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GERIATRIC EMERGENCY MEDICINE

*Scott T. Wilber, MD, FACEP**

The emergency department (ED) is commonly the point of entry to the medical system for older adults, who present with a wide variety of problems. Although the ED is generally thought of as a location for the diagnosis and treatment of acute medical and surgical emergencies, it may also be the access point for older adults with chronic conditions or social and psychiatric problems. For younger adults with single, acute problems, an emergency care model that incorporates history, physical examination, diagnostic testing, diagnosis, treatment, and disposition may be appropriate. However, there may be pitfalls when this approach is applied in the ED to older patients. [1]

Older patients may present with vague symptoms or with atypical symptoms of serious disease, which could consequently go undetected. Cognitive impairment, common in older patients, may also go undetected. Comorbidities and polypharmacy are also common and may directly or indirectly affect the older patient's care. The ED may be a presenting location for an elderly patient with functional decline, or the acute illness or injury that provoked the ED visit may result in a decrease in his or her functional abilities. Additionally, treatment may affect the ability of the older patient to live independently; for example, immobilization of an extremity may impact the patient's ability to perform basic activities of daily living (ADLs).

These factors have led to the development of a geriatric emergency care model that differs from the standard emergency care model. The geriatric model emphasizes the consideration of older ED patients as a special population, analogous to pediatric patients. Emergency physicians should include biologic, psychologic, and social factors in the evaluation of the older ED patient. [2]

This chapter reviews the emergency medicine literature to characterize its state of development and to identify important research questions. The goal of research in the emergency care of older patients is to improve patient care through optimum medical management. Other goals include the prevention of disease and injury and the maintenance of physical, social, and emotional functioning. The standard sequence of research leading to these outcomes is descriptive studies, followed by analytic studies and finally by interventional studies. The latter include studies of diagnostic testing, treatments, and outcomes. This scheme is used to classify the stage of existing research in geriatric emergency care and identify areas for future research. This review focuses on ED conditions that practicing physicians and leaders in the field have identified as leading problems.

METHODS

For emergency medicine, the MEDLINE search included the following MeSH headings: "Emergency Medicine," "Emergency Service, Hospital," or "Emergency Treatment." For trauma, the following MeSH headings were used: "Wounds, Penetrating," "Wounds, Non-penetrating," or "Multiple Trauma." This was combined using the Boolean search

* Assistant Professor of Emergency Medicine, Northeastern Ohio Universities College of Medicine, Rootstown, OH; Associate Director, Emergency Medicine Research Center, Summa Health System, Akron, OH.

operator "AND" with articles with the following geriatric identifiers: "Geriatrics" or "Geriatric Assessment" as MeSH headings, or *geriatric*, *geriatrics*, *old*, *older*, or *aged* as title words. Limits placed on the search included English language, human, aged (> 65), and years 1980 to 2001. Articles from outside of the United States or Canada were included only if they provided unique information. They were not used if they presented demographic or observational information only.

The MEDLINE search for emergency medicine resulted in a list of 3348 articles. Following review of titles and abstracts, 299 articles were obtained for inspection. The search for trauma resulted in a list of 1838 articles, of which 133 articles were obtained for inspection.

GENERAL GERIATRIC EMERGENCY CARE

PATTERNS OF ED USE

The patterns of ED use among older patients have been well described. Reports of single-hospital studies, multicenter studies, and analyses of large multihospital databases reveal consistent patterns across all these settings.

A recent population-based cross-sectional study of noninstitutionalized Medicare beneficiaries aged 66 years and older used a Medicare database from 1993. [3] It found that 18% of persons made at least one ED visit per year, including 17% among those aged 66 to 84 and 26% among those 85 years and older. The population-based visit rates were 30 per 100 persons for the group overall, and 28 per 100 in patients in the 66 to 84 age group, and 43 per 100 in the 85 and older age group, which is higher than the percentage of patients making at least one visit because some persons made more than one visit. Logistic regression identified the following as predictors of one or more ED visits over 1 year: age 85 and older (OR [odds ratio] = 1.23), less than 12 years education (OR = 1.22), living alone (OR = 1.15), worsening self-reported health, ADL deficiencies, and comorbidity. Odds ratios for the latter three vary by level of severity.

A similar study using Medicare data from Washington State found identical visit rates but also showed that persons with physicians had fewer visits (185 per 1000 patient years) than did those without physicians (457 visits per 1000 patient years). [4] Older rural patients may also be less likely than their urban counterparts to visit the ED. [5,6]

Analysis of the 1992 National Hospital Ambulatory Medical Care Survey (NHAMCS) database, a national probability sample of ED use performed by the National Center for Health Statistics, found that patients aged 65 and older accounted for 12.6 million ED visits in 1992, or 13% of all ED visits (20% of adult ED visits). [7] The hospitalization rate was 42%, which was four times that of adults aged 18 to 64 years. Cardiopulmonary complaints were most common, with chest pain and dyspnea each constituting 11% of chief complaints. Abdominal pain, vertigo, and generalized weakness each constituted approximately 3% of visits.

Other multicenter studies have shown that ED patients aged 65 and over are more likely to be admitted to the intensive care unit, to arrive by ambulance, to have comorbid illness, to have comprehensive visits, and to have higher rates of test utilization. [8–10]

Descriptive data on ED use by older adults exist, with data from large databases confirming findings of smaller studies. Analytical data are beginning to be published regarding the predictors of visits.

EmergMed 1 (Level D): **Observational and analytic studies on emergency department use by elderly patients should continue to come from large databases or national samples (such as the National Hospital Ambulatory Medical Care Survey database) so that the results can be generalized.**

PHYSICIAN TRAINING AND COMFORT

The Society for Academic Emergency Medicine with the support of the John A. Hartford Foundation formed the Geriatric Emergency Medicine Task Force to evaluate the state of the care of older patients in the ED. The task force did an extensive review of the literature and carried out a series of integrated studies. These included surveys of physicians and patients, prospective and retrospective descriptions of differences between older and younger ED patients, and an analysis of existing data sets. [11]

The task force found that emergency physicians commonly identify the management of older patients as more time-consuming, more difficult, and requiring more resources than that of younger adults. [12] Descriptive studies of physicians' and older patients' comfort with the ED encounter were conducted by the Geriatric Emergency Medicine Task Force in 1991. A survey asked practicing emergency physicians to compare the time required, resources required, and difficulty in managing younger and older patients for seven high-volume complaints (abdominal pain, altered mental status, chest pain, dizziness, fever, headache, trauma); 433 of 971 physicians responded. Two thirds of respondents reported more time and resource use for six of the seven complaints in the older patients. For the seventh, chest pain, more than half reported more time and resource use. The respondents also reported more difficulty in managing abdominal pain, altered mental status, dizziness, and trauma in older than in younger patients. Fifty-three percent of practicing emergency physicians felt that insufficient time had been spent on geriatric issues in their residencies, and 71% felt that research in geriatric emergency medicine was inadequate. [12] This descriptive information is based upon narrowly focused, limited research conducted more than 10 years ago. Only seven complaints were assessed in the former study; therefore, the results may reflect a general sense that resource and time utilization are greater for older patients, rather than a specific concern with these complaints.

EmergMed 2 (Level A): **Randomized controlled trials are needed to assess the effectiveness of interventions (eg, educational models, standardized protocols) for improving quality of care of older emergency department patients.**

ENVIRONMENT

Patient perceptions of ED care have been described through focus-group interviews and small surveys. Issues revealed by these studies include environmental issues, long wait times, anxiety, and poor communication. [13,14]

EmergMed 3 (Level B): **Large studies are needed to confirm the results of patient surveys and focus group interviews. Studies to identify characteristics of the micro-environment that affect outcomes in elderly patients (communication, emergency department environment) are needed to identify target areas for improvement.**

EmergMed 4 (Level A): **Following evidence-based identification of target areas for improvement, controlled studies of the effect of alterations in the micro-environment on outcomes for older emergency department patients should be performed. Such studies likely cannot be based on random assignments of individuals to interventions; rather, whole micro-environments will have to be compared.**

PREHOSPITAL CARE

Descriptive information regarding emergency medical service (EMS) use among older adults comes from single-city retrospective studies. One third of patients aged 65 and older in the ED arrive by ambulance. [8,10] Older patients are responsible for 22% to 39% of EMS runs, which is out of proportion to their representation in the population. [15,16] Population-based estimates of the rate of paramedic runs for older patients show a rate of approximately 100 per 1000 population per year. [15,17] This rate is nearly twice that of patients under age 65, and the rate in patients 65 and older increases with increasing age, to a rate of 291 per 1000 patients aged 85 years and older. [15,17] Given that patients aged 80 and older are the most rapidly increasing demographic group in this country and that nearly one third of patients aged 85 or older require EMS transport per year, one can see that in the years to come an increasing proportion of EMS runs will involve older patients.

Common reasons for EMS transport include respiratory distress (13.1%), unspecified pain (12.3%), and chest pain (12.0%). [17] Older patients are 2.6 times more likely than their younger counterparts to have a cardiopulmonary complaint, 1.8 times more likely to have a fall, and 1.7 times more likely to have a minor medical complaint. Additionally, they are more likely to require advanced cardiac life support care and have longer on-scene times. [16]

Providers of prehospital care have a unique opportunity to assess patients in their home situations. One trial of the feasibility of having paramedics screen older patients for medical, psychiatric, social, and environmental problems has been published. [18] This prospective study involved training paramedics to identify potential problems in older patients, referral of at-risk patients to the Area Agency on Aging for assessment by a trained geriatric assessor, and linkage of the patient to community services. The primary finding of the study was the usefulness of the program to individual patients. The program was defined as useful if a problem was identified, an assessment was done, and the problem was confirmed by the assessor. Additionally, the problem had to have the potential for improvement, and help had to be received. Paramedics identified 197 patients with potential problems out of 6000 evaluated; 124 received assessment. The assessor confirmed problems identified by paramedics in 121 cases (98%). The project was useful for 48% of patients identified as having potential problems.

EmergMed 5 (Level B): **Cohort studies should be performed to describe the ability of prehospital care providers to assess older patients in their home environments. Areas where this may be particularly beneficial include the assessment of the home environment in patients with falls and functional decline, and the assessment of potential abuse. This research should focus on whether information about home environment provided by prehospital care providers affects patient outcomes.**

COGNITIVE IMPAIRMENT

Older patients who present to the ED commonly have cognitive impairment. This may impact the patient's care in many ways, from limiting the reliability of the medical history to reducing his or her understanding of and compliance with discharge instructions. Although recognized or unrecognized dementia is a likely cause of cognitive impairment, delirium is another common cause. Delirium is considered a medical emergency because of its multiple serious medical causes (eg, sepsis, myocardial infarction, drug toxicity, occult fracture, subdural hematoma). [19] For these reasons, the assessment of cognitive impairment is considered an integral part of the evaluation of elderly persons presenting to the ED.

In a retrospective analysis of EMS transports in one county in 1990, Wofford et al reviewed patients aged 60 years and older to identify those transported for altered mental status. [20] Five percent of 4688 transports during this time were for altered mental status, and 74% of these patients were hospitalized, with a mean length of stay of 28 $\pm$ 5 days. The diagnoses included infection (26%), toxic-metabolic causes (23%), and cerebrovascular disease (20%).

In a prospective cross-sectional study, Gerson et al used the Orientation Memory Concentration Test, a validated screening instrument for cognitive impairment, to screen ED patients aged 65 years and older. [21] Patients were excluded if they had a prior diagnosis of dementia. The instrument took 1.9 $\pm$ 0.91 minutes to perform. Of 547 patients evaluated, 34% had at least moderate impairment of cognition, and an additional 26% had minimal impairment. Only 40% of patients had no impairment of cognition. Using logistic regression, the researchers determined that age 80 and above (OR = 3.68) and nursing-home residence (OR = 13.8) were independent predictors of cognitive impairment. Delirium and dementia were not differentiated.

Naughton et al conducted a prospective cross-sectional study on 188 patients in their ED who were aged 70 or older. [22] Using a combination of the Glasgow Coma Scale, the Folstein Mini–Mental Status Examination (MMSE), and the Confusion Assessment Method (a validated screening tool for delirium), they found that 8.5% of patients had impaired consciousness (patients who did not open their eyes spontaneously or in response to speech, respond to questions, or obey commands), 9.6% had delirium, 22% had cognitive impairment without delirium, and 60% were cognitively intact. Seventeen percent of patients with delirium were not admitted to the hospital. Patients with delirium had ED diagnoses of "congestive heart failure," "rule out MI," "mental status change," "sepsis," "hypertension," "seizure disorder," and "vomiting." Patients with impaired consciousness and delirium had a nonsignificant trend toward higher rates of admission and longer lengths of stay than patients who were cognitively intact. Naughton et al performed a second study to evaluate the use of computed tomography scanning in patients with delirium. [23] Methods for determining cognitive impairment were similar to those of the prior study. In the second study, 4.8% were found to have impaired consciousness, 17% delirium, and 38% cognitive impairment without delirium. Scans were most often ordered for patients with delirium. The authors believe that the differences in the prevalence of cognitive impairment between the two studies may be due to the higher proportion of nursing-home patients in the second study.

Lewis et al performed a similar prospective cross-sectional study of patients aged 65 years or older presenting to their ED. [24] Using the Confusion Assessment Method, they

found that 10% of 385 patients had delirium or probable delirium. Using a score of 3 or 4 as the standard, they determined that physician sensitivity for the diagnosis of delirium was 17%. Sixty-two percent of patients with delirium were admitted. The 3-month mortality was higher for those patients with delirium than for those without, but this did not reach statistical significance (14% versus 8%, $P = .20$). For patients discharged from the ED, the increased 3-month mortality in patients with delirium was significant ($P = .048$). The most common diagnoses for admitted patients with delirium was "rule out sepsis," "delirium," and "cerebrovascular accident." "Status post fall" was the most common diagnosis for delirious patients who were discharged from the ED.

Similar results were also found by Elie et al in a prospective cross-sectional study in Montreal of ED patients aged 65 years and older. [25] In this study, research psychiatrists used the MMSE and the Confusion Assessment Method to evaluate patients for delirium. Ten percent of the 447 patients screened had delirium; the sensitivity of ED physicians' diagnosis was 35%, and the specificity was 99%. Diagnoses in patients with delirium included neurologic problems in 65%, pulmonary problems (41%), cardiovascular problems (17%), endocrine problems (11%), infectious disease (7%), and metabolic problems (7%).

It is clear from these studies that older adults presenting to the ED commonly have impaired cognition, and this is often unrecognized by the emergency physician. Discharge from the ED of patients with delirium may result in increased mortality. Emergency physicians are limited by time in assessing older patients and must use brief, sensitive tests to assess for cognitive dysfunction. Which instruments should be used for cognitive assessment of older ED patients is controversial. Currently available instruments include the MMSE, the orientation-memory-concentration test, the Short Portable Mental Status Questionnaire, the clock-drawing test, the Confusion Assessment Method, and others. [26]

EmergMed 6 (Level B): **Screening tests for cognitive dysfunction for use in the emergency department should be validated against gold-standard assessment, and efforts should be made to determine if new, shorter screening approaches would be effective.**

EmergMed 7 (Level B): **Prospective cohort studies such as larger-scale longitudinal outcome studies of older patients with impaired cognition are necessary to confirm the finding that patients with undiagnosed delirium have worse outcomes than do those without delirium or with diagnosed and treated delirium.**

EmergMed 8 (Level A): **If research (EmergMed7) confirms that older patients with delirium that is not diagnosed in the emergency department ultimately have worse outcomes than do those either without delirium or with recognized and treated delirium, interventional trials should be designed to determine the effect on outcomes of better screening and management of cognitive impairment in older emergency department patients.**

FUNCTIONAL ASSESSMENT

Functional assessment is important in the ED evaluation of many older patients. Subacute functional decline may precipitate a visit to the ED, or the acute illness or injury that

precipitated the ED visit may cause functional impairment. This may result in frustration for the family if the emergency physician does not recognize the importance of these functional limitations. Likewise, the emergency physician may be frustrated if the patient's other physicians do not recognize the importance of these limitations.

There is little information regarding functional assessment or limitation in the emergency medicine literature. One study of minor traumatic injuries in older ED patients found that 75% of patients had been injured by a fall, 7% had a decline in ADL score, and 23% had a decline in instrumental activities of daily living ADL score. [27]

EmergMed 9 (Level B): **Development and testing of measures for functional assessment that are feasible and valid in elderly emergency department patients are needed.**

EmergMed 10 (Level B): **Case-control or cohort studies are needed to determine whether older emergency department patients with functional impairment have worse outcomes than do those without impairment.**

EmergMed 11 (Level A): **Controlled intervention trials are needed to determine whether the detection and management of functional impairment in older emergency department patients have an effect on these outcomes.**

MEDICATION USE

Explicit criteria for potentially inappropriate medication use in older patients have been defined. [28] These include inappropriate medications as well as drug-disease interactions. In a prospective ED study, Chin et al found that 11% of patients presenting to the ED were already on potentially inappropriate medications, 3.6% were given one in the ED, and 5.6% were prescribed one on discharge from the ED. [29] Drug-disease interactions were less common at presentation (5.2%), in the ED (0.6%), and on discharge (1.2%). The most common inappropriate medications on discharge were indomethacin, diphenhydramine, cyclobenzaprine, and propoxyphene. In the ED, meperidine was also a commonly used inappropriate medication. The study did not find any significant association between potentially inappropriate medications or adverse drug-disease interactions in revisit to the ED, hospitalization, or death over the 3-month follow-up period.

Adverse drug interactions may also be important in the elderly age group. Older patients are more likely to be on multiple medications on presentation to the ED, and medications are commonly added in the ED (one half to two thirds of visits). [30,31] One study showed that 42% of patients presenting to the ED had a drug interaction, but that only 10% were clinically significant. [31] Twenty-six percent of patients had a drug interaction due to medications initiated in the ED, but only 3% were clinically relevant. Multiple regression showed that age 60 and older was the only predictor of clinically significant drug interactions.

Another study showed that 10% of patients who had a drug added in the ED had a potential drug interaction. [30] The rate was significantly different in the two age groups examined by the authors, patients younger than 60 (4%) and patients over age 65 (18%). However, using multiple regression, the researchers found that age was not an independent predictor; rather, the number of medications at presentation and the number of ED medi-

cations prescribed were the only significant independent predictors. Eighty-nine percent of all interactions were found to have occurred with prescriptions for narcotics, nonsteroidal anti-inflammatory drugs, benzodiazepines, antacids, and diuretics. Adding medications in the ED may also increase medication complexity and decrease older patients' knowledge of their medications. [32]

Balanced against this negative view of adding medications in the ED is the possibility of oligoanalgesia in older patients. Among patients with long-bone fractures, the older are less likely to receive ED pain medications, wait longer to receive medications, and receive the medications at lower doses than do their younger counterparts. One retrospective review did not correlate this finding with the severity of pain, satisfaction, pain relief, or other outcome measures. [33] Interestingly, in this study, both meperidine and propoxyphene were found to be prescribed more frequently for older than for younger patients, though both are potentially inappropriate for older patients. [28] However, the study was done several years prior to Beers' 1997 update that defined explicit criteria for potentially inappropriate medications for older patients.

EmergMed 12 (Level B): **Large, long-term studies of the outcomes when older patients are prescribed potentially inappropriate medications are needed.**

EmergMed 13 (Level A): **Interventional trials (randomized or by comparison of micro-environments) are needed of methods to reduce prescription of potentially inappropriate medications for older patients, such as educational sessions or computer-assisted decision support systems integrated into emergency department discharge instructions.**

SCREENING AND COMPREHENSIVE GERIATRIC ASSESSMENT IN THE ED

The ED is generally considered a location for the treatment of acute medical emergencies rather than for screening. However, for older patients, screening for problems outside of the patient's chief complaint may be beneficial.

COMPREHENSIVE GERIATRIC ASSESSMENT

ED-based comprehensive geriatric screening has been evaluated in two studies. Miller et al performed a nonrandomized controlled trial of a 30-minute comprehensive geriatric assessment in the ED. [34] Patients were enrolled over 11 months and were seen between noon and 8 pm on alternating days. Control patients were obtained by using the ED census to identify patients seen the prior day, matching by gender and age within 5 years. Control patients were not contacted initially and received standard ED care. The intervention group received evaluations by a geriatric nurse clinician who identified medical, dental, and social problems and made recommendations to the patient, family, and physicians. For the intervention group, 434 patients were approached and 385 patients consented to participate. Intervention and control groups were similar in demographic characteristics. Sixty-seven percent of intervention patients were found to be dependent in at least one ADL. Eighty-two percent had at least one geriatric problem identified, and 77% reported at least one unmet dental or social need. The cost of the intervention was low ($5 to

identify each geriatric issue and $1 to identify each dental or social issue), but physicians complied with only 62% of suggestions and families with only 37% of suggestions. Mortality and nursing-home residence did not differ between groups at 3 months; however, there were trends toward fewer subsequent ED visits and more advance directives in the intervention group.

Gerson et al conducted a multicenter, prospective, uncontrolled trial of case findings in adults aged 60 and older in five hospital EDs. [35] Medical students were trained in the administration of a 17-item protocol that took a mean time of 17.7 ± 10.2 minutes to complete per patient. Three quarters of 338 eligible patients participated, and 96% of patients had at least one condition detected (281 conditions detected). Most commonly detected conditions were impaired ADLs (79%), decreased vision (55%), lack of influenza vaccination (54%), unhealthy home environment (49%), impaired mental status (46%), falls (40%), and depression (36%). Seventy-six patients were evaluated at follow-up, 47 (17%) conditions were confirmed, and treatment plans were initiated for 25 conditions (9%).

Sinoff et al in a retrospective review of geriatric consults in the ED found that 64% of patients who had consults were admitted, 34% died within 2 years, and 52% were admitted to long-term-care facilities. [36] They found high rates of classic geriatric problems, including falls, incontinence, iatrogenic events, and confusional states. This was an observational study, and only patients for whom a geriatric consultation was obtained in the ED were included. Consultation was not mandatory and was generally initiated by the ED staff.

Jones et al performed a prospective observational study by telephone call-back of adults aged 60 years and older who had been discharged from the ED. [37] They were able to contact 79% of patients and found that 13% of these had moderate deterioration in their ability to care for themselves, and 40% required further clarification of discharge instructions. Four percent were advised to return to the ED, and 3% were referred to a medical social worker.

IDENTIFICATION OF SENIORS AT RISK TOOL

McCusker et al have published multiple studies on screening of ED patients. [38–43] In a prospective, observational study of ED patients aged 75 years and older, they determined predictors of repeat ED visits within 90 days by using multivariate logistic regression. [43] Twenty-four percent of patients made a repeat visit within 90 days. Predictors included male gender (OR = 7.06), living alone (OR = 10.48), and the number of self-reported problems (depression, confusion, incontinence, falls, mobility, and balance) (OR = 2.68).

The Identification of Seniors at Risk (ISAR) screening tool was developed to improve the recognition of older ED patients who are at risk for adverse outcomes. [42] A screening questionnaire was developed from a literature review of predictors of functional decline and by adapting other questionnaires. The initial questionnaire had 27 questions on social, physical, and mental risk factors, on medical history, and on the use of medical services, medications, and alcohol. These questions were compared with validated tools, including the Geriatric Depression Scale and the CAGE questionnaire (Cut down, Annoyed by criticism, Guilty about drinking, Eye-opener). The screening questionnaire itself had good test-retest reliability; however, individual questions were more specific than sensitive and had only modest concurrent validity. The questions with the highest level of sensitivity and specificity were those on visual and hearing impairment, medications, and depression.

A second study looked at the ability of the questionnaire, or a subset of questions from it, to identify patients at risk of adverse health outcome over 6 months (adverse health outcome was defined as death, institutionalization, or a clinically significant decline in physical function). [38] This prospective observational study found that 30% of patients in the development phase had an adverse health outcome, including 10% who died, 3% who were institutionalized, and 16% who had increased functional dependence. The best subset of 6 questions (see Table 3.1) was based upon statistical analysis, as well as input from the ISAR Steering Committee. The area under the curve (AUC) for detection of an adverse outcome was 0.71 in the validation set. Two positive responses had a sensitivity of 75% and a specificity of 58%. Three positive responses had a sensitivity of 27% and a specificity of 81%, and four positive responses a sensitivity of 10% and a specificity of 93%.

The ISAR screening tool and the complete 27-item screening questionnaire have also been found to be predictors of return visits to the ED over 30 days (AUC = 0.63), three or more visits over 6 months (AUC = 0.68), [40] and hospital utilization over 6 months (AUC = 0.68). [39]

Feeling depressed and certain diagnoses also predicted both early and frequent return. [40] A history of heart disease, having ever been married, and not drinking alcohol predicted early return, and a history of diabetes mellitus, a recent ED visit, and lack of support predicted frequent return. [40] Other predictors of high hospital utilization included age 85 or older, living alone, and poor self-reported health. [39]

***EmergMed 14 (Level B)*: Comprehensive emergency department screening of older patients is feasible and inexpensive; however, outcomes have not been affected, possibly because of low compliance with recommendations and follow-up. Potential interventions to improve compliance with recommendations and follow-up, including direct referral to geriatric teams, should be prospectively evaluated.**

***EmergMed 15 (Level B)*: The Identification of Seniors at Risk tool should be employed at independent sites to determine its value in selecting high-risk elderly patients for interventional trials of geriatric assessment.**

Table 3.1—The Best Subset of Questions from the ISAR Screening Tool

1. *Before* the illness or injury that brought you to Emergency, did you need someone to help you on a regular basis?
2. *Since* the illness or injury that brought you to Emergency, have you needed more help than usual to take care of yourself?
3. Have you been hospitalized for one or more nights during the past 6 months?
4. In general, do you see well?
5. In general, do you have serious problems with your memory?
6. Do you take more than three different medications every day?

Source: Data from McCusker J, Bellavance F, Cardin S, et al. Detection of older people at increased risk of adverse health outcomes after an emergency visit: the ISAR screening tool. J Am Geriatr Soc 1999;47:1229-1237.

SCREENING FOR SPECIFIC CONDITIONS

Visual Deficit

A British study evaluated screening for correctable undetected visual acuity deficit in ED patients aged 65 years or older and found that 36% of patients had a correctable visual acuity deficit of 2 lines or more in one or both eyes. [44] Self-reported problems with vision are associated with adverse health outcomes in older patients discharged from the ED. [38] In a guideline for the ED management of falls in older adults, it was recommended to simply ask the patient whether he or she had had an eye examination in the prior year. [45] No interventional trials of vision screening in the ED have been performed.

Depression

Depression in older adults is common and may be an unrecognized component in a patient's ED presentation. McCusker et al found a prevalence of depression of 26% in ED patients aged 65 and older, using a score of 11 on the Geriatric Depression Scale as a cut-off. [42] The single screening question "In general, do you feel sad and depressed?" had a sensitivity of 56% and a specificity of 88% for detecting depression. Meldon et al found a prevalence of depression in their older ED patients (aged 65 and older) of 27% using the Koenig Scale, a validated 10-question scale for depression screening. [46] Nursing-home patients were found to have a prevalence of depression of 47% versus 24% for those who were living independently. Patients with poor self-reported health were also more likely to be depressed (51% prevalence). Physician sensitivity for the detection of depression was 0%. Clinical characteristics were unable to predict depression in these older patients. [47] In a second study by Meldon et al, 30% of patients were found to meet the criteria for depression, and physician sensitivity was 27% and specificity was 75%. Thirteen percent of depressed patients were referred for mental health evaluation. [48]

Alcohol Abuse

Alcoholism may also go unrecognized in older adults. In a prospective cross-sectional study, Adams et al found 24% of ED patients aged 65 years and over to have a current or prior drinking problem and 14% to be current alcohol abusers (defined as a CAGE score of ≥ 2, or a self-reported past or current drinking problem and use of alcohol over the past year). The patients who were current alcohol abusers presented with abdominal pain in 22% of cases and trauma in 7% of cases. ED physicians detected only 17% of current alcohol abusers. [49] McCusker et al reported a prevalence of current alcohol abuse (CAGE score ≥ 2) of 2.9%. [42] The question "Do you drink alcohol every day, not counting with meals?" was 33% sensitive and 94% specific for the diagnosis. An analysis of the 1995 NHAMCS database found that the annual rate of alcohol-related ED visits in patients aged 65 and older was 2.6 per 1000 population per year, and this was 0.6% of older persons' ED visits; both were the lowest among all age groups except the below-15 age group. [50] A review of trauma registry data found that 14% of 180 drivers aged 60 or over in motor vehicle crashes had blood alcohol counts of $>$ 100 mg/dL. [51] In men aged 60 and over,

21% had a positive blood alcohol counts. Only one patient was found to have a toxicology screen positive for another drug of abuse.

Elder Abuse

Elder abuse is more widespread than many clinicians realize. Although child abuse is commonly evaluated and screened for in EDs, elder abuse is less so. In fact, surveys of practicing emergency physicians found that elder abuse protocols were available to 27% of respondents, whereas child abuse protocols were available to 75%. [12] In teaching institutions, 93% had protocols for child abuse, but only 42% had protocols for elder abuse. [52] Estimates of the prevalence of elder abuse are that 10% of patients aged 65 and over are subject to some type of abuse. [53] In a stratified random sample of community-dwelling older adults in Boston, Pillemer and Finkelhor found a prevalence of elder abuse of 32 per 1000 population. [54] This included a prevalence of 20 per 1000 for physical abuse, 11 per 1000 for verbal abuse, and 4 per 1000 for neglect. In contrast to other studies and popular thought, 58% of perpetrators were spouses and only 24% were children. The proportion of abused older patients was nearly evenly split between men and women, but the risk among men was more than two times that for women, owing to their smaller representation in the population.

Lachs et al identified 182 older victims of abuse reported to the regional Elder Protection Service. [55] Of these patients, 114 had been seen in the ED over the preceding 5 years, with a median of 3 visits (range 1 to 46 visits). Thirty-eight percent had at least one visit with a high probability of abuse, and 66% had at least one injury visit. Only 9.1% of these visits resulted in a referral to the Elder Protection Service.

Fulmer et al reported on a prospective pilot study of a screening instrument for elder abuse. [56] They screened 484 patients and found a 7% rate of abuse, including physical abuse in 1%, psychologic abuse in 4.1%, and material deprivation in 2.2%. An additional 6% had suspected abuse.

In a retrospective analysis of risk factors, elder abuse was found to be more common among nonwhites (OR = 2.55 for abuse, 3.02 for neglect) and the nonmarried (OR = 2.29 for abuse, 2.49 for neglect). [57] Neglect, but not abuse, was found to be more common among patients with delirium (OR = 4.23) and dementia (OR = 4.07). Two studies present protocols for the evaluation of patients with elder abuse. [56,58]

> ***EmergMed 16 (Level B)***: **Studies are needed to develop brief screening instruments for specific conditions for use with older patients in the emergency department.**
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> ***EmergMed 17 (Level A)***: **Screening for asymptomatic conditions in older patients in the emergency department should be done only if detection of the abnormality results in treatment of the disorder and this treatment results in improvement in outcomes. Randomized interventional trials are needed to assess short- and long-term outcomes of patients who have screening and treatment for these conditions.**

SPECIFIC CLINICAL SYNDROMES

ABDOMINAL PAIN

Abdominal pain is the presenting complaint of 3% to 6% of older patients presenting to the ED. Surveys of emergency physicians and emergency medicine residency directors in the early 1990s found that abdominal pain was one of several complaints that physicians found more difficult to manage in the older patient. The mortality in older patients presenting with abdominal pain is 5%. Twenty-two percent will require surgery, and over half (52%) will be admitted to the hospital. Risk factors for death in older patients with abdominal pain include free air on radiograph (RR [relative risk] = 23), age over 84 (RR = 22), other significant radiographic findings (RR = 5.9), and bandemia (RR = 23). [59] If free air is present on abdominal radiographs, the mortality is 75%. Risk factors for surgery include hypotension (RR = 4.7), abnormal bowel sounds (RR = 4.2), other radiographic abnormalities (RR = 4.1), dilated loops on radiographs (RR = 3.2), and leukocytosis (RR = 2.3). Diagnoses in older patients with abdominal pain include infection (19%), mechanical problems (16%), ulcers (8%), genitourinary disease (8%), malignancy (7%), biliary tract disease (6%), cardiac disease (4%), pulmonary disease (2%), other (29%).

In one retrospective review, it was found that emergency physicians correctly classified 67% of patients with abdominal pain who were younger than 65 years but 44% of those who were 65 or older. [60]

Older patients with cholecystitis commonly do not have classic symptoms. In a retrospective review, it was found that 84% had neither epigastric nor right upper quadrant pain, and 5% had no pain at all. [61] Fifty-six percent of patients were afebrile and 41% had a normal white blood cell count. No difference in the presence or absence of these findings was found for the young-old (65 to 74), the old-old (75 to 84), or the oldest-old (85 and older). This mirrors results from another retrospective review, which showed that elevated temperature and abnormal laboratory studies do not differentiate patients who were admitted and underwent surgery from those who did not undergo surgery. [62] Thirteen percent of patients who had normal values for all laboratory studies and normal temperatures required surgery.

Only 20% of older patients with appendicitis present classically. Elevated temperatures are present in less than half (47%), and 23% have tenderness that is diffuse or localized to an area other than the right lower quadrant. [63]

A final retrospective review found that 43% of patients aged 65 and over with abdominal pain were admitted; 20% had immediate surgery, 17% were admitted and had subsequent surgery (41% of admitted patients), and 4% were discharged and had subsequent surgery. [64] Common diagnoses included indeterminate (23%), biliary tract disease (12%), small bowel obstruction (12%), gastritis (8%), perforated viscus (7%), diverticulitis (6%), and appendicitis, incarcerated hernia, and renal colic (4% each). A common limitation of all of these studies is their retrospective nature.

EmergMed 18 (Level B): **Prospective, longitudinal cohort or case-control studies of elderly emergency department patients with abdominal pain are necessary to adequately define which patients with abdominal pain have serious disease and which have benign disease.**

EmergMed 19 (Level B): **The value of history and physical examination findings, laboratory examination, and imaging studies in older emergency department patients should be prospectively evaluated.**

FALLS

Falls are both a common and serious event for older patients. Falls are the most common reason for injury visits in patients aged 65 years and older (52% of such visits). [65] In one study 15% of EMS transports for patients aged 65 years or older were for falls. [17] The risk of falls in older patients increases with increasing age, and women fall more often than men. [17,45] In older patients, fractures occur in 5% of falls, and other serious injuries occur in 5% to 10%. Twelve percent of deaths in the older population are directly or indirectly related to falls. [45]

A practice guideline for the ED management of falls in older patients was published in 1997. [45] This guideline recommended a comprehensive evaluation of ED patients who fall, including an expanded history (eg, ADLs, environmental hazards, last eye examination), physical examination (Timed Get Up and Go test, mental status examination), diagnostic studies and referral (geriatric assessment, social services, optometry, podiatry, physical therapy, occupational therapy). This guideline was implemented in three EDs that were part of a large health maintenance organization in southern California. The guideline was presented to emergency physicians at a 1-hour lecture and to ED nurses at a 30-minute in-service lecture. A pre-post intervention comparison over 2 years found that, following the education, more patients were diagnosed as having fallen as a result of loss of consciousness, stroke, or seizures. There was improved documentation of certain historical elements, visual acuity testing, and the Timed Get Up and Go test. However, there was still low compliance with many of these elements (visual acuity testing in 3.2%, Timed Get Up and Go test in 11.2%). Although there were small improvements in these aspects of the history, there was no difference in the rate of recurrent falls, hospitalization for falls, or hip fractures before and after the implementation of the guideline. [66,67]

Older black Americans may be at high risk of poor outcomes after falls. [68] Older patients may also be at increased risk for occupational injuries due to falls. [69,70]

EmergMed 20 (Level A): **Randomized controlled trials are necessary to assess the value of a falls prevention program in reducing subsequent falls by elderly patients presenting to the emergency department with a fall.**

INFECTIOUS DISEASE

Fever is a common presenting complaint of older ED patients. Morbidity and mortality are high. In one study of ED patients with oral temperatures $\geq$ 100°F, 18% were found to have positive blood cultures, 10% died within a month, and 7% required surgery. [71] Three fourths of patients had signs of serious illness (the above and hospitalization $\geq$ 4 days, intravenous antibiotics $\geq$ 3 days, or repeat ED visit within 72 hours). Predicting serious illness in ED patients with infectious symptoms is difficult. In this study, oral temperature $>$ 103°F, respiratory rate $\geq$ 30, leukocytosis of 11,000 or more, presence of an infiltrate on chest x-ray, and pulse $>$ 120 were found to be independent predictors of serious illness. However, 50% of patients with serious illness had none of these features.

Although the specificity for bacterial infection of such findings as elevated temperature, leukocytosis, and bandemia is relatively high (85% to 97%, varying by cut-off used), the sensitivity is low (24% to 65%). Therefore, the absence of these findings cannot be used to exclude significant bacterial infections in older adults. [72]

Another study found that the only predictive factors for bacteremia in older patients were altered mental status (OR = 2.88), vomiting (OR = 2.63), and bandemia $>$ 6% (OR = 3.5). [73] The sensitivity of $\geq$ 1 factor was 85%, specificity was 46%.

Common infections in older patients with fever are pneumonia or bronchitis (31%), urinary tract infection (22%), sepsis (18%), and cellulitis (5%). [71] Age itself is a risk factor for more serious illness in patients with pneumonia and influenza. [74,75] Patients aged 65 years or older with urinary tract infections are more likely to have multidrug-resistant pathogens (OR = 3.0). [76]

Immunizations have become a routine part of ED practice, especially tetanus immunization. Approximately 50% of older ED patients do not have protective antibodies to tetanus. [77–79] Half of these patients will not seroconvert in 14 days after immunization. [77] One third of patients also have inadequate immunity to diphtheria. [80]

ED immunization for older patients for pneumococcus and influenza has also been evaluated. Sixty-five percent of older adults are immunized for influenza, and 45% are immunized for pneumococcus; persons aged 65 to 74 years are less likely to be immunized than older persons, as are nonwhites and persons with lower socioeconomic status. [81] Studies in urban EDs suggest that only 3% to 18% of high-risk patients (a group that includes patients aged 65 and over) report immunization for pneumococcus, and 28% to 38% report immunization for influenza. [82,83] Feasibility studies of ED-based immunizations for influenza and pneumococcus found that the median time for immunization-related activities was only 4 minutes, and patient length of ED stay is not affected. [82,84]

EmergMed 21 (Level B): **Up to now, studies of fever and infectious disease in older emergency department patients have been observational and analytic retrospective studies. Prospective observational cohort studies, including longitudinal studies of outcomes and predictors of outcomes, are needed.**

EmergMed 22 (Level A): **Descriptive studies of emergency-department-based immunization programs have found them to be feasible. Intervention trials for older persons are necessary to determine if such programs are beneficial (because they access an underserved population) and whether they provide more cost-effective care and reduce adverse outcomes in comparison with usual care.**

ACUTE CORONARY SYNDROMES

Chest pain in the older patient has been identified as an area of concern for emergency physicians, who rate this complaint as more time-consuming and requiring more resources to evaluate in older than in younger patients. [12] Increasing age is an independent risk factor for the development of coronary artery disease. [85,86] Of more concern to emergency physicians, though, age is an independent risk factor for acute coronary syndromes (ACS)

in patients presenting with symptoms of possible ACS. [86,87] Age is also a risk factor for mortality in patients with ACS. [88,89]

Complicating the evaluation of older patients with possible ACS is the fact that they less commonly present with chest pain and other classic symptoms of ACS. Small, single-center studies and larger, multicenter databases have documented that increasing age increases the likelihood of myocardial infarction (MI) without pain. Bayer et al performed a retrospective study of patients aged 65 to 100 years and found chest pain to be present in the majority of patients up to age 85. [90] After that, shortness of breath was the most common symptom. Approximately 20% to 30% of patients aged 65 to 79, 50% of those aged 80 to 84, and 62% of those 85 and older presented without chest pain. Other presenting complaints in this group included syncope, confusion, weakness, and stroke. Another single-hospital study showed a much higher rate of MI without chest pain, 75%, in patients aged 85 and older. [91] Perhaps the most generalizable study to assess this phenomenon is an analysis of the National Registry of Myocardial Infarction 2, a national registry of patients with confirmed MIs at 1674 hospitals. [92] In this study, one third of all patients did not have chest pain. This included 25% of patients under age 65, 33% of patients aged 65 to 74 years, 42% of patients aged 75 to 84, and 51% of patients 85 and older. Patients without chest pain had longer delays and were less likely to receive thrombolysis, primary angioplasty, aspirin, heparin, and β-blockers. The in-hospital mortality of these patients was 2.21 times greater than that for patients with chest pain.

Although a comprehensive review of the treatment of ACS is beyond the scope of this paper, several points of concern to emergency physicians must be mentioned. Although improvements in care have been documented, there is considerable room for improvement in the acute care of the older patient with ACS. A review of changes in the management of MI between 1987 and 1990 in patients aged 65 and over using Medicare databases found significant improvements in both 30-day mortality (26% to 23%) and 1-year mortality (40% to 36%). [93] During the same period, increases in angiography (13% to 21%), revascularization (13% to 21%), angioplasty (5% to 10%), and bypass (8% to 11%) were noted. However, older patients commonly do not receive as aggressive treatment as their younger counterparts, even though there is evidence to suggest that older patients have greater absolute benefits from such therapy. [94,95] Part of the reason for this may be that older patients are less likely to have indications for and are more likely to have contraindications for thrombolytics. In the Multicenter Chest Pain Study, only 18% of patients aged 75 and older presented with ST elevation or new Q waves on electrocardiogram in less than 6 hours from the onset of their pain, whereas 34% of younger patients did so; 12% of patients aged 65 and over who were eligible by electrocardiogram and time criteria had other contraindications to thrombolysis. [96] However, in a retrospective analysis of Medicare patients in Connecticut, Krumholz et al found that 56% of patients 65 and older who were eligible for thrombolytic therapy and not referred for direct angioplasty or bypass did not receive thrombolytics. [97] Predictors of not using thrombolytics include increasing age, lack of chest pain, altered mental status, presentation after more than 6 hours of symptoms, left bundle branch block, Q waves, ST elevation of less than 6 mm total, and ST elevation in only two leads. Even in "ideal" patients for thrombolytic therapy, ie, those presenting with chest pain, ST elevation, and within 6 hours of the onset of symptoms, 25% of patients did not receive thrombolytic therapy. Although this rate of thrombolytic administration seems low, other studies have shown that only 5% of MI

patients aged 75 and older received thrombolytics, and patients in this age group had an 18% mortality. [98] In a prospective study of 4223 patients, Fleming et al found that patients aged 75 years and older were 2.5 times more likely not to be admitted to the coronary care unit, even if the diagnosis was myocardial infarction (RR = 7.1) or exclude MI (RR = 1.5). [99]

Given this information, several things are clear. Older patients, especially the oldest old (age 85 and older), present atypically with ACS. Given the symptoms with which older patients present to the ED, this diagnosis may need to be considered in one third of patients aged 65 or over who present to the ED. Although older patients are less likely to be eligible for thrombolytics, they receive a greater benefit from this treatment. Thus, in patients with ACS, "age is, therefore, best considered as an impetus to pursue prompt therapy rather than a reason to avoid it." [94]

EmergMed 23 (Level B): **Studies of techniques to improve recognition and appropriate treatment of acute coronary syndromes in older emergency department patients should be performed.**

EmergMed 24 (Level A): **Older patients should be included in intervention trials of acute coronary syndromes treatment.**

CARDIOPULMONARY ARREST

There have been multiple prospective and retrospective studies on the outcome of out-of-hospital cardiac arrest in older patients. [100–119] Although the results vary, overall, several points become apparent. Some studies have found that age is an independent predictor of mortality from cardiac arrest, [100–102,120] but other studies refute this. [105,109–111] Older patients, including octogenarians and nonagenarians, have acceptable rates of survival to hospital discharge (5% to 10%), [100,102,105,107,109,113,118] especially when the presenting rhythm is ventricular tachycardia or ventricular fibrillation (14% to 24% survival to hospital discharge). [100,107,113] In one prospective cohort, patients aged 90 or over were found to have only a 1% survival rate. [102] However, another retrospective cohort study found patients aged 90 or over to have a 4.4% rate of survival; if the presenting rhythm was ventricular tachycardia or fibrillation, the survival to hospital discharge was 17%. [100] Cerebral outcomes and quality of life are acceptable in both younger and older survivors of out-of-hospital cardiac arrest. [121] In an analysis of the Brain Resuscitation Clinical Trials data, Rogove et al found no difference in neurologic recovery by age. [106] Long-term survival rates appear similar in older and younger patients who survive to hospital discharge (65% in each group in one study). [117]

Data on resuscitation of nursing-home patients with cardiac arrest is mixed. Benkendorf et al performed a prospective cohort study comparing nursing-home with community-dwelling patients with cardiac arrest and found that no nursing-home patient survived, but that 5.6% of community-dwelling patients did. [103] Seventy-five percent of nursing-home patients had an asystolic rhythm. Appelbaum et al found similar poor outcomes in their retrospective study, with 2% of nursing-home patients and 11% of community-dwelling patients surviving to hospital discharge. [114] However, another retrospective study found similar rates of survival to hospital discharge in nursing-home (10.5%) and community-dwelling (9.2%) patients. [66] Tresch et al found a 5% survival to hospital discharge rate in nursing-home patients with cardiac arrest, but a 27% survival when the

arrest was witnessed and the rhythm was ventricular tachycardia or fibrillation. [108] Eighty percent of survivors had a functional status similar to their pre-arrest status, and 40% lived for more than 1 year.

Presenting cardiac rhythm and whether the arrest was witnessed are more important than age in predicting the outcome of out-of-hospital cardiac arrest. Given this information, there is no reason to withhold cardiopulmonary resuscitation and advanced cardiac life support on the basis of age alone. Patients with unwitnessed arrests and those with asystole have poorer outcomes at any age. In one large study from Sweden, none of 211 patients aged 70 or over who have unwitnessed, asystolic, out-of-hospital arrests survived to hospital discharge. [101]

EmergMed 25 (Level B): **Cohort or case-control studies are necessary to determine in which patients resuscitation for out-of-hospital arrest is futile. However, it appears that age alone should not be used to make this decision.**

EmergMed 26 (Level B): **Prospective, multicenter, longitudinal studies on the clinical course of older emergency department patients with important conditions (abdominal pain, fever, acute coronary syndromes) are needed (see also Key Research Questions in Emergency Medicine, end of chapter).**

TRAUMA

Injuries in patients aged 65 and over caused 37,560 deaths in 1998, a rate of 109 per 100,000 population. Injuries are therefore the seventh leading cause of death in this age group. Both the crude number of deaths and the death rate increase with age in those aged 65 and over; by age 75, the rate per 100,000 population exceeds all other age groups. [122] In addition to its high mortality, trauma in the older patient can result in significant morbidity, including functional decline and loss of independence.

There are some common limitations in much of the older trauma research. Many reports define "older" to start as young as 55 years of age, rather than the more standard 65 years. However, trauma patients aged 55 and over are a heterogeneous group, and advanced age is associated with increased trauma mortality. Nonstandardized definitions of the "older" age group limit comparisons between studies. Additionally, many of the studies are single-center retrospective analyses of trauma registries at trauma centers. This allows for potential spectrum bias (weighting toward more severe injuries) and makes the results of these studies difficult to generalize to the older trauma patient treated elsewhere. There is often no description of the data quality in these trauma registries. Each study uses different inclusion and exclusion criteria, with some studies including burn patients, patients with penetrating injuries, and patients with isolated orthopedic injuries, and other studies excluding these patients in favor of those with blunt trauma. These factors make comparison difficult and thus lead to confusion about conflicting results. Most of the research is descriptive; very little analytic research and no interventional trials were identified.

Demographics of Trauma in Older Patients

The Northeastern Ohio Trauma Study was a time-stratified random sample of visits to EDs in 1977. [123,124] This large epidemiologic study showed falls to be the leading cause of

injury in patients aged 65 and over, followed by motor vehicle crashes. The injury rate for falls was 40 per 1000 population for patients 65 to 74 years, and 69 per 1000 population for patients 75 and older. The injury rate for motor vehicle crashes was 11 and 9 per 1000 for these age groups, respectively. The study also found that the hospital admission rate for injuries rises markedly after age 65 (21% for patients 65 to 74, 34% for patients 75 and older). Population-based mortality rates also increase in older patients, but more striking are case fatality rates, which show sharp increases in patients aged 65 and over (case fatality rate is the death per 1000 injuries). The rate of fractures also increase sharply after age 65; falls were found to cause 87% of all fractures in those aged 65 and over.

Covington et al analyzed the North Carolina Trauma Registry, a statewide registry of all trauma patients admitted for at least 24 hours or dead on arrival in that state's eight level 1 and 2 trauma centers. [125] The researchers found that patients 65 and older have longer stays in the hospital and intensive care unit, higher hospital charges, and higher mortality at all levels of injury severity. Sixty-eight percent of the injuries were caused by falls, and 22% were transportation related.

In an analysis of the National Hospital Discharge Survey, MacKenzie et al found patients aged 65 and older to represent 12% of the population but 23% of the hospitalizations for trauma, and to be responsible for 28% of charges. [126] Patients 75 and older accounted for two thirds of hospitalizations and charges in the older group.

Mortality

In studies of older trauma patients, in-hospital mortality varies from 15% to 45%. [127–135] Finelli et al provided a secondary analysis of data from the Major Trauma Outcome Study of the American College of Surgeons. [135] This was a study of 46,613 major trauma patients admitted to 120 trauma centers between 1982 and 1986; it included 3669 patients aged 65 and over. The elderly group had an 18% case fatality rate; the most common mechanism of injury was fall (46%, 12% mortality), followed by motor vehicle crash (28%, 21% mortality) and pedestrian hit (10%, 33% mortality).

Mortality in trauma patients is related to several factors, including injury severity, host factors, timeliness of care, and quality of care. [136] Several studies have attempted to identify factors that are associated with mortality in older trauma patients, focusing on host factors and injury severity.

One early study of 100 patients aged 70 and over admitted to a single trauma center found that age, sex, Injury Severity Score (ISS), pre-injury ADL dependence, and pre-existing disease do not differ between survivors and nonsurvivors. [127] Central nervous system injury and the presence of shock (blood pressure $<$ 80 systolic) were found to be significantly different between groups. A second study of 39 severely injured patients aged 60 and over also found that ISS is not predictive of mortality, nor is the Trauma Score (TS). [128] These studies are limited by low power to detect an association between predictive variables and mortality. They also had varying inclusion criteria (the former included patients with burns, penetrating injuries, and same-level falls; the latter included only severely injured surgical patients in intensive care who required a pulmonary artery catheter and arterial line). Older patients with isolated hip fractures have been found to have a mortality rate higher than that predicted by anatomic injury scales; [137] thus, the inclusion of this patient subgroup in the former study may have made it more difficult to detect an association between ISS and age.

DeMaria et al retrospectively analyzed 82 patients aged 65 and over admitted to a single center's trauma service between 1982 and 1984. [138] Patients with thermal, penetrating, or isolated orthopedic injuries were excluded. The mortality rate was 21%; factors associated with mortality by univariate analysis included age, ISS, and the Anatomic Injury Severity score for head and neck. Discriminant analysis showed that four variables were associated with survival—ISS, age, and the presence of cardiac or septic complications. A "geriatric trauma survival score" was developed and prospectively tested on 61 additional patients, with 92% accuracy in prediction of mortality. However, one recent study of 326 patients found no difference in this score between survivors and nonsurvivors. [134] Additionally, this score requires knowledge of complications, which limits its use in the early evaluation of trauma patients.

Knudson et al conducted a retrospective study of 852 patients aged 65 and older with blunt trauma identified by trauma registries of three trauma centers and found the ISS to be the single variable that correlates most closely with mortality. [133] In this study, overall mortality was 18.4%. Other risk factors for death were TS $<$ 7 (RR = 6.62), Glasgow Coma Scale score of 3 (RR = 6.11), respiratory rate $<$ 10 (RR = 4.83), blood pressure $<$ 90 (RR = 4.77), abdominal injury (RR = 3.21), chest injury (RR = 2.27), head injury (RR = 2.17), and male sex (RR = 2.07). The authors developed a model for the probability of death using TS, age, and sex, and found this to have similar discriminating ability to the ISS in predicting mortality (sensitivity 37%, specificity 98%, and total correct classification 88% for the model, corresponding percentages of 41%, 97%, and 86% for the ISS).

Morris et al performed a case-control study of the effect of pre-existing conditions on trauma mortality. [136] They evaluated 3074 trauma deaths and 9868 matched controls (injury survivors) identified by the use of computerized hospital discharge data from California. They studied patients of all ages and found the presence of pre-existing conditions to increase with age. Pre-existing conditions associated with mortality included cirrhosis (OR = 4.6), congenital coagulopathy (OR = 3.2), chronic obstructive pulmonary disease (OR = 1.8), ischemic heart disease (OR = 1.8), and diabetes mellitus (OR = 1.2).

Other factors associated with mortality in studies include early intubation, [139] hypotension, [127,132,133] TS, [133,140,141] ISS, [140,141] closed head injury, [127,132,139] base deficit ≤ -6, [142] sepsis, [132] cardiopulmonary complications, [138] bradycardia, prior MI, and history of chronic renal insufficiency. [132]

Accurate prediction of mortality is important for a number of reasons. First, it may provide information to help patients and surrogate decision makers decide on their desired level of care. Second, it allows for comparison between sites for quality-assurance purposes. Third, it may help tailor patient care, by predicting patients who require more aggressive trauma care. Currently, there is no validated, accurate way of predicting mortality in older patients. This is likely due to the multifactorial nature of mortality in older trauma patients.

Several factors must be taken into account when evaluating mortality prediction in older trauma patients. First, what is the intent of the predictive model? A model intended to be used for quality assurance and comparison of mortality between sites may include complications as a predictor; however, this would not be appropriate in a model intended to identify patients for early, aggressive care. Similarly, a model developed in a trauma center may not be accurate when applied to patients in other settings. Therefore, models used to decide on the necessity of specialized trauma care should include patients from settings

other than trauma centers. Sensitive models are necessary when determining who requires aggressive care; sensitivity is not as important as correct classification for quality assurance. Also, in developing models for prediction of mortality, investigators should include all potentially relevant predictors in order to improve accuracy. This requires larger data sets; the need for quality data suggests that prospective studies would result in better models than retrospective data could produce. Finally, predicting mortality in heterogeneous groups is difficult. Patients with isolated hip fractures from same-level falls, for instance, have a higher-than-predicted mortality on the basis of anatomic injury scales. Inclusion of these patients in studies with patients with multiple injuries diminishes the predictive value of the equations if this is not taken into account as an independent risk factor.

Functional Outcome

Long-term loss of functional abilities and independence are serious morbidities in older trauma patients. Multiple studies have evaluated the long-term functional outcome of these patients and found better-than-anticipated results. [130,131,143] DeMaria et al performed a follow-up survey of 63 survivors of blunt trauma. [130] These patients were moderately injured (mean ISS 15 $\pm$ 1.1) and had high rates of cardiopulmonary comorbidity (71%), multiple injuries (62%), head injuries (25%), and surgeries (50%, two thirds of these emergent). Prior to their injury, 97% of survivors were independent. At discharge, 33% were independent, with 37% dependent at home and 30% in nursing homes. At follow-up (mean 19.6 $\pm$ 1.2 months), the best functional status obtained was 57% independent, 32% dependent at home, and 11% in nursing homes. Risk factors for permanent nursing-home placement were found to be increased age, longer hospital stay, more complications, and more severe abdominal injuries. van Aalst et al conducted a similar study of long-term outcomes of blunt trauma victims aged 65 and older. [131] They identified 98 such patients over a 5-year period and performed a follow-up survey at a mean of 2.82 years (range 1 to 6 years). Thirty-two patients were independent at follow-up; these were defined as "acceptable outcomes." Fifty patients had died, including 44 patients who died in the hospital. An additional 16 patients were dependent at follow-up. These 66 patients were considered "unacceptable outcomes." Factors associated with unacceptable outcomes included age $>$ 75, Glasgow Coma Scale score $\leq$ 7, shock on admission, closed head injury with Anatomic Injury Severity score $\geq$ 3, and sepsis. Mean values for age, ISS, Revised Trauma Score, probability of survival on Trauma and Injury Severity Score, and Glasgow Coma Scale score differed between the groups. Similar findings for comparisons between survivors and nonsurvivors were found.

Penetrating Trauma

Most published studies of trauma in older patients focus on blunt trauma; penetrating trauma is less common and less well studied. One retrospective analysis of the trauma registry at a level 1 trauma center identified 85 patients aged 65 and over with penetrating trauma who were admitted over a 5-year period and compared them with 85 control persons under age 65 and matched for mechanism of injury and ISS. [144] Older patients were found to have significantly more pre-existing conditions, longer hospital stays (2.6 days longer), and longer stays in intensive care. Complication rates were higher in the older patients (22.3% versus 17.6%), but this was not statistically significant. Mortality

was 8.2% in the older group but 3.5% in the younger group. Ninety-one percent of the older patients were discharged home. As the population continues to age, we may begin to see larger numbers of older patients with penetrating trauma, who differ not only from the younger patients but also from older blunt trauma patients.

Aggressive Resuscitation

Scalea et al retrospectively analyzed older blunt multiple trauma patients treated at their level 1 trauma center. [145] The authors describe their experience with 60 patients in 1985 aged 65 and over with diffuse multiple trauma who were stable after initial resuscitation. The overall mortality was 44%; factors that were found to predict mortality were pedestrian-motor vehicle accident, diffuse trauma, initial systolic blood pressure less than 130 mm Hg, systemic acidosis, multiple fractures, and head injuries. The authors did not describe the method used to determine these risk factors or indicate whether they were found to be statistically significant predictors of mortality. The mortality was 85% in the group with any risk factor, and 63% of deaths were in the late post-injury period, commonly from multiple-organ failure.

In 1986 the authors performed invasive monitoring on any patient who had any of the risk factors noted above. Fifteen patients were treated with invasive monitoring; the mortality rate was 93%. The average time to invasive monitoring was 5.5 hours from arrival in the intensive care unit. Because of the low survival rate, after 1986 the authors began a protocol that involved early invasive monitoring. The mortality after this was initiated was 47% ($P < .001$ compared with 1986). The average time to invasive monitoring was 2.2 hours. The groups did not differ in number of injuries, percentage requiring operation, or percentage of patients who died without significant injuries.

The authors suggest that early invasive monitoring of older patients at risk of mortality from multiple-organ failure may improve survival. Given the use of historical controls and the limited comparative information between the groups, it cannot be determined whether the improved survival was due to early invasive monitoring or some other factor.

McKinley et al developed a standardized protocol for resuscitation of trauma patients at risk for post-injury multiple-organ failure. [146] They performed an inception cohort study of patients resuscitated by this protocol, comparing patients aged 65 and older with those under age 65. Patients who had (1) specific injuries (flail chest, two or more abdominal organ injuries, major vascular injury, complex pelvic fracture, or two or more long-bone fractures), (2) base deficit of 6 mEq/L or more, and (3) need for transfusion of six units or more of packed red blood cells, or patients aged 65 and older who have any two of the above criteria, were resuscitated by this protocol; patients with severe brain injury were excluded. The protocol involved resuscitation guided by pulmonary artery catheter using a combination of fluids, blood, inotropics, and vasopressors, with a goal of an oxygen delivery index (DO_2I) of at least 600 mL/min*m2.

Over 19 months, 54 patients under age 65 and 12 patients aged 65 or over were resuscitated by this protocol. Older patients' cardiac index and DO_2I were significantly lower in the older group than in the younger group at the start of resuscitation. Eighty-three percent of older patients required inotropic support with dobutamine, versus 31% of younger patients ($P < .05$); 25% of older patients and 19% of younger patients required vasopressors (P = NS). Fifty percent of older patients and 19% of younger patients developed multiple-organ failure. Survival at 7 days was similar between groups (92% older

and 94% younger), but 30-day survival was significantly less in the older group (42%) than in the younger group (89%) ($P < .05$ for both comparisons).

Although the authors conclude that aggressive management of older blunt trauma patients is not futile, they provide no comparison with patients who are not managed using this protocol. Thus, it remains unknown whether this protocol results in improved survival over standard care.

EmergMed 27 (Level B): **Research on older trauma patients would benefit from standardization of outcomes, including short- and long-term survival and also functional outcome.**

EmergMed 28 (Level B): **Valid and accurate ways to predict outcomes in older trauma patients must be developed on the basis of cohort or case-control studies that can identify risk factors for bad outcomes.**

Early invasive monitoring and aggressive resuscitation of high-risk patients may be beneficial in reducing multiple-organ failure and death in older patients with blunt multiple trauma. A number of research questions are generated on the basis of this hypothesis:

EmergMed 29 (Level B): **Cohort or case-control studies are needed to determine which older patients are at risk for multiple-organ failure and death after blunt trauma and to construct a predictive model.**

EmergMed 30 (Level B): **Exploratory studies are needed to identify new noninvasive ways of determining which older trauma patients might benefit from invasive monitoring and aggressive resuscitation.**

EmergMed 31 (Level A): **To determine whether early invasive monitoring and aggressive resuscitation of high-risk older trauma patients result in improved outcomes, large-scale, randomized controlled trials should be performed, and outcomes that include not only short-term mortality but also long-term mortality and function should be used (see also Key Research Questions in Geriatric Emergency Medicine, next).**

KEY RESEARCH QUESTIONS IN GERIATRIC EMERGENCY MEDICINE

EmergMed KQ1: **Can alterations in the process of emergency department care, such as those found to be beneficial elsewhere (ie, geriatric specialty inpatient units), improve the outcomes of older emergency department patients?**

Hypothesis-generating studies include the following: evaluation of the micro-environment of the ED to determine the characteristics (eg, communication, physical environment) that affect outcomes in elderly patients, development of brief instruments to detect cognitive and functional impairment in older ED patients, and generation of interventions (educational

models, protocols, computer support systems) to improve physician documentation and medication prescribing.

Hypothesis-testing studies include the study of specific elements of care (ie, improved environment, communication, recognition of delirium, linkage with geriatric teams) on outcomes in older ED patients. This should lead to a controlled study of the effects of a multifaceted approach to geriatric ED care on patient outcomes.

EmergMed KQ2: **What diagnostic and therapeutic interventions can improve outcomes in older emergency department patients with high-risk common complaints, such as abdominal pain and acute coronary syndromes?**

Hypothesis-generating studies include prospective, longitudinal studies of outcomes, evaluation of predictors of adverse outcomes, and evaluation of varied diagnostic approaches to older ED patients with the high-risk common conditions.

Hypothesis-testing studies would be based on the results of the hypothesis-generating studies and would include controlled trials of methods for improving outcomes for older ED patients with the high-risk common conditions.

EmergMed KQ3: **In older blunt multiple trauma patients, does early invasive monitoring and aggressive resuscitation result in improved outcomes?**

Hypothesis-generating studies include the development and validation of sensitive and accurate methods to predict which patients are at risk for multiple-organ failure and death after blunt trauma, and the study of noninvasive methods of determining who may benefit from invasive monitoring and aggressive resuscitation.

Hypothesis-testing studies involve evaluating whether early invasive monitoring and aggressive resuscitation of high-risk older trauma patients results in improved outcomes and comparing the effect of different techniques of aggressive resuscitation on outcomes. These studies should consist of large-scale randomized controlled trials, using outcomes that include not only short-term mortality but also long-term mortality and function.

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