

# Using Predictive Models for Palliative Care Outreach

NHPCO's Developing the Care Continuum: Innovative  
Models to Meet the Unique Needs of Patients/Families

August 6, 2010

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# What Does a Palliative Care Coordination Program Do?

- **Nurses and social workers work in the community and telephonically to**
  - Minimize physical, psychological and spiritual distress at or near the end of life
  - Manage transitions from nursing home, hospital, and home helping patients and their providers prevent delivery of unwanted and intrusive services (e.g. ER use within 30 days of death)
- **Interventions include educating patients, families and providers about available choices for palliative care and other services needed at the end-of-life**
  - Culturally appropriate
  - Emphasizes patient choice for end-of-life setting
- **Produces outcomes**
  - Increases rate of hospice benefit utilization
  - Increases length of stay in hospice
  - Increases % of patients with completed Advance Directives
  - Increases % of providers who've completed POLST/POST forms

# Appropriate Timing of Outreach Improves Care & Quality

- **Predictive modeling helps target members in most urgent need of intensive intervention based on their prognostication of death<sup>1</sup>**
- **However, also identifies members who are appropriate for education around palliative care options and advance planning assistance (less intense intervention)<sup>1,2</sup>**
- **Care Coordination programs can prioritize outreach/engagement efforts, coordinate appropriate services and eligibility yet still reach all members<sup>2,3</sup>**

<sup>1</sup>**Chiang JK, Cheng YH, Koo M et al. (2010). A computer-assisted Model for Predicting Probability of Dying Within 7 Days of Hospice Admission in Patients with Terminal Cancer. Japanese Journal of Clinical Oncology. 40(3) 449-455.**

<sup>2</sup>**Drozda JP, Libby D, Keiserman W, Rundhaug P. (2008) Case Management Decision Support Tools: Predictive Risk Report or Health Risk Assessment? Population Health Management 11(4) 193-196.**

<sup>3</sup>**Shepherd D, Swanson K, Olson T. (2009). Predictive Models to Identify Risk of Medication Non-Adherence in Mental Health Treatment. Predictive Modeling News 2(7).**

# Comparison of Predictive Model Approaches

<b>Traditional (Medical Treatment) Predictive Model</b>	<b>APS-Palliative Care Coordination (PCC) Predictive Model</b>
Identifies high cost patients, with uncoordinated care which may improve quality and reduce costs	Identifies high cost patients, with uncoordinated care and impactable conditions that improve quality and reduce costs near the end of life
Identifies patients at greatest risk for disease/condition, appropriate for treatment, prevents treatment delays; patients not identified in a timely manner may be harmed if they do not receive appropriate treatment	Identifies patients who may be near the end of life, at greatest risk for unwanted high-cost care who would benefit from PCC; “delay of treatment/intervention” is temporary since entire population has access to PCC
Identifies patients who should avoid treatment for disease/conditions that they do not have; treatment to patients who do not have disease/condition may be harmful	Identifies patients nearing the end of life who may benefit from PCC before critical decisions need to be confirmed; information to some who may not be near the end of life is not harmful
Evaluation of traditional PM focused on “accuracy” as measured by high (%) Positive Predictive Value (PPV); Sensitivity	Advance planning and patient education for patients with chronic conditions, yet not near end of life, holds benefit; utility of model not dependent on PPV, Sensitivity

# Why Develop the APS-PCC Predictive Model

- **Early predictive modeling methods focused on cost only<sup>2,3</sup>**
  - Early models predicted high cost patients, which did not necessarily equate to cost savings due to patients with non-impactable conditions
- **New, innovative predictive modeling methods focus on actionable cases<sup>3</sup>**
  - Using data beyond diagnosis and prior costs better predicts not only which patients have impactable conditions, but also targets an appropriate intervention
- **APS Predictive Model focuses on physical/mental health co-morbidities and medical utilization<sup>2</sup>**
  - Many, but not all factors are associated with high cost
  - APS PM also includes evidence based considerations (e.g. depression association with non-adherence to medication)
  - APS PM identifies patients who are more likely to be impactable near the end of life and are appropriate for the intervention; Palliative Care Coordination
- **Effective palliative and hospice care guidelines are well defined, but still a need for identifying and prioritizing patients who would benefit from timely education, care options and increased quality near the end of life<sup>1</sup>**

<sup>1</sup>Chiang JK, Cheng YH, Koo M et al. (2010). A computer-assisted Model for Predicting Probability of Dying Within 7 Days of Hospice Admission in Patients with Terminal Cancer. Japanese Journal of Clinical Oncology 40(3) 449-455.

<sup>2</sup>Shepherd D, Swanson K, Olson T. (2009). Predictive Models to Identify Risk of Medication Non-Adherence in Mental Health Treatment. Predictive Modeling News 2(7).

<sup>3</sup>Shepherd D, Westover B, Orme S. (2008). Models Target Mental Health Risk Factors to Reduce Medical Costs. Predictive Modeling News 1(6).

# Development of the APS-PCC Predictive Model

- **Predictive Model used to identify and then prioritize adults appropriate for PCC among adults with multiple, serious chronic illnesses, but not necessarily terminal**
  - 1) **Review literature and recommend guidelines for care near the end of life**
  - 2) **Develop and synthesize clinical decision tree for care near the end of life**
  - 3) **Develop code sets and business rules to create markers for care near the end of life**
  - 4) **Confirm hypothesis: Some adults are at high-risk for inappropriate utilization due to declining health and will be most appropriate for PCC**

# Steps to Develop the APS-PCC Predictive Model

- 5) **Test existing predictive models available in the public domain to determine ability to identify and prioritize adults appropriate for PCC (i.e. CDPS)**
  - a) Existing predictive models in the public domain were not sufficient to identify and then prioritize adults for PCC
- 6) **Retrospective review of large sample**
  - a) APS existing data; > 350,000 patients to develop our predictive model
  - b) Retrospective claims (12-36 months) admitted to hospice or died within 24 months with a terminal disease
- 7) **Divide large data set into two sub-samples**
  - a) APS divided a large data set into two randomly assigned mutually exclusive sub-samples; the first sub-sample to develop the new model and a second randomly selected sub-sample of the data to test/validate that model
  - b) N=355,804; Divided into two randomly assigned, mutually exclusive sub-samples
    - i. **Sub-Sample #1** - n=178,533; adults with 10,373 death or hospice cases, used to develop model
    - ii. **Sub-Sample #2** – n=177,271; adults with 10,549 death or hospice cases; used to validate new model developed using Sub-Sample #1

# Identification of Significant Predictors

- Diverse data elements, significant predictors were identified to construct the predictive model
  - Integrated clinical data from medical insurance claims, pharmacy, patient/member eligibility data, patient demographics, provider specialty codes and provider expertise
    - All data elements were tested for an association with death or hospice services in the last 24 months
  - PM also includes consideration of
    - Patterns of increased utilization
    - Consistency with final stages of terminal illness
  - An initial list of 120 variables (distinct elements associated with palliative/hospice care candidacy or death)
    - Backwards selection eliminated 66 variables that were not significantly association with likely hospice use or death
    - Final model consists of 54 variables

# PCC Predictive Model, Significant Predictors

<b>Major Risk Factors</b>	<b>Examples</b>
Diagnosis risk factors	Metastatic cancer, leukemia, alcoholic liver disease, heart/pulmonary disease
Utilization risk factors	Nursing home, inpatient hospital critical care, emergency room visits, providers per month
Demographic risk factors	Age, gender, ethnicity

# Findings: Predictive Model, Success

- **The APS-PCC Predictive Model is able to identify which patients should be prioritized for palliative care coordination**

**Example: 100,000 patients (adults) with at least one chronic disease**

- **Positive Predictive Value (34.1% were correctly identified)**
  - % of positive “predictions” that are true positives
    - PM identified 10,000 patients (top 10% of population) who were more likely to die or enter hospice care within 6 months
    - 3,410 patients (or approx. one-third; PPV=34.1%) of patients were correctly identified; they actually did die or enter hospice within 6 months
- **Sensitivity (55% of all true positives were in top 10%)**
  - % of true positives identified
    - 55.1% (more than half) of the true positives are in the top 10% of the population
- **The measure of success of the APS-PCC Predictive Model is not entirely based on PPV and Sensitivity**

# APS-PCC Predictive Model Helps Outreach to Adults with SMI

- **Adults with a serious mental illness (SMI), regardless of medical condition, die 25 years earlier than adults without an SMI<sup>1,2</sup>**
  - APS-PCC Predictive model can help target outreach to SMI population with known increased morbidity and mortality
  - Appropriate (identification & prioritization) results in increase quality of care choices and cost savings

**Example: Sample of adults with at least one SMI, N=3,843**

	<b>Top 2% of total population</b>	<b><sup>a</sup>Bottom 98% of total population</b>
<b>Average number of co-morbid conditions</b>	<b>6.4</b>	<b>2.8</b>
<b>Medical Expenses; per member, per month (PMPM)</b>	<b>\$62,715</b>	<b>\$3,710</b>
<b><sup>b</sup>Estimated Savings w/PCC</b>	<b>\$8,162 PMPM</b>	<b>TBD</b>

<sup>a</sup>Bottom 98% will have access to Palliative Care Coordination, when appropriate

<sup>b</sup>Estimated Palliative Care Coordination savings based on reduction of ER visits, re-admits and inpatient stays/ambulatory care sensitive admits

<sup>1</sup>Parks, J. et al. Morbidity and Mortality in People with Serious Mental Illness. National Association of State Mental Health Program Directors, Oct. 2006.

<sup>2</sup>Morden NE, Mistler LA, Weeks WB et al. (2009). Health Care for Patients with Serious Mental Illness: Family Medicine's Role. J Am Board Fam Med. 22(2): 187-195.

## Results: APS-PCC Predictive Model, Adults with SMI (Top 2%)

- **APS-PCC Predictive Model identified and prioritized adults with SMI (top 2%) to target for improved quality of care and substantial savings (\$8,162 PMPM) as a result of palliative care coordination**
  - Reduction in uncoordinated care will reduce medical expenses; primarily reductions in re-admits, ER, in-patient stays (ambulatory care sensitive admits)
  - Traditional PM Evaluation; PPV = 34.1%; Sensitivity = 55.1%; only part of successful model
  - Palliative Care Coordination will also improve quality of life and quality of choices near the end of life

# Limitations of Predictive Model

- **Traditional concerns about “false positives” and “false negatives” do not have a negative impact since entire population will benefit from Palliative Care Coordination**
  - Identification of “**false positives**”  
***Treatment for a condition that is not actually present***
    - If predictive model identifies a patient near the end of life (6-12 months), when that is not the case and they do not actually die for 18–24 months; patients may be prioritized to receive information before it is absolutely critical
  - Identification of “**false negatives**”  
***Delay or failure to treat a condition that is present***
    - If predictive model does not identify a patient who is near the end of life, when, in fact, they actually are (model did not “predict” their mortality); patients may not receive information about care near the end of life at the ideal point in time, but the PCC will help to coordinate decisions about care and other important decisions much sooner than typically happens without care coordination near the end of life

# Success of Predictive Modeling

## Predictive Modeling with Palliative Care Coordination

- **Provides clinicians, healthcare managers and hospice care management with an effective method for identifying patients and families who may benefit from timely discussion of advance planning<sup>1</sup>**
  - Plan of care is tailored respecting patient/family wishes and appropriate treatment/palliative care plan
- **Timely discussions leading to appropriate care near the end of life may improve quality of life, control costs and extend life in some cases<sup>2</sup>**
  - Helps agencies determine effective staffing patterns and control other agency expenses
  - Better integration of care across treatment settings

<sup>1</sup>Chiang JK, Cheng YH, Koo M et al. (2010). A computer-assisted Model for Predicting Probability of Dying Within 7 Days of Hospice Admission in Patients with Terminal Cancer. *Japanese Journal of Clinical Oncology*. 40(3) 449-455.

<sup>2</sup>Connor SR, Pyenson B, Fitch K et al. (2007). Comparing hospice and nonhospice patient survival among patients who die within a three-year window. *Journal of Pain Symptom Management* 33(3): 238-46.

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