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Assessing the Utility of Patient-level Predictive Models for Patients in Palliative Care

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Abstract

Background: Patients in palliative care should be considered for exclusion from observational studies examining medication risk because their deaths are likely to reflect their underlying risk rather than an effect of the medication being studied. The objective of this study was to determine if predictive models were viable to accurately determine patients in palliative care. Method: We utilized the Medicare, Medicaid, and Commercial Claims and Encounters (CCAE) datasets from 2010 to 2015. The cohorts were developed using the Atlas tool and consisted of all plan participants who died during this time period with at least 1 year of observation time prior to death. Participants with observations or procedures associated with palliative care were considered cases and the remainder were considered controls. For these analyses, the R PatientLevelPrediction package was used. In our models, we included covariates for condition occurrence, drug exposure, observations, and measurements within 30 days of the index date (death) and comorbidity indices (e.g., Charlson index). Results: The areas under the Receiver Operating Curves were 0.78, 0.81, and 0.79 for the Medicare, Medicaid, and CCAE datasets, respectively, indicating fair to good discrimination. The concept that was found to be the best positive predictor was the Systematized Nomenclature of Medicine (SNOMED) observation code 304253006, "Not for resuscitation". Conclusion: The PatientLevelPrediction package appears to be effective in predicting patients in palliative care.

Introduction

Studies of medication adverse effects often exclude subjects who are expected to die soon. This exclusion is reasonable because such subjects may use medications and receive care that is quite different from others, and because their deaths are likely to reflect their underlying risk rather than an effect of the medication being studied. Patients in palliative care should be considered for exclusion from observational studies examining medication risk for these reasons. Directly determining those patients in palliative care using codes from administrative data may be difficult because of coding sensitivity and specificity issues. Previous approaches to improving the accuracy of the palliative care classification have mainly been attempted through heuristic approaches. Recently methods using predictive modeling to improve the accuracy of classification for other conditions have been demonstrated [1, 2]. The objective of this study was to determine if predictive models are viable to accurately determine patients in palliative care.

Methods

We utilized the Medicare, Medicaid, and Commercial Claims and Encounters (CCAE) datasets from 2010 to 2015 to conduct our analyses. CCAE is an administrative health claims database for active employees, early retirees, COBRA continuees, and their dependents insured by employer-sponsored plans. The databases have been translated from their original form into the Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM). The cohorts were developed using the Atlas tool and consisted of all participants who died during this time period with at least 1 year of observation time prior to death. Participants with observations or procedures associated with palliative care were considered cases (outcome group) and the remainder were considered controls. For these analyses, the R PatientLevelPrediction package was used. In our models we included covariates for condition occurrence, drug exposure, observations, and measurements within 30 days of the index date (death) and comorbidity indices (e.g., Charlson index). The models were trained on 75% of the cohort records and evaluated on the remaining 25%. Evaluations of the models were through analysis of the area under the Receiver Operator Characteristic (ROC) curves (AUC).

The cohort definitions used were as follows:

1) **Patients in Palliative Care** - People having any of the following:
- a death occurrence from Any Death
- occurrence start is after 2010-01-01

with observation at least 365 days prior and 0 days after index, and limit primary events to: **all events per person.**

For people matching the Primary Events, include:

People having any of the following criteria:
- at least 1 occurrences of an observation of Palliative care (SNOMED 103735009) occurring between 180 days Before and 1 days Before index
- or at least 1 occurrences of a procedure of Palliative procedures (SNOMED 362964009) occurring between 180 days Before and 1 days Before index

Limit cohort expression results to: **all events per person.**

2) **Patients not in Palliative Care:** People having any of the following:
- a death occurrence from Any Death
- occurrence start is after 2010-01-01

with observation at least 365 days prior and 0 days after index, and limit primary events to: **all events per person.**

For people matching the Primary Events, include:

People having all of the following criteria:
- exactly 0 occurrences of an observation of Palliative care (SNOMED 103735009) occurring between 365 days Before and 0 days Before index
- and exactly 0 occurrences of a procedure of Palliative procedures (SNOMED 362964009) occurring between 365 days Before and 0 days Before index

Limit cohort expression results to: **all events per person.**

The sizes of the combined cohorts (cases and controls) were 100K, 63K, and 70K for the Medicare, Medicaid, and CCAE datasets, respectively.

Results

The areas under the Receiver Operating Curves were 0.78, 0.81, and 0.79 for the Medicare, Medicaid, and CCAE datasets, respectively, indicating fair to good discrimination. Table 1 contains the top 30 predictive concepts for palliative care for the Medicare dataset.

Table 1: List of top 30 concepts predictive of palliative care for the Medicare dataset. (Positive predictors are in green, negative predictors are in red)

Rank	Type	Concept	Rank	Type	Concept
1	Observation	Not for resuscitation	16	Procedure	New patient consultation
2	Measurement	Hematocrit	17	Observation	Dependence on supplemental oxygen
3	Condition	Pain from metastases	18	Observation	Asthenia
4	Condition	Generalized aches and pains	19	Procedure	Computerized axial tomography of head
5	Condition	Mental state, behavior and/or psychosocial function finding	20	Procedure	Cardiac resuscitation
6	Procedure	Unlisted diagnostic radiographic procedure	21	Condition	Secondary malignant neoplasm of liver
7	Condition	Cardiac arrest	22	Measurement	Fibrin degradation products, D-dimer; quantitative
8	Procedure	Counseling	23	Condition	Obstructive hydrocephalus
9	Observation	Unattended death	24	Procedure	Subsequent hospital care, per day, for the evaluation and management of a patient, which requires at least 2 of these 3 key components: A problem focused interval history; A problem focused examination; Medical decision making that is straightforward
10	Condition	Anoxic encephalopathy	25	Procedure	Intubation of respiratory tract
11	Measurement	Erythrocytes [#/volume] in Blood by Automated count	26	Observation	Walking disability
12	Procedure	Prolonged service in the inpatient or observation setting, requiring unit/floor time beyond the usual service; first hour (List separately in addition to code for inpatient Evaluation and Management service)	27	Condition	Primary malignant neoplasm of pancreas
13	Procedure	Counseling	28	Procedure	Nursing facility discharge day management; more than 30 minutes
14	Condition	Adult failure to thrive syndrome	29	Condition	Closed traumatic subdural hemorrhage
15	Condition	Coma	30	Procedure	Initial hospital care, per day, for the evaluation and management of a patient, which requires these 3 key components: A detailed or comprehensive history; A detailed or comprehensive examination; and Medical decision making that is straightforward

Conclusion

The models developed from the PatientLevelPrediction package appear to show promise in predicting patients on palliative care. Future work in this area would include utilizing the models to understand how improving methods to determine those in palliative care affect observational research on medication adverse effects.

References

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