Severity Diagnosis and Neuropsychological Test Result from Clinical Notes Among Veterans with Alzheimer's Disease

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OBJECTIVES

- This study aims to extract and compare severity diagnosis and neuropsychological tests from Veterans with Alzheimer's disease (AD) in the Department of Veterans Affairs healthcare system.

METHODS

- The present investigation used clinical notes extracted through the Text Integration Utilities (TIU) of the VA Informatics and Computing Infrastructure (VINCI) database. The study cohort was obtained from 2,586,768 veterans, who collectively had 357,608,246 visits recorded between 2008 and 2021.
- Clinical notes from the electronic health record of Veterans with AD containing both severity diagnosis and mini-mental state examination (MMSE) and/or Montreal cognitive assessment (MoCA) test result were included in the study.
  - A proprietary Python algorithm was applied to extract MMSE and/or MoCA test result(s) as the objective assessment(s).
  - AD severity keywords such as "mild," "moderate," and "severe" were extracted as the subjective assessment.
- Objective and subjective assessments of AD severity were compared to evaluate concordance.
- The validation process involved a manual review of 100 randomly selected notes for 92 distinct patients, which yielded an accuracy rate of approximately 80%.

STUDY COHORT

- The study cohort comprised 4,469 patients corresponding to 7,514 notes.

Demographic Characteristics	AD Patients
Age, mean (SD)	78.1 (9.4)
Sex, n (%)	
Female	150 (3.5%)
Male	4105 (96.5%)
Race and Ethnicity, n (%)	
White	3476 (77.8%)
Black or African American	501 (11.2%)
Hispanic or Latino	258 (5.8%)
American Indian or Alaskan Native	14 (0.3%)
Asian and others	25 (0.6%)
Native Hawaiian or Other Pacific Islander	36 (0.81%)
Unknown	415 (9.3%)

Table 1: Study cohort demographic characteristics
The 7,514 notes corresponded to 4,469 AD patients. Age at first AD severity note. Patients with missing information were not included. SD, standard deviation.

RESULTS

- **Overall concordance of objective and subjective assessments was 53%.**

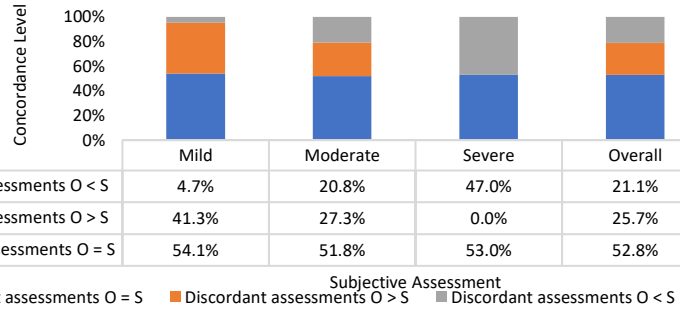

Figure 1: Concordance between subjective and objective assessments of AD severity.
O = S, objective and subjective severity assessments agreed; O > S, the objective assessment was more severe than the subjective assessment; O < S, objective assessment was less severe than the subjective assessment.

- **Concordance of subjective assessment with either MMSE or MoCA test was 53%.**

Test	Notes, n	Concordant assessments	Discordant assessments	
		O = S	O > S	O < S
MMSE	4,719	2,519 (53.4%)	1,135 (24.1%)	1,065 (22.6%)
MoCA	3,198	1,688 (52.8%)	912 (28.5%)	598 (18.7%)

Table 2: Concordance between subjective and objective assessments of AD severity by an objective test.
Total number of notes, MMSE + MoCA, is greater than 7,514; a few notes included MMSE and MoCA scores

- **Certain symptoms and comorbidities were associated with higher concordance.**

Characteristic	Notes, n	Concordant Assessments	Discordant Assessments	
		O = S	O > S	O < S
Symptom				
Wander	105	77 (73.3%)	17 (16.2%)	11 (10.5%)
Aberrant motor	89	60 (67.4%)	12 (13.5%)	17 (19.1%)
Hallucination	184	106 (56.0%)	43 (23.4%)	38 (20.7%)
Apathy	26	14 (53.9%)	6 (23.1%)	6 (23.1%)
Delirium	289	148 (51.2%)	106 (36.7%)	35 (12.1%)
Irritability	91	46 (50.6%)	30 (33.0%)	15 (16.5%)
Comorbidity				
Type I diabetes	157	95 (60.5%)	42 (26.8%)	20 (12.7%)
Grave's disease	97	57 (58.8%)	22 (22.7%)	18 (18.6%)
Post-traumatic stress disorder	1,167	654 (56.0%)	308 (26.4%)	205 (17.6%)
Anxiety disorder	1,816	1,000 (55.1%)	548 (30.2%)	268 (14.8%)
Sleep disorder	2,452	1,352 (55.1%)	674 (27.5%)	426 (17.4%)
Anemia	675	359 (53.2%)	196 (29.0%)	120 (17.8%)

Table 3: Concordance between subjective and objective assessments of AD in relation to select symptoms and comorbidities

- **The level of concordance was higher for dementia clinics than non-dementia clinics**
- **Psychiatrists/neurologists had the highest concordance.**

	Notes, n	Concordant assessments	Discordant assessments	
		O = S	O > S	O < S
Practice setting				
Dementia clinic	474	291 (61.4%)	104 (21.9%)	79 (16.7%)
Non-dementia clinic	7,040	3,705 (52.6%)	1,828 (26.0%)	1,507 (21.4%)
Clinician specialty/type				
Psychiatry/Neurology	3,778	2,003 (53.0%)	1,085 (28.7%)	690 (18.3%)
Internal Medicine	1,171	654 (55.9%)	281 (24.0%)	236 (20.2%)
Nurse Practitioner	568	286 (50.4%)	200 (35.2%)	82 (14.4%)
Licensed Practical Nurse	464	220 (47.4%)	174 (37.5%)	70 (15.1%)
Registered Nurse	408	207 (50.7%)	114 (27.9%)	87 (21.3%)
Psychology	203	105 (51.7%)	75 (37.0%)	23 (11.3%)
Social Worker	172	99 (57.6%)	43 (25.0%)	30 (17.4%)
Family Medicine	171	96 (56.1%)	40 (23.4%)	35 (20.5%)

Table 4: Concordance between subjective and objective assessments of AD severity by practice setting and clinician specialty/type.

CONCLUSIONS

- In the VA Healthcare System, the overall concordance between subjective/clinical assessment and objective/test assessment was found to be more than 50%.
- Concordance increased when Veterans had symptoms such as wandering (73%) and aberrant motor behavior (67%) as well as comorbidities such as type I diabetes(61%).
- The reported concordance of subjective and objective assessments highlights the complexity of AD diagnosis. Various factors such as level of education, cultural influences, and socioeconomic background may affect the objective assessment but are often not reported.
- As interventions designed to delay disease progression are developed, diagnosis of AD along with severity is critical to identify candidates for early-stage interventions.

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- This study was approved by the VA Bedford Healthcare System Institutional Review Board, and all data were fully de-identified before access. This study was performed in accordance with the Helsinki Declaration of 1964 and its later amendments.