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Using AI and Natural Language Processing to Uncover Population Social Determinants of Health Factors

Session #183, February 13, 2019

Varun Gupta, IT Director, Analytics and Data Management, Mt. Sinai Medical Center
Trish Birch, SVP and Global Consulting Leader, Cognizant Healthcare

Conflict of Interest

Varun Gupta
Has no real or apparent conflicts of interest to report.

Patricia Birch, MBA
Has no real or apparent conflicts of interest to report.

Agenda

- Welcome & Introduction
- Learning Objectives
- Using AI and Natural Language Processing to Uncover Population Social Determinants of Health (SDoH) Factors
- Improving Health Outcomes with SDoH
- Q&A

Learning Objectives

Discuss how social determinants of health help providers improve clinical models, understand disease progression and identify phenotypes

Apply methods for cost effectively and accurately extracting social determinants of health (SDoH) data from rich content in unstructured clinical notes

Describe best practices for defining and creating an initial ontology set

Explain process of training natural language processing algorithms to accurately identify SDoH in patient record notes

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Using Natural Language Processing to Uncover Population SDoH Factors

About Mount Sinai

8 Hospitals

1 Medical School

9 Ambulatory Surgical Centers

190 Remote Clinical & Administrative Sites

38,000 Employees

7,800 Physicians

6,340 Faculty Members

3300+ Beds

138 Operating Rooms

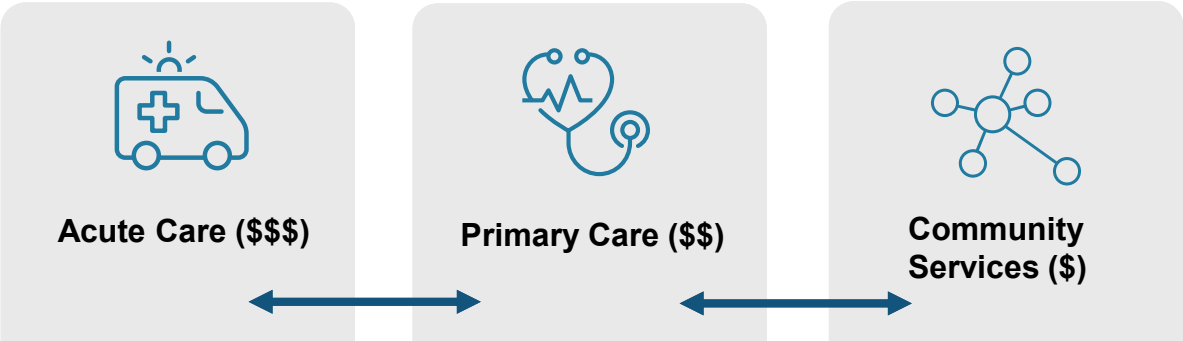
3+ million Outpatient Visits

500+ thousand ER Visits

130+ thousand Inpatient Visits

425,000 IT Service Desk Calls

Moving the Needle:
Population Health and Analytics



Enabling IT Initiatives

Establish interoperability across clinical systems

Onboard applications and technologies to drive collaboration

Enable ‘Data as a Service’

Fee for Service

Value Based Services

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Natural Language Processing in Healthcare

Unstructured

- **Behavior**
  (smoking, substance abuse etc.)
- **Education**
- **Medications**
- **Discharge Education**
- **Economics**
- (financial status, education, transportation)
- **Safety**
- **Support**
- **Cultural**
- **Lab Results**
- **Demographics**
- **Prior Admissions**
- **Clinical**
  (current diagnostics, family history)

Structured

Social Determinants Identification

- Notes (Progress, admission, procedure, consultation notes); discharge summaries

Clinical Trials Recruitment

- Identification of patient cohorts

Improved Clinical Models

- Disease progression, phenotypes identification

Revenue Cycle Management

- Identify labs, procedures, medications, etc.

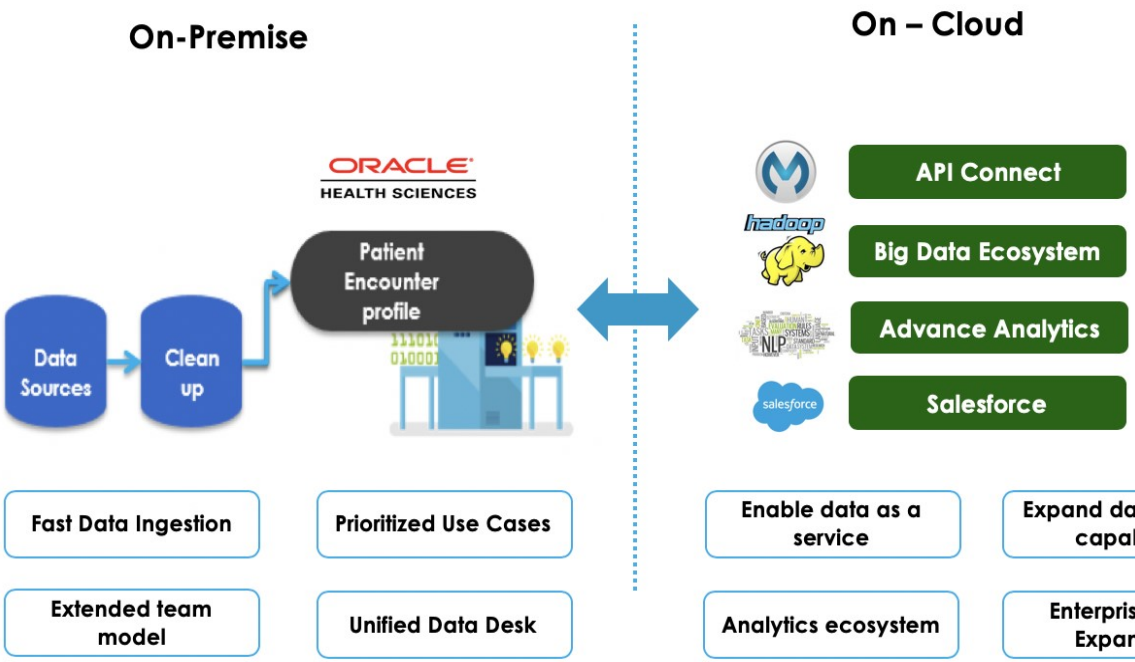
Computer-Assisted Coding/ Risk Adjustments

- Billing for correct services

Determining Risk Scores

- Smoker who quits → reduced risk of heart failure

Technology Framework



- Robust data ingestion
- FHIR-based API platform
- Hadoop data lake
- Hybrid cloud-based architecture on Azure
- Unified data desk and extended data teams

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NLP Process – Categorization

Economic Stability
- Housing, Income
- Food and Nutrition

Education
- Lack of education or Current education level causing any challenges

Healthcare System
- Medication, Prevention care
- Insurance, Language barriers

Physical Environment
- Transportation
- Concerns on overall safety and well being

Behavioral Health
- Depression/anxiety
- Substance abuse and Sleep relates problems

Care Giving Responsibility
- Patient's care giving responsibilities are having adverse effect on Patient's health

Legal
- Legal issues like divorce, child custody, alimony etc.

Support System
- Formal support: health home etc.
- Informal support: Friends, neighbors, relatives etc

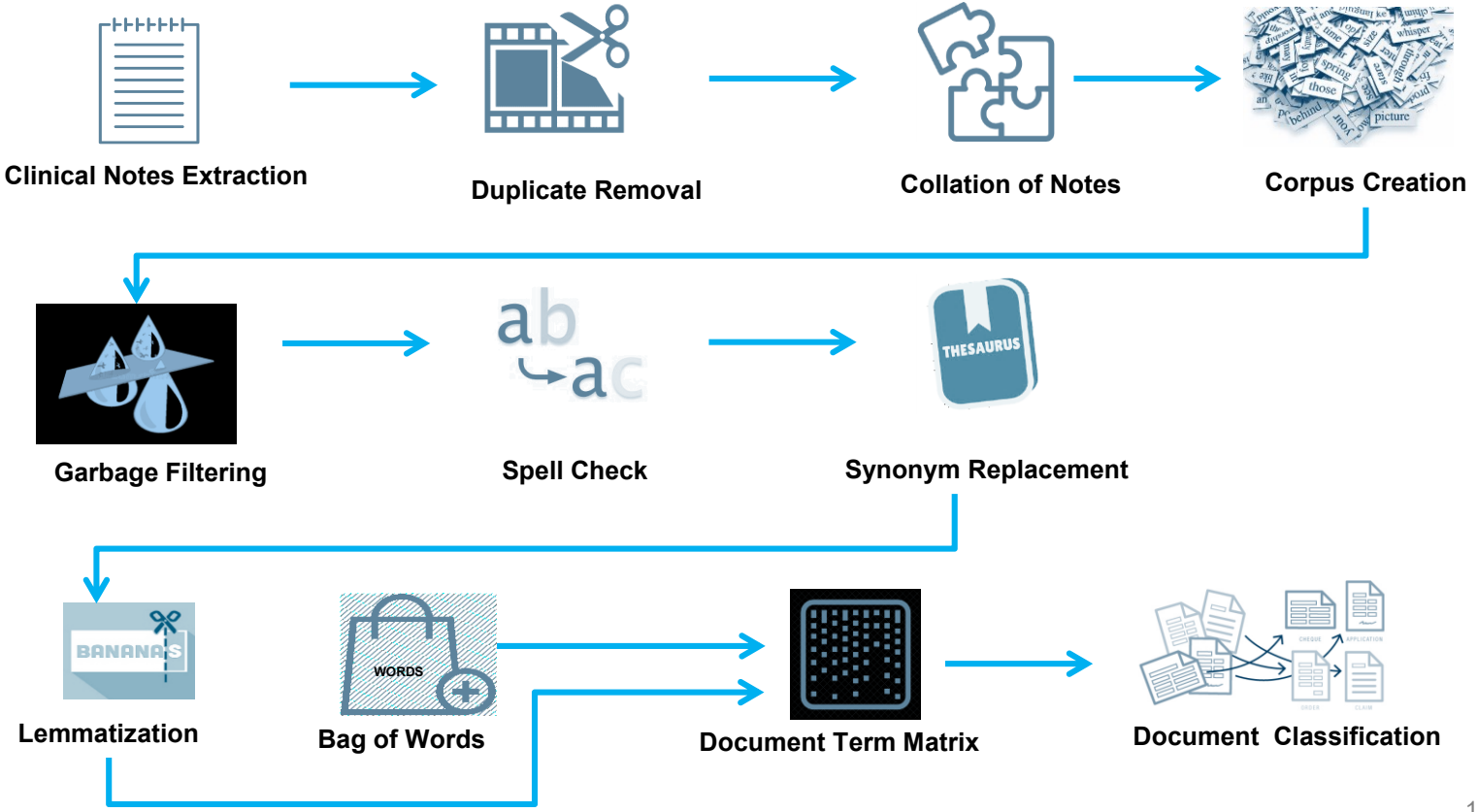
Physical Activity
- How active patient is and does patient have avenues to stay active

Fall Safety
- Includes, Identification of measures (not) taken for fall safety

Special Health needs
- Special health needs like vision, hearing, and Urinary incontinence

Legend : Phase 1 Phase 2 Phase3

NLP Workflow



Model Outcomes

*All Medicaid notes added to the database during **Dec '17 to Jul'18** were used for the model execution. Separate sample outputs for each model were manually validated by clinical SMEs to drive model parameters.*

Economic Stability

97%
Accuracy

Sensitivity: 96%
Specificity: 99%

Education

93%
Accuracy

Sensitivity: 97%
Specificity: 88%

Healthcare System

89%
Accuracy

Sensitivity: 91%
Specificity: 85%

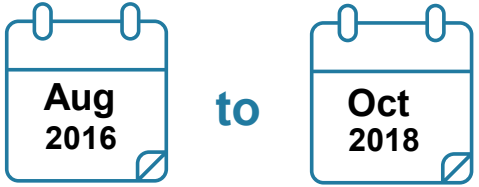
Physical Environment

86%
Accuracy

Sensitivity: 98%
Specificity: 75%

Capturing Insights

Time Period



Medicaid

7,240,320
Encounters

&

226,368
Patients

SDoH Category	Patient Count	% of Patients with SDoH
Economic Stability	**35,187**	**16%**
Healthcare	**35,781**	**16%**
Education	**8,770**	**4%**
Physical Environment	**18,685**	**9%**
Total Patients with SDoH	**70,541**	

31% of total patients *who had an encounter Aug 2016-July 2018 were found to have at least one SDoH factor.*

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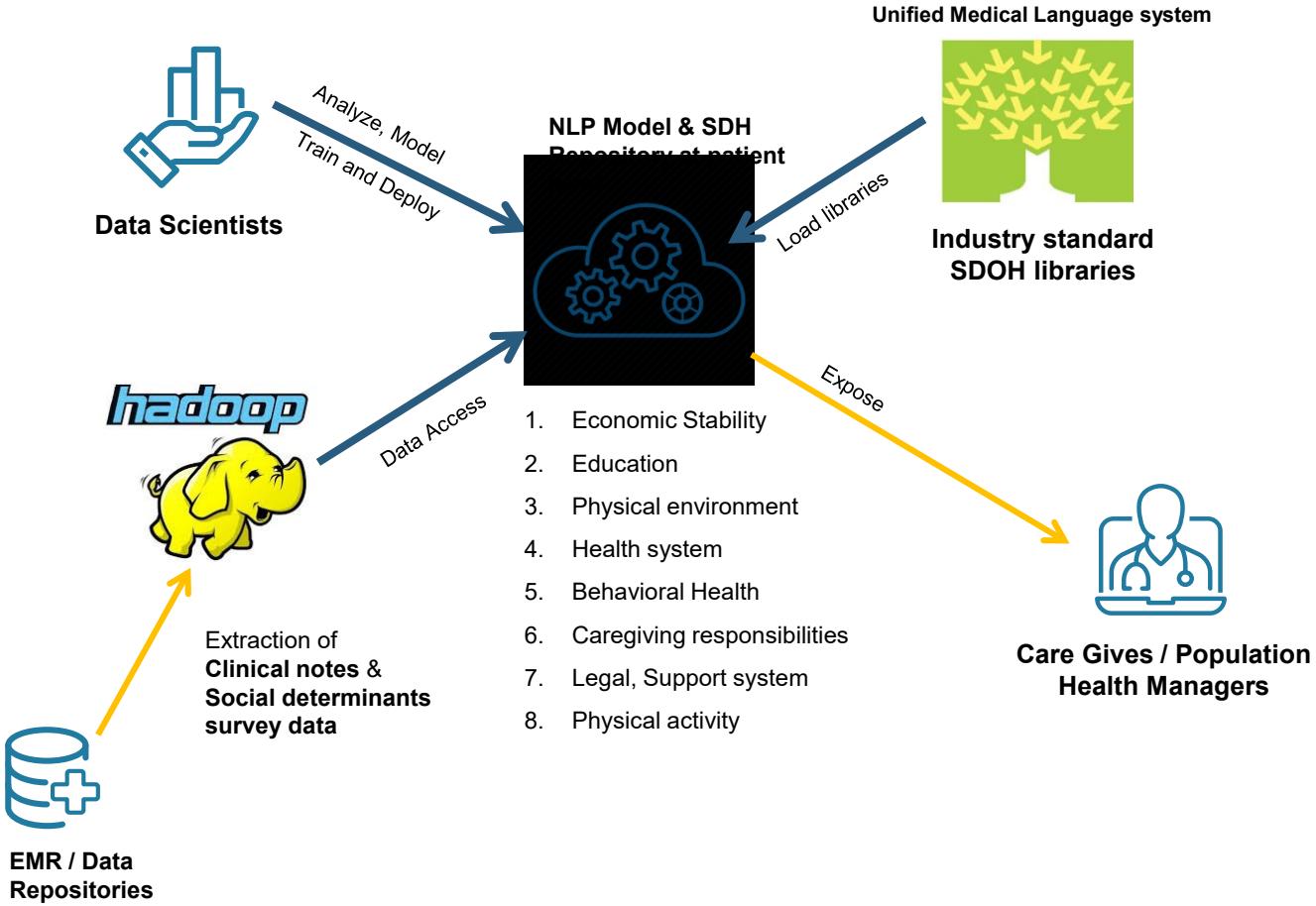
Next Steps to Scale



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Challenges

- Creating an ontology unique to Mt. Sinai, but universal enough to effectively capture SDoH
- Testing the accuracy of the algorithm's output was labor-intensive.
- Integrating findings into clinical workflows and systems
- Integrating the generated outcome back to the individual patient EMR

Best Practices

- Analyze your available data
- Identify opportunities: process fit, most impactful SDoH
- Start simply, but be comprehensive
- Develop a roadmap

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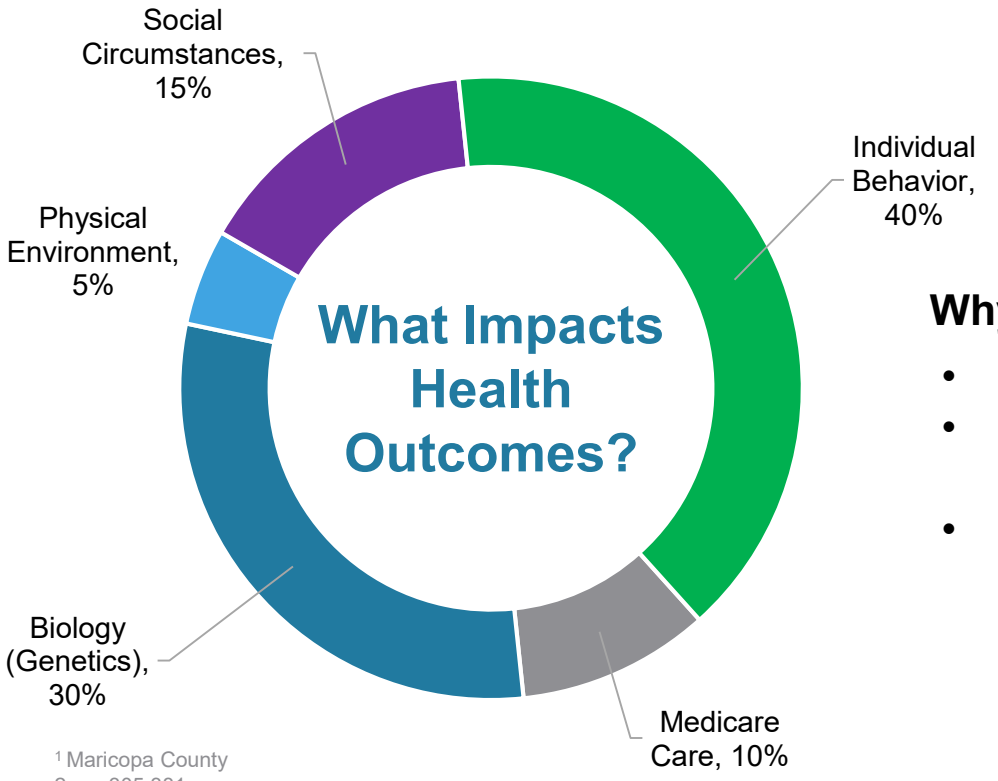
Improving Health Outcomes with SDoH

Healthcare to Social care



[1] Maricopa County
2 n = 305,381

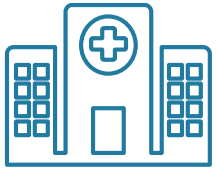
Why should you care?

- Higher utilization
- Increased presence of chronic disease
- Higher spend

Opportunity Analysis:
Impact on Payers & Providers

Health Plans

- High Cost of Care
- Unpredictable Actuarial Pool
- Member Satisfaction

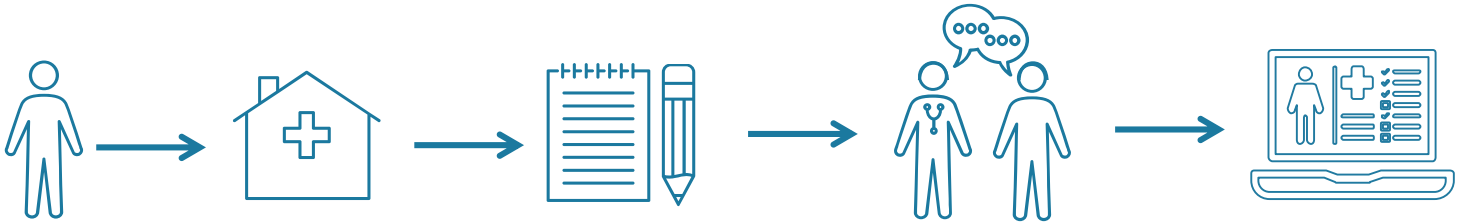


Health Systems

- Increased cost of care and financial risk
- Loss of Clinical time and resources
- Alignment of new mission: treating whole person and community

Today's SDoH Tools are Inefficient

Lack of Integration Across the Care Journey



- Manual Documentation
- Lack of Integration across the Care Journey
- Manual Entry into EMR

Lack of Integration Across Care Journey

Inefficient Integration	Upon identification of a SDoH, there's no efficient way to communicate and integrate this information across the care continuum
Referral Resources	Poor management of referral resources leads to difficulty identifying which resources will be most effective and supportive for a patient's needs
Overburdened System	Care Managers and Patient Navigators are often responsible for a handful of patients at once

Digital Tools can Uncover and Integrate SDoH into Today's Care Continuum

Leverages pre-existing data

Creates efficiency during care touchpoints

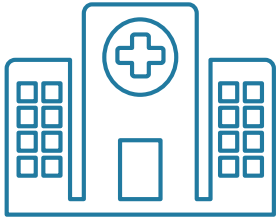
Allows for automatic integration into the care continuum

SDoH: Whole Person Care

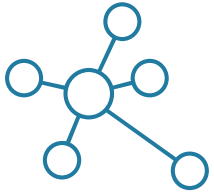
Caring for the Whole Person Requires Transformation at all 3 Levels

What can be done to better identify and integrate SDoH into a patient's care journey across all 3 levels?

Patient



Health System



Community

SDoH Transformation Takeaways

1. Solutions must be efficient

2. Integration across the care journey is needed

3. A comprehensive approach is required

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Questions

Varun Gupta
IT Director, Analytics And Data Management,
Mt. Sinai Medical Center
https://www.linkedin.com/in/varungupta7/

Patricia (Trish) Birch
Senior Vice President and Global Consulting Practice Leader, Cognizant
Patricia.Birch@Cognizant.com

Appendix

Sample Data

Enc. ID - Anonymized	Note Text – Subset	Model Tenet	Model Output
xxxxxx85919	*Physical Examination ED Assessment/Plan ASSESSMENT: …single, on SSI, domiciled at Main Chance Drop-In Center, with PMH HTN, with multiple reported prior psych hosps, no reported SAs or NSSIBs, reported* ***hx of violence in the context of incarceration*** *(2012-2015,* ***convicted of felony*** *robbery, denies violent offense, reports completed parole,….*	*Identification confirmation*	**Social Context tagged** *(the model successfully i. tagged 'context of incarceration' ii. tagged 'convicted of felony')*
xxxxxx62414	*SW will also provide patient with contact info to* ***legal aid*** *to help with her court case with her* ***custody battle*** *for her children. Has a prior 8B admission in the past with DX of Borderline Personality Disorder, recent admit to Kings County for detox in October 2017, in* ***ongoing custody battle*** *with mother over her 3 children.*	*Identification Confirmation*	**Legal Context tagged** *(the model successfully i. tagged 'ongoing custody battle' , 'legal aid')*
xxxxxx148032	*Late charting:* ***spoke to the patient's spouse*** *Patient c/o SOB started last night… Frequency of urination and polyuria [R35.0, R35.8] 09/11/2013 Delusional disorder [F22] 09/11/2013* ***Caregiver stress [Z63.6]*** *09/11/2013 Bed confinement status [Z74.01] 09/11/2013 Insomnia [G47.00] 08/15/2013 Constipation [K59.00] 08/15/2013 Left spastic hemiparesis [G81.14] 05/16/2013*	*Identification-Confirmation*	**Caregiving issue** *(the model successfully tagged 'caregiver stress' where patient was a caregiver)*
xxxxxx63126	*AED SW* ***spoke to patient's son****, <name> (xxx-xxx-xxxx), who reported significant* ***caregiver burnout****, stating that patients HHA at Big Apple Homecare, has not been coming, and that it has been difficult for <name> and patient's daughter, <name>, to supervise the patient at home.*	*Non detection-Negation*	**No caregiving issue** *(the model successfully avoided tagging 'caregiver burnout' since it is patient's son who is the caregiver)*
xxxxxx78681	***Problem: Social Isolation/Impaired Social Skills*** *Goal: Patient will begin to interact with others Outcome: Progressing ….. Patient has Medicaid metroplus Patient has been to ETPH rehab in Bronx, patient feels depressed due to ETOH and lack of work and* ***recent divorce.***	*Identification-Confirmation*	**Social Context and Legal tagged** *(the model successfully i. tagged 'social isolation' ii. tagged 'recent divorce')*

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