

High Yield Research Opportunities in Geriatric Emergency Medicine: Prehospital Care, Delirium, Adverse Drug Events, and Falls

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Emergency services constitute crucial and frequently used safety nets for older persons, an emergency visit by a senior very often indicates high vulnerability for functional decline and death, and interventions via the emergency system have significant opportunities to change the clinical course of older patients who require its services. However, the evidence base for widespread employment of emergency system-based interventions is lacking. In this article, we review the evidence and offer crucial research questions to capitalize on the opportunity to optimize health trajectories of older persons seeking emergency care in four areas: prehospital care, delirium, adverse drug events, and falls.

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EMERGENCY departments (EDs) and prehospital emergency medical services (EMS) play crucial roles in maintaining the health and safety of older persons. These services are available to patients at all hours, provide a crucial safety net, and are frequently used (1). An ED visit by an older person often indicates heightened vulnerability to adverse outcomes (eg, cognitive/functional decline, death) (2,3). These services lie at the intersection of patients' home environments and sophisticated clinical services. Given these characteristics, interventions via the emergency system offer excellent opportunities to favorably alter the clinical course of both acute and chronic conditions that contribute to the underlying vulnerability.

EDs are characterized by relatively short stays (compared with inpatient admissions), fast paced care, and rapid decision making. They are experiencing progressive overcrowding and diversion of patients to other EDs, making optimal geriatric workups even more difficult (4,5). Older ED visitors often have atypical presentations (eg, afebrile life-threatening pneumonia), multiple comorbidities, multiple

medications (which may not be knowable in the available timeframe), and complex social situations. Training for the proper management of geriatric patients, their conditions, and special considerations in their care has been and remains inadequate (6). For these and other reasons, EDs represent challenging environments for optimal geriatric care (7–11).

In 2005, the Society for Academic Emergency Medicine asked its Geriatric Task Force to propose guidelines for geriatric emergency care. The Task Force chose to develop quality indicators (QIs) in the same fashion as the Assessing Care of Vulnerable Elders (ACOVE) project used to identify *minimal standards of care* in ambulatory settings (12). The Task Force identified six key domains with important gaps in care: cognitive assessment, pain management, transitions of care, medication management, screening/prevention, and functional assessment. QIs for the first three domains have been published (13), and the last three have been accepted for publication (14). The Task Force noted that there was little high-quality research to support their proposed QI recommendations for the second set of three

Table 1. Key Research Questions for Older Patients' Emergency Care Involving Emergency Medical Services, Delirium, Adverse Drug Events, and Falls Prevention

Emergency medical services
1) Can critical illnesses be diagnosed and treated effectively in prehospital settings?
2) What is the best way to structure the prehospital, acute care delivery system to optimize outcomes for older patients with emergency conditions?
3) How can prehospital providers participate in improving the health of older adults?
Delirium
1) What is the optimal method for screening for and diagnosing delirium in the ED, and how often should delirium screening be repeated?
2) Is incident delirium in the ED associated with specific risk factors, and how can ED incident delirium be prevented or moderated?
3) Are there acceptable criteria for the safe discharge to home for older ED patients with delirium, and if so what are they?
4) What interventions will be both feasible and effective in improving outcomes for older patients with delirium in the ED?
Adverse drug events
1) What medications in older patients are associated with an increased risk of significant adverse drug events that lead to emergency department visits?
2) What medications offer the best combination of safety and efficacy for treatment of elderly emergency department patients with acutely painful conditions?
3) What medications will improve outcomes for common conditions treated in the emergency department?
Falls
1) Can high-risk geriatric fallers who require admission or expedited outpatient evaluation be identified in the ED?
2) Can simple and feasible interventions reduce fall or injurious fall rates after the ED visit?
3) Could rapid response teams or special ED-associated units evaluating geriatric adults at increased risk for recurrent falls reduce fall-related injuries and improve the efficiency of inpatient resource utilization?
4) Can hospital-at-home models for management of high-risk fallers be developed, and what are the characteristics of models that successfully lower falls rates?
5) What are the key elements of electronic information systems that facilitate point-of-care risk stratification and communication of high-risk findings to emergency providers and primary care physicians?

conditions. Therefore, they proposed research that is required to justify the proposed minimum levels of care.

In addition to minimum care criteria, research is needed to develop evidence-based strategies for *optimizing care*. Such evidence is lacking for most conditions that bring older patients to the ED. Thus, this article seeks to define research priorities for common, high priority geriatric emergencies to better understand how to reach the highest level of care for aging adults. Although a small amount of overlap exists between the QI papers and the current work, the viewpoint, intent, method, and specific research suggestions are distinctly separate.

Specifically, we offer crucial research questions to capitalize on the opportunity to alter health trajectories of older persons seeking emergency care in four domains: prehospital care, recognition and management of delirium, identifying and preventing adverse drug events, and falls prevention post-ED visit. These topics were chosen based on their prevalence and importance to older persons. We identified a preliminary set of questions via thorough reviews of current literature plus insights from our research. This preliminary set was vetted with interested clinicians and researchers at the Annual Scientific Meeting of the American Geriatrics Society, May 14, 2010, and revised based on their feedback. The final set of "Key Research Areas" derived through this process is summarized in Table 1.

Although we recognize the useful distinctions between screening and case finding (15), in the emergency environment, the differences between these approaches are frequently indistinct and vary by local circumstances. Thus, for the purposes of this article, the term "screening" will be used for both approaches.

PREHOSPITAL EMS CONSIDERATIONS FOR OLDER ADULTS

Key Research Area 1: Can Critical Illnesses Be Diagnosed and Treated Effectively in Prehospital Settings?

Studies rarely explore prehospital diagnosis and treatment specifically for older adults. Thus, high-quality research is needed to investigate how conditions can be accurately diagnosed in the prehospital setting. For instance, are clinical criteria or biomarkers reliable and valid in the prehospital setting (such as for sepsis or trauma) particularly for older adults (16)? Accurate diagnosis will always be complicated by comorbidities and medications, many of which are not known to the EMS providers.

Linked to this question of improving diagnosis is whether early intervention benefits outcomes. EMS providers can provide interventions before arriving at the ED, a time benefit that can easily approach an hour. However, very limited data exist evaluating this timeliness question. Some prehospital interventions, such as prehospital electrocardiography, are of minimal risk and improve outcomes (17). However, other interventions, such as initiating therapeutic hypothermia in an ambulance, are of unclear value and have the potential to increase costs and complications.

Underlying this Key Research Area are methodological issues similar to those that have been asked and are often debated in other gerontological, prehospital, and emergency care research. The most appropriate outcome measure to evaluate prehospital diagnosis and interventions is one fundamental question. Often process measures are used to evaluate prehospital interventions because downstream medical care and other measured and unmeasured variables can

strongly influence outcomes (eg, physical functioning, quality of life). For example, mortality (a commonly measured outcome) can be confounded by patient wishes and particularly so in geriatric emergency research. These challenges of identifying appropriate measures of success and developing the appropriate analytical approach with those variables are difficult and critical.

Key Research Area 2: What Is the Best Way to Structure the Prehospital, Acute Care Delivery System to Optimize Outcomes for Older Patients With Emergency Conditions?

In health care, we aim to maximize quality, minimize cost, and consider the patients' needs and goals of care. Research is needed to evaluate what proportion of older adults with acute illnesses can be managed with options other than ambulance transport to a hospital ED (18,19). Alternatives to prehospital emergency transport to consider include care in place with EMS providers, care in place using telemedicine, use of nonemergent transport, and preferential transport to geriatric specialty centers (10). While evaluating these and other options, issues such as medical outcomes, legal risks, psychosocial issues, patient satisfaction, and cost must be considered. Another key consideration related to the quality of care involves the information gap that occurs with transitions to and from the prehospital system and the optimal locations for care (20,21). The opportunity of using information technology to improve the quality of care transitions has developed (22). Although some research has occurred, most has not specifically analyzed issues particular to older adults.

Key Research Area 3: How Can Prehospital Providers Participate in Improving the Health of Older Adults?

Traditionally, EMS providers have had minimal role in public health activities, especially those related to primary or secondary prevention, although the characteristics of the EMS system would support such a role (23). Studies have shown that EMS providers have interest (24), can participate in surveillance programs, and can participate in screening programs (25,26). The feasibility of screening programs has been explored to identify older adults with high risk of falling, poor medication management, depressive symptoms, or extensive general needs. Studies are starting to look at the reliability and validity of prehospital screening, but generally, the validity of prehospital screening instruments has not been demonstrated (27). More importantly, the outcomes of prehospital screening programs have not been demonstrated nor the optimal composition of the team to achieve successful outcomes.

DELIRIUM

Approximately 1 in 10 older ED patients suffers from delirium, only a minority (16%–38%) is recognized as

impaired by emergency physicians, and discharged delirious ED patients are at increased risk for poor outcomes compared with non-delirious counterparts (28–36). Delirium is a medical emergency associated with an increased risk of morbidity and mortality (32,37). Patients with unrecognized delirium who are discharged home from the ED are nearly three times more likely to die within 3 months than counterparts in whom delirium is identified by the emergency physician (32). Despite this continuing evidence over 16 years, little has changed. Older ED patients with delirium are still highly prevalent, poorly recognized, and frequently are discharged to home with inadequate planning and support (28,30–32,38).

In response to this body of evidence, the Society for Academic Emergency Medicine Task Force published QIs targeted toward the care of older ED patients with altered mental status (13). These indicators set forth minimum care standards for the detection and management of older ED patients with delirium. Although these QIs and the existing body of literature are important steps toward improving care, there are significant knowledge gaps that need to be addressed to optimize recognition and management of delirium in the ED.

Key Research Area 1: What Is the Optimal Method for Screening for and Diagnosing Delirium in the ED?

Numerous studies have been published examining delirium screening in the ED using a variety of tools. The Confusion Assessment Method and the Confusion Assessment Method for the intensive care unit have been the most widely used (29–33,38) but neither has been adequately validated in the ED setting. In addition, most studies have focused on a single assessment for delirium in the ED. Given the fluctuating nature of delirium and long duration of some ED stays, this approach may not be sufficient. Thus, what is the optimal screening tool for the detection of delirium in the ED? How often and at what intervals should patients undergo delirium screening? Because different forms of delirium might have different prognoses (37, 39) (and respond differently to targeted interventions), a simple yes/no screen may not be sufficient. What is the optimal screening process for differentiating among delirium subtypes?

Key Research Area 2: Is Incident Delirium Associated With Specific Risk Factors in the ED, and How Can It Be Prevented or Moderated?

Although the prevalence of delirium in older ED patients has been well studied (28,30,31,33,35,38), little is known regarding risk factors for delirium that develops during the ED stay. Lengthy ED stays are frequent and can result in prolonged sensory deprivation, sensory overload, or deprivation of food and hydration. Many ED patients also suffer

from painful conditions, and while poor pain control has been shown to be a risk factor for the development of delirium in other settings (40), it has not been well studied in the ED. What preventable risk factors contribute to the development of delirium in the ED? What interventions targeting these risk factors are effective in preventing or moderating incident ED delirium?

Key Research Area 3: Are There Acceptable Criteria for the Safe Discharge to Home for Older ED Patients With Delirium, and If so What Are They?

Given that older patients with delirium are often discharged home, studies are needed to develop and evaluate criteria for the safe discharge to home for older ED patients with delirium. In particular, what are the critical elements of a post-ED discharge care plan? What is the necessary level of home support? What role do other factors (such as delirium precipitant[s] or subtypes) play in these criteria? Once acceptable discharge criteria are identified, what interventions will lead to their successful implementation?

Key Research Area 4: What Interventions Will Be Both Feasible and Effective in Improving Outcomes for Older Patients With Delirium in the ED? Interventions Both Within the ED and in Coordination With Other Parts of the Health Care System Need to Be Examined

What interventions will be effective in improving outcomes for older patients with delirium in the ED, such as short-term mortality, ED or hospital recidivism, functional decline, or persistence of delirium? Given the unique aspects of the ED environment, what interventions will be feasible in the ED setting?

ADVERSE DRUG EVENTS

Adverse drug events are common in older patients. The overall rate among ambulatory older patients in the United States is approximately 50 per 1,000 patient-years (41). Adverse drug events can precipitate an ED visit, can occur following administration of a medication in the ED, or can occur when a medication is added, changed, or removed from a patient at ED discharge. Several studies suggested medications that commonly cause adverse drug events, but these had important sample size and methodological limitations. In addition, there are few studies addressing the safety and efficacy of medications used to treat common conditions in older ED patients. In the following section, we identify key questions related to each of these research areas.

Key Research Area 1: What Medications in Older Patients Are Associated With an Increased Risk of Significant Adverse Drug Events That Lead to ED Visits?

Several studies have described the epidemiology of patients diagnosed with adverse drug events (41–50).

However, all suffer from two major potential biases. First, there is no confirmation of the drug exposures: These studies rely on medication histories from patients or caregivers, prescription records, or pharmacy records. Second, the outcome is determined by an investigator (or clinician) who is not blinded to the exposure. These limitations may have produced biased results. Furthermore, studies have had limited power to detect drug reactions caused by combinations of medications.

Which medications are most often associated with adverse drug reactions? Is there a concentration–response relationship for these adverse drug reactions? Can specific drug combinations be identified as “high risk”? Answering these questions will require (a) adjudication of adverse events by an investigator (or panel) masked to the results of drug screens but aware of clinical history, including the suspected exposure, and (b) high-throughput comprehensive drug screening to determine serum concentrations of a spectrum of medications.

Key Research Area 2: What Medications Offer the Best Combination of Safety and Efficacy for Treatment of Elderly ED Patients With Acutely Painful Conditions?

Pain is the most common reason that patients seek care in the ED, and older patients are less likely than younger patients to receive adequate analgesia in the ED and at discharge (51–55). Although there are no data demonstrating why these disparities occur, uncertainty regarding optimal pain management for older patients in emergency situations likely contributes. On one hand, older patients are at risk for serious adverse events such as respiratory depression, constipation, falls, and delirium (56). On the other, common sense approaches (such as “start low and go slow”) (57) seem reasonable but have not been proven to optimize pain management in emergency situations and could produce inadequate pain relief. In fact, opioid use is associated with decreased risk of delirium in patients with hip fracture (40). The reluctance of emergency physicians to treat pain in older patients highlights the need for clinical trials to identify safe, effective treatments that improve patient-centered outcomes for older ED patients with acutely painful conditions.

There is also a need to improve the management of acute painful conditions in patients discharged from the ED. Although several studies have evaluated the safety of long-term administration of opioids (58–60), few studies have carefully examined opioids for short-term use in this population. It is likely that patients who require opioids for treatment of an acutely painful condition are not at the same risk for an adverse event as patients who have treatment initiated for a chronic condition. Emergency physicians will continue to struggle with the treatment of pain in older patients until there are quality studies, particularly randomized trials, validating optimal strategies in the ED and post-ED discharge.

Key Research Area 3: What Medications Will Improve Outcomes for Common Conditions Treated in the ED?

One third to more than one half of older patients who are discharged from the ED will be prescribed one or more medications (57,61). Each represents an opportunity for an adverse drug event, a drug interaction or noncompliance. However, many of the most commonly prescribed medications (eg, meclizine, cyclobenzaprine, and promethazine, based on the 2006 National Hospital Ambulatory Medical Survey) have little evidence to support their use. Additionally, many medications newly prescribed at ED discharge are for short-term rather than long-term use. Medications that may be considered inappropriate for prolonged outpatient use (eg, diphenhydramine for sleep, nitrofurantoin for UTI prophylaxis) (62) may be appropriate when used for short-term treatment after an ED visit (eg, acute allergic reaction or treatment of cystitis). Without quality, randomized controlled trials, medication selection for these conditions will continue to be based on tradition and “expert opinion.” There are also needs to examine what non-pharmacological interventions could complement or replace pharmacological therapy, to develop new medications with better benefit-risk profiles, and to construct interventions to improve compliance with effective medications. Innovative methodologies, interdisciplinary teams of experts from several disciplines, and information technology-aided observational studies have also been recommended to help advance understanding of these issues (63).

FALL PREVENTION

One third of community-dwelling older adults suffer a fall every year, and up to 20% of these falls result in moderate to severe injury (64–66). Standing level falls are the leading cause of traumatic mortality among seniors, costing the United States alone \$19 billion annually (67). Over half of the falls by independent community-dwelling older adults occur around the home (68,69). Falls frequently herald functional decline, worsening fear of falling, and institutionalization (70). Accordingly, emergency medicine evidence-based reviews and more recent multidisciplinary guidelines advocate for prevention efforts to be focused primarily upon high-risk fallers (71–73). Unfortunately, ED evaluations following a fall rarely target risk assessment or preventive interventions (46,74). This gap between guidelines and clinical care is likely related to the paucity of evidence to support ED-based falls prevention (75). One British ED-based falls prevention model, which combined screening of ED data post-ED discharge with tight linkage to falls prevention services in the community, did demonstrate a 20% absolute risk reduction in the number of falls at 1 year (76). Notably, this intervention was conducted by clinicians outside the ED, and only 42% of eligible patients completed the study. Numerous multidisciplinary efforts based in the ED have failed to demonstrate effectiveness

(77–79), likely due to lack of direct control over the delivery of interventions or reluctance of patients to comply with recommendations (71,80).

Key Research Area 1: Can High-Risk Geriatric Fallers Who Require Admission or Expedited Outpatient Evaluation Be Identified in the ED?

Several ED-based screening tools have been derived, but none has been validated (70,81,82). Multiple individual risk factors and screening instruments have been validated in non-ED settings, but the ability of these tools to identify high-risk fallers in the ED most likely to benefit from admission, expeditious outpatient evaluation, or home-modification remains undefined (50,72,83–99). Two ED-based trials failed to verify functional assessment tests as feasible or accurate for distinguishing patients at risk for falls within 6 months (100,101). The validation of fall-risk instruments in ED settings will require methodological rigor, including the use of uniformly accepted definitions and overcoming barriers to follow-up encountered by previous trials (102,103). Additionally, new types of emergency professionals who may facilitate screening (104) and the effect of acute illnesses and events on the accuracy of fall-risk screening both deserve investigation.

Key Research Area 2: Can Simple ED Feasible Interventions Reduce Injurious Falls?

Although important questions remain (eg, optimal dose and ideal recipients), vitamin D supplementation appears to reduce falls and fall-related fractures in older outpatients (105,106). Thus, well-designed trials examining the use of vitamin D either in the ED or post-ED setting are worth exploring. Alternatively, prompt recognition and appropriately expeditious referral for remediable fall-risk factors including cognitive impairment, Parkinson-related neurological deficits, and polypharmacy might also reduce injuries (107–109), although robust control over the referral and delivery processes appear to be necessary components of successful programs (71,80).

Key Research Area 3: Do Acute Care for the Elderly ED Unit Admissions for Non-critically Ill High-Risk Fallers Reduce Injurious Falls? Alternatively, Would Rapid Response Geriatric Evaluation and Management Services Evaluating All Geriatric Fallers Prior to ED Disposition Simultaneously Reduce Injurious Falls and Inpatient Resource Utilization?

Because most elder care remains fragmented, a rapid response “point-of-care” geriatric evaluation and management consult service or an Acute Care for the Elderly program based in the ED observation unit might provide an efficient method for performing comprehensive falls-risk assessments and facilitating interdisciplinary communication between inpatient and outpatient health care providers.

Originally developed as an alternative general older adult inpatient service (110), Acute Care for the Elderly unit models have since been developed to care for oncology and stroke patients (111,112). Falls-specific Acute Care for the Elderly units could model those successfully employed for delirium (113).

Key Research Area 4: Can Hospital-at-Home Models for Management of High-Risk Fallers Be Developed?

Hospital-at-home models have been described for uncomplicated pneumonia, cellulitis, and acute COPD exacerbations (114,115). Similar home-based initiatives have been developed for cognitively impaired populations (116). Because home-safety modifications are a key component to effective fall prevention interventions (71,77,117), in-home care is an attractive option. The specific characteristics of, sustainability of, and payment mechanisms for feasible alternative management strategies in diverse settings remain to be delineated.

Key Research Area 5: What Are the Key Elements of Electronic Information Systems That Facilitate Point-of-Care Risk Stratification and Communication of High-Risk Findings to Emergency Providers and Primary Care Physicians?

Computerized decision support systems have successfully reduced inappropriate prescribing to geriatric adults and inappropriate dosing in patients with renal impairment (118,119). Similar electronic decision support and communication strategies might increase fall-risk stratification and automate notification of inpatient consultants or outpatient providers (120).

DISCUSSION

Emergency services constitute crucial care sites for older persons, an ED visit by an older person typically indicates high risk for decline and death, and interventions via emergency services offer excellent opportunities to change patients' untreated health trajectories. However, as currently constructed, emergency services entail challenging environments to provide optimal geriatric care, and many important questions need to be investigated before the large potential benefit of emergency services-based interventions can be realized. In this article, we highlighted some key research questions in four important areas: prehospital care, delirium, adverse drug events, and falls. In this section, we discuss some overriding issues. The overall intent is to stimulate an increased volume of high-quality geriatric emergency medicine research and funding to support investigations to optimize health care in these areas.

The best approach to improving the care and outcomes for older patients with emergency needs will include approaches that are tailored to the specific condition and to

local circumstances (121), and the more complete solutions will likely require system redesign. As examples, some conditions (eg, immunization) may employ screening by ED personnel and immediate treatment. Other conditions (eg, high falls risk) might include screening by emergency personnel and referral to other providers for further management. For the typical emergency service, this will necessitate system redesign (eg, much tighter coordination with home care and therapy programs than is typical now). Notably, screening for some conditions may be required to properly determine disposition (eg, delirium) or may alter plans post-discharge (eg, involvement of caregivers in the care plans of a chronically cognitively impaired patient). Another approach is to screen for overall risk (122) and collaboratively involve inpatient care, an ED observational unit, home care, primary care, outpatient geriatric service, and/or various therapeutic services (eg, physical therapy) without direct involvement in each disease or geriatric condition. Screening may involve a single assessment or multistage evaluation (123), again depending on condition and site. Because the adaptation to target condition and local circumstances is important, the critical prescription may be the process by which the local emergency service designs the optimal approach for its setting (121). In addition, computerized decision support has the potential to facilitate a number of innovative care plans.

In the past, funding to study emergency conditions for older patients has been sparse. However, recognition of the importance of the emergency system for the health and safety of older persons is increasing, and funding opportunities are starting to expand (eg, NHLBI's RFA-HL-11-001 [K12] and NIA's RFA-AG-11-007 and PAs 10-042/043/044/045). In addition to independent investigator-initiated proposals, collaborative research through available resources such as Clinical and Translational Sciences Institutes; Pepper, Roybal, Alzheimer, and Diabetes centers; and practice-based research network mechanisms provide attractive funding approaches. Finally, achieving the full potential health benefits of newly designed and tested intervention approaches frequently will require not only the necessary efficacy to effectiveness translation (124) but also changes in reimbursement.

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