PERSPECTIVE

Novel algorithms & blood-based biomarkers: Dementia detection and care transitions for persons living with dementia in the emergency department

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Abstract

Persons Living with Dementia (PLWD), diagnosed or undiagnosed, have high Emergency Department (ED) use. Identification of such patients poses significant challenges for emergency clinicians with considerable downstream implications on patients, care partners, and healthcare systems. With the advent of Geriatric Emergency Departments (GEDs) there is an opportunity to understand and improve care of PLWDs in EDs with effective allocation of resources and the development of novel techniques to better support detecting those at risk, communicating findings, and coordinating care for such patients. Advances have been made leveraging Electronic Health Record (EHR) data to risk stratify patients for dementia in the hope that those at high-risk may benefit from further evaluation. The promise of multiple blood-base biomarkers (BBM) as a future modality to improve detection of those at risk of dementias, will also have the potential to advance the delivery of care of PLWD and their care partners in EDs.

KEYWORDS
algorithms, blood based biomarkers, dementia, detection, emergency department, geriatrics

Highlights

- EDs have an integral role in delivering care for Person Living with Dementia and their care partners.
- High acuity and fast paced ED environment and other barriers makes it difficult to identify Person Living with Dementia.
- EHR-based risk stratification algorithms can identify patients at risk for Dementia in ED and outpatient settings.
- Use of Blood-Based Biomarkers in the ED setting is novel and considerations of its use and implications need to be studied.

- EHR based risk stratification algorithm and Blood Based Biomarkers when used judiciously have the potential to overcome some of the known barriers to identify and improve care for Person Living with Dementia as they transition through EDs.

1 | INTRODUCTION

Persons Living With Dementia (PLWD) are twice as likely to use the Emergency Department (ED) and 1.5 times more likely to have an avoidable visit.[1–3] When in the ED, PLWD often are at greater risk of poor outcomes.[4] In addition, PLWD are more likely to return to the ED within 30 days.[5] Three decades of research, however, demonstrate that PLWD are consistently under-recognized in the ED despite a proliferation of screening tools.[6, 7] Under-recognition of all-cause dementia in the ED increases patient safety risks, especially in underrepresented populations,[1, 8] by increasing the risk of poor comprehension of ED discharge instructions, high rates of hospitalization, falls risk, delirium, and more. The missed identification of dementia in at risk patients from the ED is subsequently perpetuated during inpatient care, with potentially broad-reaching consequences including longer hospital stays, lower patient satisfaction, accelerated cognitive declines, and increased healthcare costs.[4] Recognition of all of the above have led to the Geriatric Emergency Department Accreditation (GEDA) initiative supported by the American College of Emergency Physicians (ACEP) to advocate for improving care of older adults in ED with emphasis on improving care for PLWD. Yet, little research has explored how to improve emergency clinical care for people with dementia in the ED, as evidenced by the National Institutes of Health call for the development of a research network to generate evidence supporting the optimization of emergency care for older adults with Alzheimer's Disease and Related Dementias (ADRD).[9]

2 | THE ED & DEMENTIA

Much like the primary care setting, where dementia is missed up to 60% of the time,[10] dementia in the ED is also frequently missed, with undetected (undiagnosed) rates as high as 57%–83%.[11–14] Recognition and diagnosis of dementia, however, remain challenging for several reasons, including "attitudes and patient-provider communication, educational deficits, and system resource constraints."[15] Table 1 catalogs additional factors (with examples) that may play a role. The true prevalence of missed and delayed diagnoses of dementia in ED is unknown but appears to be high. Efforts to promote timely detection should focus on removing barriers to diagnosis across healthcare settings, including the ED.[16] To improve diagnostic equity, recommendations should include focused efforts targeting underserved populations including different racial, ethnic, and socioeconomic groups.[10]

ED encounters are an opportunity for earlier identification of PLWD, with ED visits spiking in the 6–12 months prior to a patient's first dementia diagnoses, evidence that an ED visit itself is a sentinel encounter for presentations of common geriatric syndromes.[35] (Figure 1). The ED is uniquely diverse in terms of the patients who present for care. The EDs is also where health and medical care transformation is occurring and can address special care needs of older patients,[36] making it an opportune setting to support greater recognition of undiagnosed dementia.[37] The Geriatric Emergency care Applied Research (GEAR) network 2.0–Advancing Dementia Care (GEAR 2.0-ADC), a National Institute on Aging supported initiative of transdisciplinary collaborations and taskforces and community participation groups, has stated the urgency and prioritization for research in the emergency care for PLWD to improve detection,[6] ED care,[38] care transitions,[39] and shared decision making.[17] Tools augmenting recognition of undiagnosed or missed dementia while a patient is in the ED can improve patient safety, facilitate patient transitions, and increase referrals for subsequent expanded evaluation.

Dementia diagnosis and recognition in the ED is difficult and often missed or simply unrecognized, even when patients have known diagnoses.[10–14] The next-generation clinical care pathways for dementia must incorporate a paradigm shift to optimize frameworks for detection and care, yet may prove to be a significant dementia detection opportunity in the outpatient and ED setting. Widespread adoption of the electronic health record (EHR) and rapid advancements in computing capability to process large-scale data, both structured and unstructured, can create opportunities for the prediction of disease through machine learning techniques and EHR-integrated clinical decision support (CDS).[40] Many data-driven approaches have been proposed, developed, and validated in specific populations and
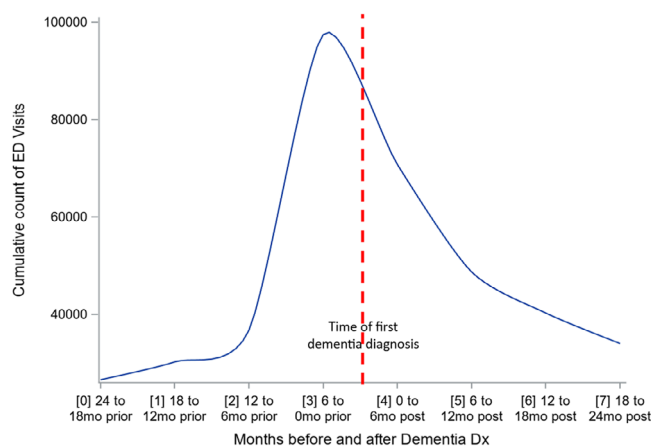

FIGURE 1 ED visits before and after first dementia diagnosis.[35] ED, emergency department.

TABLE 1 Barriers to dementia screening in ED settings at various levels.

Level of barrier	Example barriers
Patient/care partner	1. Cognitive decline resulting in patient inability to recall ED care recommendations[17, 18] 2. Denial of cognitive issue 3. Fear of unknown[19] 4. Dementia concern tangential to presenting problem[20] 5. Lack of trust/unfamiliarity with ED physician[17, 18]
Individual emergency nurse/physician	1. Burnout/staff turnover[21] 2. Concern for patient dissatisfaction score[22] 3. ED crowding/insufficient time 4. Lack of awareness of ED dementia screens 5. Emergency clinician overload (Mission creep)[23] 6. Overconfidence in ability to recognize dementia[24] 7. Perception of over-diagnosis and diagnostic error[25, 26] 8. Racial and/or language inequities with dementia assessment[8, 20, 27, 28] 9. Therapeutic nihilism[29] 10. Uncomfortable communicating dementia detection results[17]
Individual department	1. Competing quality improvement priorities 2. Competing financial incentives 3. Mandate inundation[23]
Hospital	1. Insufficient incentives for dementia-friendly care[30] 2. Leadership transitions 3. Staffing constraints for acute care for elderly units[21] 4. Transdisciplinary awareness of ED dementia screens[31]
Healthcare system	1. Limited outpatient resources/clinics[21] 2. Misaligned priorities between units of system 3. Turnovers in leadership 4. Uncoordinated communication between healthcare teams[17, 18, 32]
Insurance payor	1. Disincentives to identifying dementia
Research funders	1. Ethical concerns about ED-based dementia research[31, 33] 2. Focus on curative research[34] 3. Misunderstanding of emergency care 4. Study section underrepresentation of emergency medicine

Abbreviation: ED, emergency department.

Example: Occult or previously unrecognized dementia is not the underlying pathology that brought the patient to the ED with chest pain, dyspnea, and diaphoresis and concern for an acute coronary syndrome and the emergency physician cannot definitively diagnose nor cure dementia so efforts to identify dementia do not alter the emergency clinician's diagnostic or therapeutic approach.

settings.[41] None, however, have been developed for ED patients or leverage the opportunity of the ED setting to capture a large and vulnerable population of patients, many of whom may not be accessing care elsewhere.

Patients who are at the highest risk for dementia can be successfully identified in other settings using structured and unstructured data from the EHR.[42] A recent study developed passive risk calculators that capitalize on existing information in the EHR to identify at-risk patients and are now being tested in outpatient primary care settings.[43] Such risk stratification methodology may be useful in the ED to identify patients who are at the highest risk for cognitive impairment and dementia to narrow the screened population and help overcome traditional barriers to identifying dementia in the ED while leveraging appropriate implementation science frameworks to optimize the balance of benefits of detection versus predictable harms like over-diagnosis and misappropriation of finite resources.[25, 44]

3 | NOVEL DEMENTIA DETECTION APPROACHES IN THE ED

The two novel approaches—EHR data to identify high-risk individuals for dementia and biological samples in the form of blood-based biomarkers—when combined under the well-trained eyes of geriatric emergency medicine physicians, could significantly impact challenges and research care gaps identified in GEAR 2.0-ADC. (Figure 2) Advanced machine learning techniques such as deep learning have shown great promise in enhancing dementia detection using diagnostic imaging modalities like magnetic resonance imaging (MRI) and computed tomography (CT) scans.[45] These models can analyze subtle changes in brain structures that may not be visible to the human eye, offering early indicators of neurodegenerative changes. Furthermore, foundational models that leverage large-scale EHR data, including clinical notes processed by large language models (LLMs), have the potential to capture nuanced signals and trajectories.[46]
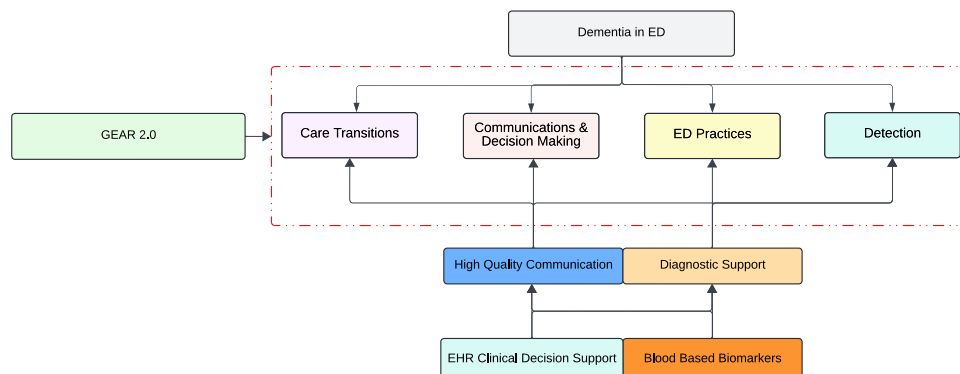
FIGURE 2 GEAR 2.0 properties for PLWD and impact of novel algorithms and blood-based biomarkers. ED-emergency department; EHR-electronic health record; GEAR, geriatric emergency care applied research; PLWD, persons living with dementia.

However, the practical implementation of these advanced techniques, particularly in the fast-paced environment of the ED, presents distinct challenges.[47] While population-based models that flag high-risk patients within a 24-h window are promising, the real-time deployment of these tools demands careful consideration.[48] Early work has begun with EHR-based algorithms and models being developed for CDS dementia detection in the ED setting.[49–51] These will need to address feasibility issues such as data latency, computational intensity, the calibration of specificity versus sensitivity when detecting patients at risk versus false positives, and the seamless integration of these models into existing ED workflows must be addressed to ensure they do not disrupt or overburden clinical care. Balancing these challenges with the need for actionable, timely interventions will be key to the successful integration of AI-driven dementia detection tools in emergency settings.

The implementation of these AI-driven systems must also prioritize usability, ensuring that data is presented in a clinician-friendly manner, such as clearly defined probability risks or actionable insights.[52, 53] Furthermore, optimal timing for CDS deployment is crucial, as overly frequent alerts can lead to alarm fatigue, while delayed interventions may miss critical windows of opportunity. These systems also need to consider downstream interventions—once a high-risk patient is identified, what actions should be taken? Incorporating these models into ED workflows will require rigorous testing and iteration to ensure they enhance clinical care without adding unnecessary cognitive burden.[44, 54]

In addition, recent advances in blood-base biomarkers (BBM) for Alzheimer's is a major step in making an early and accurate diagnosis of Alzheimer's disease. Large number of BBMs are currently in development for clinical use, and the quality and quantity of information available regarding their performance is rapidly evolving. BBM consensus groups suggest that BBMs could have high sensitivity ($\geq$90%) and specificity ($\geq$85%) when correlated with amyloid Positron Emitting Tomography (PET) or Cerebrospinal Fluid (CSF) test when used with appropriate follow-up.[55] BBMs could modify traditional diagnostic approaches away from invasive CSF biomarkers and expensive PET

scans, which are not usually performed in ED or acute care.[56] It is not farfetched to conceive that the availability of BBMs in diagnostic pathways could change the underlying uncertainty in making an accurate diagnosis of Alzheimer's or related dementia and their availability in acute care could be leveraged as a source of diagnostic support and high-quality communication in the domains identified by GEAR 2.0-ADC.

4 | COMMUNICATION, SHARED DECISION MAKING, & CARE TRANSITIONS

For Geriatric emergency medicine physicians who may be the initial or only healthcare contact for PLWD and their care partners, EHR CDS and BBM-related competencies need to be developed for their effective use. Communication strategies on how to discuss if someone is identified as high risk for cognitive impairment dementia by EHR-based algorithms or BBMs or both are yet to be established, could become essential to care effectively in the fast-moving and high acuity ED environment. Careful considerations need to be taken while providing information for patients and care partners about shared decision-making, transitions, and the coordination of evaluation after early suspected detection. Studies evaluating the referral of ED patients identified with cognitive impairment risks for follow-up demonstrate how difficult this can be, with less than 1 out of 5 scheduling and completing outpatient evaluations within 100 days.[57] Inaccurate recognition and documentation can have serious implications for patients and care partners and could lead to inappropriate treatment, unnecessary tests, increased costs, delayed care, compromised safety, and decreased trust in the healthcare system. Additional negative implications for patients and care partners include the psychological impact, stress, anxiety, and uncertainty of diagnosis, insurance concerns, and social stigma of dementia. Resources will be needed to maintain standardized patient-centric communication between the ED team and their inpatient partners, and outpatient primary care and memory clinics will be needed. Balancing such complexities, challenges, and needs
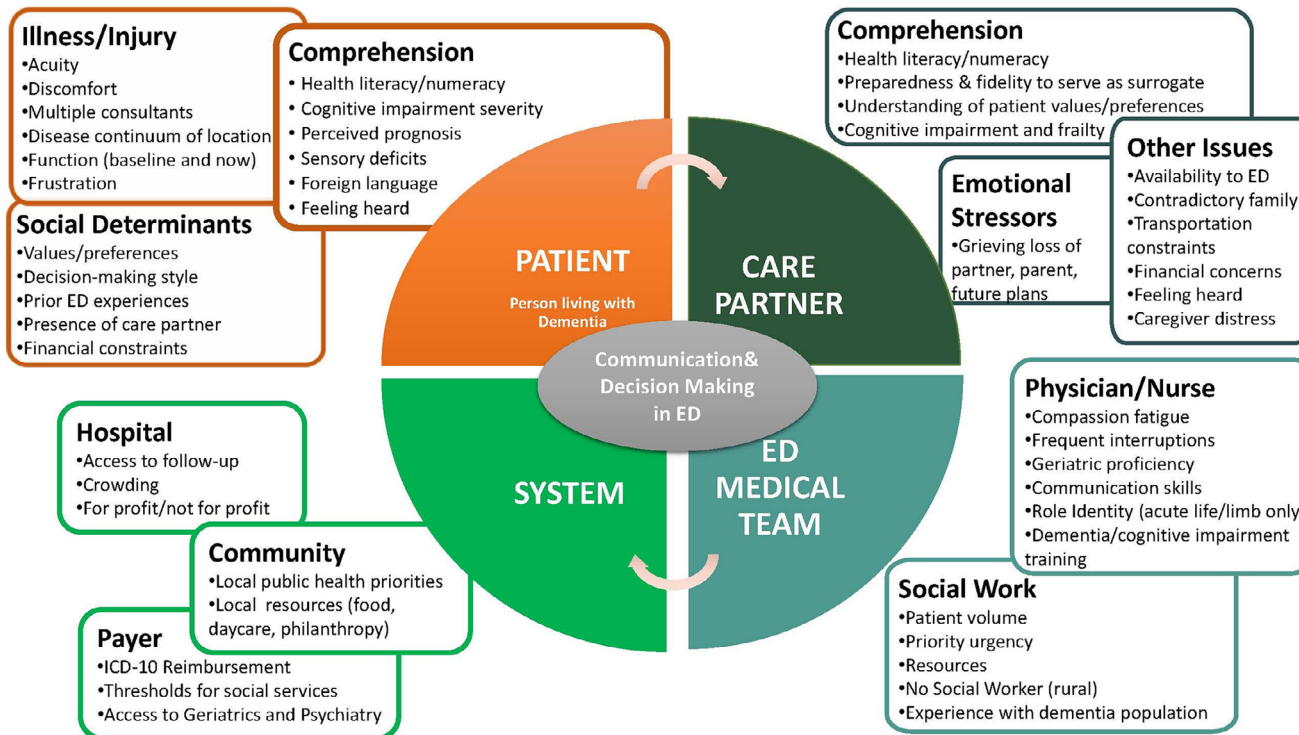
FIGURE 3 Multi-level complexities of ED communication.[17] ED-emergency department.

for PLWD and their care partners have been identified as priority areas by the GEAR 2.0-ADC Communication and Shared Decision Making task force.[17] (Figure 3)

5 | THE HORIZON

The rapidly evolving field of dementia diagnostics and therapeutics has a major impact on the healthcare system's preparedness to diagnose, identify, manage, and support PLWD and care partners while maintaining high-quality communication and shared decision-making. As with most interventions that strive to improve the experience, process, or efficiency of healthcare unintended consequences are possible and worth contemplating. For example, increasing efforts to identify PLWD during episodes of ED care without concomitant strategies to unburden emergency teams of other responsibilities may be associated with delays in care for other ED patients and increase preventable harms. In addition, if ED teams are charged with communicating new dementia concerns with patients and lack sufficient training to do so or outpatient resources with which to continue post-ED evaluation and management, some patients may suffer preventable angst or self-harm.

With recent emphasis on improving dementia detection care of older adults by the GEAR Task Force priorities,[6] and now the recently proposed new rule by the Center for Medicare and Medicaid (CMS)[58] which includes attestation of the initiatives by health systems for cognitive screening in acute care (ED and Hospital) brings acute care providers, including ED providers, to be at the forefront to be able to

adapt to advanced risk-stratification strategies and BBMs into their communication and referral pathways for better resource utilization as PLWD transition through acute, post-acute and community care. As EDs continues to play a pivotal role in healthcare delivery for PLWD and are integral part of healthcare in the US, integration of novel EHR algorithms and BBMs in ED could open innovative paths to integrate these advances into the acute care for such patients by increasing participation and harmonizing health system preparedness to deliver much needed care.

CONFLICT OF INTEREST STATEMENT

CONSENT STATEMENT

Consent was not necessary for this Perspectives piece.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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