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AN AUTOMATED APPROACH TO IDENTIFYING PATIENTS WITH DEMENTIA USING ELECTRONIC MEDICAL RECORDS

To the Editor: With the increased interest in clinical detection and management of Alzheimer's disease and related dementias, health systems and researchers have needed to quickly identify persons with these disorders to enroll them in care programs, recruit them into trials, and study the natural history and outcomes of dementia. This identification is generally done prospectively using a two-step process of screening followed by diagnostic assessment. However, this process is slow and expensive. To efficiently identify persons with dementia who could serve as a comparison group for a dementia management program,[1] we created and validated an automated electronic health record dementia identification method.

METHODS

We initially focused on 3 data sources contained in the UCLA electronic health record (an Epic-based record) that would indicate the presence of dementia. These included: (1) a recorded International Classification of Disease-9 (ICD-9) diagnosis of dementia including the following codes: 290.0, 290.1X, 290.2X, 290.3, 290.4X, 290.8, 290.9, 291.1, 291.2, 292.82, 294.0, 294.10, 294.11, 294.20, 331.0, 331.82, 331.11, and 331.19; (2) documentation that the patient was taking medications whose primary indication is to treat dementia (cholinesterase inhibitors and memantine); and (3) natural language processing (NLP) of history and physical notes, consult notes, discharge summary notes, and progress notes for evidence of patient dementia. In the NLP logic, dementia was operationalized as the presence of the terms "dementia" or "neurodegenerative" without the presence of any of the following markers in the same statement: (1) negating words, such as "not", "negative", or "ruled out"; (2) words that referred to the patient's family history or a family member's dementia status, such as "family history", "wife", or "husband"; or (3) words that indicated uncertainty, such as "suspected", "possible", or "risk".

We first examined the positive predictive value (PPV), true positives divided by all positives, of various combinations of these elements (all 3 elements and 3 different combinations of 2 elements) in diagnosing dementia compared to the gold standard of identification of documentation of dementia diagnosis by a physician during a medical record review. Physicians reviewed 60 medical records (15 patients meeting each combination, 5 in each of 3 age groups—40–64, 65–84, 85 and older). Early on, we noted a high number of false positives in the younger age group (45–64 years) and restricted the identification method in younger patients to only those who had dementia ICD-9 documented on at least two encounters. Based on initial analyses, the medications element was dropped and we reviewed an additional 64 cases that were identified only by NLP+ICD9 elements. PPV for patients of all ages and for those ≥65 years were weighted by their age representation in the entire dementia sample identified by the algorithm. Lastly, we estimated the sensitivity of the final and 3 element algorithms by applying these to the 989 patients who were enrolled in the UCLA Alzheimer's and Dementia Care (ADC) program with verified dementia. To produce a better estimate of how the algorithm would perform under typical circumstances, the dementia status of the patient was evaluated as of 3 weeks *prior* to ADC program start; this prevented the algorithm from taking advantage of the large volume of dementia-related documentation generated when a patient joined the program.

RESULTS

Findings are presented in Table 1. The 3-element model had a PPV of 87% but the 2-element models that included medications were considerably lower (27% and 47%). Based on this examination, we dropped medications from the method. When analyzed by age group, the approach was much less accurate among those 40–64 years; when this younger group was excluded, the PPV was high (93%). When the final algorithm was tested on patients of all ages with verified dementia, the sensitivity was 63% but only 35% if all 3 elements were required.

Table 1. Positive Predictive Value and Specificity of Combinations by Age of Patient

	Medical record review sample					UCLA ADC cohort	
	PPV all 3 criteria	PPV ICD-9 plus meds	PPV NLP plus meds	PPV ICD-9 plus NLP	PPV ICD9 plus NLP (all records)	Sensitivity all 3 criteria	Sensitivity NLP plus ICD-9
Age 40–64	4/5 (80%)	2/5 (40%)	0/5 (0%)	5/5 (100%)	11/23 (48%)[a]	36%	54%
Age 65–84	4/5 (80%)	2/5 (40%)	2/5 (40%)	5/5 (100%)	20/22 (91%)	36%	62%
Age ≥85	5/5 (100%)	3/5 (60%)	2/5 (40%)	4/5 (80%)	32/34 (94%)	33%	65%
All cases ≥40	13/15 (87%)	7/15 (47%)	4/15 (27%)	14/15 (93%)	92%[b]	35%	63%
All cases ≥65	9/10 (90%)	5/10 (50%)	4/10 (40%)	9/10 (90%)	93%[b]	34%	63%

PPV = Positive Predictive Value; ICD-9 = International Classification of Disease-9; NLP = natural language processing.

[a] For patients <65 years, 2 encounters with an ICD-9 code for dementia were required.

[b] Weighted percentage.

DISCUSSION

In summary, using a combination of ICD diagnoses and NLP, we were able to create a method to identify older persons who have dementia that has high positive predictive value – especially among older patients – and reasonably high sensitivity. Although initially we thought that dementia medications might be a useful indicator, this was not the case, perhaps because physicians may be prescribing these medications for "off-label" conditions (e.g., cholinesterase inhibitors for mild cognitive impairment, memantine for migraine headaches). Moreover, requiring all 3 elements reduced the sensitivity considerably. We also learned that the method was less accurate for younger patients, who may have neurologic disorders or conditions (e.g., HIV) that affect cognition but may not be dementia and who as an age group have a lower prevalence of dementia.

There are several advantages of such an automated dementia identification system. First, health systems aiming to implement programs aimed at older persons with existing dementia can readily identify appropriate patients. Second, researchers can quickly identify potential research participants and then confirm eligibility criteria. Finally, data on patients identified can be used for observational studies or to create a comparison group for studies that are not randomized clinical trials.

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Conflicts of interest: Dr. Hackbarth: The database code used to implement the dementia discovery algorithm, which is owned by the University of CA, is licensed to Ursa Health, a commercial organization in which I hold equity and serve as an officer. Dr. Wenger: Grants currently affiliated with: HRSA, ABIM, Unithealth. All other authors report no conflicts of interest.

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COMMENTS

COGNITIVE RESERVE: PREDICTOR OF ONSET OF POSTOPERATIVE DELIRIUM IN OLDER ADULTS?

To the Editor: Accumulating evidence indicates that anesthesia commonly has deleterious effects on cognitive function in older adults. A recent study concluded that greater cognitive reserve has the potential to counteract the decrease in cognitive performance in older adults after surgery.[1] This finding suggests that clinical interventions designed to increase cognitive reserve may have cognitive benefits for older adults at risk of delirium after surgery. This conclusion is in accord with the experience of the authors of the current letter in a clinical setting. This letter covers several important topics related to the use of cognitive reserve as a predictor of the onset of postoperative delirium.

Cognitive reserve refers to the mind's resistance to damage of the brain[2] and is strongly related to brain volume, head circumference, synaptic count, and dendritic branching.[3] In addition to anatomic parameters, education history and lifestyle are involved in maintaining cognitive reserve. One study indicated that greater education may be protective against the onset of postoperative delirium (POD).[4] Although education is a fixed factor that cannot be altered in a short period before surgery, lifestyle changes are an available approach to counteracting anesthesia- and surgery-triggered reductions in cognitive performance.

It may sound overly optimistic to say that changing lifestyle through regular exercise to improve muscle strength could be an effective way to reverse postoperative cognitive dysfunction (POCD) or POD, but mounting evidence indicates that increasing muscular strength with physical exercise can have be protective against a range of neurological and psychiatric diseases.[5] In addition, several lines of evidence indicate that individuals with lower limb fractures, which are associated with microthromboses in deep veins that could clog capillaries in the brain, have a higher incidence of POCD.[6] In addition to