**Supplemental Material**

**Comparison between Baystate ACE Program and University of Alabama (UAB) Programs (both examined outcomes stratified by comorbidity/CMI)**

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|  | **UAB** | **Baystate** |
| **Age Criteria** | ≥70 | ≥70 |
| **Other Admission Criteria** | * Inpatient status * Spent entire hospitalization as a hospitalist’s patient in either ACE or usual care unit | * Direct admit from Emergency Department * Inpatient status   + No transfers from other hospitals or other units   + No advanced dementia patients   + No hospice or end of life patients |
| **Model of Care** | * Geriatric assessments, including cognitive and functional screens * Daily (M-F) geriatrician-led IDT rounds * Discharge planning from day of admission * Communication of team recommendations to appropriate caregiver | * Geriatric assessments, including cognitive and functional screens * Daily (M-F) geriatrics advanced practitioner-led IDT rounds * Discharge planning from day of admission * Communication of team recommendations to hospitalists * Goals of care discussion for subset of patients who had limited prognosis on the “surprise question” |
| **Primary Physician** | * Hospitalist | * Hospitalist |
| **Interdisciplinary Team** | * ACE nurse coordinator * Geriatrician * Nurses * Physical / Occupational therapy * Pharmacist * Registered dietician * Social work | * Geriatrics advanced practitioner * Nurses * Spiritual services * Pharmacist * Volunteer advocates * Patient advocate, as available * Registered dietician, as available * Research assistant, as available |

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|  | **UAB** | **Baystate** |
| **IDT Rounds** | * ACE coordinator and social worker reported results of functional (Katz index, Lawton index), cognitive (mini-cog) and psychosocial assessments * Nurses reported daily assessments regarding geriatric syndromes (e.g. pain, mood, cognition, mobility) * Medication review | * Nurses reported daily geriatric assessment using SPICES format (Sleep, Problems with eating/feeding, Incontinence, Confusion, Evidence of falls, Skin Breakdown). Added additional “C” for comfort to screen for unmet symptom management needs. * Pharmacy calculated creatinine clearance and reviewed medications with attention to potentially inappropriate medications (PIMs) * Research assistants reported Mini Cog and Edmonton Frail Scale findings * Other team members communicated updates and concerns * Geriatrics advanced practitioner reviewed new patient H&Ps, labs and medications, provided nursing education and formulated plan of care |
| **Environmental Modifications** | * None | * Décor – warm colors, age appropriate wall décor (e.g. old city photos for reminiscence) * Orientation - visible clocks, date clearly printed on white board, clear demarcation of different functional areas (color, signage, etc.) * Mobility – matte, non-slip flooring, even color, contrasting flooring to define floor edge / pathway / exits / workspaces, wide doors; signage to mark distance ambulated, available seating in halls * Other adaptations: grab bars in bathroom, elevated toilet seats * Noise – quiet hours 10pm-6am |
| **Severity of Illness** | * Case Mixed Index | * Gagne score |
| **Outcomes** | * Variable direct cost | * Total cost |

IDT, interdisciplinary team rounds

**ACE Rounds Protocol**

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| Nurse Manager and full ACE team conduct daily (M –F) rounds on all patients meeting ACE inclusion criteria. | The purpose of ACE rounds is to review all potential risk factors for delirium and functional decline, and institute measures to prevent them. |
| Unit secretary maintains ACE roster for team. |  |
| Prior to rounds:   * Night RNs complete the NICHE *SPICES* Assessment and provide them to Daytime RNs for ACE nursing reports. * Conduct comprehensive medication review. * Check all labs and review the H & P for each new ACE patient. * Calculate creatinine clearance. * Review previous day’s recommendations to assess response to implementation and any need for revision. * Review all patients to determine which patients would benefit from1:1 interaction with specialized ACE volunteers (mobilization, nutrition or cognitive enhancement). * Give recommendation sheets to primary team on rounds. | Responsible party:   * RNs * Pharmacist or Geriatrics PA/MD * Geriatrics PA/MD * Pharmacist * All staff on rounds * All staff on rounds * Nurse Manager/Charge RN |

**MD to RN Orders for all ACE patients**

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| * Activity | * Ambulate 3 times a day with assistance as appropriate. * Range of Motion 3 times a day (for all patients unable to ambulate) |
| * Discontinue in-dwelling urinary catheters; may remain ONLY for patients meeting the criteria specified in Healthcare Infection Control Practice Advisory Committee Guideline Recommendations, 2009. | Refer to BH Nursing Policy:  *In-dwelling Bladder Catheter: Criteria for utilization, care, and removal in Adult Patients* |
| * Bowel Care | Refer to BMC Nursing Manual:  *Non ICU Adult Constipation Guideline & Bowel Management Algorithm* |
| * No Restraints | Refer to BH CO 9.805:  *MEDICAL SURGICAL USE OF RESTRAINTS*  \*\*Use only when patient is immediate danger of harming self and when non-physical interventions are ineffective.\*\* |
| * Do not wake between 10 PM & 6 AM unless medically necessary. | Follow sleep enhancement protocol. |

**Nursing Assessment & Collaboration**

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| * RN performs the CAM (Confusion Assessment Method) on all ACE patients on admission and every 12 hours thereafter. | CAM is triggered automatically by EMR for all patients > 70 yrs of age on unit. |
| * Notify physician of record the first time the CAM is positive. |  |
| * RN attends ACE rounds daily. | Report on patient’s CAM, PO intake, last BM, sleep, pain, continence, and mobility challenges, using the *SPICES* assessment sheet. |
| * Unit secretary prompts “All About Me” assessment for completion by PCT or RN. | Communicate with patient and/or family to complete information for “All About Me”. |
| * For all patients meeting the ACE criteria, initiate:  1. Mobility protocol 2. Sleep enhancement protocol 3. Therapeutic cognitive activities 4. Vision & hearing protocols 5. Nutrition/hydration protocol |  |

**Mobility Protocol:**

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| * On admission, the RN assesses both baseline and current mobility status, along with any changes in the patient’s condition. | * Assessment according to Health Data Base * Obtain prior level of functioning (walking distance, use of assistive devices for ambulation, etc.). |
| * Unless the patient has a medically appropriate bed rest order, facilitate ambulation in the hallway as tolerated, using assistive devices as necessary. | * The goal is to prevent deterioration of the patient’s functional status from being immobilized. Do not wait for PT to evaluate patients before ambulating them. * If unable to ambulate, complete passive range of motion exercises and get up to chair. |
| * At the start of every shift, plan to meet the mobilization needs of all ACE patients. RNs/ PCTs will post the ambulation goals clearly in the room. | * Please see Mobilization Safety Guidelines for Nursing for tips from Physical Therapy. |
| * Each ACE patient should be ambulated three times a day. * STANDARD of CARE: ambulate in the morning, in the afternoon, and after dinner. If there are patient specific barriers, such as the patient being off the floor or on bed rest, please note these on the ambulation log. | If there are unit specific barriers, such as inadequate staffing or lack of appropriate chairs for patients, please notify the manager, assistant manager, or the charge RN immediately. |
| * Implement walking after toileting (Vidan et al., 2009). | Utilize all opportunities to maintain mobility & functional status |
| * If patients cannot ambulate, get up to chair and/or change position q 2-3 hours (Vidan et al., 2009) & perform passive ROM while awake. |  |
| * Consult PT when a previously ambulatory patient is unable to walk. |  |
| * Document ambulation in designated area/location. |  |
| * Mobility volunteer will assist with ambulation per unit guidelines. |  |

**Sleep Enhancement Protocol**

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| * To facilitate quality sleep at night, minimize daytime sleeping. |  |
| * Turn off lights at 9pm, turn down TV volume and minimize overhead pages. |  |
| * Gentle massage (back, feet, hands), warm milk, decaf/herbal tea at bedtime |  |
| * Avoid night time tests (after 10pm). |  |
| * Avoid VS after 10pm and before 5am unless necessary or take VS with care activities (toileting, bed changes, repositioning). |  |
| * No labs from 10pm to 5am unless absolutely necessary. |  |
| * Avoid bed moves after 10pm. |  |
| * Reschedule meds to avoid 11pm-5am to facilitate sleep (RN reschedules or asks MD)-Heparin is given at 10pm-6am-2pm. Meds given q24h are scheduled prior to bedtime or during daytime. | Consult with Pharmacy, if needed. |

**Therapeutic Cognitive Activity Protocol**

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| * Provide reminders of day, date & location (white board) (Fox et al., 2013). |  |
| * Use information from the “All About Me” sheet to ask questions about things that might be interesting or pleasant for the patient. |  |
| * Refer to the ACE volunteers for cognitive enhancement. |  |

**Vision and Hearing Protocol**

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| * Encourage family to bring in glasses and hearing aids. |  |
| * Encourage patient to wear glasses and hearing aids. |  |

**Nutrition and Hydration protocol**

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| --- | --- |
| * ACE volunteerswill assist as per unit guidelines. |  |
| * Offer fluids when approaching patient. |  |

**Staff Education for ACE**

Following an analysis of educational gaps on the unit, all staff was educated in geriatrics principles and in delirium recognition. Due to the high incidence of constant companion usage, it was decided to provide this education to all constant companions on the in-house float team. The training consisted of small group one hour lectures and many 1:1 sessions resulting in seventy-three staff trained during the initial course lasting from August 2014-September 30, 2014. A total of 62 educational presentations of this material were presented from August 2014 to June 2015 as the scope of education increased to include new RNs in the hospital’s nurse residency program (68 RNs), and all nursing students (32) assigned to the unit.

Additionally, each RN on the unit was educated on how to use the Confusion Assessment Method (CAM) and to administer it twice daily for any patient admitted from the emergency room over the age of 70 years. An additional 8 RNs were given in depth education and validation of CAM to validate accuracy of the screening process. These RNs became resources for the remaining staff for CAM assessments. Weekly audits done by the unit educator provided valuable feedback as to accuracy and prompted follow up coaching as needed. Results were shared at monthly staff meetings. All new staff starting after October 2014 received initial education on delirium and CAM from their preceptors with 1:1 follow-up with the nurse educator.

In January 2015, we began the next phase of our education process by focusing on Mobility. All PCT staff (25) attended a one hour program discussing the importance of mobility, complications of immobility and how mobility impacts delirium prevention. They also received hands-on practice with physical therapists on mobility assessment and safe patient mobilization techniqes. New PCT staff received the education from their preceptors during orientation. In April 2015, the RN (40) staff also received education on potentially inappropriate medications (PIMS) using the Beers Criteria. Any staff unable to attend the program received the education 1:1 with the nurse educator that month.

Starting in June 2016, a volunteer education program was launched. Volunteers received an introduction to ACE principles and goals in a one hour class followed by one hour with the hospital physical therapists to learn safe mobility techniques, which included assessing mobility, using assistive devices for ambulation, responding to patient fall events and managing IV poles, urinary catheters and oxygen tubing. They also learned to use gait belts, basic hospital bed functions, bed alarms and call bells. Tips on how to have meaningful conversations with patients and the use of our "All About Me" patient information tool were covered as well. This education continues to this day in small group or 1:1 teaching sessions with the unit educator as new volunteers join the program.

Education of staff continued in 2017 with the introduction of "Lunch & Learns", spearheaded by a palliative care nurse practitioner. Topics included pain and symptom management at end of life, goals and advanced care planning and dealing with grief and loss. Each session lasted one hour with follow up in the clinical care area by the palliative care NP on a weekly basis.

**Senior Leadership Engagement:**

The Chief Nursing Officer and Chief Quality Officer both had worked previously in hospitals which had ACE units so they understood the value. The Chief Quality Officer was influential in engaging the Chair of Medicine and the Chief Medical Officer in support of the project and served as a coach on quality improvement processes in the early months of the project. The Chair of Medicine and the Geriatrics Division Chief presented outcomes and plans in stakeholder meetings. Later the Chair was promoted to Chief Medical Officer further solidifying support. Around this time Baystate also launched a CMS ACO. The increasing focus on population health and assumption of significant “risk” combined with the early ACE successes and resulted in the identification of geriatrics as a strategic priority in the system’s current 5-year strategic plan.

**Sensitivity analyses**

1. Excluding Patients with Hemiplegia

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| --- | --- | --- | --- | --- | --- |
|  | Readmission  Events | Unadjusted | 95% CI | Adjusted | 95% CI |
| **Overall** |  |  |  |  |  |
| ACE Unit | 201 | 13.8% | 12.0% to 15.6% | 13.9% | 12.1% to 15.7% |
| Comparator | 1,496 | 14.5% | 13.8% to 15.1% | 14.7% | 14.0% to 15.4% |
| Difference |  | -0.7% | -2.6% to 1.3% | -0.8% | -2.7% to 1.1% |
|  |  |  |  |  |  |
| **Excluding Hemiplegia** | | | | | |
| ACE Unit | 195 | 13.6% | 11.8% to 15.3% | 13.6% | 11.9% to 15.4% |
| Comparator | 1,465 | 14.7% | 14.0% to 15.3% | 14.8% | 14.1% to 15.5% |
| Difference |  | -1.1% | -3.0% to 0.8% | -1.2% | -3.1% to 0.7% |

\*\*Adjusted for age and combined comorbidity score

Table 2: Differences in Total Cost and Length of Stay for Usual Care versus ACE Units

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 25th  percentile | 95% CI | | 50th  percentile | 95% CI | | 75th  percentile | 95% CI | | 90th  percentile | 95% CI | |
| Total Cost Difference\* |  |  |  |  |  |  |  |  |  |  |  |  |
| Unadjusted | 171 | 20 | 322 | 600 | 375 | 825 | 1,932 | 1,549 | 2,315 | 3,687 | 2,945 | 4,430 |
| Adjusted\*\* | 241 | 83 | 399 | 664 | 471 | 856 | 1,924 | 1,605 | 2,243 | 3,789 | 3,085 | 4,493 |
| Excluding Hemiplegia |  |  |  |  |  |  |  |  |  |  |  |  |
| Unadjusted | 150 | -3 | 302 | 576 | 350 | 801 | 1,899 | 1,516 | 2,281 | 3,731 | 2,908 | 4,554 |
| Adjusted\*\* | 213 | 57 | 373 | 636 | 446 | 827 | 1,920 | 1,597 | 2,243 | 3,951 | 3,317 | 4,586 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| LOS Difference\* |  |  |  |  |  |  |  |  |  |  |  |  |
| Unadjusted | -0.01 | -0.11 | 0.08 | 0.18 | 0.05 | 0.31 | 0.97 | 0.80 | 1.14 | 1.86 | 1.39 | 2.32 |
| Adjusted\*\* | 0.04 | -0.07 | 0.14 | 0.30 | 0.17 | 0.43 | 0.95 | 0.72 | 1.17 | 1.79 | 1.38 | 2.20 |
| Excluding Hemiplegia |  |  |  |  |  |  |  |  |  |  |  |  |
| Unadjusted | -0.02 | -0.11 | 0.07 | 0.18 | 0.05 | 0.31 | 0.97 | 0.80 | 1.13 | 1.86 | 1.46 | 2.26 |
| Adjusted\*\* | 0.03 | -0.08 | 0.14 | 0.30 | 0.17 | 0.44 | 0.96 | 0.73 | 1.19 | 1.79 | 1.38 | 2.20 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

\*Quantile regression using clustered standard errors to account for repeated patient visits; Estimates use ACE as the referent group.\*\*Adjusted for age and combined comorbidity score

1. Evaluation of Group Differences in Mobility by Using ICD Diagnostic Codes Which Potentially Reflect Mobility/Function

We have compared ICD diagnostic codes which can be considered surrogate markers for mobility for patients hospitalized in 2014 and 2015. We have used the ICD codes included in the frailty index published by Segal et al. (Ref 23 in the main manuscript) As seen in the table below the there is no difference between the two groups for the prevalence of diagnostic codes representing mobility, gait, musculoskeletal conditions or arthritis.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Comparator | ACE Unit | p-value |
| N | 3444 | 365 |  |
| Arthritis | 670 (19.5%) | 80 (21.9%) | 0.260 |
|  |  |  |  |
| Impaired Mobility | 85 (2.5%) | 12 (3.3%) | 0.345 |
|  |  |  |  |
| Irregular Gait | 71 (2.1%) | 6 (1.6%) | 0.590 |
|  |  |  |  |
| Musculoskeletal Problems | 1084 (31.5%) | 111 (30.4%) | 0.677 |