Injuries associated with hospitalization are more common in older (≥65 years) than in younger patients (<65 years), and they may be more severe and more often preventable. The increasing age of the population magnifies the importance of this problem. In this review, we first consider medical injuries in general and then review the literature for 6 categories: adverse drug events, falls, nosocomial infections, pressure sores, delirium, and surgical and perioperative complications. For each of these categories, older patients appear to be at higher risk, ranging from a 2.2-fold increase for perioperative complications to a 10-fold increase for falling, based on Harvard Medical Practice Study rates. The main cause of these increased risks appears to be the diminished physiological reserve of elderly patients; however, age alone is a less important predictor of adverse events than comorbidities and functional status. Furthermore, many of these complications appear to be preventable, although the proportion preventable varies by type of complication. While some prevention strategies are specifically beneficial in older patients, many apply to all age groups. Geriatric care units and consultation systems have improved outcomes in some instances, although the data are mixed. The success of intervention varies by type of complications. For medications, various interventions have been successful, and fall prevention programs have been demonstrated to be effective in the nursing home and home.

As the data about the frequency and consequences of iatrogenic injury have accumulated, concern about injury in older patients (≥65 years) has increased. Older patients are at special risk, have special problems, and may require special measures to achieve acceptable levels of safety in health care. Demographic trends indicate that age-related health issues will be of increasing importance in all health care settings.

The population of Americans older than 65 years reached 34 million in 1997 and is expected to double by 2030. In 1995, more than 40% of hospital admissions were in this age group. Because of their longer average length of stay (mean, 7.1 vs 5.4 days), hospital occupancy attributed to older patients is even greater: 49%. Nearly 2 million Americans live in nursing homes, and the figure is expected to reach 5 million by 2030. In recent years, the average nursing home resident has become older, sicker, and more functionally dependent. Shortage of nursing home beds, and increasing utilization constraints for hospitalized patients, has forced many patients who previously would have been institutionalized to receive care in the community.

Outpatient use of medical services also increases with age. Reasons for these trends include advances in medical technology, increased public awareness and preferences, growing populations of chronically ill survivors, concerns of the increased risks of hospitalization, and the increasing costs of hospital care. In 1995, persons older than 65 years averaged 11 physician contacts annually compared with 5 for younger patients. In 1993, 3 million Medicare recipients received 160 million home health care visits. In addition, the
The extent and nature of medical injury in older patients

Unintentional medical injuries are a serious public health problem. Data from hospital and nursing home studies suggest that elderly patients are at particular risk. Less evidence is available concerning the extent and nature of medical injuries in the outpatient and home health settings, although it seems likely that older patients are at increased risk in these settings as well. Most studies targeting medical injuries in the older patients are recent, but several are from the early 1980s and may not reflect current conditions.

The Harvard Medical Practice Study defined an adverse event as an unintended injury caused by medical management that resulted in measurable disability. Such events occurred in nearly 4% of hospitalized patients. More than two thirds of these iatrogenic injuries were due to errors and were, therefore, potentially preventable. Adverse events were more common in patients aged 65 years and older, even after adjusting for comorbidities (Table 1).

Other studies suggest that the Harvard Medical Practice Study may have underestimated the frequency of iatrogenic injury. For example, in one of the earliest prospective studies of older patients, a 1962 prospective study of 500 consecutive admissions of elderly indigent patients admitted to a single medical service, it was found that 29% had complications as a result of hospitalization. In another hospital study, the complication rate for the younger group (mean age, 50.3 years) was 29% compared with 45% for the older group (mean age, 73.1 years).

Among nursing home patients, Gurwitz et al found 3890 reported events in a 1-year study in a 700-bed long-term care facility. The most common events were falls (n = 2032), non–fall-related injuries (n = 1631), and adverse drug events (ADEs) (n = 180). Long-term care facilities have been required by the Omnibus Budget Reconciliation Act of 1987 to record more than 300 diagnostic, demographic, clinical, and treatment variables using the Minimum Data Set and the Resident Assessment Protocols. These quality indicators are organized into care domains, such as accidents, nutrition, skin care, infection control, and others.

Recently, the Center for Health Systems Research and Analysis at the University of Wisconsin–Madison has developed a modified Minimum Data Set (version 2.0) that it has used to record the care of nursing home residents from several regions. Data from this database for midwestern states are shown in Table 2 for selected events from 1992 to 1995; extrapolated nationwide estimates are also given. With the exception of restraint use (38% decline), there were few patterns of improvement during the 4-year study cycle.

Specific Problems

Adverse Drug Events

Adverse drug events are the most common type of adverse event in hospitalized patients, including patients aged 65 years or older. An ADE has been defined as an injury...
resulting from the medical use of a drug.\textsuperscript{23} Adverse drug events include preventable ADEs (those due to errors) and nonpreventable ADEs, also called adverse drug reactions.\textsuperscript{16,24-28} In one large study\textsuperscript{29} of older patients admitted to 41 clinical centers, 5.8% were identified as younger patients. In a study of patients interviewed by telephone, 30% described at least one medication causing undesirable symptoms. In contrast, in a 1-year study\textsuperscript{30} of outpatients in which ADEs were detected by medical record review, a 10% incidence of ADEs was found. Prescription of multiple drugs has also been associated with a higher frequency of ADEs. Among 167 elderly veterans taking a minimum of 5 medications each (mean, 8 drugs per patient), 35% reported having had at least one ADE in the prior year. A quarter of those ADEs resulted in an emergency department visit or hospitalization.\textsuperscript{26}

Most ADEs are unpredictable and unpreventable, at least given the present state of knowledge. However, among hospital patients in one study,\textsuperscript{31} 28% were judged preventable; this study did not consider inappropriate prescribing, so the total figure may be higher. In the outpatient setting, studies\textsuperscript{39-41} have found that 7.5% to 23.5% of patients receive inappropriate or contraindicated drugs.

### Falls and Restraints

Falls are a major source of morbidity and mortality in older patients (Table 3).\textsuperscript{47-51} In 1985, falls resulted in more than 2 million injuries, 369,000 hospital admissions, and nearly 9000 deaths. In a study\textsuperscript{52} of hospitalized patients of all age groups, the incidence of falls for elderly patients was 1.9%. In another inpatient study\textsuperscript{53} not limited to older patients, the estimated incidence of falls and injurious falls was 0.66% and 0.04%, respectively. Like many other studies of falls, this one was limited by its dependence on incident reports. Among nursing home patients, approximately half fall each year, and 9% sustain serious injury.\textsuperscript{53} The 1-year incidence of falls among elderly patients living in the community is 32%, with resultant serious injuries in 24% of those who fall.\textsuperscript{54} Recent estimates for fall-related hip fractures are 250,000 annually, a figure that is expected to double by the year 2040.\textsuperscript{55}

Patients at risk for falling pose difficult management issues. Re-
restraint use (physical and chemical) has become controversial in recent years. Furthermore, the effectiveness of physical restraint in reducing falls or preventing injury is questionable. In fact, restraints in hospitalized patients have been associated with increased mortality rates, longer lengths of stays, pressure sore development, increased incidence of nosocomial infections, and emotional distress.

Nosocomial Infections

Hospitalized older patients appear to be particularly susceptible to nosocomial infections. The incidence of hospital-acquired nosocomial infections in older patients ranges from 5.9 to 16.9 per 1000 hospital days. A retrospective review of 1200 nosocomial infections found the risk in the 70 to 79 years age group to be 10 times that for the 40 to 49 years age group. Nosocomial infections in the nursing home setting are also a major problem. In a study of 4259 residents in 53 nursing homes, the 1-day prevalence rate for newly acquired nosocomial infections was 4.4%. One kind of nosocomial infection, pneumonia, accounts for 29% of hospital admissions of patients from nursing homes.

Pressure Sores

Frail individuals are especially vulnerable to pressure sores (Table 3). Approximately 5% of hospitalized patients acquire pressure sores during their stay, resulting in 1.7 million hospital-related cases per year. Among high-risk hospitalized older patients, the incidence ranges up to 30%. In nursing homes, a 51-site study of nearly 20000 residents revealed that 11% already had a pressure sore on admission, and for the remainder, the subsequent 1-year incidence was 13%. Another nursing home study found that among newly admitted high-risk patients, the incidence for acquiring a new pressure sore within 8 weeks climbs to 74%.

Delirium

Hospital-acquired delirium, especially after surgery, is predominantly a disease of elderly patients, and complicates 2.3 million admissions annually. Delirium at the time of admission is an independent predictor of poor hospital outcome. The prevalence of delirium on admission ranges from 14% to 24% of older patients, and new cases develop during hospitalization in 9% to 31% of older patients. Postoperative delirium is associated with prolonged length of hospital stay, increased costs, morbidity, and mortality.

Surgical and Perioperative Complications

In the Harvard Medical Practice Study, postoperative complications accounted for half of all adverse events and were nearly twice as frequent among older patients. In a more recent study of surgical adverse events in Colorado and Utah, after adjusting for comorbidities, age remained a risk factor for preventable events. Elderly patients account for half of all surgical emergencies and three quarters of operative deaths. In a study of 613 surgical patients older than 70 years, mortality was significantly higher for emergency operations (21%) compared with elective cases (1.9%).

Why Are Older Patients More at Risk of Injury?

The greater risk of harm from medical interventions to older patients results from increased exposure to opportunities for medical mistakes and from the likelihood that those mistakes will then lead to actual injury. Factors increasing risk include those associated with the aging process itself (“endogenous factors”) and those related to care (“exogenous factors”).

Endogenous Factors

Older patients have diminished reserves, especially in cognitive, renal, and hepatic function. Cascade iatrogenesis is especially frequent in elderly patients; it is the serial development of multiple medical complications associated with reduced mechanisms for coping with external stresses. An example is a patient with postoperative pain who was oversedated, leading to respiratory failure that required mechanical ventilation, who subsequently developed ventilator-associated pneumonia.

The development of adverse events or disability during hospitalization in older patients is strongly associated with a poorer prognosis following hospital discharge. Risk factors predicting postdischarge functional decline include preexisting bedsores, poor scores on the Mini-Mental State Examination, impairment in activities of daily living, and reduced social activity. The Hospital Outcomes Project for the Elderly found that, following discharge from hospitalization, a third of patients declined in at least one of their activities of daily living. The causes of functional decline include the effects of illness itself, treatment, adverse events, and deconditioning. In these patients, subsequent risks of falls, rehospitalization, institutionalization, and dying are substantially increased.

Exogenous Factors

In addition to an increased rate of complications from usual medical therapy, such as bed rest, older patients have iatrogenic injuries from inappropriate care. For example, congestive heart failure is the most common reason for hospitalization of elderly patients, responsible for more than 500000 admissions per year. In a prospective observational study, 7% of admissions for congestive heart failure were found to be the result of improper treatment, including fluid overload, procedures, and misuse of drugs. Hospital mortality for this group with congestive heart failure was much greater, 32%, as opposed to 9% in the group without iatrogenic injuries. In a prospective study of inpatient renal service consultations for predominantly older patients, the most common causes for acute renal failure were iatrogenic: drugs, errors in perioperative care, dehydration, and contrast dye.

Underdiagnosis and delayed diagnosis of illnesses are more common in elderly patients. Factors associated with underdiagnosis include the following: patient-related causes, such as symptom denial, symptom
attribution to old age, and patient passivity during physician encounters; systems-related causes, such as inadequate medical access and disincentives from reimbursement inadequacies for time-intensive needs of complex older patients; and physician-related causes. Underdiagnosis in older patients appears more likely to occur when a nongeriatrician physician cares for the patient. For example, some data suggest that patient assessments by non-geriatric-trained providers may be deficient in diagnosing gait disturbances, metabolic problems, early cancers, the presence of untreated infections, and reversible causes of incontinence and dementia.

One of the reasons for underdiagnosis of illness in elderly patients is atypical presentation. For example, patients may present with signs and symptoms that are remote from the diseased organ system, masking important diagnostic clues. The “weakest link” construct holds that illness will often present as failure of the most vulnerable organ system. Impairment usually precludes the new physiologic challenge. For example, delirium, depression, urinary incontinence, or near syncope are not uncommonly associated with remote insults to other organ systems.

SPECIFIC PROBLEMS AND RISK OF INJURY

Adverse Drug Events

While the relation between ADE rates and growing older is strong, it is less clear that age is an independent risk factor beyond the increase in illness associated with growing older. Gurwitz and Avorn have suggested that while an association does exist for certain medications, many studies addressing this relation fail to account for the confounding effects of increased coexisting illnesses and multiple drug use. One recent study addressing this issue in hospitalized patients found no increased risk after controlling for these factors.

Falls

Age, female sex, and living alone are all associated with increased rates of falling. Environmental factors are more important causes of falling for younger elderly patients, while host-related factors (decreased mobility, visual impairment, dizziness, and neurologic or cardiovascular disease) play a more significant role for the more senior and frail elderly patients. Nonenvironmental risk factors most associated with falling in long-term care facilities include a history of falling, the ability to walk, dementia, and drug use, particularly sedative-hypnotics, vasodilators, antidepressants (including newer psychotropics), and diuretics.

Nosocomial Infections

Nosocomial pneumonia among inpatients occurs twice as often in older patients and is associated with poorer outcomes. Older patients are predisposed to pneumonia because of decreased lung capacity, cough reflex, and immunity. Independent risk factors include poor nutritional status, neuromuscular disease, and witnessed aspiration events. Pneumonia and urinary tract infections account for approximately half of nosocomial infections in long-term care facilities. Risk factors responsible for nosocomial infections include urinary catheterization, fecal and urinary incontinence, recent antibiotic use, intravenous lines, nasogastric tubes, and corticosteroid use. Nursing homes are also potentially hazardous for acquiring communicable diseases such as tuberculosis. For individuals aged 65 years or older, tuberculosis rates are 4-fold higher in nursing homes than for elderly persons living at home.

Pressure Sores

Older patients at greatest risk for pressure sores are bedridden or chair bound. Risk factors include fecal incontinence, long lengths of hospital stay, traumatic injuries, neuromuscular diseases, malnutrition, lymphopenia, decreased body weight, dry skin, and an altered level of consciousness. Skin breakdown develops in the setting of moisture, friction, shearing forces, and pressure. Treatment variables that predispose to pressure ulcer development include type of surface support, nurse staffing ratios, frequency of patient repositioning, and certain medications.

Delirium

The most common causes for delirium are medications, infections, metabolic derangements, and alcohol or drug withdrawal. Prescribing factors include age, comorbid conditions, and preexisting cognitive or functional impairment. External influences include insufficient social support, sleep deprivation, unfamiliar environments, pain, and stimulant reduction. In postoperative patients, there is no clear-cut correlation between the route of anesthesia (general, epidural, or regional) and the incidence of postoperative delirium. The method of pain management may be less significant than the quality of postoperative analgesia as a determinant of developing delirium. Physicians fail to diagnose 30% to 50% of delirious patients. Reasons include poor patient-physician communication, misdiagnosis as dementia or depression, overlooking delirium while attending to other diseases, and mistakenly attributing the behavior to normal aging.

Surgical and Perioperative Complications

Age alone is not an important risk factor for many types of surgery. The oldest patients with few comorbid conditions and nonemergency operations have outcomes comparable to younger age groups. Studies from the National Veterans Affairs Surgical Quality Improvement Program database have demonstrated that age, as an independent variable, is less important in predicting postoperative outcome than complexity scores, functional status, emergency nature of cases, or the preoperative anesthesia risk assessment scores. Still, the rate of surgical complications consistently increased with age, with 3 to 4 times as many of the oldest patients having more than one complication (Table 4). Following surgery, iatrogenic injury involving the lungs, kidneys, and cardiovascular sys-
tem increased several-fold with aging (Table 5). Surgeons’ reluctance to perform early elective surgery based on chronological age alone may be a factor that has contributed to increased surgical mortality in older patients.112-114 When surgeons delay operating on elderly patients until nonsurgical treatments have failed, the perioperative risk is often increased.115

WHAT CAN BE DONE TO REDUCE ACCIDENTAL INJURY IN OLDER PATIENTS?

In the Harvard Medical Practice Study,12 two thirds of adverse events in hospitalized patients were judged to be preventable. Efforts to prevent medical errors in elderly patients begin with the same principles used successfully in caring for patients of all ages. Four general strategies with promise for reducing accidental injury in older patients are presented, followed by specific recommendations (Table 6).

Application of Lessons in Error Prevention From Other Industries

Successful programs to reduce adverse events should take advantage of techniques from cognitive science and human factors research, systems theory, institutionalizing safety, and cultural shifts.13 High-reliability organizations (such as aviation) emphasize management of work flow and schedules to prevent fatigue and stress and provide extensive training in teamwork and individual responsibility for safety.

The principles of total quality management, including interdisciplinary approaches, are important for preventing errors in the care of elderly patients.13,31,116-120 Leape et al117 have outlined several human factors’ concepts for medical error reduction that should be built into the design of all systems: simplify, standardize, stratify (customization of care), improve communication, properly use defaults, carefully automate, use affordances and natural mapping, understand limitations of attention and vigilance, and encourage the reporting of errors in a nonpunitive environment. Safety design characteristics also include improving information access, error proofing (including use of forcing functions), reducing reliance on memory, training, and the use of buffers or redundancy to intercept inevitable errors.13

Reducing Variability in the Treatment of Older Patients

Older patients often benefit greatly from interventions, even though their risk is higher.121 For example, for those with atrial fibrillation, older patients benefit the most from an-

Table 4. VA National Surgical Quality Improvement Program: Incidence of Selected Risk Factors and Outcomes*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age, y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>64 (n = 52 718)</td>
</tr>
<tr>
<td>Functional health status†</td>
<td></td>
</tr>
<tr>
<td>Independent</td>
<td>92.0 (48 503)</td>
</tr>
<tr>
<td>Partially dependent</td>
<td>6.5 (3440)</td>
</tr>
<tr>
<td>Totally dependent</td>
<td>1.5 (775)</td>
</tr>
<tr>
<td>Emergency cases (% of all operations)</td>
<td>7.0 (3703)</td>
</tr>
</tbody>
</table>

*Data are given as percentage (number) of patients. VA indicates Veterans Affairs.
†Percentages may not total 100 because of rounding.

Table 5. VA National Surgical Quality Improvement: Incidence of Selected Postoperative Complications After Major Surgery Among Veterans (Fiscal Year 1998)*

<table>
<thead>
<tr>
<th>Postoperative Complication</th>
<th>Age, y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>64 (n = 52 718)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1.0 (529)</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>0.1 (43)</td>
</tr>
<tr>
<td>Failure to wean &gt;48 h</td>
<td>1.0 (520)</td>
</tr>
<tr>
<td>Reintubation</td>
<td>0.8 (426)</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>0.2 (99)</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>0.2 (78)</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>1.0 (516)</td>
</tr>
<tr>
<td>Cardiac arrest needing CPR</td>
<td>0.3 (177)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0.2 (83)</td>
</tr>
<tr>
<td>Systemic sepsis</td>
<td>0.5 (258)</td>
</tr>
</tbody>
</table>

*Data are given as percentage (number) of patients. Major surgery is any operation conducted under general, spinal, and/or epidural anesthesia and all carotid endarterectomies and inguinal herniorrhaphies, regardless of anesthesia type. VA indicates Veterans Affairs; CPR, cardiopulmonary resuscitation.
ticoagulation, although their risk of complications is highest.\textsuperscript{122} Inappropriate care of older patients is associated with underuse, overuse, and misuse of acute care medical services, including procedures.\textsuperscript{123} Many important therapies, including some with increased risks, are actually more effective in elderly patients because the consequences of the untreated conditions are more severe.\textsuperscript{124}

### Role of Geriatric Specialists and Geriatric Care Units

Some data, although not all, suggest that outcomes may be better when geriatric physician and nurse specialists care for older patients compared with routine care. In one study\textsuperscript{95} of patients with nursing home–acquired pneumonia, those cared for by physicians with a Certificate of Added Qualifications in Geriatrics had a 3-fold greater likelihood of achieving cure than patients whose physicians did not have this certificate. In this study, the geriatric physicians had direct patient responsibility and participated in policy decisions.

Also, in geriatric units in which structural and process-oriented factors have been reorganized and directed toward the needs of older patients, care has improved.\textsuperscript{125} Clinical
trials in a hospital medical unit, which was physically redesigned along with a multidisciplinary approach to elderly care and injury prevention, have demonstrated improved functional outcomes while saving costs.126-128 "Acute care for elders units" are team directed and function focused and use nontraditional biopsychosocial models.126 The success of acute care for elders units emphasizes the importance of remodeling processes of care and strategies using specialized teams of providers (physicians, nurse practitioners, and physician assistants) with direct responsibilities in patient care. In models that focus on a team approach, it may be the team rather than the attending physician who has the major impact.

In contrast is the lack of benefit seen with geriatric consultation teams. In a Veteran's Administration study,125 the incidence of hospital-acquired complications (38%) was not reduced by the use of the geriatric team. On analysis, the failure appeared to be due to limiting them to a consultative role. Similarly, other comprehensive geriatric assessment studies20 that did not result in concurrent institutional reengineering have had disappointing results.

**Risk Profiling and Discharge Planning**

Assessing the risk profile of older patients at the time of admission can identify patients at risk for functional decline after hospitalization. The most important independent predictors are advanced age, reduced premismission independent function as measured by activities of daily living, and cognitive impairment.3 Follow-up patient assessments during the hospital stay are also important in reducing medical complications in patients following transfer or discharge from the hospital to home. In particular, ensuring physiologic stability on discharge from hospitalization improves outcome. Naylor et al130,131 have demonstrated the short-term effectiveness of comprehensive discharge planning for hospitalized elderly patients and the value of intensive follow-up of patients at risk for poor outcomes.

**SPECIFIC PROBLEMS**

**Adverse Drug Events**

Reducing ADE rates in older patients will require expanded participation of physicians and other health care professionals, hospital administrators, and the information technology sector to redesign the medication systems in most hospitals. These efforts should also include the following methods.

**New Information Technology.** Information science solutions to the ADE problem have been successfully implemented in several academic centers and are expected to soon gain widespread acceptance.24 Computerized physician order entry with decision support reduced the incidence of serious medication errors by 55% in one study.112 Outpatient pharmacotherapy in elderly patients can be improved with on-line drug utilization review interventions.130 Potentially inappropriate geriatric prescribing was changed in 24% of pharmacy orders after computer-generated alerts.134

**Increasing Physician Prescribing Knowledge.** Beers135 led a panel of nationally recognized experts who developed explicit criteria of inappropriate drug use in elderly patients. His group outlined 2 classes of drugs that are frequently associated with adverse outcomes: those that are potentially injurious for many in the general geriatric population (independent of diagnosis) and those that are hazardous only under certain conditions. The former include propoxyphene, indomethacin, flurazepam, methyl dopa, and chlorpropamide. An example of the latter is prescribing drugs with anticholinergic properties to men with benign prostatic hypertrophy.

**Early Recognition.** Physicians often fail to recognize ADEs, leading to continuing injury and unnecessary additional therapy and tests. Rochon and Gurwitz136 have described the “prescribing cascade,” which occurs when an ADE is misinterpreted as a newly acquired illness. This can lead to additional prescribed therapy for this “new illness,” which places the patient at risk for additional harm from the use of drugs. An example is extrapyramidal symptoms developing after initiating metoclopropamide therapy, which leads to drug therapy for (erroneously) presumed parkinsonism.

**Reducing Unnecessary Drug Use and Substitution With Safer Treatments.** Reducing the excessive use of medications requires periodic reviews of medications. Nonpharmacological sleep protocols for inpatients, for example, are an effective means of reducing ADEs.137

**Increased Utilization of Pharmacists.** Pharmacists are an underused resource for preventing medication errors. Pharmacists provide important safeguards for older patients in hospitals and nursing homes.138,139 Their roles should be expanded to other settings.

**Organizational Initiatives.** The Food and Drug Administration in 1998 began to implement geriatric drug use labeling requirements. This rule requires drug manufacturers to include labeling with geriatric-specific precautions, indications, and dosing modifications for drugs with predominantly renal-dependent excretion.16 Initially, 6 drug categories will require this labeling improvement: psychotropic agents, nonsteroidal anti-inflammatory agents, certain cardiac drugs, oral hypoglycemic agents, anticoagulants, and quinolone antibiotics.

**Falls and Restraints**

Fall consultation services have reduced nursing home falls by 19% and fall-related injuries by 31%.53 Successful fall prevention programs target high-risk patients and are cost-effective.141-144 In the home setting, Tinetti et al144 achieved a 31% reduction in fall rates by use of a multifactorial intervention program that included medication review, education, training in gait and transfer skills, changes in environmental hazards, strengthening exercises, and behavioral modifications. Some geriatric clinics have used computerized fall risk factor databases to improve identification of
patients in greatest need of fall prevention efforts.145

Nosocomial Infections

The prevention of nosocomial infections in older patients requires following sound health care principles that are applicable to all ages: frequent hand washing, appropriate wound and skin care, immunization, and isolation of contagious individuals. Decreasing prolonged use of broad-spectrum antibiotics or invasive devices (endotracheal tubes, nasogastric tubes, indwelling urinary catheters, and central venous catheters) can reduce infections.62,146,147

Pressure Sores

Pressure sore prevention begins with early risk assessment to identify patients most likely to benefit from prevention strategies.67 Commonly used risk assessment tools are the Norton and Braden Scales. Staff education alone can reduce hospital-acquired pressure sores by more than half.148 Prevention addresses mechanical loading due to immobility, the nature of support surfaces, skin care, moisture, incontinence, nutrition, earlier clinical recognition, improved wound care, and education. On-line decision support systems to assist in documentation and provide guideline-based recommendations have resulted in a 60% reduction in pressure sores during a 6-month period.149

Delirium

Hospital-acquired delirium, especially for postoperative patients, is amenable to prevention. Risk assessment, as for other types of preventable injuries, allows for programs to efficiently target high-risk elderly patients. Several delirium prediction models have been developed.82,150,151 In a prospective study, Inouye et al found a one third reduction in delirium for hospitalized older patients who undergo a multicomponent intervention to reduce risk factors. A geriatric-anesthesiologist team intervention program has also been able to reduce the incidence of postoperative delirium.92

Surgical and Perioperative Complications

The prevention of surgical complications requires attention to all phases of treatment, beginning with preoperative determination of the appropriateness for the planned procedure. Elderly patients require careful medical assessment by the surgeon, primary care provider, and anesthesiologist.152 Collaboration by such physician teams should continue throughout the hospitalization. Preoperative preparation includes stabilization of active medical problems. Intraoperative management requires attention to proved age-adjusted approaches.153 The postoperative period is particularly prone to complications that are a consequence of bed rest, pain management, and several predictable physiologic responses.

Effective pain management in older patients requires recognition of and adjustment to differences in pharmacological metabolism, excretion, and sensitivity.152 Patient-controlled analgesia has been successfully demonstrated to reduce complications in elderly persons, including those who are frail.154

CONCLUSIONS

Even though medical therapy is beneficial in the aggregate for elderly patients, the risks of accidental injury are high, especially for certain complications and injuries. However, these risks can be greatly reduced by application of principles and techniques that have been learned in recent years from error prevention and geriatric research. Major improvements could be realized if these principles and techniques were applied more widely in all care settings. As the recent Institute of Medicine report outlines, building a safer health system will require a national comprehensive strategic agenda.1 With careful and expert care, older patients can achieve better health outcomes. Improving our systems to provide that care is a major challenge to medicine.

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