NIA IMPACT COLLABORATORY
TRANSFORMING DEMENTIA CARE

Not all approaches to data are created equal!

Data-related challenges for pragmatic trials involving PLWD

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Housekeeping

- All participants will be muted
- Enter **all questions** in the Zoom **Q&A**
- Moderator will review questions and ask them at the end
- Want to continue the discussion? Look for the associated podcast released about 2 weeks after Grand Rounds.
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Purpose of the Technical Data Core

- The Technical Data Core (TDC) focuses on leveraging electronic health records (EHRs), administrative data and other health care system data sources to conduct ePCTs among people living with dementia (PLWD) and their care partners.

For this talk, we'll focus on these two aspects:

- Develops and disseminates data algorithms to **identify and characterize PLWD** and their care partners from EHRs and administrative datasets.
- Develops and disseminates algorithms that **capture relevant health outcomes** of PLWD and their care partners from secondary and primary data sources.

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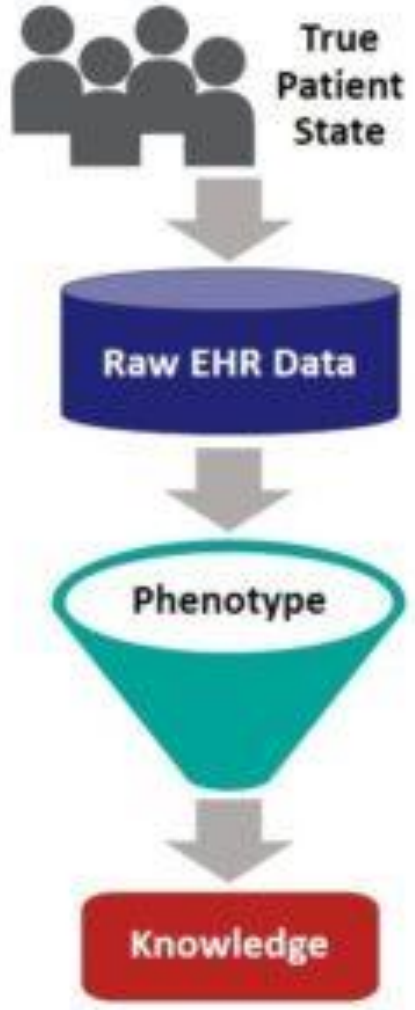
Objectives for this Talk

- Understand key data-related steps involved in designing pragmatic trials ***and trade-offs***
- Identify data-driven approaches to identify people living with dementia (PLWD) and caregivers - **focus on EHR**
- Identify challenges in validating approaches in different healthcare settings

How can you run trials using EHRs by leveraging their data?

- Identification
- Enrollment
- Randomization
- Data collection
- Outcome assessments
- Adverse events



https://rethinkingclinicaltrials.org/cores-and-working-groups/electronic-health-records/#references

Key steps for data in pragmatic trials

- Examples from studies - METRICAL and pilot studies 
- Identification - focus on EHR
  - Computable phenotypes for PLWD and caregivers
  - Machine Learning approaches
  - What's the trade-off?
- Outcome collection
- Running the trial itself

A quick look at previous TDC Grand Rounds talk

Journal of the American Geriatrics Society

AGS Geriatrics Healthcare Professionals

Brief Report | Full Access

Measuring Effects of Nondrug Interventions on Behaviors: Music & Memory Pilot Study

Ellen M. McCreedy PhD, Xiaofei Yang MS, Rosa R. Baier MPH, James L. Rudolph MD, SM, Kali S. Thomas PhD, Vincent Mor PhD

First published: 13 July 2019 | https://doi.org/10.1111/jgs.16069

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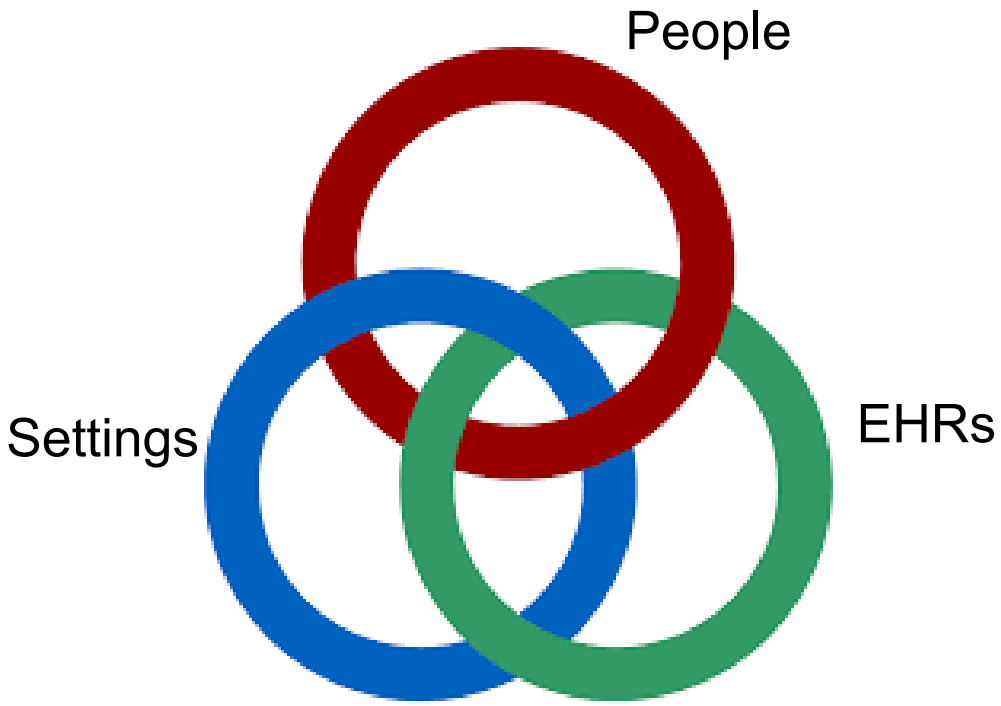
BROWN School of Public Health

Data assessments and types : METRICAL

Identifying PLWD/CG: based on pilot apps

Different settings

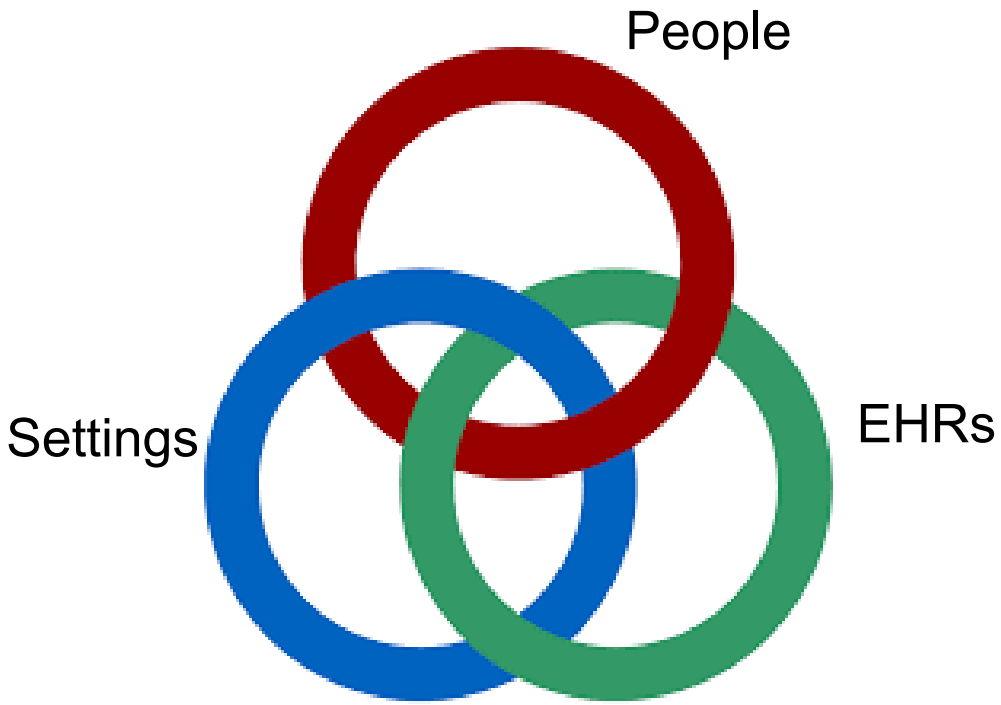
- Academic medical centers
- Hospitals, ED
- Nursing home facilities
- Community-based Organizations
- Care at home



Identifying PLWD/CG: based on pilot apps (2)

Different recruitment groups

- People living with dementia
- Caregivers (living with or near PLWD)
- Patients diagnosed with ADRD (Alzheimer's, vascular, Lewy body, …)
- Patients with mild cognitive impairment: "early onset"
- Institutions: Nursing home facilities, long-term / ACOs



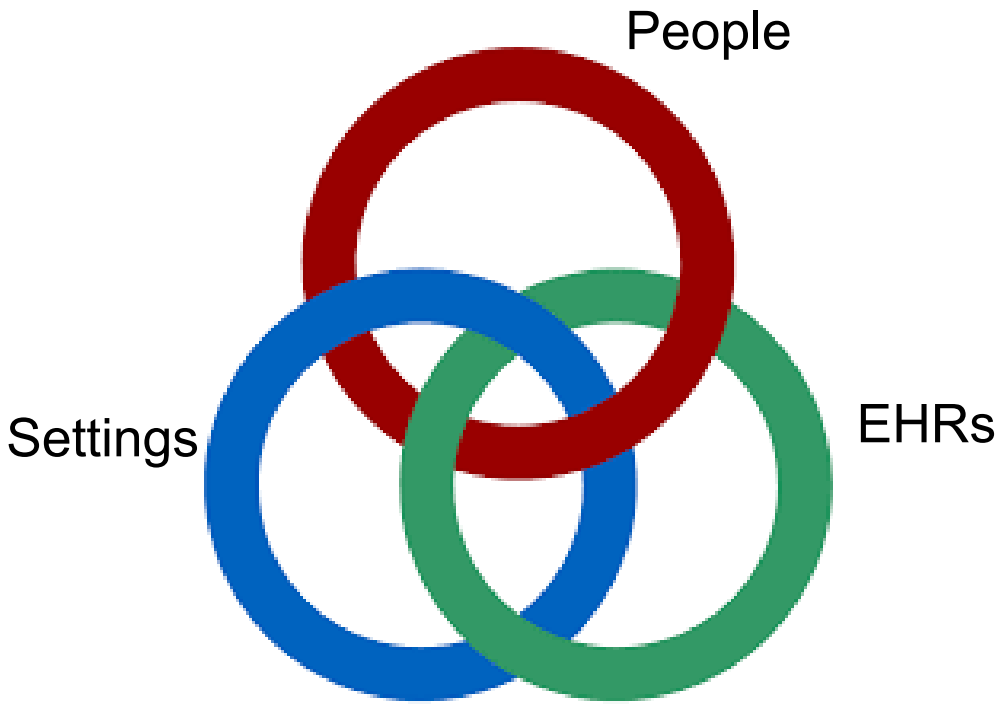
Identifying PLWD/CG: based on pilot apps (3)

Different data sources

- Dementia registries
- EHRs
- Medicare annual wellness visits
- Intake forms

Different components of “EHRs”

- ICD-10
- Current problem lists: active dementia diagnosis, ADRD
- Dementia workup
- Screening for cognitive performance
- “Significant memory loss” in intake forms



Implementing these in practice

Team A:

- Already had an algorithm, implemented in the health system
- The algorithm was not standardized -- need for standard approaches!

Team B:

- Had an informatician in the team with deep background knowledge
- If an algorithm was available, could use local help to implement it in their system

Kinds of data in EHRs

Structured Data

- Diagnosis codes (ICD-9, ICD-10, CPT codes)
- Cognitive / Neuropsychological tests

Unstructured Data

- Primarily extracted from medical notes
- Text notes from office visits, medical history
- Problem lists, medications
- Family and medical history
- Key words and key phrases associated with dementia-like symptoms

Key steps for data in trials

Given these examples from the pilot studies, what should you consider?

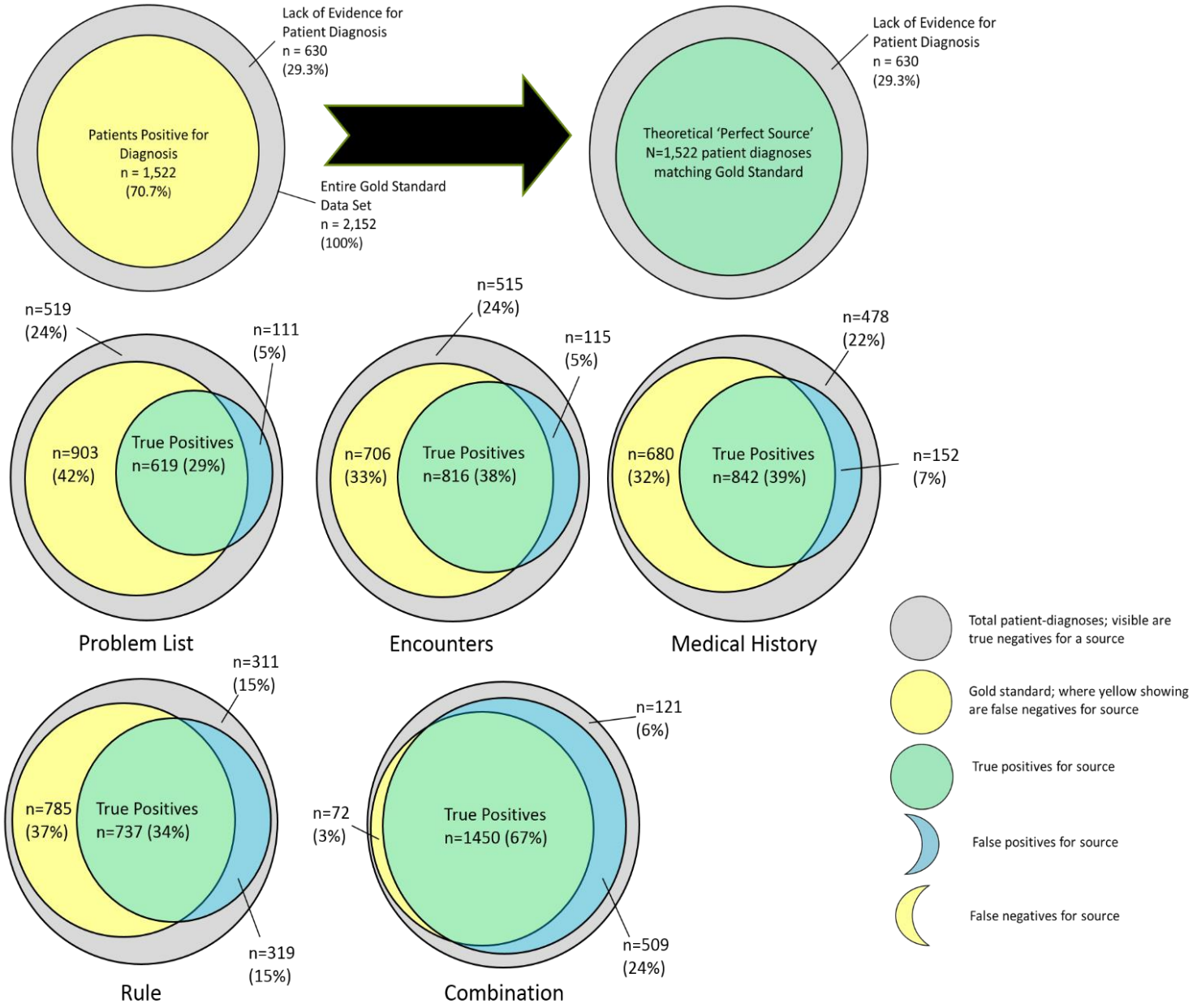
- ***Identification - focus on EHR*** 
  - *Computable phenotypes for PLWD and related persons*
  - Machine Learning approaches
  - What's the trade-off?
- Outcome collection
- Running the trial itself

Patient and caregiver identification in EHRs

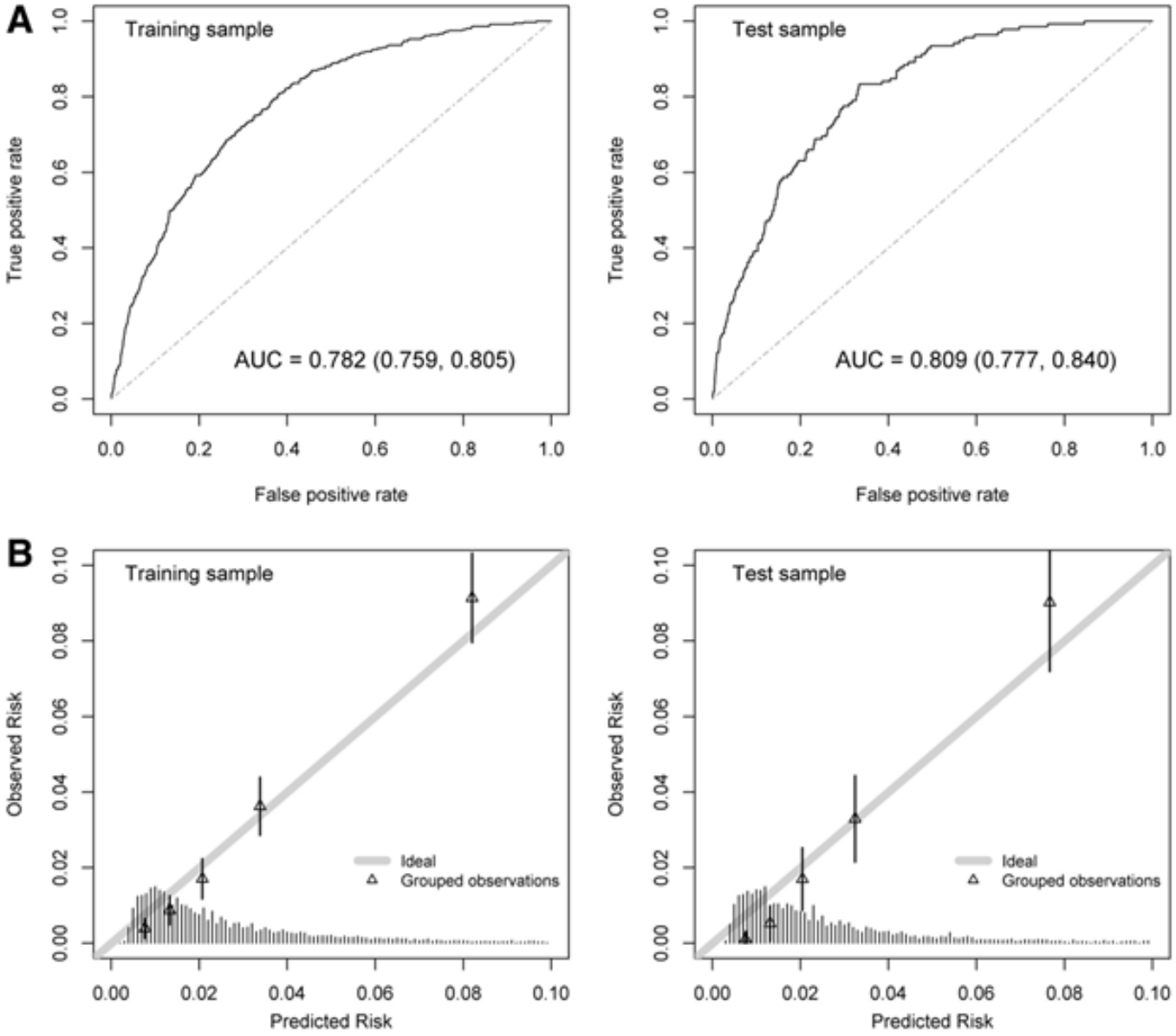
- Sensitivity = % of those with dementia that will be detected
- Specificity = % of those without dementia that will be ruled out
- PPV (Positive predictive value) = % of positive results where people have dementia

Type	Example	References (PMID)	Performance	Implementation Potential
Diagnosis codes	PheKB, Value sets	Harding (32553526)	Sens < .50, ≥1 PPV .50 ≥ 2 PPV .65 (!)	Simple
Screening tests	MMSE, 7MS, AMT, MoCA, SLUMS, and TICS (6-10 minutes); CDT, MIS, MSQ, Mini-Cog, Lawton IADL, VF, AD8, and FAQ (<5mn)	Patnode (32129963)	Mostly > .75 sens > .80 spec PPV .18-.75	3-10 minutes per patient; **should be structured;** not in wide practice
EHR variables beyond diagnoses	eRADAR - age + chronic illness + underweight + gait + utilization	Barnes (31612463)	Cutpoint at >85% Sens .47 Spec .87 PPV .10	Well defined, will identify undiagnosed, cost to screen depends on cutpoint

Diagnoses - Not a panacea



Martin, ACI, 2017;
AHRQ grant number 1R21HS023091-01



Deeper dive on eRADAR

AUC = Area under the curve; a summary of sensitivity and specificity across all points

If you have this data:

- Chronic illness diagnoses
- Demographics
- Body Mass Index
- Utilization
- Gait information

You may expand your sample at the cost of being wrong more often

Journal of the American Geriatrics Society, Volume: 68, Issue: 1, Pages: 103-111, First published: 14 October 2019, DOI: (10.1111/jgs.16182)

Patient and caregiver identification: where to find definitions

PheKB Phenotype: Dementia (excerpt)

```
data DxLst ;
 input Dx $char6. ;
cards;
290.0        Senile dementia, uncomplicated
290.10-290.13   Presenile dementia
290.11
290.12
290.13
290.20  senile dementia delusional [paranoid] features
290.21  senile dementia with depressive features
290.3        senile dementia with delirium or confusion
290.40-290.43   arteriosclerotic dementia
290.41  Vascular dementia with delirium
290.42  Vascular dementia with delusions
290.43
291.0        291.0-291.2     dementia due to alcohol
291.1
291.2
292.82  dementia due to drugs
294.8   dementia, unspecified          (added at the request of Peggy Peissig May 19, 2008
294.10-294.11   dementia not classified as senile, presenile, or arteriosclerotic
294.11
331.0        Alzheimer's disease
331.11  Pick's disease of the brain
331.19  Other frontotemporal dementia
331.82  Dementia with Lewy bodies.  Dementia with Parkinsonism
run;
```

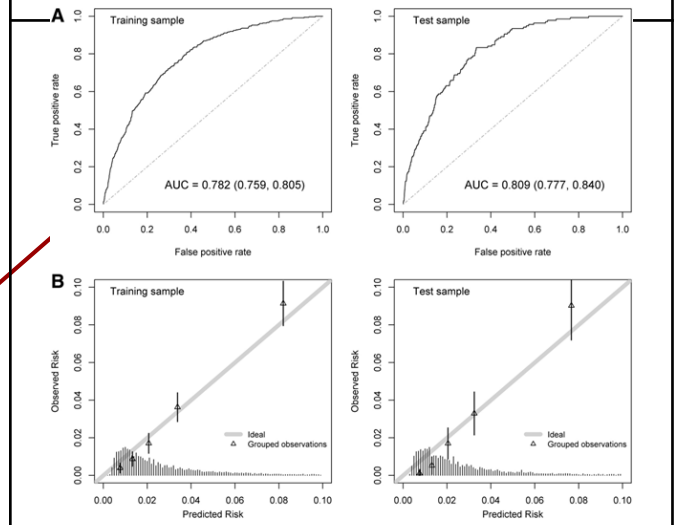
PhenX

Protocol Name	PhenX ID	LOINC Name	LOINC Code	CDE Name	CDE ID
Global Mental Status Screener - Adult	**PX130701**	Global mental status adult proto	62769-5	Adult Cognitive Assessment Score	3076130

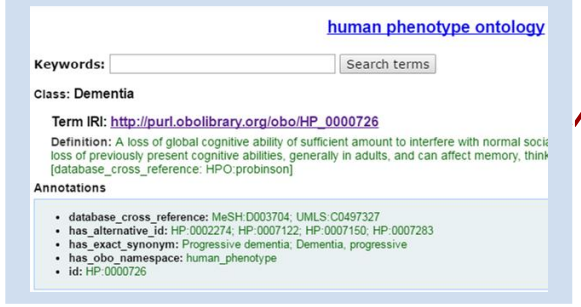
… subvariables under this level with logic

Potential computable phenotypes

Literature review



Human Phenotype Ontology: Dementia



Value Set Authority Center

Validation!

No algorithm has perfect characteristics - it will identify the wrong people (lower Positive Predictive Value); and miss people (have lower Sensitivity).

Validation can reduce these issues by:

- Comparing multiple different ways to identify the populations
- Generating estimates of missingness and inaccuracy to be used in imputation and sensitivity analysis

Major methods

- Manual chart review
- Self report
- Observation
- Comparing two data sources

Key steps for data in trials

Given these examples from the pilot studies, what should you consider?

- ***Identification - focus on EHR***
  - Computable phenotypes for PLWD and related persons
  - *Machine Learning approaches* 
  - What's the trade-off?
- Outcome collection
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Machine Learning-based models

- Combine structured and unstructured data
- Other sources of data
  - MRI images, PET scans, Cerebrospinal fluid (CSF) analysis
  - “New” Data: transcripts of conversations, speech samples, ...
- Approaches
  - Linear classifier models: Support Vector Machines
  - Random Forests
  - Even pattern-based approaches (set of rules)!
- Problems being addressed
  - Identifying people living with dementia: *Cohort identification*
  - Identifying early onset of dementia: *Classification / Prediction*
  - Deriving cognitive scores: *Regression*

Deep Learning-based approaches

- Non-linear combination of features using Recurrent Neural Network models
- Problem being addressed: predicting mild cognitive impairment
- Combining features derived from EHRs, patient reported outcomes
  - Demographics
  - Diseases / Disorders
  - Neuropsychological symptoms from clinical notes
  - Activities of daily living provided by patients
  - Other features, such as cognitive decline, impaired judgment/orientation

Problems focused by ML approaches

- Robust handling of missing data
- Using “novel” features to detect dementia (early onset, mild cognitive impairment, …)
- Phenotyping based on ICD-9/10 diagnosis codes, augmented with symptoms and medication history from EHR text
- Incorporating signal from diverse sources

Open Challenges

- Challenges in identifying PLWD and CGs in non-clinical settings

- Synthesizing existing algorithmic approaches

Key steps for data in trials

Given these examples from the pilot studies, what should you consider?

- Identification - focus on EHR
- **Outcome collection** 
- Running the trial itself

Outcome assessment - reflections from pilots

Outcome domain	Proposal	Suggestion!
Utilization (e.g., avoiding ED visits or hospitalizations)	Query participants / use EHR data	Incomplete and slow - try combining with claims; OR use different outcomes if already proven.
Patient/caregiver reported outcomes (e.g., function / anxiety / depression levels / strain)	Create a separate research survey	Consider implementing it into the EHR system; try to make it part of workflow - make sure it is coded.
Standard assessments	Use Minimum Data Set or EHR data	Test first to detect missingness; **have staff that can pull data regularly**
Standard EHR data: labs, visits, diagnoses	Create unique definitions	Use standard definitions and validate prior to use

Key steps for data in trials

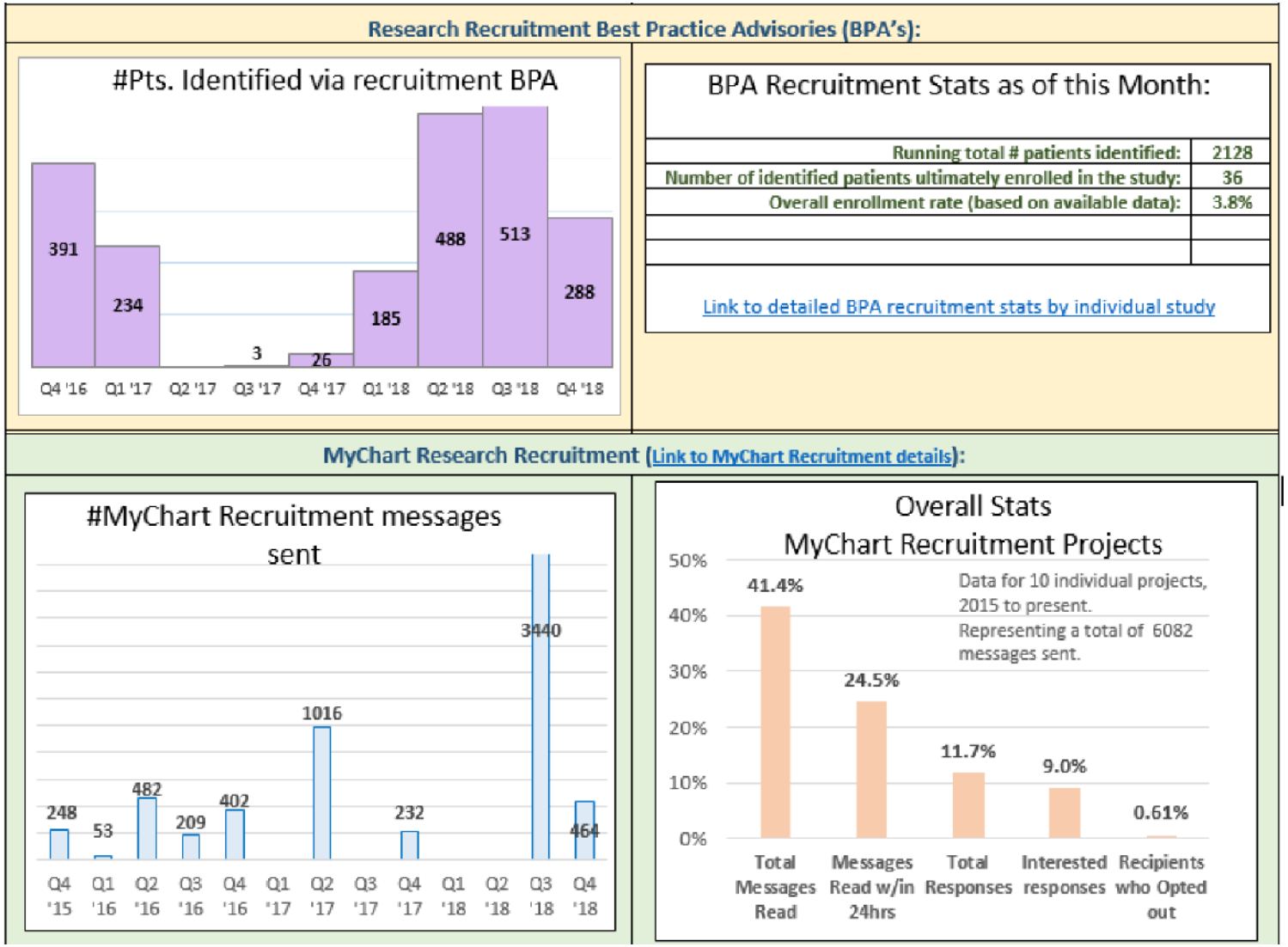
Given these examples from the pilot studies, what should you consider?

- Identification - focus on EHR
- Outcome collection
- **Running the trial itself**

Running trials with data and systems

- Past Identification
- *Enrollment / eligibility*
- Randomization
- Data collection: Integrated into care yet validated; AND/OR direct from patients/caregivers through portals
- Outcome assessments
- Adverse events - Alerting systems (e.g., automated notification when hospitalized / in the ED)

Recruitment through EHRs



BPA = Best Practice Alert - system tells user potentially eligible patient

MyChart Recruitment = recruiting through secure messages

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Conclusion

- Using standardized algorithms can help identify People Living With Dementia and their caregivers consistently
- Incorporating these approaches in nursing homes and long term care facilities remains challenging
  - But EHRs are very used widely in those settings as well, giving hope!

Q&A

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