, birthdates, telephone numbers, addresses, and medical record numbers are only viewable by the study team after entry of a unique username/password combination changed every 3 months. The master list of study ID linkage to this personal data will be deleted after study completion. The RedCAP system stores all data on a secure Duke University server with a sophisticated dual backup system. No PHI is visible in any ePRO user interface (with the exception of the clinician user interface, which will show room number and patient last name—the minimal PHI that would still allow recognition). Study participants cannot view data via the ePRO system, only enter data (a 'one-way view'). Participants access this one-way view ePRO system via secure, PHI-free email or text links sent from our study RedCAP data system.

Should participant privacy be compromised despite our attention to Duke Information Technology Security Office (ITSO) protocols, we will quickly assess the data exposed, disclose this immediately to all affected participants, and offer the assistance of the Duke ITSO in managing the breach. The ***impact*** of a privacy breach is difficult to quantify, though could be distressing (phone number, address). For this reason, the study team will make every effort to first prevent such a breach first and foremost.

Confidentiality
Subjects will not be identified on any study reports. University firewalls, multiple passwords, and encryption programs protect the security of the electronic data entry system, which will be housed on a highly secure Duke University server. All personal computers are located in lockable offices and are accessible only by frequently changed passwords. The server room is accessible only to designated University Systems Administrators.

Protected Health Information (PHI)
Duke University endeavors to build technological solutions that preserve the privacy, confidentiality, and security of protected health information (PHI) that may be part of health records or research datasets. PHI is handled according to appropriate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy and Security Regulations. Duke programmers and Duke Research staff who work with sensitive data are required to complete appropriate HIPAA training with periodic updates, complete human subjects and data privacy training, comply with site IT Security Policies, and agree to the provisions of the university Rules of Behavior and Sanction Policy. Duke strives to implement reasonable security controls in its product builds guided by the Federal Information Security Management Act (FISMA), HIPAA, and Appendix III of the OMB Circular A-130.

Of the 18 PHI elements, the study will collect the following at minimum: name (identification), address (to send surveys and/or remuneration), date of birth (to calculate age), telephone number and email address (to contact with surveys), social security number (collected only from those who wish to receive remuneration, as per Duke policy regarding payment reporting to Federal agencies), medical record number of patient (identification), and use of unique PCplanner web URLs through which data are collected in our ePRO system (per Duke / DHTS / ITSO security policy). The study team will enter some of these data into our study data system, while family caregivers will enter others. The PHI collected from clinicians includes, but may not be limited to, their name, area of medical focus, age, and relevant sociodemographic information. No PHI is ever visible in any app user interface seen by family caregivers. The PHI displayed in the PCplanner app includes the patient's last name, bed number, MRN, date of admission, and palliative care trigger(s).

Digital security
The study digital infrastructure consists of a mobile web app browser with an integrated electronic patient reported outcomes (ePRO) function designed by One Cow Standing, LLC (Durham, NC), a research system 'backend' which interfaces with the EMR, and a REDCap study data system. The security features are in line and supported by Duke's Information Technology Security Office (ITSO), the Duke Health Technology Solutions (DHTS) frameworks, HIPAA, and Duke IRB standards. Per DHTS standards, security updates and patches for the PCplanner web app will be required on a weekly basis. Our digital systems are also protected up by the Duke University firewall system and monitored 24 hours a day by DHTS digital security technicians.

Private study website
Study staff and participants will access the online elements through separate secure pathways hosted, monitored, and maintained by Duke University under the general domain of PCplanner.duke.edu.

Study staff will use their University credentials to login in a process identical in security strength to EHR login (i.e., Shibboleth multi-factor authentication). The complete PCplanner system, after development by the Duke Office of Research Informatics (ORI) team and the study team, will be hosted within the secure Duke University Internal Digital Environment and will be composed of an app subserver (app interface, content, ePRO system), the study REDCap database, and system files (e.g., scripts, code, HTML, images).

PCplanner Mobile Web Application
The study team opted for a mobile web application versus a native app such as one downloads from an app store because of its enhanced security. Web applications always have the most recent version, allowing security patches to be pushed out at any time. In contrast, native apps require the user to update their app periodically—a process that many users simply do not do regularly, making the app more vulnerable to security breaches. The programming service providers, One Cow Standing, endeavor to build technological solutions that preserve the privacy, confidentiality, and security of protected health information that may be part of health records or research datasets. Protected Health Information (PHI) is handled according to appropriate Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy and Security Regulations. All staff who work with sensitive data are required to complete appropriate HIPAA training with periodic updates, complete human subjects and data privacy training, comply with site IT Security Policies, and agree to the provisions of the University Rules of Behavior and Sanction Policy. Duke, and by extension Duke ORI, strives to implement reasonable security controls in its product builds guided by FISMA, HIPAA, and OMB Circular A-130, Appendix III.

Data security is of the upmost importance for the study, particularly in providing a digital, online intervention for the participants. Beyond the robust security that REDCap provides, One Cow Standing developers have implemented and maintains several security protocols and controls for apps as well. Duke ORI has developed a formal information security program, with a named individual responsible for its overall execution. Duke ORI also periodically conducts an information technology (IT) security risk assessment on its projects, maintains formal documented protocols for reporting security breaches, assesses and manages security risks associated with vendors and subcontractors, maintains employee on-boarding and off-boarding policies that protect study data and integrity, and ensures continuing employee awareness of and education on security policies, standards, and procedures. In terms of development approaches to security, Duke ORI evaluates and installs security patches in a timely fashion (generally weekly per DHTS guidelines), protects systems against self-propagating malware, maintains secure coding policies and practices, and utilizes standardized secure build processes to protect Duke hardware that accesses customer networks, protecting confidential data against attack. Duke does not use of off-shore service providers and/or data center facilities. For our study, the web application and supporting backend system that Duke ORI develops will be hosted internally on a Duke University server behind two secure firewalls. Thus, study data will be stored only on approved, secure University servers. In fact, all development will be conducted at all times on a Duke University server under the strict monitoring of Duke ITSO and DHTS.

REDCap
REDCap, via Duke University's secured platform, will serve as a central database for clinically relevant extracted data from each participant's electronic medical record, as well as serve as an electronic source of secure storage for documentation of study visit completion, protocol deviations or unanticipated problems, adverse and serious adverse events, screening and enrollment logs, as well as the electronic informed consent. Only delegated study team members, such as the investigator(s), statisticians, and study team members will have access to the REDCap.

For data validation, a series of project-defined data checks and conditional constraints can be required to ensure the highest quality data collection. All system login procedures and data submissions will be transported and encrypted via the Transport Layer Security (TLS) protocol to the secure central database at Duke University. The study team will have login/password (reset every 3 months) credentialing for authentication of all study staff. A University-approved plugin will be used to operationalize user-level permissions based on user roles to limit study staff access to authorized records and data fields alone.

The central REDCap database will run on a mirrored Duke University server system with automatic fail-over features, daily backups, and transaction logs. This system is physically located in a Tier II Data Center providing backup power sources, climate control, fire protection, and 24x7 surveillance. Audit logs will be reviewed routinely by Duke Health Technology Solutions staff to verify that security measures are operational. The servers are scanned twice weekly for vulnerabilities and are currently maintained at the highest level of vendor and CERT security recommendations. Data will never be shared outside the project unless authorized by the PIs (and approved by the NIH and IRB). User authentication is based on user passwords as described earlier. Password creation requirements are in place to guarantee “strong passwords” as defined by the CERT security recommendations.

15. IRB

Duke University Health System (DUHS) IRB will be utilized as the IRB of record for this project pilot randomized, RCT and the future RCT.

A copy of the most recent DUHS IRB Federal Wide Assurance (FWA) statement may be found at: https://irb.duhs.duke.edu/about-us/federal-wide-assurance

DUHS IRB current and historical rosters may be found at: https://irb.duhs.duke.edu/irb-review-process/rosters

DUHS IRB meeting dates may be found at: https://irb.duhs.duke.edu/irb-review-process/irb-meetings

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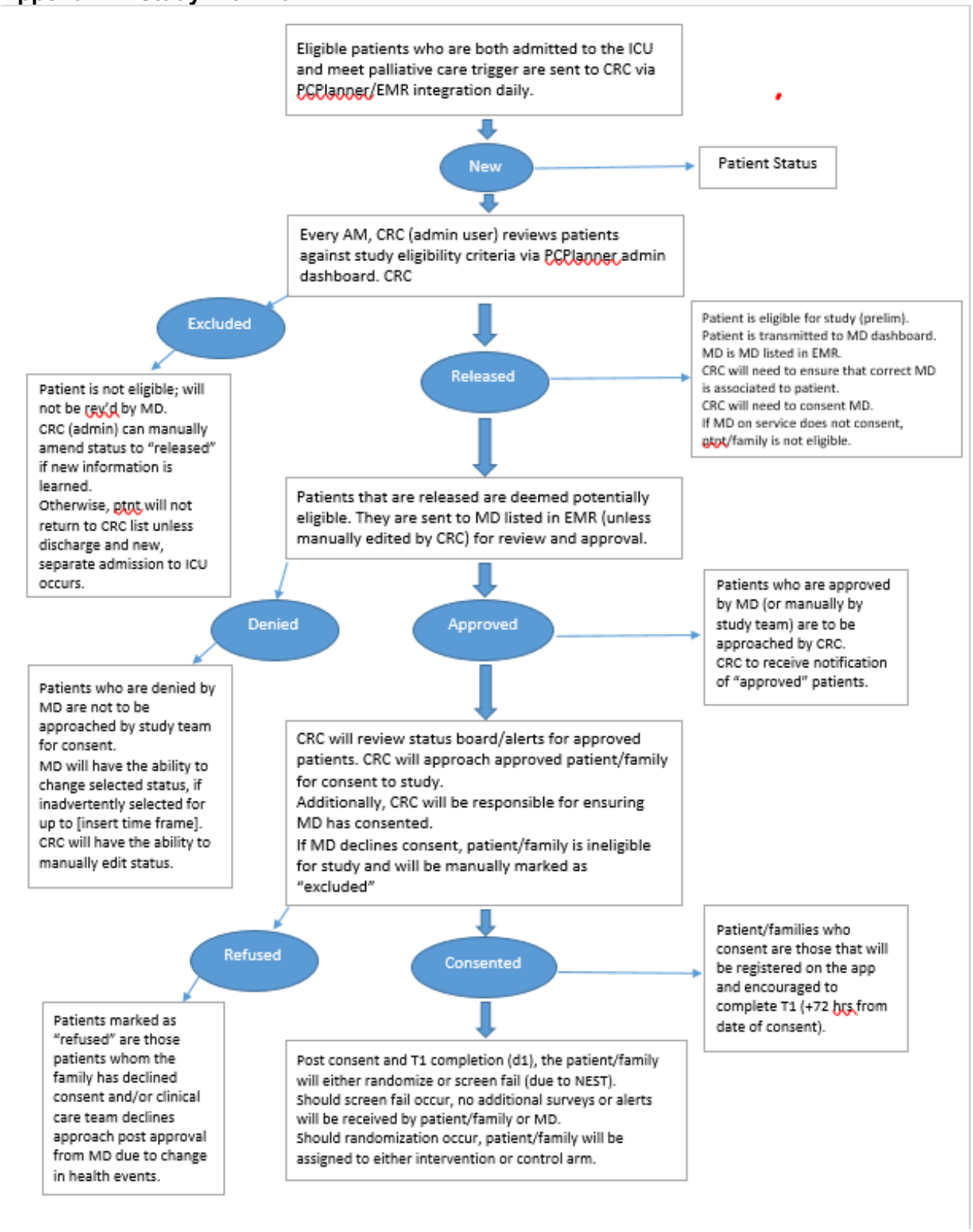
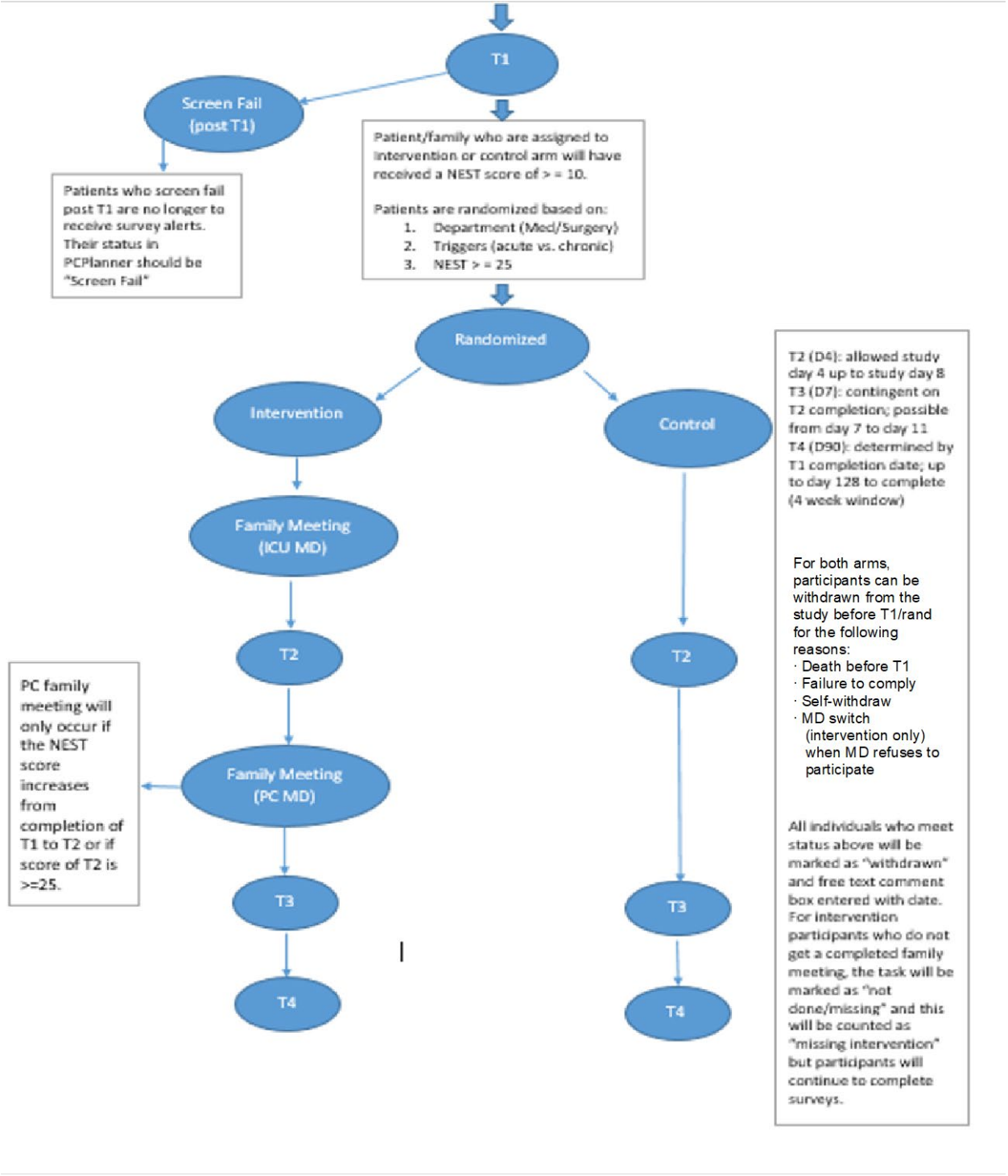
Appendix 1: Study Workflow



Appendix 1: Study Workflow Continued



Appendix 2: Acute and Chronic Palliative Care Triggers

Phenotypes	Narrative description of 'positive' trigger	Time period relevant for screening by PCplanner	Data source in EHR
Acute phenotypes			
Mechanical ventilation	Mechanical ventilation delivered via either an endotracheal tube or tracheotomy for ≥24 hours	At any point during the first 48 hours of the current ICU admission	Respiratory care provider flowsheet
Shock	Defined as ANY use of ANY continuous intravenous vasopressor medication for ≥4 hours	At any point during the first 48 hours of the current ICU admission	• Medication list • Nursing flowsheet • Vital signs flowsheet
Severe acute neurological injury	• Acute intracranial hemorrhage • Ischemic stroke • Traumatic brain injury	At any point in current hospitalization until time of screening(i.e., 48 hours after ICU admission)	• Physician billing • Problem list
Cardiac arrest	Has cardiac arrest managed in ED or during hospitalization	At any point in current hospitalization (or preceding ED visit for out-of-hospital cardiac arrests)	Physician Billing
Multisystem organ failure that is worsening	Present if Sequential Organ Failure Assessment [SOFA] score on ICU day 2 (i.e., hours 25-48 after ICU admission) is greater than SOFA score on ICU day 1 (i.e., hours 0-24 after ICU admission)	ICU days 1 and 2 (i.e., comparing first 24 hours of ICU admission to second 24 hours of ICU admission)	• Lab • Medications • Respiratory care provider flowsheet
Acute renal failure	Use of continuous venovenous hemodiafiltration (CVVHD) for ≥1 hour during screening period	on EITHER ICU day 1 (i.e., within 24 hours of ICU admission) OR ICU day 2 (within 48 hours of ICU admission) *	• Medication list from nursing flowsheet • Dialysis flowsheet • Laboratory test

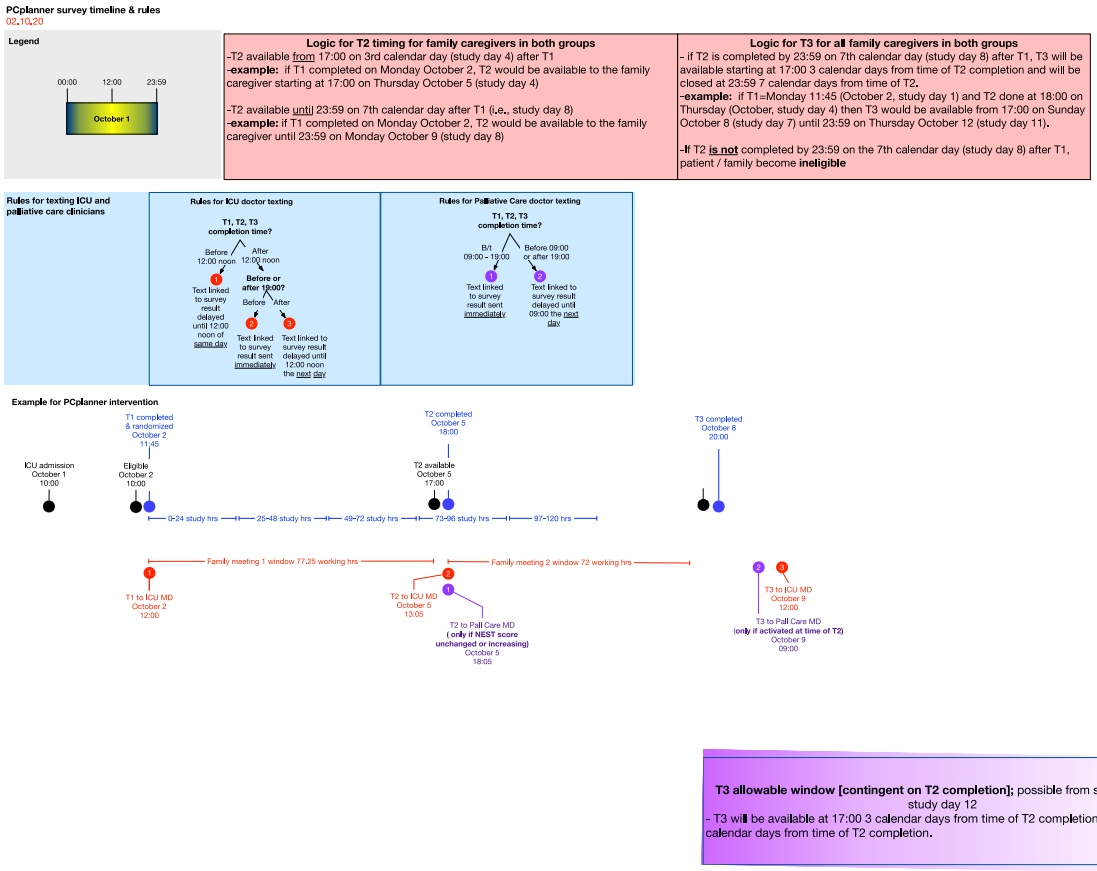
Chronic phenotypes			
Dementia	• Alzheimer's • Multi-infarct • Other dementia	• Present before hospitalization (i.e., Problem List) • Present at any point in current hospitalization until time of screening (i.e., 48 hours after ICU admission)	• Physician billing • Problem list
Admitted from facility	Admitted from Skilled Nursing Facility (SNF) or Long-Term Acute Care (LTAC) facility *	At any point in current hospitalization up until time of screening (i.e., 48 hours after ICU admission)	Intake flowsheet
Declining health trajectory	• ≥2 hospital admissions (includes Emergency Department visits) * • ≥1 ICU admission	Within the 3 months (or 90 days, whatever is easier) that preceded the date of the current hospital admission	Admission records
Declining functional status	≥2 activities of daily living (ADL) limitations *	At any point in current hospitalization	Nursing intake flowsheet
Advanced cancer	Cancer and/or metastatic cancer diagnosis	At any point in current hospitalization	• Physician billing • Problem list

Appendix 3: Schedule of Events

	Day 0 (In-Hospital, Baseline)	Family Meeting (Day 0, +3 days)	Day 4 (+4 days)	Family Meeting (Day 4, +3 days)	Day 8 (+4)	Day 90 (+28 days)
Screening	X					
Consent (a)	X					
App Registration	X					
T1 Survey (b)	X					
Randomization (c)	X					
T2 Survey (d)			X			
T3 Survey (d)					X	
T4 Survey (d)						X
ICU Physician Family Meeting (e)		X				
Palliative Care Family Meeting (f)				X		
Data Entry (g)	X		X		X	
AE/SAE assessment (h)	X		X		X	X
Survival Status (i)		X				X
End of Study		X				X

a) Study team is only able to approach family members (LARs) for consent once the ICU physician has marked the patient "approved" in the PCplanner web application (or if the ICU attending has opted out of approval for all patient/family dads).
b) Survey 1, T1 is to be completed ideally on the day of consent, but within 72 hours.
c) Family members are eligible for randomization to the study based on their NEST score at the completion of survey 1, T1 (> 10). Family members can be randomized to either the intervention or the control arm.
d) The timing of completion of surveys T2, T3, and T4 are directly linked to the timing of completion of survey 1, T1. Family members will receive automated alerts notifying them of survey completion at each set time interval based on the completion of T1.
e) The ICU Physician Family meeting occurs for any family member that is randomized to the intervention arm. The ICU physician in attendance will receive automated alerts notifying them of patient/family enrollment, the NEST score and associated results and daily reminders to complete the family meeting.
f) Like the ICU Physician family meeting, the Palliative Care family meeting will occur for those individuals who are randomized to the intervention arm; however, only family members who receive a NEST score > 25 or > their T1 NEST score at the completion of T2 will illicit the Palliative Care family meeting. The ICU Physician is responsible for facilitating in the coordination of the Palliative Care family meeting.
g) Data entry is to be completed within the study EDC, REDCap.
h) AE/SAE assessment and survival status will be completed via EMR review and/or telephone interview.

Appendix 4: Survey timelines and rules

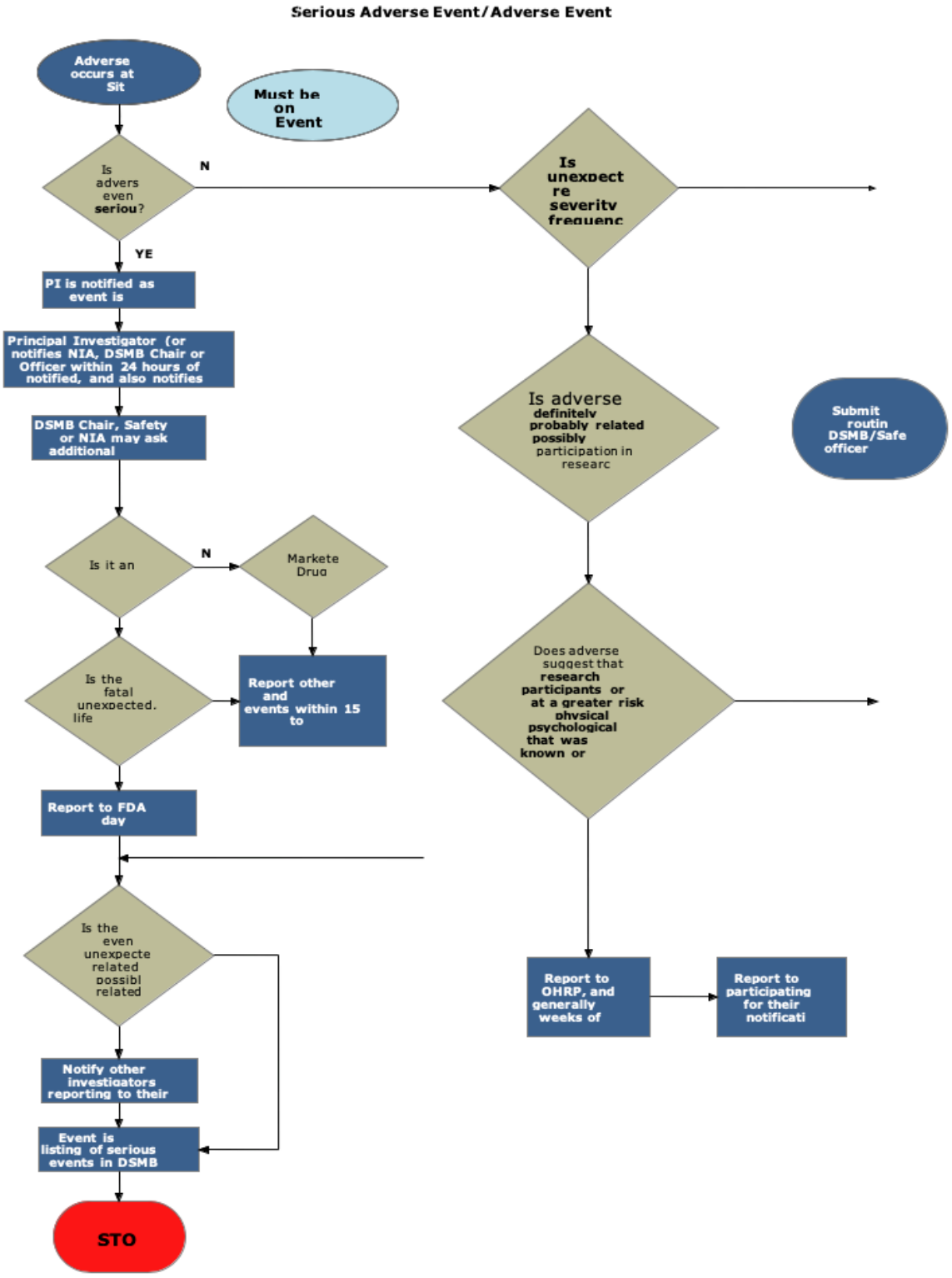


Appendix 5: Data Collection and Timing

Table 1: Data collection and timing				
A. Clinical / patient information	T1 Baseline	T2 4 days post-randomization	T3 8 days post-randomization	T4 3 months post-randomization
Baseline General information Comorbidities Diagnoses APACHE II illness severity CPR information / baseline ICU type & admission source	x	-	-	-
Across entire hospitalization CPR information / changes Palliative care consults Procedures and therapies Dates (mechanical ventilation, hospital, ICU)	(x)	-	-	-
3 months 3 month status	-	-	-	(x)
Patient & family member information				
Contact info Gender DOB, race / ethnicity, gender, marital status, children Employment Relation to patient Social support Financial distress	x	-	-	-
NEST	x	x	x	-
Goal concordant care	x	x	x	-
Quality of communication	x	x	x	-
Patient-Perceived Patient-Centeredness (PPPC) scale	-	-	x	-
PHQ-9	x	-	x	x
GAD-7	x	-	x	x
PTSS	x	-	x	x
Relationship with physician	x	x	x	-
Physician discussed needs	x	x	x	-
Readmitted?	-	-	-	X
Clinician information				
Gender Age Race / ethnicity Rank Service	Study initiation	-	-	-
Physician responses				
I did family meeting	-	X	X	-

CPR: cardiopulmonary resuscitation; GAD-7: generalized anxiety disorder 7-item instrument; ICU: intensive care unit; NEST: Needs; Existential concerns; Symptoms; and Therapeutic interaction scale; PHQ-9: patient health questionnaire 9-item depression instrument; PTSS: post-traumatic stress scale

Appendix 6: Adverse and Serious Adverse Event Reporting Diagram



Appendix 7: Study Contact Information

Principal Investigator(s)
Christopher E. Cox, MD, MPH
Division of Pulmonary Allergy & Critical Care
Box 102043
Durham, NC 27710
Phone: 919-681-7232
Email: christopher.cox@duke.edu

Sharron Docherty, Ph.D.
School of Nursing
BOX 3322
Durham, NC 27710
Phone: 919-668-3836
Email: sharron.docherty@duke.edu

Study team
Katelyn Dempsey, CRC
Clinical Research Coordinator
Division of Pulmonary, Allergy & Critical Care
Email: katelyn.dempsey@duke.edu

Santos Bermejo, CRC
Clinical Research Coordinator
Division of Pulmonary, Allergy & Critical Care
Email: santos.bermejo@duke.edu

One Cow Standing, LLC
Matthew Gauger, Programmer and Project Manager
Email: matthew.gauger@onecowstanding.com

DSMB Members
Keith Swetz
Email: kswetz@uabmc.edu

Gretchen Schwarze
Email: SCHWARZE@surgery.wisc.edu

Heather Bush
Email: heather.bush@uky.edu

Study Sponsor
Partha Bhattacharyya
NIA Program Officer
Email: bhattacharyyap@mail.nih.gov

Dennis Ongubo
NIA Program Officer
Email: dennis.ongubo@nih.gov

Statistical Team
Maren Olsen, Ph.D.
Department of Biostatistics and Bioinformatics
Email: maren.olsen@duke.edu

Alice Parish, MSPH
Department of Biostatistics and Bioinformatics
Email: alice.parish@duke.edu